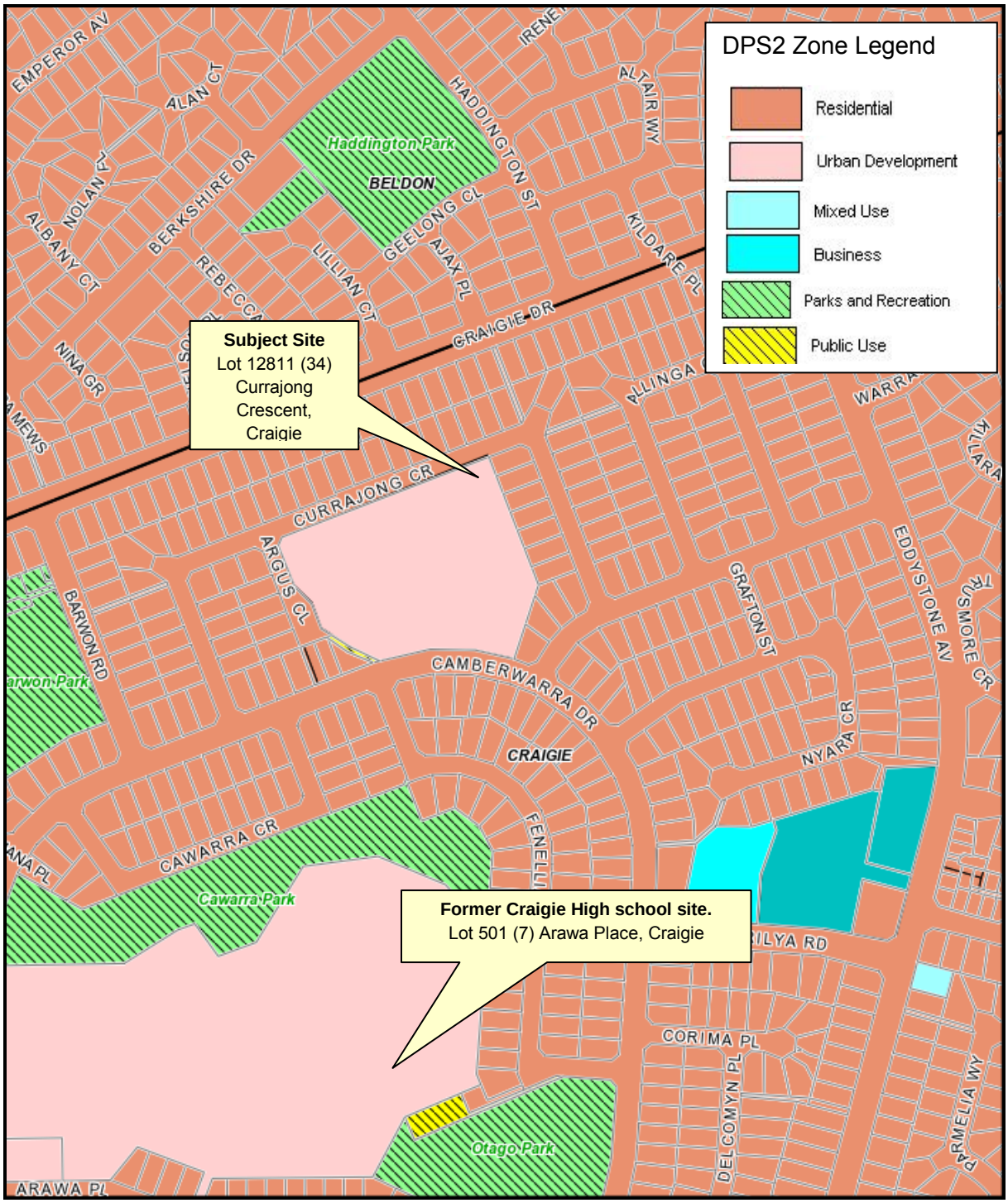
Location plan


DPS2 Zone Legend
Residential
Urban Development
Mixed Use
Business
Parks and Recreation
Public Use
Subject Site
Lot 12811 (34) Currajong Crescent, Craigie
Former Craigie High school site.
Lot 501 (7) Arawa Place, Craigie
Haddington Park
BELDON
CRAIGIE
Cawarra Park
Otago Park
CURRAJONG CR
CAMBERWARRA DR
CAWARRA CR
CRAIGIE DR
HADDINGTON ST
BERKSHIRE DR
GEELONG CL
AJAX PL
LILLIAN CT
ALAN CT
EMPEROR AV
NOLAN CT
ALBANY CT
NINA GR
ALTAIR WY
KILDARE PL
ARGUS CL
BARWON RD
GRAFTON ST
EDDYSTONE AV
NYARA CR
CORIMA PL
DELCOMYN PL
ARAWA PL

Zoning Plan


LEGEND
RESIDENTIAL R25+40
RESIDENTIAL R30+60
PUBLIC OPEN SPACE
SUBJECT LAND BOUNDARY
INDICATIVE STREET/LANEWAY DESIGN
CURRAJONG CRESCENT
BULLARA ROAD
CAMBERWARRA DRIVE
CURRAJONG CRESCENT
ARGUS CLOSE
plan 01
LOCAL STRUCTURE PLAN
Camberwarra Primary School Structure Plan
A Landcorp Project

Camberwarra Primary School Site
Local Structure Plan

STRUCTURE PLAN N^{O}. (TBC)

This Structure Plan is prepared under the provisions of Part 9 of the City of Joondalup *District Planning Scheme No. 2.*

DOCUMENT HISTORY AND STATUS

Camberwarra Primary School Site Structure Plan (10/065)		Revision	Date Issued
Prepared By:	**Taylor Burrell Barnett Town Planning and Design** 187 Roberts Road SUBIACO WA 6008 Phone: 9382 2911 Fax: 9382 4586 admin@tbbplanning.com.au	0	01.03.13
		1	04.05.13
		2	27.06.13
		3	24.07.13

TABLE OF MODIFICATIONS

Modification Reference Number	Date of Endorsement	Modification Section Number	Modification Description

CERTIFICATION OF AGREED STRUCTURE PLAN
(CLAUSE 9.6 - SCHEDULE 8)

CERTIFIED THAT AGREED STRUCTURE PLAN N^{O}. Xx/2013 (CAMBERWARRA PRIMARY SCHOOL SITE STRUCTURE PLAN), WAS ADOPTED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON:

……

AND BY

RESOLUTION OF THE COUNCIL OF THE CITY OF JOONDALUP, ON DATE 2013, AND THE SEAL OF THE MUNICIPALITY WAS PURSUANT TO THE COUNCIL'S RESOLUTION HEREUNTO AFFIXED IN THE PRESENCE OF:

……

Mayor, City of Joondalup

……

Chief Executive Officer, City of Joondalup

EXECUTIVE SUMMARY

This structure plan is intended to be the primary document that will guide subdivision and development of the former Camberwarra Primary School Site, which is located at Lot 12811 (34) Currajong Crescent, Craigie (The Subject Site).

The structure plan has been prepared in accordance with the provisions of Part 9 of *District Planning Scheme No. 2* and the WAPC's *Structure Plan Preparation Guidelines*. Upon approval by the City of Joondalup and the Western Australian Planning Commission the structure plan will supplement the provisions of *District Planning Scheme No. 2* in consideration of all subdivision and development within the structure planning area.

The structure planning area is intended to be developed for the purpose of infill residential development and the provision of public open space in accordance with **Plan 1**. The relevant specifications of the proposed development are outlined within as follows:

ITEM	DATA	SECTION NUMBER REFERENCED WITHIN THE STRUCTURE PLAN REPORT
Total area covered by the Structure Plan	3.0519 hectares	Part 1: Section 1 and Plan 1
Total Area proposed to be used for: • Residential (NDA) • Public Open Space (11.48% of NSA)	 2.1154 hectares 0.3441 hectares	Part 1 Section 6 and Part 2 Section 8.2
Estimated Lot Yield	40 lots	Part 2 Section 8.2.1
Estimated number of dwellings	60 dwellings	Part 2 Section 8.2.1
Estimated Dwellings per site hectare.	28 dwellings	Part 2 Section 8.2.1
Estimated Population (2.8 persons per dwelling)	168 persons	Part 2 Section 8.2.1
Estimated Number and % of Public Open Space	1 POS Area of 3,441m^2 (11.48%)	Part 2 Section 8.2.2

TABLE OF CONTENTS

PLANS

FIGURES

APPENDICES

PART ONE – STATUTORY PLANNING

1 THE STRUCTURE PLAN AREA

This Structure Plan shall apply to Lot 12811 Currajong Crescent, Craigie, being the land contained within the inner edge of the line denoting the Structure Plan boundary on the Structure Plan Map (**Plan 1**).

2 STRUCTURE PLAN CONTENT

The Structure Plan comprises:

a) Statutory Section (Part 1)

b) Explanatory Report (Part 2)

c) Appendices – Detailed Technical Reports

3 INTERPRETATION AND SCHEME RELATIONSHIP

Unless otherwise specified in this part, the words and expressions used in this Structure Plan shall have the respective meanings given to them in the City of Joondalup *District Planning Scheme No. 2* (the Scheme) including any amendments gazetted thereto.

The structure plan area is zoned 'Urban Development' under the provisions of the Scheme which under clause 3.12.2 of the Scheme requires that a structure plan be prepared and adopted prior to subdivision or other development being commenced or carried out with the subject area. This document has been prepared to satisfy the requirements of clause 3.12.2 and Part 9 of the Scheme, in order to facilitate subdivision and development of the structure plan area.

Pursuant to clause 9.8 of the Scheme:

a) The provisions, standards and requirements specified under Part 1 of this Structure Plan shall have the same force and effect as if it were a provision, standard or requirement of the Scheme. In the event of there being any variations or conflict between the provisions, standards or requirements of the Scheme and the provisions, standards or requirements of this Structure Plan, then the provisions, standards or requirements of this Structure Plan shall prevail;

b) Any other provisions, standard or requirement of Part 1 of the Structure Plan that is not otherwise contained in the Scheme, shall apply to the land as though it is incorporated into the Scheme, and shall be binding and enforceable to the same extent as if part of the Scheme; and

c) Part 2 of this Structure Plan and the Appendices – Technical Reports are to be used as a reference only to clarify and guide interpretation and implementation of Part 1.

4 OPERATION

An Agreed Structure Plan shall come into operation on the date it is adopted by the Commission pursuant to subclause 9.6.3.

5 LAND USE AND SUBDIVISION

The Structure Plan Map (**Plan 1**) outlines land use zones, reserves and the Residential Design Code density ranges applicable within the Structure Plan area. The zones, reserves and Residential Design Code density ranges designated under this Structure Plan apply to the land within it as if the zones, reserves and Residential Design Code density ranges were incorporated into the Scheme.

The specific Residential Design Code densities applicable to the subject land are to be determined at subdivision stage via the submission and approval of a Residential Design Code Density Plan by the Western Australian Planning Commission. The specific coding applied to individual lots is to be within the range allocated to the particular area, as outlined within **Plan 1**.

5.1 OBJECTIVES

The objectives for the Structure Plan Area are:

- To provide for housing diversity through a variety of single and grouped housing lot sizes at density ranges indicated on the Structure Plan;
- To provide residential lots with a high quality of built form design, including correct solar orientation to facilitate passive solar access, construction of energy efficient dwellings, activation and presentation toward streetscape and public open space areas and the creation of usable private open space areas;
- To provide a high quality public realm which maintains a high level of pedestrian connectivity, amenity and safety and encourages the retention of native vegetation where feasible.

5.2 LAND USE PERMISSIBILITY

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

5.3 RESIDENTIAL DESIGN CODE DENSITY ALLOCATION

The Residential Design Code density range for the structure plan area zoned 'Residential' are outlined in **Plan 1**.

5.3.1 DWELLING TARGETS

Residential development within the subject area is to provide for a minimum of 60 dwellings via subdivision and/or development.

Subdivision and/or development is to achieve a minimum site density of 19.5 dwellings per gross hectare, which equates to a minimum net density of 28 dwellings per site hectare.

5.3.2 RESIDENTIAL DENSITY

Residential Design Code density ranges have been applied based on an assessment of the surrounding density patterns and an understanding of the Department of Planning and City of Joondalup expectations with respect to density targets in infill developments. In order to facilitate the optimal use of space, whilst providing flexibility to meet the market demand, a density code range of between R25 and R40 has been applied across the majority of the site, with a higher density coding of R30 to R60 being allocated to rear-loaded lots adjacent to the public open space.

a) Plan 1 defines the broad Residential Design Code density ranges that apply to specific areas within the Structure Plan. Lot specific Residential Design Code densities, within the defined Residential Design Code density ranges, are to be subsequently assigned in accordance with a Residential Design Code Density Plan approved by the WAPC.

b) A Residential Design Code Density Plan is to be submitted at the time of subdivision to the WAPC and shall indicate the R-Code applicable to each lot within the subdivision and shall be consistent with the Structure Plan, and the Residential Design Code density ranges identified on Plan 1.

c) The Residential Design Code Density Plan is to include a summary of the proposed dwelling yield of the subdivision.

d) Approval of the Residential Design Code Density Plan shall be undertaken at the time of determination of the subdivision application by the WAPC. Once approved by the WAPC, the Residential Density Code Plan shall form part of Part 1 of the Structure Plan and shall be used for the determination of future development applications.

e) Variations to the Residential Design Code Density Plan will require further approval of the WAPC, with a revised Residential Design Code Density Plan submitted generally consistent with the approved plan of subdivision issued by the WAPC. The revised Residential Design Code Density Plan shall be consistent with Residential Design Code density ranges identified on Plan 1.

f) A revised Residential Design Code Density plan, consistent with Clause 5.3.2 (e) will replace, wholly or partially, the previously approved Residential Design Code Density Plan and shall form part of Part 1 of the Structure Plan.

g) Residential Design Code Density Plans are not required if the WAPC considers that the subdivision is for one or more of the following:

   i) the amalgamation of lots;

   ii) consolidation of land for “superlot” purposes to facilitate land assembly for future development;

   iii) the purposes of facilitating the provision of access, services or infrastructure; or

   iv) land which by virtue of its zoning or reservation under the Structure Plan cannot be developed for residential purposes.

5.4 PUBLIC OPEN SPACE

The provision of a minimum of 10% public open space being provided in accordance with the WAPC’s *Liveable Neighbourhoods.* Public open space is to be provided generally in accordance with **Plan 1**.

6 DEVELOPMENT REQUIREMENTS

The following structure plan provisions replace the 'design principle' and 'deemed to comply' of the R-Codes. All provisions of the R-Codes not mentioned below are deemed to apply. The City's Height and Scale of Building within a Residential Area Policy shall not apply to development within the structure plan area.

6.1 GENERAL DEVELOPMENT REQUIREMENTS

6.1.1 ORIENTATION

a) Dwellings must address nominated street/s and/or public open space in terms of main entry, major openings, articulation, materials and detailing. Dwellings directly abutting public reserve shall orientate as follows:

- If vehicle access is via a laneway - the public reserve is considered as the primary façade.
- If vehicle access is via a street, this shall be considered the primary façade, however the secondary façade overlooking the public open space must be articulated and include at least one major opening.

b) North-facing lots are permitted to locate outdoor living areas within the front setback area to take advantage of the northern aspect of the site and shall be constructed to maintain surveillance and activation of the adjoining streetscape.

6.1.2 CORNER LOTS

Dwellings located on corner lots shall address both streets through their design by extending the primary elevation features onto the secondary street elevation where forward of a return fence. Exposed secondary street façades must incorporate major openings.

6.1.3 LOTS ABUTTING PUBLIC OPEN SPACE

Dwellings on lots abutting public open space shall be orientated such that they offer passive surveillance over the open space by way of major openings and/or outdoor living area(s).

6.1.4 ROOFS

With the exception south facing walls, eaves or window overhangs to a minimum dimension of 400mm are required to all major openings.

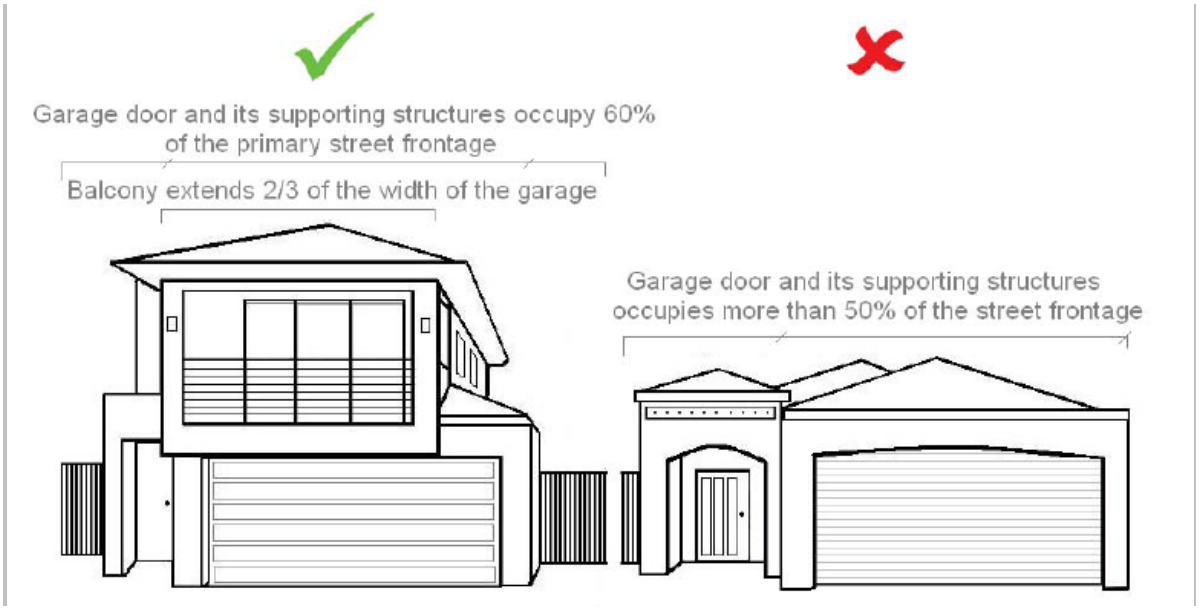
6.1.5 GARAGES/CARPORTS

a) The roof and design features shall be consistent with the form and materials of the remainder of the dwelling.

b) Garages shall be positioned to the boundary nominated for the location of the boundary wall, as specified under clause 6.2.1.2 (for R25 to R40 lots), or clause 6.3.1.2 (for R30 to R60 lots). A nil side setback to the garage is not mandatory.

c) Garages on corner lots may be permitted on the northern or eastern side boundaries for a maximum depth of 9 metres, and to a maximum height of 3.2 metres from natural ground level.

d) A garage door and its supporting structures shall not occupy more than 50% of the primary street frontage at the setback line. This may be varied to 60% where a balcony or upper floor with major openings extends 2/3 of the width of the garage (refer below figure)..



Source: City of Joondalup's Draft Dual Density Code Policy (2010)

6.1.6 BOUNDARY FENCING

a) Fencing to a secondary street must be set back at least 4 metres from the corner truncation.

b) Any fencing forward of the maximum front setback as specified under clause 6.2.1.1 (for R25 – R40 lots), or clause 6.3.1.1 (for R30 – R60 lots) shall be visually permeable 1.2 metres above natural ground level.

c) Walls and fences shall be truncated or reduced to no higher than 0.75 metres within 1.5 metres of where vehicle access points meet a street.

d) For lots abutting Public Open Space, where the developer has constructed fencing, the fencing shall be maintained.

6.1.7 OUTBUILDINGS

Outbuildings that are visible from the public domain (such as from public open space) shall complement the design and materials of the dwelling or be suitably screened from view, to the satisfaction of the City of Joondalup. Outbuildings shall not be positioned such that they obscure surveillance of public open space from a dwelling.

6.2 R25 TO R40 PROVISIONS

6.2.1 BOUNDARY SETBACK REQUIREMENTS

6.2.1.1 FRONT SETBACKS

The following setback requirements shall apply to R25 to R40 lots (except where noted, all other setbacks shall be in accordance with the R-Codes):

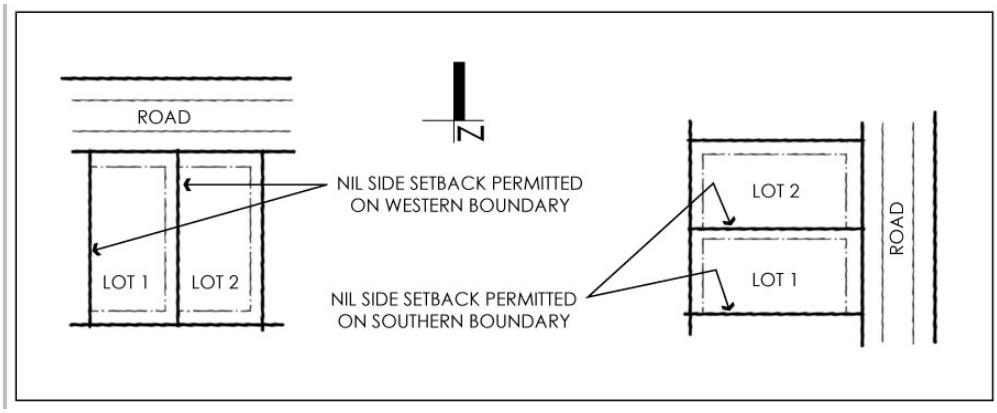
a) A 3.0 metre minimum to a 5.0 metre maximum dwelling front setback is required to the primary street, exclusive of carports and garages (no average applies).

b) Where the primary facade is to the public open space in accordance with clause 6.1.1, the minimum setback to the public open space shall be 3.0 metres.

c) Garages and carports shall be setback a minimum of 4.5 metres from the primary street or 0.5 metres behind dwelling frontage (face of building).

6.2.1.2 SIDE SETBACKS

a) Boundary walls to nominated side boundaries are permitted. For north/south oriented lots the nominated side boundary shall be the western boundary and for east/west oriented lots the nominated side boundary shall be the southern boundary (excluding to street and public open space boundaries). Boundary walls shall be to a maximum height of 3.2 metres from natural ground level, for a total length of 9 metres, and be setback a minimum of 1.5 metres behind the dwelling frontage (face of the building).



b) A 2.0 metre minimum dwelling side setback is required to a side boundary abutting public open space.

6.2.2 BUILDING HEIGHT REQUIREMENTS

a) Dwellings shall be constructed to a maximum height of two storeys, with loft areas wholly contained within the roof space permitted.

b) The maximum building height measured from natural ground level shall be:

- Maximum wall height (with pitched roof) - 7 metres
- Maximum total height to roof ridge – 10 metres
- Maximum wall and total height (parapet wall with concealed roof) - 8 metres

6.3 R30 TO R60 PROVISIONS

6.3.1 BOUNDARY SETBACK REQUIREMENTS

6.3.1.1 FRONT SETBACKS

The following setback requirements shall apply to R30 to R60 lots (except where noted, all other setbacks shall be in accordance with the R-Codes):

a) A 3.0 metre minimum to a 5.0 metre maximum dwelling front setback is required to the primary street, exclusive of carports and garages (no average applies).

b) Where the primary facade is to the public open space in accordance with clause 6.1.1, the minimum setback to the public open space shall be 3.0 metres.

c) Garages and carports shall be setback a minimum of 4.5 metres from the primary street or 0.5 metres behind dwelling frontage (face of building).

6.3.1.2 SIDE SETBACKS

a) Boundary walls to nominated side boundaries are permitted. For north/south oriented lots the nominated side boundary shall be the western boundary and for east/west oriented lots the nominated side boundary shall be the southern boundary (excluding to street and public open space boundaries). Boundary walls shall be to a maximum height of 3.2 metres from natural ground level, for a maximum of two-thirds the length of the balance of the boundary 1.5 metres behind the dwelling frontage (face of building).

b) A 2.0m minimum dwelling side setback is required to a side boundary abutting public open space.

6.3.1.3 REAR/GARAGE/STORE SETBACKS

a) A 1.5 metre minimum setback shall be provided to the ground floor level of the dwelling (inclusive of garages and carports)

b) Where a store is not located within 1.5 metres of where vehicle access point(s) meets the laneway boundary, a minimum setback of 0.5 metres is permitted.

c) A nil dwelling setback is permitted to the dwelling upper floor balcony on a laneway boundary.

6.3.2 BUILDING HEIGHT REQUIREMENTS

a) The maximum building height for multiple dwellings within an R60 coded area shall be three storeys, and measured from natural ground level shall be:

- Maximum wall height (with pitched roof) - 10 metres
- Maximum total height to roof ridge - 13 metres
- Maximum wall and total height (parapet wall with concealed roof) - 11 metres

b) The maximum building height for single or grouped dwellings, or multiple dwellings coded less than R60, shall be two storeys, and measured from natural ground level shall be:

- Maximum wall height (with pitched roof) - 7 metres
- Maximum total height to roof ridge – 10 metres
- Maximum wall and total height (parapet wall with concealed roof) - 8 metres

7 OTHER REQUIREMENTS

7.1.1 RETAINED TREES

a) A plan indicating the trees to be retained shall be submitted with the plan of subdivision. Once approved, trees indicated on this plan are to be retained unless deemed to be a safety hazard by an approved arboriculture expert to the satisfaction of the City of Joondalup.

b) Crossovers are to be located to avoid impact on existing verge trees. Approval from the City of Joondalup is required prior to the removal of a verge tree.

7.1.2 DEVELOPER WORKS

As part of the subdivision process a plan shall be submitted and agreed to by the City of Joondalup indicating the location of the pedestrian path along the boundary of properties abutting the public open space, retaining walls and fencing. The pedestrian path, retaining walls and fencing shall be constructed by the developer/applicant in accordance with the agreed plan prior to the issuing of the subdivision clearance by the City of Joondalup.

7.1.3 RETAINING WALLS

Retaining walls visible from the street or public space must be constructed of materials matching those constructed at the subdivision stage. Pre-cast concrete 'panel and post' retaining walls are not permitted.

A development application will be required for retaining walls, fill and/or excavation that does not meet the 'deemed to comply' standards of the R-Codes.

7.1.4 BIN PADS

All lots with vehicle access gained from a laneway shall provide a bin pad within the property that directly abuts the laneway, to enable bins to be stored and emptied without impacting on the function of the laneway.

7.1.5 LANEWAY LIGHTING

The provision of street lights within laneways must be accommodated through a 1.0 metre x 1.0 metre expansion of the laneway reserve, to accommodate a light pole.

8 VARIANCE FROM THE STRUCTURE PLAN

Subdivision and development shall generally be in accordance with the Structure Plan.

Any development that is the subject of an application for planning approval and does not comply with the standards of the Structure Plan shall be determined as specified under Clause 4.5 of the Scheme. Where determined appropriate by the City of Joondalup, local development plans shall be prepared and adopted in accordance with clause 9.12 of the Scheme prior to the City of Joondalup issuing the subdivision clearance.

PART TWO – EXPLANATORY REPORT

1 INTRODUCTION

This Structure Plan (refer **Plan 1** – Structure Plan) and report has been prepared on behalf of LandCorp by Taylor Burrell Barnett in collaboration with:

- JDSi (Engineering consultants);
- Ecoscape (Environmental Consultant); and
- Donald Veal Consultants (Traffic Consultant).

The Structure Plan will guide future subdivision and development within the former Camberwarra Primary School Site. It has been prepared with due regard to the requirements of the City of Joondalup *District Planning Scheme No. 2* and various City of Joondalup policy documents.

The Structure Plan is supported by a range of technical reports including traffic, servicing, landscape and environmental studies.

Part One, inclusive of sections 1-8, covers the Statutory Planning Report.

Part Two Covers the Explanatory Report. **Section 1** provides an introduction to the Structure Plan area. **Section 2** outlines the area over which the Structure Plan applies. **Section 3** outlines the key sustainability consideration and objectives, with S**ection 4** of the report examines the statutory planning framework. The analysis of this context identifies key considerations and parameters for the Structure Plan. **Section 5** outlines the existing Craigie community. **Section 6** provides a detailed description of the existing environment. **Section 7** analyses the site identifying key considerations and parameters for the Local Structure Plan. **Section 8** describes the proposed Structure Plan. **Section 9** of the report outlines the implementation process for the Structure Plan in terms of the statutory framework which has been established for the area by the City of Joondalup. Compliance is identified, management plans explained and staging considered.

The intended development of the subject site is outlined within the Masterplan as shown in **Figure 1**.

1.1 PURPOSE

The Structure Plan and Report provides the rationale and framework to support future subdivision and development within the Structure Plan area.

The Structure Plan has been prepared in accordance with the City of Joondalup *District Planning Scheme No. 2* and the applicable requirements of Liveable Neighbourhoods.

1.2 BACKGROUND

In 2007 the Camberwarra Primary School was identified as surplus to Department of Education (DoE) requirements. The State Government approved the school closure and the facility ceased operations in 2008.

In 2011 the site was rezoned under the City of Joondalup's *District Planning Scheme No. 2* to 'Urban Development' in order to facilitate residential development. Upon finalisation of the rezoning the Department of Education entered into an agreement with LandCorp to undertake project management and progress the structure plan approval on behalf of the Department. LandCorp intends to acquire the site once the structure plan for the site has been approved.

1.3 COMMUNITY CONSULTATION

LandCorp have developed a community engagement strategy for the development of the former Camberwarra Primary School site. This strategy includes the following:

- Consultation with key stakeholders, community and business to progress the local structure plan process;
- Encouraging local community support for proposal;
- Demonstrating a partnership approach with key stakeholders to ensure the local structure plan responds to the needs and expectations of the community; and
- Addressing potential issues during the local structure planning process and support City of Joondalup planning processes.

1.3.1 PROPOSED COMMUNITY CONSULTATION PROGRAM

Anticipated Timing	Milestone
January 2013	Project Website Creation
March 2013	Invitation letter re home visit Personal home visits conducted Media Statement Letter re information session invite E-shot re information session invite
April 2013	Community Information Session Open Day
April 2013	Post Event Media Release and Images

1.3.2 ADJOINING RESIDENT HOME VISIT

An invitation letter was mailed to adjacent property owners to discuss the opportunities for the site, the local structure planning process, community needs and possible design issues to consider. Feedback from the consultation was incorporated in the local structure plan report prior to lodgement with the City of Joondalup.

1.3.3 COMMUNITY INFORMATION SESSION

Community and stakeholders were invited to a Community Information Session to discuss with the project team the draft concept plan developed for the former Camberwarra Primary School Site.

The Community Information Session was held on 13 April 2013, during which the project team was available to answer any questions that the community and stakeholders had on the concept plan displayed.

The consultation comments from this Community Information session were provided to Council for consideration.

2 THE SUBJECT LAND

2.1 LAND OWNERSHIP

The subject land (refer **Appendix 1** – Certificate of Titles) is a C Class Crown Reserve, vested with the Department of Education and Training (DoE) for educational purposes (refer **Figure 2** – Land Ownership). LandCorp entered into arrangements with DoE to acquire the Camberwarra Primary School site once the site has an approved structure plan.

Lots Details	Plan No.	Landowner	Area
Lot 12811	DP219691	Crown Reserve Vested with the Department of Education	3.0519 ha

2.2 LOCATION

The subject land is located on the former Camberwarra Primary School Site within the northern suburb of Craigie, located approximately 22 km north of the CBD. It is approximately 2.8 km east of the beach and 1 km north-east of the Whitfords Shopping Centre (refer **Figure 3** – Location Plan).

The subject land is bound by Currajong Crescent to the north, Camberwarra Drive to south, the rear of existing residential development to the east, and Argus Close and residential development to the west (refer Figure 4 – Local Context). The land covers an approximate area of 3.519ha.

2.3 EXISTING LAND USES

With all Camberwarra Primary School buildings demolished there is no remaining school infrastructure except for the unkempt remains to the school oval over the south-western portion of the site. It is sparsely vegetated with a mixture of native and imported trees.

2.4 SURROUNDING LAND USES

The subject land is immediately bounded on all sides by existing residential development. There are numerous areas of public open space within 600m of the site, including Barwon Park to the west and Cawarra Reserve and Otago Park to the south of the site. The site is also within 400m of commercial and retail development in the form of Craigie Plaza, which is located to the south-east of the site (refer **Figure 4** – Local Context).

At a greater context, Whitfords Shopping Centre, a secondary centre, is located 1.5km south-west of the site. Marmion Avenue, a major north-south District Distributor Type A, is located approximately 700m west of the subject site with the Mitchell Freeway leading into the CBD, located approximately 1.5km east of the site. Various Primary Schools, High Schools, a Retirement Village and a mixture of public open spaces are all found within a 2km radius of the site (refer **Figure 5** – District Context).

LEGEND

SUBJECT LAND BOUNDARY

LAND OWNERSHIP

Lot #	Street Name	Owner	Area
12811	Currajong Crescent	Dept. of Education & Training	3.0519ha

LAND OWNERSHIP

Camberwarra Primary School Structure Plan

A Landcorp Project

N

0m 10 20 30m

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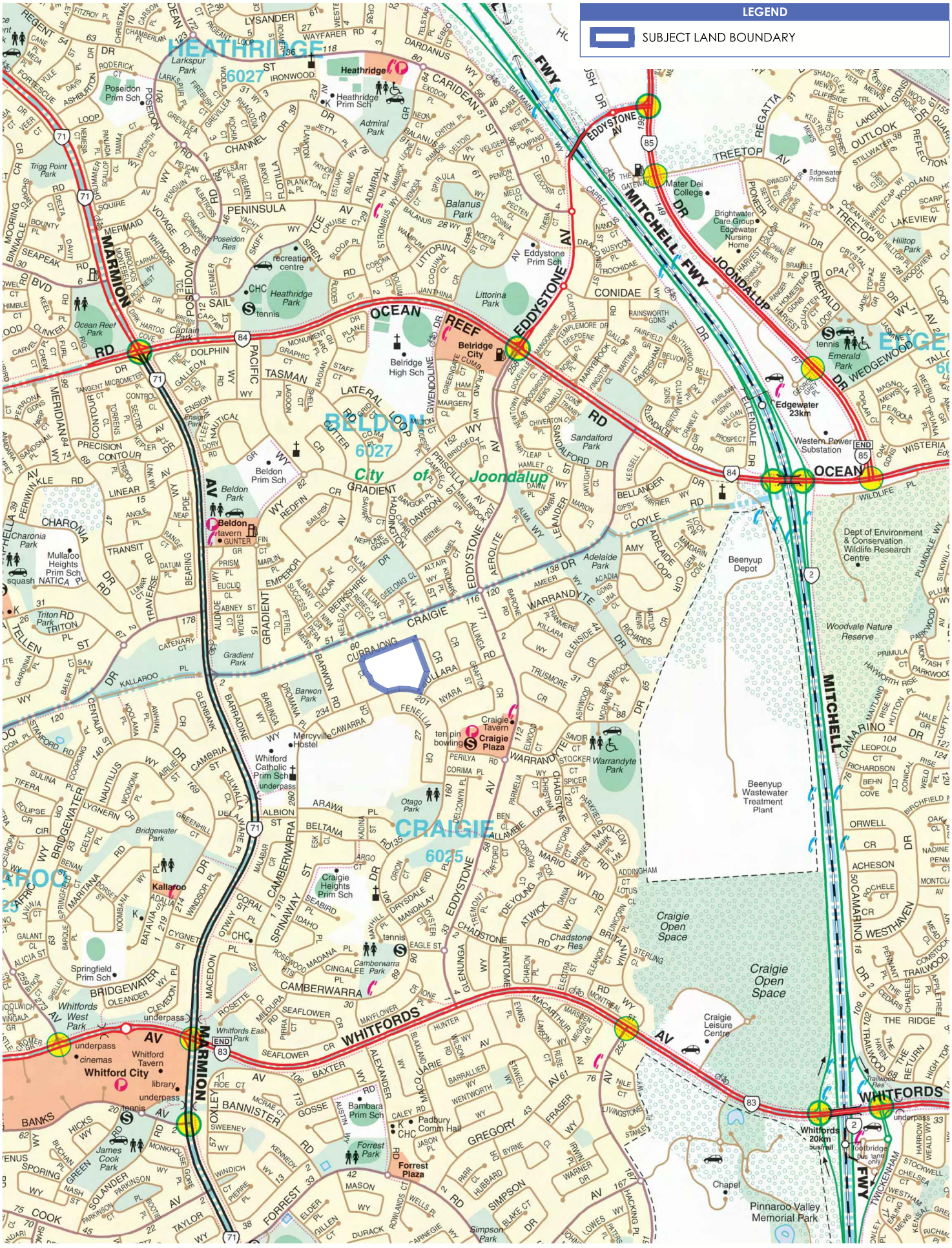
d: 26/02/2013
p: 10/065/006A

figure 02



LOCATION PLAN

Camberwarra Primary School Structure Plan

A Landcorp Project

0m 100 200 300m

s: 1:20000@A4
d: 28/02/2013
p: 10/065/008A

figure 03

LEGEND

- SUBJECT LAND BOUNDARY
- PARKS, RESERVES & RECREATION
- SCHOOL
- SHOPPING CENTRE / RETAIL
- BUS ROUTE
- RAILWAY
- RAILWAY STATIONS

SCHOOLS

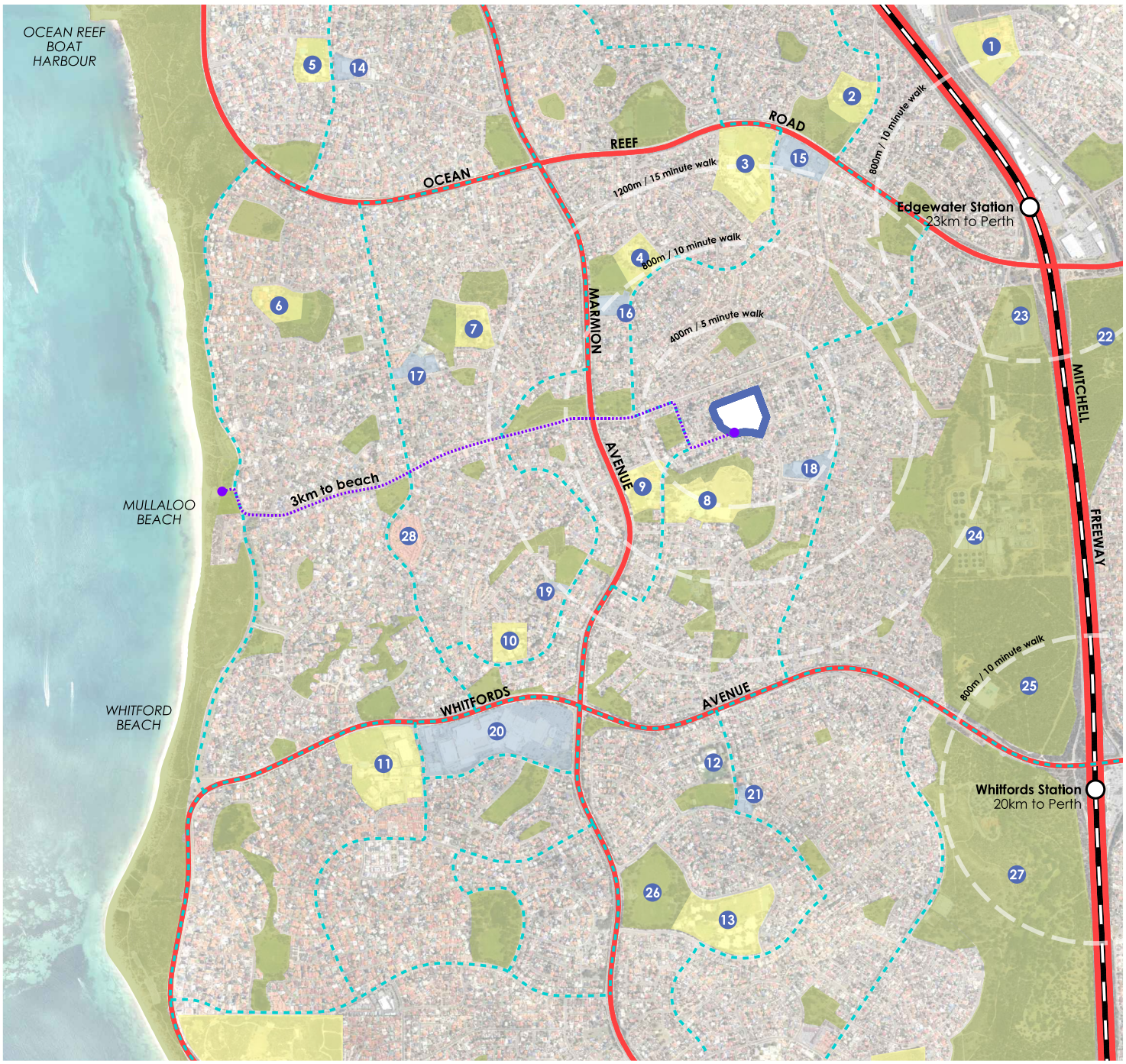
1. MATER DIA COLLEGE
2. EDDYSTONE PRIMARY SCHOOL
3. BELRIDGE HIGH SCHOOL
4. BELDON PRIMARY SCHOOL
5. OCEAN REEF PRIMARY SCHOOL
6. MULLALOO BEACH PRIMARY SCHOOL
7. MULLALOO HEIGHTS PRIMARY SCHOOL
8. CRAIGIE HIGH SCHOOL SITE
9. WHITFORD CATHOLIC PRIMARY SCHOOL
10. SPRINGFIELDS PRIMARY SCHOOL
11. ST MARKS ANGLICAN COMMUNITY SCHOOL
12. BAMBARA PRIMARY SCHOOL
13. PADBURY PRIMARY/SENIOR HIGH SCHOOL (FORMER)

SHOPPING CENTRES/RETAIL

14. OCEAN REEF LOCAL CENTRE
15. BELRIDGE CITY
16. BELDON LOCAL CENTRE
17. MULLALOO LOCAL CENTRE
18. CRAIGIE PLAZA
19. KALLAROO LOCAL CENTRE
20. WHITFORD CITY
21. FORREST PLAZA

OTHER

22. WOODVALE NATURE RESERVE
23. BEENYUP DEPOT
24. BEENYUP WASTEWATER TREATMENT PLANT
25. CRAIGIE OPEN SPACE
26. MC DONALD PARK/RECREATION CENTRE/NETBALL/BASKETBALL
27. PINNAROO VALLEY MEMORIAL PARK
28. ST. IVES NORTHSHORE ESTATE (RETIREMENT VILLAGE)



DISTRICT CONTEXT

Camberwarra Primary School Structure Plan

A Landcorp Project

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figure 05

3 SUSTAINABILITY

The vision for the development of the Camberwarra Primary School site is to create a development which is environmentally, economically and socially more sustainable.

3.1 OBJECTIVES AND INITIATIVES

The State Sustainability Strategy was released by the Government of Western Australia in September 2003. Sustainability is defined by the Strategy as meeting the needs of current and future generations through simultaneous environmental, social and economic improvement.

3.2 SOCIAL SUSTAINABILITY

The Camberwarra Primary School Structure Plan will facilitate for development that will accommodate a range of socio-demographic groups through the creation of a range of lot sizes to cater for a variety of housing products thus encouraging social diversity.

The Camberwarra Primary School Structure Plan has been designed to encourage social interaction and the development of a healthy community. The development will facilitate active lifestyles through the provision of safe, quality and attractive walking and cycling trails throughout the public open space and within the residential areas. Social interaction will be encouraged through the implementation of good urban design and development of community spaces and places.

The Camberwarra Primary School Structure Plan embraces many Liveable Neighbourhood principles such as 'walkability' and 'permeability' which contribute to reducing car use, creating a greater sense of community, better access to services and using land more efficiently.

The implementation of all of the above principles at Camberwarra Primary School will significantly contribute towards ensuring the socially sustainability of the project is maximised.

3.3 ENVIRONMENTAL SUSTAINABILITY

The Structure Plan will facilitate a residential settlement with a moderate ecological footprint, with approximately 11% of the site reserved for public open space. Selected vegetation within public open spaces and along Camberwarra Drive and Currajong Crescent will also be retained where possible and appropriate.

The site design encourages and facilitates walkability throughout the locality. This will assist in the reduction of the consumption of non-renewable resources and reducing air pollution and waste creation. Importantly, the site is in close proximity to bus services on Camberwarra Drive and railway services at Edgewater and Whitfords Stations.

3.4 ECONOMIC SUSTAINABILITY

The Camberwarra Primary School Structure Plan will facilitate development that will create numerous jobs during its planning, design, development and construction phase. Jobs in the local government will also be created for the maintenance of public open space, garbage collection and other local authority services.

The urban design incorporated in the Camberwarra Primary School Structure Plan focuses on minimising the length of road required, whilst still providing a permeable and connected residential area. This contributes to sustainable development by efficiently using resources.

Residential development at Camberwarra Primary School will introduce additional families to the area and will support existing infrastructure and community services, including the northern railway line and bus services in the area and the near-by Craigie Plaza. The development as proposed will be economically sustainable and represents an efficient use of resources and existing infrastructure.

In developing the structure plan the following key sustainability objectives and initiatives were applied:

Item	Objective
ENVIRONMENTAL LEADERSHIP	
Environmental Leadership	Leadership through the protection and management of natural systems, habitat and biodiversity, and innovation and efficient use and management of precious resources such as materials, water and energy.
WATER EFFICIENCY	
Recycling Water and Education	Water balance strategy and WSUD principles to be applied to landscaping in public domain, community park and drainage reserve. Ensure that these are integrated into the overall site water management plan and that they incorporate investigations of grey water/stormwater reuse system.
PASSIVE DESIGN	
Passive Design Features	Lot orientation.
	Built form requirements to facilitate passive solar gain and natural ventilation.
	Consider retention and enhancement of mature native vegetation.
	Improved ambient temperature through retaining and enhancing trees, green shading and vegetation and through the use of locally sourced (reconstituted) light coloured paving material, thereby reducing the community cooling load.
BUILT FORM	
Built Form Innovation	Promote quality built form and innovations
COMMUNITY WELLBEING	
Community Wellbeing	The redevelopment will create a community that is safe, healthy and an enjoyable place to live and work and the residence will have access to affordable and appropriate housing and foster active local citizenship.
SOCIAL NEEDS	
Social Needs	Improved vehicular, safety and accessibility through the provision of a dual-use pathway for both pedestrian and cyclists with improved passive surveillance and minimised vehicular impact through a human scale streetscape.
ECONOMIC HEALTH	
Economic	Efficient use of existing infrastructure.
Capital Growth	Promotion of revitalisation of Craigie to the immediate and greater area.

4 STATUTORY AND POLICY FRAMEWORK

4.1 STATUTORY PLANNING CONTEXT

4.1.1 METROPOLITAN REGION SCHEME

The subject land is currently zoned Urban under the Metropolitan Region Scheme (MRS).

4.1.2 CITY OF JOONDALUP DISTRICT PLANNING SCHEME NO. 2

The subject land is currently zoned 'Urban Development' under the City of Joondalup's Scheme (refer **Figure 6 –** District Planning Scheme No. 2).

4.2 STRATEGIC PLANNING CONTEXT

4.2.1 DIRECTIONS 2031 AND BEYOND

"Directions 2031 and beyond is a spatial framework; a high level strategic plan that establishes a vision for future growth of the Perth and Peel region, and provides a framework to guide the detailed planning and delivery of housing, infrastructure and services necessary to accommodate that growth." (Department of Planning, 2010; 1) With the population expected to climb from 1.65 million currently to 2.2 million by 2031, Directions 2031 sets out a strategic framework for accommodating this expected growth.

"Having a more compact City" has been identified in Directions 2031 and beyond as a preferred growth scenario, which means, consolidating development in appropriate locations with an emphasis on infill development. The Camberwarra Primary School site is a perfect example of an appropriate location for infill development to support the growth strategies advocated by Directions 2031.

An initiative of Directions 2031 and beyond is to support housing strategies for Perth and Peel to deliver a responsive housing system that meets the changing needs, aspirations and choices of the residents of Perth and Peel taking into account affordability and equity.

Reference: Department of Planning 2010, Directions 2031 and beyond, Western Australian Planning Commission, Perth.

4.2.2 OTHER STATE PLANNING POLICIES

Liveable Neighbourhoods is an operational policy for the design and assessment of structure plans and subdivision for new urban areas in the metropolitan area and country centres.

Liveable Neighbourhoods is applied in the City in the design and approval of urban development, structure planning and subdivision for green field sites and for the redevelopment of large brown field and urban infill sites.

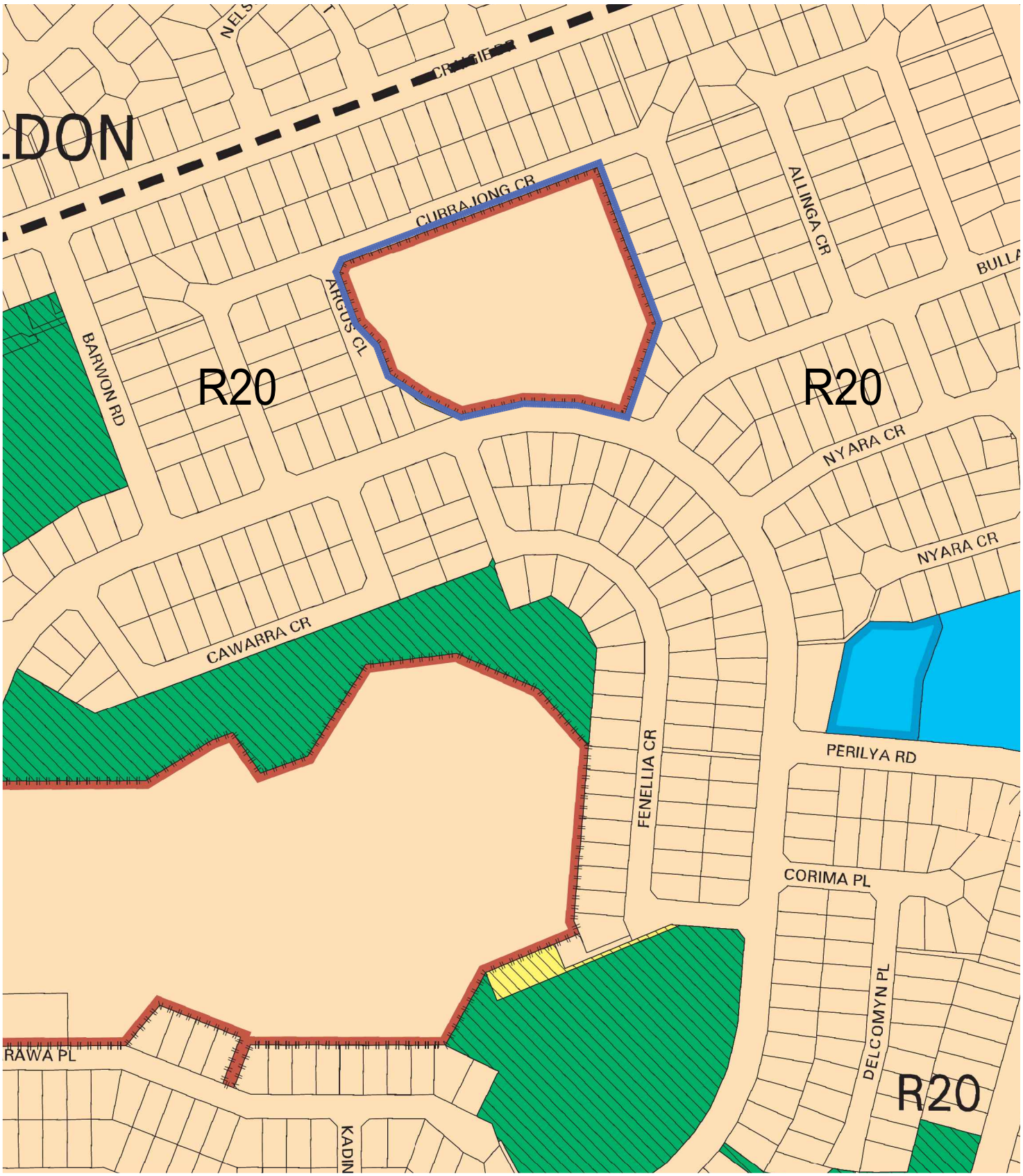
The design of the Local Structure Plan has been formulated using the Liveable Neighbourhoods planning approach to development.

LEGEND

LOCAL SCHEME RESERVES
- PARKS & RECREATION
- PUBLIC USE

ZONES
- RESIDENTIAL
- URBAN DEVELOPMENT
- BUSINESS
- COMMERCIAL

OTHER
- R CODES
- LOCALITY BOUNDARY
- SUBJECT LAND BOUNDARY



DISTRICT PLANNING SCHEME No. 2
Camberwarra Primary School Structure Plan
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figure **06**

4.2.3 LOCAL PLANNING STRATEGY

City of Joondalup's Local Planning Strategy (LPS), dated July 2008, is to enable Council and the community to determine the vision and strategic planning direction for the City of Joondalup for the next fifteen to twenty years.

Preparation of the LPS has included assessment of all relevant state, regional and council plans, policies and strategies. Community input into the strategy has been achieved through surveys on key planning strategies.

The strategy states, in relation to housing, that *"in strategically appropriate locations, planning will take into account the future housing needs of an aging population and changing household structures."* With this changing household structure, that is, household sizes decreasing, the City acknowledges the need for smaller lot sizes and consequently smaller houses to reflect changing lifestyles. The City realises Craigie, with ageing housing stock, is ready for regeneration. *"This is the natural process of housing renewal and presents excellent opportunities to provide more diverse housing types and at the same time, upgrade physical infrastructure and amenity."* An action of the LPS was to prepare a Local Housing Strategy aimed at identifying areas which are strategically located for infill or redevelopment. This is explained further below.

Together with housing, the environment is a key consideration, and the City plans to *"ensure that biodiversity and the natural environment values of the city are protected and preserved for the existing and future generations."*

4.2.4 CITY OF JOONDALUP DRAFT LOCAL HOUSING STRATEGY

At its meeting held on 16 April 2013 Council adopted the Draft Local Housing Strategy. The Strategy is currently being considered for final adoption by the Western Australian Planning Commission.

A Local Housing Strategy is a plan that identifies how future housing needs can be met within a local government area. A Strategy of this type is a requirement for local governments when preparing a new District Planning Scheme.

State government policies, in particular Directions 2031 and beyond (as previously covered), are encouraging this movement towards more efficient use of land and the City of Joondalup's draft Local Housing Strategy has been considered in this context. Research undertaken has shown that the combination of changes in household size to smaller households combined with an ageing population illustrates a need for a variety of housing options in the City of Joondalup.

Four principal objectives of the draft Local Housing Strategy, relevant to Craigie are to:

- Encourage residential development which protects amenity and ensures that growth in the City occurs in a sustainable way;
- Identify suitable areas for increased densities which are in need of private investment to make more effective use of existing community infrastructure;
- Ensure that a wide range of housing can be provided to meet the social and economic needs of the changing demographics of the City; and
- Identify mechanisms to ensure new infill development is based on good design principles thus improving the amenity of existing neighbourhoods.

As part of the Draft Local Housing Strategy, the City of Joondalup has identified 10 areas in the City as being suitable for higher residential densities. The subject land sits within Opportunity Area 5 where it is identified as an existing public school.

The general future direction for Housing Opportunity Area 5 is that it *"*presents excellent opportunities for more compact living and greater housing choices focussed around Whitfords Secondary Centre and the high frequency public transport services on Whitfords Avenue. There is an opportunity to revitalise older housing stock within these suburbs..*"*

An R20/R60 density code is recommended for residential properties close to Whitfords Centre and the public transport corridor for Whitfords Avenue. Elsewhere in the Housing Opportunity Area, and surrounding the former Craigie High School site, R20/40 is recommended for residential properties.

The former Camberwarra Primary School site is identified as 'existing public use including schools' The urban design directions for the Craigie High School Site, which are considered useful in guiding the development of Camberwarra Primary School, are:

- The focus will be on good design outcomes that will improve the area and respect the amenity of current and future residents.
- Enhancing/maintaining streetscapes and environmentally responsible housing designs..
- The expected increase in housing diversity will build on existing neighbourhood character and sense of place.

All of these urban design directions/principles have been key considerations in the design formulation of the proposed local structure plan.

The Residential Design Codes of Western Australia (R-Codes) are a regulatory and comprehensive tool for the control of built form and density of the residential development throughout WA and are supported by the Local Housing Strategy.

4.2.5 CITY OF JOONDALUP LANDSCAPE MASTER PLAN

The City of Joondalup contains a diverse range of public open space that includes: bush forever sites, conservation category wetlands, regional parks, areas of passive and active recreation, a wide range of purpose-built sporting grounds, and generous road verges and medians. In 2008, the City prepared a Water Conservation Plan to demonstrate a reduction in groundwater consumption for Public Open Space irrigation, in response to limitations imposed by the State Government in 2007. This process was a major catalyst for the production of the City of Joondalup Landscape Master Plan 2009-2019. The relevance of this document to the former Camberwarra Primary School site is discussed below.

4.2.5.1 LANDSCAPE VISION

The vision for landscape within the City of Joondalup *"will be innovative, distinctive, functional and appealing, and valued by residents and visitors and will evoke a sense of ownership and pride amongst its residents. This vision will be achieved through the application of sustainable principles that will underpin all landscaping practices, with a focus on environmental best practice and the preservation, enhancement and showcasing of local natural diversity."*

Key elements of the City's vision have been reflected in the Camberwarra Primary School Structure Plan which are described within the aims and principles listed below.

4.2.5.2 AIMS AND PRINCIPLES

The City's vision is underpinned by several aims and principles. The following have been referenced due to their relevance to the Camberwarra Primary School site, and of the proposed landscape works:

- provide more opportunities for passive recreational pursuits in public open space and 'natural' bushland ecosystems;
- increase active and passive recreational opportunities within attractive and functional landscape incorporating expanses of irrigated turf, maintained native garden beds, and rehabilitating more natural bushland areas;
- provide an effective response to the issue of climate change through reducing overall water consumption patterns across the City where appropriate;
- provide attractive and functional streetscapes;
- ensure that the City's Scheme and development plans for residential development reflect the principles of landscape master planning; and
- ensure community awareness and engagement occurs during planning and implementation.

4.2.6 OTHER LOCAL PLANNING POLICIES

4.2.6.1 HEIGHT AND SCALE OF BUILDINGS WITHIN RESIDENTIAL AREAS POLICY

Issued by the City of Joondalup in October 2005, the primary objective of the *Height and Scale of Buildings Within Residential Areas* policy is "to ensure that all development within a residential area of significant height and scale is given appropriate consideration with due regard to the protection and enhancement of the amenity and streetscape character of the surrounding area." As part of this policy development applications must comply with a building threshold envelope.

4.2.6.2 SUBDIVISION AND DWELLING DEVELOPMENT ADJOINING AREAS OF PUBLIC SPACE POLICY

Issued by the City of Joondalup in October 2009, the primary objective of the *Subdivision and dwelling development adjoining areas of public space* policy is 'to provide guidelines for the design of subdivisions and dwelling developments adjoining areas of public space to maximise the outlook onto and casual surveillance of these areas from adjoining properties and streets'. As part of this policy development and subdivision must meet prescribed standards, including uniform fencing and dwelling orientation requirements.

5 CRAIGIE COMMUNITY

5.1 DEMOGRAPHICS

In a total area of 4.6 km², current population for the suburb of Craigie (based on 2011 Census) is 5,588 making the population density 1,215 people per km². This population is accommodated within 2,310 dwellings with an average household size of 2.4 people. Craigie's median age is 35 with the number of people aged over 65 at 885, 16% of Craigie's total population. The median household income is $69,904 per annum.

5.2 HOUSING

The general housing type surrounding the Camberwarra Primary School Site is single storey dwellings/houses on approximately 700m² lots, with approximate 18m frontages and 37m depths. 2,023 of 2,302 residential lots within the suburb of Craigie are between 600-900m².

5.3 FACILITIES

The facilities available within close proximity to the Camberwarra Primary School Site include Whitfords Catholic Primary School situated over Camberwarra Crescent to the west, Craigie Plaza (local centre) situated approximately 300m south-east of the site and Otago Park to the south of the site.

6 EXISTING SITE DESCRIPTION

6.1 LANDSCAPE CONTEXT

The site has operated as a school for many years and as such has been cleared of the majority of native vegetation and reconfigured to provide functional areas suited to the operation of a school. There are several existing mature trees on site that are further discussed in Section 8.6.

6.1.1 TOPOGRAPHY AND LANDFORM

The topography of the site is hilly with the surface level generally falling from a maximum of approximately RL 37.7 m AHD in the north-east of the site to RL 30 m AHD in the north-west and RL 23.9 m AHD in the south of the site, according to a survey plan produced by McMullen Nolan. Further information on landform and topography is included within Geotechnical Report outlined in **Appendix 5.**

6.1.2 SOILS AND GEOMORPHOLOGY

The Quindalup Dune System is comprised of three soil types, all of which are present within the site: limestone, limestone sand and calcareous sand. The limestone is a pale yellowish brown in colour, is weakly cemented, friable, medium grained, with sub-rounded quartz and shell debris of aeolian origin. The sand is pale and olive in colour, with medium to coarse grain, sub-angular to sub-rounded quartz, a trace of feldspar, and moderately sorted of residual origin. The calcareous sand is white in colour, fine to medium grained with sub-rounded quartz and shell debris of aeolian origin. These soils are free draining and are capable of supporting unique flora and fauna.

The Spearwood Dune System consists of calcareous deep sands and yellow sands, coastal aeolian sand over sedimentary rocks, coastal dunes with sand flats. There are two distinctly different landscapes, one that consists of shallow yellow brown sands and exposed limestone while the other has deep yellow brown sands. Further information on soils and geomorphology is included within Geotechnical Report outlined in **Appendix 5.**

6.1.3 FLORA AND VEGETATION

In August 2010 a Level 1 flora and vegetation survey was completed by RPS Environment and Planning for Lot 12811 (Reserve 36690), 34 Currajong Crescent, Craigie (**Appendix 2**). The vegetation surrounding the former primary school sitewould originally have supported representatives of the Cottesloe Vegetation Complex such as Rottnest Island Tea Tree (*Melaleuca lanceolata*),Tuarts (*Eucalyptus gomphocephala*) and Peppermint Trees (*Agonis flexuosa*).

A total of 18 flora species were recorded, within six vegetation types. The dominant family present was *Myrtaceae* (Eucalypts). The condition of the vegetation is mostly completely degraded consisting of remnant native trees with planted Eucalypts (previously terraced) exotic gardens and lawns.

No Threatened Ecological Communities (TEC's) were recorded within the survey area due to the completely degraded condition and lack of remnant vegetation types. The results of the study due to the state of its vegetation condition also places the Camberwarra Primary School site as neither a Regionally or Locally Significant Natural Area, nor does it contain any rare, priority, or flora of other significance.

Due to the potential to provide roosting and breeding sites for the endangered Carnaby's Black Cockatoo a select number of larger native trees (Tuarts) on the site may be considered significant for both ecological habitat provision and aesthetic reasons. These trees are situated on the west and southern fringe of the site from Argus Close and along Camberwarra Drive. Based on this survey data, the intention of the landscape strategy for this site is to re-establish key habitat species into the public open space and streetscapes as integrated habitat and public amenity.

6.1.4 FAUNA

Resultant of a desktop fauna study search by RPS Environment and Planning the following table produced results from the DEC Threatened and Priority Fauna, and the EPBC Act (1999) 'Protected Matters' database in showing species with potential to occur in the study area.

- BIRDS - *Calyptorhynchuslatirostris* (Carnaby's Black Cockatoo)
  - *Calyptorhynchusbanksiinaso* (Forest Red-tailed Black Cockatoo)
- INSECTS - *Synemongratiosa*(Graceful Sun Moth)
- REPTILES - *Neelapscalonotos*(Black-striped Snake)
- MAMMALS - *Dasyurusgeoffroii*(Chuditch)

With the observed vegetation condition and further disturbance by the demolition and clearing of buildings the Camberwarra Primary School site presents an unsuitable habitat for the Graceful Sun Moth, Black-striped Snake and the Chuditch. Due to the lack of grasses, woodland understorey, hollow logs and places to burrow it is highly unlikely that these species will occur within the site.

Due to the presence of appropriate and suitable nesting trees (Tuarts) there is potential for the Carnaby's Black Cockatoo and the Forest Red-tailed Black Cockatoo to inhabit and forage the site. Both species are known to inhabit remnant native eucalypt woodlands with hollows for breeding. Particular to the Carnaby's Black Cockatoo the site is within range of its migratory route to coastal areas when moving from the east and due to a significant decline in the species this poses a key significance in the support to maintain Tuarts of reasonable and suitable condition. This support will also be encouraged through additional habitat species integration in the planting rationale.

6.1.5 OPEN SPACE NETWORK

The site is located centrally to several public open spaces, and community gathering points, each of which are within walking distance. Bridgewater Reserve can be accessed via an under-pass beneath Marmion Avenue, Whitford Catholic Primary School is west of the site on Camberwarra Drive, Gradient and Barwon Park to the west, the Craigie Plaza and Warrandyte Reserve to the south-east, and both Otago Reserve and the Craigie Primary School to the south.

Most of the road network surrounding the site contains at least one footpath within the road verge, facilitating pedestrian movement between these public spaces.

6.2 MOVEMENT NETWORK

Within the proposed structure plan, the residential lots are the major traffic generating land use. The reserve for recreation located on the southwest corner of the structure plan is not expected to attract vehicular traffic as most trips to the reserve are expected to be by walking or cycling.

The majority of traffic generated by the proposed subdivision would be attracted east from the site, i.e. Mitchell Freeway (i.e. Perth CBD, Joondalup) for work. Other key attractors would be north towards schools (Beldon Senior High School) and local shopping centres i.e. to the southwest Whitfords Shopping Centre and again to the north Joondalup.

6.2.1 EXISTING ROAD INFRASTRUCTURE

The road network servicing the subject site is shown in **Figure 7** and further discussed within **Appendix 4**. Three existing roads directly abut the site, being Camberwarra Drive, Currajong Crescent and Argus Close.

CAMBERWARRA DRIVE

Camberwarra Drive is typically constructed to a kerbed, two lane divided (painted median) single carriageway road. The approximate pavement width is 9m comprising of 2 x 3.5m traffic lanes and a 2m painted median. Immediately adjacent to the site there are parking embayment's that previously would have been used to meet the associated parking demand during the operation of the Primary School.

There are existing footpaths on both sides of Camberwarra Drive. Typical widths are 1.2m however immediately adjacent to the site the footpath is widened locally to accommodate the increased pedestrian usage during the operation of the old school.

The built up area speed limit of 50km/h would apply past the site. Camberwarra Drive forms a continuous loop within the adjacent residential area with numerous road connections along its lengths.

Camberwarra Dr, looking west towards Fenellia Cres

Camberwarra Dr, looking east towards Fenellia Cres

CURRAJONG CRESCENT

Currajong Crescent is constructed to a kerbed, two lane undivided single carriageway road. The approximate pavement width is 7m (western and eastern legs) while the width alters adjacent to the site to approximately 8.5m, comprising of 3m lanes and a 2.5m wide on street parking embayment. These parking bays would have previously been used to meet the associated parking demand during the operation of the old Primary School.

There is an existing 2.0m wide footpath located on the southern side of Currajong Crescent adjacent to the site. Pedestrian links from Currajong Crescent connect through to Craigie Drive, Barwon Road and Allinga Crescent.

The built up area speed limit of 50km/h would apply past the site. Currajong Crescent forms a u-shaped road connecting with Camberwarra Drive and Bullara Road.

Currajong Cres, looking north from Camberwarra Dr

Currajong Cres looking east adjacent to old school site

Currajong Cres, looking south towards Bullara Dr

Pedestrian Link from Currajong Cres to Craigie Drive

ARGUS CLOSE

Argus Close is constructed to a kerbed, two lane undivided single carriageway road. The approximate pavement width is 6.2m. There is an existing 1.2m wide footpath located on the eastern side of Argus Close adjacent to the site.

The built up area speed limit of 50km/h would apply past the site although the local conditions i.e. road length and cul-de-sac form would likely restrict speeds to less than this.

Argus Close, looking south towards cul-de-sac end

Pedestrian Link from Argus Close to Camberwarra Drive

6.2.2 ROAD HIERARCHY CLASSIFICATION

All the adjacent roads abutting the site, i.e. Camberwarra Drive, Currajong Crescent and Argus Close are classified as *Access Roads* under Main Roads WA's *Functional Road Hierarchy*. This classification is applied to roads which "*provide access to abutting properties with safety aspects having priority over the vehicle movement function. In urban areas, these roads are bicycle and pedestrian friendly, with aesthetics and amenity also important*".

The local distributor roads within the area which are expected to be used by local traffic include Craigie Drive, to the north of the site and Eddystone Avenue to the east of the site. The *local distributor* classification is applied to roads which: "*discourage through traffic, only carries traffic belonging to or serving the area. Local distributors should accommodate buses but discourage trucks".*

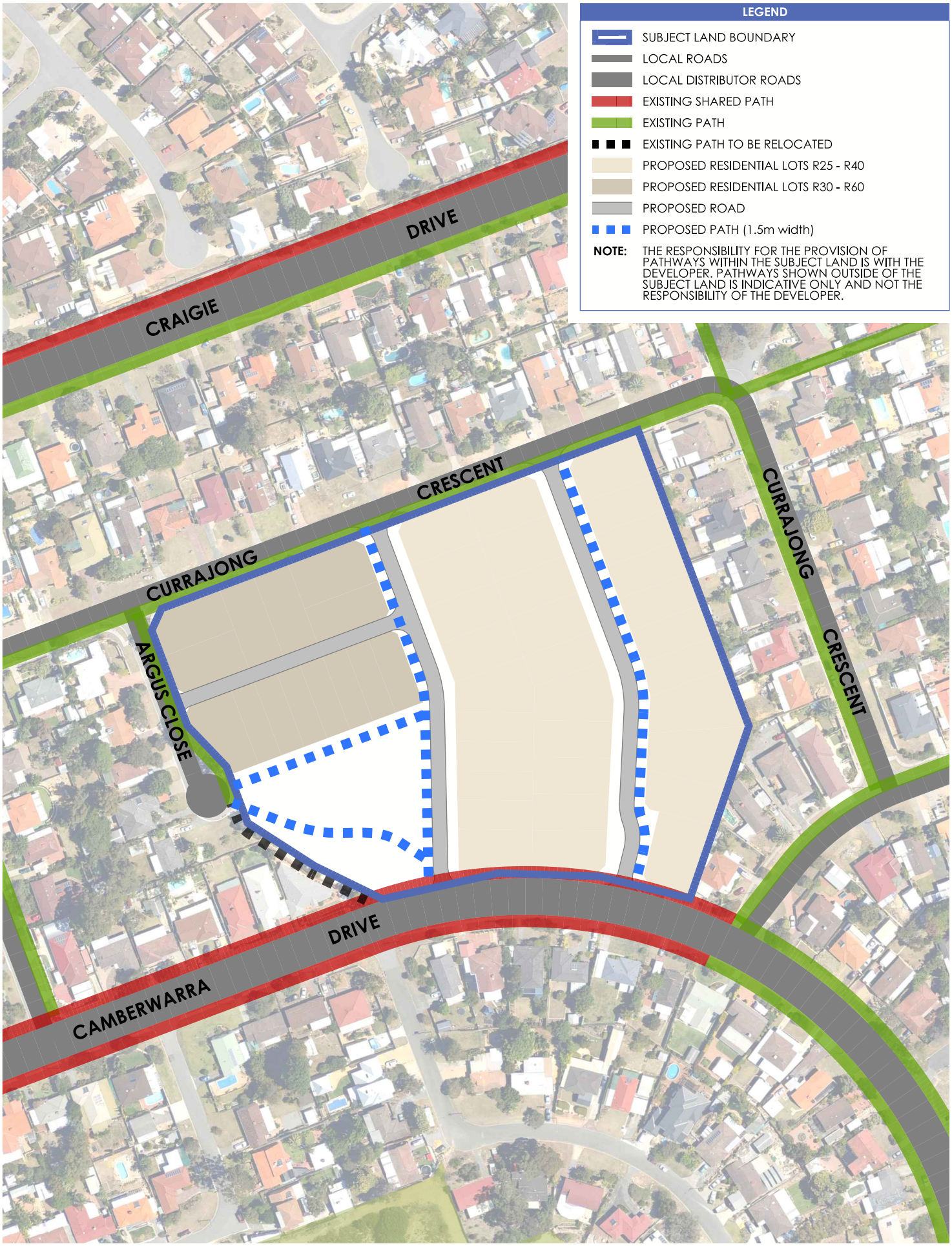
6.2.3 PEDESTRIANS & CYCLISTS

The pedestrian and cyclist movement network for the subject area is outlined within **Figure 8.** The walking distance from the new dwellings to the existing bus stops locations on Camberwarra Drive or Craigie Drive (route 463) and on Eddystone Avenue (route 464) is 400-500m. This is equivalent to a 5 minute walk.

6.2.4 PUBLIC TRANSPORT

The subject site has good access to public transport, as shown in **Figure 9.** The existing Transport bus route 463 and 464 travel along Camberwarra Drive, to the west of the structure plan and Eddystone Avenue, to the east of the structure plan respectively servicing the Whitfords and Joondalup Train Stations.

The existing Transperth bus route 463 in the vicinity of the site has stops on Camberwarra Drive, west of Barwon Road while bus route 464 has stops on Eddystone Avenue, south of Craigie Drive.



PEDESTRIAN & CYCLIST MOVEMENT NETWORK

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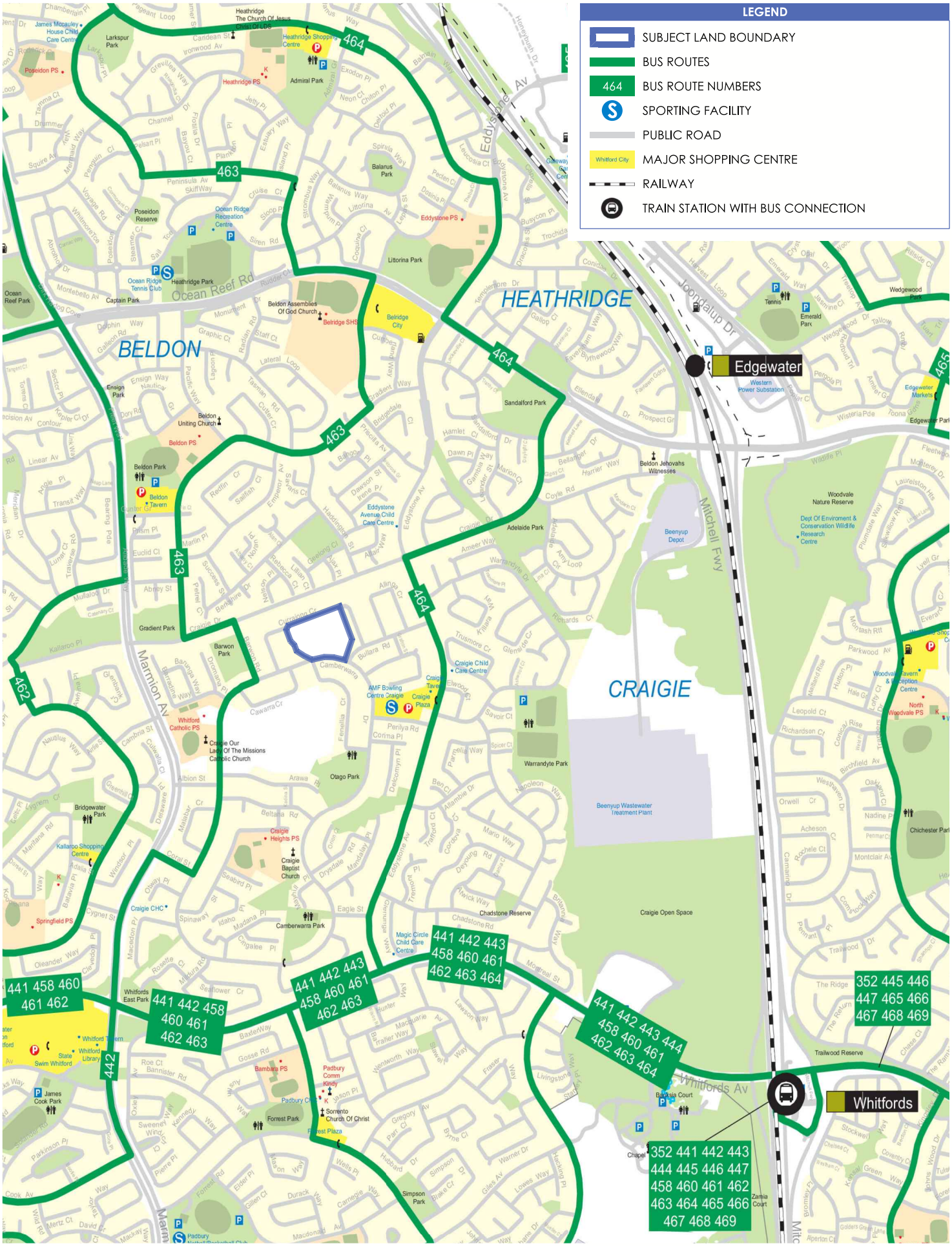

BUS ROUTES

Camberwarra Primary School Structure Plan

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figure 09

6.3 SERVICE INFRASTRUCTURE

The site is located on a former primary school site that has been fully serviced. Demolition and clearing of the primary school site was carried out in 2011.

The main constraint for the site relates to the levels changes across the site, as there is over 12m fall across the site, special consideration will be required to minimize large walls (3m or larger) and ensure that proposed levels interface with existing residents and verges.

6.3.1 SEWERAGE SYSTEM

The Camberwarra Primary School site is well serviced by Water Corporation sewer assets with existing 150mm diameter sewers located adjacent to the development site. The entire site lies within the Barwon Road Pumping Station No. 78-09.

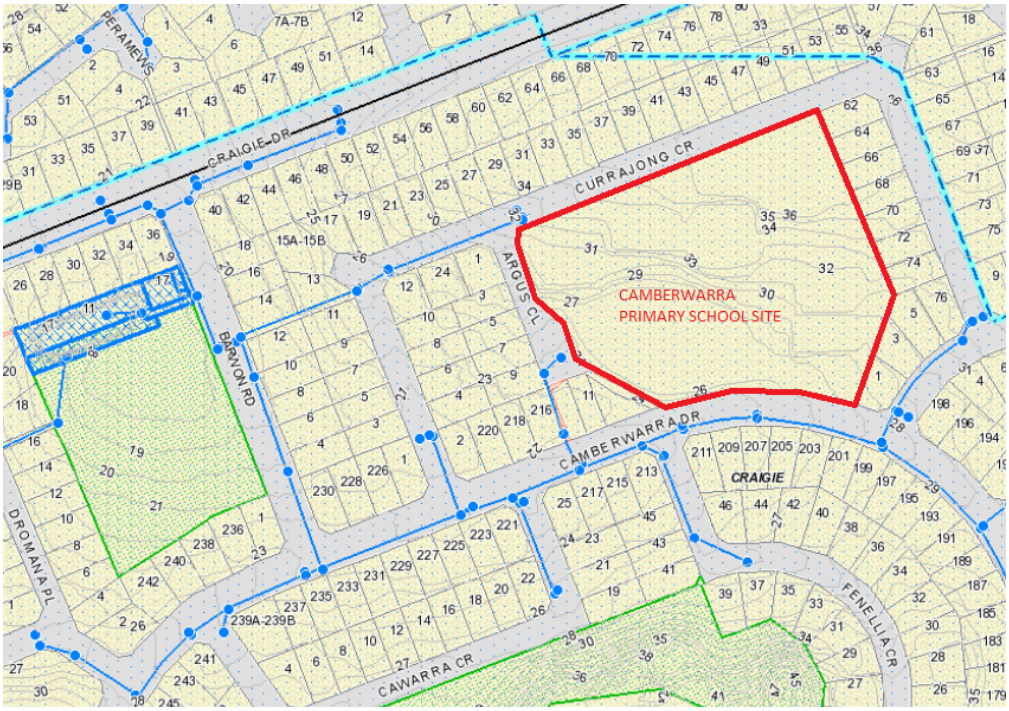
6.3.2 WATER SUPPLY

The Camberwarra Primary School site is well serviced by Water Corporation water assets with existing reticulation mains within the road reserves surrounding the proposed development including 220mm diameter mains in Camberwarra Drive and Bullara Road and 100mm diameter mains in remaining roads.

6.3.3 DRAINAGE

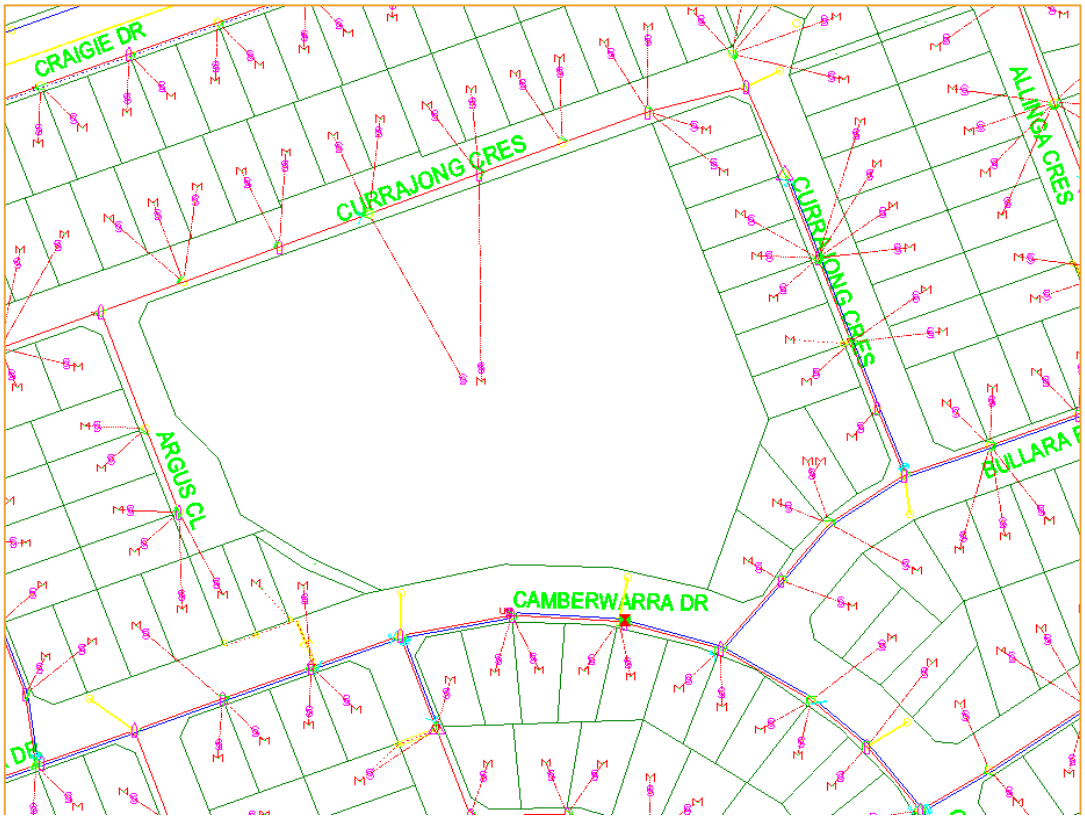
Stormwater drainage from the existing roads surrounding the site currently discharge via a pit and pipe network into the Barwon Road stormwater drainage basin.

Flood routing for large stormwater events are conveyed along the existing road network also to Barwon Road basin.



6.3.4 ELECTRICITY

There is a low voltage aerial power line along Currajong Crescent fronting the site and along Argus Close. The only high voltage network adjacent to the site is along Camberwarra Drive, which would be the likely connection point for the development. The existing aerial power lines along Currajong Crescent are located adjacent to the site.



6.3.5 GAS

The surrounding area is well reticulated with Gas infrastructure and the existing network will have the capacity to service the redevelopment of the site.

6.3.6 TELECOMMUNICATIONS

The general area is well serviced with Telstra Infrastructure with a major exchange building located at intersection of Coral Street and Marmion Avenue.

7 OPPORTUNITIES, CONSTRAINTS AND ISSUES

The site is characterised by a number of factors which are relevant in the formulation of the Structure Plan and should influence the design outcome. The outcomes of an opportunities and issues/considerations analysis of the site area is illustrated in **Figure 10** and discussed further below.

7.1 OPPORTUNITIES

7.1.1 LAND USE/SURROUNDING USES

The following land use/surrounding land use opportunities are evident in the Camberwarra Primary School Site:

- Optimise the aesthetic appearance of the development along the exposed external edges of Camberwarra Drive, Currajong Crescent and Argus Close through quality public realm, built form and retention of trees.
- Co-locate the public open space (POS) with the drainage at the lowest part of the site.
- Optimise the interface with the Public Open Space and beautify the drainage basin as a wetland feature.
- Optimise the aesthetic appearance of the side of the existing lot between Argus Close and Camberwarra Drive.
- Optimise the interface with the back/side of existing lots to the east.
- Potential green links through the site, through retention of trees in road reserves.

7.1.2 EXISTING VEGETATION

The following existing vegetation opportunities are evident in the Camberwarra Primary School Site:

- Consider the retention of significant native trees and other trees on site.
- Consider large trees that have formed hollows that have the potential to provide roosting and breeding sites for the Endangered Carnaby's Black-Cockatoo.

7.1.3 VEHICULAR AND PEDESTRIAN MOVEMENT

The following vehicular/pedestrian movement opportunities are evident in the Camberwarra Primary School Site:

- Potential linkages off existing pedestrian network.
- Potential pedestrian pathways providing legible walkability through the site.
- Opportunity to realign existing pedestrian access way (PAW) between Argus Close and Camberwarra Drive into the site/POS, improving the pedestrian movement and amenity.
- Capitalise on near-by bus route to facilitate and promote transit use.
- Camberwarra Drive provides an opportunity for access into the site due to good exposure and connectivity to the existing street network.
- Opportunity to provide direct north-south streets between Currajong Crescent and Camberwarra Drive maximising connectivity, providing legibility, optimising passive solar lot orientation and assisting drainage flow.

7.1.4 LANDFORM

The following landform opportunities are evident in the Camberwarra Primary School Site:

- The sloping topography of the site from north-east down to south-west provides potential for views, specifically long views southwards towards the Cawarra dune system and short views southwards down potential north-south streets.

7.2 CONSTRAINTS/ISSUES

7.2.1 MOVEMENT

The following movement constraints/issues are evident in the Camberwarra Primary School Site:

- Entry/Exit points onto Camberwarra Drive and Currajong Crescent to be considered.
- Treatment of potential pedestrian/vehicular connections into site to be considered.

7.2.2 INTERFACE

The following interface constraints/issues are evident in the Camberwarra Primary School Site:

- Connection to surrounding street network via Camberwarra Drive to the south, Currajong Crescent to the north and/or Argus Close to the west.
- Consider treatment of existing side lot interface between Argus Close and Camberwarra Drive.
- Consider treatment of existing back/side lot interface to the eastern boundary of the site.
- Consider treatment of proposed development interface with POS/Drainage.

7.2.3 EXISTING INFRASTRUCTURE

The following infrastructure constraints/issues are evident in the Camberwarra Primary School Site:

- All Primary School buildings demolished with pad sites remaining.
- Poor amenity provided by existing pedestrian access way (PAW) between Argus Close and Camberwarra Drive.

7.2.4 TOPOGRAPHY

The following topography constraints/issues are evident in the Camberwarra Primary School Site:

- Consider treatment of significant level change from Currajong Crescent down to Camberwarra Drive (from 37AHD down to 24AHD).
- Consider treatment of significant level change to corner of Currajong Crescent and Argus Close.
- General southwards drainage direction influencing location of onsite retention, street block orientation and solar access.
- Consider treatment of significant level change from existing PAW up to subject site level.

8 THE PLAN

8.1 DESIGN PHILOSOPHY & PRINCIPLES

The design vision of the Camberwarra development is to create a new and inspiring residential community that embraces natural landmarks, respects its urban context and uses site-specific creativity to accentuate natural landform.

Integral to the vision, is the integration of the adjacent existing residential development with the new Camberwarra Primary School development. This has been achieved through the creation of legible north south streets supporting passive solar traditional lot design, backing development onto an existing poor lot interface and the introduction of cottage product overlooking the high-amenity public open space area. The above urban structure creates communal open space areas, community focal points and promotes the site's sense of identity.

The design seeks to encourage a relaxed, healthy and social lifestyle, while complementing a new and emerging demographic through the provision of diverse housing product.

The Structure Plan embraces the following principles:

- Provide for a range of quality built form and housing product opportunities.
- Ensure a sensitive transition and integration between the existing and new development.
- Provide a legible movement network that enhances accessibility and way-finding.
- Integrate the drainage into the high-amenity public open space.
- Optimise the aesthetic appearance of the development along the exposed external edges.
- Optimise the aesthetic appearance of the lots directly fronting the high-amenity public open space.
- Laneway lot product introduced to respond to site topography, provide diversity of lot product and enable efficient use of land.
- North-south street structure supporting climate responsive and environmental design is to be incorporated into built form outcomes.
- Provide site response design that optimises climate and landform sensitive outcomes.
- Through well connected public realm and community facilities, the existing assets and sense of community are enhanced by integrating with the new development..

8.2 LAND USES

The Camberwarra Primary School Structure Plan (refer **Plan 1**) proposes the following mix of land uses over the subject land:

- Residential;
- Public Open Space; and
- Drainage.

The following sections describe the land uses proposed by the Structure Plan and provides a rationale for their location within the structure plan area.

8.2.1 RESIDENTIAL

The density within the Camberwarra Primary School Structure Plan has been considered within the context of the State Government's *Directions 2031* and the City's *Draft Local Housing Strategy*, which both encourage more efficient use of land.

To ensure that the subject land is developed to its optimal potential, a minimum density requirement has been imposed in Part 1 of 19.5 dwelling units per site hectare, or a total of 60 dwellings, which is to be imposed by regulatory authorities in subdivision and/or development applications.

This density target is higher than the surrounding subdivision density to reflect the strategic importance of a residential development site in an established residential area. The target is considered entirely appropriate to optimise built form outcomes, and is reflective of the recommended density targets for new urban development areas under Directions 2031, the Outer Metropolitan Perth and Peel Sub Regional Strategy and Liveable Neighbourhoods.

Areas of lower density have been provided where site-responsiveness has been a priority, particularly in relation to addressing the steep slope across the site, respecting the interface with the existing R20 residential areas and incorporating the existing grades within the lots.

Densities have generally been provided for by locating the lower densities on the periphery of the site to interface with the existing lower density residential, while the density intensifies towards the Public Open Space located in the south of the site.

Through the *Residential Design Codes,* together with the *Built Form Requirements* of this Structure Plan the site development encourages residential development to occur in a sustainable way.

The location, variety and orientation of the residential densities are in accordance with Element 3 – Liveable Neighbourhoods. The Structure Plan (refer **Plan 1 -** Structure Plan) provides for the following density ranges:

- R25 – R40 Residential
- R30 – R60 Residential

Based on the densities proposed by the Local Structure Plan, a minimum of 60 dwellings will be achieved. It is important to recognise, however, that given the topography of the site and the nature of the future development, there will be a need to ensure that the design of single dwelling lots and grouped housing lots can be achieved in a flexible manner. This can only be undertaken at the detailed subdivision design stage.

Based on the residential area proposed by the Local Structure Plan, approximately 21,154m² of Net Developable Area (NDA) will be achieved. The table below provides an indicative R-Code Area breakdown for the Structure Plan area:

R-Code	NDA (m^2)	% of Area
R25 –R40	15,229m^2	72%
R30 – R60	5,925m^2	28%
Total	21,154m^2	100%

8.2.1.1 R25-R40 RESIDENTIAL

The land proposed for residential development at R25-R40 has been generally located on eastern boundary of the subject land to provide a similar built form transition from the abutting R20 development to the more compact residential housing towards the north-west of the site. The Structure Plan provides for these peripheral R25-R40 zones in response to the existing residential R20 housing adjacent to the site.

8.2.1.2 R30 – R60 RESIDENTIAL

An area of R30 – R60 rear-loaded laneway product is strategically located along the north-western interface of the high amenity open space area. This location provides the opportunity for direct Public Open Space interface with rear laneway access. This R30–R60 residential zone promotes a more equitable urban structure and offers high accessibility to open space for smaller lots. This strategic allocation of density provides for increased accessibility and promotes a lively community nucleus by allowing for the population required to support these high amenity areas. The R30 – R60 Code allows for laneway lots generally between 160-350m², with some having direct access to the central open space.

8.2.2 PUBLIC OPEN SPACE

The public open space area shown in **Figure 11** represents approximately 3,991m^2 in the south-west precinct of the subject area. It should be noted that this POS Area is inclusive of a 550m^2 drainage swale for a 1:1 year rainfall event, resulting in a creditable POS are of 3441m$^{2.}$ The selected POS location is considered to be optimal as it:

a) Provides an area of accessible POS for both the new development and the existing surrounding development;

b) Forms a natural low point in the topography, allowing the collocation of drainage and POS as per Liveable Neighbourhoods standards;

c) Provides an attractive outlook for new lots immediately abutting the POS, in addition to the surrounding existing development; and

d) Reflects the historic use of this portion of the site, which was the school oval, as open space for the benefit of the community.

PUBLIC OPEN SPACE SCHEDULE Camberwarra Structure Plan		
Gross Site Area (ha)		**3.0519**
Deductions		
Restricted Open Space - Drainage Basin (1:1 yr storm event)	0.0550	
Total Deductions		**0.0550**
Net Subdivisible Area		2.9969
Required Public Open Space (10%)		**0.2997**
Public Open Space Requirements		
Unrestricted public open space - minimum 80%	0.2398	
Restricted public open space - maximum 20%	0.0599	
Total		**0.2997**
PUBLIC OPEN SPACE PROVISION		
Credited Unrestricted Public Open Space		
Active and Passive Recreation (exclusive of drainage function)	0.1791	
Unrestricted Open Space - Drainage Basin (1:100 yr storm event)[1]	0.1550	

PUBLIC OPEN SPACE SCHEDULE Camberwarra Structure Plan		
Total Credited Unrestricted POS		**0.3341**
Restricted Public Open Space		
Drainage Basins (1:5 yr storm event)[1]	0.0100	
Total Restricted POS		**0.0100**
Total Restricted and Credited Unrestricted POS		**0.3441**
Percentage of Credited POS (Restricted and Credited Unrestricted POS Contribution)		**11.48%**

1. Detailed drainage calculations are subject to detailed calculation at the subdivision stage.

This POS is intended to be developed for active and passive open space purposes, and will accommodate the drainage requirements for the subject area. The POS Schedule for the subject site is provided above in accordance with the requirements of Liveable Neighbourhoods.

It is recognised that the City of Joondalup may choose to alter the existing Public Access Way abutting the POS area, as pedestrians may prefer to use the POS area as a thoroughfare between Argus Close and Camberwarra Drive.

8.3 LANDSCAPE MASTERPLAN

The Camberwarra Primary School site offers a unique opportunity to integrate new housing and recreation models into the existing urban fabric of Craigie, this supported by a locally sourced, provenance planting rationale will:

- Celebrate and respond to the natural biodiversity of the region;
- provide more opportunities for passive recreational pursuits in public open space and ‘natural’ bushland ecosystems;
- increase active and passive recreational opportunities within attractive and functional landscape incorporating an active recreation irrigated turf area, well-maintained native garden beds, and rehabilitating naturally occurring bushland areas into the urban fabric;
- provide an effective response to the issue of climate change through reducing overall water consumption patterns across the City where appropriate;
- provide attractive, low-maintenance and spatially functional streetscapes;
- promote the principals of natural play pursuits and exposure to vernacular ecologies;
- ensure community awareness and engagement occurs during planning and implementation.

The Landscape Masterplan is included within **Figure 11.**

8.4 BUILT FORM

In promoting a Structure Plan objective to facilitate quality built form and diverse housing, it is important that achieving the required outcomes is not restricted by the City's Policy 3.2 *Height and Scale of Buildings Within Residential Areas*. For this reason, Part 1 proposes a variation to this Policy to allow more development scope for the lots within the Structure Plan area.

The *Height and Scale of Buildings within Residential Areas* Policy effectively negates any two-storey development on lots less than 17-18m wide due to the wide 5m side setback on each side of a lot that creates the building envelope for the 8.5m height limit. The majority of the Structure Plan contains a density coding between R25-R40, giving those lots a frontage of under 17-18m. On these smaller R25-R40 lots, desirable two-storey development would not be allowed by the building threshold envelope limitations within the *Height and Scale of Buildings within Residential Areas* Policy.

Current building industry experience indicates that two-storey development is often higher than 8.5m, often close to 10m high at the ridge.

8.5 STREETSCAPE

The streetscape is the interface between home, community and nature. Designed correctly, it provides the setting for social interaction and connection to nature. The key to this success is establishing human scale and preference for people over cars.

The broad street verges provide a good opportunity for people to interact in their daily activities. The major entry and dividing north/south road of the development will feature tall Tuarts (*Eucalyptus gomphocephala*) to provide continuity with the Tuarts retained in parts surrounding the site. The remaining minor roads will support smaller-scale Peppermint Trees (*Agonis flexuosa*) that will tie in with the neighbouring Craigie High School site development. Where existing street frontages are incorporated into the development, the street tree planting rationale with be reinstated to integrate seamlessly with the surrounding suburb.

It is noted that carriageway design, including street trees within the verge areas, is subject to Council approval as subdivision progresses.

8.6 SITE FEATURES

8.6.1 EXISTING TREES

A number of mature existing trees on the site provide valuable green infrastructure that have the inherent capacity to enhance and regenerate natural resources. Given the varied topography of the site, however, it is recognised that significant site works will need to occur prior to residential development being feasible. Due to the nature of the site works required to supply level homesites, it will be very difficult to retain the majority of the trees on-site.

An assessment of the vegetation by PGV Environmental has found that clearing is unlikely to have a significant impact on Carnaby's Black Cockatoos, and as a result referral to SEWPaC is not required. Further information on the results of the vegetation assessment are outlined in **Appendix 6.**

In preparation of the detailed subdivision and engineering plans the landowner will work with the City of Joondalup to optimise the retention of existing trees in accordance with the tree retention plan (**Figure 12**).

Many of the trees to be potentially retained on site are located in the grouped housing site along with some key specimens at site entry points and the lower lying drainage basin proposed to the southwest corner of the site.

Where trees proposed for possible retention are located in areas to be earth-worked, root zones will be identified, fenced-off and retained in their natural state for the duration of the project development phase. These existing trees provide:

- habitat for endangered species of native bird life
- improve air quality
- providing buffers and refuges in extreme weather events
- reduced green-house gas via carbon sequestration
- increased local distinctiveness that supports cultural identity
- enhanced biodiversity by providing connectivity, corridors and linkages
- adding value to water sensitive urban design though soil infiltration that reduces flooding and pollution from run-off.

The tree retention plan is outlined in **Figure 12** and further discussed in **Appendix 3.**

8.6.2 DRAINAGE, NUTRIENT AND WATER MANAGEMENT

Effective management of the storm water collection, filtration and distribution, will be demonstrated through the required management. These will be prepared in collaboration with project engineers to accommodate the following public landscape design principles:

- infiltrate stormwater to groundwater as close to point-source as possible
- integrate stormwater detention areas into natural topography where-ever possible
- accommodate occupational health and safety requirements
- promote natural ecologies
- provide effective vegetative stripping of nutrients before entering groundwater
- accommodate and minimise maintenance requirements in collaboration with local government.
- ensure plant species selection are appropriate for debris collection, erosion control, nutrient stripping and periodic submersion.

8.7 MOVEMENT NETWORK

8.7.1 PROPOSED ROAD NETWORK

The proposed road network is shown in **Figure 13** and further discussed within **Appendix 4.** As the proposed roads are yet to be named, the identifying names as per Road 1 and Road 2 have been adopted for use in this assessment. The two internal roads of the subdivision simply connect in a north-south orientation between Camberwarra Drive and Currajong Crescent. The nature of the road layout is such that minimal external traffic is likely to use the newly created roads with the exception being local traffic whose origin/destination is Currajong Crescent itself.

Figure 13: Proposed Movement Network

A number of residential properties abutting the public open space will not have direct street frontage. Detailed design will need to give consideration to garbage collection from these properties via rear the laneway. Turning movements into/out of the laneway on the garbage route needs to be considered at the detailed design stage of the lots to ensure appropriate truncations are allowed for.

8.7.2 ROAD RESERVATION WIDTH

The road reserve widths of Road 1 and Road 2 are typically 15m. This width is consistent with the range of 14.2m to 24m suggested in *Liveable Neighbourhoods* (WAPC 2009) as indicative reserve widths for access streets (those that accommodate shared pedestrian, bike and vehicle movements). The lower reserve width is generally for short, low volume, and low parking demand streets. The higher reserve width allows for a median and/or additional road features such as parking and paths to be incorporated. It is noted that the reserve width is reduced locally immediately adjacent to the public open space being 13m, with a 2.5m verge along the public open space. This is achievable through the reduced verge width allowance in *Liveable Neighbourhoods* for only 1m adjacent to parks.

The laneway is proposed to have a road reservation width of 6.1m which is also in line with the guidelines as suggested by in *Liveable Neighbourhoods* (WAPC 2009). It is recognised that the City of Joondalup will require dedicated reserve areas for street lighting along the northern side of the proposed laneway.

8.7.3 ROAD CROSS SECTIONS AND SPEED LIMITS

All roads within the structure plan are likely to carry less than 1,000 vehicles per day hence would be defined as access roads. It would therefore be considered appropriate to adopt a narrow yield access street cross section with typically a 6m wide pavement. **Figure 14** shows a sample cross section of an access road as outlined in *Liveable Neighbourhoods* (WAPC 2009) that would be suitable for a road reservation width of 14.2m similar to the roads within the Structure Plan.

Existing street parking along Currajong Crescent is to be maintained and reconfigured, and additional street parking is to be provided on the western side of Road 1 adjacent to proposed laneway lots and the public open space. This parking is intended to be used for visitors to laneway lots and the public open space.

The proposed speed limit is 50km/h, as per the requirement in built up areas. It should be noted however the target speed as defined by Liveable Neighbourhoods with respect to the cross sections is 40km/h.

8.7.4 INTERSECTION CONTROLS

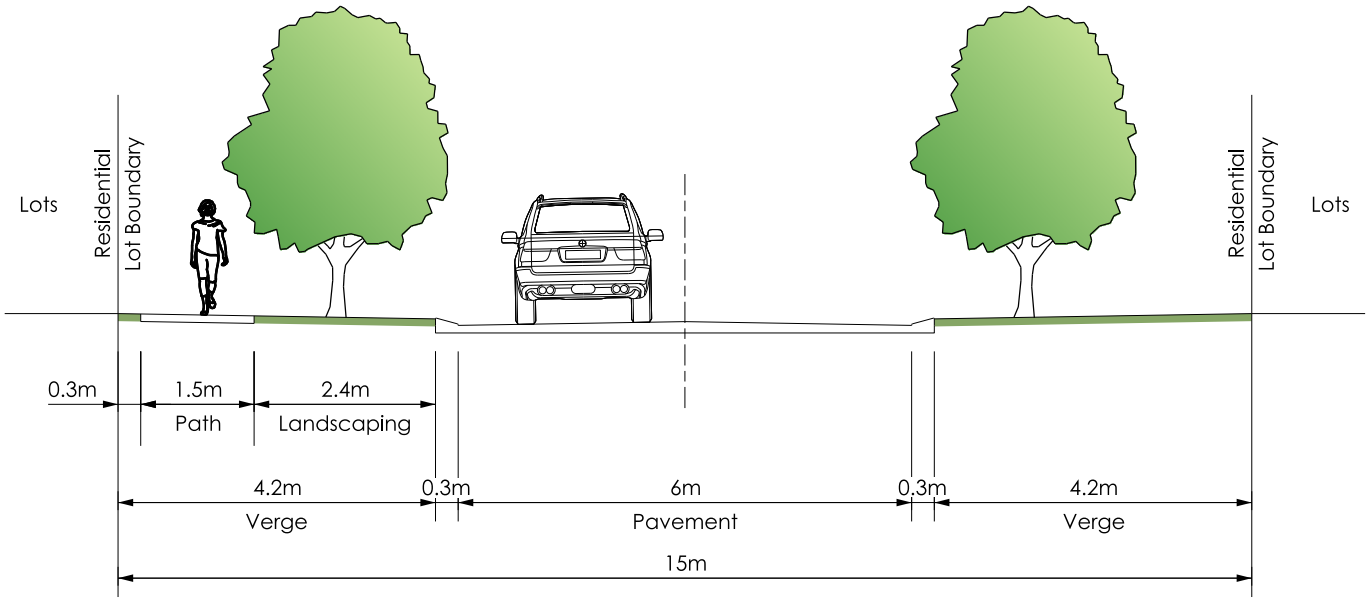
The proposed internal road network results in the creation of one internal intersection within the subdivision. This being the laneway with Road 1. A priority T junction is the proposed form of control at this intersection. The structure plan will connect to the existing road network via five new locations:

- Currajong Crescent and Road 1;
- Currajong Crescent and Road 2;
- Camberwarra Drive and Road 1;
- Camberwarra Drive and Road 2; and
- Argus Close and laneway.

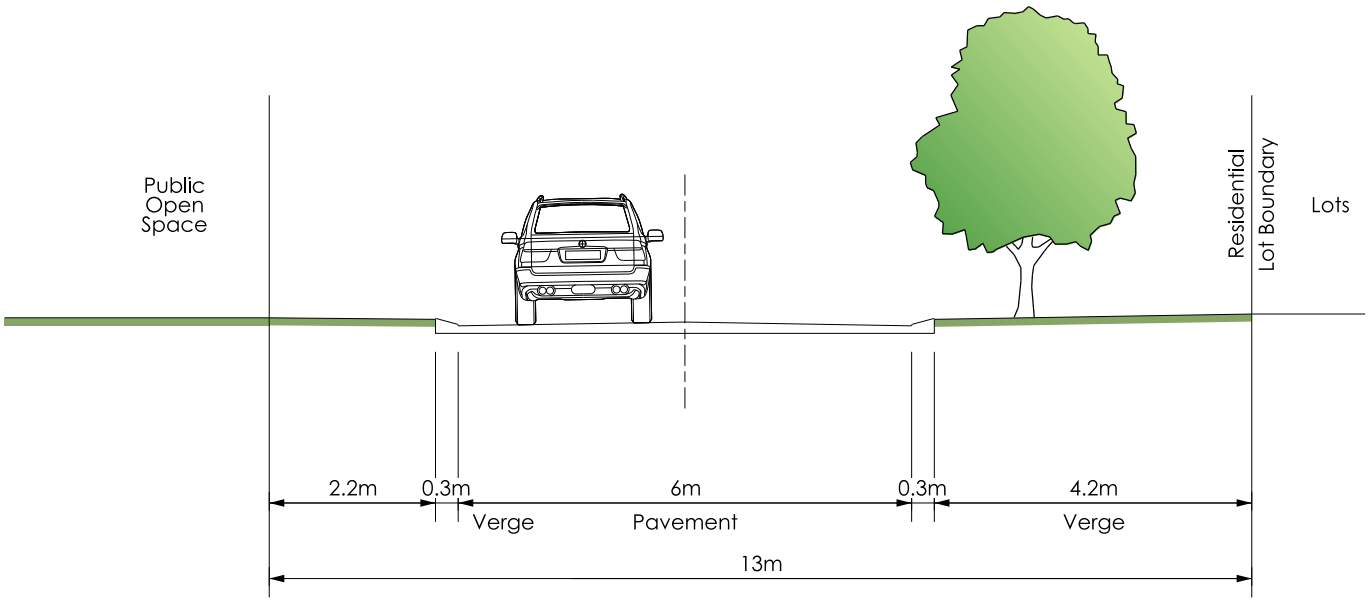
A priority T junction is the proposed form of control for each of these intersections with all vehicle movements being permitted.

Potential sight lines from the proposed intersection connections were observed on site. The sight lines are good and are appropriate within the residential environment.

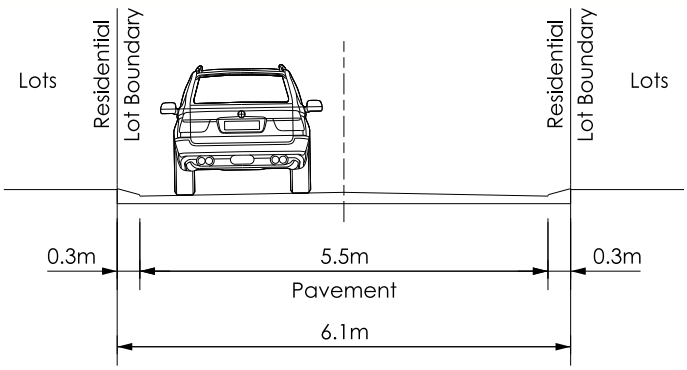
15m ROAD RESERVE



13m ROAD RESERVE (Abutting Public Open Space)



6.1m ROAD RESERVE (LANEWAY)



TYPICAL ROAD CROSS SECTIONS

Camberwarra Primary School Structure Plan

A Landcorp Project

0m 0.5 1 1.5m

s: 1:100@A4
d: 28/06/2013
p: 10/065/017C

figure 14

8.7.5 ROADS AND INTERSECTIONS

ROADS INTERNAL TO SUBDIVISION

The structure plan is expected to generate an average of approximately 416 vehicle trips per day. The indicative maximum volume of traffic suitable for an access street varies from 3,000 vehicles per day based on a pavement width of at least 7.2m and 1,000 vehicles per day based on a pavement width of 5.5-6m. (*Liveable Neighbourhoods*, WAPC 2009) The design traffic flows suggest that Road 1 and 2 with carry in the order of 104 and 120 vehicles per day. Currajong Crescent near Camberwarra Drive (west) will carry an additional 58 vehicles per day while the Currajong Crescent and Bullara Road intersection to the east will carry an additional 134 vehicles per day.

This traffic assessment confirms that all roads are expected to carry traffic volumes appropriate for roads as defined for access roads in accordance with the guidelines provided by Liveable Neighbourhoods (WAPC 2009).

The intersection of Camberwarra Drive with Road 1 and Road 2 will function as the main access/egress point to/from the proposed structure plan. Camberwarra Drive currently carries in the order of 1,865 vpd (AWT, May 2012) with corresponding maximum am and pm peak hour flows of 303/314 respectively. Road 1 and Road 2 are expected to carry in the order of 104/120 vehicles per day or 10-12 vehicles in the peak hour.

If Camberwarra Drive has a volume of 400 vehicles per hour during the peak period, the cross road Road 1 and Road 2 (i.e. road into/from the subdivision) can service a volume in the order of 250 before capacity analysis of the intersection is warranted. At an expected 10-12 vehicles, Road 1 and Road 2 is 96% below this level.

The Camberwarra Drive intersections will carry the most traffic in comparison to all other intersections (i.e. Currajong Crescent) within the structure plan. Accordingly, a capacity analysis is also not warranted for the other intersections. From this assessment, it is concluded the proposed intersections have adequate capacity to cater for the expected traffic flows.

CAMBERWARRA DRIVE

Camberwarra Drive, west of Barwon Road carries in the order of 1,865 vehicles per day (AWT, May 2012). Camberwarra Drive is constructed to a two lane single carriageway standard with a painted median. According to the Main Roads functional hierarchy Camberwarra Drive is classified as an Access Road. Camberwarra Drive is likely to be defined by Liveable Neighbourhoods as a Neighbourhood Connector due to its function connecting to numerous access roads as well as forming part of a bus route however volumes are in line with an Access Road.

Liveable Neighbourhoods (2009) suggests the indicative maximum volume for a Neighbourhood Connector ranges from 3,000 to 7,000 vehicles per day or for an Access Road 3,000vpd.. The existing volume on Camberwarra Drive, in the vicinity of Barwon Road is 1,865 vehicles per day approximately 38-73% below this level. Hence the estimated additional traffic of 125-157 vpd at various locations likely to use Camberwarra Drive can be accommodated within the spare capacity of the roadway and the resultant traffic volumes on Camberwarra Drive will remain in line with the road classification.

BULLARA ROAD

No existing volumes are available for Bullara Road however it is anticipated that they would be comparable to those along Camberwarra Drive in this vicinity. Similarly to Camberwarra Drive, in accordance with Main Roads functional hierarchy Bullara Road is classified as an Access Road while it is likely to be defined by Liveable Neighbourhoods as a Neighbourhood Connector or Access Road.

The additional trips estimated to be 291vpd can be catered for adequately within the additional spare capacity of the roadway and would also be in line with the road classification.

ARGUS CLOSE

The proposed laneway connection will result in some increase in traffic along Argus Close. There are 8 residential dwellings that will require access to their properties via the laneway. Assuming that 30% of traffic will typically be attracted to the west with the majority of 70% attracted to the east it is reasonable to assume that up to 30% of these residential trips may use Argus Close. This would equate to 19 vehicles per day or 2 trips in the peak hour. This is considered acceptable for the cul-de-sac road and is likely to be considerably less than that experienced within Argus Close during the operation of the Primary School.

8.8 SERVICING INFRASTRUCTURE

8.8.1 EARTHWORKS

The site varies from RL37m at Currajong Crescent to RL25m at Camberwarra Drive with the existing topography representing an upper terraced area for the where the original school buildings were and a lower terraced area of the playing fields.

As there is a 12m fall across the site, consideration will be required to ensure that proposed levels interface with existing residents, paths and verges. The overall site will be earthworked with the intent to achieve a cut to fill balance and to improve lot accessibility. Construction of retaining walls are required for lots (other than Group Housing Lots) to ensure level building sites with specific planning and engineering consideration required to minimise walls of significant height. Stair access will be provided to those lots fronting any POS.

It is recognised that retaining walls are likely to be required in order to adequately grade the site for residential development. In particular it is noted that the eastern boundary will need to be retained between the proposed lots and existing residential lots, with the key objective being to minimise the level difference between the site and existing properties. Retaining walls will be determined by factors including: the height difference between the site and existing lots; the levels required to retain existing trees; and, the width of new lots compared to existing lots. The developer will undertake consultation with affected landowner(s) prior to the lodgement of an application, and will work to minimise the level difference wherever possible. Such retaining walls are to be clearly outlined as a component of future subdivision and/or development applications.

8.8.2 STORMWATER MANAGEMENT

Drainage collection and conveyance system for all new roads will be designed to cater for the runoff from storms with up to a 1 in 5 year recurrence interval. An infiltration basin / swale located within the POS will be designed to store runoff from up to 1 in 10 year storms.

Based on the new subdivision layout, the new roads and stormwater drainage from Argus Close and a portion of the road overflow from Currajong Crescent (north) will be collected and stored within the infiltration basin / swale. First flush sediments (1 in 1 year ARI event) will be infiltrated into bio-retention swale immediately upstream of main storage areas within the POS.

The 1 in 100 year recurrence interval flood route will similarly be conveyed along Camberwarra Drive to the Barwon Road Basin due to existing road grades and catchments.

8.8.3 SEWER RETICULATION

The Water Corporation has advised that there is sufficient capacity within the existing pumping station for the proposed redevelopment.

Standard Water Corporation sewer headworks contributions will apply to the development.

8.8.4 WATER SUPPLY

The Water Corporation has advised that there is sufficient capacity within the existing water main infrastructure to supply the proposed redevelopment.

Standard Water Corporation water Headworks contributions will apply to the development.

8.8.5 POWER SUPPLY

The existing low voltage network fronting the site is not suitable to service the development site. A new high voltage switchgear and transformer is likely to be required and the location of this is proposed to be within the POS in close proximity to Camberwarra Drive and adjacent to the aerial high voltage network.

Being a residential development, significant costs for headworks are not envisaged as there is an existing high voltage network adjacent to the development site. This residential development will be part of the "system charge" policy which if the high voltage costs are within the economic tests, some of the high voltage headworks costs will be offset.

As the site is adjacent to the overhead power lines on Currajong Crescent, Western Power will require these power lines to be undergrounded for the frontage of the development as part of the proposed subdivision. As part of these works, existing power services for lots on the northern side of Currajong Crescent will need to be converted to underground.

8.8.6 GAS

New gas services will be installed to each lot as part of the subdivision works in liaison with ATCO Gas.

8.8.7 TELECOMMUNICATIONS

As a result of the Australian Government's decision to roll out a National Broadband Network (NBN) the ownership issues of delivering the wholesale fibre to the home system have been transferred to the Government with a number of retail service providers likely to offer services over the network. The rollout is progressing, however, as the development is less than 100 lots, Telstra will be responsible for the design and installation of the pit and pipe system at full cost to the developer.

General communication services for the development will consist of the installation of a standard pit and pipe network in accordance with the current guidelines and standards.. There may be some land requirements for equipment sites, similar to current provisions which will be accommodated at the detailed design phase.

9 IMPLEMENTATION

9.1 ADOPTION OF LOCAL STRUCTURE PLAN

The Structure Plan should be formally adopted under Clause 9.6.1 of the City of Joondalup's Scheme Once adopted, the Structure Plan will provide the basis for guiding subdivision and development within the former Camberwarra Primary School Site.

9.2 STAGING/SUBDIVISION

The proposed Structure Plan is to be approved by late 2013. Accordingly, subdivision of the subject land is expected to commence thereafter, with the subject site to be developed as a staged practical completion of works.

APPENDIX 1
CERTIFICATES OF TITLE

REGISTER NUMBER	
12811/DP219691	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

WESTERN AUSTRALIA

VOLUME **LR3110** FOLIO **37**

RECORD OF CERTIFICATE OF CROWN LAND TITLE

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997

NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE of WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 12811 ON DEPOSITED PLAN 219691

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: RESERVE WITHOUT MANAGEMENT ORDER

PRIMARY INTEREST HOLDER: STATE OF WESTERN AUSTRALIA

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

1. RESERVE 36690 FOR THE PURPOSE OF PRIMARY SCHOOL SITE

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. Lot as described in the land description may be a lot or location.

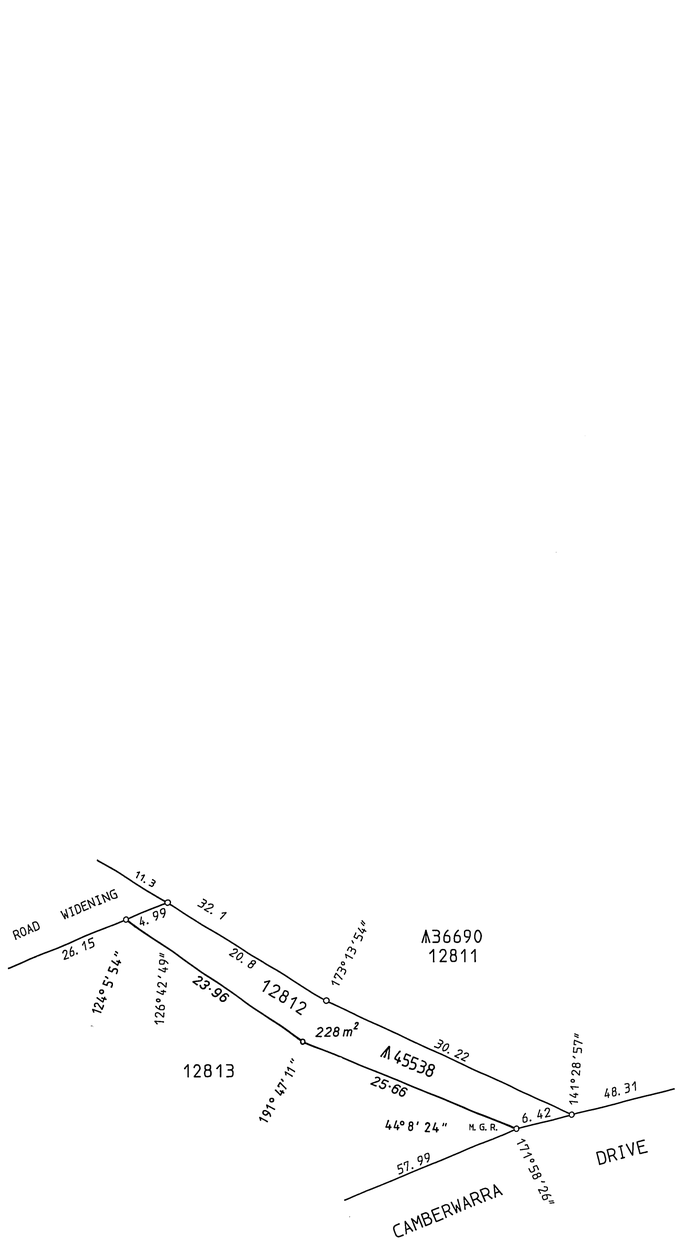
----------END OF CERTIFICATE OF CROWN LAND TITLE----------

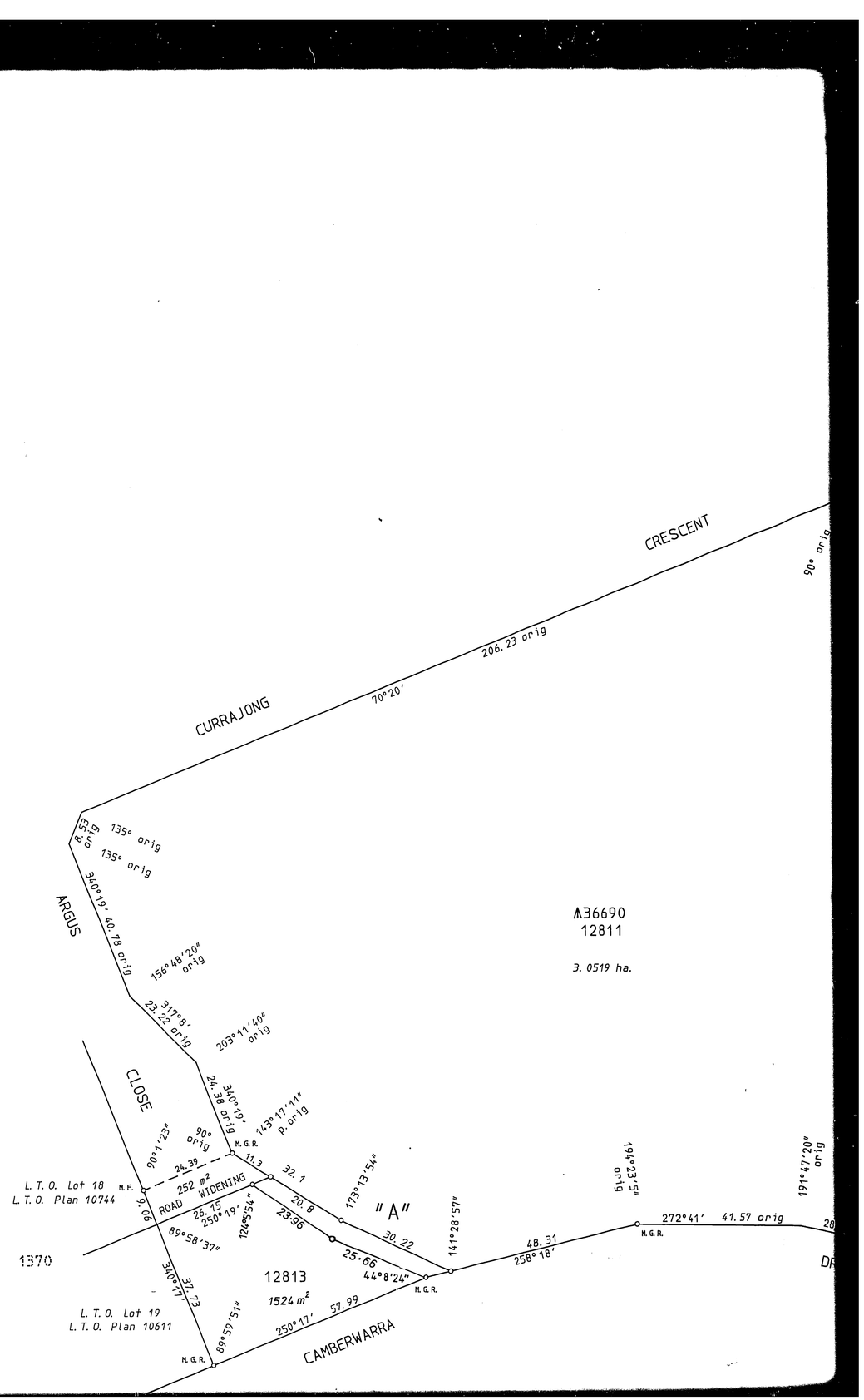
STATEMENTS:

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.

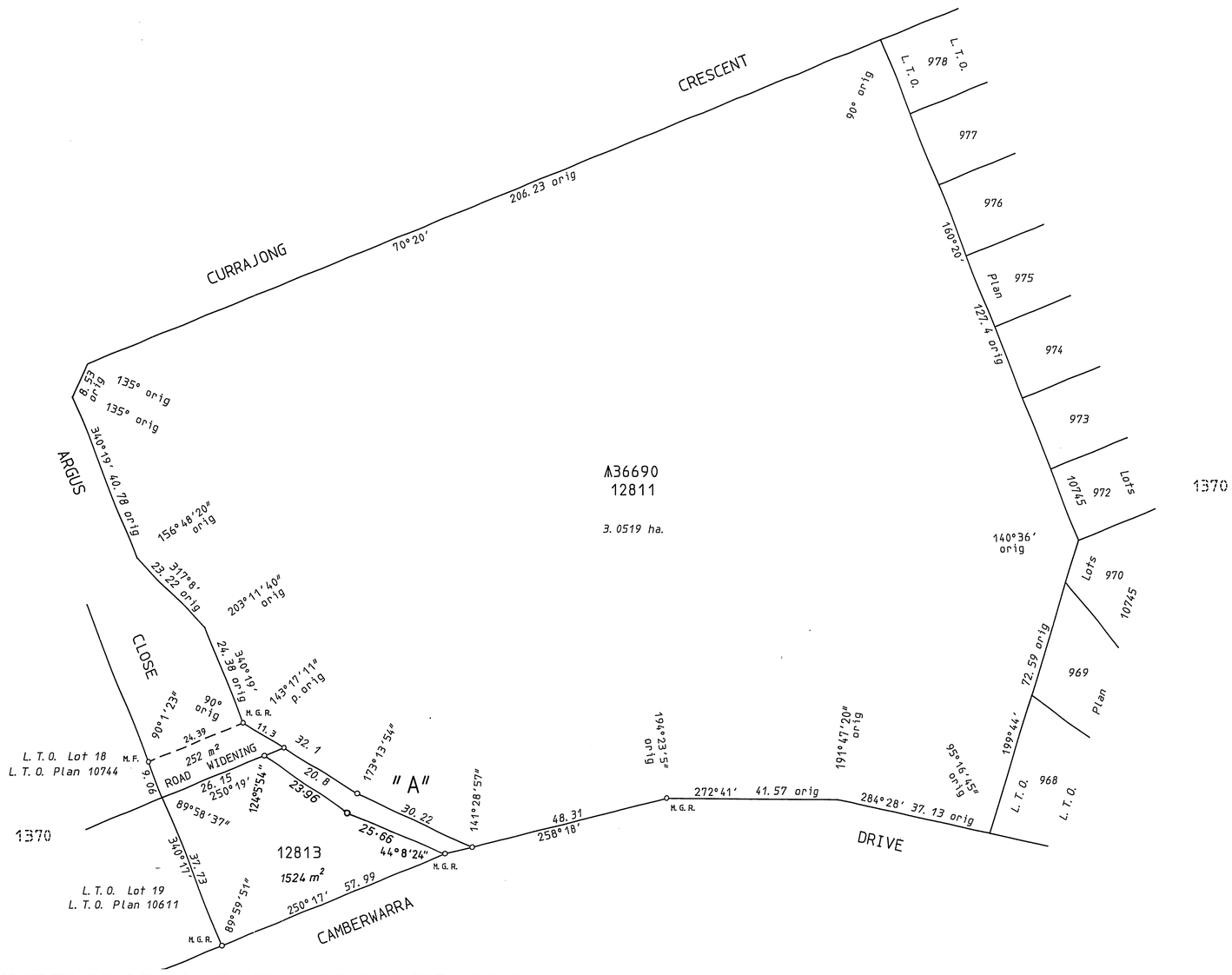
SKETCH OF LAND:	LR3110-37 (12811/DP219691).
PREVIOUS TITLE:	LR3048-265.
PROPERTY STREET ADDRESS:	34 CURRAJONG CR, CRAIGIE.
LOCAL GOVERNMENT AREA:	CITY OF JOONDALUP.
RESPONSIBLE AGENCY:	DEPARTMENT OF EDUCATION.

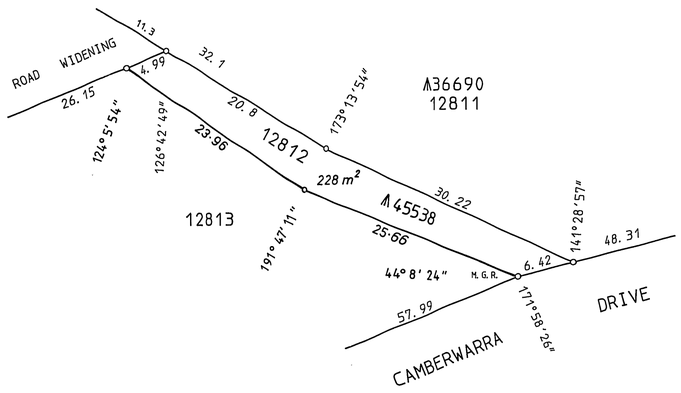
NOTE 1: A000001A CORRESPONDENCE FILE 1453/1980V2.
NOTE 2: LAND PARCEL IDENTIFIER OF SWAN LOCATION 12811 ON SUPERSEDED PAPER CERTIFICATE OF CROWN LAND TITLE CHANGED TO LOT 12811 ON DEPOSITED PLAN 219691 ON 04-SEP-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.
NOTE 3: THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE.





FORMER TENURE	ON PLANS/DIAGRAMS	AMENDMENTS
LOCATION 10093 P. A. W.	L. T. O. DIAGRAM 45939 L. T. O. PLAN 10611	





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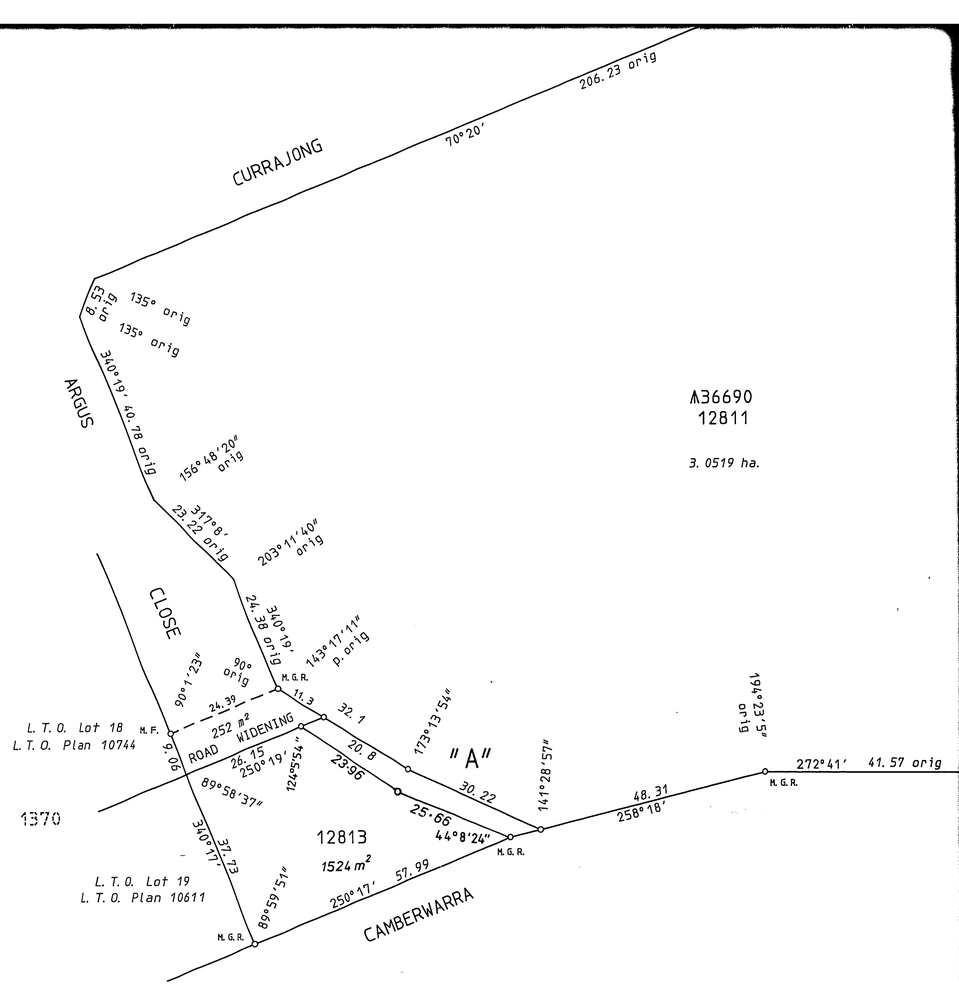
Scale 1:400



10 0 10 20 30 40

LAND DISTRICT
SWAN

SURVEYOR'S CERTIFICATE – (REG

I, J. F. CARTER hereby certify that th
plan is a correct representation of the survey
and/or calculations from measurements recorded
the field book lodged for the purposes of this
plan and that it complies with the relevant
written law(s) in relation to which it is lodg

J. F. Carter 14.11.9

Licensed Surveyor Date

SURVEYOR'S CERTIFICATE – COMPI

I, _____ hereby certify that th
compiled plan
(a) is a correct and accurate representation of
survey(s) of the subject land, and
(b) is in accordance with the relevant law in
relation to which it is lodged.

Licensed Surveyor Date

CURRAJONG

70° 20'

206.23 orig

976

160° 20'

Plan 975

127.4 orig

974

973

Lots 10745 972

1370

140° 36' orig

Lots 10745 970

969

Plan

72.59 orig

199° 44'

L. T. O. 968 L. T. O.

95° 16' 45" orig

191° 47' 20" orig

272° 41' 41.57 orig

284° 28' 37.13 orig

DRIVE

M. G. R.

48.31

258° 18'

194° 23' 5" orig

141° 28' 57"

M. G. R.

44° 8' 24"

25.66

23.96

30.22

173° 13' 54"

" A "

20.8

32.1

11.3

M. G. R.

143° 17' 11" P. orig

340° 19'

24.38 orig

203° 11' 40" orig

23.22 orig

317° 8'

156° 48' 20" orig

340° 19' 40.78 orig

135° orig

135° orig

8.55 orig

ARGUS

CLOSE

90° 1' 23"

90° orig

24.39

252 m²

ROAD WIDENING

26.15

250° 19'

124° 5' 54"

89° 58' 37"

90° orig

L. T. O. Lot 18 M.F.

L. T. O. Plan 10744

1370

12813

1524 m²

A36690

12811

3.0519 ha.

37.73

340° 17'

89° 59' 51"

57.99

250° 17'

M. G. R.

L. T. O. Lot 19

L. T. O. Plan 10611

CAMBERWARRA

10 0 10 20 30 40

U.M.G. Mercator

Dept of Land Administration
UO 225919

LAND DISTRICT SWAN	LOCATIONS 12811 - 12813 (INCL) & ROAD WIDENING		DEPT. OF LAND ADMINISTRATION PLAN 19691
SURVEYOR'S CERTIFICATE – (REG 54) I J. F. CARTER hereby certify that this plan is a correct representation of the survey and/or calculations from measurements recorded in the field book lodged for the purposes of this plan and that it complies with the relevant written law(s) in relation to which it is lodged. J. F. Carter 14.11.97 Licensed Surveyor Date	TYPE OF VALIDATION Full Audit: _____ Date _____ Legal Component: S. Cooper Date 19/11/97 CERTIFIED CORRECT Dr. Date 11-5-99 IN ORDER FOR DEALINGS SUBJECT TO 1. Restriction 2. Reservation 3. Reservation FOR AUTHORIZED LAND OFFICER DATE APPROVED Authorized Land Officer Date 2.6.99	SCALE 1: 750 measurements in metres SURVEYOR J. F. CARTER FIELD BOOK 75277 Pages 8, 12-16 1-3 76856 Date of Marking 29/10/1997 AZIMUTH FROM SCDB 12/11/1997 LOCAL AUTHORITY: CITY OF WANNEROO LOCALITY: CRAIGIE LODGED SMC 18/11/97	FILE 1453/980 PUBLIC PLAN (S): BG35 (2) 7.03 BG35 (2) 7.04 RECORDED: R.L. Date 23.6.99 SURVEY INDEX PLAN (S): BG35 (2) 7.03 BG35 (2) 7.04 RECORDED: S. Cooper Date 19/11/97 DEPARTMENT OF LAND ADMINISTRATION PLAN 19691
SURVEYOR'S CERTIFICATE – COMPILED I _____ hereby certify that this compiled plan (a) is a correct and accurate representation of the survey(s) of the subject land; and (b) is in accordance with the relevant law in relation to which it is lodged. Licensed Surveyor Date			

FORMER TENURE	ON PLANS/DIAGRAMS	AMENDMENTS
LOCATION 10093 P. A. W.	L. T. O. DIAGRAM 45939 L. T. O. PLAN 10611	

Enlargement at "A"
Scale 1: 400

10 0 10 20 30 40

Dept. of Land Administration
LO 225919

LAND DISTRICT	LOCATIONS 12811 - 12813 (INCL) & ROAD WIDENING	DEPT. OF LAND ADMINISTRATION PLAN 19691
SWAN		

SURVEYOR'S CERTIFICATE – (REG 54)

I, J. F. CARTER hereby certify that this plan is a correct representation of the survey and/or calculations from the survey carried out by me and that it complies with the relevant written legislation to which it is lodged.

Licensed Surveyor 14-11-97 Date

SURVEYOR'S CERTIFICATE – COMPILED

I, _____ hereby certify that this compiled plan (a) is a correct and accurate representation of the survey(s) of the subject land, and (b) is in accordance with the relevant law in relation to which it is lodged.

Licensed Surveyor Date

TYPE OF VALIDATION

Full Audit: _____ Date _____

Legal Component: S. Cooper Date 19/11/97

CERTIFIED CORRECT
for the Registrar of Titles
Date 4-5-99

IN ORDER FOR DEALINGS SUBJECT TO
for the Registrar of Titles
for the Executive Director
4-5-99

FOR AUTHORIZED LAND OFFICER DATE
APPROVED
Authorised Land Officer Date 7-6-99

SCALE 1: 750
measurements in metres

SURVEYOR J. F. CARTER

FIELD BOOK 75277 Pages 17-30
76855
Date of Marking 29/10/1997

AZIMUTH FROM SCDB 12/11/1997

LOCAL AUTHORITY: CITY OF WANNEROO
LOCALITY: CRAIGIE

LODGED SMC 18/11/97

FILE 1453/980

PUBLIC PLAN (S): DG95 (2) 7.03
DG95 (3) 7.04

RECORDED: D.L. Date 23.6.99

SURVEY INDEX PLAN (S): DG95 (2) 7.03
DG95 (3) 7.04

RECORDED: S. Cooper Date 19/11/97

DEPARTMENT OF LAND ADMINISTRATION
PLAN 19691

APPENDIX 2
FLORA AND VEGETATION SURVEY

APPENDIX 3
TREE ASSESSMENT SURVEY

March 8, 2013

Level 6, Westfarmers House
40 The Esplanade
Perth WA 6000

ATTENTION: **Sylvia Chan**

RE: **Preliminary Tree Survey Assessment; Camberwarra Primary School Site (Lot 12811 on Deposited Plan 219691), Craigie**

Dear Sylvia,

Further to your request, please find enclosed a copy of the report of my findings from the inspection of the trees at the (old) Camberwarra Primary School Site, Craigie.

Should you have any queries regarding the findings of this report, or if I can be of any further assistance in the Camberwarra development project, please do not hesitate to contact me.

Yours sincerely

JASON ROYAL

Dip. Arboriculture (UK)
Tech. Arbor A

Arboricultural Assessment

Camberwarra Primary School Site, Craigie

Prepared For

LandCorp

ARBOR logic

Contents

1. Background and Scope of Works

At the request of LandCorp I have been commissioned to undertake an inspection of the trees found in an area proposed for development of (what was) the Camberwarra Primary School, Craigie ("Site"); identified on the aerial image below.

The purpose of the inspection was to:

- Undertake an inspection of all of the trees in the identified Site.
- Identify any trees that have a DBH ≥ 200mm in diameter.
- Provide information in regards to the species of each of the identified trees, its current physical attributes (height, main stem calliper, canopy width, health condition, and structural condition etc.), recommended zone of protection, and any comments deemed pertinent to the identified tree.
- Based on this information, identify any trees that would be considered suitable for inclusion into an urban development, and provide an opinion on which ones would be more favourable for retention.
- Provide any broad-brush purposeful and practical recommendations for any design and construction implications that may apply for any trees identified as being suitable for retention so to ensure their preservation, if undertaken, remains successful.

2. Particulars to the Assessment

The information and opinions provided in this document are based predominantly on the findings from the visual observations of the identified trees during the Site inspection undertaken February 15th and 18th 2013.

During the assessment it was noted that a number of the trees on this Site had already been tagged with identification plates; trees numbered 1 – 79 inclusive.

All of these trees were included in this assessment.

Any other tree with a main stem diameter of 200mm or greater (measured at 1.4 meters above ground level) were also identified and included as part of this assessment.

Tree's smaller than this size were not included in this assessment (as they are typically easily and readily replaceable should the need arise).

Species typically considered to be 'shrub' species such as Oleander, Hibiscus, Euphorbia etc. were also not included as part of this assessment; other than those already identified during the earlier survey undertaken on this Site.

Dead trees were also not included as part of this particular assessment; other than those already identified during the earlier survey undertaken on this Site.

It should also be noted that no exploratory excavations were undertaken as part of my assessment to verify the actual root spread of any given tree.

As such the allocation of tree protection zones has at this stage been based on the physical size and condition of the tree and the known root zone morphology of specimens of the tree's given species in the sort of soil profile considered to be typical to this area of Western Australia.

3. Tree Protection and Preservation; an Overview

Tree preservation is an important part of responsible urban development, and protection often becomes a requirement where trees are found to be situated in an area proposed for development.

As part of the protection of trees, it is of critical importance to understand their basic requirements.

It is important to note that it is the tree's absorbing root zone that is primarily responsible for the health, vigour, and overall aesthetic appearance of the trees canopy.

It is also important to note that the majority of this absorbing root zone is generally found in the initial 300 – 500 mm of the soil profile, where soil oxygen, water, and nutrient levels are at their highest. It is therefore essential that the retention of a suitable volume/area of this section of the soil profile becomes the primary concern when designing and constructing an area of development adjacent to existing trees desired to be retained.

There must be a focus towards protecting an appropriate amount of a tree's root mass if tree retention and protection is to be successful and achievable.

Through the advances of research it is also now known that there is also a wide variation in the tolerance of the various tree species to root disturbance, root loss or changes to the soil chemistry and is an area often misunderstood or ignored during a development process; often to the detriment of the tree.

Each individual tree must be allocated a 'zone of protection' or Tree Protection Zone ("TPZ") during all phases of the design and construction of the development.

Australian Standard Guidelines are available; AS 4970, Protection of Trees on Development Sites ("Standard"), and provide a good basis from which to work from.

However as is stated within the Standard, variations and encroachments into a tree's TPZ can occur; providing arboricultural input and further investigation has been undertaken to ascertain the level of encroachment proposed, its potential impact on the tree, and what remedial measures or design modifications may need to be implemented if the tree is desired (or required) to be retained.

As such input from an arboricultural consultant is an integral and critical part of any successful tree preservation process; even if it is to be situated in an area where on landscape works are proposed to occur.

It is common occurrence for tree preservation strategies to be implemented once root zone damage has already occurred. However remedial efforts are often of little to no value (depending on the extent of damage that has been caused), and have proven to become a difficult, potentially expensive, and time consuming exercise to implement once the damage has occurred.

Successful preservation of trees on a development site must therefore begin at the design and planning stages of any development.

4. Tree Assessment Methodology

Methodology of the Assessment

Each of the identified trees within the site was visually inspected from ground level.

Health Condition

The overall health of each tree was adjudged from an inspection of its leaf, overall percentage of leaf mass present in the canopy of the tree, and the presence (or absence) of any pest or disease factor that could have an effect on the overall health of the tree.

Structural Condition

The structural integrity of each tree was determined from a visual inspection of its main stem, primary (and secondary) branch unions, and its root plate area.

The presence of cavities, decay, and/or any pathogen that could have an effect on the structural integrity of the tree is also taken into consideration as part of the assessment process.

Where considered necessary further investigation by way of the use of sounding techniques was utilised to determine the presence and general extent of any areas of cavity or associated decay within a tree's main stem structure.

Known Species Traits

Species suitability for use in an urban area and if the identified specimen is of a species that can be subject to the sudden branch failure phenomenon was also considered as part of the assessment process.

With regards to any future development the known natural species traits of the given tree and its ability to cope with disturbances to its root zone that typically occur as part of a development process, as well as its ability to cope with the new parameters that are commonly created by an urban development (i.e. decreased soil oxygen due to compaction, increased un-seasonal watering from irrigation, increased pollution, increased radiated heat/light from urban infrastructure (roads, walls, buildings etc.) are all also taken into consideration.

The known root zone morphology of the species was taken into consideration when allocating the recommended TPZ for each of the identified trees. Note: Whilst some reference and acknowledgment is given to the guidelines set down in AS 4970, the TPZ for each tree has been based on the known typical root zone morphology for specimens of their species, the condition of the given tree, and the known tolerance to root zone disturbance of the given species.

5. Key Findings of the Assessment

5. Key Findings of the Assessment

5.1 General Comments and Number of Trees Identified

A total of 153 individual trees were identified during the inspection, and the relevant information on these trees was collected.

A location guide for each tree identified during the assessment has been provided by McMullen Nolan Group (detail survey drawing titled; 96414-DE-002-13); a copy of which has been provided as an attachment to this report.

5.2 Species Identified

A total of 27 different species were identified on the Site.

All were noted as being Australian native species.

Of these 26 species, 15 were noted to be West Australian native species, with the remaining 11 species being native to other parts of Australia; predominantly parts of NSW and Queensland areas.

The table below shows a summary of the species identified on the Site.

Table 1; List of the species Identified on Site

Botanical Name	Common Name	Origin	No of on Site
Acacia saligna	Coojong	WA	1
Allocasuarina fraseriana	Common Sheoak	WA	3
Allocasuarina littoralis	Black Sheoak	Parts of NSW and Qld	1
Banksia attenuata	Coastal Banksia	WA	1
Callistemon 'Kings Park Special'	Bottlebrush	WA	6
Casuarina obesa	Swamp Sheoak	WA	7
Corymbia ficifolia	Red Flowering Gum	WA	1
Eucalyptus camaldulensis 'Camaldulensis'	River Red Gum	Aus wide	31
Eucalyptus camaldulensis 'Obtusa'	Northern River Red Gum	Aus wide (northern parts)	2
Eucalyptus conferruminata	Bald Island Marlock	WA	5
Eucalyptus erythrocorys	Illyarrie	WA	2
Eucalyptus gomphocephala	Tuart	WA	49
Eucalyptus grandis	Rose Gum	NSW-Queensland	2
Eucalyptus lansdowneana spp. Albopurpurea	Port Lincoln Gum	South Australia	1
Eucalyptus leucoxylon 'Rosea'	South Australian Yellow Gum	South Australia	7
Eucalyptus marginata	Jarrah	WA	5
Eucalyptus microtheca	Coolibah	Parts of northern WA, NT, Qld	4
Eucalyptus platypus var. heterophylla	Coastal Moort	WA	12
Eucalyptus robusta	Swamp Mahogany	NSW	1
Eucalyptus rudis	Flooded Gum	WA	1
Eucalyptus sideroxylon	Ironbark	NSW	2
Leptospermum laevigatum	Coastal Tea-tree	WA	1
Melaleuca armillaris	Bracelet Honey-myrtle	Parts of NSW and eastern Vic	2
Melaleuca nesophila	Showy Honey-myrtle	WA	3
Melaleuca quinquenervia	Broadleaved Paperbark	Parts of NSW and Qld	1
Xanthorrhoea preissii	Grass Tree	WA	2

5. Key Findings of the Assessment

Tuart and River Red Gum were noted to be (by far) the most common species of tree found on this Site.

All of the species identified during the inspection are considered to be common to the metropolitan Perth area.

5.3 Health Condition

The majority of the trees showed to be in (what is considered to be) 'excellent or 'good' health for specimens of their given species as adjudged by the condition of their leaf and overall volume of canopy leaf mass.

Whilst many showed to have (mostly minor diameter sized) deadwood within their respective canopies, its appearance was considered to be indicative of deadwood occurring as part of the natural growth processes of trees as opposed to any pest or disease factor.

Two dead trees were identified during the inspection (tagged during the earlier survey undertaken), and a further eight trees were considered to be in a 'poor' state of health, and considered likely to have limited life span remaining.

A further 30 trees were considered to be in a 'fair' state of health, as their canopy's were displaying signs/indications that their health is being impacted on to some extent with an increased volume of deadwood, sparse volumes of leaf mass and/or chlorotic (yellowing) and/or scorched leaf.

At this stage this is suspected to be due to environmental factors such as poor successive seasonal rainfalls and/or impact from *abiotic* factors such as damage to root zones and main stem structures from other activities.

Impact from having any supplementary irrigation switched off since the School was made redundant that (at least some of) the trees are considered likely to have been have been accustomed to is also considered likely to be a contributing factor to the decline in health of some of the trees on this Site.

Impact from disturbance and/or damage to their root zones and changes to their local environment conditions as a result of the recent demolition and clearing of the school buildings that were on this Site may also be a contributing factor to the decline in health of some of the trees on this Site.

I could see no visual evidence of any 'major' pest or disease pathogen such as *Phytophthora* or *Armillaria* species being present during my inspection, although this is not to say that pathogens such as these would or could not be present in some form within the soil at this time. Further investigation by way of soil analysis would be required to verify its presence.

5. Key Findings of the Assessment

5.4 Structural Condition

The majority of the trees showed to have (what is considered to be) typical structural forms for specimens of their given species.

A number showed to have what are considered to be 'structural defects' such as bi-furcated unions with signs of swelling and included bark which are considered to potentially have an increased likelihood for failure than other forms of branch unions.

A number of the trees on this Site also showed to have grown on lean (in some instances severely so) as a result of their proximity to each other and influence of adjacent trees (limiting availability of physical space and light); examples of which can be seen in the images below.

In many instances specimens of this nature will develop amounts of reactive woody tissues to enable them to maintain support of their above ground parts, and as such the risks associated with such trees is not necessarily greater than if they had grown on a more vertical plane.

However they will be likely to have a higher potential for branch (or even complete root plate) failure than more 'up-right' trees; especially in the event that they become suddenly exposed to wind forces they are currently protected from due to the clearing of other trees.

A number of the trees also showed to have developed (what can be best described as) a somewhat 'leggy' upright canopy habit with relatively little lower canopy mass; again due to their proximity to each other and availability of physical space and light; examples seen in the images below.

Whilst this is again not necessarily always a cause of major concern, trees with structures of this nature can have an increased potential for failure; particularly if they become suddenly exposed to wind forces that they are currently protected from as a result of the clearing of other adjacent trees.

5. Key Findings of the Assessment

Eight of trees also showed evidence of a history of branch failures.

In the majority of instances the failures were noted to be (what is considered to be) relatively small diameter sized branches (i.e. ≤100mm in diameter).

The available visual evidence would suggest that the majority of the failures occurred due to force loading; i.e. during storm events as opposed to any genetic predisposition for the given tree to be subject to branch failures.

Two of the failures were however attributed to the 'sudden branch drop' phenomenon which is known to (potentially) affect a number of the tree species found on this Site, and in both of these incidences the size of part that failed was noted to be larger than 100mm in diameter.

A small number of the trees also showed clear indications of the presence of areas of decay and/or cavity in their main stem and/or primary branch structures, and in some incidences termites were also found.

However in the majority of incidences the presence of the areas of decay and/or termites was not considered to be of any major concern at this time, although the retention of some of these trees into an area where an increased volume and value of potential Targets will occur as a result of the development was considered questionable.

Overall though, in the majority of these instances any structural defects present were considered to be within the realms and scope of modern arboricultural management practices at this stage.

5.5 Potential Transplants

Only one of the species identified during the inspection were considered to be able to be transplanted; namely the Grass Tree's.

However I only noted two specimens on this Site in a suitable condition to be considered as worthwhile transplanting.

None of the other species/trees were considered as viable for transplanting as part of any development of the Site.

5. Key Findings of the Assessment

5.6 Higher 'Risk' Species

14 of the tree species identified on Site were noted to be species that are considered to have a potentially 'higher' associated risk than many of the other tree species.

This is mainly due to the known occurrence for some (but not necessarily all) specimens of these species to be subject to the 'sudden' or 'summer' branch drop phenomenon as mature trees; often despite the adoption of any best canopy management practices, and a very small number of these trees already showed evidence to suggest that they have been previously subject to this phenomenon occurring.

Table 2; Showing tree species found on Site that are considered likely to have a higher associated risk

Botanical Name	Common Name	No. of on Site	Propensity for Sudden Branch Drop (based on personal experience and observations)	Evidence of it having occurred on Site
Eucalyptus camaldulensis 'Camaldulensis'	River Red Gum	31	Medium – Low (depending on 'sub-species'/provenance)	1 (Tree 137)
Eucalyptus camaldulensis 'Obtusa'	Northern River Red Gum	2	High	None
Eucalyptus gomphocephala	Tuart	49	Medium to High	1 (Tree 107)
Eucalyptus grandis	Rose Gum	2	Medium	None
Eucalyptus leucoxylon 'Rosea'	South Australian Yellow Gum	7	Medium	None
Eucalyptus robusta	Swamp Mahogany	1	Medium - Low	None
Eucalyptus rudis	Flooded Gum	1	Medium - High (depending on 'sub-species'/provenance)	None
Eucalyptus sideroxylon	Ironbark	2	Medium	None

Whilst many of these trees have clearly been successfully managed within an urban situation for many years, the retention of some of them within an area where (potentially) a higher volume and frequency and value of potential Targets may be encouraged to occur as a result of the development may be considered questionable; particularly if the trees in question already display some propensity for the sudden drop phenomenon.

5. Key Findings of the Assessment

5.7 Suitability for inclusion into an 'urbanised' area (Retention Value)

Retention value of the various tree species and specimens will always be open to some personal opinion.

In general trees displaying good health and deemed to have a good aesthetic quality will be generally considered to have a high retention value.

Species known to be native to the given area, or known to have some form of historical association with the given area will also generally be considered to have a high retention value.

Conversely, common species of tree or trees known (or considered to be) a problematic species (i.e. ones that have propensity for branch failures, or ones that could self-seed freely), or one that display poor health or low aesthetic traits would typically be considered to have a low retention value.

However as part of ascertaining the suitability for inclusion into a development other aspects of the tree must be considered; primarily its structural form, suitability for inclusion into an urbanised area with high volumes of potential Targets, and its potential to cope with changes to its soil and surrounding environment that typically occur as part of a development process.

Of the 153 individual trees identified and inspected:

- 27 trees were considered to have a 'high' retention value at this point in time.

  These trees are considered to be in good health and structural condition, be of a species that is considered suited to an urban environment and situation, and have a good aesthetic amenity form and value.

- A further 56 trees were considered to have a 'medium' retention value.

  These trees are considered to be reasonably good specimens of their given species and are considered suitable for inclusion into an urban area.

- 48 were considered to have a 'low' retention value.

  Their retention and inclusion into an area with an increased volume and/or frequency of potential Targets as a result of a development process may become questionable; primarily due to their species traits being known to have some propensity for branch failure issues; sometimes even if the very best management are being undertaken.

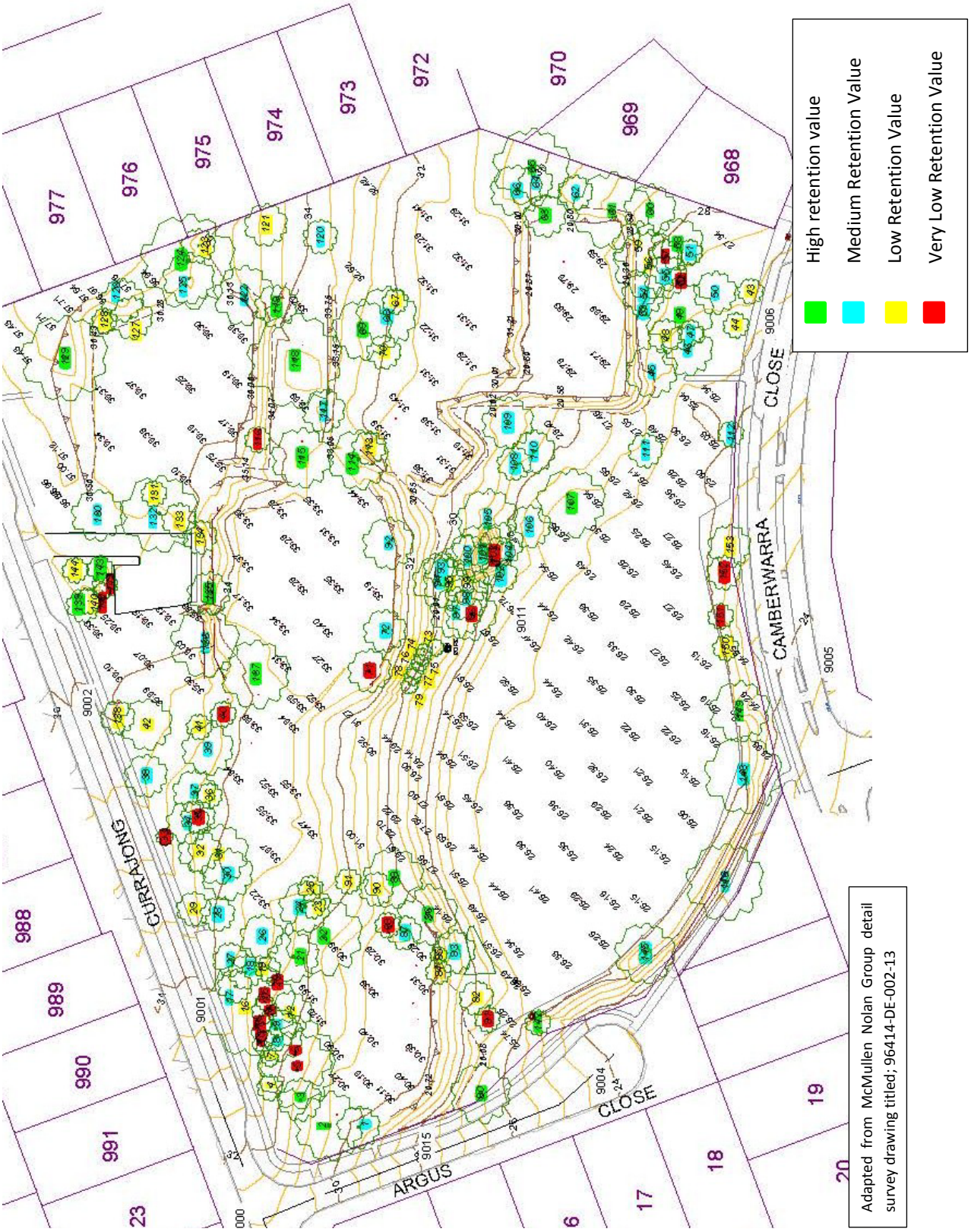
- 22 were considered to have a 'very low' retention value.

  The inclusion of these trees into an area of increased potential Targets would in my opinion be highly questionable; again mainly due to their structural form and/or being of species that can have some propensity for either the sudden branch drop phenomenon, or branch failure issues in general.

  A number of these trees are dead trees that were previously identified and tagged during an earlier survey undertaken on this Site by others.

The above Retention Values overlayed in a simple colour-code onto the tree location guides for ease of reference.

5. Key Findings of the Assessment

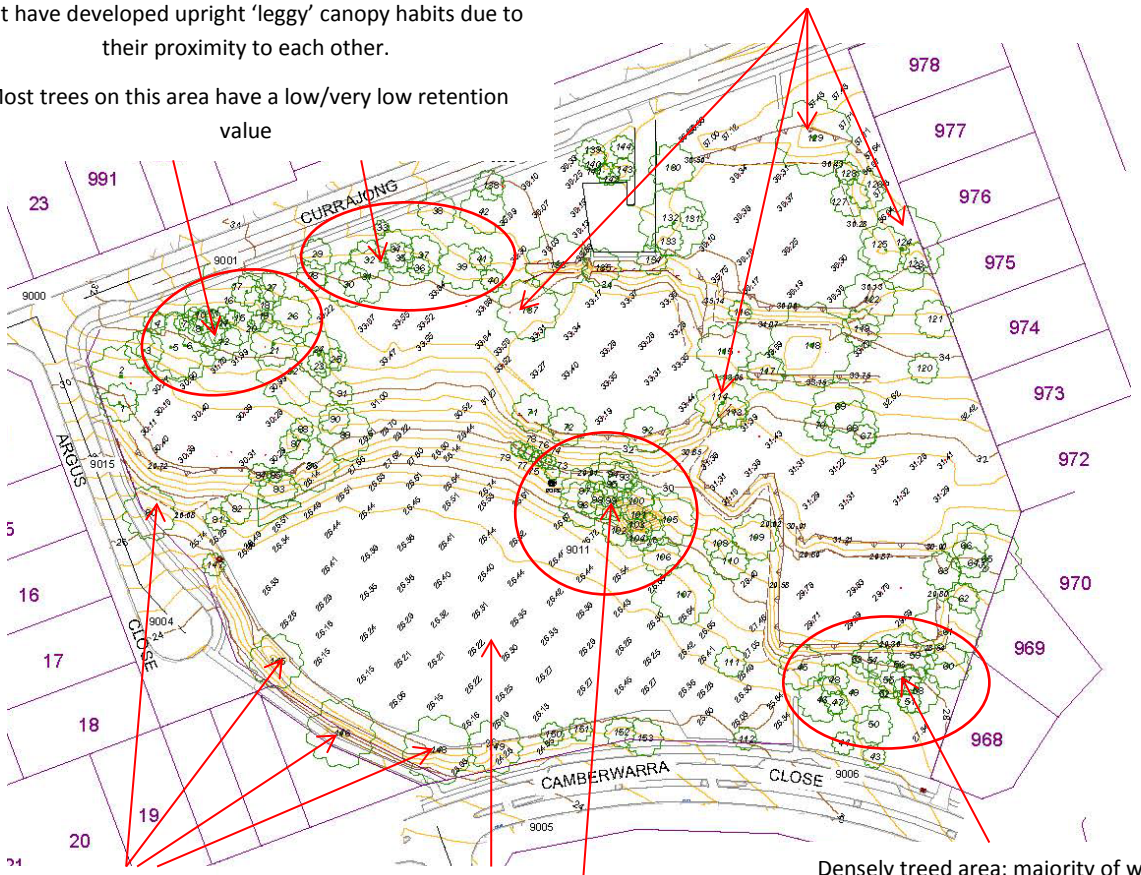


6. Summary of the Key Findings of the Assessment

Densely treed areas; majority of which are River Red Gum that have developed upright 'leggy' canopy habits due to their proximity to each other.

Most trees on this area have a low/very low retention value

Large mature individual specimens of some note



Large mature individual specimens of some note

Open area with relatively few trees

Densely treed area; majority of which are mature Tuart some of which are considered to (potentially be) remnant trees for this area

Densely treed area of mixed species

7. Potential Impact from Development and Further Considerations

7.1 General Comments

It is difficult to provide specific comments for each tree on the potential of the impact of the development on the trees on this Site at this stage, as much of the impact caused will be very much dependent on the detailed design aspects of the development.

The (draft) Taylor Burrell Barnett proposed Masterplan for this Site shows an area of public open space in the south-western corner of the Site.

All of the other areas of the Site are noted to become either road reserve, or Lots.

The Site was also noted to have a relatively large difference in ground levels from the northern to the southern boundary.

As such fairly extensive earthworks are (at this stage) expected to be a requirement as part of the development of this Site.

As previously mentioned retention of the existing current ground level and soil profile within a tree's designated TPZ is of paramount and key importance in the success of tree retention.

To this extent, should the Site require extensive soil remediation or cut/fill (and more specifically soil remediation/cut-fill within the TPZ of any tree), then the successful retention of the given tree is likely to be compromised due to the expected impact from excavations and subsequent root loss.

Protection of each and every tree on a Site and scale such as this is also considered unlikely to be a viable or achievable option due to the practicalities of a development process.

However protection of the better quality trees should be considered as a priority if trees are to be retained as part of the project.

It must also be noted that successful tree preservation and protection must be initiated during the design stage of any development so that the physical protection of a tree and a sufficient volume of its root zone will be achievable during construction.

The key factor to take into consideration will be the treatment and protection of any tree's designated TPZ. Note: The details of each tree's TPZ area can be found in the Table of Assessment Results attached to this report (column 11 of the table).

Treatment of a tree's designated TPZ is recommended to be undertaken in accordance with AS 4970 guidelines and further discussion with an experienced independent arboricultural consultant.

This is not to say that some encroachment and development activity would not be permitted to be undertaken within a TPZ area as part of the development process.

However any encroachment required/proposed will require further input and discussion with the arboricultural consultant as part of any detailed design process to determine what the potential impact on the tree will be, and what design modifications or measures may need to be implemented to mitigate any potential negative impact on the tree.

Aspects such as resulting levels, delineation of any underground service pipework, drainage, sewerage etc. can all (potentially) have a major impact on a tree's root zone, and in turn its future health and potential lifespan.

7. Potential Impact from Development and Further Considerations

7.2 Retention of Trees in Road Reserve

Successful retention of trees in a road reserve situation often comes down to the detailed design aspects of the road as well as the delineation and installation requirements of any underground service pipework that may need to be installed within the road reserve as part of the development.

In this instance further discussion will be required to determine if the trees that look to be within an area of road reserve (and are considered to be worth retaining) are indeed able to be retained as part of the development.

At this stage, based on the available information this includes trees numbered:

45, 46, 53, 54, 97, 98, 150' all 'medium' retention value trees; and trees numbered

69 and 118; both high retention value trees

Note: Tree number 53 is a Grass Tree, and as such could be relocated if necessary.

Aspects such as road levels, proximity of kerbing and road pavement, and the delineation of underground service pipework (including drainage, sewerage, water, gas, electricity, telecommunications, Foxtel and the like), all need to be detailed further to determine the viability of the retention of (any of) these trees.

7.3 Retention of Trees in Lot situations

Protection of physically larger trees within the areas of proposed Lot also has its own set of specific considerations and limitations.

There will be a requirement that (at least part of) the Lot may not be able to be remediated in the 'typical' manner, and often specific building envelopes for the Lot need to be designated, with the remaining area being left alone so to limited the impact to any tree that may be present.

Due to tree protection requirements there is often a requirement for further arboricultural input during Lot development stages, and the presence of a tree and its protection requirements (particularly a larger tree) can have some limitations on the development potential of the Lot if the tree is desired or required to be retained.

The presence of trees can lead to alternative design and/or building methods to need to be adopted and implemented which of course adds to the cost of Lot development.

It has also been in my own personal experience that the presence of trees within a Lot can cause concerns over safety; particularly if the tree is a larger Eucalypt species; even if the tree shows no indications of any history of branch failures, and even if the risks associated with the given tree are within what is generally considered to be an acceptable level of risk.

This often makes the retaining of trees in Lot situations to be difficult to say the least, and it is not uncommon to find that a Lot with a tree on it will only be purchased subject to the removal of the tree; thus wasting all efforts to retain the tree.

This is not to say that trees cannot (or should not) be retained into a Lot as part of a development process.

However, retention of trees on a Lot requires careful consideration before being undertaken so to ensure the desired outcome is able to be achieved.

7. Potential Impact from Development and Further Considerations

7.4 Retention of Trees in areas of Public Open Space

Overall, retention of trees as part of a development is more often achievable where areas of public open space ("POS") can be effectively designed around them so to ensure that impact to their root zone area during the physical construction of the development will be minimal.

In this instance four trees look to be within the proposed area of POS; trees numbered

146, 147, 148; all 'medium' retention value trees; and

149; a high retention value tree

Retention of these trees at this stage is considered to be viable, although the success of their retention will be again down to aspects of the detailed design of the POS; particularly treatment of the embankment area along the south-western edge of the Site.

Aspects such as final landscape of the area within any tree's designated TPZ (including any irrigation pipework, underground services, hardscape structures, or soft-scape landscaping) will also require a degree of further discussion so to ensure that any physical works undertaken as part of the development of the POS have minimal impact to the trees selected to be retained.

Canopy works will also likely be required on a number of the trees should they be selected for retention; details of extent of work required will again be very much dependent on detailed design and extent of construction/development to be undertaken in the vicinity of the given tree.

8. Recommendations

Based on my findings and observations, at this stage:

8.1 I would recommend omitting any tree considered to have a 'low' or 'very low' retention value, and simply remove them as part of the development process.

8.2 I would recommend undertaking efforts to explore the possibilities of retaining and incorporating as many of the better quality trees identified in this report (i.e. those trees considered to have a high or medium retention value) as possible as part of the development's design.

8.3 Further input and discussion with the nominated arboricultural consultant is recommended to occur as part of this process to discuss further the viability of the retention of any of the better quality trees found to be within a Lot, or road reserve situation.

8.4 I would recommend that the design of the POS area of the Site takes into consideration the recommended TPZ area of the four trees situated in this area that are considered suitable for retention.

Should any aspect of the design of the POS (including any drainage aspects that may be proposed to be installed into the POS) be found to encroach into the designated TPZ of any of these trees, then further discussion with the arboricultural consultant is strongly recommended to occur to ensure that any impact that will occur during the physical construction phases will be minimal by way of good design.

Attachments to this Report

Attachment 1; Tree Location Guide; Copy of McMullen Nolan Group detail survey drawing 96414-DE-002-13

Attachment 2; Table of Assessment Results

Attachment 3; References Used

Attachment 4; Glossary of arboricultural terms

Attachment 5; Company Information & Disclaimer

Attachment 1; Tree Location Guide

Rev.	Description	Drawn	Date	Checked
B	Tree Details Added	DHI	01/03/2012	TAV
A	Initial Issue	PKA	21/12/2012	TAV

SCALE 1:1000 @ A3

0 10 20 30 40 50

ALL DISTANCES ARE IN METRES

For a true to scale reproduction of this plan, plot it to A3 with the Paging Scaling set to None.

Surveyor:- TPV
Survey Date:- 25/02/2013
Precal/Cad:- WALIS

FILES
File - Drawing
96414B3 - 96414de-002b

N

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CLIENT:

LANDCORP

Project Mngr.	Datum
TREVOR VEEN	PCG94 / AHD

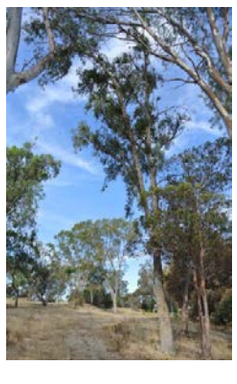
96414 - DE - 002 - B

Job Number - Type - Plan Number - Revision

Attachment 2; Table of Assessment Results

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
1	Tuart	12	550	8-10	8-10	Good	Acceptable - Good		Reasonably good mature specimen	6	Medium	382751.633	6483087.752
2	Tuart	21	900	14-16	14-16	Good	Acceptable - Good		Large mature specimen. High aesthetic and amenity value. Canopy is slightly sparse. Main stem bi furcates with some degree of swelling noted at the union	9	High	382752.591	6483094.713
3	Red Flowering Gum	8	600	8-10	8-10	Excellent	Good		Very good specimen of its species	6	High	382759.201	6483102.652
4	Coastal Moort	3.5	250	4-6	4-6	Excellent	Acceptable - Poor (undesirable)		. Canopy is one sided and has grown on a lean west. Suited to a low target area only	3	Low	382759.774	6483109.071
5	Rose Gum	18	650	16-18	8-10	Poor (Indicating Decline)	Acceptable - Poor (undesirable)		Canopy condition suggests it may have limited life span remaining.	7	Very Low	382766.657	6483102.280
6	Rose Gum	18	650	16-18	10-12	Poor (Indicating Decline)	Acceptable - Poor (undesirable)		Canopy condition suggests it may have limited life span remaining. Evidence of history of branch failures; looks to be storm damage	7	Very Low	382769.316	6483102.934
7	River Red Gum	8	300	2-4	2-4	Good	Acceptable - Poor (undesirable)		Leggy canopy habit due to proximity and influence of the adjacent. Large bark wound on main stem	3	Low	382767.587	6483110.013
8	River Red Gum	18	650	10-12	8-10	Excellent	Good		Good mature specimen. Canopy is slightly one sided due to proximity and influence of the adjacent tree but otherwise ok	6	Medium	382771.925	6483107.358

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
9	River Red Gum	19	650	8-10	8-10	Excellent	Good		Good mature specimen. Main stem bi furcates but union looks to be ok at this stage	6	Medium	382773.296	6483108.817
10	River Red Gum	12	300	2-4	2-4	Good	Acceptable - Poor (undesirable)		Leggy canopy habit and slightly suppressed by the adjacent tree	3.5	Very Low	382770.613	6483110.983
11	River Red Gum	16	300	2-4	2-4	Fair	Acceptable - Poor (undesirable)		Very leggy canopy habit due to proximity and influence of the adjacent trees. likely to cause future issues longer term	3	Very Low	382773.640	6483109.547
12	Tuart	17	600	8-10	8-10	Fair	Acceptable - Good		Canopy is slightly sparse and suggests that it may be starting to decline in health. Main stem furcates into 3. Probably better suited to a low target area if retained	6	Low	382776.727	6483105.543
13	River Red Gum	9	350	6-8	6-8	Fair	Good		Canopy is slightly sparse and suggests that it may be starting to decline in health	3.5	Low	382784.509	6483095.515
14	River Red Gum	15	400	4-6	2-4	Fair	Acceptable		Canopy is slightly sparse and suggests that it may be starting to decline in health. Upright canopy habit and has grown on a slight lean north due to proximity and influence of the adjacent trees	4	Very Low	382776.853	6483109.337
15	River Red Gum	13	300	2-4	2-4	Fair	Acceptable		Canopy is slightly sparse and suggests that it may be starting to decline in health. Tall upright canopy habit due to proximity and influence of the adjacent trees	3	Very Low	382778.948	6483112.869
16	River Red Gum	7	300	20-22	20-22	Excellent	Acceptable		Ok specimen. Slightly suppressed by the adjacent tree	3	Low	382779.087	6483115.502

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
17	River Red Gum	17	500	6-8	6-8	Excellent	Acceptable - Good		Reasonably good mature specimen. Upright canopy habit due to past powerline pruning	5	Medium	382785.269	6483118.553
18	River Red Gum	16	500	6-8	6-8	Excellent	Acceptable - Good		Reasonably good mature specimen. Relatively upright canopy habit due to proximity and influence of the adjacent trees	5	Medium	382788.391	6483115.525
19	River Red Gum	16	450	4-6	4-6	Good	Acceptable		Reasonably good mature specimen. Tall upright canopy habit due to proximity and influence of the adjacent trees. Main stem bi furcates but union looks to be ok	4.5	Low	382789.914	6483111.146
20	River Red Gum	6	150	1-2	1-2	Poor (Indicating Decline)	Acceptable		Near dead tree	2	Very Low	382783.587	6483110.859
21	River Red Gum	18	650	10-12	10-12	Good	Good		Good mature specimen. Canopy is slightly sparse but otherwise ok	6	High	382792.931	6483100.865
22	River Red Gum	22	900	16-18	20-22	Good	Good		Large mature specimen. High aesthetic and amenity value. Canopy is slightly sparse but otherwise ok	9	High	382798.521	6483096.693
23	Bald Island Marlock	7	250	4-6	8-10	Fair	Acceptable - Good		Ok specimen. Canopy is slightly sparse. Main stem bi furcates but union looks to be ok at this stage	3.5	Low	382801.207	6483098.909
24	Tuart	18	650	10-12	8-10	Fair	Acceptable - Good		Large mature specimen. High aesthetic and amenity value. Canopy is slightly sparse. Main stem bi furcates. bark damage at union which may cause future issues longer term	6	Medium	382806.200	6483102.636

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
25	Bald Island Marlock	8	250	4-6	6-8	Fair	Acceptable - Good		Ok specimen. Canopy is slightly sparse. Has grown on a slight lean east due to proximity and influence of the adjacent tree	3	Low	382808.290	6483097.714
26	River Red Gum	14	500	8-10	8-10	Good	Acceptable - Good		Reasonably good mature specimen. Has grown on a slight lean north. Canopy is slightly sparse but otherwise ok	5	Medium	382795.567	6483111.709
27	River Red Gum	20	650	6-8	6-8	Excellent	Acceptable		Reasonably good mature specimen. Canopy is one sided and has an upright canopy habit due to past powerline pruning. Part of a group of trees	6	Medium	382791.127	6483120.107
28	River Red Gum	15	450	6-8	6-8	Excellent	Good		Reasonably good mature specimen. Fairly upright canopy habit	4.5	Medium	382802.346	6483122.735
29	Coastal Moort	5	350	6-8	6-8	Excellent	Acceptable		Reasonably good mature specimen. Area of decay noted in main stem. Low canopy spread needs to be retained	4	Low	382804.174	6483128.063
30	River Red Gum	15	600	10-12	10-12	Excellent	Acceptable - Good		Reasonably good mature specimen. Canopy is slightly one sided due to proximity and influence of the adjacent tree but otherwise ok	6	Medium	382810.264	6483121.718
31	Tuart	22	800	12-14	10-12	Fair	Acceptable		Reasonably good mature specimen. Upper canopy is slightly sparse. Evidence of termites. Suited to a low target area only	8	Low	382815.510	6483120.859
32	Bald Island Marlock	7	350	8-10	8-10	Excellent	Acceptable - Poor (undesirable)		Has grown on a lean due to proximity and influence of the adjacent tree. Area of decay in main stem	4	Low	382817.468	6483128.018

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
33	Coastal Moort	3.5	180	2-4	2-4	Fair	Acceptable - Poor (undesirable)		Canopy condition suggests it may have limited life span remaining. Smaller tree. Canopy is one sided.	2.5	Very Low	382819.869	6483132.036
34	River Red Gum	15	500	8-10	6-8	Good	Acceptable - Good		Reasonably good mature specimen. No lower canopy	5	Medium	382823.612	6483133.554
35	Bald Island Marlock	8	350	6-8	4-6	Good	Poor (potentially Hazardous)		Area of decay noted in main stem structure. Termites noted	3.5	Very Low	382822.487	6483126.504
36	River Red Gum	6	300	4-6	4-6	Good	Acceptable - Poor (undesirable)		Ok specimen. Canopy development has clearly been affected by the proximity of the adjacent tree. Suited to a low target area	3	Low	382831.497	6483125.201
37	River Red Gum	16	650	8-10	6-8	Good	Good		Reasonably good mature specimen. Canopy is slightly sparse	6	Medium	382830.456	6483127.414
38	Coastal Moort	5	300	8-10	8-10	Excellent	Acceptable - Good		Reasonably good mature specimen. Low canopy spread needs to be retained	4	Medium	382833.848	6483138.751
39	River Red Gum	10	450	10-12	8-10	Good	Acceptable - Good		Ok specimen. Has grown on a lean north. Canopy is slightly sparse but otherwise ok	5	Medium	382839.823	6483124.346
40	Tuart	9	400	4-6	4-6	Poor (Indicating Decline)	Acceptable - Poor (undesirable)		Near dead tree.	4	Very Low	382848.581	6483121.573

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
41	Bracelet Honey-myrtle	4	300	4-6	4-6	Fair	Good		Canopy is slightly sparse and suggests that it may be starting to decline in health.	3	Low	382842.590	6483124.568
42	Coastal Moort	6	400	10-12	10-12	Fair	Acceptable		Area of decay noted in main stem structure. Ok mature specimen	4	Low	382845.919	6483136.945
43	South Australian Yellow Gum	7	300	4-6	4-6	Excellent	Acceptable		Reasonably good mature specimen. Evidence of recent branch failures	3	Low	382947.254	6482998.510
44	South Australian Yellow Gum	4	200	4-6	4-6	Good	Good		Reasonably good mature specimen. Smaller tree. Canopy is slightly sparse	2.5	Low	382941.400	6483003.987
45	Tuart	18	700	10-12	10-12	Fair	Acceptable - Good		Ok specimen. Main stem furcates into numerous primary branch structures. Canopy is slightly sparse. Large bark wound on main stem	7	Medium	382930.697	6483020.248
46	Tuart	22	850	10-12	14-16	Fair	Acceptable - Good		Large mature specimen. High aesthetic and amenity value. Canopy is slightly sparse. Main stem furcates into 4 primary branch structures. Probably self better suited to a low target area	8	Medium	382935.262	6483011.013
47	Tuart	12	350	4-6	4-6	Good	Acceptable - Good		Reasonably good semi-mature specimen. Canopy is slightly sparse but otherwise ok	3.5	Medium	382939.995	6483010.223
48	Tuart	17	400	6-8	6-8	Fair	Acceptable - Good		Canopy indicates decline. Upper canopy is dead. Main stem furcates into 3	5	Low	382936.343	6483019.684

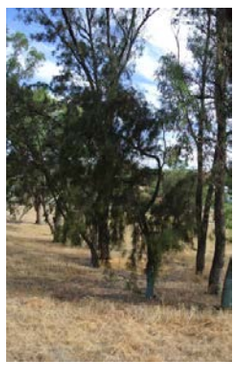
Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
49	Tuart	26	800	14-16	14-16	Good	Good		Large mature specimen. High aesthetic and amenity value. Canopy is slightly sparse but otherwise ok	8	High	382940.305	6483015.966
50	Ironbark	17	450	8-10	8-10	Good	Acceptable - Good		Reasonably good mature specimen. Canopy is slightly sparse. Evidence of history of branch failures	4.5	Medium	382948.738	6483007.749
51	Tuart	17	450	4-6	4-6	Excellent	Acceptable - Good		Reasonably good mature specimen. Relatively upright canopy habit due to proximity and influence of the adjacent trees. Canopy is slightly sparse	4.5	Medium	382958.170	6483014.310
52	Grass Tree	2	350	1-2	1-2	Dead	Acceptable		Dead tree.		Very Low	382948.567	6483009.365
53	Grass Tree	2	300	1-2	1-2	Excellent	Good		Good mature specimen. multi-headed specimen. Transplantable if necessary	2	Medium	382938.718	6483027.309
54	Tuart	15	500	8-10	8-10	Fair	Good		Reasonably good mature specimen. Canopy is slightly sparse	5	Medium	382946.430	6483023.676
55	Tuart	20	600	8-10	8-10	Good	Acceptable - Good		Reasonably good mature specimen. Canopy is slightly sparse. Upright leggy canopy habit due to proximity and influence of adjacent trees	6	Medium	382953.842	6483020.774
56	Tuart	24	700	14-16	14-16	Fair	Acceptable - Good		Ok specimen. Large mature tree. Canopy is sparse though and suggests a decline in health	7	Low	382953.866	6483021.964

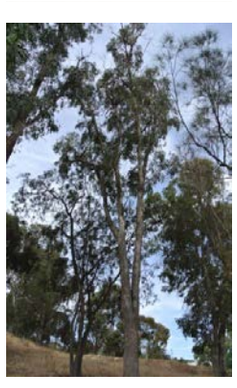
Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
57	Tuart	16	450	6-8	6-8	Dead	Acceptable - Poor (undesirable)		Dead tree.		Very Low	382956.529	6483019.645
58	Tuart	24	600	10-12	10-12	Excellent	Good		Large mature specimen. High aesthetic and amenity value.	6	High	382962.167	6483014.995
59	Tuart	18	600	10-12	6-8	Good	Acceptable		Reasonably good mature specimen. Canopy is slightly sparse. Relatively upright leggy canopy habit and one sided (north) due to proximity and influence of the adjacent trees. Suited to a low target area only	6	Low	382957.334	6483027.723
60	Tuart	18	600	10-12	8-10	Excellent	Good		Large mature specimen. High aesthetic and amenity value.	6	High	382966.760	6483024.964
61	Tuart	22	850	16-18	18-20	Good	Good		Large mature specimen. High aesthetic and amenity value. Canopy is slightly sparse but otherwise ok	8	High	382967.613	6483031.748
62	Common Sheoak	9	300	6-8	4-6	Fair	Acceptable		Reasonably good mature specimen. Canopy is slightly sparse. Large (old) wound on main stem	3.5	Medium	382969.585	6483034.921
63	Common Sheoak	9	450	8-10	8-10	Good	Good		Very good specimen of its species. Canopy is slightly sparse	4.5	High	382968.379	6483047.131
64	Jarrah	5	200	6-8	6-8	Good	Acceptable - Good		Canopy is slightly sparse and suggests that it may be starting to decline in health.	2.5	Medium	382972.238	6483050.187

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
65	Tuart	22	850	16-18	16-18	Good	Good		Large mature specimen. High aesthetic and amenity value. Canopy is slightly sparse	8	High	382975.198	6483046.634
66	Tuart	17	800	10-12	10-12	Excellent	Acceptable		Reasonably good mature specimen. Canopy is one sided (west) due to proximity and influence of the adjacent tree but otherwise ok	8	Medium	382969.538	6483052.758
67	Common Sheoak	8	250	4-6	4-6	Good	Acceptable - Good		Ok specimen. Multi stemmed from ground level. Sections of its canopy are slightly sparse	3	Low	382948.171	6483078.556
68	South Australian Yellow Gum	10	450	12-14	8-10	Excellent	Acceptable - Good		Large mature specimen. High aesthetic and amenity value. Canopy is slightly one sided (south) due to proximity and influence of the adjacent tree but otherwise ok	4.5	Medium	382941.143	6483082.429
69	Tuart	22	800	12-14	12-14	Excellent	Acceptable		Large mature specimen. High aesthetic and amenity value. Main stem furcates into a number 0f primary branch structures but otherwise ok	8	High	382936.800	6483086.693
70	Coastal Moort	7	350	6-8	6-8	Excellent	Acceptable - Poor (undesirable)		Reasonably good mature specimen. Evidence of termites in main stem	3.5	Low	382930.580	6483083.592
71	Tuart	18	550	8-10	6-8	Poor (Indicating Decline)	Acceptable - Good		Canopy indicates decline.	5	Very Low	382859.632	6483083.144
72	Tuart	21	700	8-10	10-12	Fair	Acceptable - Good		Ok specimen. Large mature tree. Canopy is slightly sparse	7	Medium	382867.032	6483080.626

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
73	Swamp Sheoak	7	150	2-4	2-4	Good	Acceptable - Good		Reasonably good semi-mature specimen. Relatively leggy canopy habit	2	Low	382861.781	6483071.120
74	Bottlebrush	3	100	2-4	2-4	Excellent	Good		Reasonably good mature specimen. Multi stemmed from near ground level. Part of a group of 6 trees	2.5	Low	382859.069	6483067.430
75	Bottlebrush	3	100	2-4	2-4	Excellent	Good		Reasonably good mature specimen. Multi stemmed from ground level. Part of a group of 6 trees	2.5	Low	382853.748	6483070.413
76	Bottlebrush	3	100	2-4	2-4	Excellent	Good		Reasonably good mature specimen. Part of a group 6 trees	2	Low	382856.952	6483069.835
77	Bottlebrush	3	100	2-4	2-4	Excellent	Good		Reasonably good mature specimen. Multi stemmed from ground level. Part of a group of 6 trees	2	Low	382853.553	6483069.522
78	Bottlebrush	3	100	2-4	2-4	Excellent	Good		Reasonably good mature specimen. Multi stemmed from ground level. Part of a group of 6 trees	2	Low	382852.059	6483073.421
79	South Australian Yellow Gum	3	150	2-4	2-4	Excellent	Acceptable - Good		Reasonably good semi-mature specimen. Canopy is one sided (south-west) due to proximity and influence of the adjacent trees. Part of a group of 6 trees	2.5	Low	382851.670	6483068.915
80	River Red Gum	18	800	12-14	12-14	Excellent	Acceptable - Good		Large mature specimen. High aesthetic and amenity value. Multi stemmed from near ground level	8	High	382759.181	6483058.096

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
81	Tuart	6	300	4-6	4-6	Good	Acceptable		Ok specimen. Looks to be stump regrowth	3	Very Low	382774.448	6483057.965
82	Coastal Banksia	4	350	6-8	4-6	Fair	Acceptable		Reasonably good mature specimen. Main stem bi furcates but union looks to be ok. Canopy is slightly sparse	4.5	Low	382782.815	6483058.969
83	River Red Gum	9	450	8-10	8-10	Good	Good		Reasonably good mature specimen. Canopy is slightly sparse but otherwise	4.5	Medium	382792.096	6483066.051
84	Swamp Mahogany	6	300	4-6	4-6	Good	Acceptable - Good		Ok specimen. Canopy is slightly sparse	3	Low	382787.846	6483070.171
85	Black Sheoak	7	250	2-4	2-4	Good	Good		Ok specimen. Canopy is slightly sparse and one sided	2.5	Low	382793.064	6483070.570
86	River Red Gum	16	500	12-14	10-12	Excellent	Good		Good mature specimen.	5	High	382801.299	6483071.820
87	Illyarrie	6	300	6-8	6-8	Excellent	Acceptable		Reasonably good mature specimen.	3	Medium	382797.089	6483076.822
88	Coastal Tea-tree	6	200	4-6	4-6	Poor (Indicating Decline)	Acceptable		Canopy indicates decline. Multi stemmed from ground level	2	Very Low	382799.179	6483079.613

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
89	Tuart	22	700	12-14	12-14	Good	Good		Very good specimen of its species. Canopy is slightly sparse but otherwise ok	7	High	382809.609	6483078.855
90	Swamp Sheoak	6	250	6-8	6-8	Excellent	Acceptable - Good		Reasonably good mature specimen. Slightly suppressed by the adjacent tree but otherwise ok	2.5	Low	382806.129	6483086.056
91	Coastal Moort	5	250	4-6	4-6	Excellent	Acceptable - Good		Reasonably good mature specimen. Canopy is slightly one sided (north) but otherwise ok	2.5	Low	382808.790	6483090.956
92	Tuart	17	750	10-12	10-12	Good	Good		Good mature specimen. Canopy is slightly sparse	7	Medium	382886.256	6483081.749
93	Swamp Sheoak	6	300	6-8	6-8	Excellent	Good		Reasonably good mature specimen. Slightly suppressed by the adjacent tree but otherwise ok	3	Medium	382887.087	6483065.242
94	Tuart	16	550	10-12	8-10	Good	Acceptable - Good		Reasonably good mature specimen. Canopy is slightly sparse. Slightly one sided due to proximity and influence of the adjacent tree but otherwise ok	5	Medium	382880.809	6483072.260
95	Tuart	18	500	10-12	10-12	Fair	Good		Canopy condition suggests it may have limited life span remaining.	5	Low	382878.372	6483066.629
96	Northern River Red Gum	5	350	10-12	6-8	Excellent	Acceptable - Poor (undesirable)		Has grown on a major lean south with all canopy on the southern side of its main stem	8	Very Low	382873.386	6483061.278

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
97	Tuart	18	600	10-12	10-12	Excellent	Acceptable - Good		Reasonably good mature specimen. Canopy is one sided (west) due to proximity and influence of the adjacent trees but otherwise ok	6	Medium	382872.735	6483065.822
98	Tuart	18	450	8-10	6-8	Excellent	Acceptable - Good		Reasonably good mature specimen. Relatively upright canopy habit due to proximity and influence of the adjacent trees but otherwise ok	4.5	Medium	382876.172	6483062.932
99	Tuart	18	550	8-10	8-10	Excellent	Acceptable - Poor (undesirable)		Main stem bi-furcates and evidence of included bark and swelling at the union. Structure likely to cause future issues longer term	5	Low	382878.884	6483066.074
100	Swamp Sheoak	9	350	8-10	8-10	Excellent	Acceptable		Reasonably good mature specimen. Slightly suppressed by the adjacent tree but otherwise ok	3.5	Medium	382884.614	6483064.512
101	Tuart	21	550	12-14	8-10	Good	Acceptable		Large mature specimen. High aesthetic and amenity value. Main stem bi furcates with some swelling at the union which may cause future issues longer term but ok at this stage	6	Medium	382882.282	6483062.203
102	Swamp Sheoak	5	300	6-8	6-8	Excellent	Good		Reasonably good mature specimen. Canopy is slightly one sided due to proximity and influence of the adjacent tree but otherwise ok	3	Medium	382879.496	6483059.267
103	Swamp Sheoak	8	200	4-6	2-4	Poor (Indicating Decline)	Acceptable		Canopy condition suggests it may have limited life span remaining. One side of its canopy is dead	2	Very Low	382885.928	6483053.580
104	Swamp Sheoak	8	450	8-10	6-8	Good	Acceptable - Good		Reasonably good mature specimen. Canopy is slightly sparse. Evidence of branch failures (look to be storm damage)	4.5	Medium	382889.193	6483054.137

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
105	Tuart	21	700	12-14	12-14	Good	Good		Reasonably good mature specimen. Canopy is slightly sparse. Otherwise ok	7	Medium	382892.917	6483058.094
106	Tuart	12	600	8-10	8-10	Good	Good		Reasonably good mature specimen. Sections of its canopy are slightly sparse. Otherwise ok	6	Medium	382893.064	6483044.919
107	Tuart	19	850	14-16	16-18	Good	Good		Large mature specimen. High aesthetic and amenity value. Sections of its canopy are slightly sparse. Evidence of a recent branch failure (possibly sudden branch drop phenomenon). Otherwise ok	8	High	382899.880	6483039.380
108	Jarrah	10	350	6-8	6-8	Fair	Good		Canopy is slightly sparse and suggests that it may be starting to decline in health. Foliage slightly chlorotic	3.5	Medium	382908.574	6483053.639
109	Tuart	14	450	10-12	8-10	Excellent	Acceptable - Good		Reasonably good mature specimen. Main stem bi furcates but union looks to be ok at this stage	4.5	Medium	382918.340	6483053.841
110	Jarrah	12	500	8-10	6-8	Fair	Good		Canopy is slightly sparse and suggests that it may be starting to decline in health. Foliage is slightly chlorotic	5	Medium	382912.774	6483046.493
111	Jarrah	11	250	6-8	6-8	Good	Acceptable - Good		Reasonably good mature specimen. Looks to be regrowth around and old burnt out stump, and the close proximity of the 4 main stems effectively forms the one canopy. Canopy is slightly sparse but otherwise ok	4	Medium	382912.338	6483018.729
112	Ironbark	8	300	4-6	4-6	Good	Good		Good mature specimen. Canopy is slightly sparse and chlorotic but otherwise ok	3	Medium	382915.606	6483003.633

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
113	Tuart	15	400	6-8	6-8	Good	Acceptable - Poor (undesirable)		Ok specimen. Relatively leggy canopy habit. Main stem bi furcates. Canopy is slightly sparse	4	Low	382909.083	6483085.315
114	River Red Gum	20	750	12-14	14-16	Good	Good		Large mature specimen. High aesthetic and amenity value. Canopy is slightly sparse	8	High	382908.561	6483090.480
115	Tuart	24	900	12-14	12-14	Fair	Good		Large mature specimen. High aesthetic and amenity value. Canopy is slightly sparse	9	High	382910.445	6483104.021
116	Showy Honey-myrtle	5	350	4-6	6-8	Poor (Indicating Decline)	Acceptable - Good		Canopy indicates decline. Part of the tree has failed	3.5	Very Low	382912.402	6483110.007
117	Tuart	23	650	8-10	10-12	Fair	Acceptable - Good		Large mature specimen. High aesthetic and amenity value. Canopy is sparse. Main stem bi furcates	6	Medium	382920.398	6483098.173
118	Tuart	23	1050	20-22	20-22	Good	Good		Large mature specimen. High aesthetic and amenity value. Canopy is slightly sparse. Sections of its canopy may have been previously lopped. Very old specimen. possibly 100-150 years old	10	High	382930.176	6483101.506
119	South Australian Yellow Gum	9	400	8-10	8-10	Excellent	Good		Very good specimen of its species.	4	High	382944.361	6483111.188
120	Broadleaved Paperbark	9	400	6-8	6-8	Good	Good		Reasonably good mature specimen. Canopy is sparse in sections	4	Medium	382959.296	6483097.910

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
121	Showy Honey-myrtle	6	450	8-10	8-10	Excellent	Good		Good mature specimen. Has grown on a lean west. Very low spreading canopy would need to be retained	5	Low	382962.160	6483104.220
122	South Australian Yellow Gum	11	400	12-14	12-14	Excellent	Acceptable - Good		Good mature specimen. Two main stems from ground level (possibly even two separate trees). Wide low spreading canopy would (ideally) need to be retained	6	Medium	382947.614	6483116.722
123	Bald Island Marlock	8	400	6-8	6-8	Excellent	Acceptable - Good		Reasonably good mature specimen. Has grown on a slight lean south due to proximity and influence of the adjacent tree which may cause future issues longer term	4	Low	382956.863	6483125.353
124	Tuart	24	950	20-22	16-18	Excellent	Good		Large mature specimen. High aesthetic and amenity value. Very good specimen	9	High	382948.503	6483129.732
125	Tuart	15	550	10-12	10-12	Excellent	Acceptable		Reasonably good mature specimen. Multi stemmed from ground level. Canopy is one sided (west) due to proximity and influence of the adjacent tree but otherwise ok	5	Medium	382946.021	6483127.051
126	Port Lincoln Gum	13	450	8-10	8-10	Excellent	Acceptable - Good		Reasonably good mature specimen. Has grown on a slight lean east due to proximity and influence of the adjacent tree. Relatively upright leggy canopy habit but otherwise ok	4.5	Medium	382944.446	6483144.171
127	River Red Gum	16	450	8-10	8-10	Excellent	Acceptable - Poor (undesirable)		Ok specimen. Main stem bi furcates. Sections of its canopy have been previously lopped. structure likely to cause future issues longer term	4.5	Low	382937.122	6483141.751
128	Bracelet Honey-myrtle	4	300	4-6	4-6	Fair	Good		Reasonably good mature specimen. Canopy is sparse	3	Low	382942.072	6483144.831

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
129	Tuart	23	1000	18-20	18-20	Good	Good		Large mature specimen. High aesthetic and amenity value. Canopy is slightly sparse. Old specimen. possibly 100-150 years old	10	High	382931.341	6483155.648
130	Tuart	12	750	10-12	8-10	Good	Acceptable - Good		Reasonably good mature specimen. Canopy is slightly sparse	7	Medium	382892.660	6483149.348
131	Bottlebrush	5	250	4-6	4-6	Fair	Good		Canopy condition suggests it may have limited life span remaining.	3	Low	382897.953	6483134.108
132	Tuart	16	750	16-18	16-18	Fair	Good		Canopy is slightly sparse and suggests that it may be starting to decline in health. Large mature tree but sections of its canopy indicate decline	7	Medium	382896.037	6483133.352
133	Illyarrie	5	200	6-8	4-6	Fair	Acceptable - Good		Reasonably good mature specimen. Canopy is one sided (west) and slightly sparse but otherwise ok	2.5	Low	382895.006	6483130.097
134	Showy Honey-myrtle	5	300	6-8	8-10	Good	Acceptable - Good		Multi-stemmed from near ground level. Low canopy spread needs to be retained	4	Low	382889.936	6483124.566
135	River Red Gum	11	550	8-10	8-10	Excellent	Good		Good mature specimen. Location on tiered section which may make retention difficult	5	High	382877.399	6483120.134
136	River Red Gum	19	800	14-16	14-16	Excellent	Acceptable - Good		Reasonably good mature specimen. Large mature tree but structure suggests it may have been previously lopped so may cause future issues longer term so suited to a low target area only	7	Medium	382863.549	6483123.976

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
137	River Red Gum	19	850	14-16	14-16	Excellent	Acceptable - Good		Reasonably good mature specimen. Large mature tree. Evidence of recent branch failure (possibly sudden branch drop phenomenon) but otherwise ok	9	High	382859.128	6483113.033
138	Coastal Moort	6	300	6-8	8-10	Excellent	Acceptable - Good		Reasonably good mature specimen. Canopy is slightly one sided due to proximity and influence of the adjacent tree. Situated on boundary, but outside of fence	3	Low	382848.638	6483142.604
139	Coolibah	9	300	6-8	6-8	Excellent	Good		Very good specimen of its species.	3.5	High	382874.137	6483150.618
140	Coastal Moort	5	200	4-6	2-4	Excellent	Acceptable		Ok specimen. Canopy is one sided (south) due to proximity and influence of the adjacent tree	2.5	Low	382876.053	6483147.418
141	Coastal Moort	6	200	2-4	4-6	Excellent	Acceptable - Poor (undesirable)		Ok specimen. Has grown on a lean east due to proximity and influence of the adjacent tree. Leggy canopy habit	2.5	Very Low	382878.240	6483147.044
142	Coastal Moort	7	250	4-6	4-6	Excellent	Acceptable - Poor (undesirable)		Ok specimen. Has grown on a lean south east due to proximity and influence of the adjacent tree	2.5	Very Low	382878.721	6483146.566
143	Coolibah	9	300	4-6	4-6	Excellent	Good		Very good specimen of its species.	3.5	High	382883.318	6483147.220
144	Coolibah	7	350	4-6	6-8	Excellent	Acceptable		Reasonably good mature specimen. Has grown on a lean east. Main stem bi furcates. Otherwise ok	3.5	Low	382881.452	6483152.902

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
145	Tuart	16	650	12-14	12-14	Excellent	Good		Good mature specimen. Multi stemmed from near ground level	7	High	382778.478	6483044.522
146	Tuart	16	750	16-18	14-16	Excellent	Acceptable - Good		Multi-stemmed from ground level. Evidence of (large) branch failures. Area of decay noted in base of main stem	10	Medium	382795.157	6483020.297
147	Jarrah	6	300	4-6	4-6	Excellent	Good		Good mature specimen. Multi stemmed from ground level	3	Medium	382811.962	6482999.747
148	Northern River Red Gum	12	550	16-18	18-20	Excellent	Acceptable - Good		Large mature specimen. High aesthetic and amenity value. Wide canopy spread. Multi stemmed from ground level	10	Medium	382836.839	6482998.102
149	Flooded Gum	15	650	12-14	12-14	Excellent	Acceptable - Good		Good mature specimen. Main stem bi furcates but union looks to be ok	6	High	382852.102	6483000.775
150	Coolibah	5	200	4-6	4-6	Excellent	Acceptable - Poor (undesirable)		Ok specimen. Previously lopped and structure likely to cause future issues longer	2.5	Low	382864.683	6483002.167
151	Coojong	5	200	4-6	6-8	Excellent	Acceptable - Good		Ok specimen. Multi stemmed from ground level. Short lived species and likely to have limited life span remaining	2.5	Very Low	382869.810	6483003.593
152	Coastal Moort	5	450	6-8	2-4	Fair	Acceptable - Poor (undesirable)		Canopy condition suggests it may have limited life span remaining. Area of decay noted in main stem	4.5	Very Low	382883.455	6483002.649

Tree No	Common Name	Approx Height	DBH	Canopy Spread N/S	Canopy Spread E/W	Health	Structure	Image	Comments	TPZ	Retention Value	Easting	Northing
153	South Australian Yellow Gum	7	400	8-10	8-10	Excellent	Acceptable		Reasonably good mature specimen. Evidence of branch failures. Open spreading canopy habit	4.5	Low	382889.444	6483001.556

Attachment 3; References

The following references were utilised during this assessment:

1. Field Guide to Eucalypts; Brooker & Kleinig; Volumes 1, 2, and 3
2. Field Guide to Melaleuca's; Ivan Holiday
3. Australian Standards guideline 4970 (2009); Protection of Trees on Development Sites

Attachment 4; Glossary of arboricultural terms

GLOSSARY OF ARBORICULTURAL TERMS

Abscission. The shedding of a leaf or other short-lived part of a woody plant, involving the formation of a corky layer across its base; in some tree species twigs can be shed in this way

Abiotic. Pertaining to non-living agents; e.g. environmental factors

Absorptive roots. Non-woody, short-lived roots, generally having a diameter of less than one millimetre, the primary function of which is uptake of water and nutrients

Adaptive growth. In tree biomechanics, the process whereby the rate of wood formation in the cambial zone, as well as wood quality, responds to gravity and other forces acting on the cambium This helps to maintain a uniform distribution of mechanical stress

Adaptive roots. The adaptive growth of existing roots; or the production of new roots in response to damage, decay or altered mechanical loading

Adventitious shoots. Shoots that develop other than from apical, axillary or dormant buds; see also 'epicormic'

Anchorage. The system whereby a tree is fixed within the soil, involving cohesion between roots and soil and the development of a branched system of roots which withstands wind and gravitational forces transmitted from the aerial parts of the tree

Architecture. In a tree, a term describing the pattern of branching of the crown or root system

Axil. The place where a bud is borne between a leaf and its parent shoot

Bacteria. Microscopic single-celled organisms, many species of which break down dead organic matter, and some of which cause diseases in other organisms

Bark. A term usually applied to all the tissues of a woody plant lying outside the vascular cambium, thus including the phloem, cortex and periderm; occasionally applied only to the periderm or the phellem

Basidiomycotina (Basidiomycetes). One of the major taxonomic groups of fungi; their spores are borne on microscopic peg-like structures (basidia), which in many types are in turn borne on or within conspicuous fruit bodies, such as brackets or toadstools. Most of the principal decay fungi in standing trees are basidiomycetes

Bolling. A term sometimes used to describe pollard heads

Bottle-butt. A broadening of the stem base and buttresses of a tree, in excess of normal and sometimes denoting a growth response to weakening in that region, especially due to decay involving selective delignification

Bracing. The use of rods or cables to restrain the movement between parts of a tree

Branch:

- **Primary.** A first order branch arising from a stem
- **Lateral.** A second order branch, subordinate to a primary branch or stem and bearing sub-lateral branches
- **Sub-lateral.** A third order branch, subordinate to a lateral or primary branch, or stem and usually bearing only twigs

Branch bark ridge. The raised arc of bark tissues that forms within the acute angle between a branch and its parent stem

Branch collar. A visible swelling formed at the base of a branch whose diameter growth has been disproportionately slow compared to that of the parent stem; a term sometimes applied also to the pattern of growth of the cells of the parent stem around the branch base

Brown-rot. A type of wood decay in which cellulose is degraded, while lignin is only modified

Buckling. An irreversible deformation of a structure subjected to a bending load

Buttress zone. The region at the base of a tree where the major lateral roots join the stem, with buttress-like formations on the upper side of the junctions

Cambium. Layer of dividing cells producing xylem (woody) tissue internally and phloem (bark) tissue externally

Canker. A persistent lesion formed by the death of bark and cambium due to colonisation by fungi or bacteria

Canopy species. Tree species that mature to form a closed woodland canopy

Cleaning out. The removal of dead, crossing, weak, and damaged branches, where this will not damage or spoil the overall appearance of the tree

Compartmentalization. The confinement of disease, decay or other dysfunction within an anatomically discrete region of plant tissue, due to passive and/or active defences operating at the boundaries of the affected region

Compression strength. The ability of a material or structure to resist failure when subjected to compressive loading; measurable in trees with special drilling devices

Compressive loading. Mechanical loading which exerts a positive pressure; the opposite to tensile loading

Condition. An indication of the physiological vitality of the tree. Where the term 'condition' is used in a report, it should not be taken as an indication of the stability of the tree

Construction exclusion zone. Area based on the Root Protection Area (in square metres) to be protected during development, by the use of barriers and/or ground protection

Crown/Canopy. The main foliage bearing section of the tree

Crown lifting. The removal of limbs and small branches to a specified height above ground level

Crown thinning. The removal of a proportion of secondary branch growth throughout the crown to produce an even density of foliage around a well-balanced branch structure

Crown reduction/shaping. A specified reduction in crown size whilst preserving, as far as possible, the natural tree shape

Crown reduction/thinning. Reduction of the canopy volume by thinning to remove dominant branches whilst preserving, as far as possible the natural tree shape

Deadwood. Dead branch wood

Decurrent. In trees, a system of branching in which there is a well defined central main stem, bearing branches which are limited in their length, diameter and secondary branching (cf. excurrent) In fungi with toadstools as fruit bodies, the description of gills which run some distance down the stem, rather than terminating abruptly

Defect. In relation to tree hazards, any feature of a tree which detracts from the uniform distribution of mechanical stress, or which makes the tree mechanically unsuited to its environment

Delamination. The separation of wood layers along their length, visible as longitudinal splitting

Dieback. The death of parts of a woody plant, starting at shoot-tips or root-tips

Disease. A malfunction in or destruction of tissues within a living organism, usually excluding mechanical damage; in trees, usually caused by pathogenic micro-organisms

Distal. In the direction away from the main body of a tree or subject organism (cf. proximal)

Dominance. In trees, the tendency for a leading shoot to grow faster or more vigorously than the lateral shoots; also the tendency of a tree to maintain a taller crown than its neighbours

Dormant bud. An axial bud which does not develop into a shoot until after the formation of two or more annual wood increments; many such buds persist through the life of a tree and develop only if stimulated to do so

Dysfunction. In woody tissues, the loss of physiological function, especially water conduction, in sapwood

DBH (Diameter at Breast Height). Stem diameter measured at a height of 1.5 metres (UK) or the nearest measurable point. Where measurement at a height of 1.5 metres is not possible, another height may be specified

Deadwood. Branch or stem wood bearing no live tissues. Retention of deadwood provides valuable habitat for a wide range of species and seldom represents a threat to the health of the tree. Removal of deadwood can result in the ingress of decay to otherwise sound tissues and climbing operations to access deadwood can cause significant damage to a tree. Removal of deadwood is generally recommended only where it represents an unacceptable level of hazard

Endophytes. Micro-organisms which live inside plant tissues without causing overt disease, but in some cases capable of causing disease if the tissues become physiologically stressed, for example by lack of moisture

Epicormic shoot. A shoot having developed from a dormant or adventitious bud and not having developed from a first year shoot

Excrescence. Any abnormal outgrowth on the surface of tree or other organism

Excurrent. In trees, a system of branching in which the crown is borne on a number of major widely-spreading and secondarily branched limbs (cf. excurrent)

Felling licence. In the UK, a permit to fell trees in excess of a stipulated number of stems or volume of timber

Flush-cut. A pruning cut which removes part of the branch bark ridge and or branch-collar

Girdling root. A root which circles and constricts the stem or roots possibly causing death of phloem and/or cambial tissue

Guying a form of artificial support with cables for trees with a temporarily inadequate anchorage

Habit. The overall growth characteristics, shape of the tree and branch structure

Hazard beam. An upwardly curved part of a tree in which strong internal stresses may occur without being reduced by adaptive growth; prone to longitudinal splitting

Heartwood/false-heartwood/ripewood. Sapwood that has become dysfunctional as part of the natural aging processes

Heave. A term mainly applicable to a shrinkable clay soil which expands due to re-wetting after the felling of a tree which was previously extracting moisture from the deeper layers; also the lifting of pavements and other structures by root diameter expansion; also the lifting of one side of a wind-rocked root-plate

High canopy tree species. Tree species having potential to contribute to the closed canopy of a mature woodland or forest

Incipient failure. In wood tissues, a mechanical failure which results only in deformation or cracking, and not in the fall or detachment of the affected part

Included bark (ingrown bark). Bark of adjacent parts of a tree (usually forks, acutely joined branches or basal flutes) which is in face-to-face contact

Increment borer. A hollow auger, which can be used for the extraction of wood cores for counting or measuring wood increments or for inspecting the condition of the wood

Infection. The establishment of a parasitic micro-organism in the tissues of a tree or other organism

Internode. The part of a stem between two nodes; not to be confused with a length of stem which bear nodes but no branches

Lever arm. A mechanical term denoting the length of the lever represented by a structure that is free to move at one end, such as a tree or an individual branch

Lignin. The hard, cement-like constituent of wood cells; deposition of lignin within the matrix of cellulose microfibrils in the cell wall is termed Lignification

Lions tailing. A term applied to a branch of a tree that has few if any side-branches except at its end, and is thus liable to snap due to end-loading

Loading. A mechanical term describing the force acting on a structure from a particular source; e.g. the weight of the structure itself or wind pressure

Longitudinal. Along the length (of a stem, root or branch)

Lopping. A term often used to describe the removal of large branches from a tree, but also used to describe other forms of cutting

Mature Heights (approximate)**:**

- **Low maturing –** less than 8 metres high
- **Moderately high maturing –** 8 – 12 metres high
- **High maturing –** greater than 12 metres high

Microdrill. An electronic rotating steel probe, which when inserted into woody tissue provides a measure of tissue density

Minor deadwood. Deadwood of a diameter less than 25mm and or unlikely to cause significant harm or damage upon impact with a target beneath the tree

Mulch. Material laid down over the rooting area of a tree or other plant to help conserve moisture; a mulch may consist of organic matter or a sheet of plastic or other artificial material

Mycelium. The body of a fungus, consisting of branched filaments (hyphae)

Occluding tissues. A general term for the roll of wood, cambium and bark that forms around a wound on a woody plant (cf. woundwood)

Occlusion. The process whereby a wound is progressively closed by the formation of new wood and bark around it

Pathogen. A micro-organism which causes disease in another organism

Photosynthesis. The process whereby plants use light energy to split hydrogen from water molecules, and combine it with carbon dioxide to form the molecular building blocks for synthesizing carbohydrates and other biochemical products.

Phytotoxic. Toxic to plants

Pollarding. The removal of the tree canopy, back to the stem or primary branches. Pollarding may involve the removal of the entire canopy in one operation, or may be phased over several years. The period of safe retention of trees having been pollarded varies with species and individuals. It is usually necessary to re-pollard on a regular basis, annually in the case of some species.

Primary branch. A major branch, generally having a basal diameter greater than 0.25 x stem diameter

Primary root zone. The soil volume most likely to contain roots that are critical to the health and stability of the tree and normally defined by reference to Table 1 of BS5837 (1991) Guide for Trees in Relation to Construction.

Priority. Works may be prioritised, 1. = high, 5. = low

Probability. A statistical measure of the likelihood that a particular event might occur

Proximal. In the direction towards from the main body of a tree or other living organism (cf. distal)

Pruning. The removal or cutting back of twigs or branches, sometimes applied to twigs or small branches only, but often used to describe most activities involving the cutting of trees or shrubs

Radial. In the plane or direction of the radius of a circular object such as a tree stem

Rams-horn. In connection with wounds on trees, a roll of occluding tissues which has a spiral structure as seen in cross-section

Rays. Strips of radially elongated parenchyma cells within wood and bark. The functions of rays include food storage, radial translocation and contributing to the strength of wood

Red-rot. A form of decay in which reddish pigments are present but which is biochemically a white-rot; not to be confused with brown-rots which sometimes also have a reddish-brown colour

Reactive Growth/Reaction Wood. Production of woody tissue in response to altered mechanical loading; often in response to internal defect or decay and associated strength loss (cf. adaptive growth)

Removal of dead wood. Unless otherwise specified, this refers to the removal of all accessible dead, dying and diseased branchwood and broken snags

Removal of major dead wood. The removal of, dead, dying and diseased branchwood above a specified size

Respacing. Selective removal of trees from a group or woodland to provide space and resources for the development of retained trees.

Residual wall. The wall of non-decayed wood remaining following decay of internal stem, branch or root tissues

Root-collar. The transitional area between the stem/s and roots

Root-collar examination. Excavation of surfacing and soils around the root-collar to assess the structural integrity of roots and/or stem

Root protection area. An area of ground surrounding a tree that contains sufficient rooting volume to ensure the tree's survival. Calculated with reference to Table 2 of BS5837 (2005) and shown in plan form in square metres

Root zone. Area of soils containing absorptive roots of the tree/s described

microscopic and dispersed in air or water. The **Primary** root zone is that which we consider of primary importance to the physiological well-being of the tree

Sapwood. Living xylem tissues

Secondary branch. A branch, generally having a basal diameter of less than 0.25 x stem diameter

Selective delignification. A kind of wood decay (white-rot) in which lignin is degraded faster than cellulose

Shedding. In woody plants, the normal abscission, rotting off or sloughing of leaves, floral parts, twigs, fine roots and bark scales

Silvicultural thinning. Removal of selected trees to favour the development of retained specimens to achieve a management objective

Simultaneous white-rot. A kind of wood decay in which lignin and cellulose are degraded at about the same rate

Snag. In woody plants, a portion of a cut or broken stem, branch or root which extends beyond any growing-point or dormant bud; a snag usually tends to die back to the nearest growing point

Soft-rot. A kind of wood decay in which a fungus degrades cellulose within the cell walls, without any general degradation of the wall as a whole

Spores. Propagules of fungi and many other life-forms; most spores are
Shrub species. Woody perennial species forming the lowest level of woody plants in a woodland and not normally considered to be trees

Sporophore. The spore bearing structure of fungi

Sprouts. Adventitious shoot growth erupting from beneath the bark

Stem/s. The main supporting structure/s, from ground level up to the first major division into branches

Stress. In plant physiology, a condition under which one or more physiological functions are not operating within their optimum range, for example due to lack of water, inadequate nutrition or extremes of temperature

Stress. In mechanics, the application of a force to an object

Stringy white-rot. The kind of wood decay produced by selective delignification

Storm. A layer of tissue which supports the fruit bodies of some types of fungi, mainly ascomycetes

Structural roots. Roots, generally having a diameter greater than ten millimetres, and contributing significantly to the structural support and stability of the tree

Subsidence. In relation to soil or structures resting in or on soil, a sinking due to shrinkage when certain types of clay soil dry out, sometimes due to extraction of moisture by tree roots

Subsidence. In relation to branches of trees, a term that can be used to describe a progressive downward bending due to increasing weight

Taper. In stems and branches, the degree of change in girth along a given length

Target canker. A kind of perennial canker, containing concentric rings of dead occluding tissues

Targets. In tree risk assessment (with slight misuse of normal meaning) persons or property or other things of value which might be harmed by mechanical failure of the tree or by objects falling from it

Topping. In arboriculture, the removal of the crown of a tree, or of a major proportion of it

Torsional stress. Mechanical stress applied by a twisting force

Translocation. In plant physiology, the movement of water and dissolved materials through the body of the plant

Transpiration. The evaporation of moisture from the surface of a plant, especially via the stomata of leaves; it exerts a suction which draws water up from the roots and through the intervening xylem cells

Understorey. A layer of vegetation beneath the main canopy of woodland or forest or plants forming this

Understorey tree species. Tree species not having potential to attain a size at which they can contribute to the closed high canopy of a woodland

Vascular wilt. A type of plant disease in which water-conducting cells become dysfunctional

Vessels. Water-conducting cells in plants, usually wide and long for hydraulic efficiency; generally not present in coniferous trees

Veteran tree. A loosely defined term for an old specimen that is of interest biologically, culturally or aesthetically because of its age, size or condition and which has usually lived longer than the typical upper age range for the species concerned

White-rot. A range of kinds of wood decay in which lignin, usually together with cellulose and other wood constituents, is degraded

Wind exposure. The degree to which a tree or other object is exposed to wind, both in terms of duration and velocity

Wind pressure. The force exerted by a wind on a particular object

Windthrow. The blowing over of a tree at its roots

Wound dressing. A general term for sealants and other materials used to cover wounds in the hope of protecting them against desiccation and infection; only of proven value against fresh wound parasites

Woundwood. Wood with atypical anatomical features, formed in the vicinity of a wound'

Attachment 5; Company Information & Disclaimer

Company Information

Company Name:	ARBOR logic
A.C.N.:	107 194 061
A.B.N.:	66 566 369 687

Insurance Details:

General Liability;	Zurich	$20 million
Professional Indemnity;	Dual Australia	$5 million
Personal Protection;	Macquarie	

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Disclaimer

This advice has been provided in good faith and based upon the material information provided by the Client to Arbor logic, and based on the visual inspection of the tree(s) at the time this advice was prepared.

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- The provision of misleading or incorrect information by the Client or any other party to Arbor logic upon which this advice was prepared.
- This advice being used by the Client or any other party in circumstances or situations other than the specific subject of this advice.
- Failure by the Client to follow this advice.
- The action(s) or inaction(s) of the Client or any other party that gives rise to the loss of, or damage to, the subject of this advice.

The information provided in this advice may not be reissued or printed without Arbor logic's written permission.

It is also important to take into consideration that all trees are living organisms and as such there are many variables that can affect their health and structural properties that remain beyond the scope of reasonable management practices or the advice provided in this report based on the visual inspection of the tree(s).

As such a degree of risk will still remain with any given tree(s) despite the adoption of any best management practices or recommendations made in this report.

APPENDIX 4
TRAFFIC REPORT

February 2013

Final

Redevelopment of Camberwarra Primary School, Craigie

Prepared For:

JDSi Consulting Engineers

On Behalf of Landcorp

Transport Report

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0	0	18/02/13	Internal Draft Report	JH	DNV
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1 INTRODUCTION

1.1 BACKGROUND

This Transport Statement has been prepared by Donald Veal Consultants on behalf of Landcorp, with regard to the proposed Structure Plan of the old Camberwarra Primary School Site. Whilst the final dwelling yield is subject to further detailed design, the structure plan area can possibly accommodate in the order of 52 dwellings, comprised indicatively of about 39 single residential lots and one grouped residential lot with a yield of up to 13 dwellings. The site will also accommodate public open space. The subject land was previously the old Camberwarra Primary School however this has been demolished and the site is currently vacant.

1.2 SITE LOCATION

The site is located within the City of Joondalup, in the suburb of Craigie. It is located approximately 20km to the north of the Perth CBD. Major arterial roads within close proximity include the Mitchell Freeway to the east, Marmion Avenue to the west, Ocean Reef Road to the north and Whitfords Avenue to the south. **Figure 1.1** indicates the location of the site in context of the surrounding region.

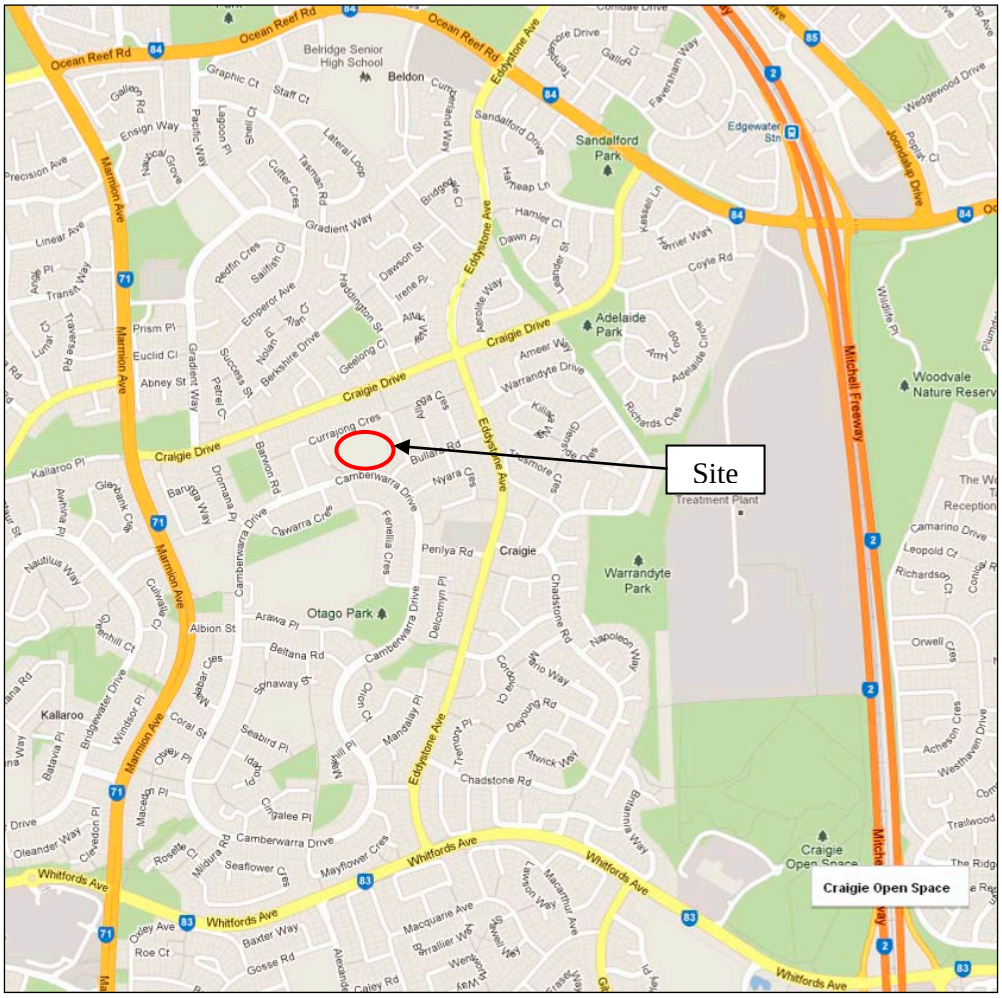

Figure 1.1: Site location
Source: Google Maps

1.3 SCOPE OF ASSESSMENT

This Transport Statement has been prepared in accordance with the Western Australian Planning Commission's (WAPC's) *Transport Assessment Guidelines for Developments Volume 2 Structure Plans* (2009).

The intent of this statement is to provide the approving authority with sufficient traffic information to confirm that the proponent has adequately considered the traffic aspects of the development and that it would not have an adverse traffic impact on the surrounding area.

2 STRUCTURE PLAN PROPOSAL

2.1 STRUCTURE PLAN CONTEXT

The subject land is currently vacant and undeveloped. The site is typically surrounded by existing residential land uses. Craigie is an established suburb and as such surrounding land is subsequently fully developed. **Figure 2.1** contains an aerial view of the subject site and its immediate surrounds and its location in a local context. **Figure 2.2** shows the site in a regional context.

Figure 2.1: Site location – Local context
Source: JDSi

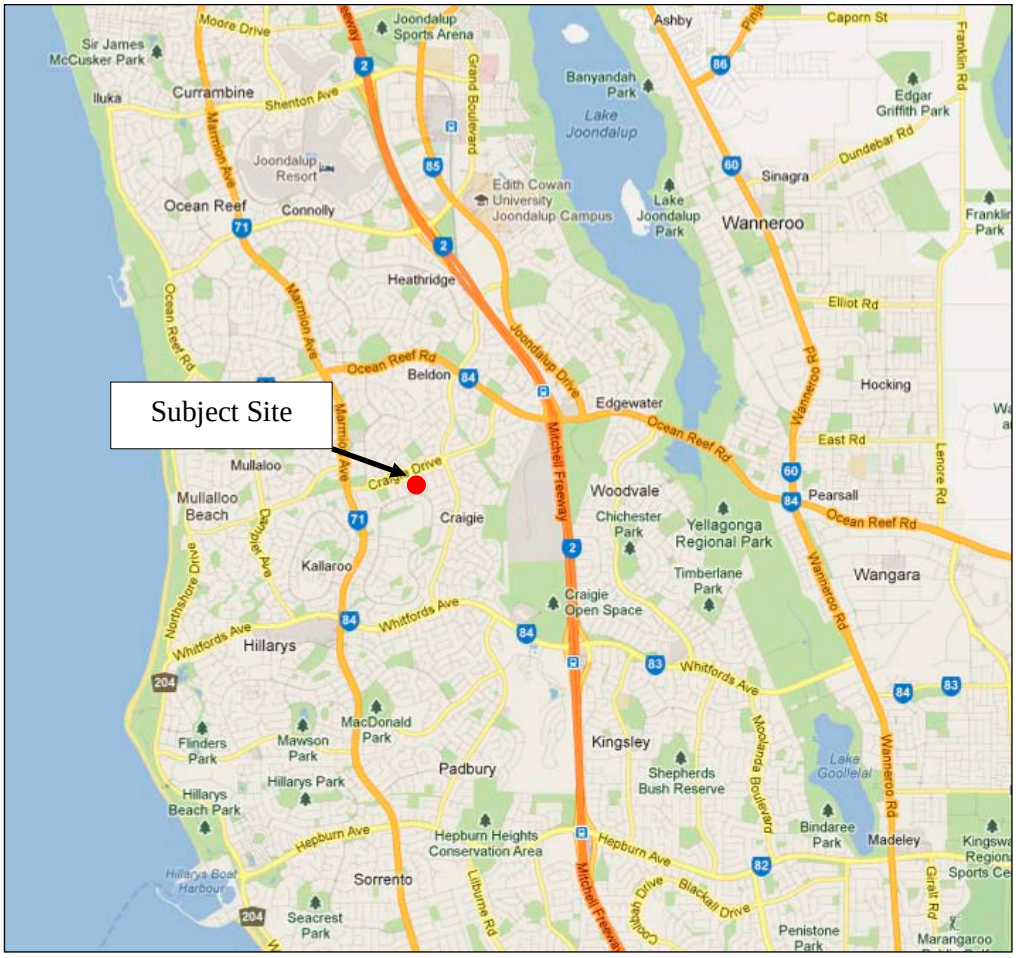

Figure 2.2: Site location – Regional context
Source: Google Maps

2.2 PROPOSED LAND USES

The structure plan proposes residential living zoning of R25-R40 with Public Open Space. Based on an indicative lot layout it is estimated that the total number of lots created will be 40, equating to approximately52 residential dwellings.

2.3 MAJOR ATTRACTORS AND GENERATORS OF TRAFFIC

Within the proposed structure plan, the residential lots are the major traffic generating land use. The reserve for recreation located on the southwest corner of the structure plan is not expected to attract vehicular traffic as most trips to the reserve are expected to be by walking or cycling.

The majority of traffic generated by the proposed subdivision would be attracted east from the site, i.e. Mitchell Freeway (i.e. Perth CBD, Joondalup) for work. Other key attractors would be north towards schools (Beldon Senior High School) and local shopping centres i.e. to the southwest Whitfords Shopping Centre and again to the north Joondalup.

3 ROAD NETWORK SITUATION

3.1 EXISTING ROAD INFRASTRUCTURE

Figure 3.1 illustrates the road network servicing the subject site. Three existing roads directly abut the site, being Camberwarra Drive, Currajong Crescent and Argus Close.

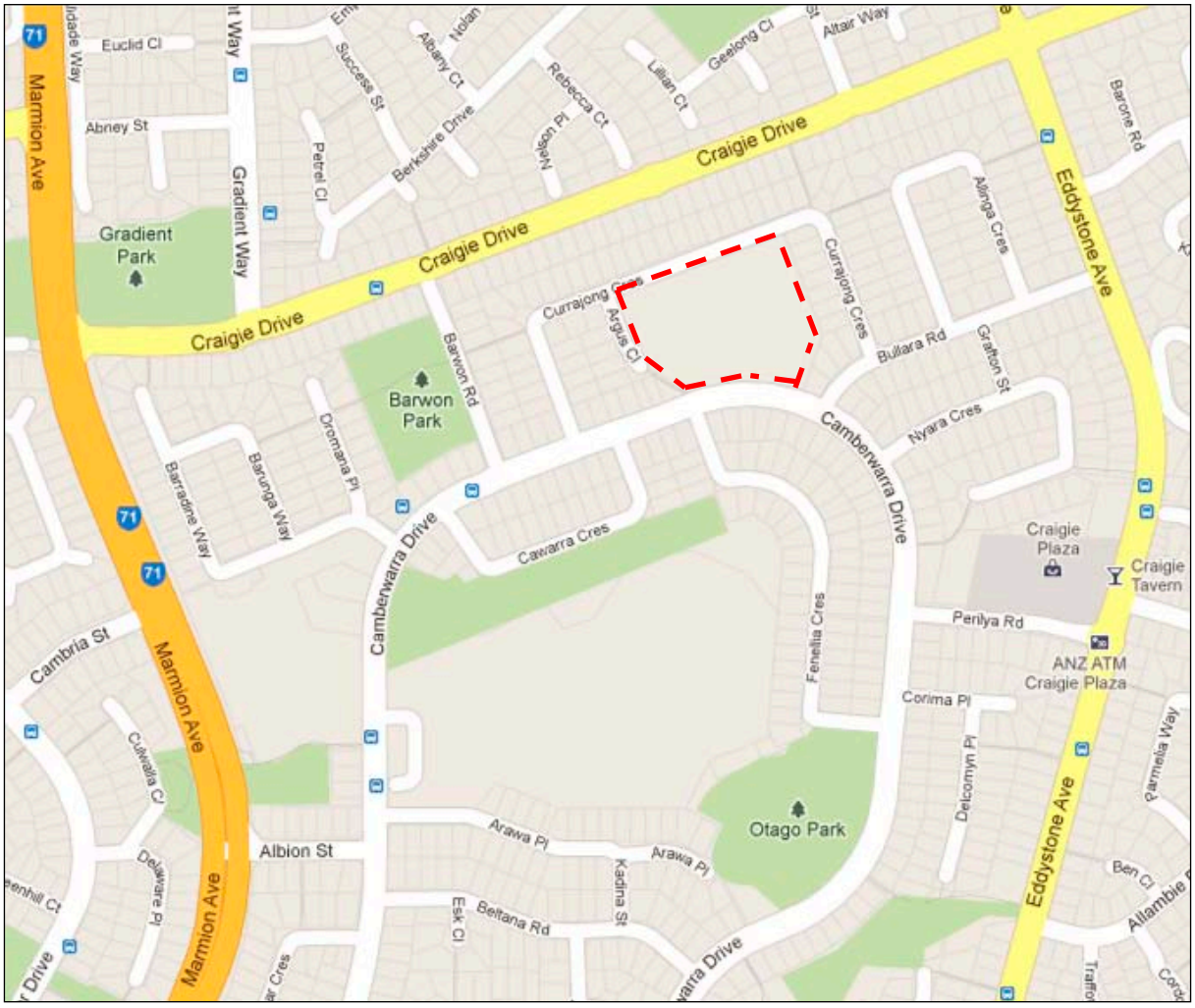

Figure 3.1: Existing Road Network
Source: Google Maps

3.1.1 Camberwarra Drive

Camberwarra Drive is typically constructed to a kerbed, two lane divided (painted median) single carriageway road. The approximate pavement width is 9m comprising of 2 x 3.5m traffic lanes and a 2m painted median. Immediately adjacent to the site there are parking embayments that previously would have been used to meet the associated parking demand during the operation of the Primary School.

There are existing footpaths on both sides of Camberwarra Drive. Typical widths are 1.2m however immediately adjacent to the site the footpath is widened locally to accommodate the increased pedestrian usage during the operation of the old school.

The built up area speed limit of 50km/h would apply past the site. Camberwarra Drive forms a continuous loop within the adjacent residential area with numerous road connections along its lengths.

Photo 1: Camberwarra Dr, looking west towards Fenellia Cres

Photo 2: Camberwarra Dr, looking east towards Fenellia Cres

3.1.2 Currajong Crescent

Currajong Crescent is constructed to a kerbed, two lane undivided single carriageway road. The approximate pavement width is 7m (western and eastern legs) while the width alters adjacent to the site to approximately 8.5m, comprising of 3m lanes and a 2.5m wide on street parking embayment. These parking bays would have previously been used to meet the associated parking demand during the operation of the old Primary School.

There is an existing 2.0m wide footpath located on the southern side of Currajong Crescent adjacent to the site. Pedestrian links from Currajong Crescent connect through to Craigie Drive, Barwon Road and Allinga Crescent.

The built up area speed limit of 50km/h would apply past the site. Currajong Crescent forms a u-shaped road connecting with Camberwarra Drive and Bullara Road.

Photo 3: Currajong Cres, looking north from Camberwarra Dr

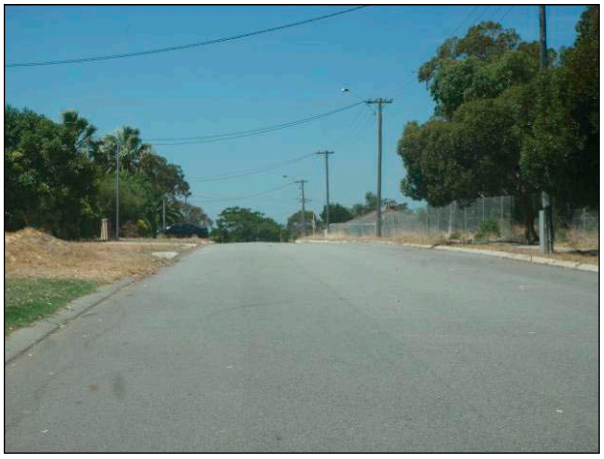

Photo 4: Currajong Cres looking east adjacent to old school site

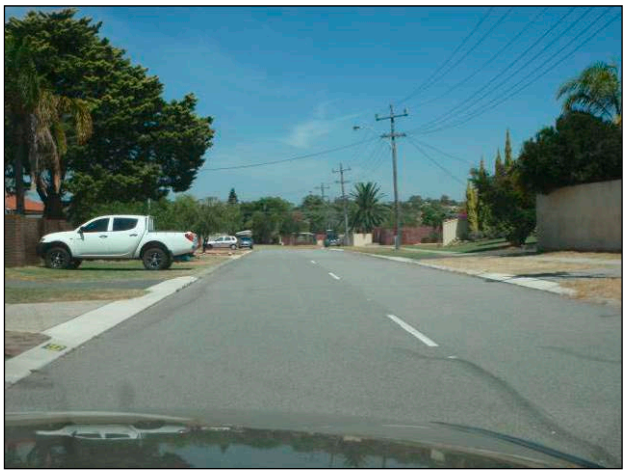

Photo 5: Currajong Cres, looking south towards Bullara Dr

Photo 6: Pedestrian Link from Currajong Cres to Craigie Drive

3.1.3 Argus Close

Argus Close is constructed to a kerbed, two lane undivided single carriageway road. The approximate pavement width is 6.2m. There is an existing 1.2m wide footpath located on the eastern side of Argus Close adjacent to the site.

The built up area speed limit of 50km/h would apply past the site although the local conditions i.e. road length and cul-de-sac form would likely restrict speeds to less than this.

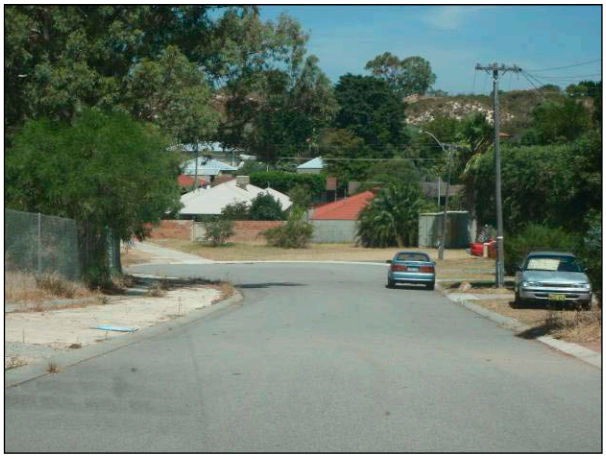

Photo 7: Argus Cl, looking south towards cul-de-sac end

Photo 8: Pedestrian Link from Argus Cl to Camberwarra Dr

3.2 ROAD HIERARCHY CLASSIFICATION

All the adjacent roads abutting the site, i.e.Camberwarra Drive, Currajong Crescent and Argus Close are classified as *Access Roads* under Main Roads WA's *Functional Road Hierarchy*. This classification is applied to roads which "*provide access to abutting properties with safety aspects having priority over the vehicle movement function. In urban areas, these roads are bicycle and pedestrian friendly, with aesthetics and amenity also important"*

The local distributor roads within the area which are expected to be used by local traffic include Craigie Drive, to the north of the site and Eddystone Avenue to the east of the site. The *local distributor* classification is applied to roads which: "*discourage through traffic, only carries traffic belonging to or serving the area. Local distributors should accommodate buses but discourage trucks"*

The City of Joondalup own and operate all of these roads.

Figure 3.2 outlines the road hierarchy classification of the surrounding road network.

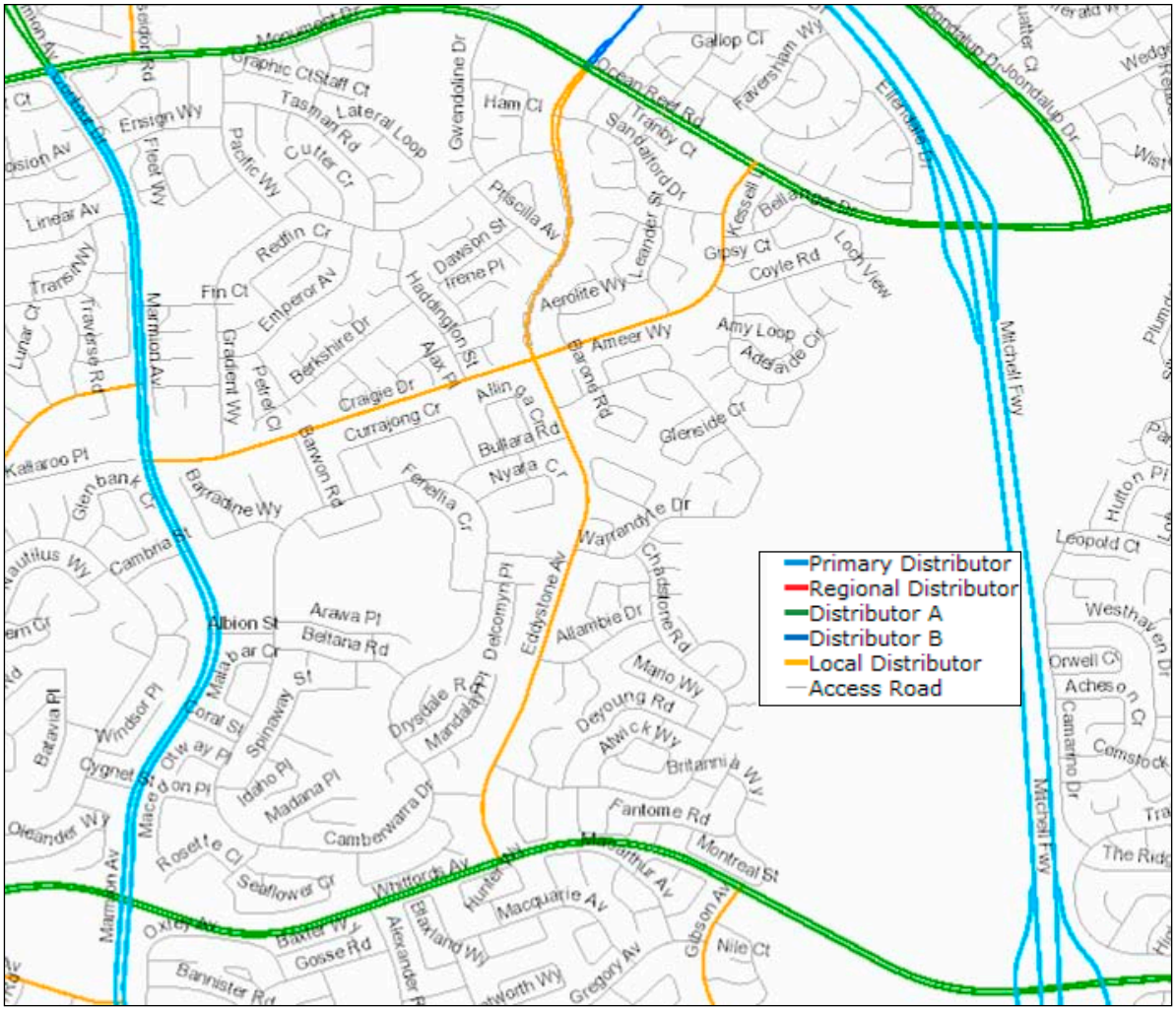

Figure 3.2: Road Hierarchy of Surrounding Road Network

Source: Main Roads Functional Road Hierarchy

3.3 TRAFFIC VOLUMES

The latest available traffic counts for the sounding road network were sourced from the City of Joondalup. **Table 3.1** summarises the existing available data.

Location	Date	AWT	AM Peak		PM Peak	
			Hour	Vol	Hour	Vol
Camberwarra Dr, west of Barwon Rd	05/12	1,865	8-9am	303	3-4pm	314
Camberwarra Dr, north of Arawa Pl	05/12	1,889	8-9am	386	3-4pm	351
Craigie Dr, east of Barwon Rd	12/12	3,243	8-9am	322	3-4pm	347
Craigie Dr, west of Eddystone Ave	12/12	3,857	8-9am	364	3-4pm	394
Eddystone Ave, south of Perilya Rd	02/09	6,763	8-9am	511	5-6pm	712
Eddystone Ave, north of Warrandyte Dr	02/09	7,666	11am-12pm	589	5-6pm	761
Eddystone Ave, north of Bullara Rd	02/09	8,177	11am-12pm	643	5-6pm	793
Eddystone Ave, south of Craigie Dr	02/09	8,336	11am-12pm	674	5-6pm	819
Barwon Rd, south of Craigie Dr	04/08	1,684	8-9am	299	3-4pm	242
Perilya Rd, west of Eddystone Ave	02/09	2,688	11am-12pm	275	5-6pm	281

Table 3.1: Existing Daily Traffic Flows for the Surrounding Road Network

Source: City of Joondalup

4 VEHICLE TRANSPORT NETWORK

4.1 INTERNAL ROAD NETWORK

4.1.1 Layout

The proposed road network is shown in **Figure 4.1**. As the proposed roads are yet to be named, the identifying names as per **Figure 4.1**have been adopted for use in this assessment. The two internal roads of the subdivision simply connect in a north-south orientation between Camberwarra Drive and Currajong Crescent. The nature of the road layout is such that minimal external traffic is likely to use the newly created roads with the exception being local traffic whose origin/destination is Currajong Crescent itself.

Figure 4.1: Internal Road Network and Identifying Names
Source: Taylor Burrell Barnett

A number of residential properties abutting the public open space will not have direct street frontage. Detailed design will need to give consideration to garbage collection from these properties via rear the laneway. Turning movements into/out of the laneway on the garbage route needs to be considered at the detailed design stage of the lots to ensure appropriate truncations are allowed for.

4.1.2 Road reservation width

The road reserve widths of Road 1 and Road 2 are typically 15m. This width is consistent with the range of 14.2m to 24m suggested in *Liveable Neighbourhoods* (WAPC 2009) as indicative reserve widths for access streets (those that accommodate shared pedestrian, bike and vehicle movements). The lower reserve width is generally for short, low volume, and low parking demand streets. The higher reserve width allows for a median and/or additional road features such as parking and paths to be incorporated. It is noted that the reserve width is reduced locally immediately adjacent to the public open space being 13m, with a 2.5m verge along the public open space. This is achievable through the reduced verge width allowance in *Liveable Neighbourhoods* for only 1m adjacent to parks.

The laneway is proposed to have a road reservation width of 6m which is also in line with the guidelines as suggested by in *Liveable Neighbourhoods* (WAPC 2009).

4.1.3 Road cross sections and speed limits

All roads within the structure plan are likely to carry less than 1,000 vehicles per day hence would be defined as access roads. It would therefore be considered appropriate to adopt a narrow yield access street cross section with typically a 6m wide pavement. **Figure 4.2** shows a sample cross section of an access road as outlined in *Liveable Neighbourhoods* (WAPC 2009) that would be suitable for a road reservation width of 14.2m similar to the roads within the Structure Plan.

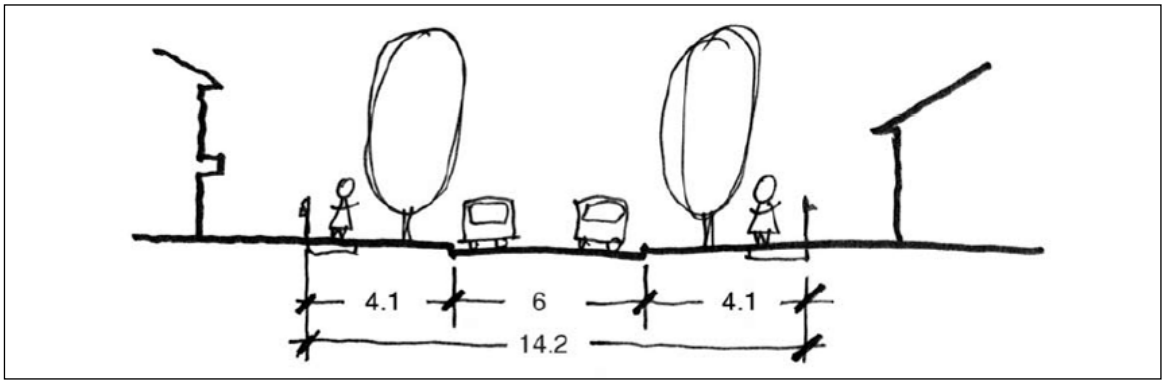

Figure 4.2: Sample Road Cross Section Narrow Yield Access Street, 40km.hr, <1000vpd
Source: Liveable Neighbourhoods WAPC (2009)

No additional parking embayments are proposed within the structure plan. It is envisaged that the park is more likely to be used by residents within the structure plan and the immediate surrounds who are within walking distance. Visitors to the structure plan are more likely to be visiting residents than the park hence a significant on street parking demand would not be present.

The existing parking embayments currently located along Camberwarra Drive and Currajong Crescent are no longer considered necessary. The detailed design should consider maintaining some existing on street parking embayments along Currajong Crescent in the vicinity of the group dwelling site to accommodate visitor parking demand.

Figure 4.3 shows a sample cross section for a rear laneway.

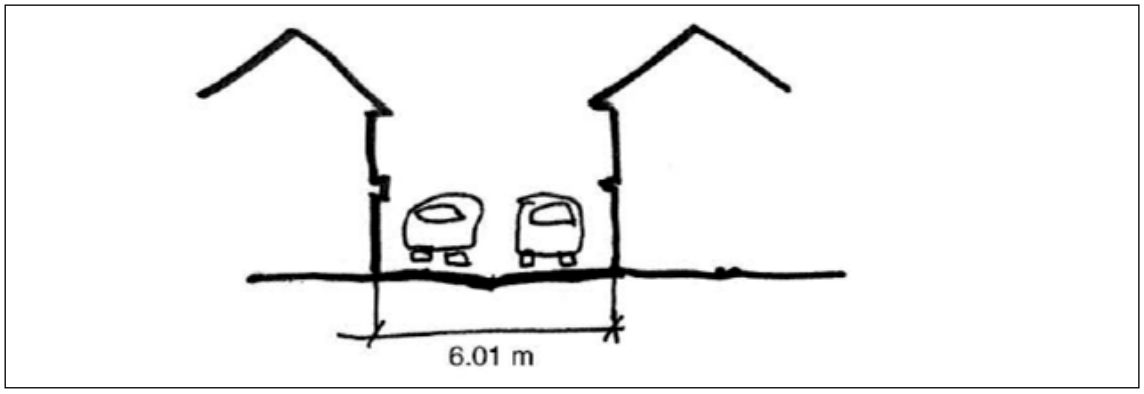

Figure 4.3: Sample Road Cross Section Laneway Rear Access
Source: Liveable Neighbourhoods WAPC (2009)

The proposed speed limit is 50km/h, as per the requirement in built up areas. It should be noted however the target speed as defined by Liveable Neighbourhoods with respect to the cross sections is 40km/h.

4.1.4 Intersection controls

The proposed internal road network results in the creation of one internal intersection within the subdivision. This being the laneway with Road 1. A priority T junction is the proposed form of control at this intersection.

4.2 EXTERNAL ROAD NETWORK

4.2.1 Connections to the external road network

The structure plan will connect to the existing road network via five new locations:

- Currajong Crescent and Road 1;
- Currajong Crescent and Road 2;
- Camberwarra Drive and Road 1;
- Camberwarra Drive and Road 2; and
- Argus Close and laneway.

A priority T junction is the proposed form of control for each of these intersections with all vehicle movements being permitted.

Potential sight lines from the proposed intersection connections were observed on site as shown in **Photos 9 to 12**. The sight lines are good and are appropriate within the residential environment.

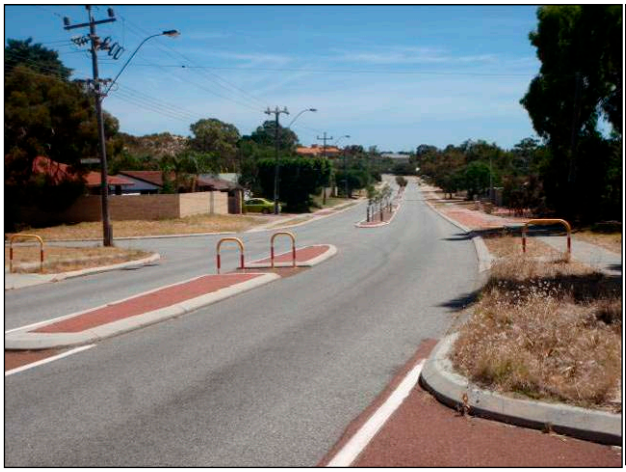

Photo 9: Approximate sight lines from Road 1 along Camberwarra Dr to the west

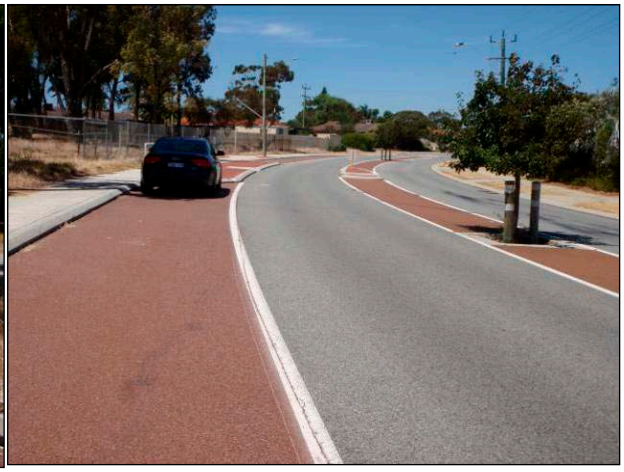

Photo 10: Approximate sight lines from Road 1 along Camberwarra Dr to the east

Photo 11: Approximate sight lines from Road 2 along Camberwarra Dr to the west

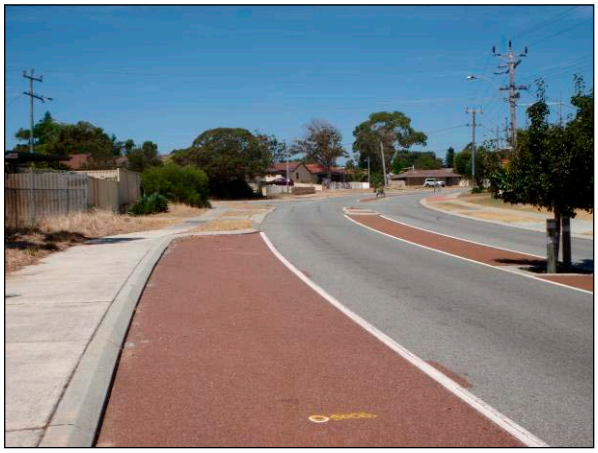

Photo 12: Approximate sight lines from Road 2 along Camberwarra Dr to the east

4.2.2 Changes proposed by the City of Joondalup

Current planning by the City of Joondalup does not propose any changes to the road network in this area.

5 ANALYSIS OF TRANSPORT NETWORKS

5.1 ASSESSMENT PARAMETERS

The transport assessment has been undertaken assuming full development of the structure plan.

5.2 STRUCTURE PLAN GENERATED TRAFFIC

The traffic generated by the proposed structure plan was forecast using rates suggested in the *WAPC*'s document "*Transport Assessment Guidelines for Developments"* (2006). These rates are based on the Perth and Regions Travel Survey (PARTS) data averaged over the range of dwelling types. The rates adopted are:

- 0.8 vehicles trips per dwelling for the am and pm peak hours

The peak is typically accepted to represent 10% of the daily traffic hence the daily trip generation rate is assumed to be 8 trips per dwelling.

There are a total of approximately 40 lots of which 1 is a grouped dwelling that may contain up to 13 dwellings and the remaining lots are all single dwellings. Hence there will be a total of approximately 52 dwellings within the structure plan area.

On this basis, it is estimated that there will be 416 daily trips (and 42 peak hour trips) generated within the structure plan site.

5.3 NON SUBDIVISION TRAFFIC

Minimal non subdivision traffic is expected to pass through the newly created Roads 1 and 2 within the proposed subdivision due to the overall layout of the adjoining road network. The only external non subdivisional traffic that may be likely to use Roads 1 and 2 are those whose origin/destination is to an existing dwelling located on the northern side of Currajong Crescent. This equates to approximately 19 dwellings. It is assumed that only half of the dwelling traffic would use either Road 1 or 2. Hence for the assessment an additional volume of 80 vehicles per day would travel along Road 1 and 2 external to that generated by the newly created lots.

5.4 DESIGN TRAFFIC FLOWS

Of the generated traffic, 208 vehicle movements are assumed to be inbound and 208 vehicle movements are assumed to be outbound.

The resulting additional trip assignment at the external connections to the existing road network are shown in **Figure 5.1.**

The following trip distribution patterns have been assumed after giving consideration to various trip purposes and the surrounding land uses:

- 30% in a westerly direction along Camberwarra Dr
- 70% is a easterly direction along Camberwarra Dr or Bullara Road

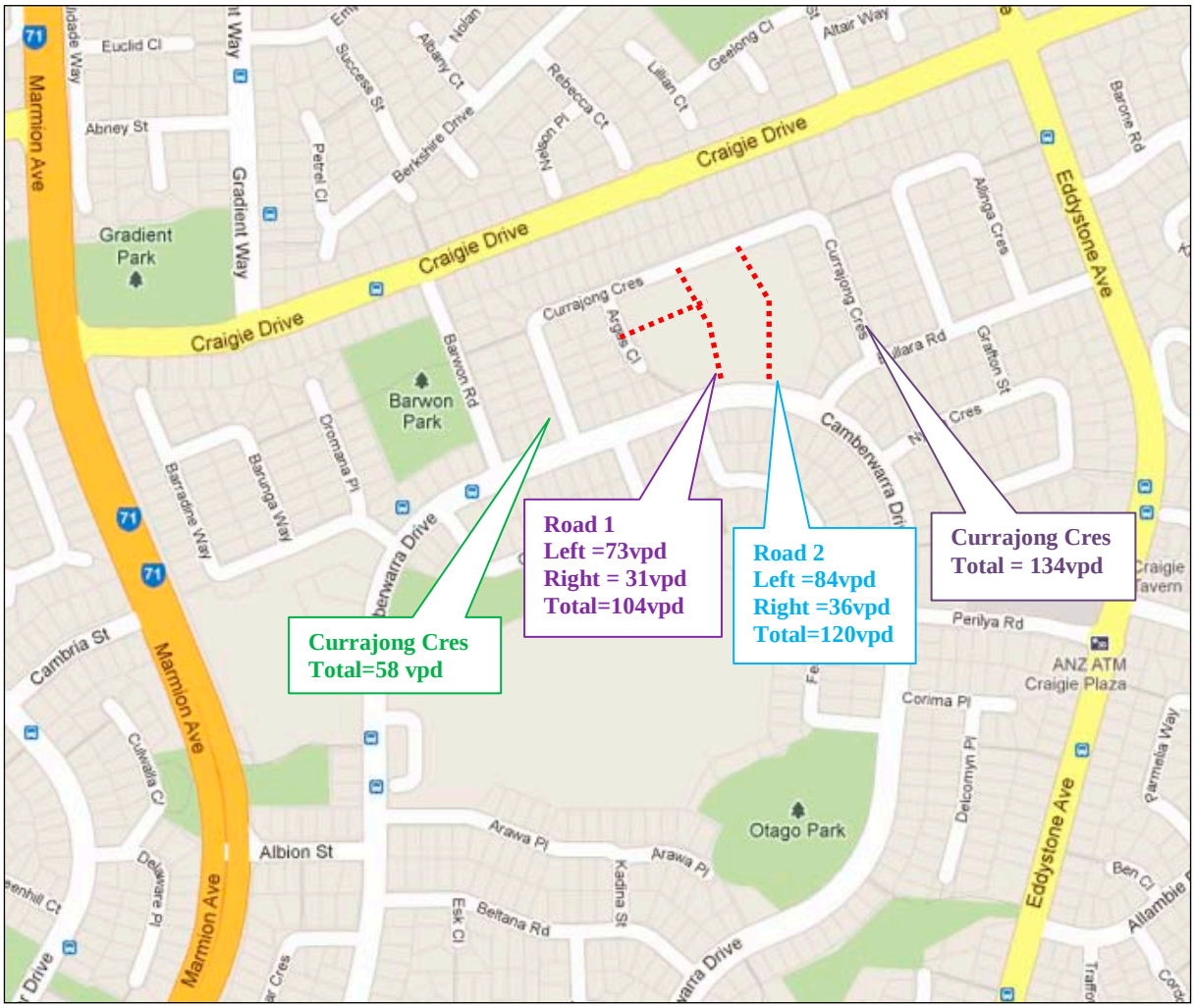

Figure 5.1: Additional Daily Traffic Volume

5.5 ROADS AND INTERSECTIONS

5.5.1 Roads internal to subdivision

The structure plan is expected to generate an average of approximately 416 vehicle trips per day. The indicative maximum volume of traffic suitable for an access street varies from 3,000 vehicles per day based on a pavement width of at least 7.2m and 1,000 vehicles per day based on a pavement width of 5.5-6m. (*Liveable Neighbourhoods, WAPC 2009*) The design traffic flows suggest that Road 1 and 2 with carry in the order of 104 and 120 vehicles per day. Currajong Crescent near Camberwarra Drive (west) will carry an additional 58 vehicles per day while the Currajong Crescent and Bullara Road intersection to the east will carry an additional 134 vehicles per day.

This traffic assessment confirms that all roads are expected to carry traffic volumes appropriate for roads as defined for access roads in accordance with the guidelines provided by *Liveable Neighbourhoods* (WAPC 2009).

5.5.2 Camberwarra Drive

Camberwarra Drive, west of Barwon Road carries in the order of 1,865 vehicles per day. (AWT, May 2012). Camberwarra Drive is constructed to a two lane single carriageway standard with a painted median. According to the *Main Roads functional hierarchy* Camberwarra Drive is classified as an *Access Road*. Camberwarra Drive is likely to be defined by *Liveable Neighbourhoods* as a *Neighbourhood Connector* due to its function connecting to numerous access roads as well as forming part of a bus route however volumes are in line with an *Access Road.*

Liveable Neighbourhoods (2009) suggests the indicative maximum volume for a Neighbourhood Connector ranges from 3,000 to 7,000 vehicles per day or for an *Access Road* 3,000vpd.. The existing volume on Camberwarra Drive, in the vicinity of Barwon Road is 1,865 vehicles per day approximately 38-73% below this level. Hence the estimated additional traffic of 125-157 vpd at various locations likely to use Camberwarra Drive can be accommodated within the spare capacity of the roadway and the resultant traffic volumes on Camberwarra Drive will remain in line with the road classification.

5.5.3 Bullara Road

No existing volumes are available for Bullara Road however it is anticipated that they would be comparable to those along Camberwarra Drive in this vicinity as outlined in section 5.5.3. Similarly to Camberwarra Drive, in accordance with *Main Roads functional hierarchy* Bullara Road is classified as an *Access Road* while it is likely to be defined by *Liveable Neighbourhoods* as a *Neighbourhood Connector or Access Road.*

The additional trips estimated to be 291vpd can be catered for adequately within the additional spare capacity of the roadway and would also be in line with the road classification.

5.5.4 Argus Close

The proposed laneway connection will result in some increase in traffic along Argus Close. There are 8 residential dwellings that will require access to their properties via the laneway. Assuming that 30% of traffic will typically be attracted to the west with the majority of 70% attracted to the east it is reasonable to assume that up to 30% of these residential trips may use Argus Close. This would equate to 19 vehicles per day or 2 trips in the peak hour. This is considered acceptable for the cul-de-sac road and is likely to be considerably less than that experienced within Argus Close during the operation of the Primary School.

5.5.5 Intersection of Camberwarra Drive/Road 1 and Camberwarra Drive/Road 2

Austroads *Guide to Traffic Management* provides advice on the capacity of unsignalised intersections. For minor roads where there are relatively low volumes of turning traffic, capacity considerations are usually not significant and capacity analysis is unnecessary. Intersection volumes below which capacity analysis is unnecessary are indicated in **Table 5.1**.

Type of road	**Light cross and turning volumes maximum design hour volumes (vehicles per hour (two way))**		
Two lane major road	400	500	650
Cross road	250	200	100

Table 5.1: Intersection volumes below which capacity analysis is unnecessary
Source: Austroads 2009

The intersection of Camberwarra Drive with Road 1 and Road 2 will function as the main access/egress point to/from the proposed structure plan. Camberwarra Drive currently carries in the order of 1,865 vpd (AWT, May 2012) with corresponding maximum am and pm peak hour flows of 303/314 respectively. Road 1 and Road 2 are expected to carry in the order of 104/120 vehicles per day or 10-12 vehicles in the peak hour.

As indicated by the table, if Camberwarra Drive has a volume of 400 vehicles per hour during the peak period, the cross road Road 1 and Road 2 (i.e. road into/from the subdivision) can service a volume in the order of 250 before capacity analysis of the intersection is warranted. At an expected 10-12 vehicles, Road 1 and Road 2 is 96% below this level.

The Camberwarra Drive intersections will carry the most traffic in comparison to all other intersections (i.e. Currajong Crescent) within the structure plan. Accordingly, a capacity analysis is also not warranted for the other intersections.

From this assessment, it is concluded the proposed intersections have adequate capacity to cater for the expected traffic flows.

6 PUBLIC TRANSPORT ACCESS

6.1 NEAREST BUS/TRAIN ROUTES AND STOPS

The subject site has good access to public transport. The existing Transport bus route 463 and 464 travel along Camberwarra Drive, to the west of the structure plan and Eddystone Avenue, to the east of the structure plan respectively servicing the Whitfords and Joondalup Train Stations. Refer **Figure 6.1.**

The existing Transperth bus route 463 in the vicinity of the site has stops on Camberwarra Drive, west of Barwon Road while bus route 464 has stops on Eddystone Avenue, south of Craigie Drive.

Figure 6.1: Bus Routes Local to the Subject Site

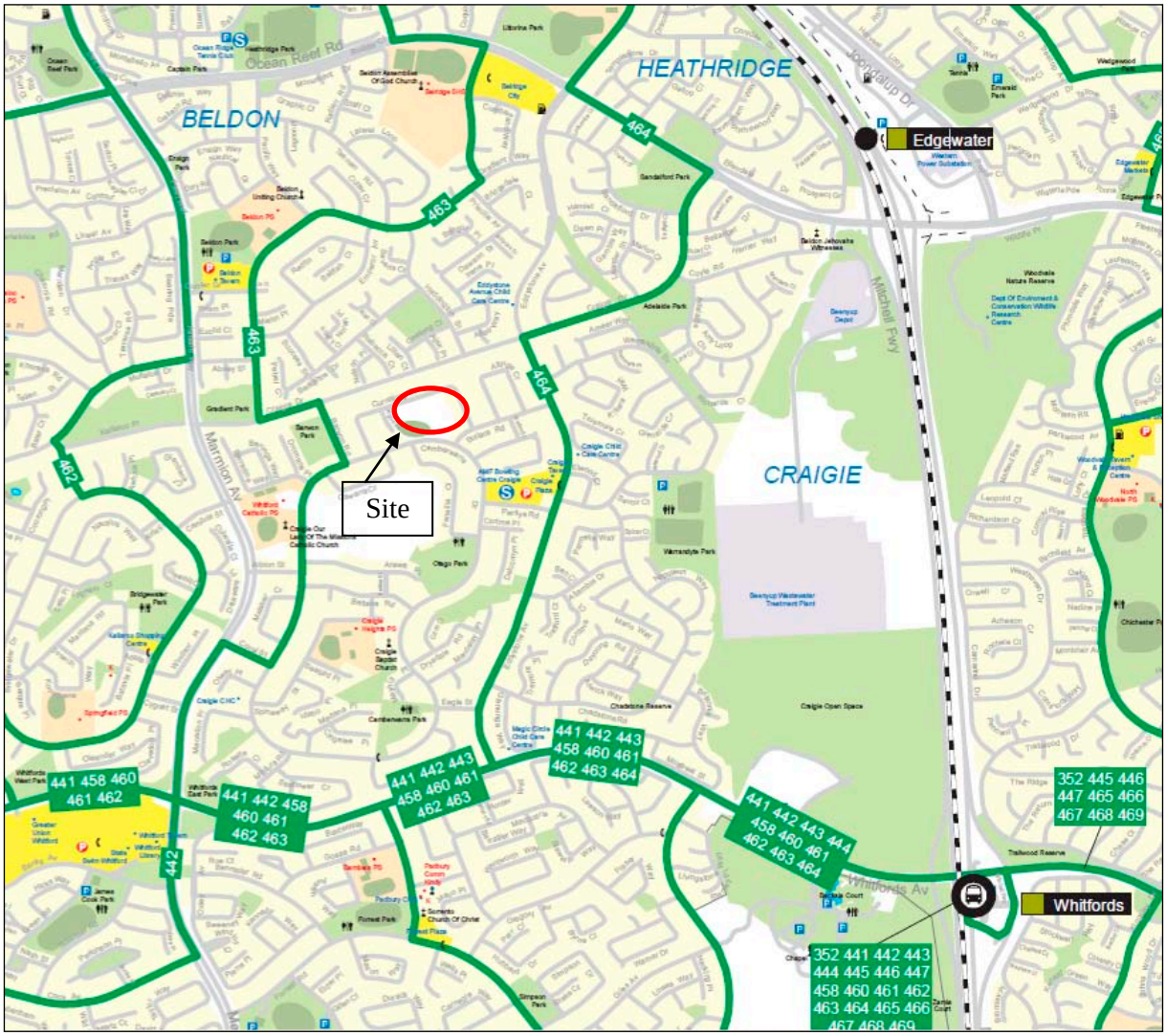

Figure 6.1: Bus Routes Local to the Subject Site
Source: Transperth Bus Network Maps

6.2 PEDESTRIAN/CYCLE ROUTES TO BUS/TRAIN STOPS

The walking distance from the new dwellings to the existing bus stops locations on Camberwarra Drive or Craigie Drive (route 463) and on Eddystone Avenue (route 464) is 400-500m. This is equivalent to a 5 minute walk.

7 PEDESTRIAN AND CYCLE ACCESS FACILITIES

7.1 EXISTING FACILITIES SURROUNDING THE SITE

There are existing footpaths on both sides of Camberwarra Drive. Typical widths are 1.2m however immediately adjacent to the site the footpath is widened locally to accommodate the increased pedestrian usage during the operation of the school. Camberwarra Drive has been classed as *medium road riding environment* by the Department for Planning and Infrastructure.

There is an existing 2.0m wide footpath located on the southern side of Currajong Crescent adjacent to the site. Pedestrian links from Currajong Crescent connect through to Craigie Drive, Barwon Rd and Allinga Crescent.

Eddystone Avenue to the east of the site forms part of the Perth Bicycle Network (PBN) designated as route NW1

Figure 7.1 shows the existing cycling facilities in the vicinity of the site.

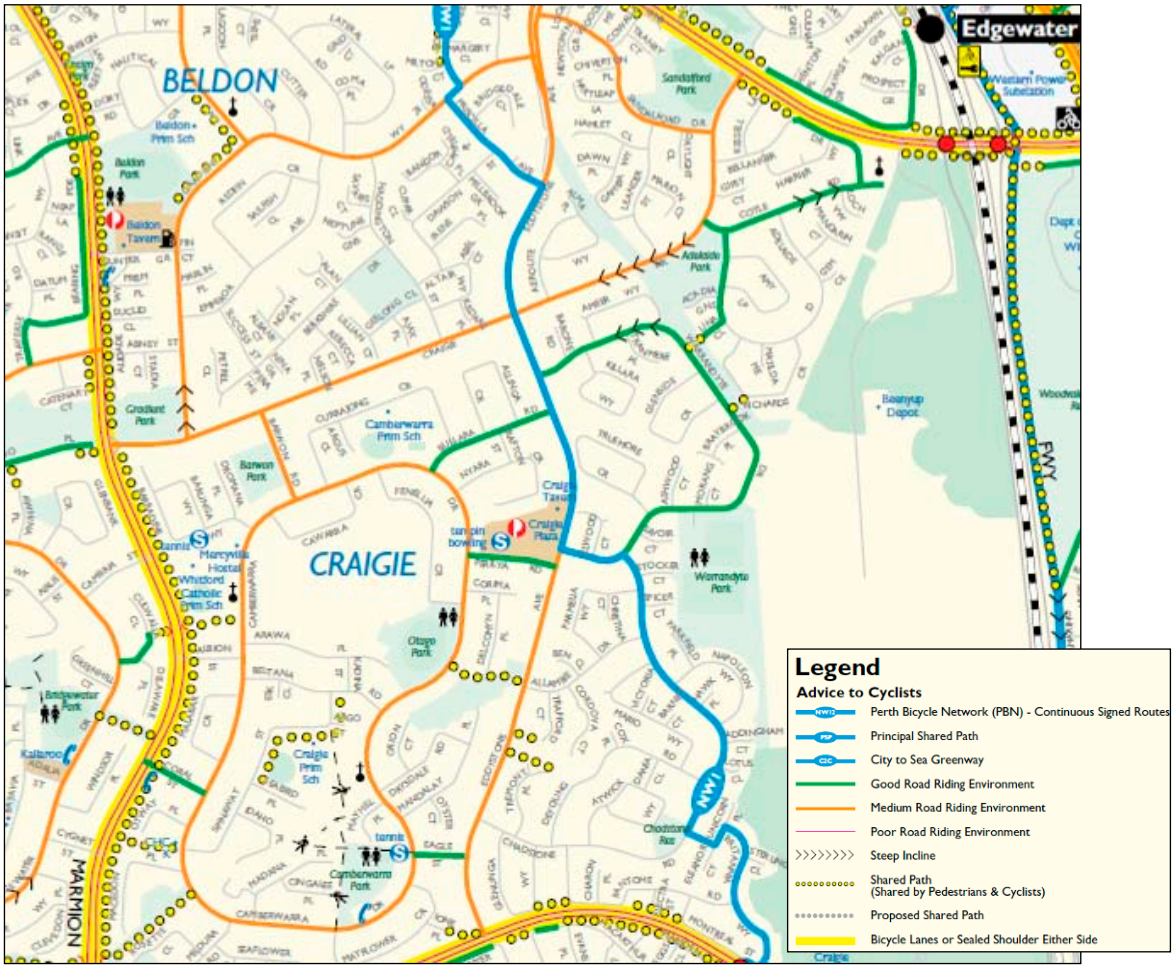

Figure 7.1: Existing Cycling Facilities in the vicinity of the Site

Source: Perth Bike Map Series

7.2 PROPOSED FACILITIES

The structure plan has yet to propose a network of shared use paths to facilitate cyclist and pedestrian movements hence the following recommendations for incorporation are made:

- Provide as a minimum a path along at least one side of Road 1 and Road 2; and
- Pedestrian ramps along Camberwarra Drive and Currajong Crescent as appropriate to facilitate crossing Roads 1 and 2 Link to the roundabout at Bertram Road and Johnson Road.

8 CONCLUSIONS

The Structure Plan for the old Camberwarra Primary School site, proposes residential living zoning of R25-R40 with Public Open Space. Based on an indicative lot layout it is estimated that the total number of lots created may be approximately 40, with one lot being a grouped dwelling site approximately 52 additional residential dwellings are proposed.

The subject site is bordered by three existing roads, being, Camberwarra Drive, Currajong Crescent and Argus Close. Major arterial roads within close proximity include the Mitchell Freeway to the east, Marion Avenue to the west and Ocean Reef Road to the north and Whitfords Avenue to the south.

The two internal roads of the subdivision simply connect in a north south orientation between Camberwarra Drive and Currajong Crescent. The nature of the road layout is such that minimal external traffic is likely to use the newly created roads with the exception being local traffic whose origin/destination is Currajong Crescent.

A number of residential properties abutting the public open space will not have direct street frontage. Detailed design will need to give consideration to garbage collection from these properties via rear laneways. Turning movements into/out of the laneway on the garbage route needs to be considered at the detailed design stage of the lots to ensure appropriate truncations are allowed for.

The internal road network of the proposed structure plan is consistent with the recommendations of *Liveable Neighbourhoods* with regards to road reservation widths. The volume of traffic expected to be generated by this development is 416 vehicles per day with 42 peak hour trips distributed mainly over Road 1 and 2. The expected volumes are within the capacity of the roads and intersections. The additional traffic generated by the development can be accommodated by Camberwarra Drive, Currajong Crescent and Bullara Road with spare capacity. The forecast traffic movements at the intersections are below those that require capacity analysis to occur.

Road cross sections are yet to be proposed however the following recommendations are made:

- New internal roads to adopt a narrow yield access street cross section with 6m wide pavements;
- Maintain some on street parking embayments as appropriate along Currajong Crescent to service group dwelling site; and
- Removal of redundant on street parking embayments along Camberwarra Drive and Currajong Crescent.

The structure plan has yet to propose a network of shared use paths to facilitate cyclist and pedestrian movements hence the following recommendations for incorporation are made:

- Provide as a minimum a path along at least one side of Road 1 and Road 2; and
- Pedestrian ramps along Camberwarra Drive and Currajong Crescent as appropriate to facilitate crossing Roads 1 and 2 Link to the roundabout at Bertram Road and Johnson Road.

The Structure Plan proposal is supported by the findings of this Transport Statement and there are no identified traffic related issues to be addressed other than those stated above. We therefore recommend approval of the proposal from a traffic perspective.

APPENDIX 5
GEOTECHNICAL REPORT

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Proposed Residential Development
Camberwarra Primary School Site
Camberwarra Drive, Craigie

Prepared for
JDSi Consulting Engineers Pty Ltd

Project 82006
February 2013

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

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1	1	1	Mr. David Hellmuth, JDSi Consulting Engineers Pty Ltd

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author	C. Cigulev	25/2/2013
Reviewer	F. Verheyde	25/02/2013

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Table of Contents

Report on Geotechnical Investigation
Proposed Residential Development
Camberwarra Drive, Craigie

1. Introduction

This report presents the results of a geotechnical investigation undertaken by Douglas Partners Pty Ltd (DP) for a proposed residential development at the former Camberwarra Primary School site, Camberwarra Drive in Craigie, Western Australia. The investigation was commissioned in an email dated 20 December 2012 by Mr David Hellmuth of JDSi Consulting Engineers Pty Ltd, and was undertaken in accordance with DP's proposal dated 5 December 2012.

The purpose of this geotechnical investigation was to determine the subsurface conditions beneath the site and thus:

- Provide a description of the sub-soil conditions including identification of areas of uncontrolled fill.
- Provide an appropriate site classification in accordance with the requirements of AS 2870-2011 and requirements to improve the classification, if required.
- Provide recommendations and comments on site preparation, including suitability of excavated material for re-use as fill and compaction. This is also to include recommendation on the appropriate "bulking factor" associated with a density of 90% and 95% MMDD.
- Provide suitable parameters for pavement design, including an indicative California bearing ratio based on field observations and limited laboratory testing.
- Suggest appropriate foundation system(s) for the proposed structures, and provide an allowable bearing capacity and an estimate of the likely settlement.
- Assess the permeability of the soils at nominated locations and comment on suitability for onsite stormwater disposal.
- Assess the groundwater level beneath the site at the time of investigation, if encountered.
- Comment on the risk of acid sulphate soils based upon the results on the geotechnical investigation and readily available desktop information and provide a recommendation for site testing for acid sulphate soils.

The investigation included the excavation of 14 test pits, the performance of three cone penetration tests (CPT), two permeability tests and the laboratory testing of selected samples. The details of the field work are presented in this report, together with comments and recommendations on the issues listed above.

2. Site Description

The site is identified as the former Camberwarra Primary School, Camberwarra Drive in Cragie and comprises an irregular shaped area of approximately 6.8 ha. The site is bound by Currajong Crescent to the north-west, houses to the east, Camberwarra Drive to the south and Argus Close and houses to the south-west (Refer to Drawing 1, Appendix A). It is understood that the Camberwarra Primary School formerly occupied the site.

At the time of the investigation, the buildings of the former primary school had been demolished. The footprints of the former buildings were generally covered with sand, with some demolition rubble and remnants of buried services observed at the surface. Part of a bitumen road and car park which originated from Currajong Crescent to the north-west of the site, were present at the time of investigation. Groups of trees between 4 m and 15 m in height were present around the boundaries of the site and former oval and in between the footprints of the former school buildings. To the south-west of the site where the oval previously existed, the surface was covered with grass.

The topography of the site is hilly with the surface level generally falls from a maximum of approximately RL 37.7 m AHD in the north-east of the site to RL 30 m AHD in the north-west and RL 23.9 m AHD in the south of the site, according to a survey plan produced by McMullen Nolan.

The Fremantle 1:50 000 Geology sheet indicate that shallow sub surface conditions beneath the site comprise sand derived from Tamala Limestone.

The Perth Groundwater Atlas (2004) indicates that in May 2003 the groundwater level was approximately 3 m AHD (approximately between 22 m to 33 m below the existing surface level in May 2003).

Published acid sulphate soil risk mapping indicates that the site is located within areas of “no known risk of acid sulphate soils within 3 m of natural soil surface”.

3. Field Work Methods

Field work was carried out on 17 January 2013 and comprised the excavation of 14 test pits with adjacent Perth sand penetrometer (PSP) tests, the performance of three CPTs and two in situ permeability tests.

The test pits (TP4 to TP17) were excavated to a maximum depth of 3.0 m, using a 5 tonne excavator equipped with a 450 mm wide flat bucket, and logged in general accordance with test procedure AS 1726–1993, by a suitably experienced representative from DP. Soil samples were recovered at selected locations for subsequent geotechnical laboratory testing.

The PSP tests were carried out in general accordance with the method described in AS 1289.6.3.3, to a maximum depth of 5.15 m below the surrounding ground level, to assess the in situ density of the shallow soils.

The CPTs (CPT1 to CPT3) were carried out by using a 36 mm diameter instrumented cone with a following 130 mm long friction sleeve attached to rods of the same diameter, pushed continuously at a

rate of 20 mm/sec into the soil by hydraulic thrust from a ballasted truck mounted rig. Strain gauges in the cone and sleeve measure resistance to penetration and friction along the sleeve. This data is recorded on a computer and analysed to allow the assessment of the type, properties and condition of the materials penetrated.

The permeability tests were performed at locations nominated by the client using the falling head method, and were undertaken at depths of 4.0 m and 5.0 m below the surrounding ground level, within hand augered boreholes, BH18 and BH19, within excavated trenches.

Test locations were determined using hand held GPS and existing site features, and are shown on Drawing 1. Surface elevations at each test location were interpolated from a survey plan produced by McMullen Nolan and are quoted in metres above Australian Height Datum (AHD) on the test pit logs and CPT results (Appendix B).

4. Field Work Results

4.1 Ground Conditions

Detailed logs of the ground conditions and results of the field testing are given in Appendix B, together with notes defining descriptive terms and classification methods.

A summary of the ground conditions encountered at the test locations is given below in increasing depth order:

- **Topsoil –** brown and grey, generally silty sand topsoil filling with a trace of roots and rootlets, generally to depths of between 0.05 m and 0.1 m at TP4 to TP14, TP16, TP17, BH18 and BH19.
- **Filling (Sand)** – generally well compacted, brown and grey, sand filling was observed at CPT1 to CPT3, TP4, TP5, TP7 to TP9, TP11, TP12, TP14, TP15 to TP17, BH18 and BH19 from the surface or underlying the topsoil and extending to depths of between 0.1 m and 2.6 m. Some demolition rubble including gravel and cobble sized fragments of concrete, tile, brick and limestone and former services including PVC pipes, an electrical conduit/cable, a stormwater pipe and a soak well were excavated at TP4, TP5, TP8, TP9, TP15, TP16 and BH19 within this sand filling layer. Loose material was identified between 0.95 m and 1.1 m at CPT3.
- **Sand –** medium dense to very dense near ground surface surface, becoming medium dense with depth, yellow-brown, fine to medium grained sand with a trace of silt, underlying the topsoil and filling to test pit termination depths of up to 3.1 m and CPT depths of up to 6.1 m. Limestone pinnacles were observed within this layer from depths of between 1.3 m and 2.5 m at TP9, TP13 and TP15.
- **Limestone –** hard ground conditions, inferred to be limestone, were encountered at CPT locations CPT1 and CPT3 between depths of 3.65 m and 6.2 m. Limestone pinnacles protruding into the overlying sand layer are noted above. The depth and level of encountered limestone is summarised in Table 1 below.

Table 1: Depth and Level of Encountered Limestone

Test	Ground Surface Elevation (RL m AHD)	Depth to Limestone (m)	Inferred Limestone Elevation (RL m AHD)	Estimated Rock Strength	Comments
CPT1	36.3	4.0	32.3	-	
CPT3	33.3	6.28	27.02	-	
TP9	36.0	1.3	34.7	Very Low to Low	Limestone pinnacle from 1.3 m depth; Base of pinnacles not encountered to base of test (3 m)
TP13	26.5	2.5	24.0	Very Low to Low	Limestone pinnacle from 2.5 m depth; Base of pinnacles not encountered to base of test (3 m)
TP15	33.9	1.4	32.5	Very Low to Medium	Limestone pinnacle from 1.4 m depth; Refusal on limestone at 2.2 m depth

Exceptions to the above mentioned soil profile are as follows:

- **Filling (Sandy Gravel)** - light grey, blue-grey, fine to coarse sized sandy gravel filling from the surface to a depth of 0.2 m was observed at TP9. This layer is presumed to the surface asphalt layer of a former car park which has been partly stripped.
- **Basecourse (Crushed Limestone) –** crushed limestone from a depth of 0.05 m to a depth of 0.2 m was observed at TP7.

4.2 Groundwater

No free groundwater was observed within the test pits excavated to depths of up to 3.0 m below surface level (RL 24.1 m AHD), boreholes drilled to depths of up to 5.0 m below the surface level (RL 21.0 m AHD) and within the CPT holes to depths of 6.3 m (RL 27 m AHD) on 17 January 2013. The test pits and test holes were immediately backfilled following the investigation, which precluded longer-term monitoring of groundwater levels.

4.3 In Situ Permeability Testing

In situ permeability tests were carried out at depths of 5.0 m (RL 21.1 m AHD) and 4.0 m (RL 22.1 m AHD) within boreholes drilled (BH18 and BH19) in excavated trenches 2.0 m below surface level. Field permeability values were estimated using the Hvorslev method (1951). Permeability values were also derived using grading results from the laboratory testing and Hazen's formula which applies for sand in a loose state. Results of the permeability analysis are summarised in Table 1.

Table 1: Summary of the In Situ Permeability Testing and Derived Values

Test	Depth (m)	Measured Permeability (m/s) [1]	Derived Permeability (m/s) [2]	Material
BH18	5.0	3.3×10^{-4}	2.0×10^{-4}	Sand with a some silt
BH19	4.0	4.9×10^{-5}	2.6×10^{-4}	Sand with a trace to some silt

Notes for Table 1: - [1]: Horslev's method.
- [2]: Hazen's method.

5. Geotechnical Laboratory Testing

A geotechnical laboratory testing programme was carried out by a NATA registered laboratory and comprised the determination of the particle size distribution of four samples.

The detailed test report sheets are given in Appendix C, with the results summarised in Table 2 below.

Table 2: Results of Geotechnical Laboratory Testing

Test	Depth (m)	Fines (%)	d_{10} (mm)	d_{60} (mm)	Material
TP8	0.5	3	0.16	0.41	Sand filling with some rubble and a trace of silt
BH18	5.0	6	0.14	0.34	Sand with some silt
BH19	4.0	5	0.16	0.41	Sand with a trace to some silt

Notes for Table 2: - The % fines is the amount of particles smaller than 75 µm.
- A d_{10} of 0.17 mm means that 10% of the sample particles are finer than 0.17 mm.
- A d_{60} of 0.44 mm means that 60% of the sample particles are finer than 0.44 mm.

6. Proposed Development

The proposed development is understood to comprise 45 new lots with associated access roads and drainage basin.

7. Comments

7.1 Site Suitability

The investigation indicates that the site is generally underlain by a profile consisting of sand and sand filling overlying limestone, as described in Section 4.1 above.

From a geotechnical standpoint, the land is physically capable of development for residential lots, provided that the provisions outlined in the subsequent subsections of the report are taken into consideration.

7.2 Site Classification

The shallow ground conditions beneath the site generally comprise well compacted sand filling, uncontrolled in areas, overlying medium dense to very dense natural sand and limestone. Due to the presence of apparently uncontrolled filling, and in strict accordance with AS 2870-2011, a site classification 'P' applies for the site. It is considered that a classification 'A' should be achievable for the entire site, provided site preparation is carried out as outlined in Section 7.3.

7.3 Site Preparation

All deleterious material including topsoil, tree roots, and any particles larger than 150 mm in size should be stripped from the proposed development areas of the site. Tree roots remaining from any clearing operations should be completely removed and the excavation backfilled with sand and suitably compacted. It is recommended that backfill be placed in loose lift thickness of not more than 300 mm and compacted to achieve a minimum blow count of 8 blows per 300 mm penetration using a PSP in accordance with test method outlined in AS 1289.6.3.3

It is noted that sandy gravel basecourse material and a partly stripped asphalt layer of a former car was observed during the fieldwork at test locations TP7 and TP9, respectively. Such materials should be stripped prior to excavation of foundations and/or to any cut/fill works and removed from site.

As noted in Sections 4.1 and 7.2, filling containing variable contents of deleterious material was observed across the site.

Within parts of the site other than the former oval, it is recommended that the existing filling be excavated to its base and screened or similarly processed to remove all large particles and deleterious items, including but not limited to remnant buried services and soak wells. The use of a screening plant, a grid or an excavator fitted with a screened bucket is suggested for this task. It is

recommended that the material be stockpiled and inspected by a suitably experienced geotechnical engineer following screening and prior to re-use as structural filling.

The filling encountered at TP11 to TP13, BH18 and BH19 within the location of the former oval, appeared to be well compacted and contain little to no deleterious materials. Therefore, as an alternative to excavating and screening the filling, it is suggested that some inspections and possible testing be carried out by a geotechnical engineer prior or during the bulk earthworks of the project in order to assess the quality of the filling across this area. The objective of the inspections and possible testing is to assess the suitability of the existing filling in its current condition as foundation material, or otherwise the requirement to screen it as detailed in the previous paragraph.

If the above inspections and testing are not carried out to confirm the quality of the filling material which lies within the oval area, then all filling material encountered across the site should be screened or similarly processed as recommended above.

Following removal of unsuitable material, screening and prior to any filling, it is recommended that the subgrade be compacted using a heavy (minimum of 12 tonne deadweight) vibrating smooth drum roller. Any areas that show signs of excessive deformation during compaction should be continually compacted until deformation ceases or, alternatively, the poor quality material should be excavated and replaced with suitable, compacted structural filling to achieve a minimum blow count of 8 blows per 300 mm penetration to a depth of not less than 1.0 m below subgrade level. Compaction control of the sand at the site could be carried out using a PSP in accordance with test method outlined in AS 1289.6.3.3. Care should be taken not to operate heavy plant immediately adjacent to existing buildings and services. It is recommended that the earthworks are undertaken under geotechnical supervision.

It is recommended that a minimum cover of 600 mm of compacted clean sand, free of particles greater than 150 mm in diameter, exists or is placed between in situ rock and earthworks finished levels. The placement of this sand cover will minimise differential settlement, and reduce the requirement for excavation of rock during construction of building footings and services.

During construction, some loosening of the surface sands in foundation excavations is expected. Therefore the top 300 mm in the base of any excavation should be re-compacted using a vibratory plate compactor prior to construction of any footings.

7.4 Reuse of On Site Soils as Structural Filling

It is considered that the materials encountered across the site should be suitable for reuse as structural filling material provided they are free from organic matter and particles greater than 150 mm in size and are prepared with the site preparation procedures outlined in Section 7.3. Imported filling, if required, should comprise free draining cohesionless sand with less than 5% by weight of particles passing a 0.075 mm sieve. The material should be free from organic matter and particles greater than 150 mm in size. It is recommended that sand be placed in loose lift thickness of not more than 300 mm, within 2% of the optimum moisture content, with each layer compacted to achieve a minimum blow count of 8 blows per 300 mm penetration using a PSP in accordance with test method AS 1289.6.3.3.

As a general guide, a bulking factor of between 0.8 and 0.9 is anticipated during compaction of sand from a loose condition to a compacted condition of 90% to 95% MMDD.

Limestone was encountered from a depth of 1.3 m at the test locations (see Table 1, Section 4.1). If excavated, limestone following crushing could form a suitable structural filling material. Based upon the test pits excavated during the investigation, it is considered that the limestone should be able to be crushed to an appropriate size through the excavation and compaction process although a mechanical crusher may be required to bring it down to an acceptable size. Crushed rock materials used for filling should result in a well graded mix of particle sizes to prevent the formation of voids between large particles, and will require geotechnical supervision during placement. Limestone particles, up to say 300 mm in diameter, are considered acceptable in such a well graded fill, provided the material is placed at least 1 m below finished level.

7.5 Excavation Conditions

As noted in Table 1, Section 4.1, limestone was encountered at shallow depths at several locations across the site, although its possible existence at shallower depths than those encountered in this investigation should not be precluded. The strength of the limestone encountered at the test locations was estimated to range from very low strength to medium strength.

Excavation of the limestone will possibly be required during trenching for installation of services and also if cutting of the site is proposed. Consequently, contingency provisions for the excavation of limestone would be advisable. Such provision could include large excavators, tynes, hydraulic rock breakers and rock headers for minor excavations such as trenching, and large dozers, say D10, with heavy rippers for bulk excavation.

7.6 Foundation Design

Shallow foundation systems comprising slab, pad and strip footings should be suitable to support typical residential structures such as houses. Footings of buildings covered by AS 2870-2011 should be designed to satisfy the requirements of this standard for ‘Class A’ conditions, provided that site preparation is carried out as outlined in Section 7.3.

AS 2870-2011 applies to single houses, townhouses and the like classified as Class 1 and 10a under the Building Code of Australia. For buildings not covered by AS 2870-2011, a presumptive allowable bearing pressure of 250 kPa is suggested for foundation design of strip and pad footings founded at a minimum depth of 0.5 m in sand that is medium dense or denser, and provided that site preparation is carried out as outlined in Section 7.3. It is estimated that total and differential settlements will be less than 10 mm. It is recommended that site specific geotechnical investigations are undertaken during the detailed design phase of the larger structures to confirm these values.

7.7 Pavement Design and Construction

Based on the results of the field work and laboratory testing it is suggested that a CBR of 12% should be suitable for the design of flexible pavements on sand subgrade, provided site preparation is carried

out in accordance with recommendations of Section 7.3 and the sand is compacted to achieve a minimum blow count of 8 blows per 300 mm penetration using a PSP in accordance with test method outlined in AS 1289.6.3.3.

Pavements bridging rock and sand may result in differential settlement and possible cracking. Therefore it is recommended that any limestone be over excavated to at least 0.4 m beneath the base of pavement layers.

7.8 Soil Permeability and Stormwater Disposal

The shallow soil conditions beneath the site generally comprise sand, therefore it is considered that stormwater disposal using soakwells and sumps should be feasible at this site where a suitable depth of sand exists over limestone.

Limestone is generally considered impervious at small scale and thus on site stormwater disposal might not be suitable in areas of shallow limestone. A clearance of not less than 0.5 m is suggested between the base of drainage systems and the top of the limestone.

As a general guide, soak wells should be positioned with a clearance of 2 m from all buildings, retaining walls and boundaries. However, a lower clearance may be suitable in specific cases.

Results of the analyses in Section 4.3 indicate field infiltration values of between 4.9×10^{-5} m/s and 3.3×10^{-4} m/s for the sand encountered at depths of 4.0 m (RL 22.1 m AHD) and 5.0 m (RL 21.1 m AHD) at locations nominated by the client. It should be noted that the lower field infiltration value of 4.9×10^{-5} m/s measured at BH19 is considered uncharacteristic for the material encountered and should be discarded. Therefore, a preliminary design permeability value of 1.0×10^{-4} m/s is suggested for natural sand at this site. A lower permeability than that indicated may be appropriate for a long-term design value which takes into account bio build-up, siltation from surface infiltration, and increased compaction of the soils due to possible earthworks.

7.9 Acid Sulphate Soil Risk

The Western Australian Planning Commission (WAPC) in conjunction with the Department of Environment and Conservation (DEC) have prepared a series of acid sulphate soil risk maps targeting high development areas across Western Australia. These risk maps have been prepared on the basis of geological origin, depth to groundwater and partial ground truthing.

The published risk mapping indicates that most of the site is located within an area depicted as being “no known risk of acid sulphate soils within 3 m of natural soil surface”. This risk area generally corresponds to the sand derived from Tamala Limestone geology unit underlying the site.

The ground conditions encountered during the investigation are generally consistent with the published geology and thus support the level of risk depicted on the risk mapping.

8. References

1. Geological Survey of Western Australia (1986), Fremantle 1:50,000 Sheet.
2. Department of Environment, Perth Groundwater Atlas, Second Edition, December 2004.
3. Department of Environment and Conservation (2006) Acid Sulphate Soil Risk Mapping, WA.
4. Australian Standard AS 1289.6.5.1-1999, Methods of testing soils for engineering purposes Determination of the static cone penetration resistance of a soil.
5. Australian Standard AS 2870-2011, Residential Slabs and Footings.
6. Australian Standard AS 1289.6.3.3-1999, Soil Strength and Consolidation Tests-Determination of the Penetration Resistance of a Soil – Perth Sand Penetrometer Test.
7. Australian Standard AS 1726-1993, Geotechnical Site Investigation.

9. Limitations

DP has prepared this report for a residential development at the former Camberwarra Primary School site in Craigie, WA in accordance with DP's proposal dated 5 December 2012 and acceptance received from Mr David Hellmuth of JDSi Consulting Pty Ltd on 20 December 2012. The report is provided for the exclusive use of JDSi Consulting Engineers for this project only and for the purpose(s) described in the report. It should not be used for other projects or by a third party. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be limited by undetected variations in ground conditions between sampling locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Douglas Partners Pty Ltd

Appendix A

About this Report
Drawing 1

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Cone Penetration Tests

Douglas Partners

Introduction

The Cone Penetration Test (CPT) is a sophisticated soil profiling test carried out in-situ. A special cone shaped probe is used which is connected to a digital data acquisition system. The cone and adjoining sleeve section contain a series of strain gauges and other transducers which continuously monitor and record various soil parameters as the cone penetrates the soils.

The soil parameters measured depend on the type of cone being used, however they always include the following basic measurements

- Cone tip resistance q_c
- Sleeve friction f_s
- Inclination (from vertical) i
- Depth below ground z

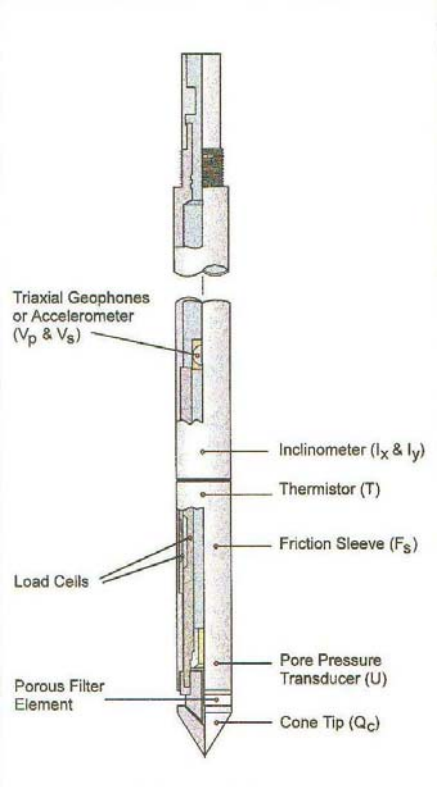


Figure 1: Cone Diagram

The inclinometer in the cone enables the verticality of the test to be confirmed and, if required, the vertical depth can be corrected.

The cone is thrust into the ground at a steady rate of about 20 mm/sec, usually using the hydraulic rams of a purpose built CPT rig, or a drilling rig. The testing is carried out in accordance with the Australian Standard AS1289 Test 6.5.1.

Figure 2: Purpose built CPT rig

The CPT can penetrate most soil types and is particularly suited to alluvial soils, being able to detect fine layering and strength variations. With sufficient thrust the cone can often penetrate a short distance into weathered rock. The cone will usually reach refusal in coarse filling, medium to coarse gravel and on very low strength or better rock. Tests have been successfully completed to more than 60 m.

Types of CPTs

Douglas Partners (and its subsidiary GroundTest) owns and operates the following types of CPT cones:

Type	Measures
Standard	Basic parameters (q_c, f_s, i & z)
Piezocone	Dynamic pore pressure (u) plus basic parameters. Dissipation tests estimate consolidation parameters
Conductivity	Bulk soil electrical conductivity (σ) plus basic parameters
Seismic	Shear wave velocity (V_s), compression wave velocity (V_p), plus basic parameters

Strata Interpretation

The CPT parameters can be used to infer the Soil Behaviour Type (SBT), based on normalised values of cone resistance (Qt) and friction ratio (Fr). These are used in conjunction with soil classification charts, such as the one below (after Robertson 1990)

Cone Penetration Tests

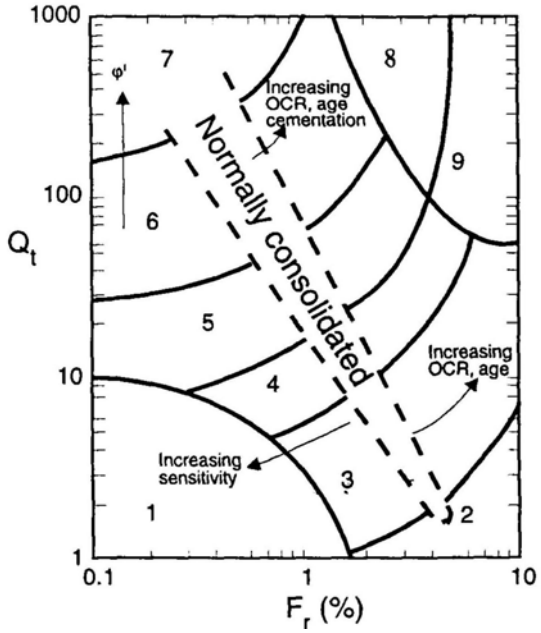


Figure 3: Soil Classification Chart

DP's in-house CPT software provides computer aided interpretation of soil strata, generating soil descriptions and strengths for each layer. The software can also produce plots of estimated soil parameters, including modulus, friction angle, relative density, shear strength and over consolidation ratio.

DP's CPT software helps our engineers quickly evaluate the critical soil layers and then focus on developing practical solutions for the client's project.

Engineering Applications

There are many uses for CPT data. The main applications are briefly introduced below:

Settlement

CPT provides a continuous profile of soil type and strength, providing an excellent basis for settlement analysis. Soil compressibility can be estimated from cone derived moduli, or known consolidation parameters for the critical layers (eg. from laboratory testing). Further, if pore pressure dissipation tests are undertaken using a piezocone, in-situ consolidation coefficients can be estimated to aid analysis.

Pile Capacity

The cone is, in effect, a small scale pile and, therefore, ideal for direct estimation of pile capacity. DP's in-house program ConePile can analyse most pile types and produces pile capacity versus depth plots. The analysis methods are based on proven static theory and empirical studies, taking account of scale effects, pile materials and method of installation. The results are expressed in limit state format, consistent with the Piling Code AS2159.

Dynamic or Earthquake Analysis

CPT and, in particular, Seismic CPT are suitable for dynamic foundation studies and earthquake response analyses, by profiling the low strain shear modulus G_0. Techniques have also been developed relating CPT results to the risk of soil liquefaction.

Other Applications

Other applications of CPT include ground improvement monitoring (testing before and after works), salinity and contaminant plume mapping (conductivity cone), preloading studies and verification of strength gain.

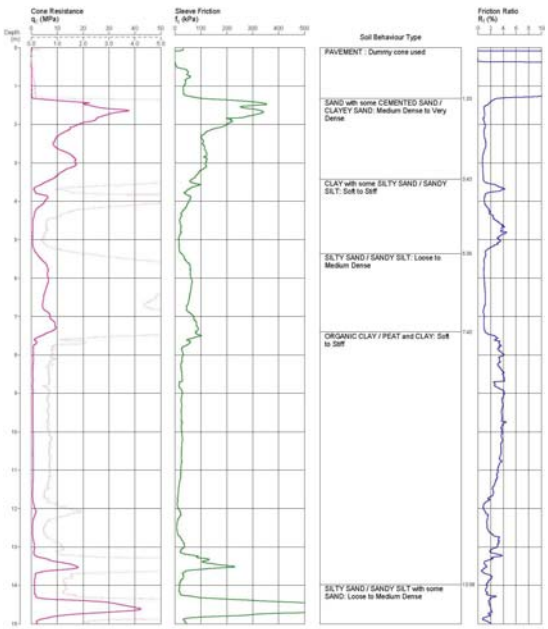


Figure 4: Sample Cone Plot

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Soil Descriptions

Douglas Partners

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Symbols & Abbreviations

Douglas Partners

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core Drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete


Filling

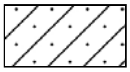
Soils


Topsoil

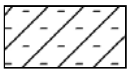

Peat


Clay

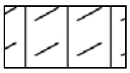

Silty clay

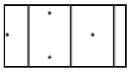

Sandy clay

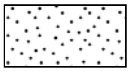

Gravelly clay

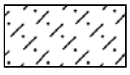

Shaly clay

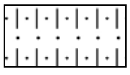

Silt


Clayey silt


Sandy silt

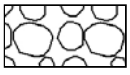

Sand

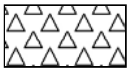

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

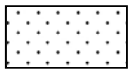

Talus

Sedimentary Rocks

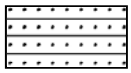

Boulder conglomerate

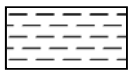

Conglomerate


Conglomeratic sandstone

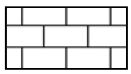

Sandstone


Siltstone


Laminite

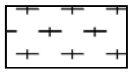

Mudstone, claystone, shale

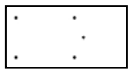

Coal


Limestone

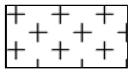
Metamorphic Rocks

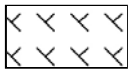

Slate, phyllite, schist

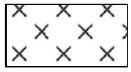

Gneiss

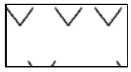

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

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Geotechnics / Environment / Groundwater

Location of Tests
Camberwarra Primary School
Site, Craigie, WA

CLIENT: JDSi Consulting Engineers Pty Ltd

PROJECT No.: 82006
DRAWING No.: 1
REVISION: A
DATE: 4 Feb 2013

82006-d01.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136

Appendix B

Results of Field Work

CONE PENETRATION TEST

CLIENT: JDSi Consulting Engineers Pty Ltd

PROJECT: Camberwarra Primary School Site

LOCATION: Camberwarra Drive, Craigie

REDUCED LEVEL: 36.3 m AHD*

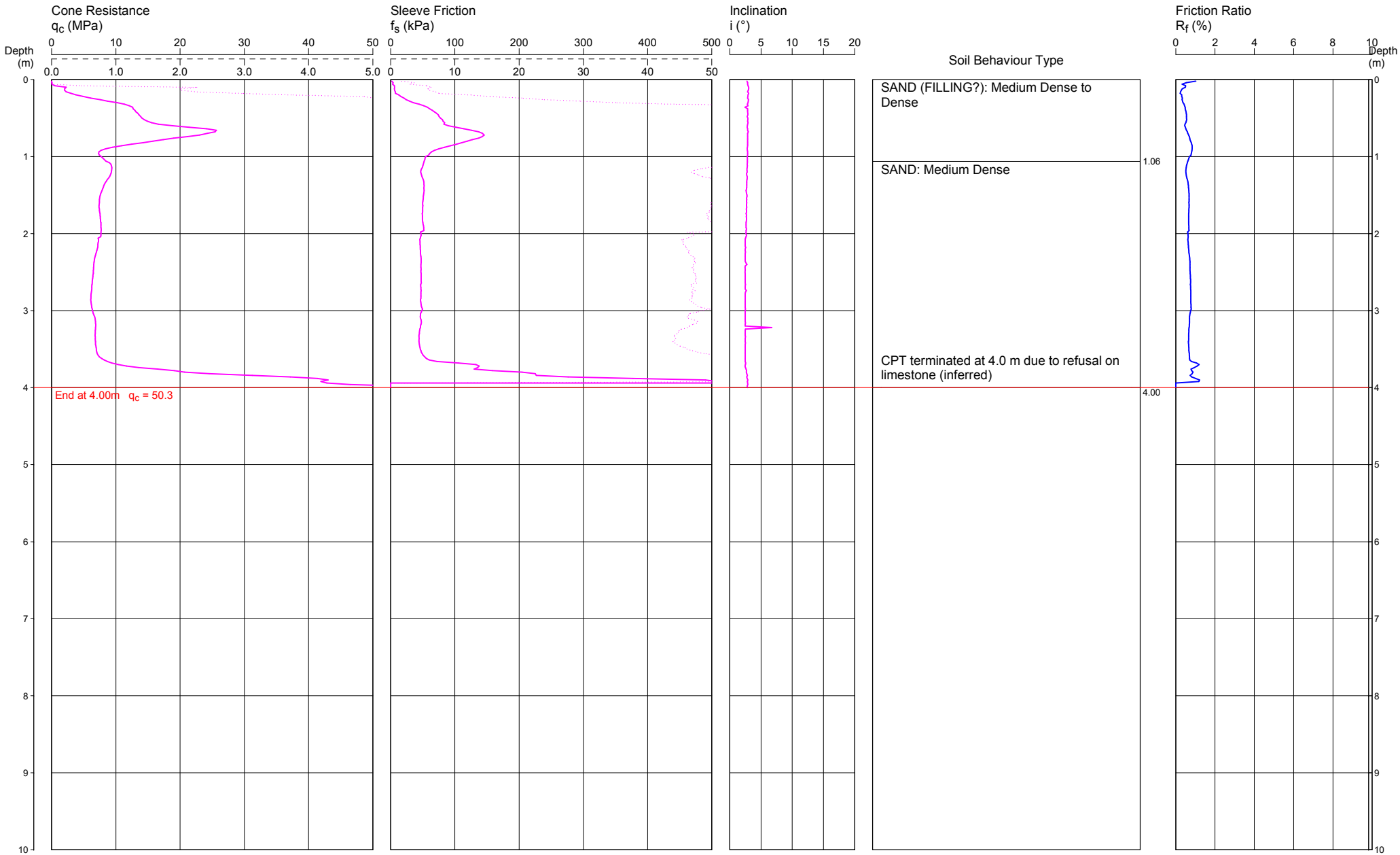
COORDINATES:

CPT1

Page 1 of 1

DATE 17/01/2013

PROJECT No: 82006



REMARKS: * Surface level interpolated from survey plan provided by the client. **File:** P:\82006 Craigie, Camberwarra Primary School Site\Field\CPT1.CP5

Cone ID: Probedrill **Type:** EC04

ConePlot Version 5.9.1

Douglas Partners
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CONE PENETRATION TEST

CLIENT: JDSi Consulting Engineers Pty Ltd

PROJECT: Camberwarra Primary School Site

LOCATION: Camberwarra Drive, Craigie

REDUCED LEVEL: 32.4 m AHD*

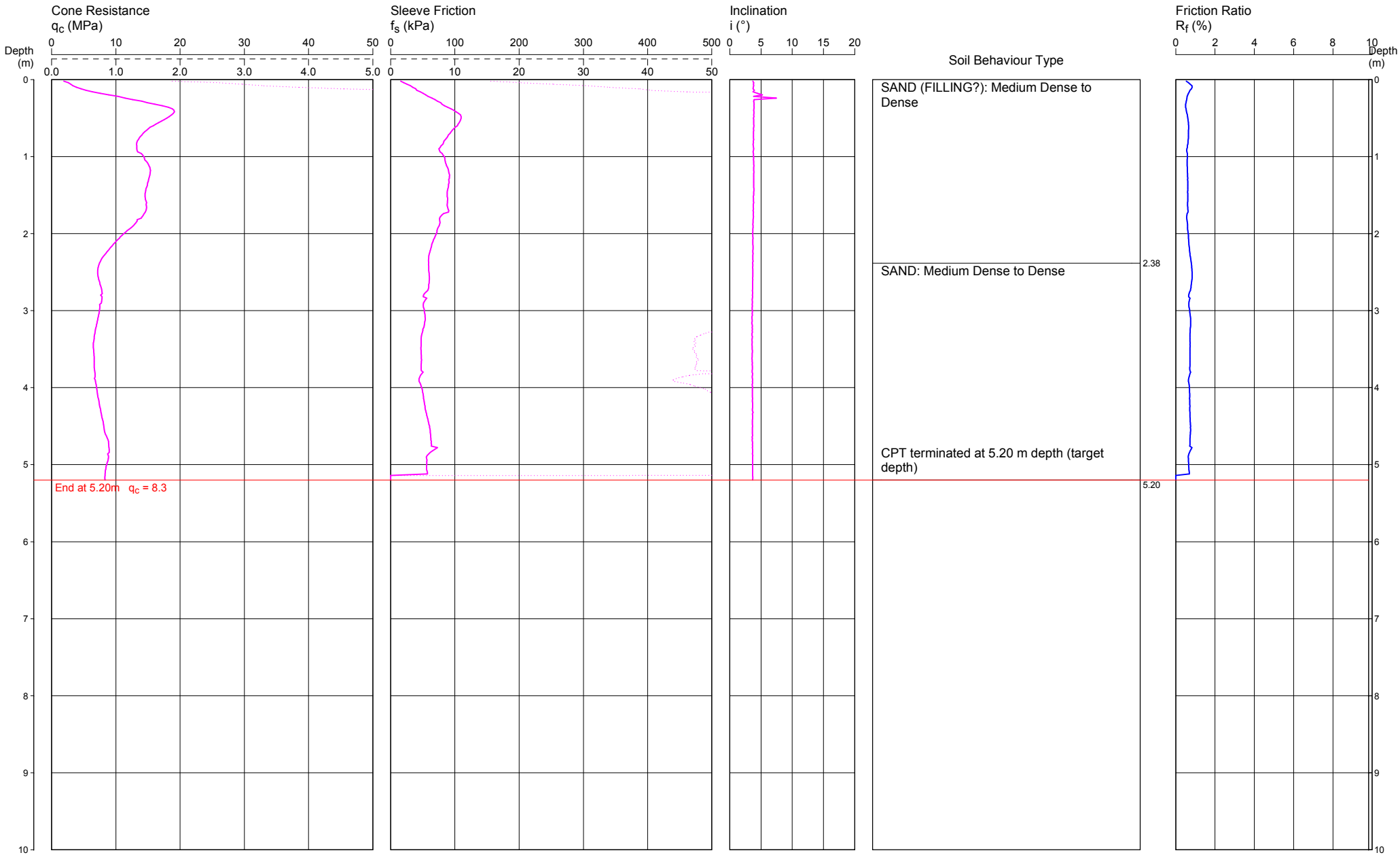
COORDINATES:

CPT2

Page 1 of 1

DATE 17/01/2013

PROJECT No: 82006



REMARKS: * Surface level interpolated from survey plan provided by the client. **File:** P:\82006 Craigie, Camberwarra Primary School Site\Field\CPT2.CP5

Cone ID: Probedrill **Type:** EC04

ConePlot Version 5.9.1

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CONE PENETRATION TEST

CLIENT: JDSi Consulting Engineers Pty Ltd

PROJECT: Camberwarra Primary School Site

LOCATION: Camberwarra Drive, Craigie

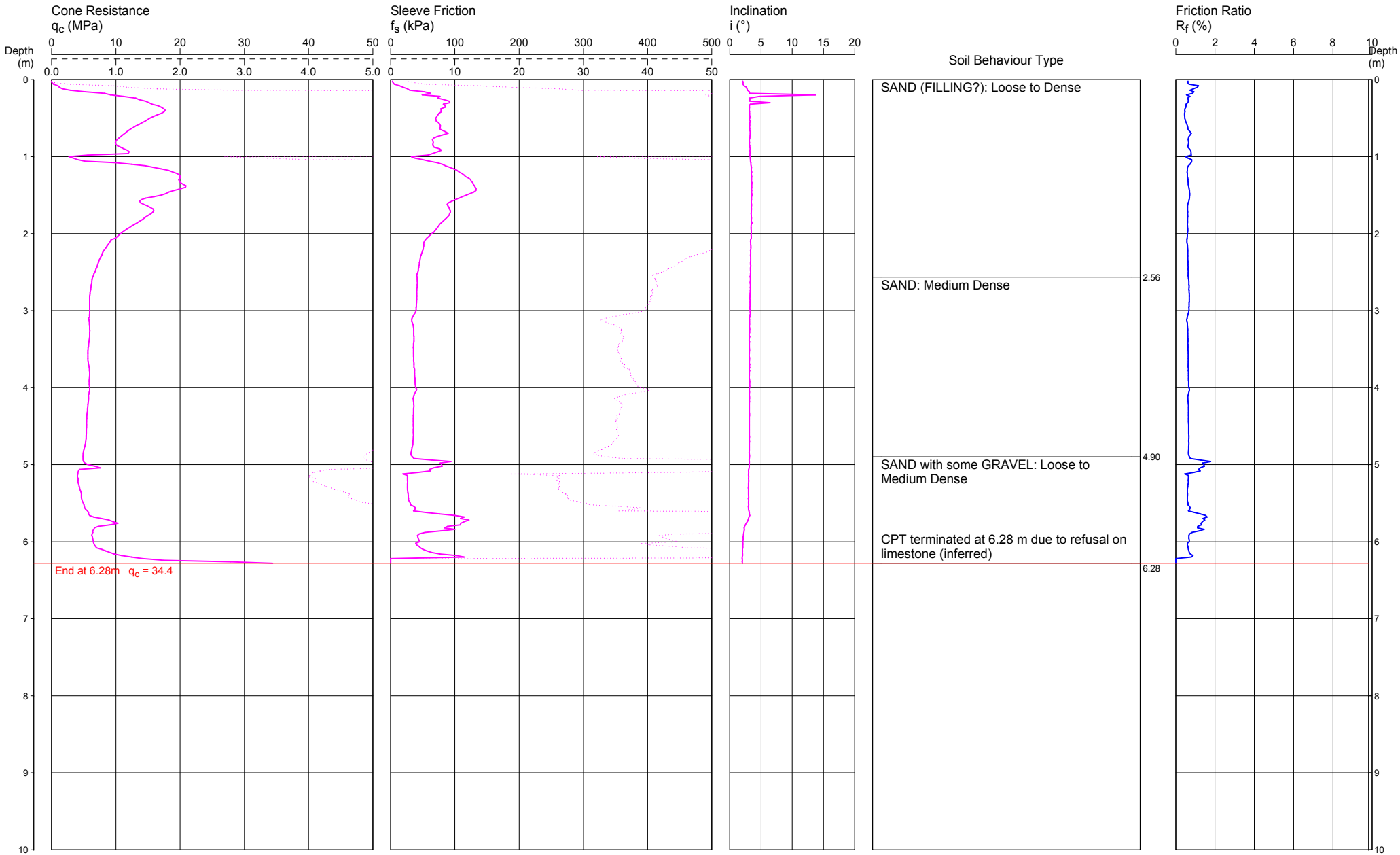
REDUCED LEVEL: 33.3 m AHD*

COORDINATES:

CPT3

DATE 17/01/2013

PROJECT No: 82006



REMARKS: * Surface level interpolated from survey plan provided by the client. **File:** P:\82006 Craigie, Camberwarra Primary School Site\Field\CPT3.CP5

Cone ID: Probedrill **Type:** EC04

ConePlot Version 5.9.1

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: JDSI Consulting Engineers
PROJECT: Camberwarra Primary School Site
LOCATION: Camberwarra Drive, Craigie

SURFACE LEVEL: 37.6 m AHD*
EASTING:
NORTHING:

PIT No: TP4
PROJECT No: 82006
DATE: 17/1/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
37	0.1	FILLING (TOPSOIL) - dark brown, yellow-brown, fine to medium grained silty sand topsoil with a trace of rootlets, dry.							
		FILLING (SAND) - dense, yellow-brown, fine to medium grained sand with some cobbles, fine to coarse sized gravel and roots/rootlets, dry to moist.							
	0.5	SAND - medium dense to dense, yellow-brown, fine to medium grained sand with a trace of silt and roots/rootlets, moist.							
	1			D	1.0				1
36									
	2								2
35									
	3	3.0 Pit discontinued at 3.0m (Target depth)							3

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 4.5 tonne Kobelco with 450 mm wide flat bucket.
LOGGED: CC
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: * Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: JDSI Consulting Engineers
PROJECT: Camberwarra Primary School Site
LOCATION: Camberwarra Drive, Craigie

SURFACE LEVEL: 31.0 m AHD*
EASTING:
NORTHING:

PIT No: TP5
PROJECT No: 82006
DATE: 17/1/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
31	0.15	FILLING (TOPSOIL) - brown, fine to medium grained silty sand topsoil with a trace of rootlets, moist.							
		FILLING (SAND) - dense, grey, yellow-brown, fine to medium grained sand filling with some cobbles and a trace of fine to coarse sized gravel, roots/rootlets and concrete pipe fragments, moist.							
		- with a PVC pipe (approximately 3 cm diameter) from 0.3 m depth.		D	0.5				
		- with a PVC pipe (approximately 5 cm diameter) from 0.3 m depth.							
30	1								1
	1.2	SAND - grey, fie to medium grained sand with some rootlets and a trace of silt, moist.							
		- becoming yellow-brown with a trace of rootlets from 1.4 m depth.							
29	2								2
28	3								3
	3.1	Pit discontinued at 3.1m (Target depth)							

RIG: 4.5 tonne Kobelco with 450 mm wide flat bucket.
LOGGED: CC
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: * Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
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TEST PIT LOG

CLIENT: JDSI Consulting Engineers
PROJECT: Camberwarra Primary School Site
LOCATION: Camberwarra Drive, Craigie

SURFACE LEVEL: 26.8 m AHD*
EASTING:
NORTHING:

PIT No: TP6
PROJECT No: 82006
DATE: 17/1/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
26	0.1	TOPSOIL (SILTY SAND) - dark brown, fine to medium grained silty sand topsoil with some roots/rootlets, dry.							
	1	SAND - very dense, brown, fine to medium grained sand with a trace of silt and roots/rootlets, moist.							
		- becoming yellow-brown from 1.2 m depth.							
25		- with a root (approximately 4 cm diameter) at 1.7 m depth.							
	2								
		- with a root (approximately 4 cm diameter) at 2.3 m depth.							
24	3	3.0 Pit discontinued at 3.0m (Target depth)							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 4.5 tonne Kobelco with 450 mm wide flat bucket.
LOGGED: CC
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: * Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: JDSI Consulting Engineers
PROJECT: Camberwarra Primary School Site
LOCATION: Camberwarra Drive, Craigie

SURFACE LEVEL: 29.0 m AHD*
EASTING:
NORTHING:

PIT No: TP7
PROJECT No: 82006
DATE: 17/1/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
29	0.05	FILLING (TOPSOIL) - grey, fine to medium grained sand with some silt and fine to coarse sized gravel and a trace of roots/rootlets, dry to moist.							
	0.2	BASECOURSE (CRUSHED LIMESTONE) - weakly cemented, white, fine to coarse sized sandy gravel with some silt, dry to moist.							
	0.4	FILLING (SAND) - medium dense, grey, yellow-brown, fine to medium grained sand with a trace of silt and roots/rootlets, moist.							
28	1	SAND - dense, yellow-brown, fine to medium grained sand with a trace of silt and rootlets, moist.							1
27	2			D	2.0				2
26	3	3.0 Pit discontinued at 3.0m (Target depth)							3

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 4.5 tonne Kobelco with 450 mm wide flat bucket.
LOGGED: CC
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: * Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: JDSI Consulting Engineers
PROJECT: Camberwarra Primary School Site
LOCATION: Camberwarra Drive, Craigie

SURFACE LEVEL: 36.0 m AHD*
EASTING:
NORTHING:

PIT No: TP8
PROJECT No: 82006
DATE: 17/1/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
36		FILLING (SAND) - medium dense to dense, light brown, medium grained sand filling with some rubble comprising bricks, concrete, limestone, broken tiles and PVC pipes and a trace of silt and rootlets, dry to moist.		D	0.5				
35	1								1
	1.1	SAND - yellow-brown, fine to medium grained sand with a trace of silt and rootlets, moist.							
34	2								2
33	3	3.0 Pit discontinued at 3.0m (Target depth)							3

Dynamic Penetrometer Test (blows per 150mm): 5 10 15 20

RIG: 4.5 tonne Kobelco with 450 mm wide flat bucket.
LOGGED: CC
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: * Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: JDSI Consulting Engineers
PROJECT: Camberwarra Primary School Site
LOCATION: Camberwarra Drive, Craigie

SURFACE LEVEL: 36.0 m AHD*
EASTING:
NORTHING:

PIT No: TP9
PROJECT No: 82006
DATE: 17/1/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
36	0.2	FILLING (SANDY GRAVEL) - light grey, blue-grey, fine to coarse sized sandy gravel filling with a trace of silt, dry to moist.							
	0.6	FILLING (SAND) - dense, brown, fine to medium grained sand filling with some cobbles of limestone and a trace of gravel, rootlets and silt, dry to moist. - with a PVC pipe (electric cable conduit) at 0.4 m depth.							
35	1	SAND - medium dense, yellow-brown, fine to medium grained sand with a trace of silt and rootlets, moist.							1
	1.3	- with a very low to low strength limestone pinacle, a few boulders and some cobbles from 1.3 m depth. Test pit continued in sand adjacent to pinnacle.							
34	2								2
33	3	3.0 Pit discontinued at 3.0m (Target depth)							3

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 4.5 tonne Kobelco with 450 mm wide flat bucket.
LOGGED: CC
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: * Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: JDSI Consulting Engineers
PROJECT: Camberwarra Primary School Site
LOCATION: Camberwarra Drive, Craigie

SURFACE LEVEL: 28.9 m AHD*
EASTING:
NORTHING:

PIT No: TP10
PROJECT No: 82006
DATE: 17/1/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
28	0.1	TOPSOIL (SAND) - brown, fine to medium grained sand topsoil with some silt and a trace of roots/rootlets, dry to moist.							
	1	SAND - dense to very dense, yellow-brown, fine to medium grained sand with a trace of silt and roots/rootlets, moist.							
27	2								
26	3	3.0 Pit discontinued at 3.0m (Target depth)							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 4.5 tonne Kobelco with 450 mm wide flat bucket.
LOGGED: CC
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: * Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: JDSI Consulting Engineers
PROJECT: Camberwarra Primary School Site
LOCATION: Camberwarra Drive, Craigie

SURFACE LEVEL: 26.4 m AHD*
EASTING:
NORTHING:

PIT No: TP11
PROJECT No: 82006
DATE: 17/1/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
26	0.1	FILLING (TOPSOIL) - brown, fine to medium grained silty sand topsoil with a trace of rootlets, dry.							
	1	FILLING (SAND) - very dense, brown, grey, fine to medium grained sand filling with a trace of silt and rootlets, dry to moist.							1
25	1.1	SAND - yellow-brown, fine to medium grained sand with a trace of silt and rootlets, moist.							
	2								2
24	3	3.0 Pit discontinued at 3.0m (Target depth)							3
23									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 4.5 tonne Kobelco with 450 mm wide flat bucket.
LOGGED: CC
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: * Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: JDSI Consulting Engineers
PROJECT: Camberwarra Primary School Site
LOCATION: Camberwarra Drive, Craigie

SURFACE LEVEL: 26.2 m AHD*
EASTING:
NORTHING:

PIT No: TP12
PROJECT No: 82006
DATE: 17/1/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
26	0.1	FILLING (TOPSOIL) - brown, fine to medium grained silty sand topsoil with a trace of rootlets, dry.							
		FILLING (SAND) - very dense, brown, fine to medium grained sand with a trace of silt and rootlets, dry to moist.		D	0.6				
25	1	- becoming grey-brown from 1.15 m depth. - with a root (approximately 5 cm diameter) from 1.3 m depth.							
	1.65	SAND - yellow-brown, fine to medium grained sand with a trace of silt and rootlets/roots, moist.							
24	2								
	3	3.0 Pit discontinued at 3.0m (Target depth)							
23									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 4.5 tonne Kobelco with 450 mm wide flat bucket.
LOGGED: CC
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: * Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: JDSI Consulting Engineers
PROJECT: Camberwarra Primary School Site
LOCATION: Camberwarra Drive, Craigie

SURFACE LEVEL: 26.5 m AHD*
EASTING:
NORTHING:

PIT No: TP13
PROJECT No: 82006
DATE: 17/1/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
26	0.05	FILLING (TOPSOIL) - brown, fine to medium grained silty sand topsoil with a trace of rootlets, dry.							
		SAND - very dense, yellow-brown, fine to medium grained sand with a trace of silt and roots/rootlets, dry to moist.							
		- becoming moist from 0.5 m depth.							
25	2.5	- with a very low to low strength limestone pinnacle with some cobbles from 2.5 m depth. Test pit continued in sand adjacent to pinnacle.							
24	3.0	Pit discontinued at 3.0m (Target depth)							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20; 1, 2, 3

RIG: 4.5 tonne Kobelco with 450 mm wide flat bucket.
LOGGED: CC
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: * Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: JDSI Consulting Engineers
PROJECT: Camberwarra Primary School Site
LOCATION: Camberwarra Drive, Craigie

SURFACE LEVEL: 29.6 m AHD*
EASTING:
NORTHING:

PIT No: TP14
PROJECT No: 82006
DATE: 17/1/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
29	0.1	FILLING (TOPSOIL) - brown, fine to medium grained silty sand topsoil with a trace of roots/rootlets, dry to moist.							
		FILLING (SAND) - dense, light grey, fine to medium grained sand filling with some silt and a trace of roots/rootlets, moist. - becoming yellow-brown, grey with a trace of silt from 0.3 m depth.							
	0.5	SAND - very dense, yellow-brown, fine to medium grained sand with a trace of silt and roots/rootlets, moist.							
28	1								
	2								
27	3	3.0 Pit discontinued at 3.0m (Target depth)							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 4.5 tonne Kobelco with 450 mm wide flat bucket.
LOGGED: CC
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: * Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: JDSI Consulting Engineers
PROJECT: Camberwarra Primary School Site
LOCATION: Camberwarra Drive, Craigie

SURFACE LEVEL: 33.9 m AHD*
EASTING:
NORTHING:

PIT No: TP15
PROJECT No: 82006
DATE: 17/1/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
33	0.5	FILLING (SAND) - medium dense, light brown, grey, fine to medium grained sand filling with a trace of fine to coarse sized gravel, roots/rootlets and silt, dry to moist.							
	1	SAND - dense, yellow-brown, fine to medium grained sand with a trace of silt and roots/rootlets, moist.							
32	1.4	- with a very low to low strength limestone pinnacle, a few boulders and some cobbles from 1.4 m depth. Test pit continued in sand adjacent to pinnacle.							
	2								
	2.1	LIMESTONE - medium strength, white, limestone, fine to medium grained.							
	2.2	Pit discontinued at 2.2m (Due to refusal on limestone)							
31	3								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 4.5 tonne Kobelco with 450 mm wide flat bucket.
LOGGED: CC
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: * Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: JDSI Consulting Engineers
PROJECT: Camberwarra Primary School Site
LOCATION: Camberwarra Drive, Craigie

SURFACE LEVEL: 30.8 m AHD*
EASTING:
NORTHING:

PIT No: TP16
PROJECT No: 82006
DATE: 17/1/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
30	0.1	FILLING (TOPSOIL) - grey-brown, fine to medium grained sand topsoil with some silt and a trace of rootlets, dry.							
		FILLING (SAND) - medium dense, yellow-brown, fine to medium grained sand filling with a trace of silt and roots/rootlets, moist. - with a PVC stormwater pipe form 0.3 m depth.							
	0.4	SAND - medium dense to dense, yellow-brown, fine to medium grained sand with a trace of silt and rootlets, moist. - with a soakwell on the east face of test pit from 0.7 m to 1.2 m depth (test pit orientation north).		D	1.2				
29	1.4								
28	3.0	Pit discontinued at 3.0m (Target depth)							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 4.5 tonne Kobelco with 450 mm wide flat bucket.
LOGGED: CC
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: * Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: JDSI Consulting Engineers
PROJECT: Camberwarra Primary School Site
LOCATION: Camberwarra Drive, Craigie

SURFACE LEVEL: 27.1 m AHD*
EASTING:
NORTHING:

PIT No: TP17
PROJECT No: 82006
DATE: 17/1/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
27	0.05	FILLING (TOPSOIL) - brown, fine to medium grained silty sand topsoil with a trace of rootlets, dry.							
	0.1	FILLING (SAND) - brown, fine to medium grained sand with a trace of silt and rootlets, dry to moist.							
		SAND - dense, yellow-brown, fine to medium grained sand with a trace of silt and roots/rootlets, moist.							
	1								1
26									
	2								2
25									
	3								3
	3.0	Pit discontinued at 3.0m (Target depth)							
24									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 4.5 tonne Kobelco with 450 mm wide flat bucket.
LOGGED: CC
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: * Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: JDSI Consulting Engineers
PROJECT: Camberwarra Primary School Site
LOCATION: Camberwarra Drive, Craigie

SURFACE LEVEL: 26.1 m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH18
PROJECT No: 82006
DATE: 17/1/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
26	0.1	FILLING (TOPSOIL) - brown, fine to medium grained silty sand topsoil with a trace of rootlets, dry.							
		FILLING (SAND) - yellow-brown, grey, fine to medium grained sand filling with a trace of silt and rootlets, dry to moist.							
25	1	- becoming grey-brown from 1.7 m depth.							
	1.9	SAND - medium dense, yellow-brown, medium grained sand with some silt, moist.							
24	2								
23	3								
22	4								
21	5			D	5.0				
	5.0	Bore discontinued at 5.0m (Target depth)							

RIG: 110 mm diameter hand auger **DRILLER:** CC **LOGGED:** CC **CASING:** None

TYPE OF BORING: Hand auger

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: * Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: JDSI Consulting Engineers
PROJECT: Camberwarra Primary School Site
LOCATION: Camberwarra Drive, Craigie

SURFACE LEVEL: 26.1 m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH19
PROJECT No: 82006
DATE: 17/1/2013
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
26	0.1	FILLING (TOPSOIL) - brown, fine to medium grained silty sand topsoil with a trace of rootlets, dry.							
		FILLING (SAND) - brown, grey, fine to medium grained sand filling with some cobbles and a trace of fine to coarse sized gravel, silt and rootlets, dry to moist.							
25	1								1
	2								2
24	2.05	SAND - medium dense, yellow-brown, medium grained sand with a trace to some silt, moist.							
23	3	- with a trace of organic particles from 3.2 m depth.							3
	4			D	4.0				4
22	4.0	Bore discontinued at 4.0m (Target depth)							
	5								5
21									

RIG: 110 mm diameter hand auger **DRILLER:** CC **LOGGED:** CC **CASING:** None

TYPE OF BORING: Hand auger

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: * Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix C

Laboratory Test Certificates

Particle Size Distribution & Plasticity Index tests

Mining & Civil Geotest Pty Ltd

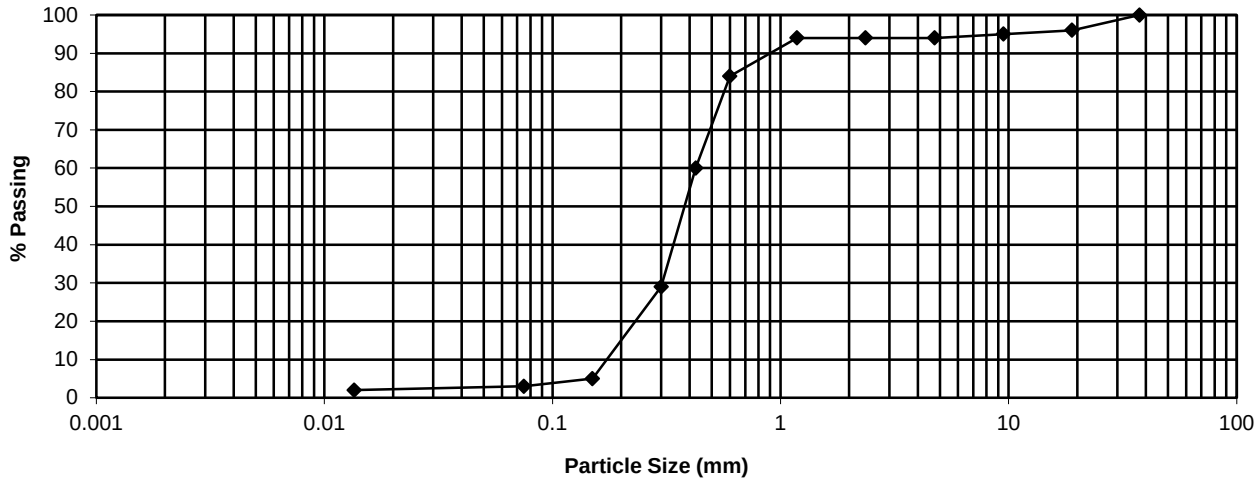
unit1/1 Pusey Road, Jandakot, WA 6164

Ph (08) 9414 8022 Fax (08) 9414 8011

Email: kevin@mcgeotest.com.au

Job No:	**60017**
Report No:	**60017-P13/112**
Sample No:	**P13/112**
Issue Date:	**30 January 2013**

Client:	**JDSi Consulting Engineers Pty Ltd**	Sample Location:	**TP8**
Project:	**Camberwarra Primary School Site**	Depth (m):	**0.5**
Location:	**Camberwarra Drive, Craigie**		



SIEVE ANALYSIS WA 115.1

Sieve Size (mm)	% Passing
75.0	
37.5	100
19.0	96
9.5	95
4.75	94
2.36	94
1.18	94
0.600	84
0.425	60
0.300	29
0.150	5
0.075	3
0.0135	2

Plasticity index tests
Australian Standard 1289.

Liquid limit 3.1.1	na	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

Approved signature

Kevin M Jones

Particle Size Distribution & Plasticity Index tests

Mining & Civil Geotest Pty Ltd

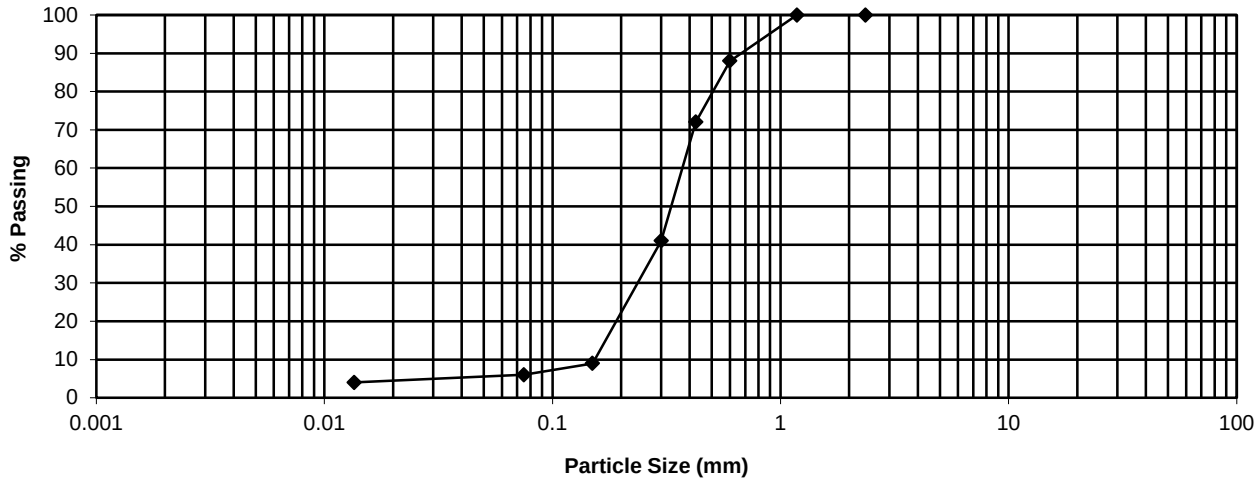
unit1/1 Pusey Road, Jandakot, WA 6164

Ph (08) 9414 8022 Fax (08) 9414 8011

Email: kevin@mcgeotest.com.au

Job No:	**60017**
Report No:	**60017-P13/110**
Sample No:	**P13/110**
Issue Date:	**30 January 2013**

Client:	**JDSi Consulting Engineers Pty Ltd**	Sample Location:	**BH18**
Project:	**Camberwarra Primary School Site**	Depth (m):	**5.0**
Location:	**Camberwarra Drive, Craigie**		



SIEVE ANALYSIS WA 115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	88
0.425	72
0.300	41
0.150	9
0.075	6
0.0135	4

Plasticity index tests
Australian Standard 1289.

Liquid limit 3.1.1	na	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Kevin M Jones

Particle Size Distribution & Plasticity Index tests

Mining & Civil Geotest Pty Ltd

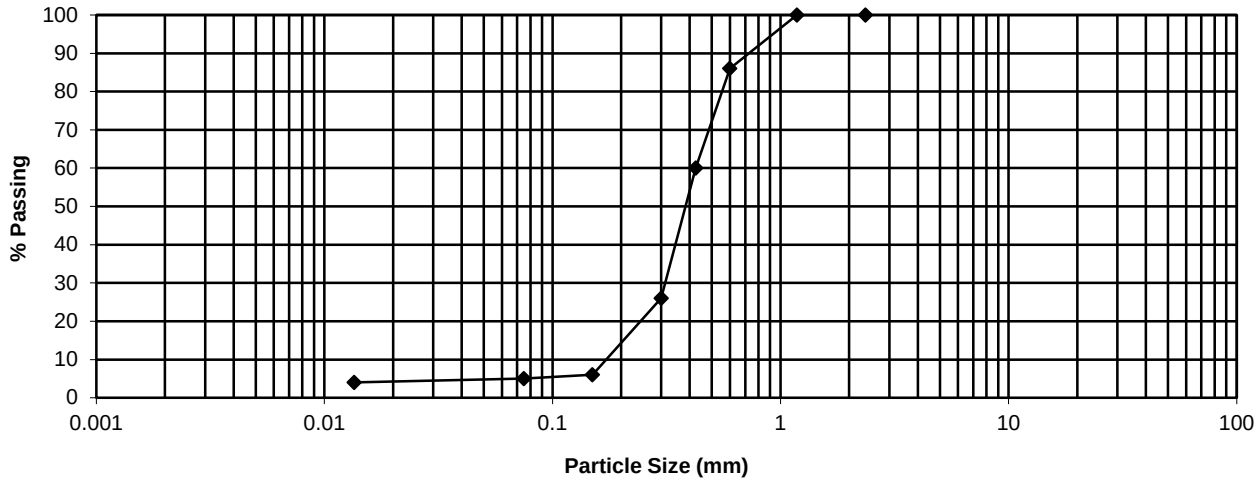
unit1/1 Pusey Road, Jandakot, WA 6164

Ph (08) 9414 8022 Fax (08) 9414 8011

Email: kevin@mcgeotest.com.au

Job No:	**60017**
Report No:	**60017-P13/111**
Sample No:	**P13/111**
Issue Date:	**30 January 2013**

Client:	**JDSi Consulting Engineers Pty Ltd**	Sample Location:	**BH19**
Project:	**Camberwarra Primary School Site**	Depth (m):	**4.0**
Location:	**Camberwarra Drive, Craigie**		



SIEVE ANALYSIS WA 115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	86
0.425	60
0.300	26
0.150	6
0.075	5
0.0135	4

Plasticity index tests
Australian Standard 1289.

Liquid limit 3.1.1	na	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client address: 36 O'Malley Street, Osborne Park

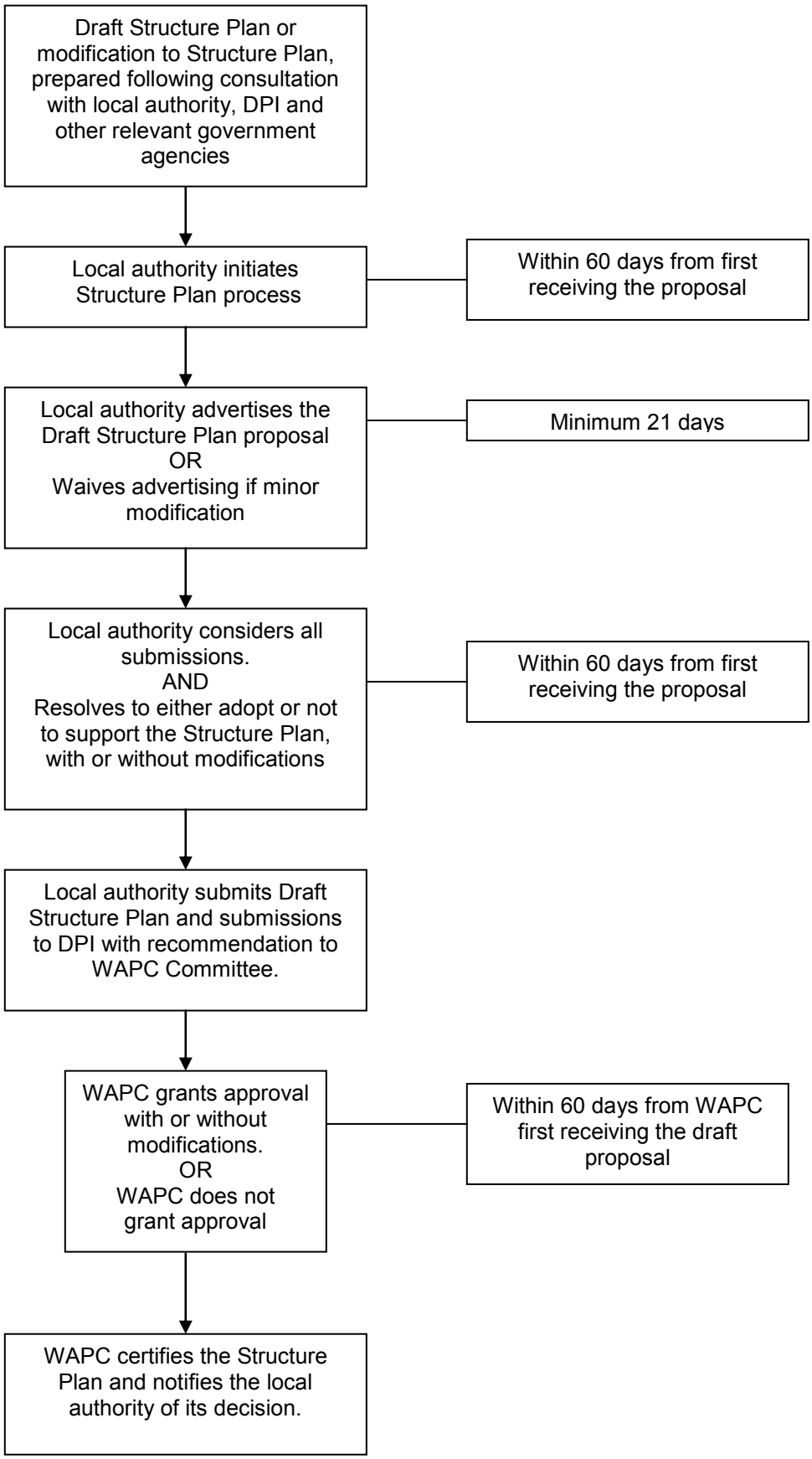
Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Kevin M Jones

STRUCTURE PLAN PROCESS




Haddington Park
ALAN CT
NOLAN PL
BERKSHIRE DR
ALBANY CT
REBECCA CT
NELSON PL
NINA CR
LILLIAN ST
GEELONG CL
AJAX PL
HADDINGTON ST
ALTAIR WY
KILDARE PL
EDDYSTONE AV
CRAIGIE DR
ALLINGA CR
CURRAJONG CR
ARGUS CL
BARWON RD
BULLARA RD
GRAFTON ST
CAMBERWARRA DR
NYARA CR
PENELLIA CR
CAWARRA CR
Cawarra Park
PERILYA RD
OWAN PL