Ordinary Council Meeting

8 February 2017

Minutes

Members of the public who attend Council meetings should not act immediately on anything they hear at the meetings, without first seeking clarification of Council's position. Persons are advised to wait for written advice from the Council prior to taking action on any matter that they may have before Council.

Agendas and Minutes are available on the City's website www.kwinana.wa.gov.au

Vision Statement

Kwinana 2030
Rich in spirit, alive with opportunities, surrounded by nature – it's all here!

Mission

Strengthen community spirit, lead exciting growth, respect the environment - create great places to live.

We will do this by –

- providing strong leadership in the community;
- promoting an innovative and integrated approach;
- being accountable and transparent in our actions;
- being efficient and effective with our resources;
- using industry leading methods and technology wherever possible;
- making informed decisions, after considering all available information; and
- providing the best possible customer service.

Values

We will demonstrate and be defined by our core values, which are:

- Lead from where you stand – Leadership is within us all.
- Act with compassion – Show that you care.
- Make it fun – Seize the opportunity to have fun.
- Stand Strong, stand true – Have the courage to do what is right.
- Trust and be trusted – Value the message, value the messenger.
- Why not yes? – Ideas can grow with a yes.

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Present:

DEPUTY MAYOR P FEASEY
CR W COOPER
CR S LEE
CR S MILLS
CR B THOMPSON
CR D WOOD

MS J ABBISS	-	Chief Executive Officer
MR R HERON	-	Acting Director City Strategy
MR P NEILSON	-	Acting Director City Development
MS M BELL	-	Corporate Lawyer
MR E LAWRENCE	-	Director Corporate and Engineering Services

Members of the Press	0
Members of the Public	1

1 Declaration of Opening:

Presiding Member declared the meeting open at 7:00pm and welcomed Councillors, City Officers and gallery in attendance and read the Welcome.

"IT GIVES ME GREAT PLEASURE TO WELCOME YOU ALL HERE AND BEFORE COMMENCING THE PROCEEDINGS, I WOULD LIKE TO ACKNOWLEDGE THAT WE COME TOGETHER TONIGHT ON THE TRADITIONAL LAND OF THE NOONGAR PEOPLE"

2 Prayer:

Councillor Sandra Lee to read the Prayer

"OH LORD WE PRAY FOR GUIDANCE IN OUR MEETING. PLEASE GRANT US WISDOM AND TOLERANCE IN DEBATE THAT WE MAY WORK TO THE BEST INTERESTS OF OUR PEOPLE AND TO THY WILL. AMEN"

3 Apologies/Leave(s) of Absence (previously approved)

Apologies

Her Worship Mayor C Adams

Leave(s) of Absence (previously approved):

Councillor Ruth Alexander from 9 January 2017 to 9 February 2017 inclusive.

4 Public Question Time:

Nil

5 Applications for Leave of Absence:

COUNCIL DECISION
423
MOVED CR B THOMPSON **SECONDED CR W COOPER**

That Mayor C Adams be granted a leave of absence from 27 February 2017 to the 11 March 2017 inclusive.

CARRIED
6/0

6 Declarations of Interest by Members and City Officers:

Nil

7 Community Submissions:

7.1 Mr Chris Oughton, Kwinana Industries Council regarding item 15.1, Modified Mandogalup East Local Structure Plan (Version 3) – Part Lots 9002 and 9006 Hoffman Road and 9019 Rowley Road, Mandogalup.

Kwinana Industries Council is pleased that the Proponent of this Application has revised its Structure Plan to respect the line of the Buffer Zone as proposed several years ago by the WAPC and more recently as reflected in the government's Draft legislation to create the Western Trade Coast Industry Protection Area.

This Council, in particular, knows how important it is to industry to be protected from residential encroachment, and that this protection needs to be rock solid if existing industries that rely on a sensible buffer zone are to invest in their own expansions and for possible new entrants to have the confidence to establish in the Western Trade Coast. Of course this confidence translates into locally-based jobs for this and the other communities surrounding the WTC.

That's 5,000 direct jobs, 26,000 indirect jobs, and 16Bn$ into the State economy annually; and the Western Trade Coast is only half full, so double these numbers.

Let's be clear, the long term future of the industrial area is reliant on a secure buffer. It is the role of the various planning authorities to protect it – and I refer in this case to the three local governments being yourselves, and the Cities of Rockingham and Cockburn, and of course the WAPC.

The report refers in numerous places to the Alcoa Residue Storage Area (RSA) Buffer. Please be very clear on this; the buffer has never been described using these words, as far as I am aware, by any government department or agency, or anyone other than people who stand to directly benefit from a westward movement of the buffer.

7 COMMUNITY SUBMISSIONS CONTINUED

That description directly conflicts with the correct wording, which is the 'Kwinana Air Quality Buffer', or KAQB. This is what it has been called for decades.

It is critically important to the protection of the buffer zone that the words used to describe it are accurate.

It is KIC's view that the description of the Buffer which is referred to in the report could conceivably be used to support an argument to have the buffer line moved westwards, by creating uncertainty as to the actual purpose of the buffer, or for what it exists to protect.

Because, tragically, I read Council agendas in my spare time, it was by sheer luck I came across this agenda report accidently only couple of days ago. This despite KIC having been a major stakeholder in the previous applications related to this proponent. I could easily have missed it entirely. This is disappointing. I ask therefore that as a key stakeholder, KIC, or any known key stakeholder for that matter, be given a heads up in advance where it is considered a specific Application is likely to warrant comment, in this instance, by industry. I don't think this is unreasonable.

The wording in the report is, as I have said, factually incorrect when it comes to its description of the buffer zone in the Mandogalup area.

I urge you move to have this factually incorrect statement reworded in all of the numerous places it appears in the offers' report to reflect the correct wording, and that the amended officers' report appear in full in the Minutes of this meeting, so that a future party has no ability, deliberate or accidental, to misrepresent or misconstrue the intent of the buffer in this, the Mandogalup area, or indeed near any part of the KAQB

8 Minutes to be Confirmed:

8.1 Ordinary Meeting of Council held on 18 January 2017:

COUNCIL DECISION

424

MOVED CR S MILLS **SECONDED CR S LEE**

That the Minutes of the Ordinary Meeting of Council held on 18 January 2017 be confirmed as a true and correct record of the meeting.

CARRIED
6/0

9 Referred Standing / Occasional / Management /Committee Meeting:

Nil

10 Petitions:

Nil

11 Notices of Motion:

Nil

12 Reports – Community

Nil

13 Reports – Economic

Nil

14 Reports – Natural Environment

Nil

15 Reports – Built Infrastructure

15.1 Modified Mandogalup East Local Structure Plan (Version 3) – Part Lots 9002 and 9006 Hoffman Road and 9019 Rowley Road, Mandogalup

SUMMARY:

The Western Australian Planning Commission (WAPC) is seeking the City of Kwinana's (City) comments on a modified version of the Mandogalup East Local Structure Plan (MELSP) (Version 3) (Attachment 1).

Two earlier versions of the MELSP (Versions 1 and 2) (Attachments 2 & 3) have been previously considered by Council, including the consideration of submissions received during the public advertising period. The main issues of concern were the:

a) width of the Kwinana Industrial (including Air Quality) Buffer (KIB) and how it impacts on the MELSP;
b) provision of public open space associated with the primary school within the KIB;
c) provision of an active playing field inside of the KIB; and
d) traffic access to Rowley Road.

The City and WAPC have worked through these concerns with the proponent. Version 3 of the MELSP includes all of the modifications that were recommended by Council for Versions 1 and 2. The most significant modifications relate to:

a) relocating the local playing field from within the KIB to an area centrally located within the Mandogalup urban cell;
b) relocating the primary school from an area near the boundary of the KIB to an area centrally located within the Mandogalup urban cell; and
c) re-configuring the road network to restrict access to Rowley Road.

In addition to the above modifications, the proponent has also made the following additional modifications to Version 3:

a) changes to accommodate *Water Sensitive Urban Design* (WSUD) measures; and
b) retention of additional *significant trees* (additional to the significant trees that were already being retained in Versions 1 and 2).

The City's assessment of Versions 1, 2 and 3 are outlined in the Discussion Section of this report.

The City (Engineering Department) has liaised extensively with the proponent to ensure that the risk to the City of inheriting ongoing stormwater management problems and maintenance costs is minimised. The Local Water Management Strategy (LWMS), which accompanies Version 3, has been modified by the proponent in accordance with the City's requirements.

The City is of the view that the proposed LSP is suitable to be forwarded to the WAPC in accordance with clause 20 of the Planning and Development Regulations 2015 (P&D Regulations).

15.1 MODIFIED MANDOGALUP EAST LOCAL STRUCTURE PLAN (VERSION 3) – PART LOTS 9002 AND 9006 HOFFMAN ROAD AND 9019 ROWLEY ROAD, MANDOGALUP

OFFICER RECOMMENDATION:

The Council advise the Western Australian Planning Commission (WAPC) that it supports Version 3 of the Mandogalup East Local Structure Plan (Attachment 1) subject to the following:

a) Inclusion of a statement in the Local Structure Plan text requiring the preparation of the following management plans to the City's satisfaction as part of the subdivision application process:

i. Urban Water Management Plan
ii. Landscape and Tree Management Strategy
iii. Fauna Management Plan

b) Forward this *Ordinary Council Meeting Report* and Council's resolution to the WAPC pursuant to clause 20 of the *Planning and Development Regulations 2015*.

DISCUSSION:

Background
Two versions of the MELSP (Versions 1 and 2) have been previously considered by Council as described below:

MELSP Version 1
Version 1 of the MELSP (Attachment 2) was submitted to the City, by the proponent, in August 2014. This version of the MELSP proposed, that the portion of the playing field being shared with the primary school site be situated within the KIB (The primary school was situated outside of the KIB but adjacent to the boundary).

Version 1 was considered by Council, on 22 July 2015, prior to advertising. Council deemed that Version 1 was not satisfactory for advertising for the following reasons:

a) *the public open space (POS) associated with the primary school should not be located within the 1.5km Alcoa Residue Disposal Area (RDA) buffer;*

b) the MELSP required modification to ensure the provision of a suitably sized POS area for active recreational needs in accordance with the City's Community Infrastructure Planning. This POS area should be situated outside the buffer area and within the Urban zoned land. The provision of the POS may well require a redesign of the balance of the LSP (eg. the location of roads, Local Centres and POS).

c) clear and agreed transport arrangements and delivery are required to provide confidence to Council that it can support the LSPs. Main Roads had objected to a key entry interchange off Rowley Road proposed by the proponent's of MWLSP. This will be a critical intersection for the Mandogalup urban cell.

15.1 MODIFIED MANDOGALUP EAST LOCAL STRUCTURE PLAN (VERSION 3) – PART LOTS 9002 AND 9006 HOFFMAN ROAD AND 9019 ROWLEY ROAD, MANDOGALUP

MELSP Version 2

Version 2 of the MELSP (Attachment 3) included a number of the above modifications, required by Council at its meeting on 22 July 2015.

That portion of the playing field shared with the primary school site was relocated outside of the KIB, however, the balance of the local playing field remained within the KIB. However, Version 2 still proposed providing access and egress to Rowley Road (via the Mandogalup West LSP), which was not supported by Main Roads WA.

Versions 1 and 2 of the MELSP were both advertised between 7 August and 4 September 2015 and presented to Council on 11 November 2015. At that meeting, Council resolved to:

1. *Advise the WAPC that the Council does not support Versions 1 or 2 of the MELSP for the following reasons:*

    a) *The location of the local sports field within 1.5 kilometres of the Alcoa Reside Disposal Area is not supported. This is because of the uncertainty concerning the extent of dust 'lift off' from the disposal area, particularly given that the City will be actively encouraging use of the sporting ground for a range of recreational activities.*

    b) *Main Roads has advised that it will not permit long term connection from either the Mandogalup West LSP or MELSP to Rowley Road and a clear solution to short and long term road access is required*

2. *Advise the WAPC that the Council would be prepared to support the MELSP subject to the following modifications and concerns being addressed.*

    a) *The local sports field being situated within the boundary of the Development Zone within the MELSP. Further, the provision of this POS would likely require the co-operation of Satterley (MELSP) and Qube (MWLSP) and/or coordination for its delivery by the City under a developer contribution scheme. Either way, certainty is required and the Active POS should be provided to the satisfaction of the City.*

    b) *The road network in the MELSP and MWLSP should be revised so that long term access to Rowley Road from both the MWLSP and MELSP is via the proposed Rowley Road/Hammond Road interchange, located to the west.*

MELSP Version 3

Rowe Group, on behalf of the proponent, submitted a third version of the MELSP in response to the above Council resolution in relation to Versions 1 and 2. The Department of Planning has requested that the City forward its comments on Version 3, by 27 January 2017.

The modifications to Version 3, described below, are consistent with Council's recommendations:

15.1 MODIFIED MANDOGALUP EAST LOCAL STRUCTURE PLAN (VERSION 3) – PART LOTS 9002 AND 9006 HOFFMAN ROAD AND 9019 ROWLEY ROAD, MANDOGALUP

a) Primary School and Local Sports Field

In Version 1 of the MELSP, a 5.8ha local sports ground was situated within the KIB (outside of the boundary of the MELSP). A 3.5ha primary school site was situated adjacent to the local sports ground, with the intention that the primary school would utilise a portion of the local playing fields.

Primary school playing fields are generally regarded as a sensitive land use and the City was of the view that the primary school's playing fields should not be located within the KIB. The Department of Health expressed similar views.

The proponent responded to the City's comments and revised the MELSP (Version 2) to increase the size of the primary school site from 3.5ha to 4ha so that it has its own self contained playing fields situated outside of the KIB.

At its meeting, on 11 November 2015, Council did not support the balance of the local playing field being situated within the KIB because of the uncertainty concerned with dust lift off from the Alcoa Residue Disposal Area and the City would be responsible for managing and actively encouraging the use of the playing fields.

The modifications, included in Version 3, include relocation of the primary school site and local playing field so that these facilities are centrally located within the Mandogalup urban catchment and are no longer situated within, or adjacent, to the KIB, as proposed in Versions 1 and 2.

The size, location and configuration of the local playing fields in a shared use arrangement with the primary school, as proposed in Version 3, has been supported by the Department of Education.

City officers liaised extensively with the proponent in relation to the required size, shape and location of the balance of the local playing fields and are satisfied with the configuration of the local playing field shown in Version 3.

Version 3 of the MELSP provides 4.3ha of POS, including 3.4ha of unrestricted POS (8.84% of gross subdivisible area) and 0.9ha of restricted POS (2.39% of gross subdivisible area).

The MELSP states that a *Landscape Management Strategy* will be prepared at the subdivision stage to guide the development of the open space.

b) Road network

Versions 1 and 2 of the MELSP were reliant on permanent access to Rowley Road via a neighbourhood connector within the MWLSP. Main Roads advised that it would not permit a long term connection from either MELSP or MWLSP to Rowley Road because Rowley Road will become a four lane divided road and access will be tightly co ntrolled. Main Roads advised that future access to Rowley Road from both the MWLSP and MELSP should be via the proposed Rowley Road/Hammond Road interchange, located to the west.

15.1 MODIFIED MANDOGALUP EAST LOCAL STRUCTURE PLAN (VERSION 3) – PART LOTS 9002 AND 9006 HOFFMAN ROAD AND 9019 ROWLEY ROAD, MANDOGALUP

At its meeting, on 11 November 2015, Council resolved that it did not support a long term connection from the MELSP (and MWLSP) directly to Rowley Road and advised the WAPC that:

The road network in the MELSP and MWLSP should be revised to provide a Neighbourhood Connector to Hammond Road. Future long term access to Rowley Road from both the MWLSP and MELSP should be via the proposed Rowley Road/Hammond Road interchange.

Version 3 has been modified, by the proponent, so that access will be via Hammond Road which complies with Main Road's, WAPC's and Council's position.

A north - south road connection under Rowley Road (through to Barfield Road) has been previously touted, however, Main Roads and the DoP have advised that a connection under Rowley Road at Barfield Road is not viable and is not included in Version 3.

c) Tree Retention

In accordance with the City's recently adopted *Landscape Feature and Tree Retention Policy* (LPP1), the proponent has undertaken the following additional aboricultural assessments to identify significant trees and landscape features with the MELSP area:

- *Assessment of melaleuca: Mandogalup* (Arborlogic, March 2016); and
- *Significant Tree Assessment: Mandogalup* (Arborlogic, October 2016)

The proponent has undertaken an aboricultural assessment of individual trees with a diameter greater than 500mm. An assessment of the structural integrity and viability of retaining individual trees was also undertaken.

During October 2016, Arborlogic completed an assessment of significant trees to inform the location and configuration of POS as well as the design of the road network.

A *Landscape Feature and Significant Tree Retention Strategy* has been prepared for the MELSP area in accordance with LPP1. The City has reviewed the strategy and recommends that it be supported as the basis for retaining significant trees within the MELSP area. There has been considerably more emphasis placed on tree retention in Version 3 in accordance with LPP1.

The City will request that a condition be imposed on future subdivision applications requiring the preparation of a *Landscape Feature and Tree Retention Plan* in accordance with the City's *Landscape Feature and Tree Retention Policy*.

d) Local Water Management Strategy (Water Sensitive Urban Design)

The modifications to Version 3, include the introduction of the following water sensitive urban design (WSUD) measures which are intended to improve the amenity of the streetscape:

- *Rain gardens* - a term used to describe an area of land (in this case approximately 250m^2) which is an extension to the road reserve that will serve as a vegetated drainage area. These areas are intended to be self sustaining at maturity, include an amended soil profile to strip nutrients from the stormwater runoff. The rain gardens are not included in the 10% POS provision.

The use of rain gardens throughout the MELSP will reduce the area down catchment required for stormwater retention within POS, therefore, increasing the amount of useable land within POS.

- *Tree pits* – are to be located throughout the MELSP to capture stormwater up to the 5 year Average Recurrence Interval (ARI).

The WSUD measures initially proposed, by the proponent, intended utilising road verges as swales for drainage and overland stormwater flow to rain gardens. The City was concerned that the reliance on road verges for drainage and overland flow may result in significant on-going maintenance issues and management costs.

The City (Engineering Department) has liaised extensively with the proponent to ensure that the risk to the City of inheriting ongoing stormwater management problems and maintenance costs is minimised. The Local Water Management Strategy (LWMS), which accompanies Version 3, has been modified by the proponent in accordance with the City's requirements.

The use of drainage swales has been replaced by using kerbing to direct stormwater to tree pits. The LWMS does not include any pit and/or pipe drainage infrastructure typically provided in greenfield subdivision developments.

The City will request that a condition be imposed on future subdivision applications requiring the preparation of a Urban Water Management Plan.

OTHER ELEMENTS ASSESSED BY THE CITY OF KWINANA

In addition to the matters discussed above, the City has also assessed version of the MELSP against the following matters, including the objectives and requirements of elements of *Liveable Neighbourhoods*:

Community Design
The MELSP (Version 3) report states that a range of lot sizes are intended to be provided to facilitate a diversity of dwelling types. The density codes shown on the LSP are Residential 30 to 60.

The LSP proposes a yield of approximately 581 lots (674 dwellings). This equates to 15.8 dwellings per gross 'Urban' zoned hectare or 30.5 dwellings per net site hectare. The yield exceeds *Direction 2031* which requires 15 dwellings per gross hectare and exceeds *Liveable Neighbourhoods* which requires 22 dwellings per net hectare. The City is satisfied with the lot yield.

Lot Layout
The MELSP (Version 3) allocates a base density of R30, with R40 and R60 allocated to lots near to the primary school, POS and adjacent to public transport and neighbourhood connector routes.

The density code range will also provide a range of lot sizes and dwelling types across the MELSP.

Utilities
The LSP area is able to be connected to water, sewer, electricity, gas and telecommunications services. It is normal practice for the WAPC to impose subdivision conditions requiring that these services be provided to an urban standard.

The servicing agencies did not raise any concerns with the MELSP.

Activity Centres and Employment
Consistent with the City's draft *Local Commercial and Activity Centres Strategy (LCAC)*, a Neighbourhood Centre (or Local Centre) is not proposed within Version 3 of the MELSP. LCAC proposes that the Neighbourhood Centre be generally situated within the MWLSP area.

The proponent undertook a *Retail Needs Assessment* for the Mandogalup urban cell which also concluded that there may be an opportunity to provide a supermarket based centre in the Mandogalup urban cell.

A Neighbourhood Centre is shown in Version 2 of the MWLSP adjacent to the primary school and playing fields and is a midpoint along the local distributor road that will connect Anketell and Rowley Roads.

Biodiversity (Vegetation, Flora & Fauna)
A flora survey was undertaken across the LSP area during Spring and Autumn 2007. A targeted threatened flora survey was also undertaken in 2014. The surveys identified the MELSP area as being predominantly cleared farmland with patches of eucalypts. A total of six vegetation types were mapped across the site.

A small confined area of vegetation within the north western portion of the site is identified through the surveys as being significant and worthy or retention. This is based on the excellent condition of the vegetation, the relative rarity of this vegetation type within the local area, and the presence of the Priority 3 Species *Cyathochaeta teretifolia*. The City has negotiated for a portion of this vegetation type to be retained in public open space.

The City will request that Fauna Management Plan be prepared at the subdivision stage to minimise potential impacts to Carnaby's Black Cockatoo.

Bushfire Management

The *State Planning Policy 3.7 – Planning in Bushfire Prone Area*s (SPP 3.7) (WAPC, 2015) and *Guidelines for Planning in Bushfire Prone Areas* (WAPC, 2015) are the predominant documents used by decision making authorities and referral agencies during the consideration of strategic planning proposals, subdivisions and development applications.

SPP 3.7 states that local structure plans should be accompanied by a *Bushfire Management Plan* which includes a *Bushfire Hazard Level* assessment or *BAL Contour Map* for those areas identified as bushfire prone.

The majority of the MELSP area is identified as a *Bushfire Prone Area* in the *Map of Bushfire Prone Areas* (2016), therefore, a *Bushfire Management Plan* is required for the area to support the LSP in accordance with SPP 3.7.

The Guidelines state that the following matters should be addressed in the *Bushfire Management Plan:*

a) Location of bushfire prone areas;
b) Avoidance of land use and development intensification extreme hazards areas;
c) Existing fire fighting infrastructure;
d) Existing and proposed road network and its effectiveness in a bushfire emergency; and
e) Integration of biodiversity protection in a bush fire management plan

The City's bushfire management consultant (Preplan) has advised that the *Bush Fire Management Plan* (Strategen Environmental, November 2016) is consistent with the current *Guidelines for Planning in Bushfire Prone Areas*.

Contamination

A Preliminary Site Investigation was undertaken by the proponent in 2015 which confirmed a number of potential contamination sources and contaminating activities had occurred from previous rural activities. On this basis remediation was undertaken to remove known potential sources of contamination.

Following removal of the potential sources of contamination to an off-site licensed landfill facility, a Detailed Site Investigation was undertaken. A human health and ecological risk assessment for the site was then undertaken and concluded that:

a) Residual contamination sources have been removed and there are no residual soil risks to human health or the environment; and
b) Ground water and surface water is suitable for non-potable use and irrigation and is not considered to be a risk to human health.

An accredited contaminated sites auditor was commissioned by the proponent to prepare a voluntary audit report for the site following completion of the Detailed Site Investigation. The voluntary audit report has been submitted to the Department of Environment Regulation (DER) by the proponent to support the assessment of the MELSP under the P&D Act.

Acid Sulfate Soils
The DoE's *Acid Sulfate Soil Risk Mapping* identifies the majority of the MELSP area as having a 'high' risk of Acid Sulfate Soils (ASS) within 3 metres of the surface. Conditions are likely to be imposed by the WAPC on the subdivision requiring that ASS is managed in accordance with the relevant WAPC's Guidelines.

Consistency of Infrastructure Standards across Multiple Development Sites
The City will require a consistent standard of infrastructure (roads and streetscape, lighting, POS landscaping) to be provided within the various landholdings in the Mandogalup urban cell.

LEGAL/POLICY IMPLICATIONS:

For the purpose of the Councillors considering a financial or impartiality interest only, Satterley Property Group is the proponent and owner of Part Lots 9002 and 9006 Hoffman Road and 9019 Rowley Road, Mandogalup.

Relevant legislation
Planning and Development Regulations 2015
Part 4 of the P&D Regulations sets out the requirements for the preparation, advertising and assessment of structure plans.

Metropolitan Region Scheme

City of Kwinana Town Planning Scheme 2

ASSET MANAGEMENT IMPLICATIONS:

Version 3 of the MELSP includes the following modifications intended to assist with asset management and reduce maintenance costs for the City:

a) ensuring that the WSUD measures, to be implemented within the MELSP, do not impose ongoing management problems or maintenance costs on the City;
b) the WSUD measures are replacing the need for management and replacement of traditional stormwater infrastructure such pipes and drainage sumps.
c) relocation of the primary school site and local playing field so that these facilities are centrally located within the Mandogalup urban catchment and are no longer situated within, or adjacent, to the KIB, as proposed in Versions 1 and 2.

The City liaised extensively with the proponent in relation to the required size, shape and location of the balance of the local playing fields so that it can accommodate the required sport and recreation facilities.

ENVIRONMENTAL IMPLICATIONS:

Metropolitan Region Scheme (MRS) Amendment 1114/33 to rezone Mandogalup from 'Rural' to 'Urban Deferred' was assessed by the EPA under section 48A of the *Environmental Protection Act 1986* (EP Act). The EPA advised, in a letter dated 13 March 2006, that Amendment 1114/33 did not require "formal assessment" under the EP Act and provided advice and recommendations. In particular, the EPA advised that it had not assessed the following issues in its assessment of Amendment 1114/33:

- Drainage
- Peel Harvey catchment
- Wetlands
- Remnant vegetation
- Fauna
- Contamination
- Air emissions
- Noise and vibration

The EPA's decision to not "formally assess" Amendment 1114/33 was on the basis that the environmental issues listed above can be resolved during subsequent stages of the planning process. If significant environmental impacts are not resolved as part of the planning process (eg. local structure plan), then future subdivision and developments may be referred to the EPA under section 48I of the EP Act. Section 48I places the onus on the WAPC (subdivision) or the City (development applications) to determine if proposals (subdivision/development) are likely to cause significant environmental impacts and whether they should be referred to the EPA for assessment.

The City is confident that future development in accordance with Version 3 of the MELSP will not cause any significant environmental impacts.

15.1 MODIFIED MANDOGALUP EAST LOCAL STRUCTURE PLAN (VERSION 3) – PART LOTS 9002 AND 9006 HOFFMAN ROAD AND 9019 ROWLEY ROAD, MANDOGALUP

STRATEGIC/SOCIAL IMPLICATIONS:

This proposal will support the achievement of the following objectives and strategies detailed in the *Strategic Community Plan* and *Corporate Business Plan 2016-2021*.

STRATEGIC COMMUNITY PLAN 2015-2025		**CORPORATE BUSINESS PLAN 2016 – 2021**
OBJECTIVE	**STRATEGY**	**ACTION**
3.2 Ensure high levels of environmental protection are achieved in new developments.	3.2.3 Ensure, where practicable, retention of remnant vegetation and natural systems within new residential subdivisions.	3.2.3.1 Ensure retention, where practicable, of remnant vegetation and encourage the retention of trees and other flora within new residential subdivisions above the 10% minimum required.
3.5 Encourage and exercise best practice water management.	3.5.1 Implement the City of Kwinana Water Conservation Plan, the Peel and Cockburn Catchment Regional Water Program and adopt Water Sensitive Urban Design Technical Guidelines in order to maximise water quality, recovery and reuse.	3.5.1.6 Implement the Water Conservation Plan
4.1 Residents are provided with a range of multifunctional community places and accessible recreation facilities.	4.1.1 Implement the City of Kwinana's Community Infrastructure Plan that identifies the location, nature and anticipated construction date of new community and recreation facilities.	4.1.1.2 Ensure Developer Contribution Schemes are aligned with the Community Infrastructure Plan.
		4.1.1.5 Reach a formal agreement with public and private education providers for shared use of facilities in accordance with the Community Infrastructure Plan.
4.2 The community has easy access to well equipped, quality parks and public open spaces.	4.2.1 In accordance with regulatory standards and the Community Infrastructure Plan, provide active recreation opportunities and develop public open space and infrastructure in new developments.	4.2.1.1 Implement the City's public open space development standards to ensure best practice standards are implemented and ongoing maintenance costs are minimised.
4.4 Create diverse places and spaces where people can enjoy a variety of lifestyles with high levels of amenity.	4.4.6 Ensure that an appropriate density of development is achieved that accommodates projected population growth and is balanced against community expectations.	4.4.2 Encourage and promote the design of places of activity and enjoyment
		4.4.6 Ensure that an appropriate density of development is achieved that accommodates projected population growth and is balanced against community expectations
		4.4.9 Engage with developers on infrastructure and sustainability issues.

15.1 MODIFIED MANDOGALUP EAST LOCAL STRUCTURE PLAN (VERSION 3) – PART LOTS 9002 AND 9006 HOFFMAN ROAD AND 9019 ROWLEY ROAD, MANDOGALUP

COMMUNITY ENGAGEMENT:

The City advertised Versions 1 and 2 of the MELSP between the 7 August and 4 September 2015 in accordance with the P&D Regulations. Advertising included the placement of a notice in a local newspaper, on the City's webpage and the erection of a sign on site inviting submissions to be lodged with the City on the LSP.

Under the City's *Community Engagement Policy,* adopted by the City in March 2016, the proposed MELSP is classified as a high impact proposal. The process of engagement undertaken by the City in August and September 2015, for the MELSP, were consistent with the processes outlined in the *Community Engagement Policy* (Community Engagement Matrix) adopted by the City, in March 2016.

The submissions received during the advertising period for Versions 1 and 2 of the MELSP have been previously considered by Council. The main issues of concern were the:

a) width of the KIB and how it impacts on the MELSP;
b) provision of public open space associated with the primary school within the KIB;
c) provision of active playing field inside of the KIB; and
d) traffic access to Rowley Road.

RISK IMPLICATIONS:

The risk implications in relation to this proposal are as follows:

Risk Analysis	Description
Risk Event	The WAPC could approve the MELSP if the City fails to provide timely advice in accordance with the procedures set out in the Planning and Development Regulations. This could result in development progressing without due regard for the City's planning policies and objectives.
Risk Theme	Failure to fulfil statutory regulations or compliance requirements
Risk Effect/Impact	Compliance
Risk Assessment Context	Strategic
Consequence	Moderate
Likelihood	Possible
Rating (before treatment)	Moderate
Risk Treatment in place	The City has project management procedures in place to ensure that statutory deadlines are met.
Response to risk treatment required/in place	The City is to give due regard to the MELSP when providing advice to the WAPC in relation to subdivision applications and making decisions in relation to development applications.
Rating (after treatment)	Moderate

15.1 MODIFIED MANDOGALUP EAST LOCAL STRUCTURE PLAN (VERSION 3) – PART LOTS 9002 AND 9006 HOFFMAN ROAD AND 9019 ROWLEY ROAD, MANDOGALUP

COUNCIL DECISION

425

MOVED CR B THOMPSON **SECONDED CR S MILLS**

The Council advise the Western Australian Planning Commission (WAPC) that it supports Version 3 of the Mandogalup East Local Structure Plan (Attachment 1) subject to the following:

c) Inclusion of a statement in the Local Structure Plan text requiring the preparation of the following management plans to the City's satisfaction as part of the subdivision application process:

iv. Urban Water Management Plan
v. Landscape and Tree Management Strategy
vi. Fauna Management Plan

d) Forward this *Ordinary Council Meeting Report* and Council's resolution to the WAPC pursuant to clause 20 of the *Planning and Development Regulations 2015*.

CARRIED
6/0

Council Note:

The Officer Report has been corrected to amend all references to the term AIcoa Residue Disposal Area buffer, except when referencing previous Council decisions, to now read, Kwinana Industrial (including Air Quality) Buffer as this is the terminology used by the Western Australian Planning Commission.

Planning Design Delivery

Rowley Road

Kwinana Freeway

1

PS

Hoffman Road

N

RESIDENTIAL

Residential (R30-R60)

PUBLIC PURPOSE

PS Educational/Institutional

PS Primary School

PARKS,RECREATION & CONSERVATION

Parks, Recreation and Drainage

Drainage

TRANSPORT

Access Street - Local Road

Primary Distributor Road

District Distributor Integrator A

Neighbourhood Connector

Temporary Neighbourhood Connector

Indicative Cycleway Access

OTHER

Structure Plan Boundary

ADDITIONAL INFORMATION

Proposed WTCPA - 1.5km Buffer

DBNGP Easement

Western Power Easement

1 Investigation Area - Local Playing Fields

Existing Lot Boundaries

ATTACHMENT 1

0 200 400 Metres

REVISIONS

Rev	Date	Drawn
A	2016.09.06	M. Sullivan
B	2016.09.07	M. Sullivan
C	2016.11.03	M. Sullivan

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Date Drawn:	2016-09-06
Job Ref:	7282A
Scale:	1:7,500 @ A3
Client:	Satterley Property Group
Designer:	R. Cumming
Drawn:	M. Sullivan
Projection:	PCG 94
Plan ID:	7282A-STR-07-C

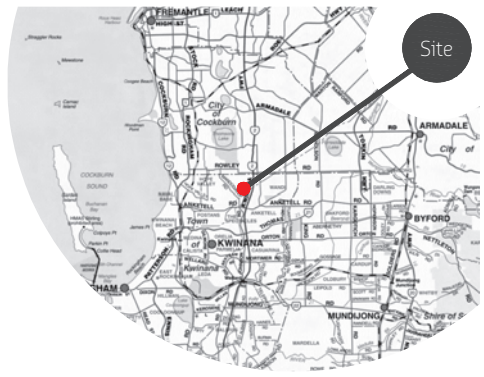
Mandogalup East Local Structure Plan

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_STR07C_20161103 MANDOGALUP (WAPC - PROPOSED EAST).DWG
Matt Sullivan 7 November 2016

ORIGINAL
DRAFT MANDOGALUP EAST LOCAL STRUCTURE PLAN

Version 1
9 July 2014

Planning Design Delivery



RESIDENTIAL
- Residential - Medium Density (R30-R60)

PUBLIC PURPOSE
- PS Educational/Institutional
  - PS Primary School

PARKS,RECREATION & CONSERVATION
- Strategic Public Open Space
- Drainage - Regional

TRANSPORT
- Access Street - Local Road
- Primary Distributor Road
- District Distributor Integrator A
- Neighbourhood Connector
- Temporary Neighbourhood Connector
- Indicative Future Road Connection

OTHER
- Structure Plan Boundary

ADDITIONAL INFORMATION
- Air Quality Buffers
- DBNGP Easement
- Western Power Easement
- Investigation Area - Future Land Use to be Determined
- Existing Lot Boundaries
- Rising Main Water Easement

Kwinana Freeway

Subject to Local Structure Planning by Others

PS

Local Playing Fields

Hoffman Road

N

0 200 400 Metres

ATTACHMENT 2

REVISIONS

Rev	Date	Drawn
A	2014.04.08	K. Trenberth
B	2014.05.07	K. Trenberth
C	2014.06.16	K. Trenberth
D	2014.07.09	M. Winfield

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Client:	Satterley Property Group
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Drawn:	K. Trenberth
Projection:	PCG 94
Plan ID:	7282A-STR-02-D

Local Structure Plan

Mandogalup
Plan 1

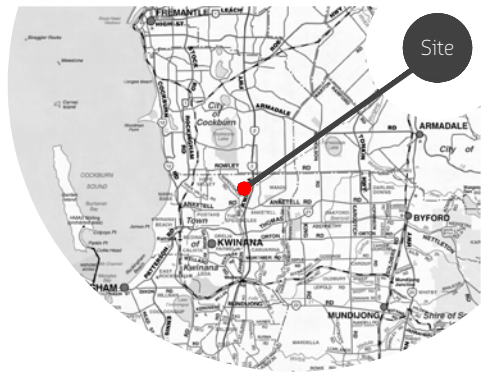
N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_STR02D_20140616 MANDOGALUP (WAPC).DWG
Matt Winfield 15 July 2014

REVISED
DRAFT MANDOGALUP EAST LOCAL STRUCTURE PLAN

Version 2

12 August 2015

Planning Design Delivery



Kwinana Freeway

Subject to Local Structure Planning by Others

PS (2.266ha)

PS (1.734ha)

Local Playing Fields

Hoffman Road

RESIDENTIAL

- Residential - Medium Density (R30-R60)

PUBLIC PURPOSE

- PS — Educational/Institutional
  - PS Primary School

PARKS,RECREATION & CONSERVATION

- Strategic Public Open Space
- Drainage - Regional

TRANSPORT

- Access Street - Local Road
- Primary Distributor Road
- District Distributor Integrator A
- Neighbourhood Connector
- Temporary Neighbourhood Connector
- Indicative Future Road Connection

OTHER

- Structure Plan Boundary

ADDITIONAL INFORMATION

- Air Quality Buffers
- DBNGP Easement
- Western Power Easement
- Investigation Area - Future Land Use to be Determined
- Existing Lot Boundaries
- Rising Main Water Easement
- Balance of Primary School site to be provided by adjoining landowner under the mandogalup west LSP

ATTACHMENT 3

0 200 400 Metres

REVISIONS

Rev	Date	Drawn
C	2014.06.16	K. Trenberth
D	2014.07.09	M. Winfield
E	2015.08.11	W. Clements
F	2015.08.12	W. Clements

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Designer:	R. Cumming
Drawn:	K. Trenberth
Projection:	PCG 94
Plan ID:	7282A-STR-02-F

Local Structure Plan

Mandogalup Plan 1

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_STR02F_20150812 MANDOGALUP (WAPC).DWG
Kim Kyle 12 August 2015

LOCAL STRUCTURE PLAN

MANDOGALUP EAST

SPN/0774

ATTACHMENT 4

ROWEGROUP

OUR REF: 7282 12/12/2016

DOCUMENT CONTROL

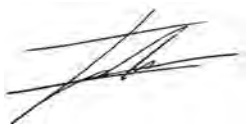
Printed 13 December 2016 7282_16dec01R_rc

Version	File Name	Prepared by	Approved by	Date
1	7282_14may01R_rc	R. Cumming	K. Kyle	06/08/2014
2	7282_16jan01R_rc	R. Cumming	K. Kyle	25/01/2016
3	7282_16june01R_rc	R. Cumming	G. Hajigabriel	8/06/2016
4	7282_16dec01R_rc	R. Cumming	G. Hajigabriel	12/12/2016

This report has been authorised by;

George Hajigabriel
General Manager

Rebecca Cumming Designer



Jamie Baxter Quality Control

CONTACT PERTH OFFICE

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ENDORSEMENT PAGE

This structure plan is prepared under the provisions of the City of Kwinana Town Planning Scheme No. 2.

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

..... Date

Signed for and on behalf of the Western Australian Planning Commission:

.....

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

..... Witness

..... Date

..... Date of Expiry

TABLE OF AMENDMENTS

Amendment No.	Summary of the Amendment	Amendment Type	Date Approved by WAPC
0	*[Original Local Structure Plan]*		

EXECUTIVE SUMMARY

This Local Structure Plan addresses the Urban zoned land comprising Part Lots 9002, 9006 and 11 Hoffman Road, and Lot 9019 Rowley Road, Mandogalup. The Local Structure Plan area also includes a portion of the Peel Main Drain (Lot 8018). The subject site is herein referred to as the Mandogalup East Local Structure Plan or MELSP.

The Local Structure Plan area was transferred to the Urban zone on 18 March 2014, by notice in the Government Gazette (notice reference PL403).

The purpose of this Local Structure Plan is to provide a plan for the coordination of future zoning and subdivision of the subject land to facilitate development for residential purposes, complementary to its Urban zoning.

The preparation of this Local Structure Plan has been undertaken in liaison with Qube Property Group (the adjacent landholder comprising the Mandogalup West Local Structure Plan), the City of Kwinana and all other relevant approval agencies.

Structure Plan Summary Table

Item	Data	Section number referenced in report
Total area covered by the Structure Plan	42.67 hectares	1.2
Area of each land use proposed: Zones Residential Reserves Road Parks, Recreation and Drainage Public Purpose – Primary School	Hectares / Lot yield 22.12 hectares / 581 lots 11.64 hectares 4.3 hectares 1.49 hectares	3
Estimated lot yield	581 lots	3.3
Estimated number of dwellings	674 dwellings	3.3
Estimated residential site density Dwellings per Gross Urban Hectare Dwellings per Site Hectare	30.5 dwellings per gross urban hectare. 15.8 dwellings per residential site hectare.	3.3
Estimated population	1887 people @ 2.8 people per household	3.3
Number of high schools	nil	3.7
Number of primary schools	1 primary school	3.7
Estimated commercial floor space (for activity centres if appropriate)	Not applicable	3.8
Estimated area and % of public open space: Total public open space Unrestricted public open space Restricted public open space *1:1 yr drainage deduction from net area*	 4.3 hectares 3.4 hectares (8.84% of GSA) 0.9 hectares (2.39% of GSA)	3.2
Composition of public open space: - Regional open space - District open space - Neighbourhood parks - Local parks	 - nil - 1.15 hectares (playing fields) - 2.8 hectares, 4 parks - 0.35 hectares, 2 parks	3.2
Estimate percentage of natural area	POS Area 5 comprises approximately 0.9 hectares of retained vegetation, subject to detailed design. Various significant trees and landscape features to be retained throughout the site, subject to detailed design.	2.1.2 and 3.2

Note: All information and areas are approximate only and are subject to survey and detailed design.

CONTENTS

FIGURES

TECHNICAL APPENDICES

Appendix Number	Document Title	Nature of Document	Referral/ Approval Agency	Approval status and Modifications
1.	Certificates of Title	Supporting	n/a	
2.	Government Gazette Notice for Urban Zoning	Supporting	n/a	
3.	Environmental Assessment Report	Supporting	n/a	
4.	Bushfire Management Plan	Requires Approval	City of Kwinana / DFES	Lodged. Awaiting Approval.
5.	Acoustic Report	Requires Approval	Main Roads WA	Comments received. Awaiting approval of amended document.
6.	Landscape and Public Open Space Strategy	Supporting	n/a	
7.	Transport Assessment	Supporting	n/a	
8.	Local Water Management Strategy	Requires Approval	Department of Water / City of Kwinana	Comments received. Awaiting approval of amended document.
9.	Retail Needs Assessment	Supporting	n/a	
10.	Engineering Services Report	Supporting	n/a	
11.	Department of Education Correspondence	Supporting	n/a	

Part One
IMPLEMENTATION

ROWEGROUP

1. Structure Plan Area

This Structure Plan applies to the land contained within the inner edge of the line denoting the Structure Plan boundary on the Structure Plan map (Refer Plan 1 situated at the end of Part 1 of this Structure Plan report).

2. Operation

This Structure Plan comes into effect on the day it is approved by the Western Australian Planning Commission.

3. Staging

Figure 15 of Part Two of this Structure Plan report depicts indicative staging for the subdivision of the structure plan area.

Development of the site will generally be from the south to north. Whilst water mains are to be extended from the north, initial site access and sewerage infrastructure servicing will come from the south.

4. Subdivision and Development Requirements

4.1 Residential densities for the structure plan area are the residential densities shown on the Local Structure Plan Map, and as indicatively shown at Figure 10.

4.2 The Local Structure Plan is to provide for a minimum of 10% public open space in accordance with the WAPC's Liveable Neighbourhoods requirements. Public open space is to be provided generally in accordance with the Local Structure Plan Map, and as indicatively shown at Figures 11 and 12.

4.3 This Structure Plan is supported by a Bushfire Management Plan (BMP) (Strategen November 2016). Any land falling within 100 metres of a bushfire hazard identified in the BMP is designated as a Bushfire Prone Area for the purpose of the Building Code of Australia.

4.4 Notifications on Title

The Council shall recommend to the Western Australian Planning Commission that a condition be imposed on the grant of subdivision approval for a notification to be placed on the Certificate of Title to suitably respond to the following:

a) The Bushfire Management Plan for lots with a Bushfire Attack Level (BAL) rating of 12.5 or higher;

b) Transport noise for lots that are the subject of noise levels exceeding the noise target as per *State Planning Policy 5.4 – Road and Rail Transport Noise and Freight Considerations in Land Use Planning*.

4.5 Management Plans

The Council shall recommend to the Western Australian Planning Commission that a condition be imposed on the grant of subdivision approval to respond to the following as identified by the structure plan:

a) An Urban Water Management Plan.

5. Local Development Plans

A Local Development Plan is required in the following circumstances:

a) Lots with an area of 260 square metres or less;

b) Irregular shaped lots;

c) Lots where specific vehicle access and egress control is required;

d) Lots abutting public open space;

e) Lots with particular site constraints; and

f) Lots subject of a notification on title.

6. Other Requirements

6.1 Investigation Area

The classification of land use within Investigation Area 1 has no force or effect until the Western Australian Planning Commission is satisfied on the advice of the City of Kwinana and the Department of Education that suitable land has been set aside for the purpose of the primary school.

A minor amendment to the Structure Plan will be required to remove the Investigation Area allocation.

6.2 Developer Contribution Arrangements

Under the City of Kwinana Town Planning Scheme No. 2, the following development contribution arrangements apply and/or are contemplated:

a) Development Contribution Area 8 for the funding of community infrastructure; and

b) Development Contribution Area 6 for traditional infrastructure.

Planning Design Delivery

RESIDENTIAL
- Residential (R30-R60)

PUBLIC PURPOSE
- PS Educational/Institutional
  - PS Primary School

PARKS,RECREATION & CONSERVATION
- Parks, Recreation and Drainage
- Drainage

TRANSPORT
- Access Street - Local Road
- Primary Distributor Road
- District Distributor Integrator A
- Neighbourhood Connector
- Temporary Neighbourhood Connector
- Indicative Cycleway Access

OTHER
- Structure Plan Boundary

ADDITIONAL INFORMATION
- Proposed WTCPA - 1.5km Buffer
- DBNGP Easement
- Western Power Easement
- 1 Investigation Area - Local Playing Fields
- Existing Lot Boundaries

0 200 400 Metres

REVISIONS

Rev	Date	Drawn
A	2016.09.06	M. Sullivan
B	2016.09.07	M. Sullivan
C	2016.11.03	M. Sullivan

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PLANNING DESIGN DELIVERY

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Date Drawn:	2016-09-06
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Designer:	R. Cumming
Drawn:	M. Sullivan
Projection:	PCG 94
Plan ID:	7282A-STR-07-C

Mandogalup East Local Structure Plan

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_STR07C_20161103 MANDOGALUP (WAPC - PROPOSED EAST).DWG
Matt Sullivan 7 November 2016

Part Two
EXPLANATORY SECTION

ROWEGROUP

01 Planning Background

1.1 Introduction and Purpose

The purpose of the Local Structure Plan is to provide a plan for the coordination of future zoning and subdivision of the subject land. The subject land relates to the urban zoned land within Part Lot 9002 Hoffman Road, Part Lot 9006 Hoffman Road, Part Lot 11 Hoffman Road, and Lot 9019 Rowley Road, Mandogalup, herein referred to as the Mandogalup East Local Structure Plan or MELSP.

Subdivision and development of the subject land in accordance with this structure plan represents a logical progression of the development front from the north (Hammond Park), as well as the eastern side of the Kwinana Freeway (Wandi).

1.2 Land Description

1.2.1 Location

The MELSP is located within the metropolitan south west corridor, within the municipality of the City of Kwinana. The site is situated approximately 24 km south of the Perth Central Area, and is accessible via the Kwinana Freeway. The Kwinana Town Centre is located approximately 8 km south of the site and the Spectacle Regional Reserve approximately 4 km from the subject site.

The subject site is generally bound by the Kwinana Freeway to the east and Rowley Road to the north. Land to the immediate west of the site is zoned urban and urban deferred. The Urban zoned portion of the adjoining site is subject to a separate LSP currently being progressed with the City by Qube Property Group, known as the Mandogalup West Local Structure Plan or MWLSP.

Refer to Figure 1 – Regional Location.

Refer to Figure 2 – Local Location.

1.2.2 Area and Land Use

The MELSP comprises approximately 42.67 hectares of land situated west of the Kwinana Freeway, immediately south of Rowley Road. The site is currently accessed by Hoffman Road, which runs parallel to the Kwinana Freeway and connects to Anketell Road in the south.

The subject site has historically been used for agricultural purposes including grazing, cropping and horse agistment. There are no existing dwellings or structures remaining on site.

Lot 9019 comprises existing vegetation, with some areas of larger and denser vegetation. Lots 9002, 9006 and 11 are generally cleared with some stands of trees. A referral under the EPBC Act was submitted for the site in August 2014, with an approved controlled action issued by the Department of the Environment in July 2015, and appropriate offset arrangements secured in October 2015.

The Peel Main Drain (PMD) and the Dampier to Bunbury Natural Gas Pipeline (DBNGP) both dissect the site from its eastern to western boundaries.

The south western boundary of the LSP area is defined by the outer edge of the Revised Kwinana Industrial (including air quality) Buffer (as of 21 September 2010) (herein referred to as KIB), being the extent of the urban zone. Further information on the KIB and its impact on the MELSP area are provided throughout this report.

1.2.3 Legal Description and Ownership

The MELSP comprises five land parcels, being:

Lot Number / Address	Proprietor	Deposited Plan	Volume / Folio
Lot 9019 Rowley Road	Wandi Anketell Holdings Pty Ltd	400699	2838/776
Part Lot 9006 Hoffman Road	Wandi Anketell Holdings Pty Ltd	70124	2769/ 846
Part Lot 9002 Hoffman Road	Wandi Anketell Holdings Pty Ltd	69132	2758/ 177
Part Lot 11 Hoffman Road	S and A Galati Rando	76538	2809/ 569
Lot 8018 (UCL – Peel Main Drain)	State of WA	77243	LR 3024 / 314

The LSP area comprises approximately 42.67 hectares of land.

Refer Figure 3 - Site Plan and Appendix 1 - Certificates of Title.

1.3 Planning Framework

1.3.1 Zoning and Reservations

Land within the MELSP boundary is zoned 'Urban' under the Metropolitan Region Scheme (MRS), and 'Development' under the City of Kwinana Town Planning Scheme No. 2 (TPS 2).

The land was transferred to the 'Urban' zone under the MRS on 18 March 2014, by notice in the Government Gazette (notice reference PL403). Upon Gazettal of the Urban zone, the site was concurrently zoned 'Development' under TPS 2, by resolution of the WAPC and notice in the Government Gazette.

The subdivision, use and development of land within the Development zone is to generally be in accordance with a Structure Plan that has been prepared and adopted under the provisions of 6.17 of TPS 2.

The Hoffman Road reservation runs parallel to the Kwinana Freeway. Hoffman Road provides access to the site from Anketell Road and will form part of the development of the site, however is excluded from the MELSP boundary.

The Peel Main Drain comprises Lot 8018.

The Dampier to Bunbury Natural Gas Pipeline (DBNGP) also dissects the site generally in an east-west direction along the southern boundary of Lot 9006.

Refer Figure 4 - Metropolitan Region Scheme Zoning.

Refer Figure 5 – Town Planning Scheme No.2 Zoning.

1.3.2 Regional and Sub-Regional Structure Plan

1.3.2.1 Jandakot Structure Plan

The MELSP is situated within the Jandakot Structure Plan area.

The Jandakot Structure Plan was finalised in August 2007 and provides a strategic direction to coordinate the development of the region while ensuring environmental, social and economic objectives are met.

Previously, the major constraint to urban development within this corridor was the resolution of groundwater and stormwater management. With the preparation of the Jandakot District Water Management Plan (JDWMP) however, these issues have now been resolved and have been accommodated in current planning for the cell under this structure plan and the associated Local Water Management Strategy.

The district level requirements of the Jandakot Structure Plan, such as the identification and preservation of natural areas, the allocation of public open space and public purpose areas, road network and hierarchy, and the allocation of school sites have been further refined through the preparation of this structure plan.

The Jandakot Structure Plan identifies the MELSP area for urban development.

The proposed MELSP is considered to be consistent with the intent and requirements of the Jandakot Structure Plan.

1.3.2.2 Eastern Residential Intensification Concept (ERIC)

The City of Kwinana's draft District Structure Plan, referred to as the 'Eastern Residential Intensification Concept' (ERIC) was prepared by the City of Kwinana in 2005 to provide strategic direction and refinement of the future urban areas identified under the Jandakot Structure Plan. Whilst ERIC has yet to be finally adopted by Council, it provides a framework for the preparation of structure plans within the urban corridor.

The ERIC plan identifies the following land uses within the MELSP area:

- Residential R20;
- Residential R25 and Higher;
- Local Open Space, and
- Special Residential associated with the Western Power easement.

The MELSP has been prepared giving due consideration to the provisions of ERIC, albeit updated to respond to the current planning framework, policies, principles and objectives.

1.3.2.3 Draft Perth and Peel @ 3.5 Million

The Draft Perth and Peel @ 3.5 Million was released for public comment in May 2015, and seeks to provide a framework for the development of the Perth and Peel regions as the population reaches an estimated 3.5 million by 2050. The document seeks to meet the targets identified under Directions 2031 and the State Planning Strategy 2050. The suite of documents also includes four draft sub-regional planning frameworks for the Central, North-West, North-East and South Metropolitan Peel sub-regions.

The subject site is situated within the South Metropolitan Sub-Region, and is identified as 'Urban', consistent with the current MRS zoning.

1.3.2.3.1 Draft South Metropolitan Peel Sub-Regional Planning Framework

As noted above, the subject site is identified for Urban development under the draft South Metropolitan Sub-Regional Planning Framework (the Framework). The Framework identifies a projected additional dwelling target of 19,549, with a projected additional population of 49,499, within the City of Kwinana. Indicative subdivision design for the MELSP identifies an approximate yield of 581 lots (674 dwellings), equating to a population of approximately 1,887 people (based on 2.8 people per household). The

development of the MELSP will therefore assist in achieving dwelling and population targets identified under the Draft Framework.

The Draft Framework also requires new urban development meet a residential density target of 15 dwellings per gross hectare. The proposed MELSP is capable of achieving this.

1.3.3 Liveable Neighbourhoods

Liveable Neighbourhoods (2009) is a Western Australian Planning Commission (WAPC) operational policy that guides structure planning and subdivision for greenfield and large brownfield (urban infill) sites. The MELSP has been designed in accordance with the principles and requirements of Liveable Neighbourhoods.

The indicative layout has been designed using relatively short street blocks to provide for a permeable and legible pedestrian, cycle and vehicle movement network. The public open space network provides for connectivity through the site, intended to serve a variety of functions to cater for a wide demographic, with all proposed lots within approximately 200 metres of public open space.

The structure plan provides for a primary school and local playing fields generally central within the Mandogalup catchment (MELSP and MWLSP areas).

The indicative layout has also had consideration for the existing topography and landform of the site, as well as facilitating relatively good solar orientation of future lots. Servicing and water management considerations have also been facilitated within the indicative layout.

In accordance with Liveable Neighbourhoods requirements for a minimum average density of 22 dwellings per residential site hectare, indicative subdivision design for the MELSP achieves approximately 30.5 dwellings per residential site hectare.

1.3.4 Planning Policies

The MELSP responds to the following City of Kwinana Local Planning Policies:

- Planning for Bushfire Protection Guidelines
  - Preparation of a Bushfire Management Plan to support the MELSP; and
  - Consideration of fire management in concept planning and allocation of public open space, as well as in the landscape master plan.
- Public Open Space
  - Provision of a minimum of 10% open space;
  - Consideration for the City of Kwinana Community Infrastructure Plan;
  - Consideration of public open space location, size, functional distribution and useability requirements;
  - Consideration for drainage requirements and restrictions within credited public open space areas; and
  - Consideration for requirements regarding conservation and wetland areas within public open space.

- Landscape Feature and Tree Retention
  - Identification and retention of significant trees (in accordance with the definition under the policy) within public open space and road reserves;
  - Consideration of existing site topography in preliminary earthworks, servicing and drainage considerations, informing the indicative street block layout; and
  - The preparation of the landscape feature and significant tree retention strategy (comprising part of the Environmental Assessment Report).

Other Local Planning Policies to be addressed and considered through the subdivision and detailed stages include:

- Design Guidelines for Medium Density Development;
- Crossovers;
- Footpaths;
- Residential Development
- Residential Subdivision Development Guidelines;
- Residential Subdivision Road Standards;
- Retaining Wall Levels;
- Street Lighting;
- Street Naming, and
- Street Trees and Verge Treatments.

1.3.5 Other Approvals and Decisions

1.3.5.1 Urban Deferred Lifting

As previously noted, the land was concurrently transferred to the 'Urban' zone under the MRS and 'Development' zone under TPS 2 in March, 2014.

Land adjoining the MELSP on its south western boundary remains Urban Deferred pending resolution of the KIB and associated land uses.

Refer Appendix 2 - Government Gazette Notice for the Urban zoning.

1.3.5.2 Revised Kwinana Industrial (Including Air Quality) Buffer (21 September 2010)

The south west boundary of the MELSP is defined by the extent of the MRS Urban zone, which aligns to the *Revised Kwinana Industrial (Including Air Quality) Buffer (as of 21 September 2010)* (the KIB). The KIB is currently subject to draft legislation for the Western Trade Coast Protection Area.

The MELSP provides a road interface to the KIB to provide for flexibility for future land uses within the KIB, to be defined by the Western Trade Coast Protection Area Bill and subsequent relevant Region and Local Scheme zonings.

The MELSP proposes drainage within the KIB to support the urban residential development of the structure plan area. The use of the KIB for urban drainage has been supported by the City of Kwinana.

Such drainage areas are not proposed to contribute to the public open space requirements for the MELSP.

Refer Figure 6 – KIB Plan.

1.3.5.3 Mandogalup Train Station

Under the draft Jandakot Structure Plan, two railway station sites were proposed for the Perth to Mandurah railway line adjacent to the MELSP area, being the Rowley Road (north) and Anketell Road sites. However, in early 2007 under a Ministerial directive, the then Department of Planning and Infrastructure in conjunction with the Public Transport Authority began a review of all proposed railway stations along the Perth to Mandurah railway line, including the Rowley Road (north) and Anketell Road sites.

As a result of this review, the WAPC resolved in 2008 to consolidate the two sites and endorse a station 400-600 metres south of Rowley Road (Mandogalup Station site). The station was also identified in the 2010 draft Outer Metropolitan Perth and Peel Sub-Regional Strategy for the south-west sub region.

Notwithstanding, the Public Transport Plan for Perth in 2031 was released by the Department of Transport for public comment in 2011, identifying the location of a single station at either Success or Mandogalup before 2031, contrary to the WAPC's resolution of 2008.

Following further review and consideration, and in order to provide certainty for the future development of the corridor, the WAPC resolved on 23 April, 2013 to delete the Mandogalup station from future planning for the corridor. The MELSP is therefore reflective of this decision.

1.3.5.4 EPBC Act Referral

The MELSP was referred to the Department of the Environment (DotE) in August 2014. The referral identified the clearing of 19.7 ha of Carnaby's Black-Cockatoo foraging and potential breeding habitat. DotE released a notification in September 2014 determining that the referral was considered a Controlled Action to be assessed by preliminary documentation. The preliminary assessment documentation was released for public comment during March 2015. Additional information relating to the proposal was released for public comment in June 2015. In July 2015 DotE approved the proposed action subject to a number of conditions relating to clearing procedures, reporting and the acquisition of an offset property. Satterley Property Group secured the appropriate offset property in agreement with DotE and the Department of Parks and Wildlife (DPaW) in October 2015. The approval remains in effect until 31 July 2025.

No clearing to date has been undertaken.

02 Site Conditions and Constraints

The following provides a summary of the environmental site conditions and constraints. For further information the Environmental Assessment Report (EAR) is provided in Appendix 3.

2.1 Biodiversity and Natural Area Assets

2.1.1 Flora and Vegetation

A Level 2 flora survey was undertaken across the MELSP area during Spring and Autumn 2007. A targeted threatened flora survey was also undertaken in 2014.

The surveys identified the MELSP area as being predominantly cleared farmland with patches of eucalypts. A total of six vegetation types were mapped across the site, comprising of:

1. Banksia attenuata Low Woodland, with *Eucalyptus marginata*, *Dasypogon bromeliifolius*, *Phlebocarya ciliate*, local *Melaleuca preissiana*, *Pultenaea reticulata* and *Hypocalymma angustifolium*, some other natives and, commonly, weeds.
2. *Banksia attenuata* Low Woodland with *Eucalyptus marginata*, *Allocasuarina fraseriana* and understoreys of *Xanthorrhoea preissii*, *Adenanthos cygnorum*, Acacia pulchella, *Stirlingia latifolia* and other natives, and of weeds; much of it regenerating after the 2004 fire.
3. Banksia attenuata Low Woodland, with thickets of Adenanthos cygnorum.
4. Eucalyptus rudis very healthy Open Forest in soak/spring, with Melaleuca preissiana and M. Rhaphiophylla tall trees, over Pteridium esculentum – Cyathochaeta teretifolia – Baumea articulata Closed Herb-Sedgeland; with Lepidosperma longitudanale, Hemarthria uncinata, Hibbertia perfoliata, Dielsia stenostachya, Baumea vaginalis, Poa serpentum; few aliens.
5. *Eucalyptus rudis* (largely leafless) Woodland (to Open Forest) over *Kunzea glaberescens* and *Astartea sp*. Closed Tall Scrubs, dense *Pteridium esculentum* and weeds; locally with healthy *Eucalyptus marginata* and *Melaleuca preissinana* trees.
6. *Kunzea glabrescens* Closed Tall to Tall Open Scrub; with, in more open sites, *Dasypogon bromeliifolius*, *Phlebocarya ciliate*, *Euchilopsis linearis* and other natives; some weedy degraded areas and many dead shrubs over 1 metre tall.

The condition of vegetation ranges in quality across the site from Excellent to Completely Degraded, with most remnant vegetation being in Very Good to Degraded condition. Weeds are common in the majority of the bushland existing across the site.

2.1.2 Significant Trees and Landscape Features

In accordance with the City of Kwinana *Landscape Feature and Tree Retention Policy*, the following arboricultural assessments have been undertaken for the identified significant trees and landscape features within the MELSP area:

- Mandogalup Urban Development Site Lyon Road, Mandogalup Tree Survey (Paperbark Technologies, July 2014 – Appendix 7 of the EAR).
- Assessment of melaleuca: Mandogalup (Arborlogic, March 2016 – Appendix 8 of EAR).

- Significant Tree Assessment: Mandogalup (Arborlogic, October 2016 – Appendix 9 of EAR).

In response to the *Landscape Feature and Tree Retention Policy,* arboricultural assessments of individual trees within unique landscape features and/or having a diameter breast height greater than 500mm were undertaken across the site. Assessment of the structural integrity and viability of retaining individual trees within the site was also undertaken.

During October 2016, Arborlogic completed a site wide assessment of significant trees, assessing 173 trees as having a retention value of 'very low', 'low', 'medium' or 'high'. The retention value was based on an assessment of health and/or structural integrity. This was used to inform the location and configuration of public open space across the MELSP, as well as road network configuration considerations.

A landscape feature and significant tree retention strategy is provided within the attached Environmental Assessment Report (refer MELSP Appendix 3).

2.1.3 Conservation Areas

There are no Bush Forever sites or other such areas of conservation significance mapped over the Structure Plan area.

A Protected Matters database search identified nine species under the EPBC Act that may occur within the MELSP area. However, during surveys undertaken for the site, no Threatened Ecological Communities (TEC) as listed under the EPBC Act or the Wildlife Conservation Act 1950, or Priority Ecological Communities (PEC) as listed by Department of Parks and Wildlife (DPaW) were recorded in the MELSP area.

A small confined area of vegetation within the north western portion of the site is identified through the surveys as being significant and worthy or retention. This is based on the excellent condition of the vegetation, the relative rarity of this vegetation type within the local area, and the presence of the Priority 3 Species Cyathochaeta teretifolia. A portion of this vegetation type is intended to be retained in public open space.

The survey recorded one individual of Jacksonia sericea (Priority 4 species) in the MELSP area. However, the survey noted the removal of this individual during development is not considered to have a significant impact to this taxon.

2.1.4 Dieback

A dieback assessment of the MELSP area was undertaken in November 2013.

Much of the area was found to be either heavily disturbed (hence unmappable), or completely void of vegetation (excluded from the assessment). No confirmed dieback infestations were recorded during the survey, however, some areas exhibited a pattern of vegetation decline consistent with *Phytopthora* dieback infestation, and are highly likely to be infested.

A single, uninfested protectable area was identified and demarcated during the assessment. The area exhibited some signs of vegetation decline; however, representative samples were negative for the presence of *Phytopthora cinnamoni*.

A Dieback Management Plan is expected to be required as a condition of subdivision approval.

2.1.5 EPBC Referral

A Carnaby's Black Cockatoo habitat assessment was undertaken for the site in 2013. The assessment identified approximately 19.07 hectares of potential foraging habitat and up to 29 significant trees are likely to be impacted by the MELSP.

On this basis, an EPBC Act referral was submitted to the Department of the Environment (DotE) in August 2014. The referral identified the clearing of 19.7 hectares of Carnaby's Black-Cockatoo foraging and potential breeding habitat. DotE released a notification in September 2014 determining the referral was considered a Controlled Action to be assessed by preliminary documentation, with the preliminary assessment documentation being released for public comment during March 2015.

Additional information relating to the proposal was later released for public comment in June 2015. In July 2015 DotE approved the proposed action subject to a number of conditions relating to clearing procedures, reporting and the acquisition of an offset property. Following this, Satterley Property Group secured the appropriate offset property in agreement with DotE and the Department of Parks and Wildlife (DPaW) in October 2015. The approval remains in effect until 31 July 2025. No clearing to date has been undertaken.

Opportunities to minimise potential impacts to Carnaby's Black Cockatoo will be addressed in the Fauna Management Plan, to be prepared at the subdivision stage.

2.1.6 Wetlands

There is a Multiple-Use (MU) category wetland mapped over the northern and southern portions of the MELSP area, with a small area of Resource Enhancement (RE) wetland mapped in the north of the site. The Resource Enhancement wetland forms part of a larger wetland which originally extended to the Wandi North Urban Cell, however was dissected and degraded through works associated with the construction of the Kwinana freeway. Vegetation within the RE wetland is predominantly in a degraded condition and is considered to have low wetland values. On this basis, the RE wetland is not intended to be retained under the MELSP.

The closest Ramsar-listed wetland to the site is the 'Spectacles Reserve,' situated approximately 4 kilometres south of the site. The Spectacles wetland is classified as a Conservation Category Wetland by the DPaW and is also situated within Bush Forever site number 269.

The Thomsons Lake Nature Reserve is situated approximately 3 kilometres to the north of the MELSP and comprises the Ramsar-listed Thomsons Lake. This area forms part of the Beeliar Regional Park.

These wetlands will not be impacted by the proposed development.

Refer Figure 7 – Wetland Plan.

2.2 Landform and Soils

The MELSP is situated at the interface of the Bassendean and Spearwood dune systems. Soils within the site are predominantly Lacustrine deposits consisting of sandy silt and light grey, fine to medium grey sand over Lacustrine deposits. A small portion in the north of the site does not contain underlying Lacustrine deposits.

The topography of the site is mostly low lying and gently undulating, with local relief from 12 metres AHD at the westernmost point to 28 metres AHD in the north. The site slopes generally in a south west direction.

2.2.1 Acid Sulfate Soils

The Department of Environmental Regulation (DER) Acid Sulfate Soil Risk Mapping identifies the site as having a moderate to high risk of Acid Sulfate Soils (ASS) occurring within three metres of natural soil surface.

A study undertaken for the site in 2009 determined there was a high risk of disturbing potential or actual ASS during ground intrusive earthworks in the low lying central, western and northern areas of the MELSP area, given most of this area is less than 1 metre above the water table.

In this regard, an ASS Management Plan will be required to be prepared and implemented as a condition of subdivision approval.

Refer Figure 8 – Acid Sulfate Soils Plan.

2.2.2 Contamination

The Department of Environmental Regulation Contaminated Sites Database does not list the site as being a known or suspected contaminated site.

Notwithstanding, a Preliminary Site Investigation was undertaken in 2015 which confirmed a number of potential contamination sources and contaminating site activities had occurred. On this basis, remediation was undertaken between June 2015 and February 2016 to remove known potential contamination sources.

Following removal of all known potential contamination sources to an off-site licensed landfill facility, the soil and groundwater quality was further investigated (Detailed Site Investigation) to:

- Assess the nature and extent of contamination, if any, following preliminary remediation activities at the site.
- Assess the future risk to human health and the environment from residual site contamination.

Based upon the results of the Detailed Site Investigation (DSI), a human health and ecological risk assessment for the site was undertaken and concluded:

- Residual contaminant sources have been removed from the site and there are no residual soil risks to human health or the environment.
- Groundwater and surface water is suitable for non-potable use and irrigation, and is not considered to be a risk to human health. Groundwater is not recommended for drinking water purposes.
- Groundwater quality is indicative of the regional superficial aquifer and minor groundwater contamination is considered a result of regional agricultural activities. There are no unacceptable groundwater or surface water contamination risks to human health and/or the environment.

Based on the DSI results, no further investigations to characterise soil, groundwater and/or surface water contamination are deemed necessary and the site is considered to be suitable for residential purposes, as proposed by the MELSP.

A Contaminated Sites Auditor accredited under the *Contaminated Sites Act 2003* was commissioned to prepare a voluntary audit report for the site and surrounds following completion of the DSI. The

voluntary audit report was submitted to Department of Environment Regulation in December 2016 to support the assessment of the MELSP application under the *Planning and Development Act 2005*.

2.3 Groundwater and Surface Water

2.3.1 Groundwater

There are two aquifers of significance underlying the site; each assigned the name of the major geological unit in which the aquifer occurs. In descending order of depth from natural surface they are:

- Superficial Aquifer (unconfined, +20 to -25 mAHD)
- Leederville Aquifer (confined, -25 to -250 mAHD)

2.3.1.1 Superficial Aquifer

The Superficial Formation forms an unconfined aquifer containing generally fresh to slightly brackish groundwater (500 to 1500 mg/L Total Dissolved Solids), with slightly acid to neutral pH (5 to 7). The water table is shallow in places, rising to the surface during winter, depending on surface elevation.

Pre-development groundwater monitoring was completed in 2007 to determine the estimated AAMGL. Water quality bores were monitored from 19 October 2004 to September 2006.

A summary of the monitoring results are as follows:

- Average Total Nitrogen (TN) concentrations for all bores were above the ANZECC 2000 TN guideline of 1.2 mg/L with the exception of WAM3(d).
- Average Total Phosphorus (TP) concentrations varied between bores. WAM3(d), WAM4(s) and WAM4(d) were above the Peel-Harvey WQIP TP target value of 0.1 mg/L.
- The pH is slightly acidic to neutral (4.5 to 7.1) and below ANZECC guideline values.

The site is characterised by high nutrient concentrations and pH levels generally less than 6.0. Groundwater quality at the water table, within the Bassendean Sand, is generally acidic due to organic acids generated by decomposition of vegetation in swampy environments. High nitrate and phosphorous levels are present in the superficial aquifer in areas of intensive horticulture as a direct result of fertiliser leaching.

The Superficial Aquifer is the most cost effective groundwater source for irrigation of public open space for the development of the site.

2.3.1.2 Leederville Aquifer

The Leederville Aquifer is a major regional aquifer from which large yields of fresh groundwater can be obtained. The groundwater in the Leederville Formation is confined within the potentiometric surface in this area approximately at ground level.

The South Perth Shale is present from -260 to -310m AHD and forms the confining layer between the Leederville Aquifer and Yarragadee Aquifer.

2.3.2 Surface Water

The Peel Main Drain runs east to west through the MELSP between Lots 9019 and 9006. The Peel Main Drain flows into the Mandogalup Swamp at the southern boundary of the site and the Spectacles Wetland south of Anketell Road. The Peel Main Drain outlets at the Serpentine River, which flows to the Peel Harvey Estuary.

The Peel Main Drain was modelled by the Department of Water as part of the preparation of the Jandakot DWMP. The maximum flood level for the 100 year ARI for the existing system is 16.05 metres AHD, upstream of the Mandogalup Swamp causing inundation of the Mandogalup Swamp area along the southern boundary of the site. The balance of the site is not expected to be affected by flooding.

The surface water quality of the Peel Main Drain was measured as part of pre-development monitoring from October 2004 to September 2006. Results indicate the Peel Main Drain is characterised by high nutrient concentrations and pH levels generally less than 6.8. This is consistent with other drains in the area, as well as the historic land use.

2.4 Bushfire Management

The majority of the MELSP is designated as bushfire prone under the Western Australian *Map of Bush Fire Prone Areas* (DFES 2016). On this basis, a Bushfire Management Plan (BMP) has been prepared for the MELSP in accordance with *State Planning Policy 3.7: Planning in Bushfire Prone Areas* (SPP 3.7) and Australian Standard 3959 (AS 3959). The BMP is provided within Appendix 4, however the following provides an overview of fire management assessment undertaken and applicable provisions to development of the site.

2.4.1 Hazard Assessment

The BMP identifies the site as comprising predominantly a moderate fire hazard, with isolated areas of extreme hazard associated with remnant vegetation. The development of the MELSP area in accordance with the proposed layout will result in a reduction to bush fire risk across the site. Additionally, any existing hazards within the MELSP can be managed through a staged clearing approach and ongoing fuel management undertaken in and around individual development stages.

The BMP concludes the worst case bushfire hazard currently affecting future development within the MELSP is from the vegetation existing within the MWLSP. Given the development proposed by the MWLSP, this risk is considered to be temporary. Notwithstanding, bushfire risk to the MELSP from this vegetation will need to be adequately managed until such time as this vegetation is removed. This may be achieved through delayed development, application of AS 3959/Asset Protection Zones (APZ's), or provision of a temporary low fuel buffer within and along the interfacing boundary of the MWLSP.

There is also existing scrub and woodland vegetation to the east of MELSP along the Kwinana Freeway, however this is 'patchy' in nature and contained within relatively short runs, and will therefore not facilitate elevated levels of radiant heat and ember attack. The BMP therefore concludes this is not considered to be a significant bushfire hazard risk to the MELSP.

On the basis of the above hazard assessment (as summarised), the BMP considers the bushfire hazards within and adjacent to the MELSP, and the associated bushfire risk, is readily manageable through standard management responses and compliance with acceptable solutions outlined in SPP 3.7 and AS 3959.

2.4.2 Bushfire Attack Level (BAL) Assessment

Vegetation with a 'Moderate' or 'Extreme' bushfire hazard level is considered bushfire prone and any proposed development within 100 m of the bushfire prone vegetation extent will require application of *Australian Standard AS 3959–2009 Construction of Buildings in Bushfire-prone Areas (SA 2009)* via implementation of increased building construction standards in response to the assessed Bushfire Attack Level (BAL).

The BMP includes a BAL assessment and plan for the MELSP, utilising an indicative subdivision layout and taking into consideration the landscape master plan proposal (type and nature of public open space areas etc). The assessment also takes in to account the existing vegetation within the MWLSP. However, as subdivision within the MWLSP progresses and detailed landscape design is undertaken for the MELSP, it is likely the extent of classified vegetation will change. On this basis, the BALs are indicative only and will be reassessed at the subdivision application and/or development application stage.

2.4.3 Interim Emergency Access

Access to the initial development stages is proposed via Hoffman Road, connecting to Anketell Road in the south. Following the initial stages of development within the MELSP area and the adjoining MWLSP (subject to a similar development program), ultimate primary access will be through the adjoining MWLSP north to Rowley Road. Given the initial development stages will only have one point of formal public access, an Indicative Fire and Emergency Access Plan has been prepared for the site (refer Figure 9), providing for alternate emergency access points.

The temporary fire and emergency access route is proposed along the water mains alignment, connecting from the initial stages in the south of the site, north to Rowley Road. This route has been determined in consultation with the adjoining owner, Qube Property Group.

The Bushfire Management Plan will be required to be implemented as a condition of subdivision approval.

Refer Figure 9 – Indicative Fire and Emergency Access Plan.

Refer Appendix 4 – Bushfire Management Plan.

2.5 Heritage

A search of the Department of Indigenous Affairs Aboriginal Heritage Inquiry System identified no registered sites of aboriginal heritage significance within the MELSP area or immediate surrounds. However, the search did identify one 'Other Heritage Place', being a mythological site (Site 3427 – Mandogalup Swamp / Spectacles) that extends in to the southern portion of the MELSP area. This listing does not restrict development.

A search of the Western Australian Register of Heritage Places identified no sites of state heritage significance within the MELSP area.

A search of the City of Kwinana's Municipal Heritage Inventory identified no sites of local historic significance within the MELSP area.

2.6 Context and Other Land Use Constraints and Opportunities

2.6.1 Peel Main Drain

The Peel Main Drain dissects the site in an east west direction between Lots 9006 and 9019. The drain is currently constructed to a 'rural' standard, and is intended to be upgraded and landscaped to an urban standard as part of residential development works. The Peel Main Drain will therefore be integrated in to the public open space for the site, however not credited towards the MELSP 10% public open space provision.

The Peel Main Drain (PMD) within the subject site is currently under the management of the Department of Water.

As with the agreements for the portion of the PMD dissecting the Wandi North LSP area on the eastern side of the Kwinana Freeway, it is understood the City of Kwinana will take over the management of the PMD following upgrade works. Further discussion is required in regard to any agreements relating to the management and maintenance of the drain. The Department of Water has been provided with initial concepts for the PMD to initiate this discourse.

2.6.2 Dampier to Bunbury Natural Gas Pipeline

The Dampier to Bunbury Natural Gas Pipeline (DBNGP) traverses the MELSP area in an east west direction between Lots 9006 and 9002. The DBNGP is protected by an easement for its full extent.

The DGNGP is intended to be landscaped to a minimum urban standard, providing a lineal active public open space corridor through the site. This is consistent with the landscape treatment for the DBNGP corridor on the eastern side of the Kwinana Freeway within the Wandi North LSP area (Honeywood estate). Notwithstanding the intended landscape treatment for the DBNGP, the easement is not afforded a credit toward the MELSP required 10% public open space provision.

2.6.3 High Voltage Power Line Easement

The subject site abuts a high voltage power line easement on its northern boundary. This easement does not affect the development potential of the site.

The MELSP proposes residential development directly abutting (backing on to) the easement. It is anticipated any subdivision approvals for the site will include a standard uniform fencing condition for this interface. This will provide for a consistent amenity along this interface, whilst also restricting access within the easement. This approach will also assist with noise attenuation in the north of the site, mitigating against road and rail noise impacts emanating from the Kwinana Freeway and Rowley Road (identified by MRWA as a designated freight route).

2.6.4 Noise Management

The Kwinana Freeway and the Perth to Mandurah railway line abuts the MELSP on its eastern boundary. On this basis, in accordance with *State Planning Policy 5.4: Road and Rail Transport Noise and Freight Considerations in Land Use Planning* (SPP 5.4), a Road and Railway Noise Impact Assessment has been prepared to inform the MELSP, included as Appendix 5 of this report.

The acoustic modelling and assessment considers the potential noise impacts from the Kwinana Freeway within a 20 year planning horizon (to year 2037). Modelling for the railway line was undertaken based on the current 2016 situation.

The acoustic modelling indicates that transport noise from both the road and rail infrastructure are likely to cause noise impacts above the prescribed criteria under SPP 5.4. On this basis, modelling considered the effect of a 4 metre high noise attenuation wall along the extent of the MELSP abutting the Kwinana Freeway, as well as along the northern Rowley Road boundary. The noise wall showed a significant reduction in the predicted transport noise levels, and is consistent with the noise mitigation strategy adopted for the Wandi North MELSP area on the eastern side of the Kwinana Freeway.

Notwithstanding the construction of a noise attenuation wall, a number of allotments are still predicted to receive traffic noise levels above the minimum target levels prescribed under SPP 5.4. This will be managed through notifications on Certificates of Title, requiring dwellings to be constructed to minimum construction standards consistent with the 'deemed to comply' noise limit packages. These requirements are outlined within the Noise Impact Assessment report contained in Appendix 5 of this report.

03 Land Use and Subdivision Requirements

3.1 Land Use

The MELSP sets out land use, residential densities, public open space, public and private transport provision, environmental considerations and servicing requirements.

The MELSP is proposed to comprise residential development with density codes ranging from R30 to R60. The MELSP also comprises a range of local and neighbourhood public open space areas in accordance with Liveable Neighbourhoods requirements, as well as a Primary School site to service the Mandogalup catchment.

The following describes the design response proposed under the MELSP, and addresses the relevant elements of Liveable Neighbourhoods (LN). Please also refer to the land use summary table provided within the Executive Summary on Page IV of this report.

Please also refer to Plan 1 – MELSP, and Figure 10 – Indicative Zoning and Residential Density Code Plan.

3.2 Public Open Space

Under the provisions of LN a range of site responsive urban parkland is required, which appropriately addresses district, neighbourhood and local needs of residents, comprising a mixture of unrestricted and restricted open space.

The MELSP therefore provides a framework for the hierarchy and location of public open space areas across the site, considering the requirements for drainage and vegetation retention. Detailed subdivision design will provide further refinement to the MELSP public open space framework, defining the configuration, uses and treatment within each public open space area.

The MELSP provides for approximately 4.3 hectares of public open space (POS) across the MELSP area by way of four neighbourhood and two local parks, as well as local playing fields. This comprises approximately 3.4 hectares of unrestricted (8.84% of gross subdivisible area) and approximately 0.9 hectares of restricted open space (2.39% of gross subdivisible area). As noted above, the hierarchy and location of POS areas have been designed to ensure residents are within:

- 150m of a local park;
- 400m of a neighbourhood park; and
- 600m – 1km of an active playing field.

The following provides a detailed overview of the public open space design response proposed under the MELSP.

A Landscape and Public Open Space Strategy has been prepared for the MELSP area, depicting the anticipated use and intent of each of the public open space areas. Refer Appendix 6.

Please also refer Figure 11 - Public Open Space Distribution and Figure 12 - Public Open Space Schedule.

3.2.1 Public Open Space Area 5

Through consultation with the City's Technical Officer's in preparation of the MELSP, the City advised of its preference to prioritise the retention of upland vegetation within areas of POS rather than the degraded wetland vegetation located within the mapped RE wetland. It is understood the preference for upland vegetation is on the basis that upland vegetation is of higher conservation value to the City, given the extensive and larger wetland reserves which already exist within the locality.

As a consequence, POS 5 was established within the north western area of the site to enable the retention of a landscape feature and specific trees identified by the City, as well as by definition under the City of Kwinana *Landscape Feature and Tree Retention Policy*. The final extent of retention of the landscape feature will be subject to further detailed landscape design at subdivision stage.

Throughout the MELSP area, significant trees (as defined by the City of Kwinana *Landscape Feature and Tree Retention Policy*) have also been identified for retention within areas of POS and road reserves. The retention of significant trees also formed the basis of the Federal EPBC Act Referral, as approved in July 2015.

3.2.2 Local Playing Fields

The MELSP and MWLSP provide for a 2.5 hectare local playing fields site located immediately adjacent to the proposed primary school, intended for a shared-use arrangement. Of the 2.5 hectare site, approximately 1.15 hectares is situated within the MELSP, and approximately 1.35 hectares in the MWLSP.

The size, location and configuration of the local playing fields in a shared use arrangement, as proposed by the MELSP, has been supported by the Department of Education and the City of Kwinana.

The local playing fields are intended to form part of the 10% public open space contribution (unrestricted POS) for the MELSP, and are therefore included in the public open space schedule.

3.2.3 Peel Main Drain

The Peel Main Drain (PMD) traverses the northern portion of the MELSP area abutting Lots 9019 and 9006. As previously discussed, this drain currently exists within a 20m corridor and is built to a rural standard. The MELSP proposes additional open space either side of the existing PMD to provide sufficient width to facilitate the urbanisation of this drain to a living stream profile (with appropriate urban grades). The reconfiguration of the drain will utilise a mixture of planted, walled or contoured banks, with native sedges and rushes to assist with nutrient stripping and midge and mosquito control. The reconfigured drain will be unfenced and landscape in accordance with LN to allow for informal and passive recreational uses, to be integrated with a neighbourhood park located to the northern boundary of the PMD corridor.

The landscaped outcome of the reconfigured PMD and associated neighbourhood park will continue the landscaping treatment of the PMD within the Wandi North LSP area (Honeywood estate).

Whilst intended to serve a passive recreational function and landscaped accordingly, the PMD does not form part of the credited minimum 10% POS provision for the site.

3.2.4 DBNGP Corridor

The DBNGP, traversing Lots 9006 and 9002, comprises an underground high pressure gas pipeline protected within an easement. As per the landscape response delivered within Wandi North LSP area (Honeywood estate), the MELSP proposes the development of the DBNGP as a lineal public open space corridor to a minimum urban standard, serving an active recreation function.

Notwithstanding, given the restrictions placed on development and hard landscaping within the easement, the DBNGP easement does not form part of the credited minimum 10% POS provision for the site.

3.2.5 Rebated Lot Rain Gardens

The landscape strategy for the MELSP is tightly woven into the Local Water Management Strategy (LWMS), whereby streetscapes will contain at source infiltration of the minor storm events (up to 5yr ARI). The development of good streetscapes through landscaping has been a strong objective of the MELSP, as well as to satisfy the City's streetscape objectives. Amongst other features, the use of 'rebated lot rain gardens' to capture and infiltrate minor event stormwater runoff has been proposed (as detailed under the LWMS). The rain gardens are not intended to comprise part of the POS provision for the MELSP and will be an extension of the road reserve; however will have a significant positive impact to the streetscape amenity of the MELSP, providing unique landscape opportunities whilst also serving an important drainage function.

Rebated lot rain gardens are proposed to be positioned at specified locations within the local road network to capture minor storm events (up to 5 year ARI) higher in the drainage catchment. These will be developed as traditional rain gardens (of approximately 250m^2) adjacent to rebated residential lots, comprising part of the road reserve (refer Landscape Strategy and LWMS for further detail). These areas are proposed to be self-sustaining at maturity, include an amended soil profile and specialised planting palette to address stripping of nutrients contained within the runoff.

The use of rain gardens throughout the road network will reduce the area down catchment required for minor event stormwater retention within POS, therefore facilitating a greater useability of and flexibility in the design of POS areas. The location and configuration of POS areas will therefore not be dictated by minor event drainage events. Notwithstanding, POS areas are intended to accommodate major drainage events (detention of up to 100 year ARI events), and are therefore proposed to be located at the low points in the catchment.

3.2.6 External Local Drainage

Whilst drainage is principally managed within the MELSP, two local drainage basins are proposed within the south western portion of the site situated adjacent to the MELSP area, within the Rural A zone, straddling the DBNGP. The existing topography results in the general east to west movement of drainage across the site. The location of the two local drainage basins along the western boundary of the catchment therefore maximises the drainage efficiency whilst minimising the importation of fill and earthworks required within these drainage catchments. These are not intended to form part of the open space contribution for the MELSP area, and are intended to be used for drainage purposes only. No drainage is proposed to be retained within the DBNGP easement.

In addition to local drainage, there is also an area of regional drainage to be provided in accordance with the requirements under the JDWMP. This is to be provided within and adjacent to the Western Power easement along the southern boundary of Lots 9006, 9002, 11 and 9000. Whilst the regional drainage area is situated outside the MELSP boundary, it may be created and handed over to the City of Kwinana as part of the development of the MELSP area.

The location of the local and regional drainage basins within the Rural A zone enables the maximisation of the residential catchment, assisting in achieving density targets for the site and the minimum population requirements for the delivery the primary school and playing fields. It is acknowledged that whilst this arrangement is not a standard approach to residential drainage

planning, the Mandogalup Cell characteristics, specifically the resulting regional drainage being dissected from the residential catchment, lends itself to a site specific approach to drainage provision.

This approach has been agreed to in principle by both the Department of Water and the City of Kwinana.

3.3 Residential

An indicative subdivision layout has been prepared for the site, identifying a yield of approximately 581 lots (approximately 674 dwellings). Based on 674 dwellings, the site achieves a density of approximately 30.5 dwellings per site hectare, and 15.8 dwellings per gross hectare. This is consistent with Liveable Neighbourhoods targets for a minimum average residential density of 22 dwellings per site hectare for green field subdivision areas. This is also consistent with the Draft Sub-regional Planning Framework targets for a minimum of 15 dwellings per gross urban hectare.

For reference, an Indicative Plan of Subdivision is provided at Figure 13. This is provided for explanatory purposes only, and is subject to review and detailed design at the subdivision stage.

Residential density codes have been allocated across the site and have been used in the preparation of indicative subdivision layouts and density calculations. The MELSP allocates a base density of R30, with areas of R40 and R60 allocated to lots within proximity to areas of high amenity and access including (but not limited to) within proximity to the primary school, around public open space, and adjacent to public transport or neighbourhood connector routes.

The density code range also facilitates a diversity of lot product across the site, providing for a range of dwelling types. The preparation of Local Development Plans will also assist in facilitating the delivery of diversity in lot product, as well as seeking to achieve built form outcomes consistent with the development intent of the site.

Please refer to Figure 10 for the Zoning and Residential Density Code Plan.

3.4 Local Development Plans

A Local Development Plan is required in the following circumstances:

- Lots with an area of 260 square metres or less;
- Irregular shaped lots;
- Lots where specific vehicle access and egress control is required;
- Lots abutting public open space;
- Lots with particular site constraints; and
- Lots subject of a notification on title.

Local Development Plans are to address, as a minimum, the following:

- Dwelling orientation;
- Type of fencing;
- Location of carports/ garages and vehicular access;
- Surveillance;

- Setback variations;
- Solar Orientation; and
- Requirements for dwelling construction compliant with an approved Bushfire Management Plan and Noise Management Plan.

3.5 Movement Networks

The following provides a summary of the proposed movement network. For further information it is recommended the reader consult the Transport Assessment included at Appendix 7.

3.5.1 Existing Road Network

Hoffman Road

Hoffman Road is a local access road that runs parallel to the Kwinana Freeway, and connects the LSP area to Anketell Road in the south.

Hoffman Road is proposed to be the interim primary access to the MELSP area, until such time as an alternate access becomes available via connections to Rowley Road in the north through the adjoining development on the site's western boundary (MWLSP), and connection to Anketell Road in the south via the future extension of Hammond Road.

The intersection of Hoffman Road and Anketell Road is currently a basic T-intersection. Hoffman Road is constructed to a sealed rural standard, and is intended to be upgraded to an urban standard as part of the development of the site.

There is no existing traffic volume data available for Hoffman Road, however given the limited development adjacent to Hoffman Road volumes are likely low.

Rowley Road

Rowley Road is classified as a District Distributor Type A road in the Main Roads WA Functional Road Hierarchy. It provides an east-west connection between the South Western Highway (via Eleventh Avenue in Armadale), Tonkin Highway, Kwinana Freeway and Rockingham Road in Wattleup (via Wattleup Road).

Rowley Road is currently constructed as a rural standard single carriageway road, with existing traffic volumes of approximately 4,870 vehicles per day east of Barfield Road and approximately 3,280 vehicles per day between Frankland Avenue and Barfield Road. Notwithstanding, Rowley Road has been identified as a primary freight route to the Naval Base / Kwinana Beach industrial areas. Timing for the upgrades to Rowley Road are unknown at this stage. The widening and upgrade of Rowley Road is not expected to impact the development of the subject site.

There is currently no connection from the subject site to Rowley Road. It is anticipated future connections will be established via access roads through the land to the west of the site (MWLSP).

Hammond Road (future extension)

Current planning identifies the extension of Hammond Road south to Rowley Road, ultimately connecting with Anketell Road. The connections of Hammond Road with Rowley and Anketell Roads are intended to be full movement intersections.

It is anticipated the Neighbourhood Connector proposed along the western boundary of the MELSP, running north through the MWLSP area, will ultimately connect with Hammond Road to the west,

providing a higher order access from the site to Anketell and Rowley Roads. Following establishment of this connection, Hoffman Road will be downgraded to a lower order access road. At this time, it is expected the intersection of Hoffman Road and Anketell Road will be downgraded to left in/ left out or be terminated, given its proximity to the Kwinana Freeway interchange.

3.5.2 Proposed Road Network

The proposed road hierarchy for the MELSP has been determined from modelling based on the indicative subdivision layout, and provides for simple and efficient vehicle movements through the site.

The movement network reflects a strong north-south and east-west configuration modified grid configuration, with a number of direct connections to the road network within the MWLSP. The street block lengths are consistent with the requirements of Liveable Neighbourhoods, providing for connectivity and permeability through the site, for both pedestrians and vehicles.

The indicative road network is proposed to comprise of the following road classifications:

Road Classification	Indicative Upper Traffic Volume (Vehicles Per Day)	Indicative Road Reserve Width
Neighbourhood Connector A	7,000	25.2 metres
Neighbourhood Connector B	3,000	19.4 metres
Access Street B	3,000	17.9 metres
Access Street D	1,000	15.4 metres (13.2 metres adjacent to POS)

The road hierarchy primarily consists of Access Street D roads, with a central Access Street B providing the key north south link connection through the MELSP.

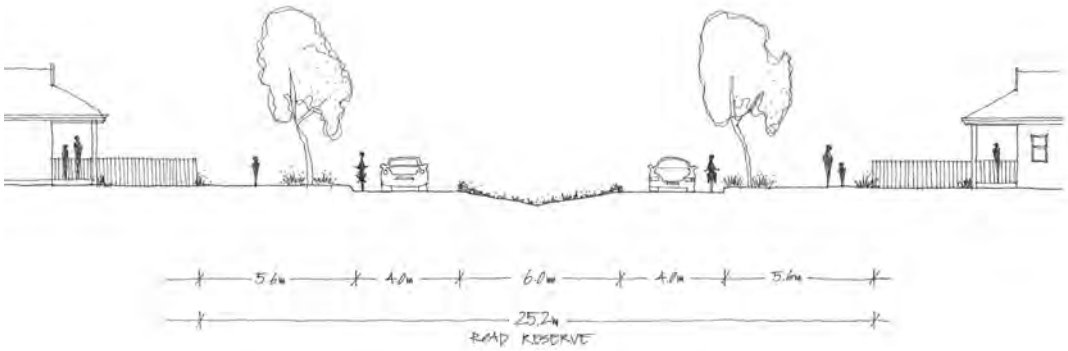
Neighbourhood Connector

The Neighbourhood Connector runs along the western boundary of the MELSP and is proposed to connect to Anketell Road in the south, initially via an interim connection along the existing Hoffman Road reserve. This interim connection will be superseded by the ultimate alignment of the Neighbourhood Connector to Hammond Road to the west.

The Neighbourhood Connector will also extend north to Rowley Road via connections through the future development within the MWLSP.

Traffic volumes along the Neighbourhood Connector routes are estimated to be between 3,000 to 7,000 vehicles per day.

TYPICAL NEIGHBOURHOOD CONNECTOR CROSS-SECTION



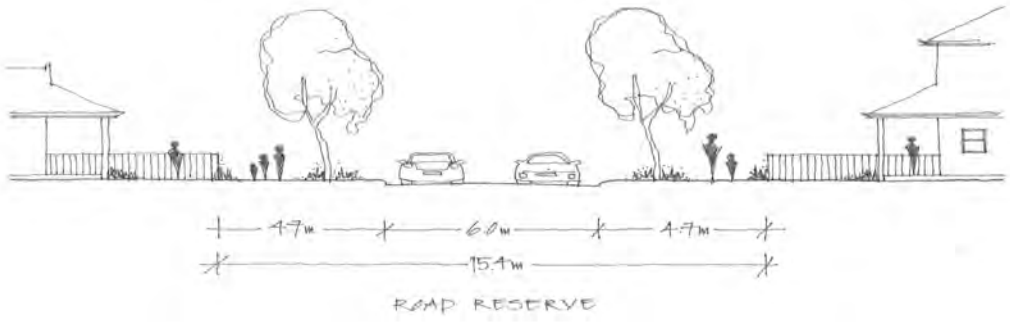
Access Streets

The access streets are proposed to primarily consist of Access Street D roads, designed to a 15.4 metre cross-section. Where services are only required to one side of the road, such as adjacent to public open space or the Kwinana Freeway reserve, a reduced Access Street D cross-section of 13.2 metres is proposed. This is consistent with other recent developments within the City of Kwinana, including within the Wandi North and South LSP areas on the eastern side of the Kwinana Freeway.

Traffic volumes along the access roads are typically estimated to be in the order of 1,000 to 3,000 vehicle movements per day, which is consistent with the road hierarchy classification under Liveable Neighbourhoods.

Traffic modelling for the MELSP area estimates the completed development will generate in the order of approximately 4,856 vehicle movements per day.

TYPICAL ACCESS STREET C ROAD CROSS-SECTION



Refer Figure 14 - Indicative Movement Network

3.5.2.1 Truncation Variation – Small Lot Product

In accordance with the provisions of Liveable Neighbourhoods, Element 2 – Movement Network R55, truncations of 3m x 3m are to generally be provided on corner lots. Notwithstanding, truncations of 6m x 6m have been the traditional standard applied by Local Governments in greenfield areas.

With the introduction of small lot product, the traditional 6m x 6m truncations significantly impede on small lot sites. As such, discussions with the City's Technical Services have indicated that reduced

truncations of 3m x 3m in accordance with Liveable Neighbourhoods may be entertained at subdivision, subject to an assessment of appropriate sightlines in accordance with Austroads Standards.

Further assessment and documentation is proposed to be undertaken at detailed subdivision, to enable truncations and kerb radii in accordance with R55 and R57 of Liveable Neighbourhoods.

3.5.3 Public Transport

The MELSP area is not currently directly serviced by public transport. The closest existing bus service is Bus Route No. 57, which runs along Lyon Road, north of Rowley Road through Aubin Grove, approximately 500 metres east of the site.

The Public Transport Authority has advised the area west of the Kwinana Freeway would be served by future Bus Routes 535 and 536. It is anticipated these routes are likely to commence around year 2016, subject to the progress of adjoining development and availability of funding. These services will operate out of the Russell Road/Success train station, and are intended to ultimately connect Hammond Park to Mandogalup.

Timing for the extension of bus services through Mandogalup is not known at this stage. Notwithstanding, the proposed Neighbourhood Connector will be designed to accommodate buses, should future services be established.

The Perth to Mandurah railway line runs along the eastern boundary of the site within the Kwinana Freeway reserve. The closest passenger stations to the site are Cockburn Central, approximately 6 kilometres to the north, and Kwinana, approximately 5 kilometres to the south. An additional station is also planned for Russell Road / Success, approximately 2.7 kilometres to the north.

3.5.4 Pedestrian and Cycle Network

In accordance with Liveable Neighbourhoods requirements, footpaths will be provided on at least one side of every street. A shared path is proposed along the Access Street B running north south through the site and adjacent to the proposed Primary School.

The Perth Bike Map series shows an existing principal shared path (PSP) along the Kwinana Freeway adjacent to the MELSP area. The Perth Bike Map also designates Rowley Road and Barfield Road (north of the site) as being part of the Perth Bicycle Network, and nominates these as continuous signed routes. The MELSP proposes two connections to the PSP, one in the north of the site and one in the south.

3.6 Water Management

3.6.1 Regional Water Management Strategy

The Jandakot Drainage and Water Management Plan (JDWMP) was released by the Department of Water in December 2009. The JDWMP provides district scale flood modelling, a surface water management strategy and a groundwater management strategy, which specify post-development levels and flows to address the City of Kwinana's District Structure Plan (ERIC).

3.6.2 District Water Management Strategy

A District Water Management Strategy (DWMS) was prepared in 2011 and provides guidance on water re-use options, stormwater detention basins, monitoring requirements, and structural and non-structural controls for stormwater treatment. The DWMS has been approved by both the City of Kwinana and the Department of Water.

3.6.3 Local Water Management Strategy

A Local Water Management Strategy (LWMS) has been prepared in support of this MELSP, and is provided at Appendix 8.

The LWMS addresses the MELSP area, and provides a refinement of flood modelling, the surface water management strategy and the groundwater management strategy to a local scale. The LWMS has been prepared in accordance with the water sensitive urban design practices as described in the Stormwater Management Manual of WA.

3.6.4 Proposed Drainage Network and Infrastructure Requirements

3.6.4.1 Wetland Management

The following measures will be implemented to ensure the wetlands and watercourses to the south and east of the site, including Mandogalup Swamp, will not be negatively impacted by urban stormwater runoff:

- All stormwater and groundwater discharge from the development will be treated prior to discharging to the Peel Main Drain.
- Peak outflows will be consistent with pre-development flow rates.

3.6.4.2 Regional / District Drainage

As previously discussed, the PMD will be retained through the MELSP area, upgraded to an urban standard generally characteristic of the design concept implemented for the portion of the drain within the Wandi North LSP.

The final drain profile will be required to achieve sufficient hydraulic capacity to convey the post-development 100 year ARI flow within the drain, and maintain the current drain easement width of 20 metres.

It is expected the management and maintenance requirements and responsibilities will be reflective of the portion of the drain running through the Wandi North LSP area. However, this is subject to further discussion and agreement between the Water Corporation and the City of Kwinana.

In addition to the PMD, the LWMS identifies an area of district drainage associated with the Mandogalup Swamp to satisfy the requirements under the JDWMP. This drainage, within the Satterley landholdings (Lots 9006 and 9002), is proposed to be retained within the Western Power easement. The use of the Western Power easement for district drainage purposes is consistent with the drainage scenarios identified under the JDWMP, recognising this approach has a minimal and manageable effect on the Spectacles Wetlands, when compared to other scenarios explored.

3.6.4.3 Local Drainage

The local stormwater drainage system has been designed using a major/minor approach.

The major drainage system is designed to manage rainfall events greater than the 5 year ARI, up to the 100 year ARI. The key elements of the major drainage system strategy are as follows:

- In major storm events the minor drainage structures will be at capacity, with excess stormwater bypassing the minor drainage structures and discharging to the major storage basin. The basin is to be located in the lowest point of the catchment.
- Discharge rates from POS detention basins will be controlled to pre-development flow rates.

- All finished lot levels will have a minimum 0.5 metre clearance above the estimated 100 year ARI flood level of the detention storages.
- Storage areas are to have a minimum separation of 0.5 metres between maximum or controlled groundwater levels, and a side slope of 1:6.
- Catchment A utilises infiltration to dispose of stormwater.

This design strategy is consistent with the objectives provided in the DWMS.

The minor drainage system is designed to manage rainfall events up to the 5 year ARI. The following strategies are proposed:

- All lots are to have soakwells to infiltrate the 1year 1 hour rainfall event.
- Soak wells are to be interconnected, with overflow directed towards the road drainage system.
- Approximately 10% of the lot area is expected to contribute to the road drainage system in events up to the 5yr ARI.
- Retention storages (pocket gardens, linear rain gardens and rebated lot rain gardens) are to be located throughout the MELSP to increase infiltration higher in the catchment, sized to contain the critical 5yr ARI.
- No pit and pipe system is proposed.
- In events above the 5yr ARI, the retention storages are assumed to be full, with excess stormwater runoff bypassing the structures and discharging to the major detention storages via overland flow. The detention storages will be located in the catchment low point with public open space.

In accordance with the processes defined under *Better Urban Water Management*, an Urban Water Management Plan (UWMP) will be required to be prepared and implemented at the time of subdivision. The UWMP will refine and implement the proposed drainage network/system, as defined under the LWMS.

3.7 Education Facilities

In accordance with discussions undertaken with the Department of Education (DoE) regarding school catchment requirements, the MELSP proposes one primary school located generally centrally within the Mandogalup urban cell, to be co-located with the local playing fields in a shared use arrangement.

The provision of one primary school is consistent with the catchment requirements under Liveable Neighbourhoods, which stipulates an average of one primary school per 1500 lots. Based on current planning, it is envisaged the current Mandogalup urban cell (MELSP and MWLSP) has the potential to yield in the order of 1500 lots.

The location, size and configuration of the primary school identified on the MELSP and MWLSP has been informally supported by the Department of Education and City of Kwinana. Please refer Appendix 11 for email correspondence outlining this support.

Whilst there is currently an informal agreement in place for the location, size and configuration of the primary school and playing fields as shown on the MELSP and MWLSP, they are contained within an 'Investigation Area' to provide flexibility for further investigation in to alternate locations outside the

current LSP boundaries. The classification of land use within the Investigation Area has no force or effect until the Western Australian Planning Commission is satisfied on advice of the City of Kwinana and Department of Education that suitable land has been set aside for the purpose of a primary school and local playing fields. Should an alternate location not be agreed by the time the development staging and population demand requires the provision and development of the primary school and local playing fields, these would be developed as shown on the MELSP and MWLSP.

It is understood from discussions with the DoE, the Mandogalup cell will be serviced by the Wandi High School site located within the Wandi South LSP area.

A search of the DoE system identifies the Mandogalup area as currently being within the intake areas for the Hammond Park Primary School (approximately 4.7km to the north), Gilmore College (Kwinana Senior High School) (approximately 5km to the south), and Atwell College (approximately 7.3km to the north). It is understood these will service the proposed Mandogalup population until such time as the Mandogalup Primary School and Wandi High School are delivered.

3.8 Activity Centres and Employment

The MELSP does not propose any commercial or retail uses, reflective of the current strategic planning for the locality.

3.8.1 Secondary Centres

In accordance with *State Planning Policy 4.2: Activity Centres for Perth and Peel* (SPP 4.2), the closest secondary centres to the MELSP area are Cockburn Gateway (approximately 6 kilometres to the north) and the Kwinana Town Centre (approximately 7.5 kilometres to the south).

Beside the Perth City Centre (Strategic Metropolitan Centre), these centres comprise the main regional activity centres within relatively close proximity to the Mandogalup cell. They provide a diversity of uses, providing for a range of economic and community services required to service the future population.

3.8.2 District Centre

Current strategic planning identifies a future District Centre to be located within Wandi on Anketell Road, east of the Kwinana Freeway.

Under the City of Kwinana's *Local Commercial and Activity Centres Policy* (LCAC), the District Centre has been allocated approximately 16,000m^2 of retail floor space and 10,000m^2 of bulky goods/ showroom floor space. This floor space allocation is capable of supporting two full line supermarkets and a discount department store, as well as a wide range of complementary specialty shops.

In accordance with the City of Kwinana *Draft Community Infrastructure Plan* (2015), the District Centre is also intended to comprise a range of community facilities.

Mandogalup residents will have direct access to the District Centre via Anketell Road. The centre will provide for the daily and weekly needs of residents.

Timing for the development of concept plans and lodgement of a Structure Plan for the District Centre is unknown at this stage, and is subject to ongoing negotiations for a potential anchor tenant.

3.8.3 Neighbourhood / Local Centre

Consistent with the draft LCAC Policy, the MELSP does not propose a Neighbourhood or Local Centre within the MELSP area. Notwithstanding a Retail Needs Assessment was prepared to inform the

proposed MELSP and assess the needs of the future population across both the MELSP and MWLSP. This is provided within Appendix 9.

The assessment concludes there may be spatial opportunity to provide for a single supermarket based centre in the Mandogalup locality. The potential retails sales from the residential population for the MELSP and MWLSP will ultimately be capable of supporting a centre of approximately 7,50m^2 of retail floor space, comprising a small supermarket and up to 4 specialty shops. These activities will not be sustained until the full development of the catchment occurs.

On the basis of the modelling undertaken for the current Mandogalup urban cell, the MWLSP identifies an interim local centre generally central within the catchment.

Notwithstanding, any expansion of the current residential catchment within Mandogalup would increase the spending capacity and sales potential within the community. Therefore, any future planning for the expansion of the Mandogalup residential catchment should be cognisant of providing and planning for additional retail activity.

Should expansion of the residential catchment occur, there may be opportunity to provide a larger centre. This would ideally be located within close proximity to Rowley Road and the future extension of Hammond Road to capitalise on the future needs of the Hammond Park community. A centre located more centrally within the Mandogalup Cell would be less viable given the location of the proposed District Centre on Anketell Road (east of the Kwinana Freeway). Accessibility and passing trade exposure would also be limited and therefore be less likely to attract a wider catchment beyond the current urban area within Mandogalup.

The location of a larger centre in an alternate location to that currently identified under the MWLSP is subject to zoning and further detailed planning.

3.9 Infrastructure Coordination, Servicing and Staging

The following provides a summary of the infrastructure and servicing for the MELSP area, however for further information it is recommended the reader consult the Engineering Services Report provided as Appendix 10.

3.9.1 Water

Preliminary information from the Water Corporation indicates there are no existing potable water services available within the MELSP area. Notwithstanding, planning for a number of developments to the north has now resolved supply issues adjacent to the MELSP area, enhancing the regional network to ultimately provide services to the site.

The Water Corporation has indicated water distribution mains along Brushfoot Boulevard and Russell Road (situated to the north of the site in Success) have been completed, and a 500DN extension southwards along Hammond Road / Frankland Avenue will be completed in the near future. To enable connection of these services to the site, construction of additional water mains southwards along Frankland Avenue to the intersection of Rowley Road will be required.

Prefunding arrangements for the extension of water supply services to the site is yet to be confirmed by the Water Corporation.

All internal water reticulation pipe-work will be designed and constructed in accordance with Water Corporation standards and requirements. Standard Water Corporation head work charges will apply.

3.9.2 Sewer

Preliminary information from the Water Corporation indicates there are no existing wastewater services available to the MELSP area. Notwithstanding, wastewater planning for development to the north has now resolved supply issues adjacent to the MELSP area, enhancing the regional network to ultimately accept discharge from the MELSP area.

The MELSP area will be serviced in accordance with current Water Corporation sewerage planning. This sewer planning identifies the need for a prefunded waste water pump station (WWPS), with a long term pumping rate of approximately 190 litres per second. This is intended to be located in the south-eastern corner of the MELSP area on Lot 9002.

The WWPS and associated rising main (to be routed through the MELSP area) is required to be included on the Water Corporation capital works program.

A preliminary staging plan has been developed by Peritas Group for discussion with Water Corporation that outlines a staged approach proposing to use the existing Honeywood pump station (Thompsons Lake Pump Station J) by diverting flow under the Kwinana Freeway from the southern corner of the Mandogalup precinct and upgrading the existing pump station for the increased flow conditions.

This may be a temporary or an interim measure until such time as the Mandogalup catchment develops to its full extent and as the MWLSP comes on stream in later stages. The Water Corporation may consider allowing the early stages of the MELSP to gravitate to that catchment to save construction of the major infrastructure necessary for the Mandogalup catchment to stall the major expenses within the Capital works for the Mandogalup area.

3.9.3 Electricity

It is intended all lots within the MELSP area will be serviced with underground power. The cost of this work will be funded by the developer.

Western Power studies indicate the existing power network in the vicinity of MELSP area has insufficient capacity to accommodate the whole development and provide recommendations for possible network extensions that would be required to deliver power services to the site. It is anticipated the initial stages of the MELSP development could be serviced from the existing network by way of upgrading existing feeders. However, the exact capacity cannot be established until the detailed design stage.

Standard Western Power requirements will apply, including the cost for head works upgrades and exclusions to service the site.

It is understood, as is standard practice, that a number of pad mount sites will be required throughout the development. The location of these will be determined at the detailed design and subdivision stage.

3.9.4 Gas

ATCo Gas has advised reticulated gas services are available in the surrounding locality.

ATCo gas may provide road crossing conduits for future use; however this is subject to cost allocations and budgets being approved by the relevant gas authorities. No developer contributions to provide for future reticulated gas supplies are anticipated.

In addition, as previously noted, the DBNGP traverses the MELSP area in an east west direction between Lots 9006 and 9002. Earthworks within the DBNGP easement are not permitted, with adjacent land required to be graded to maintain access and existing DBNGP levels. Any services or

roads required to cross the corridor will need prior approval of the Dampier Bunbury Pipeline Authority.

3.9.5 Telecommunications

It is intended all lots within the MELSP area will be serviced with telecommunication services. This will be either by way of standard Telstra services or an external private supplier such as LBN Co (as was the case for the Wandi North and South LSP areas).

The service provider will be responsible for installing telecommunication facilities within the development. The developer will fund the provision of trenches for cable laying. Alternatively, where cable routes are on the same alignment as Western Power underground power supply routes, the telecommunications will use, where possible, the Western Power trenches in lieu of the developer providing additional trenching.

Head works charges for telecommunication service extensions are anticipated.

3.9.6 Earthworks

Based on the information currently available, it is not expected that any major difficulties will be experienced during the development of the MELSP area in regard to earthworks and the creation of building pads.

Site grading will generally be determined by the servicing requirements and environmental constraints of the site, with a view to keeping grading and remodelling to minimum limits wherever possible.

It is anticipated that bulk earthworks will be completed using material available from within the site, and that if required, importation of material will be locally sourced from existing sand mining operations within the locality. Once earthworks have been completed, the site will be stabilised either by the respreading of stockpiled top soil from the bulk earthworks operations, or by hydromulch stabilisation as appropriate, or otherwise in accordance with the requirements of the City of Kwinana.

Site levels are intended to be set in accordance with the following parameters:

- Geotechnical and soil parameters are to ensure the site achieves an appropriate site classification for its purpose, which is generally *Class A* for residential purposes.
- Fill levels are to provide clearance to groundwater.
- Building pad levels are to be designed to ensure floor levels maintain a clearance of a minimum of 0.5 metres to the regional 1 in 100 year flood levels.
- Finished pad levels are to conform to the regional drainage requirements as identified in the published urban stormwater drainage strategies consistent with recent government initiatives for the area.

3.9.7 Indicative Staging

It is intended development of the site will commence from the south of the MELSP area and will occur across approximately seven stages, moving northward.

The staging of development has predominantly being informed by the servicing (delivery of the sewer pump station) and access requirements for the site (Hoffman Road). Until such time as development to the west of the site (MWLSP) has commenced providing alternate access, Hoffman Road provides for the sole access in to the site, connecting with Anketell Road in the south. In addition, the extension of sewer services will be most efficient and cost effective if occurring in a south to north direction.

Please refer to Figure 15 for an indicative staging plan. This is subject to further detailed design and is provided for explanatory purposes only.

3.10 Developer Contribution Arrangements

The MELSP is situated within the Mandogalup cell for the purposes of Developer Contribution arrangements, and forms part of Development Contribution Area 8 (DCA 8) for community infrastructure and Development Contribution Area 6 (DCA 6) for traditional infrastructure.

DCA 8 was introduced to TPS 2 by way of Scheme Amendment 115 (Gazetted on 19 June 2012). However, the City of Kwinana has since reviewed the requirements for community infrastructure on the basis of current planning and population forecasts, in accordance with a revised draft Community Infrastructure Plan (2011-2031). The City of Kwinana therefore advertised Amendments 145 and 100A, concurrently with the Community Infrastructure Plan (2015) between 16 October and 30 November 2015, seeking to amend DCA 8 and introduce DCA 6 to TPS 2. Amendment 100A was subsequently adopted by Council on the 23 November 2016, however is yet to be considered by the Minister and Gazetted. It is understood Amendment 145 and the Community Infrastructure Plan will be adopted by Council in the relatively near future.

Timing for Gazettal of the Amendments is unknown at this stage.

As advertised, the following items are intended to be funded by DCA 8 and DCA 6 (adopted), however noting these are yet to be Gazetted and may therefore be subject to change.

DCA 8	**Item**
Sub-Regional	Community Knowledge and Resource Centre (excluding leasable office space and cafe component)
	Destination Park (Calista)
	Wells Beach Foreshore Upgrade (Park and Boating facility)
	Sub-Regional Sporting Ground (Thomas Oval / Kelly Park extension/ upgrade)
District A	Sporting Ground
	Youth Centre
	Dry Recreation Centre
	Branch Library
Local	Community Centre
	Sporting Ground with Community Sports Facility Building A
Admin	Administrative Costs

DCA 6	**Item**
Roads	Frankland Avenue extension – 100% of the full cost of design and construction of the Frankland Avenue extension to a single carriageway urban standard, for a distance of approximately 600 metres south from Rowley Road, or as required to connect with the internal connector road. Includes full earthworks, carriageway, drainage, landscaping, undergrounding of power, and all

DCA 6	Item
	treatments (including intersections, lighting, kerbing and footpaths).
	East-west connection between internal connector road to Frankland Avenue extension. 100% of the full cost of design and construction of the east-west internal connector road to cross Lot 2 on DP11392 to a single carriageway urban standard. Includes land acquisition, full earthworks, carriageway, drainage, landscaping, undergrounding of power and all treatments (intersections, roundabouts, lighting, kerbing and footpaths).
Public Open Space	100% of total cost of land and improvements for public open space in accordance with the adopted structure plans for the DCA, including land for community purposes and local sporting grounds as per the City of Kwinana Community Infrastructure Plan 2011-2031, as revised. Only creditable public open space as per Liveable Neighbourhoods forms part of this contribution.
District Sporting Ground	Costs associated with the acquisition, site works and basic servicing of land for a District Sporting Ground to be located within Casuarina as per the Community Infrastructure Plan 2011-2031.
Community Facilities	Costs associated with the acquisition of land for a Branch Library as part of a combined community facility to be located with the Wandi District Centre as per the City of Kwinana Community Infrastructure Plan 2011-2031, as revised.
	Costs associated with the acquisition of land for a District Youth Centre as part of a combined community facility to be located with the Wandi District Centre as per the City of Kwinana Community Infrastructure Plan 2011-2031, as revised.
Administration Costs	Administration costs associated with administering the DCP.

Whilst the Amendments are considered to be seriously entertained proposals, should these not be Gazetted prior to subdivision within the MELSP area, it is likely a legal agreement will be entered into between the City of Kwinana and the Developer for the payment of interim costs. These costs are to be reconciled upon the Gazettal of the Amendments. This is consistent with the approach taken for the Wandi North LSP (DCA 9 and DCA 5). However, this is subject to further discussion and negotiation with the City of Kwinana.

FIGURES

ROWEGROUP

Planning Design Delivery

Regional Location

Mandogalup
Figure 1

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_FIG08A_20140207_MANDOGALUP (REGIONAL).DWG
Matt Winfield 16 July 2014

REVISIONS

Rev	Date	Drawn
A	2014.02.07	K. Trenberth

ROWEGROUP
PLANNING DESIGN DELIVERY

w: www.rowegroup.com.au
e: info@rowegroup.com.au
p: 08 9221 1991

Date Drawn:	2014-02-07
Job Ref:	7282A
Scale:	N.T.S. @ A3
Client:	Satterley
Designer:	R. Cumming
Drawn:	K. Trenberth
Projection:	PCG94
Plan ID:	728A-FIG-08-A

Planning Design Delivery

LEGEND

Local Structure Plan Boundary

0 250 500 Metres

REVISIONS

Rev	Date	Drawn
A	2014.02.07	K. Trenberth
B	2016.08.02	W. Clements
C	2016.09.06	M. Sullivan

ROWEGROUP
PLANNING DESIGN DELIVERY

w: www.rowegroup.com.au
e: info@rowegroup.com.au
p: 08 9221 1991

Date Drawn:	2014-02-07
Job Ref:	7282A
Scale:	1:10,000 @ A3
Client:	Satterley
Designer:	R. Cumming
Drawn:	K. Trenberth
Projection:	PCG94
Plan ID:	7282A-FIG-09-C

Map supplied by STREETSMART

Local Location

Mandogalup
Figure 2

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_FIG09C_20160906_MANDOGALUP (LOCAL).DWG
Matt Sullivan 12 September 2016

Planning Design Delivery

LEGEND

- Local Structure Plan Boundary
- 9500 Existing Lot Numbers
- Existing Boundaries
- DBNGP Easement
- High Voltage Powerline Easement

0 125 250 Metres

REVISIONS

Rev	Date	Drawn
A	2014.02.07	K. Trenberth
B	2016.09.06	M. Sullivan

ROWEGROUP
PLANNING DESIGN DELIVERY

w: www.rowegroup.com.au
e: info@rowegroup.com.au
p: 08 9221 1991

Date Drawn:	2014-02-07
Job Ref:	7282A
Scale:	1:6000 @ A3
Client:	Satterley
Designer:	R. Cumming
Drawn:	K. Trenberth
Projection:	PCG94
Plan ID:	7282A-FIG-10-B

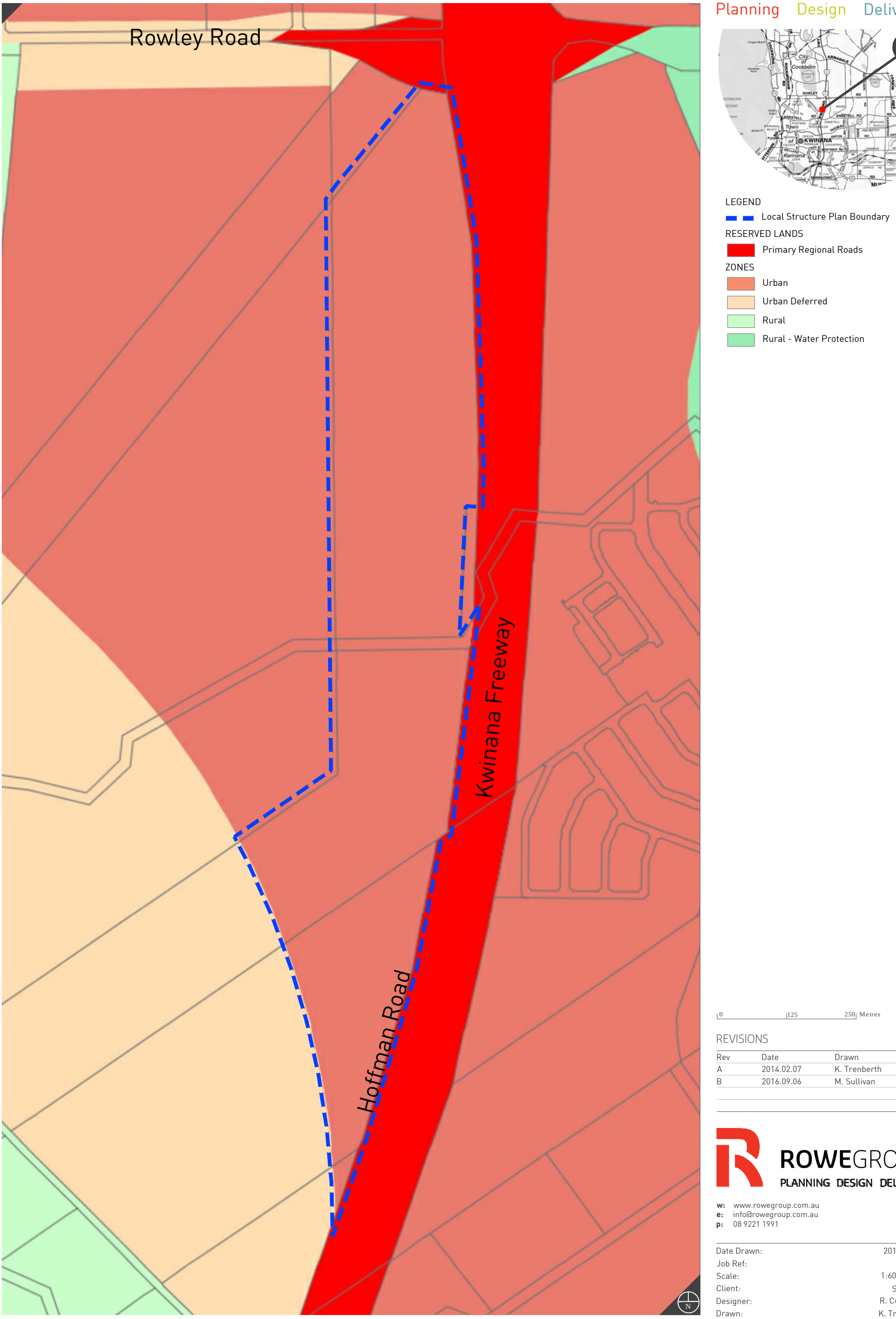
Aerial photography captured and supplied by NEARMAP

Site Plan

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_FIG10B_20160906_MANDOGALUP (SITE).DWG
Matt Sullivan 12 December 2016

Mandogalup
Figure 3

Planning Design Delivery



LEGEND

Local Structure Plan Boundary

RESERVED LANDS

Primary Regional Roads

ZONES

Urban

Urban Deferred

Rural

Rural - Water Protection

0 125 250 Metres

REVISIONS

Rev	Date	Drawn
A	2014.02.07	K. Trenberth
B	2016.09.06	M. Sullivan

ROWEGROUP
PLANNING DESIGN DELIVERY

w: www.rowegroup.com.au
e: info@rowegroup.com.au
p: 08 9221 1991

Date Drawn:	2014-02-07
Job Ref:	7282A
Scale:	1:6000 @ A3
Client:	Satterley
Designer:	R. Cumming
Drawn:	K. Trenberth
Projection:	PCG94
Plan ID:	7282A-FIG-11-B

Zoning supplied by WAPC

Metropolitan Region Scheme

Mandogalup
Figure 4

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_FIG11B_20160906_MANDOGALUP (MRS).DWG
Matt Sullivan 6 September 2016

Planning Design Delivery

LEGEND

Local Structure Plan Boundary

METROPOLITAN REGION SCHEME RESERVES

- Primary Regional Roads

LOCAL SCHEME RESERVES

- Open Space/recreation

ZONES

- Development
- Rural A
- Special Rural

OTHER

- Area of Landscape Protection
- DCA8 — Development Contribution Area (See Scheme Text)
- 14 — Policy Areas (See Scheme Text)
- SR2 — Special Rural Area (See Scheme Text)
- No Zone

0 125 250 Metres

REVISIONS

Rev	Date	Drawn
A	2014.02.07	K. Trenberth
B	2016.09.06	M. Sullivan

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PLANNING DESIGN DELIVERY

w: www.rowegroup.com.au
e: info@rowegroup.com.au
p: 08 9221 1991

Date Drawn:	2014-02-07
Job Ref:	7282A
Scale:	1:6000 @ A3
Client:	Satterley
Designer:	R. Cumming
Drawn:	K. Trenberth
Projection:	PCG94
Plan ID:	7282A-FIG-12-B

Zoning supplied by WAPC

Town Planning Scheme No. 2

Mandogalup
Figure 5

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_FIG12B_20160906_MANDOGALUP (TPS).DWG
Matt Sullivan 7 September 2016

Planning Design Delivery

Rowley Road

Peel Main Drain

Kwinana Freeway

Hoffman Road

Anketell Road

LEGEND

- Local Structure Plan Boundary
- Existing Cadastre
- ALCOA Residue Storage Area F
- Urban
- Urban Deferred
- Revised Kwinana Industrial (Including Air Quality) Buffer - 21 September 2010
- 0.5km Residential Development and Sensitive Land Uses Restriction Area

0 250 500 Metres

REVISIONS

Rev	Date	Drawn
A	2014.07.09	M. Winfield
B	2016.09.07	M. Sullivan

ROWEGROUP
PLANNING DESIGN DELIVERY

w: www.rowegroup.com.au
e: info@rowegroup.com.au
p: 08 9221 1991

Date Drawn:	2014-07-09
Job Ref:	7282A
Scale:	1:10,000 @ A3
Client:	Satterley Property Group
Designer:	K Kyle
Drawn:	M. Winfield
Projection:	PCG94
Plan ID:	7282A-FIG-35-B

Revised Kwinana Industrial (Including Air Quality) Buffer 21 September 2010

Mandogalup Figure 6

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_FIG35B_20160907_MANDOGALUP (AIR BUFFER).DWG
Matt Sullivan 8 December 2016

Planning Design Delivery

Rowley Road

Kwinana Freeway

Hoffman Road

MU
RE
C

LEGEND

- Local Structure Plan Boundary
- Existing Cadastre
- Wetlands
- MU Multiple Use Wetlands
- RE Resource Enhancement Wetlands
- C Conservation Category Wetlands

0 50 100 200 400 Metres

REVISIONS

Rev	Date	Drawn
A	2014.07.09	M. Winfield
B	2016.09.07	M. Sullivan

ROWEGROUP
PLANNING DESIGN DELIVERY

w: www.rowegroup.com.au
e: info@rowegroup.com.au
p: 08 9221 1991

Date Drawn:	2014-07-09
Job Ref:	7282A
Scale:	1:7500 @ A3
Client:	Satterley Property Group
Designer:	K. Kyle
Drawn:	M. Winfield
Projection:	PCG 94
Plan ID:	7282A-FIG-33-B

Cadastre supplied by McMullen Nolan

Wetlands

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_FIG33B_20160907_MANDOGALUP (WETLANDS).DWG
Matt Sullivan 13 September 2016

Mandogalup
Figure 7

Planning Design Delivery

Rowley Road

Kwinana Freeway

Hoffman Road

LEGEND

- Local Structure Plan Boundary
- Existing Cadastre
- Class 1 - High to Moderate Risk ASS
- Class 2 - Moderate to Low Risk ASS

N

0 50 100 200 400 Metres

REVISIONS

Rev	Date	Drawn
A	2014.07.09	M. Winfield
B	2016.09.07	M. Sullivan

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PLANNING DESIGN DELIVERY

w: www.rowegroup.com.au
e: info@rowegroup.com.au
p: 08 9221 1991

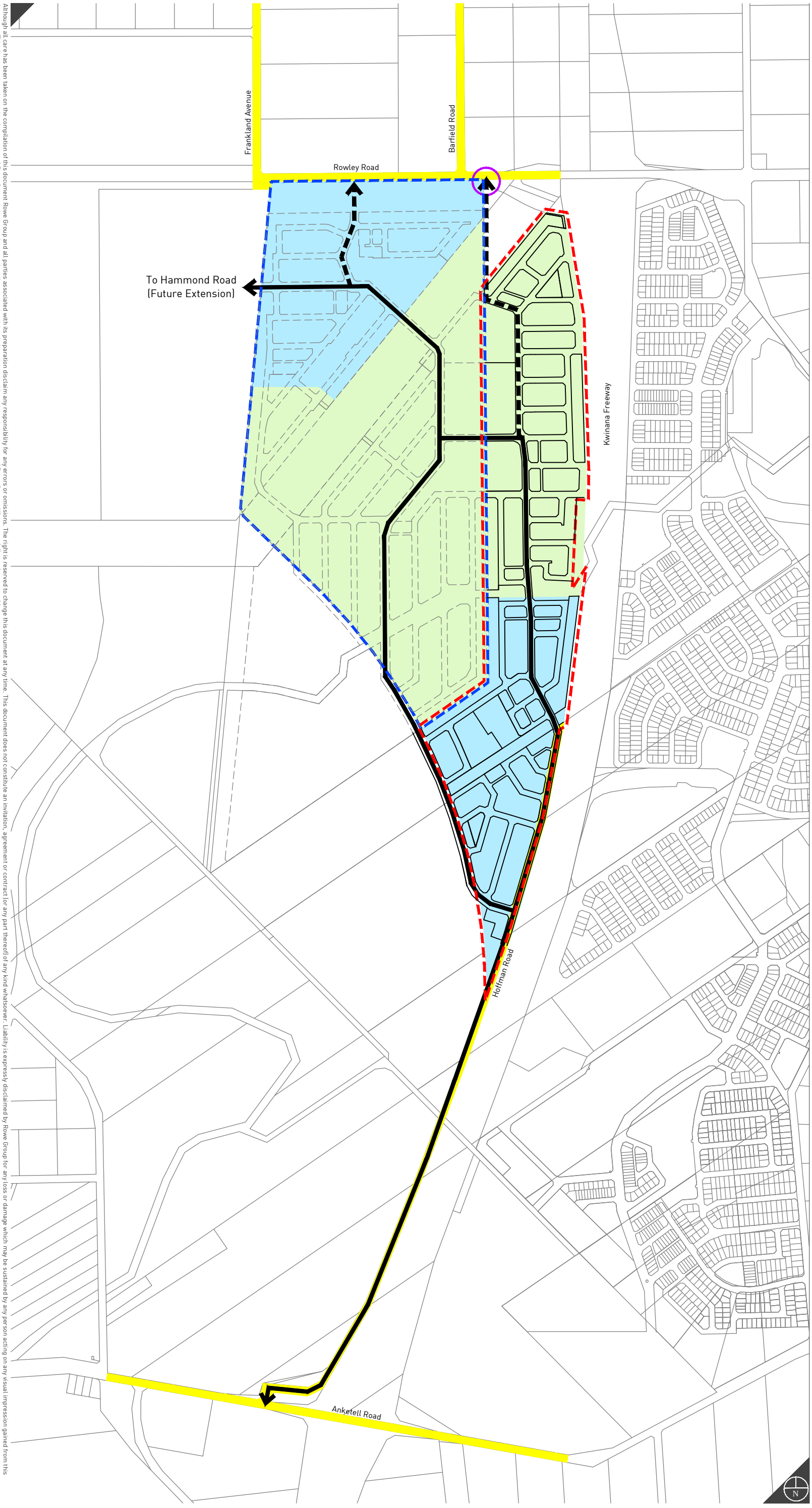
Date Drawn:	2014-07-09
Job Ref:	7282A
Scale:	1:7500 @ A3
Client:	Satterley Property Group
Designer:	K. Kyle
Drawn:	M. Winfield
Projection:	PCG 94
Plan ID:	7282A-FIG-34-B

Cadastre supplied by McMullen Nolan

Acid Sulfate Soils

Mandogalup
Figure 8

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_FIG34B_20160907_MANDOGALUP (ASS).DWG
Matt Sullivan 13 September 2016



Planning Design Delivery

LEGEND

- Local Structure Plan Boundary
- Local Structure Plan by others (QUBE)
- Existing Cadastre
- Indicative Lot Layout
- Indicative Lot Layout By Others
- Indicative Fire & Emergency Access Route (Permanent)
- Interim Emergency Access (Short Term)
- Controlled Gated Emergency Access
- Existing Gazetted Road (Public Access)
- Phase One Development (2017 / 2018)
- Phase Two Development (2018+)

NOTES:

1. Emergency access route to follow 300 diameter water main. Water main to be constructed as part of Stage 1 works.
2. Emergency access to be constructed to a minimum 6 metre wide trafficable surface.
3. Interim emergency access to be closed upon completion of initial stages of development of adjacent landholdings.
4. Layout shown for explanatory purposes only. Subject to review and detailed design at subdivision stage.

0 250 500 Metres

REVISIONS

Rev	Date	Drawn
A	2014.05.06	K. Trenberth
B	2016.09.07	M. Sullivan
C	2016.11.29	M. Sullivan

ROWEGROUP
PLANNING DESIGN DELIVERY

w: www.rowegroup.com.au
e: info@rowegroup.com.au
p: 08 9221 1991

Date Drawn:	2014.05.06
Job Ref:	7282A
Scale:	1:10,000 @ A3
Client:	Satterley
Designer:	R. Cumming
Drawn:	K. Trenberth
Projection:	PCG 94
Plan ID:	7282A-FIG-25-C

Cadastre supplied by McMullen Nolan. Access routes supplied by Peritas Group.

Indicative Fire & Emergency Access

Mandogalup
Figure 9

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_FIG25C_20161129_MANDOGALUP (FIRE & EMERGENCY ACCESS).DWG
Matt Sullivan 30 November 2016

Planning Design Delivery

LEGEND

- Local Structure Plan Boundary
- Existing Cadastre
- Indicative Lot Layout
- Indicative Lot Layout By Others
- DBNGP Easement
- High Voltage Powerline Easement
- Peel Main Drain
- Residential - R30
- Residential - R40
- Residential - R60
- Parks, Recreation & Drainage
- Public Purpose - Primary School

NOTE: Lot layout provided for explanatory purposes only, and is subject to review and detailed design at subdivsion stage.

0 125 250 Metres

REVISIONS

Rev	Date	Drawn
A	2014.07.09	M. Winfield
B	2015.10.12	W. Clements
C	2016.09.07	M. Sullivan
D	2016.11.29	M. Sullivan

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PLANNING DESIGN DELIVERY

w: www.rowegroup.com.au
e: info@rowegroup.com.au
p: 08 9221 1991

Date Drawn:	2014-07-09
Job Ref:	7282A
Scale:	1:6000 @ A3
Client:	Satterley Property Group
Designer:	K. Kyle
Drawn:	M. Winfield
Projection:	PCG 94
Plan ID:	7282A-FIG-31-D

Cadastre supplied by McMullen Nolan

Indicative Zoning and Residential Density Code Plan

Mandogalup
Figure 10

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_FIG31D_20161129_MANDOGALUP (ZONING PLAN).DWG
Matt Sullivan 8 December 2016

Planning Design Delivery

LEGEND

- Local Structure Plan Boundary
- Existing Boundaries
- Indicative Layout
- Indicative Layout By Others
- DBNGP Easement
- Peel Main Drain
- High Voltage Powerline Easement
- (6) POS Reference No.
- Unrestricted POS
- Restricted POS
- Rebated Lot Rain Gardens
- Drainage (5 year ARI)
- Primary School

NOTE: Layout provided for explanatory purposes only, and is subject to review and detailed design at subdivsion stage.

Rowley Road
Primary School
Kwinana Freeway
Hoffman Road
1
2
3
4
5
6
7
N

0 150 300 Metres

REVISIONS

Rev	Date	Drawn
C	2016.05.11	M. Sullivan
D	2016.07.12	M. Sullivan
E	2016.09.07	M. Sullivan
F	2016.11.28	M. Sullivan

ROWEGROUP
PLANNING DESIGN DELIVERY

w: www.rowegroup.com.au
e: info@rowegroup.com.au
p: 08 9221 1991

Date Drawn:	2014-07-09
Job Ref:	7282A
Scale:	1:6,000 @ A3
Client:	Satterley Property Group
Designer:	K. Kyle
Drawn:	M. Winfield
Projection:	PCG 94
Plan ID:	7282A-FIG-29-F

Cadastre supplied by McMullen Nolan

Indicative Public Open Space Plan

Mandogalup
Figure 11

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_FIG29F_20161128_MANDOGALUP (POS).DWG
Matt Sullivan 8 December 2016

NOTE: Layout provided for explanatory purposes only, and is subject to review and detailed design at subdivsion stage.

Mandogalup Local Structure Plan – Public Open Space Schedule			
Site Area (Local Structure Plan boundary)			42.67 ha
Less			
Peel Main Drain	1.07 ha		
DBNGP Easement	1.08 ha		
Rain Gardens	0.78		
Total		**2.93 ha**	
Net Site Area			39.75 ha
Deductions			
Primary School	1.49 ha		
Total		1.49 ha	
Gross Subdivisible Area			**38.25 ha**
POS @10%			3.83 ha
Public Open Space Contribution			
May comprise: - Min 80% unrestricted POS - Min 20% restricted use POS		3.06 ha 0.77 ha	
Total Required POS			**3.83 ha**
POS Reference Number		**Unrestricted Urban POS sites (m²)**	**Restricted Urban POS sites (m²)**
1		2,007.87	0
2		8,392.62	0
3		1,508.65	0
4		4,551.33	0
5		3,060.67	9124.80
6		11,541.74	0
7		2,744.29	0
Total		**33,807.16 m²** **(3.4 ha)**	**9,124.80 m²** **(0.9 ha)**

Schedule based on plan – 7282A_Fig38H_20161115

Table Notes:

- Unrestricted POS equates to approx 8.84% of gross subdivisible area.
- Restricted POS equates to approx 2.39% of gross subdivisible area.
- Oversupply of Unrestricted POS – Approx. 3203.46m²
- Total site area excludes existing Hoffman Road reserve and Lot 1404
- Layout based on total 2.5 hectare playing fields and 3.5 hectare primary school
- DBGNP as a deduction. No POS credit.
- Area of restricted / unrestricted for POS 5 is to be reconciled at detailed design once fenced boundary of vegetation retention/ conservation is determined.

REVISIONS

Rev	Date	Drawn
A	2014.07.16	M. Winfield
B	2016.05.11	M. Sullivan
C	2016.11.28	M. Sullivan

ROWEGROUP
PLANNING DESIGN DELIVERY

w: www.rowegroup.com.au
e: info@rowegroup.com.au
p: 08 9221 1991

Date Drawn:	2014-07-16
Job Ref:	7282A
Scale:	N.T.S. @ A3
Client:	Satterley
Designer:	R. Cumming
Drawn:	M. Winfield
Projection:	PCG94
Plan ID:	7282A-FIG-36-C

Indicative Public Open Space Schedule

Mandogalup
Figure 12

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_FIG36C_20161128_MANDOGALUP (POS SCHEDULE).DWG
Matt Sullivan 28 November 2016

Planning Design Delivery

Rowley Road

POS

Playing Fields

Primary School

POS

POS

POS

POS

POS

POS

Kwinana Freeway

Hoffman Road

LEGEND

- Local Structure Plan Boundary
- Existing Cadastre
- Indicative Lot Layout
- Indicative Layout By Others
- Local Drainage
- DBNGP Easement
- High Voltage Powerline Easement
- Peel Main Drain

NOTE: Lot layout provided for explanatory purposes only, and is subject to review and detailed design at

0 125 250 Metres

Indicative Plan of Subdivision

Mandogalup
Figure 13

REVISIONS

Rev	Date	Drawn
E	2016.11.03	M. Sullivan
F	2016.11.07	M. Sullivan
G	2016.11.15	M. Sullivan
H	2016.11.15	M. Sullivan

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

Date Drawn:	2014-07-16
Job Ref:	7282A
Scale:	1:6000 @ A3
Client:	Satterley Property Group
Designer:	K. Kyle
Drawn:	M. Winfield
Projection:	PCG 94
Plan ID:	7282A-FIG-38-H

Cadastre supplied by McMullen Nolan

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_FIG38H_20161115_MANDOGALUP (SUBDIVISION).DWG
Matt Sullivan 8 December 2016

Planning Design Delivery

LEGEND

- Local Structure Plan Boundary
- Existing Cadastre
- Indicative Lot Layout
- Indicative Lot Layout By Others
- Neighbourhood Connector A
- Temporary Neighbourhood Connector
- Neighbourhood Connector B
- Access Street B
- Access Street D
- Laneway (Rear)

NOTE: Layout provided for explanatory purposes only, and is subject to review and detailed design at subdivsion stage.

Rowley Road

Kwinana Freeway

0 125 250 Metres

REVISIONS

Rev	Date	Drawn
A	2014.07.09	M. Winfield
B	2016.09.07	M. Sullivan
C	2016.11.29	M. Sullivan

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e: info@rowegroup.com.au
p: 08 9221 1991

Date Drawn:	2014-07-09
Job Ref:	7282A
Scale:	1:6000 @ A3
Client:	Satterley Property Group
Designer:	K. Kyle
Drawn:	M. Winfield
Projection:	PCG 94
Plan ID:	7282A-FIG-30-C

Cadastre supplied by McMullen Nolan

Indicative Movement Network

Mandogalup
Figure 14

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_FIG30C_20161129_MANDOGALUP (MOVEMENT NETWORK).DWG
Matt Sullivan 8 December 2016

Planning Design Delivery

Rowley Road

Stage 7

Stage 6

Stage 5

Stage 3

Stage 2

Stage 4

Stage 1

Kwinana Freeway

1

2

N

LEGEND

- Local Structure Plan Boundary
- Existing Cadastre
- Indicative Layout
- Indicative Layout By Others
- Indicative Staging Boundary
- Display Village Precinct (Stage 1)
- Connections with MWLSP

NOTES

1. Hoffman Road to be landscaped as part of Stage 1.
2. Indicative Wastewater Pump Station Location.

NOTE: Layout provided for explanatory purposes only, and is subject to review and detailed design at subdivsion stage.

0 375 Metres

REVISIONS

Rev	Date	Drawn
A	2014.07.09	M. Winfield
B	2016.11.29	M. Sullivan

ROWEGROUP
PLANNING DESIGN DELIVERY

w: www.rowegroup.com.au
e: info@rowegroup.com.au
p: 08 9221 1991

Date Drawn:	2014-07-09
Job Ref:	7282A
Scale:	1:7,500 @ A3
Client:	Satterley Property Group
Designer:	K. Kyle
Drawn:	M. Winfield
Projection:	PCG 94
Plan ID:	7282A-FIG-32-B

Cadastre supplied by McMullen Nolan

Indicative Staging Plan

Mandogalup
Figure 15

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_FIG32B_20161129_MANDOGALUP (STAGING PLAN).DWG
Matt Sullivan 8 December 2016

Part Three
TECHNICAL APPENDICES

ROWEGROUP

APPENDIX 1

CERTIFICATES OF TITLE

ROWEGROUP

243V

WESTERN AUSTRALIA

REGISTER NUMBER	
9019/DP400699	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	29/4/2014

RECORD OF CERTIFICATE OF TITLE

VOLUME 2838 FOLIO 776

UNDER THE TRANSFER OF LAND ACT 1893

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

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 9019 ON DEPOSITED PLAN 400699

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

WANDI ANKETELL HOLDINGS PTY LTD OF LEVEL 2, 18 BOWMAN STREET, SOUTH PERTH
(AF M580288) REGISTERED 29 APRIL 2014

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

1. L537548 MORTGAGE TO AUSTRALIA & NEW ZEALAND BANKING GROUP LTD REGISTERED 24.1.2011.
2. L537549 MORTGAGE TO WANDI ANKETELL LAND FINANCE COMPANY PTY LTD REGISTERED 24.1.2011.
   L537550 TRANSFER OF MORTGAGE L537549 , MORTGAGEE NOW AUSTRALIA AND NEW ZEALAND BANKING GROUP LTD REGISTERED 24.1.2011.
3. L629136 EASEMENT TO WATER CORPORATION FOR ACCESSWAY PURPOSES. SEE DEPOSITED PLAN 400699 REGISTERED 17.5.2011.
4. M460534 EASEMENT TO WATER CORPORATION FOR WATER AND WASTE WATER PIPELINE PURPOSES. SEE DEPOSITED PLAN 400699 REGISTERED 12.11.2013.
5. EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR DRAINAGE PURPOSES TO CITY OF KWINANA - SEE DEPOSITED PLAN 400699
6. EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR SEWERAGE PURPOSES TO WATER CORPORATION - SEE DEPOSITED PLAN 400699
7. EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR WATER PURPOSES TO WATER CORPORATION - SEE DEPOSITED PLAN 400699
8. EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR ELECTRICITY PURPOSES TO ELECTRICITY NETWORKS CORPORATION - SEE DEPOSITED PLAN 400699

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

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

STATEMENTS:
The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land

END OF PAGE 1 - CONTINUED OVER

and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	DP400699.
PREVIOUS TITLE:	2836-567.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	CITY OF KWINANA.

WESTERN AUSTRALIA

REGISTER NUMBER	
9006/DP70124	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	18/5/2011

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME 2769 FOLIO 846

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

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 9006 ON DEPOSITED PLAN 70124

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

WANDI ANKETELL HOLDINGS PTY LTD OF LEVEL 2, 18 BOWMAN STREET, SOUTH PERTH
(AF L608279) REGISTERED 16 MAY 2011

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

1. C463023 EASEMENT TO STATE ENERGY COMMISSION OF WESTERN AUSTRALIA FOR ELECTRICITY PURPOSES- SEE SKETCH ON DEPOSITED PLAN 70124 AND INSTRUMENT C463023. REGISTERED 2.12.1982.
2. D311642 EASEMENT TO STATE ENERGY COMMISSION OF WESTERN AUSTRALIA FOR ELECTRICITY PURPOSES - SEE SKETCH ON DEPOSITED PLAN 70124 AND INSTRUMENT D311642. REGISTERED 27.8.1986.
   H621767 SUNDRY. THE GRANTEE OF TRANSFER D311642 IS NOW THE DBNGP LAND ACCESS MINISTER PURSUANT TO THE DAMPIER TO BUNBURY PIPELINE ACT 1997. REGISTERED 13.12.2000.
3. H621767 SUNDRY. PORTION OF THE LAND HEREIN IS WITHIN THE DBNGP CORRIDOR PURSUANT TO THE DAMPIER TO BUNBURY PIPELINE ACT 1997. SEE DEPOSITED PLAN 215575 AND 215576 REGISTERED 13.12.2000.
4. L537548 MORTGAGE TO AUSTRALIA & NEW ZEALAND BANKING GROUP LTD REGISTERED 24.1.2011.
5. L537549 MORTGAGE TO WANDI ANKETELL LAND FINANCE COMPANY PTY LTD REGISTERED 24.1.2011.
   L537550 TRANSFER OF MORTGAGE L537549 , MORTGAGEE NOW AUSTRALIA AND NEW ZEALAND BANKING GROUP LTD REGISTERED 24.1.2011.

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

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

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land

END OF PAGE 1 - CONTINUED OVER

and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	DP70124.
PREVIOUS TITLE:	2229-82, 2229-81.
PROPERTY STREET ADDRESS:	LOT 9006 HOFFMAN RD, MANDOGALUP.
LOCAL GOVERNMENT AREA:	CITY OF KWINANA.

WESTERN AUSTRALIA

REGISTER NUMBER	
9002/DP69132	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
3	14/2/2011

RECORD OF CERTIFICATE OF TITLE

VOLUME 2758 FOLIO 177

UNDER THE TRANSFER OF LAND ACT 1893

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

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 9002 ON DEPOSITED PLAN 69132

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

WANDI ANKETELL HOLDINGS PTY LTD OF LEVEL 2, 18 BOWMAN STREET, SOUTH PERTH
(AF L494837) REGISTERED 1 DECEMBER 2010

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

1.	B927637	EASEMENT TO THE STATE ENERGY COMMISSION OF WESTERN AUSTRALIA. SEE SKETCH ON DEPOSITED PLAN 69132. REGISTERED 29.5.1980.
2.	C463023	EASEMENT TO THE STATE ENERGY COMMISSION OF WESTERN AUSTRALIA. SEE SKETCH ON DEPOSITED PLAN 69132. REGISTERED 2.12.1982.
3.	C556532	EASEMENT TO THE STATE ENERGY COMMISSION OF WESTERN AUSTRALIA. SEE SKETCH ON DEPOSITED PLAN 69132. REGISTERED 26.5.1983.
	H622728	SUNDRY. THE GRANTEE OF TRANSFER C556532 IS NOW THE DBNGP LAND ACCESS MINISTER PURSUANT TO THE DAMPIER TO BUNBURY PIPELINE ACT 1997. REGISTERED 14.12.2000.
4.	H622728	SUNDRY. PORTION OF THE LAND HEREIN IS WITHIN THE DBNGP CORRIDOR PURSUANT TO THE DAMPIER TO BUNBURY PIPELINE ACT 1997. SEE LAND ADMINISTRATION PLAN 15576. REGISTERED 14.12.2000.
5.	L537548	MORTGAGE TO AUSTRALIA & NEW ZEALAND BANKING GROUP LTD REGISTERED 24.1.2011.
6.	L537549	MORTGAGE TO WANDI ANKETELL LAND FINANCE COMPANY PTY LTD REGISTERED 24.1.2011.
	L537550	TRANSFER OF MORTGAGE L537549 , MORTGAGEE NOW AUSTRALIA AND NEW ZEALAND BANKING GROUP LTD REGISTERED 24.1.2011.
7.	*L556227	CAVEAT BY TOWN OF KWINANA LODGED 2.3.2011.

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

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

END OF PAGE 1 - CONTINUED OVER

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:	DP69132.
PREVIOUS TITLE:	1919-564, 1911-23.
PROPERTY STREET ADDRESS:	LOT 9002 HOFFMAN RD, MANDOGALUP.
LOCAL GOVERNMENT AREA:	CITY OF KWINANA.

WESTERN AUSTRALIA

REGISTER NUMBER	
11/DP76538	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	26/3/2013

RECORD OF CERTIFICATE OF TITLE

VOLUME 2809 FOLIO 569

UNDER THE TRANSFER OF LAND ACT 1893

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

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 11 ON DEPOSITED PLAN 76538

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

SANTO GALATI RANDO
ANNUNZIATA GALATI RANDO
BOTH OF 72 THE HORSESHOE, WANDI
AS JOINT TENANTS

(AF M209157) REGISTERED 26 MARCH 2013

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

1.	C788797	EASEMENT TO THE STATE ENERGY COMMISSION OF WESTERN AUSTRALIA. SEE DEPOSITED PLAN 76538 REGISTERED 8.6.1984.
2.	J753357	MORTGAGE TO NATIONAL AUSTRALIA BANK LTD REGISTERED 22.5.2006.

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

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

STATEMENTS:

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

SKETCH OF LAND:	DP76538.
PREVIOUS TITLE:	1979-881.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	CITY OF KWINANA.

WESTERN AUSTRALIA

REGISTER NUMBER	
8018/DP77243	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

VOLUME **LR3024** FOLIO **314**

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 8018 ON DEPOSITED PLAN 77243

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: UNALLOCATED CROWN LAND

PRIMARY INTEREST HOLDER: STATE OF WESTERN AUSTRALIA

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

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. 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:	DP77243.
PREVIOUS TITLE:	LR3013-104.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	CITY OF KWINANA.
RESPONSIBLE AGENCY:	DEPARTMENT OF LANDS (SLSD).

NOTE 1: M474366 CORRESPONDENCE FILE 00473-2009-01RO

APPENDIX 2

GOVERNMENT GAZETTE NOTICE FOR URBAN ZONING

ROWEGROUP

PL402*

PLANNING AND DEVELOPMENT ACT 2005

METROPOLITAN REGION SCHEME

Resolution—Clause 27

Pt Lot 1 Armadale Road, Banjup

City of Cockburn

Amendment 1269/27 File No.: 812-2-22-15 (RLS/0420/1)

Notice is hereby given that in accordance with Clause 27 of the Metropolitan Region Scheme, the Western Australian Planning Commission resolved on 28 January 2014 to transfer land from the urban deferred zone to the urban zone, as shown on plan number 4.1599.

This amendment is effective from the date of publication of this notice in the *Government Gazette*.

The plan may be viewed at the offices of—

- Western Australian Planning Commission, 140 William Street, Perth
- J S Battye Library, Level 3 Alexander Library Building, Perth Cultural Centre
- City of Cockburn

TIM HILLYARD, Secretary,
Western Australian Planning Commission

PL403*

PLANNING AND DEVELOPMENT ACT 2005

METROPOLITAN REGION SCHEME

Resolution—Clause 27

Mandogalup Urban Precinct

City of Kwinana

Amendment 1260/27 File No.: 812-2-26-12 (RLS/0210/2)

Notice is hereby given that in accordance with Clause 27 of the Metropolitan Region Scheme, the Western Australian Planning Commission resolved on 25 February 2014 to transfer land from the urban deferred zone to the urban zone, as shown on plan number 4.1578.

In considering issues associated with MRS amendment 1114/33—Mandogalup, the Minister for Planning made the following direction in accordance with Section 17(1) of the *Planning and Development Act 2005*—

> *No decision to transfer land in the Mandogalup locality from the Rural or Urban Deferred zones to the Urban zone in the Metropolitan Region Scheme shall be made without the prior approval of State Cabinet and the Minister at the time responsible for the Metropolitan Region Scheme and amendments to it. Further, no such decision will be made until the Kwinana Air Quality Buffer (or whatever title said buffer may come to be known as) has been finalised clearly indicating what land is outside a buffer area and therefore could appropriately be transferred to the Urban zone, subject to whatever other planning circumstances may apply to the locality at the time.*

In accordance with that direction, MRS amendment 1260/27—Portion of Mandogalup Urban Precinct has been approved by both the Minister for Planning and State Cabinet.

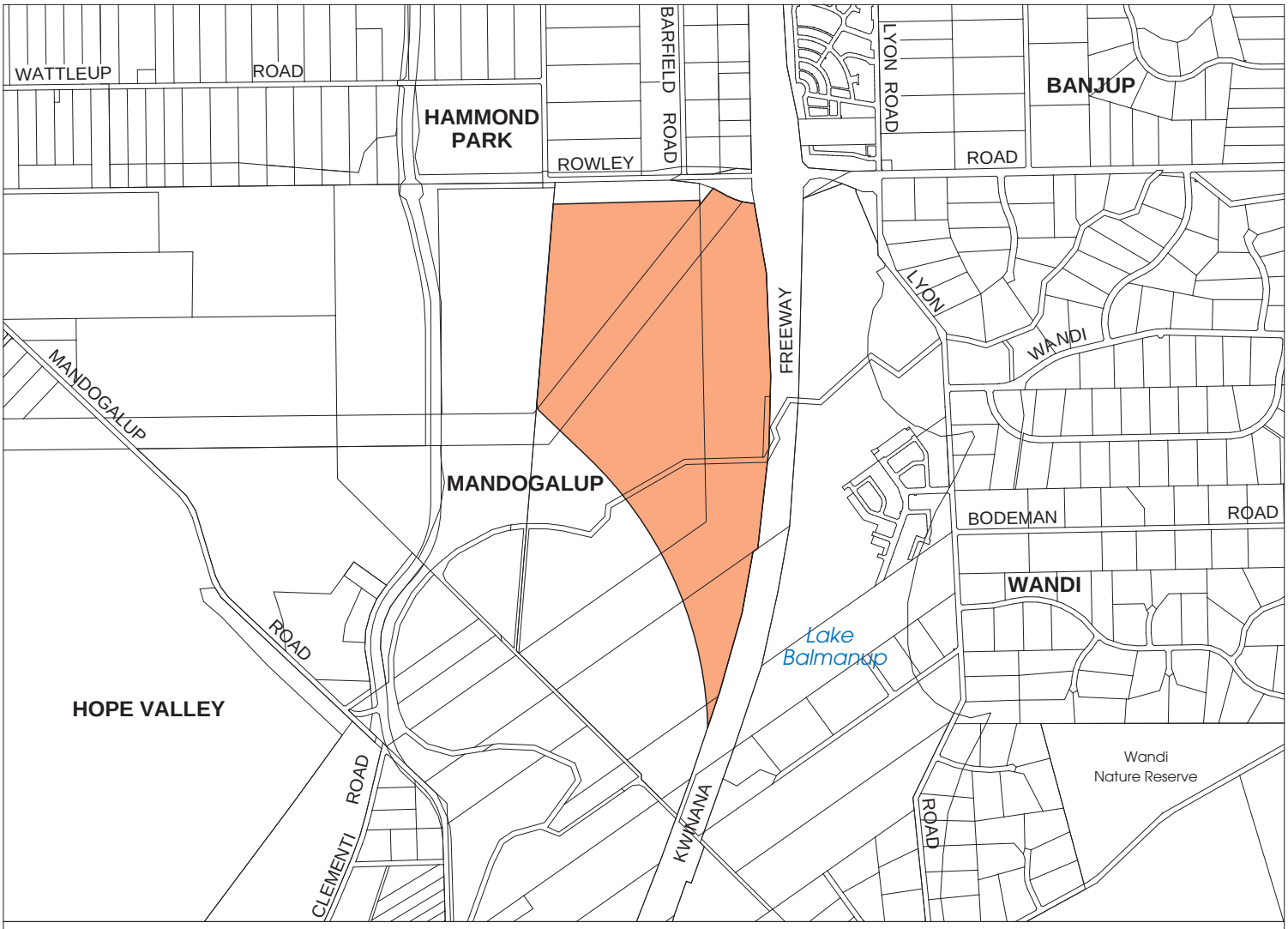
The City of Kwinana has requested the concurrent amendment to a "Development" zone under its Town Planning Scheme No. 2 using the provisions of section 126(3) of the Planning and Development Act. This request has been agreed to by the WAPC. Accordingly, the amendment to the Metropolitan Region Scheme and the City of Kwinana Town Planning Scheme No. 2 is effective from the date of publication of this notice in the *Government Gazette*.

This amendment is effective from the date of publication of this notice in the *Government Gazette*.

The plan may be viewed at the offices of—

- Western Australian Planning Commission, 140 William Street, Perth
- J S Battye Library, Level 3 Alexander Library Building, Perth Cultural Centre
- City of Kwinana

TIM HILLYARD, Secretary,
Western Australian Planning Commission



Signed for and on behalf of the
Western Australian Planning Commission

An officer duly authorised by the Commission
pursuant to section 24 of the
Planning and Development Act 2005
for that purpose in the presence of :

Witness

Date

Approved
Minister for Planning

Date

Excluded from urban deferred zone and included in urban zone.

N

Scale 1:25000

Metropolitan Region Scheme

Clause 27 - Transfer of land from urban deferred zone to urban zone

Amendment number 1260/27

1000 750 500 250 0 1

metres kilometres

GOVERNMENT OF WESTERN AUSTRALIA

Western Australian Planning Commission

Project Manager: A. Muscara

Draftsperson: T. Lynch

Examined:

Revised:

Date: WAPC/1829 25 February 2014

File reference: 812/2/26/12 (RLS/0210/1)

Plan reference:
Peel 1:2000 sheets 12.38, 12.39, 13.37 - 13.39
Metropolitan Region Scheme 1:25000 sheet 24
detail plan 1.7320

2683 Plan number 4.1578

4_1578.amd
28 Feb 2014
Produced by Mapping & GeoSpatial Data Branch, Department of Planning, Perth WA
On behalf of the Western Australian Planning Commission.
Base information supplied by Western Australian Land Information Authority LI 430-2009-4

GDA

APPENDIX 3

ENVIRONMENTAL ASSESSMENT REPORT

ROWEGROUP

Environmental Assessment Report

Supporting document to Mandogalup East Local Structure Plan

Prepared for
Satterley Property Group
by Strategen

December 2016

strategen
ENVIRONMENTAL

Environmental Assessment Report

Supporting document to Mandogalup East Local Structure Plan

Strategen is a trading name of
Strategen Environmental Consultants Pty Ltd
Level 1, 50 Subiaco Square Road Subiaco WA 6008
ACN: 056 190 419

December 2016

Limitations

Scope of services

This report ("the report") has been prepared by Strategen Environmental Consulting Pty Ltd (Strategen) in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, Strategen has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, Strategen has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen has also not attempted to determine whether any material matter has been omitted from the data. Strategen will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen. The making of any assumption does not imply that Strategen has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

Client: Satterley Property Group

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
				Form	Date
Preliminary Draft Report	A	For client review	T Stehbens/ H Ventriss, D Goundrey	Electronic	21/03/2014
Final Report	0	For lodgement	B Downe / D Goundrey	Electronic	1/08/2014
Final Report	1	For lodgement	P Brand / D Goundrey	Electronic	26/11/2016
Final Report	C	Submission to Client	D Goundrey	Electronic	29/11/16
Revised Final Report	**2**	**For lodgement**	**D Goundrey**	**Electronic**	**6/12/16**

Filename: SPG13027_01 R002 Rev 2 - 6 December 2016

Executive summary

Strategen was commissioned by Satterley Property Group (Satterley) to undertake an environmental assessment of the Mandogalup East Local Structure Plan (MELSP) area located on the western side of the Kwinana Freeway on Lot 9029 Rowley Rd, Pt Lot 9006, Pt Lot 9002 and Pt Lot 11 Hoffman Road, and Lot 8018 (UCL – Peel Main Drain) on Deposited Plan 77243, Mandogalup.

The MELSP comprises a total area of 42.67 ha and is located approximately 30 km south of Perth in the City of Kwinana. The Proposal area is bounded by the Kwinana Freeway to the east, Anketell Road to the south, Mandogalup West Local Structure Plan to the west and Rowley Road to the north.

The EAR was prepared to support the MELSP and investigates the existing environment, the environmental opportunities and constraints associated with development of the Proposal Area in accordance with the proposed MELSP, including proposed management measures to mitigate impacts.

The following summarises the key factors considered during development planning for the Proposal Area:

- the Proposal do not impact on known occurrences of threatened flora or TECs, although two Priority species were identified
- the development of the Proposal Area meets the OEPA Guidance 10 (2006) requirement as vegetation assoication1001 will continue to be represented above 10%
- Carnaby's Black-Cockatoo, listed as Endangered under the EPBC Act, is likely to utilise the Proposal Area. The Proposal has an approval under the EPBC Act to clear up to 19.7 ha of Carnaby's Black-Cockatoo foraging and potential breeding habitat. The approval is subject to conditions relating to clearing procedures, reporting and the acquisition of an offset property. An offset property has been secured in agreement with the Department of Parks and Wildlife.
- the site is subject to a Voluntary Auditors report to demonstrate the Proposal Area is fit for the proposed future use. The Voluntary Auditors report is expected to be lodged to the Department of Environment Regulation in December 2016.
- the site will be subject to an ASS management plan to manage the risk of impact to groundwater
- no site registered Aboriginal Sites are located within or immediately adjacent to the Proposal Area
- no registered heritages sites are known to occur within the Proposal Area
- no confirmed dieback infestations were recorded in the Proposal Area; however, some areas exhibited a pattern of vegetation decline consistent with Phytophthora dieback infestation, and are likely infested
- a significant tree physical assessment and an Engineering and Planning assessment in accordance with the City of Kwinana's Local planning Policy No. 1 as resulted in:
    - the retention of 62 significant trees
    - the potential retention of an additiona13 significant trees subject to further design work associated with the education site, group housing site and road reserve
    - the removal of 97 significant trees of which 56 of these trees are of 'very low' retention value
- the Proposal Area is not considered to represent significant habitat for conservation significant fauna species.

The final MELSP design incorporates environmental management actions into the plan to assist in the retention of environmental values at the Proposal Area. Additional management plans will be prepared for use during development of the Proposal Area, including a CEMP, Water Management Strategy, ASS Management Plan, FHMP, and Dieback Management Plan.

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1. Introduction

Strategen was commissioned by Satterley Property Group (Satterley) to undertake an environmental assessment of the Mandogalup East Local Structure Plan (MELSP) area located on the western side of the Kwinana Freeway on Lot 9029 Rowley Rd, Pt Lot 9006, Pt Lot 9002 and Pt Lot 11 Hoffman Road, and Lot 8018 (UCL – Peel Main Drain) on Deposited Plan 77243, Mandogalup.

The MELSP comprises a total area of 42.67 ha and is located approximately 30 km south of Perth in the City of Kwinana. The Proposal area is bounded by the Kwinana Freeway to the east, Anketell Road to the south, Mandogalup West Local Structure Plan to the west and Rowley Road to the north. The regional location is shown in Figure 1 and the Proposal Area is shown in Figure 2. The MELSP is shown in Appendix 1.

This Environmental Assessment Report (EAR) was prepared to support the MELSP and investigates the existing environment, the environmental opportunities and constraints associated with development of the Proposal Area in accordance with the proposed MELSP, including proposed management measures to mitigate impacts.

1.1 Surrounding land use

1.1.1 Existing land use

The local area has historically been used for agricultural purposes including grazing, cropping and horse agistment, and the Proposal Area predominately cleared. The Proposal Area comprises two portions of land separated by the Peel Main Drain (Lot 8018). Surrounding land uses include residential, conservation, mining (Franklin Sand), poultry farming and industrial (Alcoa tailing ponds and Kwinana Wastewater Treatment Plant).

The Proposal Area is zoned 'Development' under City of Kwinana Town Planning Scheme No. 2. The Proposal Area has been identified for long-term urban development under the Jandakot Structure Plan – Area 1 Mandogalup (WAPC 2007) and was rezoned to 'Urban' under the Metropolitan Region Scheme (MRS).

Portions of Lots 9006, 9002 and 11 outside the MELSP area are situated within a 1.5 km Revised Kwinana Industrial (including air quality) Buffer (as of 21 September 2010) (KIB). This land is currently zoned urban deferred.

1.1.2 Future land use

The proposed development is consistent with the planned expansion of Perth as outlined in the MRS developed by the West Australian Planning Commission (WAPC). The MELSP incorporates residential developments, a primary school and Public Open Space (POS) (Appendix 1).

The KIB located to the west overlies portions of Lots 9006, 9002 and 11. The KIB stipulates no residential development within 1 km of the residue storage area, with an additional 0.5 km non-residential transition zone. As a result, the Proposal Area will be designed so that development can occur independent of the adjacent land within the KIB. The development will function as a locally self-sufficient and independent community that will ultimately be integrated with the *Mandogalup West Local Structure Plan* (MWLSP) into a larger, coherent and functional neighbourhood. .

Figure 1 Site location

Scale 1:200,000 at A4

0 1 2 3 4 5 km

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 26/11/2016
Author: JCrute
Source: Topography: Geoscience Australia 2011.

Legend

- Town
- Local government boundary
- Proposal Area
- Major road
- Minor road
- Major river
- Lakes
- Native vegetation

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www.strategen.com.au

Path: Q:\Consult\2013\SPG\SPG13027.01\ArcMap_documents\R002\SPG13027_01_R002_Rev1_F001.mxd

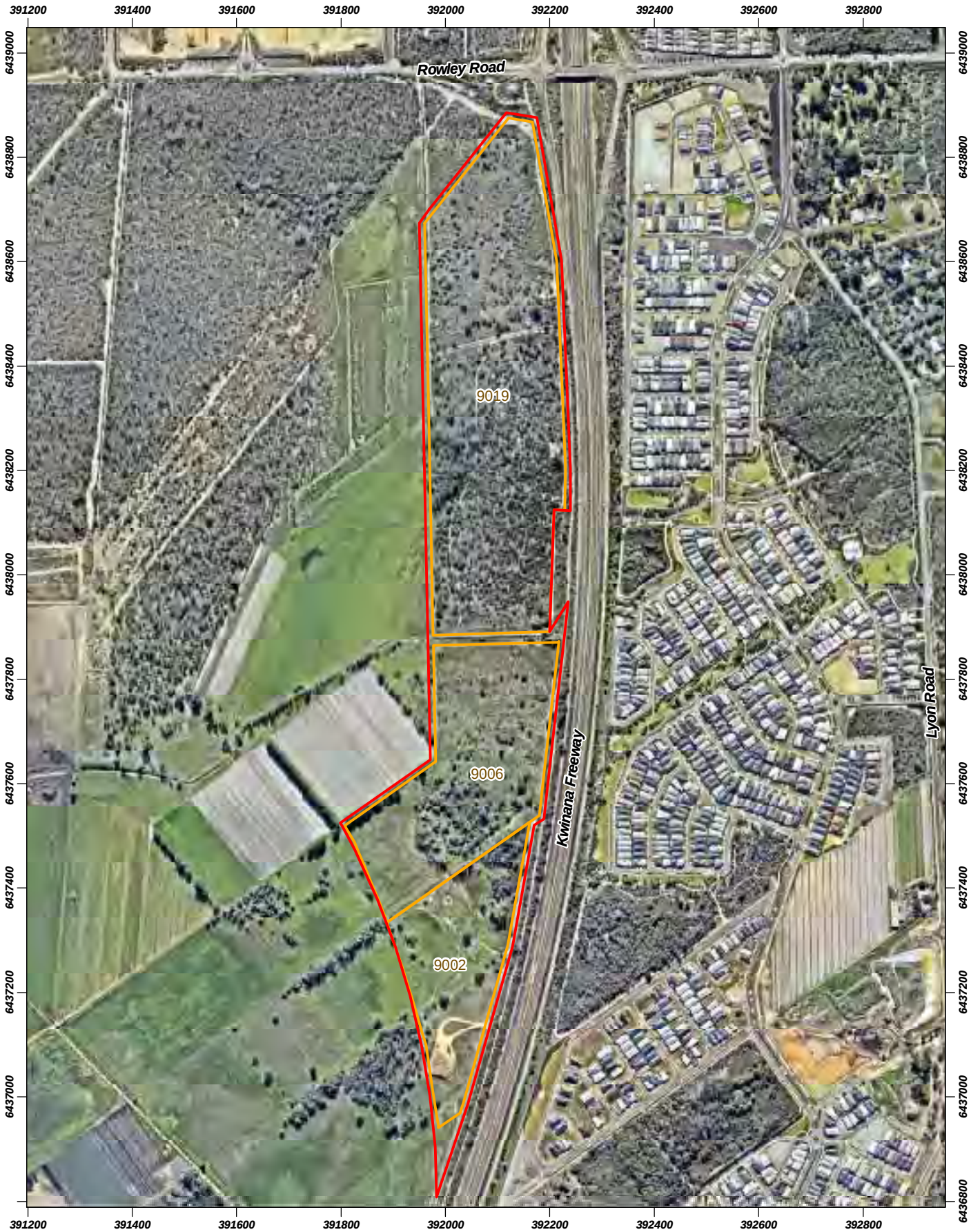


Figure 2 Proposal area

Scale 1:10,000 at A4

0 50 100 150 200 250 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 26/11/2016
Author: JCrute
Source: Aerial image: Nearmaps 2016

Legend

- Proposal Area
- Lot boundaries

info@strategen.com.au
www.strategen.com.au

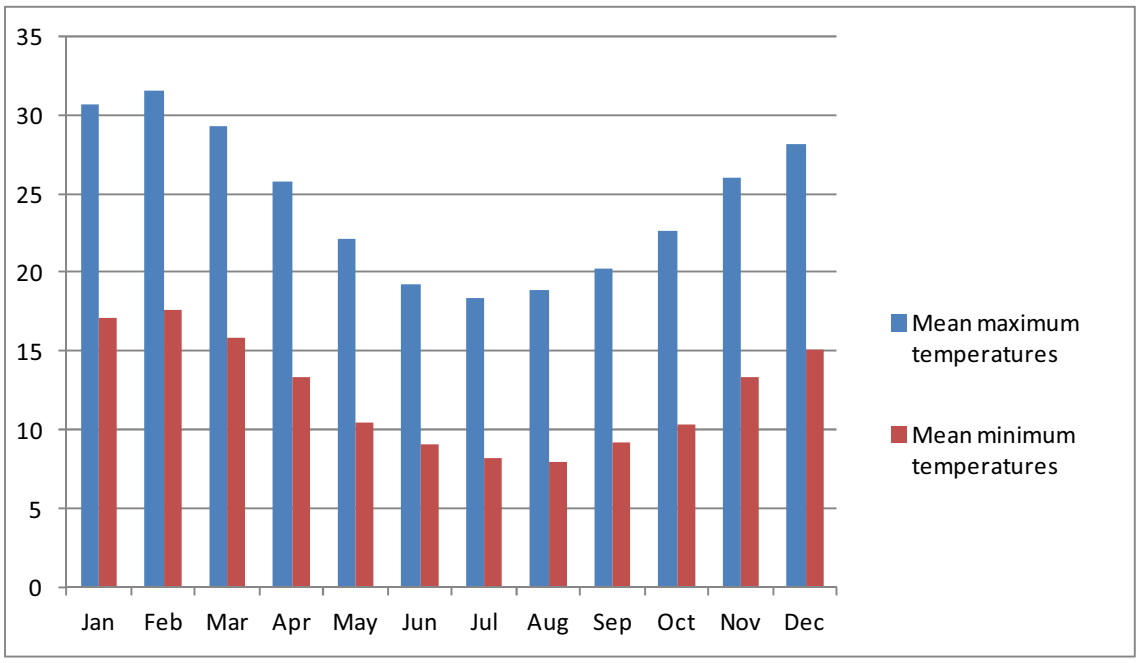
Path: Q:\Consult\2013\SPG\SPG13027.01\ArcMap_documents\R002\SPG13027_01_R002_Rev1_F002.mxd

2. Existing environment

2.1 Climate

The climate of this region is described as Mediterranean, similar to that of other coastal areas in the Perth Metropolitan region, with hot dry summers and mild wet winters and rainfall ranging between 600 and 1000 mm annually (Mitchell et al. 2002).

The nearest official meteorological weather station is the Mandogalup station located approximately 3 km from the Proposal Area. Mean minimum and maximum temperatures based on these records are presented in Figure 3. The highest mean maximum temperature during 2013 was recorded in February at 35.2 C and the mean minimum temperature was recorded during July at 5.4 C.



Source: BoM 2014

Figure 3: Mean monthly maximum and minimum temperatures for Mandogalup

2.2 Geology, soils and topography

The Proposal Area is situated on the interface of the Bassendean and Spearwood dune systems. Soils within the Proposal Area are predominantly lacustrine deposits consisting of sandy silt (black friable silt with abundant organic material, variable fine quartz sand content, soft) and light grey, fine to medium grey sand (Bassendean Sand) over Lacustrine deposits (Gozzard 1983). A small portion of the far north of the Proposal Area is Bassendean Sand without underlying Lacustrine deposits (Gozzard 1983).

The topography of the study area is mostly low and gently undulating, with local relief from 12 mAHD at the westernmost point to 28 mAHD in the north (DoW 2015). The Proposal Area slopes in a generally south westerly direction (DoW 2015).

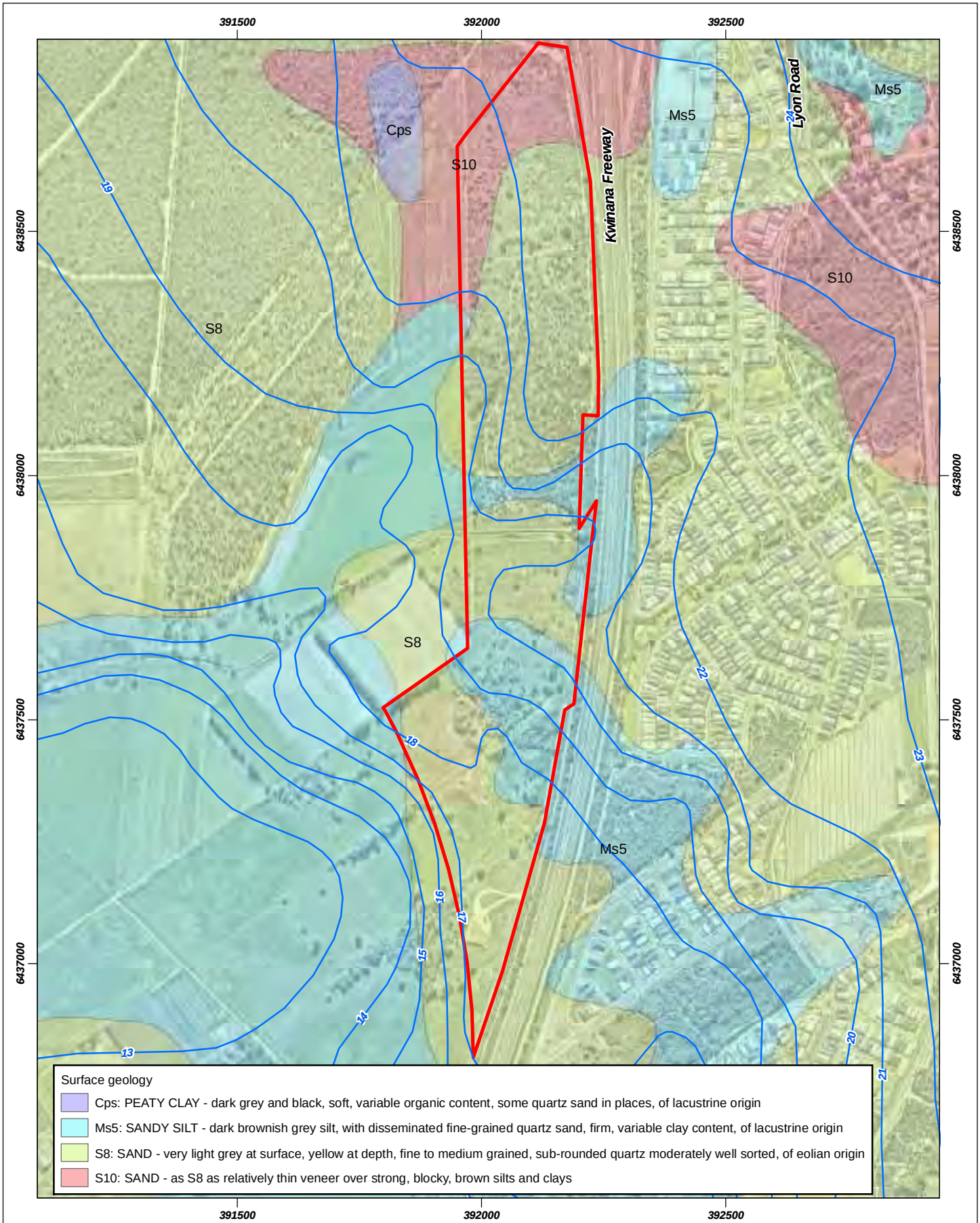


Figure 4 Soils and geology

Scale 1:10,500 at A4

0 50 100 150 200 250 m

N

Legend

- Groundwater contours maximum (mAHD)
- Proposal Area

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 26/11/2016

Author: JCrute

Source: Aerial image: Nearmap 2016. Surface geology 1:50,000, Mapsheet Fremantle. DMP 2001. Groundwater: Department of Water 2000.

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2.3 Hydrology

Groundwater levels beneath the Proposal Area range from 21 mAHD–13 mAHD inland, corresponding to groundwater levels between 15 metres below ground level (mbgl) to as little as 0.3 mbgl (RPS 2009). Groundwater flow direction within the site generally follows the natural topography and flows in a south-westerly direction according to the Perth Groundwater Atlas (DoW 2015) and observations made at the site (JDA 2014).

The Jandakot Mound supplies groundwater for public water supply, private abstraction for irrigated agriculture, industry, public open space and recreation grounds. Although the Proposal Area is within the Jandakot Mound catchment, it is not within a proclaimed public drinking water source area (JDA 2014).

2.4 Wetlands

2.4.1 Conservation significant wetlands

Two Ramsar-listed wetlands are located in proximity to the Proposal Area as identified in an *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters search (DotE 2016; Appendix 3):

- Forrestdale and Thomsons lakes—located within 10 km of the Proposal Area (to the northeast and north respectively)
- Peel-Yalgorup system—Proposal Area located within catchment area (the Ramsar site, the Spectacles Wetlands, is located approximately 4 km away to the south).

Forrestdale and Thomsons lakes

Surface water within the Proposal Area flows in a southerly direction towards the Spectacles wetlands via the Peel Main Drain (RPS 2009). Groundwater under the Proposal Area generally flows west-southwest towards the ocean (DoW 2015). Therefore, surface water and groundwater from the Proposal Area flows away from both Forrestdale and Thomsons lakes. As a result, no significant impacts to either lake are expected as a result of the Proposal.

Peel-Yalgorup system

The Peel Main Drain, which flows from Banjup Swamp (located near Gibbs Rd, Aubin Grove) in the north to the Peel-Yalgorup system in the south (via Serpentine River), passes through the Proposal Area. Given that this portion of the Proposal Area is cleared and the surrounding land in the MWLSP area is currently used for horticultural activities, implementation of the Proposal is unlikely to lead to a decline in the water quality of the drain. Nutrient loads may decrease over time due to the cessation of horticultural activities in the MWLSP area.

2.4.2 Geomorphic wetlands

The majority of the Proposal Area is mapped by the Department of Parks and Wildlife (Parks and Wildlife) as a Multiple Use Category Dampland (seasonally waterlogged flat) with a small area of Resource Enhancement Category Sumpland (seasonally inundated flat) in the north of the Proposal Area (Figure 5; Landgate 2016). Waterlogging and inundation occurs in localised areas of the Proposal Area as a result of elevated groundwater levels at the end of the winter wet season.

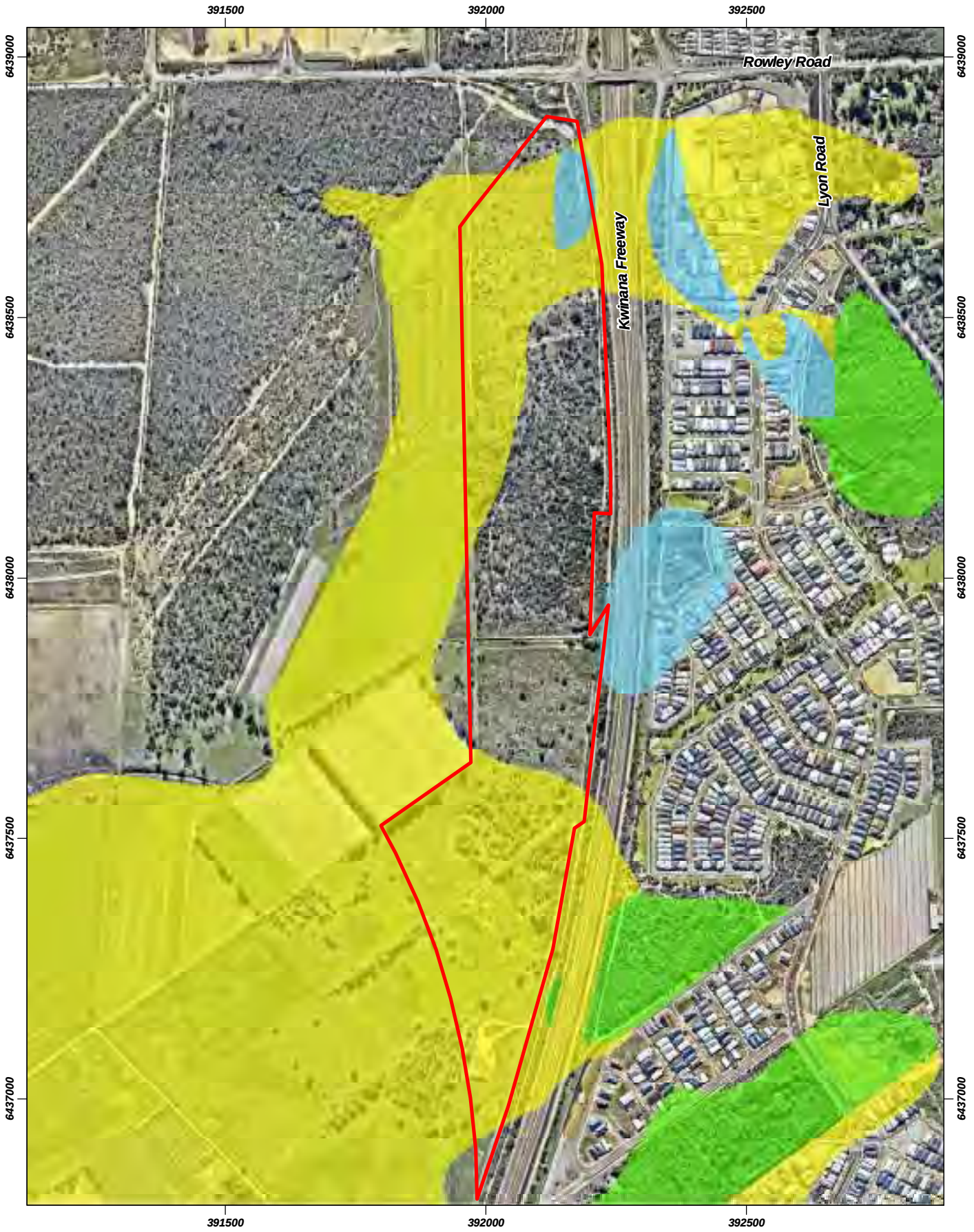

Figure 5 Wetlands

Scale 1:10,000 at A4

0 50 100 150 200 250 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 26/11/2016
Author: JCrute
Source: Aerial image:Nearmap 2016. Wetlands: DEC 2012.

Legend

Proposal Area

Wetland Management Categories

- Conservation
- Multiple Use
- Resource Enhancement

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2.5 Acid sulfate soils

Acid sulfate soils (ASS) are naturally occurring soils and sediments containing iron sulfides, most commonly pyrite. When ASS are exposed to air, the iron sulfides in the soil react with oxygen and water to produce a variety of iron compounds and sulfuric acid. The resulting acid can release other substances, including heavy metals, from the soil and into the surrounding environment (DEC 2013).

Inappropriate disturbance of these soils can generate large amounts of sulfuric acid, resulting in the leaching of contaminants (heavy metals) naturally occurring in soils. Flushing of acidic leachate to groundwater and surface waters can cause off-site impacts including:

- ecological damage to aquatic and riparian ecosystems
- effects on estuarine fisheries and aquaculture projects
- contamination of groundwater with arsenic, aluminium and other heavy metals
- reduction in agricultural productivity through contamination of soils (predominantly by aluminium)
- damage to infrastructure through the corrosion of concrete and steel pipes, bridges and other subsurface assets.

The ASS Guidelines (West Australian Planning Commission [WAPC] and Department of Planning and Infrastructure [DPI] 2008) state that an ASS investigation is required for rezoning when a Proposal Area is depicted as partially or wholly within an area of 'high to moderate risk of ASS occurring within 3 m of natural soil surface'. Appropriate management of ASS by landowners and developers is required to avoid environmental harm under the *Environmental Protection Act 1986*.

According to the Acid Sulfate Soils Risk Map (Landgate 2016), the Proposal Area has a moderate to high risk of ASS (Figure 6).

RPS (2009) undertook a desktop analysis of the Proposal Area to determine the likelihood of ASS being present on the Proposal Area. This analysis incorporated geomorphic and Proposal Area description criteria, including:

- soil and sediment of recent geological age (Holocene)
- marine or estuarine sediments and tidal lakes
- low-lying coastal wetlands or back swamp areas, waterlogged or scalded areas, stranded beach ridges and adjacent swales, interdunal swales or coastal sand dunes
- coastal alluvial valleys
- areas where dominant vegetation is tolerant of salt, acid and/or water-logging conditions, e.g. mangroves, salt couch, swamp-tolerant reeds, rushes, paperbarks (*Melaleuca* spp.) and swamp oak (*Casuarina* spp.)
- areas identified in geological descriptions or in maps as bearing sulfide minerals, coal deposits or marine shales/sediments, and deep older estuarine sediments below ground surface of either Holocene or pre-Holocene age.

RPS (2009) concluded that there was a high risk of disturbing potential or actual ASS during ground intrusive earthworks in the low-lying central, western and northern areas of the Proposal Area, as most of this area is less than 1 m above the watertable.

Based on these desktop findings an ASS investigation was undertaken across the Proposal Area in 2015 and 2016. The investigation identified various amounts of ASS present across the Proposal Area requiring management during intrusive development works to prevent environmental harm. An ASS Management Plan and implementation prior to intrusive disturbance works being undertaken will manage environmental risk.

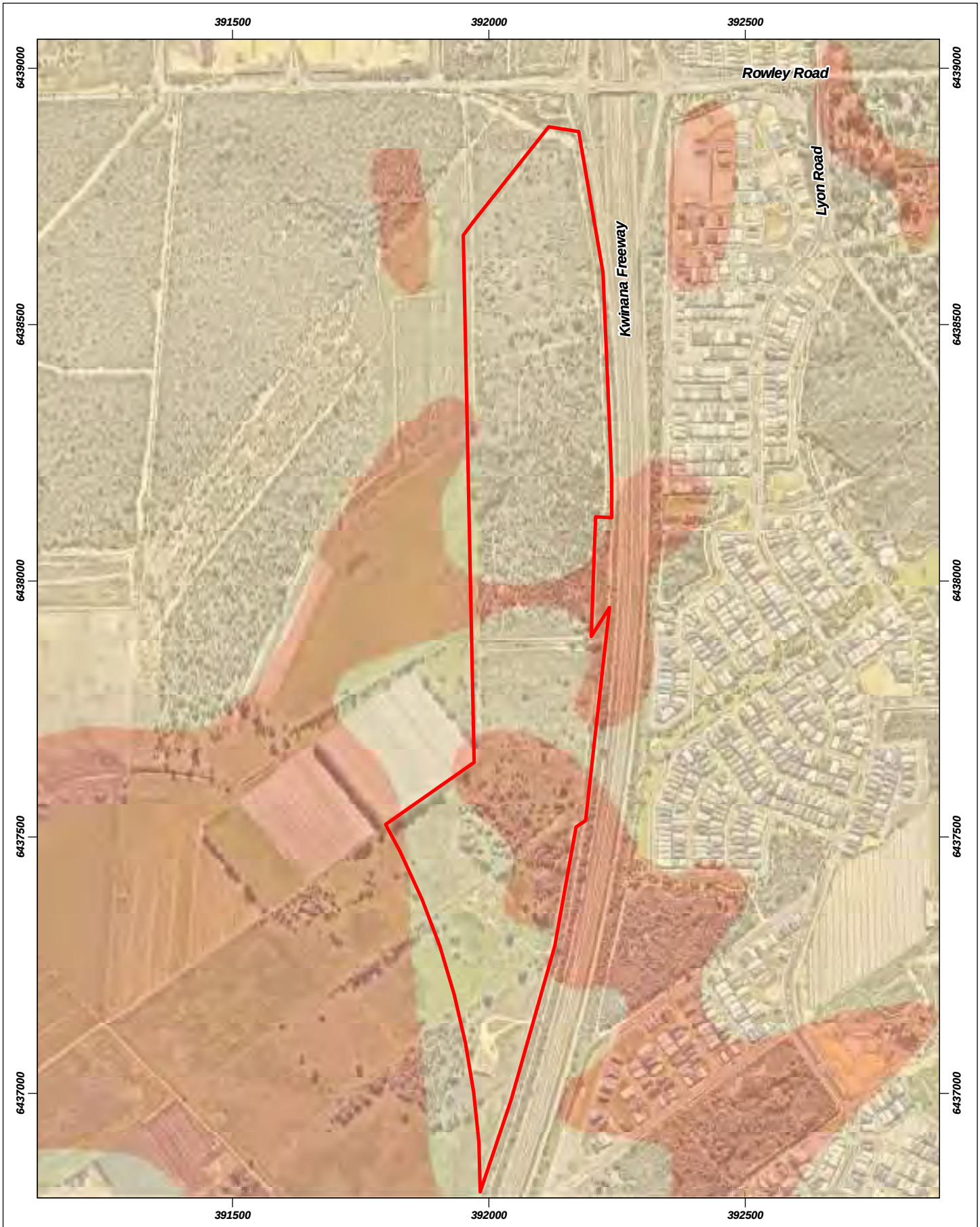

Figure 6 Acid sulphate soils

Scale 1:10,000 at A4

0 50 100 150 200 250 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 26/11/2016
Author: JCrute
Source: Aerial image: Nearmap 2016; ASS: DEC 2012.

Legend

Proposal Area

Acid Sulphate Soil Risk Mapping

High to moderate risk

Moderate to low risk

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2.6 Conservation areas

The Spectacles wetlands occur approximately 4 km the south of the Proposal Area (see Section 2.4). The Spectacles are Ramsar-listed (RPS 2009), and are also identified under the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 (WA). The Spectacles are classified as a conservation category wetland (Landgate 2016).

Thomsons Lake Nature Reserve is located approximately 3 km to the north of the Proposal Area and encompasses the Ramsar-listed Thomsons Lake (see Section 2.4). Thompsons Lake Nature Reserve is part of Beeliar Regional Park.

In addition, numerous Bush Forever sites are also located nearby (DEP 2000) including:

- Site 268 Mandogalup Road Bushland (located within 1 km of the Proposal Area, to the west)
- Site 269 The Spectacles (located within 1 km of the Proposal Area, to the southwest)
- Site 270 Sandy Lake and Adjacent Bushland (located within 1 km of the Proposal Area, to the south)
- Site 347 Wandi Nature Reserve and Anketell Road Bushland (located within 1 km of the Proposal Area, to the northwest)
- Site 392 Harry Waring Marsupial Reserve (located within 2 km of the Proposal Area, to the northwest).

None of these conservation places will be affected by the proposed development.

2.7 Aboriginal heritage

According to the WA Department of Aboriginal Affairs (DAA) Aboriginal Heritage Inquiry System, no Registered Aboriginal sites are located within or immediately adjacent to the Proposal Area (DAA 2016, Appendix 4). However, one mythological site, Site 3427 (Mandogalup Swamp/spectacles) extends into the southern portion of the Proposal Area (DAA 2016, Appendix 4).

Impacts to this designated 'Other Heritage Place' as a result of the proposed Mandogalup Urban Development are unlikely to be significant given that the majority of Site 3427 is located outside the Proposal Area. Consent under s 18 of the *Aboriginal Heritage Act 1972* (WA) will be sought if required.

2.8 European heritage

A search of the WA Register of Heritage Places database indicates no registered heritage sites occur within the Proposal Area (SHC 2016).

2.9 Site contamination

An assessment of the Proposal Area was undertaken in 2015 which confirmed a number of potential contamination sources and contaminating site activities had occurred including:

- illegally fly-tipped waste including chemical storage containers and inert waste
- storage of dangerous goods (petroleum hydrocarbons)
- surficial and partially buried potential asbestos containing material (PACM)
- potential pesticide application (intensive agriculture) in a stock yard
- construction of a horse training track.

Remediation was undertaken within the Proposal Area between June 2015 and February 2016 to remove known potential contamination sources. Following removal of all known potential contamination sources to an off-site licensed landfill facility the soil and groundwater quality was further investigated to:

1. Assess the nature and extent of contamination, if any, following preliminary remediation activities at the site.
2. Assess the future risk to human health and the environment from residual site contamination.

Based upon the results of the Detailed Site Investigation (DSI) a human health and ecological risk assessment for the Proposal Area was undertaken and concluded:

1. Residual contaminant sources have been removed from the site and there are no residual soil risks to human health or the environment.
2. Groundwater and surface water is suitable for non-potable use and irrigation and is not considered to be a risk to human health. Groundwater is not recommended for drinking water purposes.
3. Groundwater quality is indicative of the regional superficial aquifer and minor groundwater contamination is considered a result of regional agricultural activities. There are no unacceptable groundwater or surface water contamination risks to human health and/or the environment.

Based on the DSI results, no further investigations to characterise soil, groundwater and/or surface water contamination are deemed necessary and the Proposal Area is considered to be suitable for residential purposes based as proposed.

A Contaminated Sites Auditor accredited under the *Contaminated Sites Act 2003*, was commissioned to prepare a voluntary audit report for the Proposal Area and surrounds following completion of the DSI. The voluntary audit report will be submitted to Department of Environment Regulation prior to your during November 2016 to support the assessment of the MELSP application under the *Planning and Development Act 2005*.

2.10 Flora and vegetation

The following three studies have been undertaken on the flora and vegetation within the Proposal Area:

1. A Level 2 flora survey was undertaken in accordance with EPA Guidance Statement No. 51 (EPA 2004a) in spring of 2004 and 2006, and autumn of 2007 (RPS 2010, Appendix 5).
2. A 2013 targeted Threatened flora survey (Woodman 2014, Appendix 6).

The survey and study results are summarised in Sections 2.10.1 and 2.10.2.

It should be noted that the RPS Level 2 survey area was 232 ha in size and included not only the Proposal Area but also land to the east of Kwinana Freeway in the suburb of Wandi (refer to Figure 1 of RPS 2010; Appendix 5).

The following arboricultural assessments have been undertaken for significant trees and landscape features including:

1. Mandogalup Urban Development Site Lyon Road, Mandogalup Tree Survey (Paperbark Technologies July 2014, Appendix 7).
2. Assessment of melaleuca: Mandogalup (Arborlogic March 2016, Appendix 8).
3. Significant Tree Assessment: Mandogalup (Arborlogic October 2016 Appendix 9).

Arboricultural assessments of individual trees within unique landscape features and/or had diameter breast heights greater than 500 mm were undertaken across the Proposal Area in 2016. The assessments response to the City of Kwinana Local Planning Policy No.1 Landscape Feature and Tree Retention and in addition assessed the structural integrity and viability of retaining individual trees within the Proposal Area for the Mandogalup Urban Development.

Arborlogic (October 2016 completed a site wide assessment of significant trees assessing 173 trees as having a retention value of 'very low', 'low', 'medium' or 'high'. The retention value was based on an assessment of health and/or structural integrity.

2.10.1 Flora

A 2015 desktop review of the Parks and Wildlife 'NatureMap' identified 358 vascular plant taxa, of which 296 are native, from 65 plant families that have the potential to occur within the vicinity of the Proposal Area (i.e. 5 km radius search area around the Proposal Area). The majority of taxa were from within the Myrtaceae (41 taxa), Fabaceae (37 taxa), Poaceae (25 taxa), Asteraceae (24 taxa) and Cyperaceae (22 taxa) families. The 'NatureMap' search report is provided in Appendix 10.

Approximately 100 vascular plant taxa from 23 genera were recorded in the Proposal Area including 23 introduced species (weed) (RPS 2010, Appendix 5). The native taxa recorded during the survey are estimated to constitute at least 70% of the native flora actually present within the Proposal Area. The recorded alien taxa are estimated to constitute at least 50% of the alien flora actually present within the Proposal Area (RPS 2010).

Threatened and Priority flora

A desktop review of Parks and Wildlife 'NatureMap' was undertaken to determine whether any Threatened species protected under the *Wildlife Conservation Act 1950* (WC Act) or Priority flora species as listed by Parks and Wildlife are known from within a 5 km radius of the Proposal Area. Three Threatened and seven Priority flora species potentially occur within the Proposal Area based on the desktop review as outlined in Table 1. The 'NatureMap' search report is provided in Appendix 10.

A 2016 Protected Matters database search identified seven Threatened species protected under the EPBC Act that may occur in the Proposal Area as outlined in Table 1. These species were assessed for likelihood of occurrence within the Proposal Area, based on the known habitat requirements and the results of the flora surveys (Table 1). The Protected Matters database search report is provided in Appendix 3.

No Threatened flora species as listed under the EPBC Act or WC Act have been identified within, or are considered likely to occur in the Proposal Area (Table 1).

Two Priority flora species (*Cyathochaeta teretifolia* [P3] and *Jacksonia sericea* [P4]) have been identified in the Proposal Area. RPS (2010) recorded a population of *Cyathochaeta teretifolia* (P3) in the Proposal Area within the ErOF vegetation unit (refer to Section 2.10.2). This area will be retained as Public Open Space (POS), thus removing potential impacts to this species resulting from the Proposal.

One individual of *Jacksonia sericea* (P4) was recorded in the Proposal Area (Woodman 2014). Woodman (2014) states that removal of this individual during future development is not considered to constitute a significant impact to this taxon.

Table 1: Threatened and Priority flora species that may occur within the Proposal Area and likelihood of occurrence

Species	Conservation status		Description	Assessment	Likelihood of occurrence in Proposal Area
	EPBC Act	WC Act / Parks and Wildlife listing			
Andersonia gracilis	Endangered	Threatened	A slender shrub to 50 cm tall with few, spreading branches. Flowers are pink to pale mauve. Habitat for this species occurs within seasonally damp, black sandy clay flats near swamps (Western Australian Herbarium 1998-, DotE 2015).	Species only known from the Badgingarra, Kenwick and Dandaragan areas where it is found on seasonally damp, black sandy clay flats near or on the margins of swamps; often on duplex soils supporting low open heath vegetation with species such as *Calothamnus hirsutus*, *Verticordia densiflora* and *Kunzea recurva* over sedges (DotE 2015). No low open heath vegetation is present within the Proposal Area. The closest known location of the species (Kenwick) is located to the north-east of the Proposal Area approximately 20 km away. The Proposal Area is within the Bassendean aeolian deposit characterised by sand plains with low dunes and occasional swamps, while the Kenwick area is within the Guildford fluviatile deposit characterised by yellow duplex soils and flat plain with medium textured deposits (Churchward & McArthur 1978).	Unlikely
Caladenia huegelii	Endangered	Threatened	A slender orchid from 30 to 50 cm tall. One or two striking flowers characterised by a greenish-cream lower petal with a maroon tip. Other petals are cream with red or pink suffusions. Habitat for this species occurs within well-drained, deep sandy soils in low mixed Banksia, Allocasuarina and Jarrah woodlands (Western Australian Herbarium 1998-, DotE 2015).	*Caladenia huegelii* occurs in mixed woodland of *Eucalyptus marginata*, *Banksia attenuata*, *B. ilicifolia* and *B. menziesii* with scattered *Allocasuarina fraseriana* and *Corymbia calophylla* over dense shrubs of *Stirlingia latifolia*, *Hypocalymma robustum*, *Hibbertia hypericoides*, *H. subvaginata*, *Xanthorrhoea preissii*, *Adenanthos cuneatus* and *Conostylis* spp. (DotE 2015). Its distribution extends from just north of Perth to Busselton, usually located within 20 km of the coast and in deep grey-white sand associated with the Bassendean sand-dune system. It also tends to favour dense undergrowth (DotE 2015). Several populations of the species are known to exist in close proximity to the Proposal Area. Despite this, the species was has been not identified during suitably timed flora surveys of the Proposal Area (RPS 2010, Woodman 2014).	Unlikely
Diuris micrantha	Vulnerable	Threatened	A slender orchid to 60 cm tall. Yellow flowers with reddish-brown markings measuring 1.3 cm across. Habitat for this species occurs within clay-loam substrates in winter-wet depressions or swamps (DotE 2015).	*Diuris micrantha* is known from four locations (Collie, Yalgorup, Manjimup and Perth) and grows in swamps, drainage lines and seasonally inundated flats in clay soils (DotE 2015). While potentially suitable habitat occurs to the north of the Proposal Area, the species has been not identified during suitably timed flora surveys of the Proposal Area (RPS 2010, Woodman 2014,) and vegetation within suitable habitat within the Proposal Area is dominated by weed species which would likely stifle any occurrence of the species.	Unlikely

Species	Conservation status		Description	Assessment	Likelihood of occurrence in Proposal Area
	EPBC Act	WC Act / Parks and Wildlife listing			
Diuris purdiei	Endangered	Threatened	A slender orchid to 45 cm tall. Unusually flattened flowers, marked with brown blotches on their under surface. Habitat for this species occurs in areas subject to winter inundation within dense heath with scattered Myrtaceous trees (DotE 2015).	*Diuris purdiei occurs* from Perth south to near the Whicher Range, within the Swan (Western Australia) Natural Resource Management Region. It grows on sand to sandy clay soils, in areas subject to winter inundation, and amongst native sedges and dense heath with scattered emergent *Melaleuca preissiana, Eucalyptus calophylla, E. marginata* and *Nuytsia floribunda* (DotE 2015). While habitat potentially suitable for the species occurs on the Proposal Area, the species was has been not identified during suitably timed flora surveys of the Proposal Area (RPS 2010, Woodman 2014) and vegetation within suitable habitat within the Proposal Area is dominated by weed species which would likely stifle any occurrence of the species.	Unlikely
Drakaea elastica	Endangered	Threatened	A slender orchid to 30 cm tall with a prostrate, round to heart shaped leaf. Singular, bright green, glossy flower. Habitat for this species is within bare patches of white sand over dark sandy loams on damp areas (DotE 2015).	*Drakaea elastica* is currently known only from the Swan Coastal Plain over a range of approximately 350 km between Cataby in the north and Busselton in the south. The species is known to grow on bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps (DotE 2015). The species typically grows in Banksia (*Banksia menziesii, B. attenuata* and *B. ilicifolia*) woodland or Spearwood (*Kunzea glabrescens*) thicket vegetation. Despite several populations of the species existing in close proximity to the Proposal Area, the species was not identified during the flora survey of the Proposal Area (RPS 2010), or during the targeted Threatened flora survey undertaken in August 2013 by Woodman. Woodman (2014) concluded that the potential habitat for this species is very limited within the Proposal Area and this species is highly unlikely to occur.	Unlikely
Drakaea micrantha	Vulnerable	Threatened	A tuberous, terrestrial orchid to 30 cm tall. Silvery-grey heart shaped leaf with prominent green veins. Red and yellow singular flower. Habitat for this species occurs within cleared, open sandy patches (Brown et al. 1998).	Species habitat might exist; however, the species was not recorded in any of the surveys of the Proposal Area (RPS 2010, Woodman 2014) and vegetation within suitable habitat within the Proposal Area is dominated by weed species which would likely stifle any occurrence of the species. Therefore the species is unlikely to occur within the Proposal Area.	Unlikely
Lepidosperma rostratum	Endangered	Threatened	A rhizomatous sedge to 30 cm in diameter. Stems are circular in cross section and flowers are spike-like and up to 4 cm long. Habitat for this species occurs in sandy soils among low heath comprised of *Banksia telmatiaea* and *Calothamnus hirsutus* in winter-wet swamps.	*Lepidosperma rostratum* is associated with Marsh Banksia (*Banksia telmatiaea*) and Hairy Clawflower (*Calothamnus hirsutus*). It grows in sandy soil among low heath in winter-wet swamps (Brown et al. 1998), which does not occur within the Proposal Area.	Unlikely

Species	Conservation status		Description	Assessment	Likelihood of occurrence in Proposal Area
	EPBC Act	WC Act / Parks and Wildlife listing			
Cyathochaeta teretifolia	Not listed	Priority 3	A rhizomatous, clumped, robust perennial sedge to 2 m tall. Habitat for this species occurs in grey sand and sandy clay in swamps or along creek edges (Western Australian Herbarium 1998-).	Species habitat might exist; however, the species was not recorded in any of the surveys of the Proposal Area (RPS 2010, Woodman 2014) and therefore the species is unlikely to occur within the Proposal Area.	Unlikely
Jacksonia gracillima	Not listed	Priority 3	Spreading, compact shrub (100 cm high x 100 cm wide) with orange flowers (standard orange with darker band near base, wings orange, keel darker orange) and angular buds. Found along Swan Coastal Plain on well-drained Bassendean Sands.	Species habitat might exist; however, the species was not recorded in any of the surveys of the Proposal Area (RPS 2010, Woodman 2014) and therefore the species is unlikely to occur within the Proposal Area.	Unlikely
Pimelea calcicola	Not listed	Priority 3	An erect to spreading shrub to 1 m tall. Flowers are pink and visible between September to November. Habitat for this species occurs in sand on coastal limestone ridges (Western Australian Herbarium 1998-).	Coastal limestone ridges do not exist within the Proposal Area and therefore the species is unlikely to occur.	Unlikely
Pithocarpa corymbulosa	Not listed	Priority 3	An erect to spreading perennial herb to 1 m tall. Flowers are white and visible from January to April. Habitat for this species occurs on gravelly or sandy loam amongst granite outcrops (Western Australian Herbarium 1998-).	Granite outcrops do not exist within the Proposal Area and therefore the species is unlikely to occur.	Unlikely
Stylidium paludicola	Not listed	Priority 3	A reed-like perennial herb 1 m tall. Flowers are pink and visible from October to December. Habitat for this species occurs in peaty sand over clay in winter-wet habitats associated with Marri/*Melaleuca woodlands*/shrublands (Western Australian Herbarium 1998-).	Species habitat might exist; however, the species was not recorded in any of the surveys of the Proposal Area (RPS 2010, Woodman 2014) and therefore the species is unlikely to occur within the Proposal Area.	Unlikely

Species	Conservation status		Description	Assessment	Likelihood of occurrence in Proposal Area
	EPBC Act	WC Act / Parks and Wildlife listing			
Centrolepis caespitosa	Not listed	Priority 4	A diminutive, densely tufted, glabrous annual herb. Flowers are red/brown and are singular. Habitat for this species is relatively unknown. Brown et al. (1998) identified that this species occurs within winter-wet claypans dominated by low shrubs and sedges.	*Centrolepis caespitosa* occurs in winter-wet clay pans dominated by low shrubs and sedges (Brown et al 1998). No winter-wet clay pans dominated by low shrubs and sedges exist within the Proposal Area (RPS 2010).	Unlikely
Verticordia lindleyi subsp. *lindleyi*	Not listed	Priority 4	An erect shrub between 20-75 cm tall. Flowers are pink and visible in May or November-January. Habitat for this species occurs on sand or sandy clay soils in winter wet depressions (Western Australian Herbarium 1998-).	Species habitat might exist; however, the species was not recorded in any of the surveys of the Proposal Area (RPS 2010, Woodman 2014) and therefore the species is unlikely to occur within the Proposal Area.	Unlikely
Dodonaea hackettiana	Not listed	Priority 4	An erect shrub or tree between 1 to 5 m tall. Habitat for this species occurs on sand and outcropping limestone (Western Australian Herbarium 1998-).	Limestone outcropping does not exist within the Proposal Area and therefore the species is unlikely to occur	Unlikely

2.10.2 Vegetation

Regional vegetation

Regional vegetation occurring was initially mapped at a broad scale (1:1 000 000) by Beard during the 1970s. This dataset has formed the basis of several regional mapping systems, including physiographic regions defined by Beard (1981); System 6 Vegetation Complex mapping undertaken by Heddle *et al.* (1980); and the biogeographical region dataset (Interim Biogeographic Regionalisation for Australia, IBRA) for Western Australia.

The Proposal Area occurs within the Swan Coastal Plain IBRA region and Perth subregion, which is dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains and paperbark (*Melaleuca*) in swampy areas (Mitchell et al. 2002).

The Proposal Area occurs within the Drummond Botanical Subdistrict, which is characterised by low *Banksia* woodlands on leached sands; *Melaleuca* swamps on poorly-drained depressions; and *Eucalyptus gomphocephala* (tuart), *Eucalyptus marginata* (jarrah) and *Corymbia calophylla* (marri) woodlands on less leached soils (Beard 1990). Mapping undertaken by Beard (1981) indicates that the majority of the site and Proposal Area is within vegetation association 1001: Medium very sparse woodland; jarrah, with low woodland; *Banksia* & *Casuarina* (Bassendean system) (Figure 7).

The pre-European and current extent of the 1001 vegetation association, as well as the current extent within Parks and Wildlife managed land, is listed in Table 2, based on the latest GIS-based estimate undertaken by Parks and Wildlife (Government of Western Australia 2014).

Table 2: Pre-European and current extent of vegetation association 1001 within the Proposal Area

Vegetation association	Pre-European extent (ha)	Current extent (ha)	% remaining	Percentage of current extent in Parks and Wildlife managed land (%)
1001	53 283.54	11 903.55	22.34	1.22

The development of the Proposal Area meets the OEPA Guidance 10 (2006) requirement as vegetation assoication1001 will continue to be represented above 10%.

System 6 mapping refers to vegetation mapping undertaken at a Vegetation Complex scale by Heddle et al. (1980). This is the primary source of information used to calculate potential impacts of proposals to clear native vegetation on the Swan Coastal Plain. The Proposal Area occurs at the interface between the Bassendean and Herdsman vegetation complexes as described in Table 3. The majority of the Proposal Area is mapped as the Bassendean vegetation complex while small portions of land along the southwestern boundary of the Proposal Area are mapped as the Herdsman vegetation complex.

Table 3: Vegetation complexes in the site and Proposal Area

Vegetation complex	Description
Bassendean Vegetation Complex – Central and South	Vegetation ranges from woodland of *Eucalyptus marginata* – *Allocasuarina fraseriana* – *Banksia* spp. to low woodland of *Melaleuca* spp. and sedgelands on the moister sites.
Herdsman Vegetation Complex	Dominated by sedgelands and woodland of *Eucalyptus rudis* – *Melaleuca* spp., with the species of Melaleuca depending on the local drainage and adjacent soils. This vegetation is associated with the series of swamps and small lakes on the Swan Coastal Plain. Other plants include species of *Typha, Baumea, Juncus, Leptocarpus* and *Scirpus.*

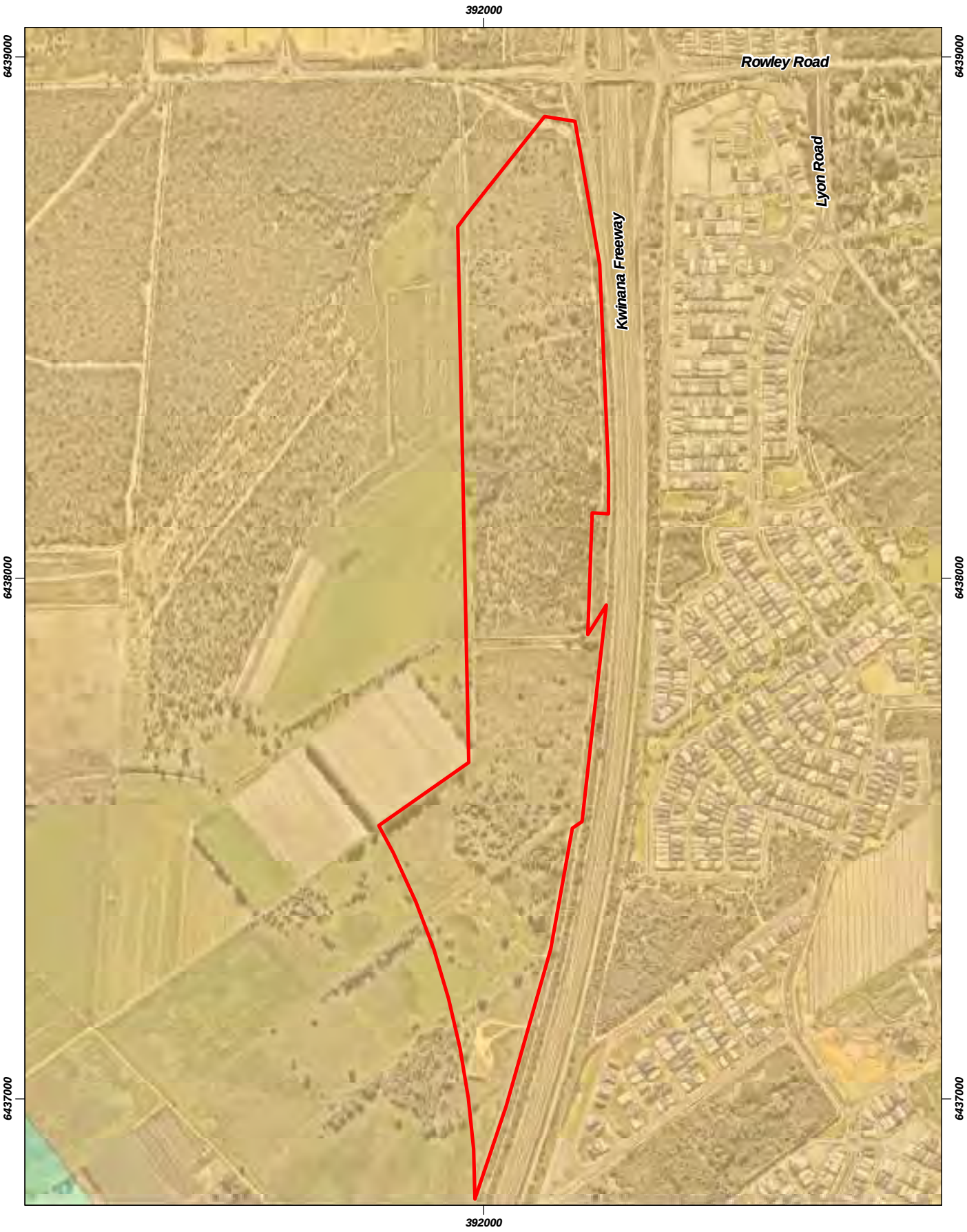

Figure 7 Regional vegetation

Scale 1:10,000 at A4

0 50 100 150 200 250 m

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 26/11/2016
Author: JCrute
Source: Aerial image: Nearmap 2016. Vegetation: DAFWA 2011.

Legend

Proposal Area

Vegetation association

6: Eucalyptus woodland / Acacia mixed open shrubland / Acacia mixed heath

1001: Banksia mixed woodland

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Vegetation type

The Proposal Area is predominantly cleared farmland with some small patches of eucalypts. A total of seven vegetation types (Table 4) have been mapped in the Proposal Area (Figure 8) (RPS 2010).

Table 4: Vegetation types within the Proposal Area

Vegetation type	Description
BLOW(J)	*Banksia attenuata - B. menziesii - B. ilicifolia* Low Woodland, with *Eucalyptus marginata, Dasypogon bromeliifolius, Phlebocarya ciliata*, local *Melaleuca preissiana*, *Pultenaea reticulata* and *Hypocalymma angustifolium*, some other natives and, commonly, weeds.
BLW(J)	*Banksia attenuata - B. menziesii* Low Woodland, with *Eucalyptus marginata, Allocasuarina fraseriana* and understoreys of *Xanthorrhoea preissii, Adenanthos cygnorum, Acacia pulchella, Stirlingia latifolia* and other natives, and of weeds; much of it regenerating after 2004 fire.
BLWAc	*Banksia attenuata - B. menziesii* Low Woodland, with thickets of *Adenanthos cygnorum*.
ErOF	*Eucalyptus rudis* very healthy Open Forest in soak/spring, with *Melaleuca preissiana* and *M. rhaphiophylla* tall trees, over *Pteridium esculentum - Cyathochaeta teretifolia - Baumea articulata* Closed Herb-Sedgeland; with *Lepidosperma longitudinale, Hemarthria uncinata, Hibbertia perfoliata, Dielsia stenostachya, Baumea vaginalis, Poa serpentum*; few aliens.
ErW	*Eucalyptus rudis* (largely leafless) Woodland (to Open Forest) over *Kunzea glabrescens* and *Astartea sp*. Closed Tall Scrubs, dense *Pteridium esculentum* and weeds; locally with healthy *Eucalyptus marginata* and *Melaleuca preissiana* trees.
KgCT-TO	*Kunzea glabrescens* Closed Tall to Tall Open Scrub; with, in more open sites, *Dasypogon bromeliifolius, Phlebocarya ciliata, Euchilopsis linearis* and other natives; some weedy Degraded areas and many dead shrubs over 1 m tall.
Weeds	Fields of established aliens, in some places with scattered natives; apparently not recently plowed or cropped.

Vegetation condition

Vegetation condition is assessed using the Keighery (1994) scale, as presented Table 5.

Vegetation condition within the Proposal Area ranges from Excellent to Completely Degraded, with most remnant vegetation being in Very Good to Degraded condition (Figure 8; RPS 2010). The Proposal Area to the south of Peel Main Drain has been subject to historical clearing and grazing. The Proposal Area to the north of Peel Main Drain comprises areas of native vegetation. Weeds are common in the majority of bushland and cleared areas of the Proposal Area (RPS 2010).

Table 5: Vegetation condition scale (Keighery 1994)

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

Vegetation of conservation significance

No Threatened Ecological Communities (TECs) as listed under the WC Act, or Priority Ecological Communities (PECs) as listed by Parks and Wildlife were recorded in the Proposal Area. One TEC as listed under the EPBC Act is present within the Proposal Area to the north of the Peel Main Drain and is described as 'Banksia Woodlands of the Swan Coastal Plain'. This vegetation community was listed as Threatened under the EPBC Act on 16 September 2016 but was not identified in the Protected Matters database search report (Appendix 3).

RPS (2010) identified vegetation type ErOF (Figure 8, Table 4) as having conservation significance based on the Excellent condition of the vegetation, the relative rarity of this vegetation type within the local area and the presence of the Priority 3 species *Cyathochaeta teretifolia* (Figure 8). The stand of vegetation type ErOF is confined to a small area of the western margin of the Proposal, and will be retained in the final design as POS.

The closest Bush Forever sites to the Proposal Area include (Landgate 2015):

- Site 268 (approximately 1 km west): Mandogalup Road Bushland, Mandogalup
- Site 269 (approximately 2 km south southwest): The Spectacles
- Site 270 (approximately 2 km south): Sandy Lake and Adjacent Bushland, Anketell
- Site 347 (approximately 1.5 km southeast): Wandi Nature Reserve and Adjacent Bushland, Wandi/Oakford
- Site 392 (approximately 2.5 km northwest): Harry Waring Marsupial Reserve, Wattleup
- Site 393 (approximately 2.5 km northwest): Wattleup Lake and Adjacent Bushland, Wattleup/Mandogalup.

Bush Forever sites surrounding the Proposal Area are outlined in Figure 9.

2.10.3 Dieback

A dieback assessment of the Proposal Area was undertaken on 6 November 2013 by Glevan (undated). A copy of this report is available in Appendix 11.

Much of the Proposal Area was found to be either heavily disturbed (hence unmappable), or completely void of vegetation (excluded from the assessment). No confirmed dieback infestations were recorded in the Proposal Area; however, some wetland areas exhibited a pattern of vegetation decline consistent with Phytophthora dieback infestation, and are almost certainly infested (Glevan undated).

A single, uninfested protectable area was identified and demarcated during the assessment (see figure in Appendix 11 Glevan undated). The area exhibited some signs of vegetation decline; however, representative samples were negative for the presence of *Phytophthora cinnamomi* (Glevan undated).

2.10.4 Significant trees and landscape Strategy

In accordance with the City of Kwinana's Local Planning Policy No.1 Landscape Feature and Tree Retention, this section of the EAR:

1. Details an appropriate level of information concerning significant trees and landscape features for a structure plan.
2. Describes how the retention of significant trees and landscape features have been optimised through the design process to maximise the retention of character in the development.

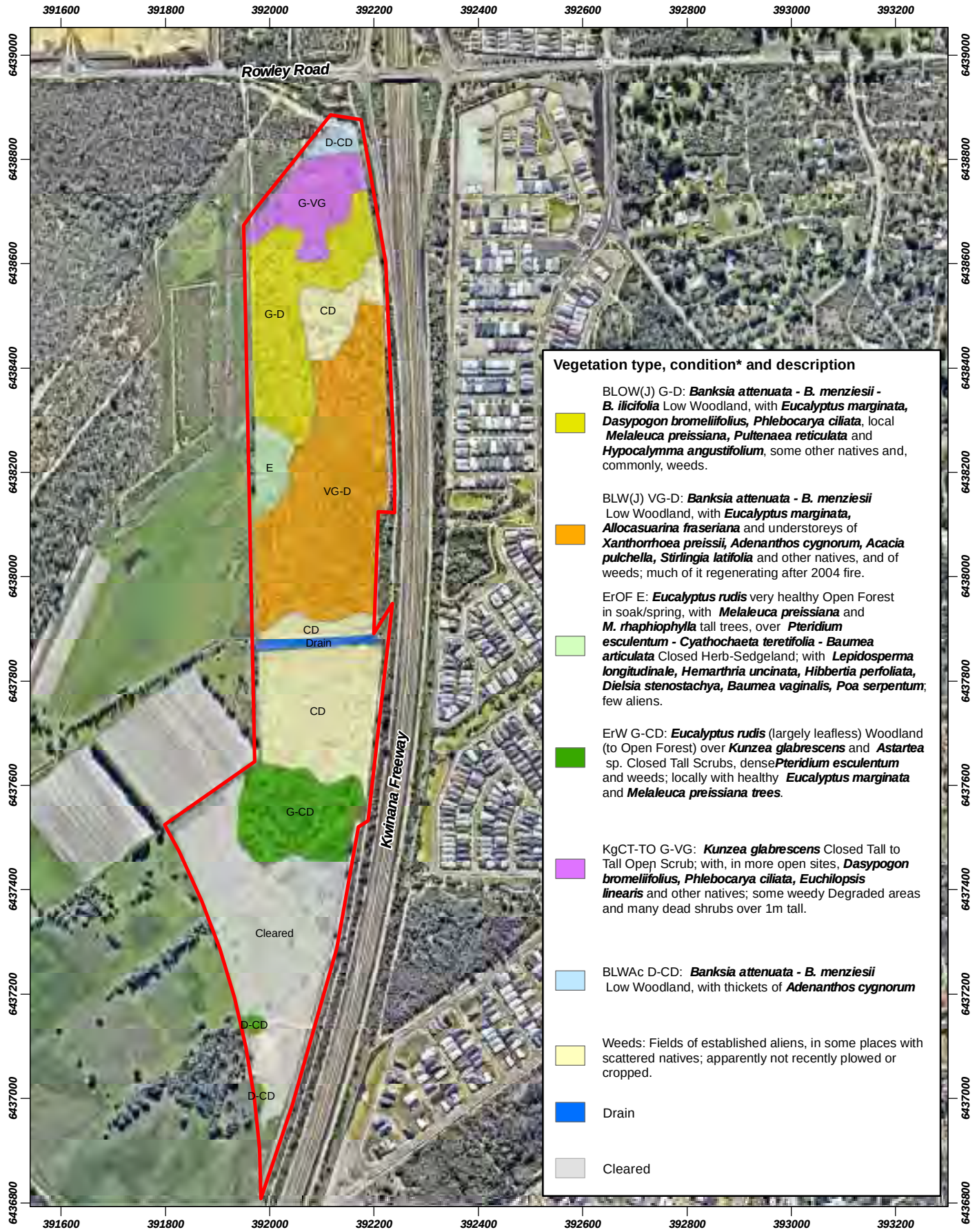

Figure 8 Vegetation type and condition

Scale 1:10,000 at A4

0 50 100 150 200 250 m

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 26/11/2016

Author: JCrute

Source: Aerial image: Landgate 2014.
Vegetation: Adapted from RPS 2010.

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Legend

Proposal Area

***Vegetation condition description**

E: Excellent
VG-D: Very Good toGood
G-VG: Good to Very Good
G-D: Good to Degraded
G-CD: Good to Completely Degraded
D-CD: Degraded to Completely Degraded
CD: Completely Degraded

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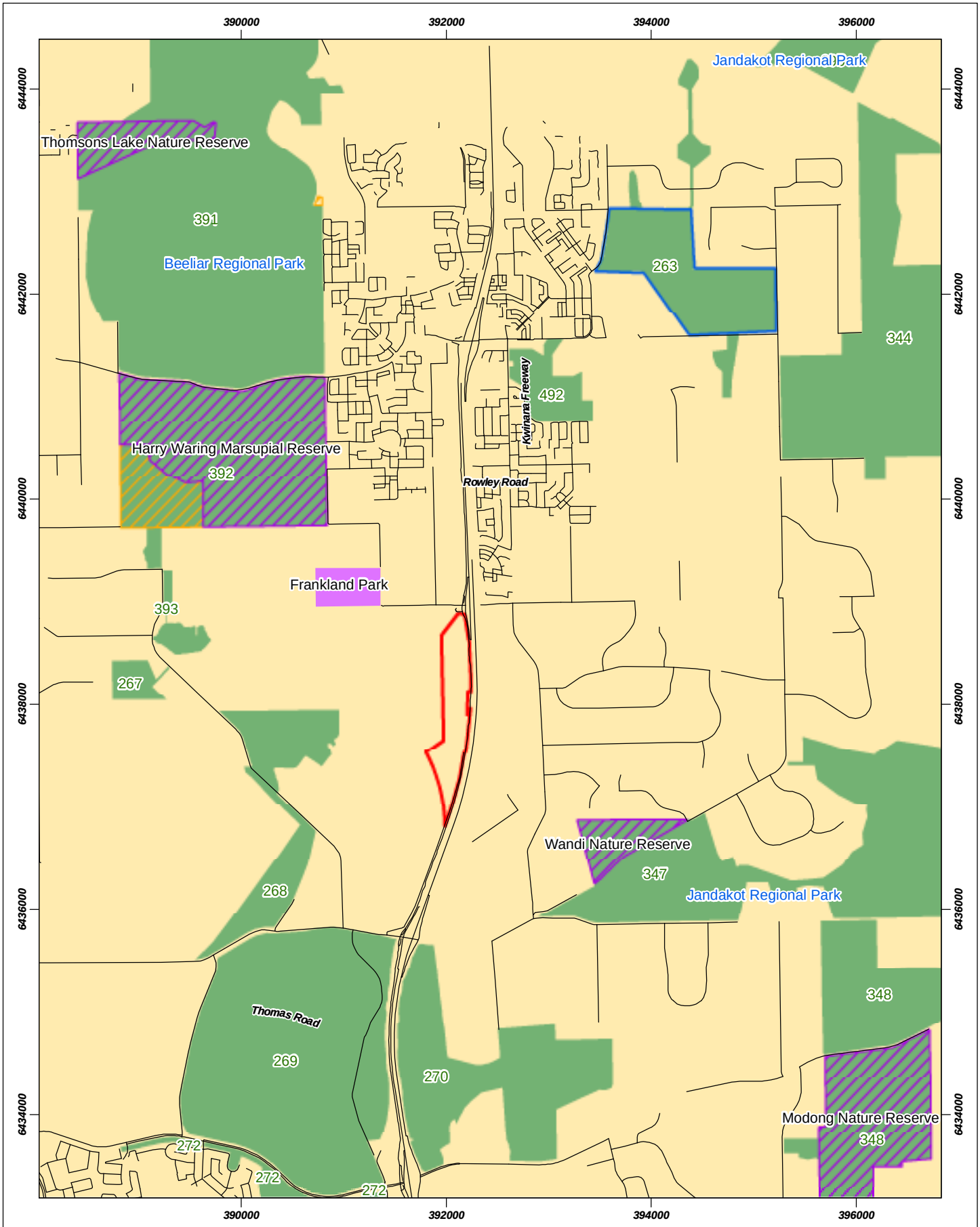

Figure 9 Conservation areas

Scale 1:50,000 at A4

0 500 1,000 1,500 m

N

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 26/11/2016

Author: JCrute

Source: Topography: Geoscience Australia 2011.
Bush Forever sites: DoP 2012.

Path: Q:\Consult\2013\SPG\SPG13027.01\ArcMap_documents\R002\SPG13027_01_R002_Rev1_F009.mxd

Legend

- Town
- Roads
- Frankland Park
- Regional Parks
- Conservation Park
- Nature Reserve
- Bush Forever sites
- Proposal Area

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Trees with a diameter at breast height (DBH of 0.5m or greater (significant trees) and those significant trees within the areas of landscape feature within the Proposal Area were surveyed by Arborlogic in March and October 2016, and are described in Appendix 7 and 8. The survey's identified 173 significant trees within the Proposal Area.

In consultation with the City of Kwinana Environmental Services during 2014 to 2016 the following two landscape features are identified within the Proposal Area:

1. Stand of *Eucalyptus rudis* Open Forest comprising of *Eucalypts rudis* Open Forest in soak/spring with *Melaleuca preissiana* and *M. rhaphiophylla* tall trees.
2. Stand of Melaleuca comprising of *Melaleuca preissiana* and *Melaleuca raphiophylla.*

The significant trees including those supported within the landscape features are shown in Figure 10 (Arborlogic 2016). The landscape features are represented by the stand of significant *Eucalyptus rudis* Open Forest trees and the stand of significant Melaleuca trees shown in the insets in the northern and southern aspect of Figure 10 respectively. The surveys (Arborlogic 2016) undertook a physical assessment of each significant tree to identify tree location, species, size and structural health. The physical assessment enabled each significant tree to be allocated a retention value of 'very low', 'low', 'medium' or 'high' based on the assessment of health and/or structural integrity. A summary of significant tree retention value is presented in Appendix 10.

In order to maximise the retention of viable trees and avoid impacts to significant trees and landscape features on site the following measures were undertaken by the Proponent:

1. An assessment of the landscape features and significant trees was undertaken within the context of the proposed development.
2. Public Open Space areas where located to maximise retention of the *Eucalyptus rudis* Open Forest and Melaleuca.
3. An engineering and planning assessment was undertaken. A key consideration in this assessment was the level of cut and fill required at the location of the significant tree. A significant tree was retained where the tree met all of the following criteria, being:
   (a) of 'high' and 'medium' retention value located within outside areas of Public Open Space
   (b) located in fill less than 0.5m
   (c) a species retained by the City of Kwinana
   (d) able to be designed into a location of public open space, road reserve, rebated lot for drainage, group housing or education.

Where trees have an ability to be designed in to a location of road reserve, rebated lot for drainage, group housing or education the retention of the tree is subject to detailed design at subdivision stage. The retention outcomes of these trees subject to further design will be detailed in the Landscape Feature and Tree Retention Plan at Subdivision and Development Approval stage.

In consultation with the City of Kwinana Environment Services all trees identified with a 'very low' or 'low' retention value located outside of a Public Open Space are not considered as a viable tree for retention due to the potential risk to community. Therefore trees of 'very low' or 'low' retention value located outside Public Open Space are not proposed to be retained.
The above measures reduced impact on significant trees through a number structure planning design amendments being undertaken to maximise significant tree retention and landscape value retained including:

- the retention of a two landscape features within Public Open Space comprising:
  - a stand of *Eucalyptus rudis* Open Forest
  - a stand of Melaleuca
- the retention of 62 significant trees retained in Public Open Space
- the retention of an additional 13 significant trees subject to the following detailed design:
  - four trees subject to the design of services and road space within the road reserve

- one tree subject to the design of the drainage within rebated lots
- two trees subject to the design of the proposed group housing site
- four trees subject to the outcome of the proposed education site.

A summary of the engineering and planning assessment design outcomes is summarised in Appendix 12. Figure 11 identifies the proposed significant tree and landscape feature retention for the proposed development.

Table 6 below provides a summary of tree retention outcomes associated with the engineering and planning assessment.

Table 6: Proposed tree significant retention by retention value

Retention Value	Removed	Retention subject to design	Retained
High	8	5	17
Medium	15	7	26
Low	18	1	17
Very Low	56	0	2
Total	**97**	**13**	**62**

The following ongoing management and maintenance actions will be undertaken to continue to maximise significant tree and landscape feature retention:

- identify retained trees on engineering and planning documentation
- identify trees where retention is subject to detailed design on engineering and planning documentation
- undertaken prior, during and at the completion of detailed design to ensure all opportunities to retain significant trees subject to design outcomes are applied
- communicate tree retention performance within the landscape feature and Tree Retentions Plan at subdivision and development approval stage
- continue to implement an open and consultative dialogue with the City of Kwinana on significant tree and landscape feature design outcomes
- implement the following management plans during the development:
  - Construction Environmental Management Plan (CEMP)
  - Fauna and Habitat Management Plan
  - Dieback Management Plan.

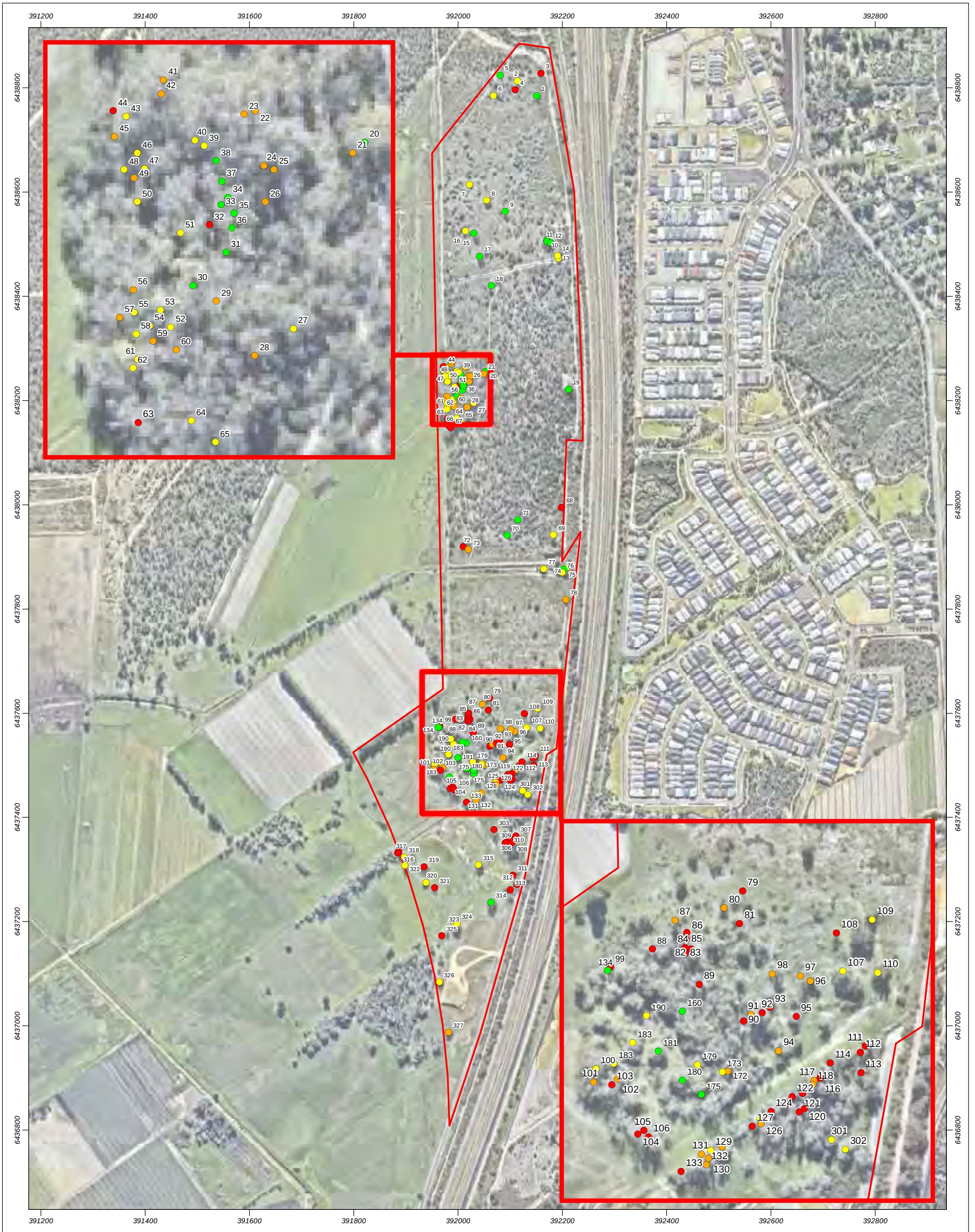

Figure 10 Significant trees and retention value

Scale 1:6,692 at A3

0 50 100 150 200 250 Meters

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 29/11/2016

Author: JCrute

Source: Topography: Geoscience Australia 2011.

Legend

Retention value

- High
- Medium
- Low
- Very Low

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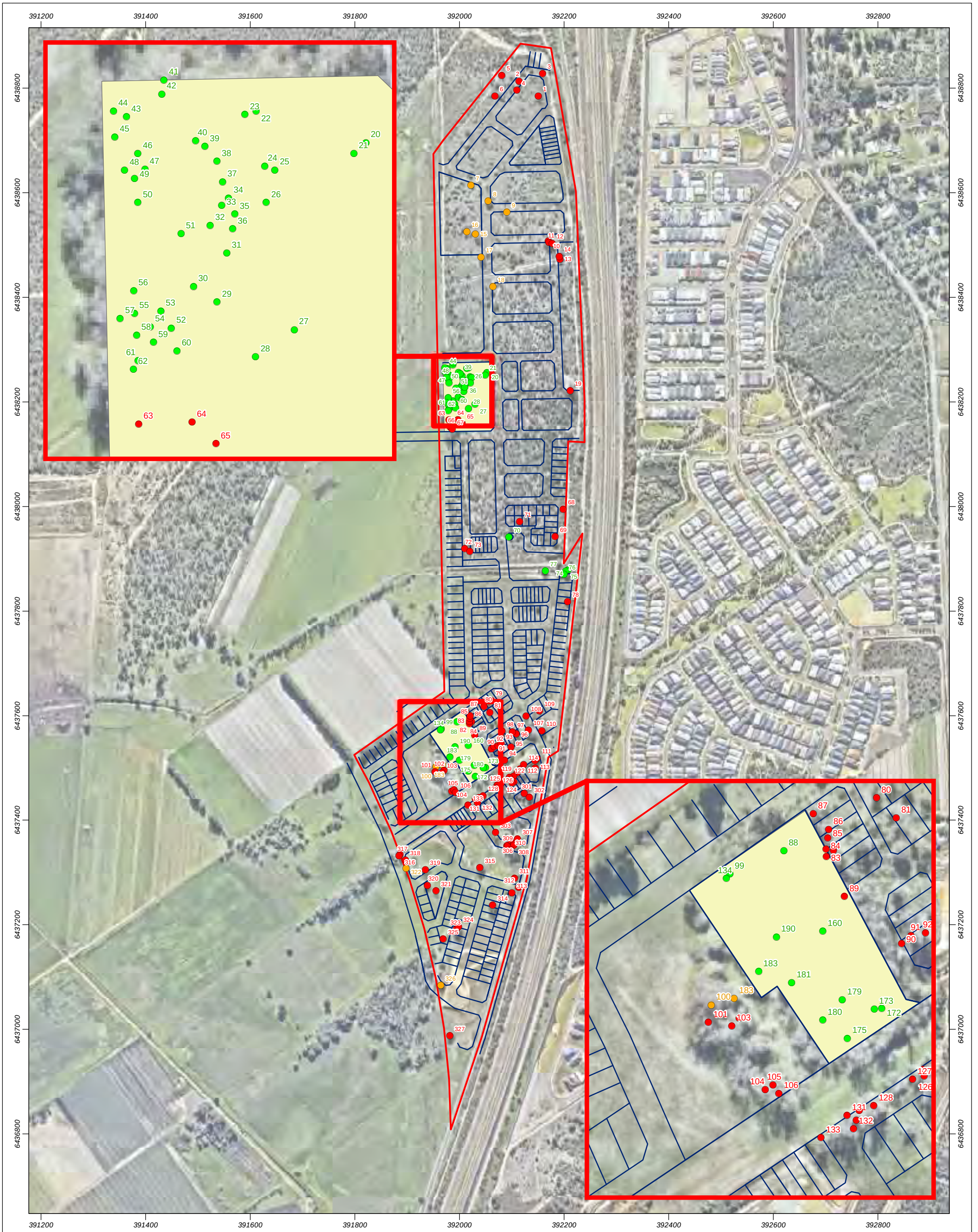

Figure 11 Significant trees and management

Scale 1:6,692 at A3

Meters
0 50 100 150 200 250

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 29/11/2016
Author: JCrute
Source: Topography: Geoscience Australia 2011.

Legend

- Significant tree for retention
- Significant trees removed
- Significant trees design permitting
- Subdivision layout
- Landscape feature retention

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2.11 Fauna and fauna habitat

A 2015 desktop review of the Parks and Wildlife 'NatureMap' identified 180 animalia taxa, of which 172 are native, from 68 families that have the potential to occur within the vicinity of the Proposal Area (i.e. 5 km radius search area around the Proposal Area). The 'NatureMap' search report is provided in Appendix 10.

Western Wildlife undertook a Level 1 fauna survey of the site in accordance with EPA Guidance Statement 56 (EPA 2004b) in 2007. Western Wildlife determined that the cleared areas within the site have very little habitat value for fauna while vegetated areas of the site may support a range of fauna typical of Banksia/Eucalypt woodland of the Swan Coastal Plain, including a number of conservation significant fauna. A copy of this report is presented in Appendix 13.

Potential impacts to fauna utilising the Proposal Area will be managed under a Fauna Management Plan (see Section 4.1.6).

2.11.1 Threatened and Priority fauna

Western Wildlife (2007) identified a number of conservation significant species that are considered likely to occur within the Proposal Area based on database records and known habitat requirements. A desktop review of Parks and Wildlife 'NatureMap' was undertaken in 2015 to confirm the Level 1 (desktop) survey findings and determine whether any Threatened species protected under the WC Act or Priority fauna species as listed by Parks and Wildlife are known from within a 5 km radius of the Proposal Area. A Protected Matters database search was also undertaken in 2016 to confirm the 2007 Level 1 (desktop) survey findings and determine whether any Threatened or Migratory species protected under the EPBC Act are known from within a 5 km radius of the Proposal Area.

A cumulative list of the conservation significant species identified by the Level 1 survey and recent database reviews is presented in Table 7. The 'NatureMap' and Protected Matters search reports are provided in Appendix 10 and Appendix 3, respectively, while the Level 1 fauna survey report (Western Wildlife 2007) is provided in Appendix 13.

Thirteen (13) Threatened fauna species protected under the WC Act and eleven Priority fauna species have the potential to occur within the Proposal Area as outlined in Table 7. Eleven Threatened and eleven Migratory fauna species protected under the EPBC Act have the potential to occur in the Proposal Area. These species were assessed for likelihood of occurrence within the Proposal Area, based on the known habitat requirements and local records (Table 7). Of the species identified with the potential to occur in the site, only six conservation significant species are considered likely to occur including:

- Carnaby's Black-Cockatoo (CBC)
- Migratory species including Fork-tailed Swift, White-bellied Sea-Eagle, Rainbow Bee-eater, Great Egret, Wood Sandpiper.

The only conservation significant species recorded during the Level 1 survey of the site was Rainbow Bee-eater (*Merops ornatus*); however, the site habitat is considered unlikely to represent habitat critical to the survival of the Rainbow Bee-eater and other migratory species (Western Wildlife 2007). Although not recorded during the Level 1 survey, the presence of CBC habitat was noted and prompted the undertaking of a targeted survey of the Proposal Area for conservation significant black cockatoos including CBC, Baudin's Black-Cockatoo and Forest Red-tailed Black-Cockatoo (Strategen 2013). These species are discussed further in Section 2.11.2.

Many of the listed Migratory species may use the Proposal Area infrequently; however, the Proposal Area is unlikely to represent habitat critical to the survival of these species (Table 7).

The Proposal Area may also provide habitat for the Quenda or Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) (Strategen 2013). While not formally listed under federal or state legislation, the Quenda is recognised by Parks and Wildlife as a priority species and is ranked as 'Priority 5'; taxa in need of monitoring (conservation dependent). Habitat clearing and fragmentation, fire, and predation by foxes, cats and domestic dogs threaten this species.

2.11.2 Carnaby's Black-Cockatoo

Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris)* is endemic to the south-west of Western Australia. They mainly occur in uncleared remnant native eucalypt woodlands, especially those that contain Salmon gum, wandoo, and in shrubland or kwongan heathland dominated by *Hakea, Dryandra, Banksia* and *Grevillea* species (DotE 2013).

A 2013 habitat assessment (Strategen 2013, Appendix 14) identified black cockatoo foraging and roosting habitat in the northern portion of the Proposal Area where signs of foraging were observed, and potential breeding trees were identified across the Proposal Area suggesting that CBC is likely occur within the Proposal Area (Table 7, Figure 12). The Red-tailed Black-Cockatoo was identified as a possible visitor to the Proposal Area, potentially using the Proposal Area for breeding or roosting (Strategen 2013) (Table 7). Baudin's Black-Cockatoo is unlikely to visit the Proposal Area except on very rare occasions as the Proposal Area is located outside of its normal distribution range (Strategen 2013) (Table 7).

Approximately 18.14 ha of potential foraging habitat for CBC and up to 46 potential black cockatoo breeding trees are likely to be impacted by development in the MELSP area (Strategen 2013, Figure 12). The impact of clearing of up to 46 potential black cockatoo breeding trees on CBC or the Red-tailed Black-Cockatoo is managed due to the presence of surrounding habitat on and off the site at nearby conservation reserves (i.e. The Spectacles and Beeliar Regional Park) and Bush Forever sites.

The Mandogalup Urban Development was referred to the Department o f the Environment (DotE) in August 2014. The referral identified the clearance of 19.7 ha of Carnaby's Black-Cockatoo foraging and potential breeding habitat. DotE released a notification in September 2014 determining that the referral was considered a Controlled Action to be assessed by preliminary documentation. The preliminary assessment documentation was released for public comment during March 2015. Additional information relating to the proposal was released for public comment in June 2015. In July 2015 DotE approved the proposed action subject to a number of conditions relating to clearing procedures, reporting and the acquisition of an offset property. Satterley Property Group secured the appropriate offset property in agreement with DotE and the Department of Parks and Wildlife (DPaW) in October 2015. The approval remains in effect until 31 July 2025. No clearing to date has been undertaken. Further detail is provided in Section 3.1.

Opportunities to minimise potential impacts to CBC will be addressed in the Fauna Management Plan (see Section 4.1.6).

Table 7: Threatened, Migratory and Priority fauna species that may occur within the Proposal Area and likelihood of occurrence

Species	Conservation status		Assessment	Likelihood of occurrence in Proposal Area
	EPBC Act	WC Act / Parks and Wildlife listing		
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo	Vulnerable	Threatened	Because of low numbers preferred native food sources, such as of Jarrah, the Proposal Area is considered unsuitable for foraging by this species, although the species may roost or breed in the area (Strategen 2013). The Proposal is not expected to have a significant impact on this species.	Possible – low risk of significant impact
Calyptorhynchus baudinii Baudin's Black-Cockatoo	Vulnerable	Threatened	The Proposal Area is outside of this species normal range and it is unlikely to frequent the area except on very rare occasions (Strategen 2013). The Proposal is not expected to have a significant impact on this species.	Unlikely
Calyptorhynchus latirostris Carnaby's Black-Cockatoo	Endangered	Threatened	Black cockatoo foraging signs were present in the Proposal Area site as well as potential roosting and breeding trees (Strategen 2013). There is also a known CBC roost 1.3 km east of the Proposal Area, at the intersection of Satinover Way and Wandi Drive (Birdlife and Parks and Wildlife 2013). Therefore, the Proposal Area is likely to contain suitable foraging, roosting and breeding habitat for this species (Strategen 2013). The Proposal is not expected to have a significant impact on this species.	Likely – low risk of significant impact
Dasyurus geoffroii Chuditch, Western Quoll	Vulnerable	Threatened	*Dasyurus geoffroii* is now known only from Western Australia where it predominantly occurs in Jarrah (*Eucalyptus marginata*) forest. This habitat type does not occur within the site and this species is considered locally extinct in the Mandogalup area (Western Wildlife 2007). The Proposal is not expected to have a significant impact on this species.	Unlikely
Myrmecobius fasciatus Numbat, Walpurti	Vulnerable	Threatened	Numbats inhabit areas of open woodland, dominated by Wandoo, with minimal undergrowth. They require an abundant supply of hollow Wandoo logs on the ground, which provide plenty of protection and shelter, as well as a constant food supply of termites which attack the Wandoo. This habitat type is absent from the Proposal Area. The Proposal is not expected to have a significant impact on this species.	Unlikely
Botaurus poiciloptilus Australasian Bittern	Endangered	Threatened	Species inhabits terrestrial wetlands and, rarely, estuarine habitats. It favours wetlands with tall, dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. The species favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and/or reeds (e.g. *Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, , Bolboschoenus*) or cutting grass (*Gahnia*) growing over muddy or peaty substrate. A portion of the Proposal Area may provide habitat for this species during the winter wet season; however the species has not been recorded in the area (Western Wildlife 2007). Due to their transient nature, and wide distribution (DotE 2013), the Australasian Bittern is not expected to be impacted by the proposed clearing and therefore is not discussed further. The Proposal is not expected to have a significant impact on this species.	Possible – low risk of significant impact
Leipoa ocellata Malleefowl	Vulnerable	Threatened	*Leipoa ocellata* predominately occupies shrublands and low woodlands that are dominated by mallee vegetation (Benshemesh 2005a, 2005b; Marchant & Higgins 1993; Priddel & Wheeler 1995). This habitat type does not occur within the Proposal Area. The Proposal is not expected to have a significant impact on this species.	Unlikely
Rostratula benghalensis australis Australian Painted Snipe	Endangered	Threatened	This species is usually found in shallow inland wetlands, either freshwater or brackish, that are either permanently or temporarily filled. This habitat type does not occur within the Proposal Area. The Proposal is not expected to have a significant impact on this species.	Unlikely

Species	Conservation status		Assessment	Likelihood of occurrence in Proposal Area
	EPBC Act	WC Act / Parks and Wildlife listing		
Pseudocheirus occidentalis Western Ringtail Possum	Vulnerable	Threatened	The main determinant of suitable habitat for this species appears to be the presence of Peppermint Tree, whether as the dominant tree or as an understorey component of eucalypt forest of woodland (Jones et al. 1994). This habitat type is not present in the Proposal Area. The Proposal is not expected to have a significant impact on this species.	Unlikely
Calidris ferruginea Curlew Sandpiper	Critically Endangered, Migratory	Threatened	Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland (Higgins & Davies 1996). This species may infrequently visit the Proposal Area, particularly in winter when pastures are flooded. On this basis the proposed clearing is likely to have minimal impact on this species.	Possible – low risk of significant impact
Numenius madagascariensis Eastern curlew	Critically Endangered, Migratory	-	The Eastern Curlew is found on intertidal mudflats and sandflats, often with beds of seagrass, on sheltered coasts, especially estuaries, mangrove swamps, bays, harbours and lagoons (Birdlife Australia 2016). This habitat type is not present in the Proposal Area. The Proposal is not expected to have a significant impact on this species.	Unlikely
Phascogale tapoatafa subsp. tapoatafa Southern Brush-tailed Phascogale, Wambenger	-	Threatened	This species habits dry leafy forests and woodlands, where there is sparse ground cover and plenty of trees with hollows in which it can nest. This species can be found in dry open forests near lakes and rivers, rocky woodlands, and deciduous vine thickets. These favoured habitats are absent from the Proposal Area. The Proposal is not expected to have a significant impact on this species.	Unlikely
Morelia spilota imbricata Carpet Python	-	Specially protected	The Carpet Python could occur anywhere in the Proposal Area where native vegetation remains, but does require dense vegetation or tree hollows for shelter. On the Swan Coastal Plain, the Carpet Python tends to favour areas of heath over limestone, which is not present in the Proposal Area. If present in the area, this species is likely to be at relatively low densities; however, the Carpet Python may be locally extinct on the site (Western Wildlife 2007). The Proposal is not expected to have a significant impact on this species.	Unlikely
Falco peregrinus Peregrine Falcon	-	Specially protected	The Peregrine Falcon may forage over the Proposal Area, and may nest on the Proposal Area in a tall tree. If the Peregrine Falcon is present in the Proposal Area, the Proposal Area would only be a part of a larger home range for a pair of birds (Western Wildlife 2007). The Proposal is not expected to have a significant impact on this species.	Possible – low risk of significant impact
Apus pacificus Fork-tailed Swift	Migratory	-	The Fork-tailed Swift is a largely aerial species and the effect of the residential development on this species is likely to be negligible (Western Wildlife 2007). The Proposal is not expected to have a significant impact on this species.	Likely– low risk of significant impact
Haliaeetus leucogaster White-bellied Sea-Eagle	Migratory	-	This species potentially utilises some sections of the site as part of a much larger home range. On this basis the proposed clearing is likely to have minimal impact on this species.	Likely– low risk of significant impact
Ardea alba Great Egret, White Egret	Migratory	-	This species is likely to commonly visit the area in low numbers, particularly in winter when adjacent areas of pasture are flooded but the Proposal Area is unlikely to represent key habitat. On this basis the proposed clearing is likely to have minimal impact on this species. The Proposal is not expected to have a significant impact on this species.	Likely – low risk of significant impact

Species	Conservation status		Assessment	Likelihood of occurrence in Proposal Area
	EPBC Act	WC Act / Parks and Wildlife listing		
Ardea ibis Cattle Egret	Migratory	-	This species may potentially infrequently visit the general area, however was not recorded in the Proposal Area during the most recent Birds Australia Atlas survey (Barrett 2003), nor are there any WA Museum records in the region. On this basis the proposed clearing is likely to have minimal impact on this species.	Possible – low risk of significant impact
Calidris ruficollis Red-necked Stint	Migratory	-	The Red-necked Stint is mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores. They sometimes use flooded paddocks or damp grasslands (Higgins & Davies 1996). This species may infrequently visit the Proposal Area, particularly in winter when adjacent pastures are flooded. On this basis the proposed action is likely to have minimal impact on this species.	Possible – low risk of significant impact
Limosa limosa Black-tailed Godwit	Migratory	-	The Black-tailed Godwit has a primarily coastal habitat environment. There are a few inland records, around shallow, freshwater and saline lakes, swamps, dams and bore-overflows (Higgins & Davies 1996). This species may infrequently visit the Proposal Area, particularly in winter when adjacent pastures are flooded. On this basis the proposed action is likely to have minimal impact on this species.	Possible – low risk of significant impact
Tringa glareola Wood Sandpiper	Migratory	-	The Wood Sandpiper uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. They are typically associated with emergent, aquatic plants or grass, and dominated by taller fringing vegetation, such as dense stands of rushes or reeds, shrubs, or dead or live trees, especially *Melaleuca* and River Red Gums *Eucalyptus camaldulensis* and often with fallen timber. They also frequent inundated grasslands, short herbage or wooded floodplains, where floodwaters are temporary or receding, and irrigated crops (Higgins & Davies 1996). This species is likely to commonly visit the general area, particularly in winter when areas of adjacent pasture are flooded but is unlikely to rely on the habitat for survival. On this basis the proposed clearing is likely to have minimal impact on this species.	Likely – low risk of significant impact
Tringa nebularia Common greenshank	Migratory	-	The Common Greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats. The edges of the wetlands used are generally of mud or clay, occasionally of sand, and may be bare or with emergent or fringing vegetation, including short sedges and saltmarsh, thickets of rushes, and dead or live trees (Higgins & Davies 1996).	Possible – low risk of significant impact
Tyto novaehollandiae novaehollandiae Masked Owl (SW ssp)	Not listed	P3	This species relies on large hollows in matures eucalypts for breeding; however, there are not any hollows large enough for this species that are known in the Proposal Area (Western Wildlife 2007, Strategen 2013). The species may forage over the Proposal Area if there is a nesting pair nearby (Western Wildlife 2007). The Proposal is not expected to have a significant impact on this species.	Possible – low risk of significant impact
Lerista lineata Perth Slider, Lined Skink	Not listed	P3	The Perth Slider, Lined Skink is a small fossorial skink that normally inhabits heathlands and shrublands on pale sands. This skink has a very limited distribution, restriction to the coastal plain between the south suburbs of Perth and Yalgorup (Western Wildlife 2007). The Proposal is not expected to have a significant impact on this species.	Possible – low risk of significant impact
Ctenotus gemmula Jewelled Ctenotus	Not listed	P3	The Jewelled Ctenotus occurs in isolated populations and is scarce on the Swan Coastal Plain. It generally inhabits heathlands associated with banksia, on pale sandy soils (Western Wildlife 2007). The Proposal is not expected to have a significant impact on this species.	Possible – low risk of significant impact

Species	Conservation status		Assessment	Likelihood of occurrence in Proposal Area
	EPBC Act	WC Act / Parks and Wildlife listing		
Neelaps calonotos Black-striped Snake	Not listed	P3	The Black-striped Snake has a limited distribution, inhabiting sandy heathlands and banksia/eucalypt woodlands on the Swan Coastal Plain (Western Wildlife 2007). The Proposal is not expected to have a significant impact on this species.	Possible – low risk of significant impact
Oxyura australis Blue-billed Duck	Not listed	P4	The Blue-billed Duck is almost wholly aquatic, and is seldom seen on land. Non-breeding flocks, often with several hundred individuals, congregate on large, deep open freshwater dams and lakes in autumn. The daylight hours are spent alone in small concealed bays within vegetation or communally in large exposed rafts far from the shore (Birdlife Australia 2016). The Proposal is not expected to have a significant impact on this species.	Unlikely
Falsistrellus mackenziei Western False Pipistrelle	Not listed	P4	This species is a small insectivorous bat that inhabits forests and woodlands. These bats roost in grounds in tree hollows and have been recorded near the site at Harry Waring Marsupial Reserve in 1993 (Western Wildlife 2007). The Proposal is not expected to have a significant impact on this species.	Possible – low risk of significant impact
Macropus irma Western Brush Wallaby	Not listed	P4	The Western Brush Wallaby is likely to occur in areas of forest or woodland where there is a dense, shrub understorey. The species has been recorded near the Proposal Area (Western Wildlife 2007). The Proposal is not expected to have a significant impact on this species.	Possible – low risk of significant impact
Hydromys chrysogaster Water-rat	Not listed	P4	This species is generally associated with permanent wetlands, but may move into seasonal wetlands when they hold water. This species is unlikely to be present in the Proposal Area all year round, but may be sometimes present in the wetland on the western boundary of the Proposal Area (Wester Wildlife 2007). The Proposal is not expected to have a significant impact on this species.	Unlikely
Synemon gratiosa Graceful Sun Moth	Not listed	P4	The Graceful Sun Moth (GSM) is restricted to the Swan Coastal Plain and south Midwest. It occurs in areas of Banksia woodland or in areas close to the coast where their host plants *Lomandra maritima* and *L. hermaphrodita occur*. The closest record of the species to the site is located 2 km east at Bush Forever site (BF 347), a bushland adjacent to Wandi Natural Reserve (Ecologia 2011). Ecologia undertook a targeted survey for the GSM and did not record the species at the site. There is a low likelihood that GSM currently occurs with the site given the lack of evidence of the species and the high level of disturbance of the habitat present. The Proposal is not expected to have a significant impact on this species (Ecologia 2011).	Unlikely
Isoodon obesulus subsp. Fusciventer Quenda, Southern Brown Bandicoot	Not listed	P5	The Quenda favours areas with dense understorey, and is often particularly common in dense wetland vegetation. The species has been recorded nearby to the site (Western Wildlife 2007). The Proposal is not expected to have a significant impact on this species.	Possible – low risk of significant impact
Macropus eugenii subsp. Derbianus Tammar Wallaby (WA subsp)	Not listed	P5	Dense, low vegetation for daytime shelter and open grassy areas for feeding. This species inhabits coastal scrub, heath, dry sclerophyll forest and thickets in mallee and woodland (DEC 2012). The Proposal is not expected to have a significant impact on this species.	Possible – low risk of significant impact

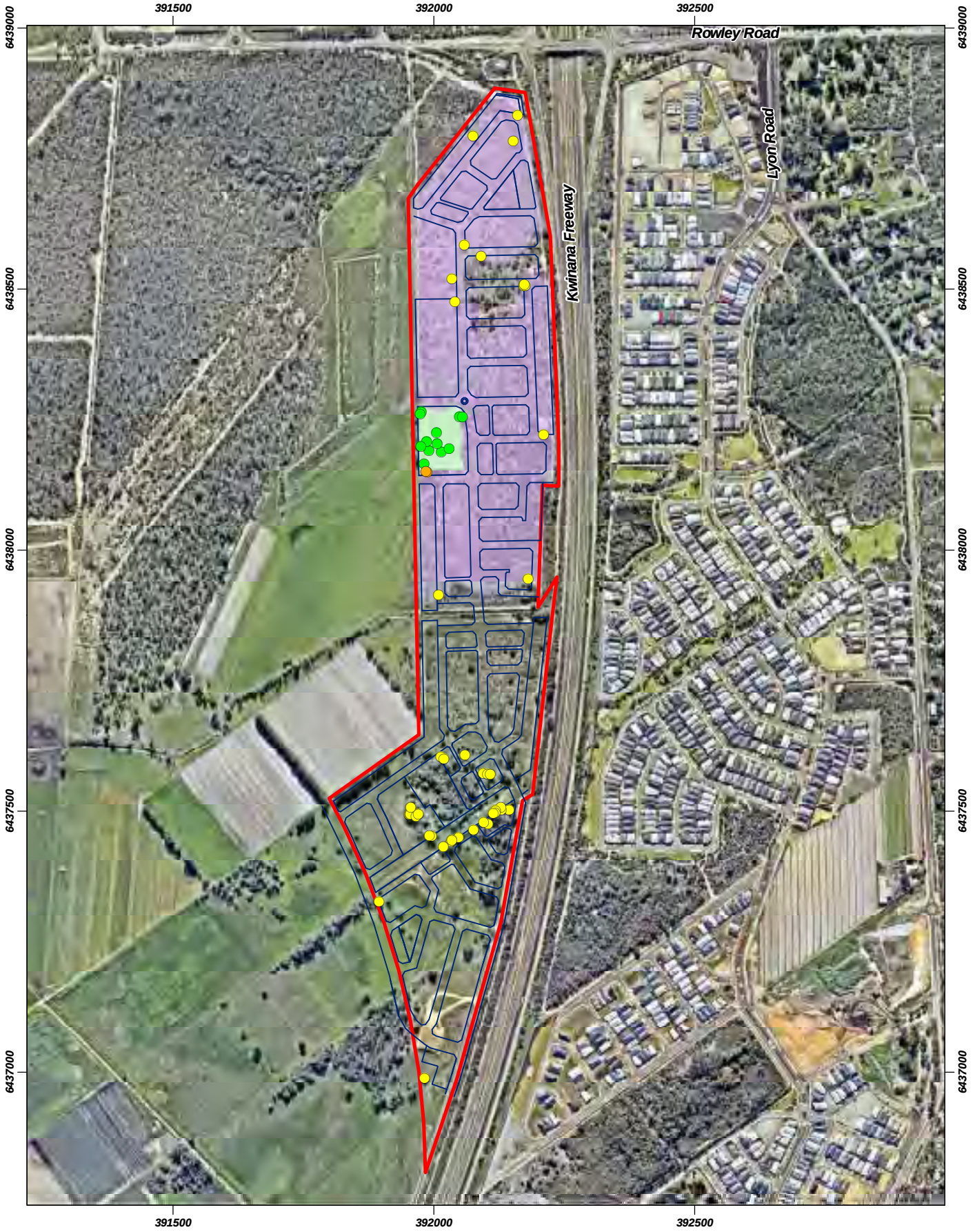

Figure 12 Potential Black Cockatoo habitat

Scale 1:10,000 at A4

0 50 100 150 200 250 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 29/11/2016
Author: JCrute
Source: Aerial image: Nearmap 2016.

Legend

- Potential cockatoo breeding tree design permitting (2)
- Potential cockatoo breeding tree for retention (12)
- Potential cockatoo breeding tree to be cleared (44)
- Concept plan
- Proposal area
- Cleared vegetation (18.76 h
- Retained vegetation (0.992 ha)

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www.strategen.com.au

Path: Q:\Consult\2013\SPG\SPG13027.01\ArcMap_documents\R002\SPG13027_01_R002_Rev1_F012.mxd

3. Key environmental approvals and policies

3.1 Environment Protection and Biodiversity Conservation Act 1999

Department of the Environment and Energy (formerly Department of the Environment, DotE) recommends that proposed urban developments in areas which contain nationally listed threatened species or ecological communities (matters of national environmental significance) are likely to be significant under the EPBC Act and should be referred to the Minister for the Environment.

The Mandogalup Urban Development was referred to DotE in August 2014. The referral identified the clearance of 19.7 ha of CBC foraging and potential breeding habitat. DotE released a notification in September 2014 determining that the referral was considered a Controlled Action to be assessed by preliminary documentation. The preliminary assessment documentation was released for public comment during March 2015. Additional information relating to the proposal was released for public comment in June 2015. In July 2015 DotE approved the proposed action subject to a number of conditions relating to clearing procedures, reporting and the acquisition of an offset property. Satterley secured the appropriate offset property in agreement with DotE and Parks and Wildlife in October 2015. The approval remains in effect until 31 July 2025.

3.2 Metropolitan Region Scheme

MRS Amendment 1114/33 relating to the Proposal Area was referred to the Environmental Protection Authority (EPA) under Part IV of the *Environmental Protection Act 1986* (EP Act) in February 2006. The EPA set the level of assessment as Scheme Amendment Not Assessed – Advice Given. The environmental issues identified by the EPA were:

- drainage (management of water quality and quantity)
- special catchment requirements – Peel Harvey Catchment
- wetlands
- remnant vegetation
- fauna
- soil and groundwater contamination
- emissions impacting on adjoining land uses
- noise and vibration and
- Cockburn Sound catchment.

Urban Deferred was lifted and the land rezoned to Urban under the MRS in February 2014.

4. Environmental impacts and management

As described in the following sections, there are several environmental considerations that will require management at subdivision level. The MELSP area has been designed in a manner to optimise the retention of native trees and landscape features by incorporating these environmental assets into proposed areas of POS and road reserve where possible. Various management plans will be developed prior to and implemented during subdivision to manage environmental impacts of the Mandogalup Urban Development including:

- Construction Environmental Management Plan (CEMP)
- ASS Management Plan
- Fauna and Habitat Management Plan
- Dieback Management Plan.

In addition to the management plans described below, there may be a requirement to consult with the Traditional Owners if disturbance to the Aboriginal mythological site is likely.

4.1.1 Construction Environmental Management Plan

Overall environmental impacts during construction will be managed through implementation of a CEMP. The CEMP will be prepared prior to subdivision taking place in the Proposal Area.

While there are no sensitive receptors in proximity to the MELSP area that may potentially be affected by dust, air and noise; local traffic travelling on Rowley Road or Kwinana Freeway may be affected by noise and dust issues. Aspects to be addressed in the CEMP will include:

- protection of significant trees and landscape features
- protection of fauna and fauna habitat
- drainage
- noise
- dust and air quality
- management, monitoring and contingency plans regarding the above factors.

4.1.2 Water Management Strategy

Water management and drainage on the Proposal Area will require preparation of a Local Water Management Strategy for the Proposal Area.

4.1.3 Acid sulfate soils

An ASS Management Plan will be prepared to manage the risk of disturbing potential or actual ASS during ground intrusive earthworks in the Proposal Area. This will apply particularly to low-lying areas where the risk of ASS is highest.

4.1.4 Vegetation management

During construction, vegetation will be managed through the CEMP. This will include protection of the areas of vegetation to retained, particularly the area of vegetation type ErOF containing the Priority 3 species *Cyathochaeta teretifolia* (P3).

Although dieback was not recorded within the Proposal Area, Glevan (undated) found it was highly likely to be present across much of the Proposal Area. Areas of vegetation to be retained include both uninfested and unmappable (likely to be infested) areas. A dieback management plan will be prepared to manage the risk of spreading dieback within the Proposal Area, particularly in areas of retained vegetation.

4.1.5 Tree and landscape feature retention

A summary of the engineering and planning assessment design outcomes is summarised in Appendix 12. Figure 11 identifies the proposed significant tree and landscape feature retention for the proposed development.

Table 6 below provides a summary of tree retention outcomes associated with the engineering and planning assessment.

Table 8: Proposed tree significant retention by retention value

Retention Value	Removed	Retention subject to design	Retained
High	8	5	17
Medium	15	7	26
Low	18	1	17
Very Low	56	0	2
Total	**97**	**13**	**62**

The following ongoing management and maintenance actions will be undertaken to continue to maximise significant tree and landscape feature retention:

- identify retained trees on engineering and planning documentation
- identify trees where retention is subject to detailed design on engineering and planning documentation
- undertaken prior, during and at the completion of detailed design to ensure all opportunities to retain significant trees subject to design outcomes are applied
- communicate tree retention performance within the landscape feature and Tree Retentions Plan at subdivision and development approval stage
- continue to implement an open and consultative dialogue with the City of Kwinana on significant tree and landscape feature design outcomes
- implement the following management plans during the development:
  - Construction Environmental Management Plan (CEMP)
  - Fauna and Habitat Management Plan
  - Dieback Management Plan.

4.1.6 Fauna and habitat protection

In order to protect fauna, fauna habitat and conservation values, a Fauna and Habitat Management Plan (FHMP) will be prepared and implemented for the Proposal Area. Key aspects that will be addressed in the FHMP include:

- descriptions of fauna and fauna habitat within the Proposal Area
- pre-clearing Quenda trapping plan
- identified achievable management objectives
- management actions to ensure management objectives are able to be achieved (may include demarcation of buffers, conservation of vegetation and fencing)
- identified monitoring actions to ensure management actions are achieved
- development of contingency plans
- outline of responsibilities and timeframes for the implementation of the FHMP.

The FHMP will also address street planting of native vegetation, the retention of existing habitat within POS and regeneration of habitat within POS.

4.1.7 Midge and mosquito management

As there are no wetlands with standing water included in the final design, a Midge and Mosquito Management Plan will not be required for the Proposal Area.

5. Summary

This report has been developed as a supporting document for the MELSP being submitted for the proposed Mandogalup Urban Development. The report discusses the site environmental characteristics, site work undertaken and policy requirements applicable to the management of environmental factors associated with the development.

The following summarises the key factors considered during development planning for the Proposal Area:

- the Proposal do not impact on known occurrences of threatened flora or TECs, although two Priority species were identified
- the development of the Proposal Area meets the OEPA Guidance 10 (2006) requirement as vegetation assoication1001 will continue to be represented above 10%
- Carnaby's Black-Cockatoo, listed as Endangered under the EPBC Act, is likely to utilise the Proposal Area. This is the subject of an EPBC Act referral being prepared for the Commonwealth to confirm if the development is considered to be a controlled action
- the site is subject to a Voluntary Auditors report to demonstrate the Proposal Area is fit for the proposed future use
- the site will be subject to an ASS management plan to manage the risk of impact to groundwater
- no site registered Aboriginal Sites are located within or immediately adjacent to the Proposal Area
- no registered heritages sites are known to occur within the Proposal Area
- no confirmed dieback infestations were recorded in the Proposal Area
- a significant tree physical assessment and an Engineering and Planning assessment in accordance with the City of Kwinana's Local planning Policy No. 1 as resulted in:
  - the retention of 62 significant trees
  - the potential retention of an additiona13 significant trees subject to further design work associated with the education site, group housing site and road reserve
  - the removal of 97 significant trees of which 56 of these trees are of 'very low' retention value
- the Proposal Area is not considered to represent significant habitat for conservation significant fauna species.

The final MELSP design incorporates environmental management actions into the plan to assist in the retention of environmental values at the Proposal Area. Additional management plans will be prepared for use during development of the Proposal Area, including a CEMP, Water Management Strategy, ASS Management Plan, FHMP, and Dieback Management Plan.

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Appendix 1
Mandogalup Local Structure Plan

Planning Design Delivery

RESIDENTIAL

- Residential (R30-R60)

PUBLIC PURPOSE

- PS — Educational/Institutional
  - PS Primary School

PARKS,RECREATION & CONSERVATION

- Parks, Recreation and Drainage
- Drainage

TRANSPORT

- Access Street - Local Road
- Primary Distributor Road
- District Distributor Integrator A
- Neighbourhood Connector
- Temporary Neighbourhood Connector
- Indicative Cycleway Access

OTHER

- Structure Plan Boundary

ADDITIONAL INFORMATION

- Proposed WTCPA - 1.5km Buffer
- DBNGP Easement
- Western Power Easement
- 1 — Investigation Area - Local Playing Fields
- Existing Lot Boundaries

Rowley Road

Kwinana Freeway

Hoffman Road

1

PS

N

0 200 400 Metres

REVISIONS

Rev	Date	Drawn
A	2016.09.06	M. Sullivan
B	2016.09.07	M. Sullivan
C	2016.11.03	M. Sullivan

ROWEGROUP
PLANNING DESIGN DELIVERY

w: www.rowegroup.com.au
e: info@rowegroup.com.au
p: 08 9221 1991

Date Drawn:	2016-09-06
Job Ref:	7282A
Scale:	1:7,500 @ A3
Client:	Satterley Property Group
Designer:	R. Cumming
Drawn:	M. Sullivan
Projection:	PCG 94
Plan ID:	7282A-STR-07-C

Mandogalup East Local Structure Plan

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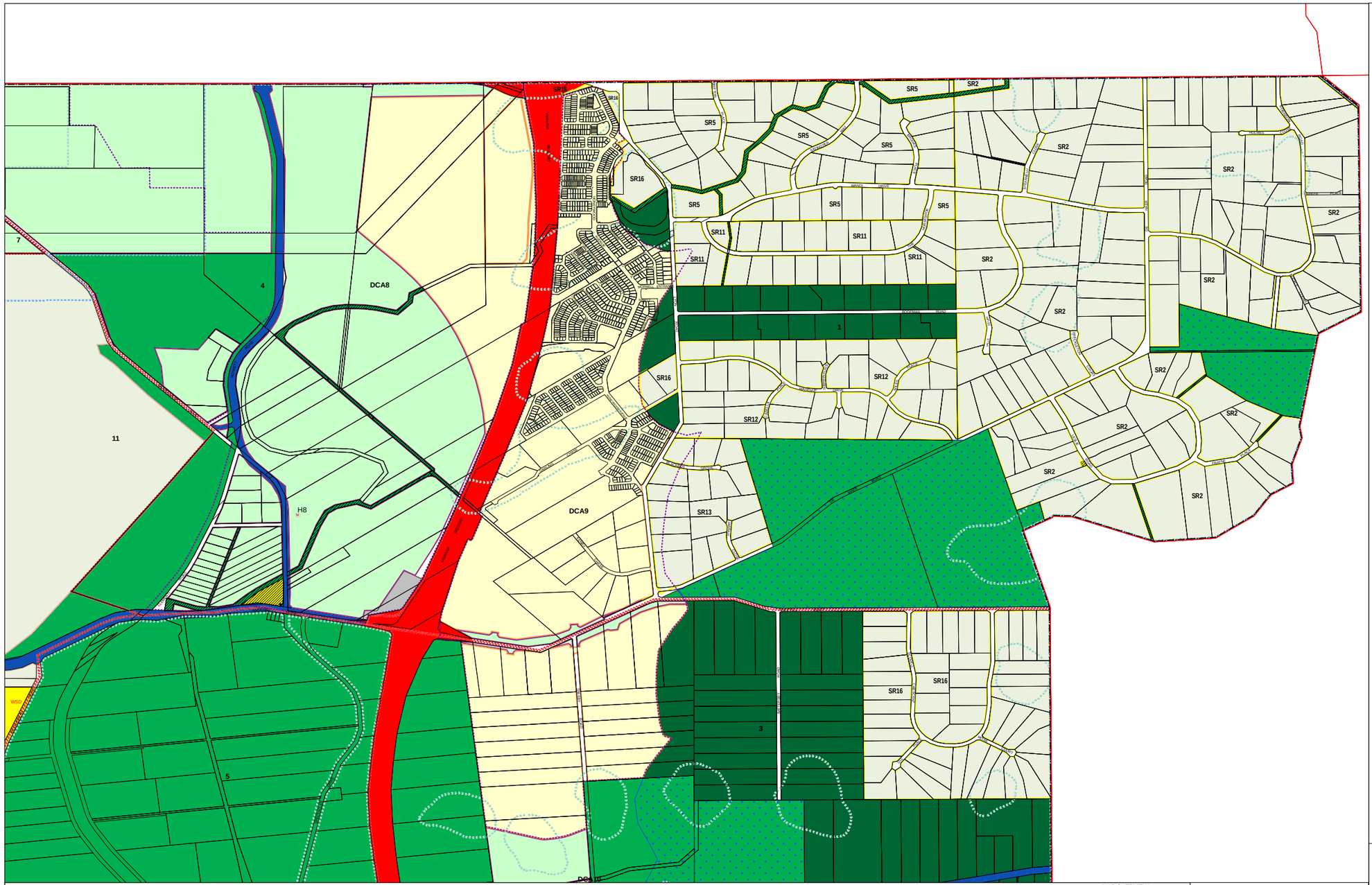
Matt Sullivan 7 November 2016

Appendix 2
Town Planning Scheme



LEGEND

REGION SCHEME RESERVES (MRS)

- Civic and cultural
- Other regional roads
- Parks and recreation
- R Parks and recreation restricted
- Port installations
- Primary regional roads
- Railways
- State forests
- Waterways
- Water catchments
- Public purposes
- CP Public purposes - car park
- CG Public purposes - Commonwealth Government
- HS Public purposes - high school
- H Public purposes - hospital
- P Public purposes - prison
- SU Public purposes - special uses
- SEC Public purposes - State Energy Commission
- TS Public purposes - technical school
- U Public purposes - university
- WSD Public purposes - Water Authority of WA

LOCAL SCHEME RESERVES

(see scheme text for additional information)

- Park recreation and drainage
- Public purposes
- CF Public purposes : Community facility
- K Public purposes : Kindergarten
- LG Public purposes : Local government
- PS Public purposes : Primary school
- SG Public purposes : State Government
- T Public purposes : Telecom
- WSD Public purposes : Water supply sewerage and drainage

LOCAL SCHEME ZONES

(see scheme text for additional information)

- Cluster/communal rural settlement
- Commercial
- Development
- General industry
- Kwinana town centre
- Light industry
- Mixed business 1
- Residential
- Rural A
- Rural B
- Rural water resource
- Service commercial
- Special residential
- Special rural
- APH Special use : Aged persons home
- CC Special use : Cultural centre
- H Special use : Hotel
- SS Special use : Service station
- V Special use : Various
- W Special use : Welfare

OTHER CATEGORIES

(see scheme text for additional information)

- Scheme boundary
- Local Government boundary
- Hope Valley - Wattleup Redevelopment Area
- R20 R Codes
- A1 Additional uses
- SRes1 Special residential area
- SR1 Special rural area
- Area of landscape protection
- DA1 Development area
- DCA1 Development contribution area
- Drainage catchment management
- 1 Policy areas
- Preservation of buildings, objects and places
- No zone
- Waterbodies

VERSION No 1

Produced by GeoSpatial Planning Support, Department of Planning.

Base Information Supplied by the Western Australian Land Information Authority, LI 646-2014-3

City of Kwinana

Town Planning Scheme No. 2

(District Scheme)

N

0 250 500 750 1,000

metres

MAP OVERVIEW

Authorised: T.Servaas

Plot Date: 02 October 2015

G.Gazette: 20 November 1992

Town Planning Scheme Map No. 3 of 14
MAP: Wandi Locality

City of Kwinana

Town Planning Scheme No. 2

(District Scheme)

Appendix 3
Protected Matters Search

Australian Government
Department of the Environment

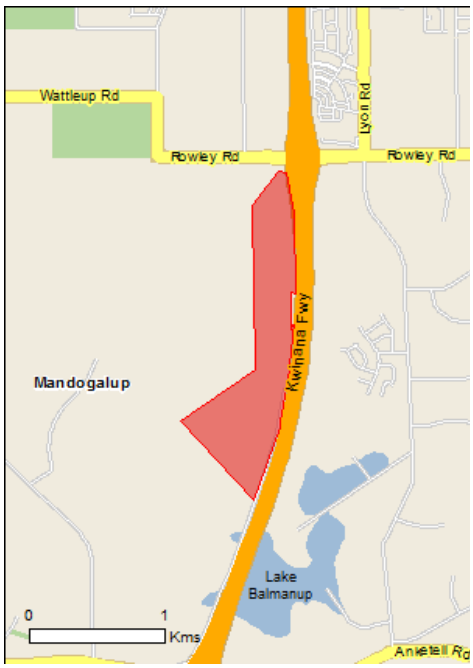
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 23/09/16 17:04:06



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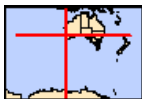
Buffer: 5.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	18
Listed Migratory Species:	17

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	26
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	6
Regional Forest Agreements:	None
Invasive Species:	42
Nationally Important Wetlands:	3
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Forrestdale and thomsons lakes	Within Ramsar site
Peel-yalgorup system	30 - 40km upstream

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Vulnerable	Species or species habitat likely to occur within area
Plants		

Name	Status	Type of Presence
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area
Drakaea elastica Glossy-leafed Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Charadrius dubius Little Ringed Plover [896]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Charadrius dubius Little Ringed Plover [896]		Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis		
Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Harry Waring Marsupial Reserve	WA
Modong	WA
Thomsons Lake	WA
Unnamed WA48291	WA
Unnamed WA49561	WA
Wandi	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis		
Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos		
Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis		
European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia		
Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus		
House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus		
Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis		
Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis		
Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within

Name	Status	Type of Presence
		area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus densiflorus Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Gibbs Road Swamp System	WA
Spectacles Swamp	WA

Name	State
Thomsons Lake	WA

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.183349 115.853858,-32.181423 115.855617,-32.181532 115.856089,-32.183784 115.856562,-32.188252 115.856733,-32.188215 115.856433,-32.190286 115.85639,-32.18985 115.856647,-32.193118 115.856218,-32.195443 115.855703,-32.195733 115.85566,-32.199837 115.853987,-32.195406 115.849094,-32.192574 115.854072,-32.183385 115.853858,-32.183385 115.853858,-32.183349 115.853858

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Parks and Wildlife Commission NT, Northern Territory Government
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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+61 2 6274 1111

Appendix 4
Aboriginal Heritage Inquiry System

Search Criteria

1 Other Heritage Places in Custom search area; 391170.66mE, 6436690.97mN z50 (MGA94) : 392258.88mE, 6438929.19mN z50 (MGA94)

Disclaimer

The ***Aboriginal Heritage Act 1972*** preserves all Aboriginal sites in Western Australia whether or not they are registered. Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist.

The information provided is made available in good faith and is predominately based on the information provided to the Department of Aboriginal Affairs by third parties. The information is provided solely on the basis that readers will be responsible for making their own assessment as to the accuracy of the information. If you find any errors or omissions in our records, including our maps, it would be appreciated if you email the details to the Department at heritageenquiries@daa.wa.gov.au and we will make every effort to rectify it as soon as possible.

South West Settlement ILUA Disclaimer

Your heritage enquiry is on land **within or adjacent to** the following Indigenous Land Use Agreement(s): Gnaala Karla Booja People ILUA

On 8 June 2015, six identical Indigenous Land Use Agreements (ILUAs) were executed across the South West by the Western Australian Government and, respectively, the Yued, Whadjuk People, Gnaala Karla Booja, Ballardong People, South West Boojarah #2 and Wagyl Kaip & Southern Noongar groups, and the South West Aboriginal Land and Sea Council (SWALSC).

The ILUAs bind the parties (including 'the State', which encompasses all State Government Departments and certain State Government agencies) to enter into a Noongar Standard Heritage Agreement (NSHA) when conducting Aboriginal Heritage Surveys in the ILUA areas, unless they have an existing heritage agreement. It is also intended that other State agencies and instrumentalities enter into the NSHA when conducting Aboriginal Heritage Surveys in the ILUA areas. It is recommended a NSHA is entered into, and an 'Activity Notice' issued under the NSHA, if there is a risk that an activity will 'impact' (i.e. by excavating, damaging, destroying or altering in any way) an Aboriginal heritage site. The Aboriginal Heritage Due Diligence Guidelines, which are referenced by the NSHA, provide guidance on how to assess the potential risk to Aboriginal heritage.

Likewise, from 8 June 2015 the Department of Mines and Petroleum (DMP) in granting Mineral, Petroleum and related Access Authority tenures within the South West Settlement ILUA areas, will place a condition on these tenures requiring a heritage agreement or a NSHA before any rights can be exercised.

If you are a State Government Department, Agency or Instrumentality, or have a heritage condition placed on your mineral or petroleum title by DMP, you should seek advice as to the requirement to use the NSHA for your proposed activity. The full ILUA documents, maps of the ILUA areas and the NSHA template can be found at https://www.dpc.wa.gov.au/lantu/Claims/Pages/SouthWestSettlement.aspx.

Further advice can also be sought from the Department of Aboriginal Affairs (DAA) at heritageenquiries@daa.wa.gov.au.

Copyright

Coordinate Accuracy

Accuracy is shown as a code in brackets following the coordinates. Map coordinates (Latitude/Longitude and Easting/Northing) are based on the GDA 94 Datum. The Easting/Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '500000mE:Z50' means Easting=500000, Zone=50.

Terminology (NB that some terminology has varied over the life of the legislation)

Place ID/Site ID: This a unique ID assigned by the Department of Aboriginal Affairs to the place

Status:

- **Registered Site**: The place has been assessed as meeting Section 5 of the ***Aboriginal Heritage Act 1972***
- **Other Heritage Place which includes:**
  - **Stored Data / Not a Site:** The place has been assessed as not meeting Section 5 of the ***Aboriginal Heritage Act 1972***
  - **Lodged:** Information has been received in relation to the place, but an assessment has not been completed at this stage to determine if it meets Section 5 of the ***Aboriginal Heritage Act 1972***

Status Reason: e.g. Exclusion - Relates to a portion of an Aboriginal site or heritage place as assessed by the Aboriginal Cultural Material Committee (ACMC). e.g. such as the land subject to a section 18 notice.

Origin Place ID: Used in conjuction with Status Reason to indicate which Registered Site this Place originates from.

Access and Restrictions:

- **File Restricted = No:** Availability of information (other than boundary) that the Department of Aboriginal Affairs holds in relation to the place is not restricted in any way.
- **File Restricted = Yes:** Some of the information that the Department of Aboriginal Affairs holds in relation to the place is restricted if it is considered culturally sensitive. This information will only be made available if the Department of Aboriginal Affairs receives written approval from the informants who provided the information. Download the Request to Access Restricted Information letter and form.
- **Boundary Restricted = No:** place location is shown as accurately as the information lodged with the Registrar allows.
- **Boundary Restricted = Yes:** To preserve confidentiality the exact location and extent of the place is not displayed on the map. However, the shaded region (generally with an area of at least 4km²) provides a general indication of where the place is located. If you are a landowner and wish to find out more about the exact location of the place, please contact DAA.
- **Restrictions:**
  - **No Restrictions:** Anyone can view the information.
  - **Male Access Only:** Only males can view restricted information.
  - **Female Access Only:** Only females can view restricted information

Legacy ID: This is the former unique number that the former Department of Aboriginal Sites assigned to the place. This has been replaced by the Place ID / Site ID.

List of Other Heritage Places with Map

ID	Place Name	File Restricted	Boundary Restricted	Restrictions	Status	Status Reason	Origin Place ID	Type	Knowledge Holders	Coordinates	Legacy ID
3427	MANDOGALUP SWAMP/SPECTACLES.	No	No	No Gender Restrictions	Stored Data / Not a Site			Mythological, Hunting Place, Water Source	*Registered Knowledge Holder names available from DAA	391457mE 6436663mN Zone 50 [Unreliable]	S02729

Aboriginal Heritage Inquiry System

Aboriginal Sites Database

Legend

Selected Heritage Places

- Other Heritage Places
- Aboriginal Community Occupied
- Aboriginal Community Unoccupied
- Town
- Search Area

Search Criteria

0 Registered Aboriginal Sites in Custom search area; 391170.66mE, 6436690.97mN z50 (MGA94) : 392258.88mE, 6438929.19mN z50 (MGA94)

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The ILUAs bind the parties (including 'the State', which encompasses all State Government Departments and certain State Government agencies) to enter into a Noongar Standard Heritage Agreement (NSHA) when conducting Aboriginal Heritage Surveys in the ILUA areas, unless they have an existing heritage agreement. It is also intended that other State agencies and instrumentalities enter into the NSHA when conducting Aboriginal Heritage Surveys in the ILUA areas. It is recommended a NSHA is entered into, and an 'Activity Notice' issued under the NSHA, if there is a risk that an activity will ‘impact’ (i.e. by excavating, damaging, destroying or altering in any way) an Aboriginal heritage site. The Aboriginal Heritage Due Diligence Guidelines, which are referenced by the NSHA, provide guidance on how to assess the potential risk to Aboriginal heritage.

Likewise, from 8 June 2015 the Department of Mines and Petroleum (DMP) in granting Mineral, Petroleum and related Access Authority tenures within the South West Settlement ILUA areas, will place a condition on these tenures requiring a heritage agreement or a NSHA before any rights can be exercised.

If you are a State Government Department, Agency or Instrumentality, or have a heritage condition placed on your mineral or petroleum title by DMP, you should seek advice as to the requirement to use the NSHA for your proposed activity. The full ILUA documents, maps of the ILUA areas and the NSHA template can be found at https://www.dpc.wa.gov.au/lantu/Claims/Pages/SouthWestSettlement.aspx.

Further advice can also be sought from the Department of Aboriginal Affairs (DAA) at heritageenquiries@daa.wa.gov.au.

Coordinate Accuracy
Accuracy is shown as a code in brackets following the coordinates. Map coordinates (Latitude/Longitude and Easting/Northing) are based on the GDA 94 Datum. The Easting/Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '500000mE:Z50' means Easting=500000, Zone=50.

Terminology (NB that some terminology has varied over the life of the legislation)
Place ID/Site ID: This a unique ID assigned by the Department of Aboriginal Affairs to the place
Status:
- **Registered Site**: The place has been assessed as meeting Section 5 of the ***Aboriginal Heritage Act 1972***
- **Other Heritage Place which includes:**
  - **Stored Data / Not a Site:** The place has been assessed as not meeting Section 5 of the ***Aboriginal Heritage Act 1972***
  - **Lodged:** Information has been received in relation to the place, but an assessment has not been completed at this stage to determine if it meets Section 5 of the ***Aboriginal Heritage Act 1972***

Status Reason: e.g. Exclusion - Relates to a portion of an Aboriginal site or heritage place as assessed by the Aboriginal Cultural Material Committee (ACMC). e.g. such as the land subject to a section 18 notice.
Origin Place ID: Used in conjuction with Status Reason to indicate which Registered Site this Place originates from.
Access and Restrictions:
- **File Restricted = No:** Availability of information (other than boundary) that the Department of Aboriginal Affairs holds in relation to the place is not restricted in any way.
- **File Restricted = Yes:** Some of the information that the Department of Aboriginal Affairs holds in relation to the place is restricted if it is considered culturally sensitive. This information will only be made available if the Department of Aboriginal Affairs receives written approval from the informants who provided the information. Download the Request to Access Restricted Information letter and form.
- **Boundary Restricted = No:** place location is shown as accurately as the information lodged with the Registrar allows.
- **Boundary Restricted = Yes:** To preserve confidentiality the exact location and extent of the place is not displayed on the map. However, the shaded region (generally with an area of at least 4km²) provides a general indication of where the place is located. If you are a landowner and wish to find out more about the exact location of the place, please contact DAA.
- **Restrictions:**
  - **No Restrictions:** Anyone can view the information.
  - **Male Access Only:** Only males can view restricted information.
  - **Female Access Only:** Only females can view restricted information

Legacy ID: This is the former unique number that the former Department of Aboriginal Sites assigned to the place. This has been replaced by the Place ID / Site ID.

List of Registered Aboriginal Sites with Map

No Results

Aboriginal Heritage Inquiry System

Aboriginal Sites Database

Legend

Selected Heritage Sites

- Registered Sites
- Aboriginal Community Occupied
- Aboriginal Community Unoccupied
- Town
- Search Area

Appendix 5
Level 2 Flora Survey

(to be provided separately)

VEGETATION AND FLORA REPORT

Proposed Urban Development Area
Wandi / Mandogalup

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Disclaimer

SUMMARY

As part of the Wandi/Mandogalup Proposed Urban Development area, RPS Environment and Planning Pty Ltd (RPS) was commissioned to undertake a vegetation and flora survey of Satterley Property Group's landholding (subsequently referred to as the 'survey area').

The survey area is between Rowley Road and Darling Chase, north of Anketell Road, and adjacent to Kwinana Freeway, with part west of the freeway in Mandogalup, and part east of the freeway in Wandi.

This report presents the results of the flora and vegetation survey of the study area. The survey undertaken meets the EPA Guidance No. 51 Level 2 (EPA 2004) survey requirements comprising of Background research or 'desktop' study, Reconnaissance survey, and Detailed survey, undertaken between spring 2004 and autumn 2007.

Field work included establishing and sampling seventeen plots, or quadrats, and analysing floristic species presence/absence lists to determine vegetation complexes, condition, which floristic community types (FCTs) that vegetation units of the study area most closely approximate, and identification of rare and priority flora.

Vegetation Complexes

According to the 1:250,000 scale vegetation map by Heddle et al. (1980) the vegetation of the survey area belongs to two vegetation complexes; the Bassendean Vegetation Complex – Central and South (44), and the Herdsman Vegetation Complex (53). Complex 53 is on either side of the freeway, mainly south of the drain, and the rest of the survey area is Complex 44.

Heddle et al. (1980) describe the vegetation of Complex 44 as, basically, ranging from woodland of jarrah-sheoak-banksia to a low woodland of *Melaleuca* species, to sedgelands in low-lying depressions and swamps. Complex 53 vegetation is 'Sedgelands and fringing woodland of *E. rudis* – *Melaleuca* spp.'. The Spectacles vegetation is also in Complex 53.

Bush Forever (Government of Western Australia 2000) indicates that 24% of the original area of Bassendean Vegetation Complex – Central and South (44) in the Perth Metropolitan Region remains, and that 1,423 ha of this remaining 10,919 ha is 'protected'.

Approximately 31% of the original area of Herdsman Vegetation Complex (53) in the Perth Metropolitan Region remains, and that 1,423 ha of this remaining 2,017 ha is 'protected'.

On this basis, both vegetation complexes present at the site remain above the 10% retention target proposed in Bush Forever (Government of Western Australia, 2000).

Vegetation Condition

The vegetation of the survey area is in predominantly Good to Completely Degraded condition, according to the Bush Forever Scale (Government of Western Australia 2000) (Figure 2). There were four exceptions where the vegetation was in Excellent to Very Good condition. These four areas of Excellent – Very Good condition vegetation represent approximately 7.8% of the project site. The breakdown is shown below:

- ErOf = 0.75 ha (0.3%).
- ErMpr = 1.7 ha (0.7%).
- BLW-OF(J)(E-VG) = 3.6 ha (1.6%).
- BLW-OF(J)(VG-E) = 12.1 ha (5.2%).

Approximately 1,500 ha of regionally significant vegetation was identified in *Bush Forever* within 5 km of the project area, however the current site was not nominated as a regionally significant vegetation worthy of protection within this process.

Vegetation Units

Thirty-one vegetation units were mapped (Figure 2), and can be broadly categorised into four groups:

1. *Eucalyptus rudis* and/or paperbark woodlands and forests.
2. *Banksia* low open woodlands, woodlands and open forests.
3. *Kunzea glabrescens* scrubs and heaths.
4. *Austrostipa ?compressa* grassland (and *Hypolaena – Schoenus* sedgeland).

There are three areas in the survey area that support Conservation Category Wetlands (CCW) and their native vegetation (including fringing vegetation), and associated upland vegetation, and are by definition considered 'significant'.

However, the vegetation in the CCW wetland areas are predominately in a degraded condition due to repeated fires, human disturbance and weed invasion. This warrants further investigation to determine what management is required to ensure the long-term viability of these CCWs and possible Vulnerable Floristic Community.

CCW wetlands and the area within 50 m of the wetland are listed as Environmentally Sensitive Areas (ESAs) under the *Environmental Protection Act, 1986* (as amended) (Clearance of Native Vegetation Regulations) and as such are considered significance vegetation.

Vegetation Significance

Areas of significant vegetation within the study area are shown in Figure 4.

The vegetation in the survey area with the highest conservation significance is the unit ErOF: *Eucalyptus rudis* Open Forest in a soak or spring, with *Melaleuca preissiana* and *M. rhaphiophylla* tall

trees, over *Pteridium esculentum – Cyathochaeta teretifolia – Baumea articulata* Closed Herbland-Sedgeland. It is located in Lot 683, west of the freeway as shown in Figure 2 (Figure 3 shows the Legend). It is considered to have significance due to:

- The Excellent condition of the vegetation.
- It contains the Priority 3 *Cyathochaeta teretifolia*, which is unique in the survey area and is uncommon or rare in the rest of the Perth Metropolitan Area.
- This vegetation unit may also meet the criteria for Rarity in that it is 'an environmental, biological or ecological feature or phenomenon which can be regarded as outstanding because it is one of the few of its type'.

One of the three areas of CCW also potentially contains a rare plant community. A multivariate analysis (Appendix 2) identified that the vegetation at Plot 06, vegetation unit EROF-OW/MrLC-OF (Figure 1, Figure 2) potentially represents a state listed Threatened Ecological Community (TEC). *TEC21: SCP15 Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain*, which is listed as Vulnerable under the *Wildlife Conservation Act, 1950* (as amended). Vulnerable means that it 'has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction in the medium to long-term future'. This Floristic Community Type (FCT) is not listed under the Federal *EPBC Act (1999)* as a TEC.

No part of the study area was included within *Bush Forever* which was compiled to identify and protect areas of regionally significant bushland and wetlands on the Swan Coastal Plain.

Flora and Conservation Significance

More than 220 species of vascular plants were recorded in the survey area.

No DRF or flora species listed under the *EPBC Act, 1999* were identified from the study area.

One Priority 3 species, *Cyathochaeta teretifolia,* was recorded from Quadrat 3 (Figure 1) in the north-west of the survey area. This species 'are known from several populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered)'. There are twenty-eight records of this species in the Western Australian Herbarium, with a distribution of near coastal areas from near Walpole to north of Perth. Priority species are not protected by legislation.

A wetland rush species*, Dielsia stenostachya* was recorded across the site. This species is endemic to the SCP and is listed as a significant species in *Bush Forever* (Government of Western Australia, 2000).

A shrub*, Lysinema elegans* was recorded in the east of the survey area, near the junction of Bodeman and Lyon Roads. This species is endemic to the Swan Coastal Plain and poorly reserved. It is listed as a significant species in B*ush Forever* (Government of Western Australia, 2000).

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APPENDICES

1.0 INTRODUCTION

As part of the Wandi/Mandogalup Proposed Urban Development, RPS Environment and Planning Pty Ltd (then RPS Bowman Bishaw Gorham) was commissioned to undertake a vegetation and flora survey in Satterley Property Group's 232 ha landholding in the proposed development (subsequently referred to as the 'survey area'). This report presents the results of the flora and vegetation survey of the study area.

1.1 Location

The survey area is between Rowley Road and Darling Chase, north of Anketell Road, and adjacent to Kwinana Freeway, with part west of the freeway in Mandogalup, and part east of the freeway, in Wandi. The survey area is outlined in red on Figures 1 and 2.

1.2 Existing Environment

1.2.1 Soils

According to Gozzard (1983), the study area is, with one relatively small exception, Bassendean Sand (S_8), Thin Bassendean Sand over Guildford Formation (S_{10}) and Sandy Silt Swamp Deposits (Ms_5). The relatively small exception is Peaty Clay Swamp Deposits (Cps), which, along with the S_{10} unit, is only in the northern part of the study area. The S_{10} unit is in northern and eastern parts. The StreetSmart Perth Street Directory shows a Lake Balmanup north of Darling Chase, but no lake is shown by Gozzard in the study area. The 'lake' was created by the owner of Lot 677 as a water storage reservoir (R. Galati pers. comm.).

1.2.2 Vegetation Complexes

According to the 1:250,000 scale vegetation map by Heddle et al. (1980) the vegetation of the study area is in two vegetation complexes, the Bassendean Vegetation Complex – Central and South (44) and the Herdsman Vegetation Complex (53). Complex 53 is on either side of the freeway, mainly south of the drain, and the rest of the study area is Complex 44. Heddle et al. (1980) describe the vegetation of Complex 44 as, basically, ranging from woodland of jarrah-sheoak-banksia to a low woodland of *Melaleuca* species, to sedgelands in low-lying depressions and swamps. Complex 53 vegetation is 'Sedgelands and fringing woodland of *E. rudis - Melaleuca* spp.'. The Spectacles vegetation is also in Complex 53.

The nearest other vegetation complexes are Cottesloe Complex – Central and South (52), which is south of the study area, and Karrakatta Complex - Central and South (49), which is west of the study area. Vegetation Complex 52 is, basically, closed heaths on limestone outcrops and a mosaic of tuart woodland and tuart-jarrah-marri open-forest on deeper sands, while Complex 49 is predominantly open forest of tuart-jarrah-marri and woodland of jarrah-*Banksia* spp. *Bush Forever* (Government of Western Australia 2000, Volume 1, Table 4) indicates that 24% of the original area of Bassendean Vegetation Complex – Central and South (44) in the Perth Metropolitan Region remains, and that 1,423 ha of this remaining 10,919 ha is 'protected'. *Bush Forever* indicates that 31% of the original area of Herdsman Vegetation Complex (53) in the Perth Metropolitan Region remains, and that 1,423 ha of this remaining 2,017 ha is 'protected'.

1.2.3 Bush Forever Sites

Four Bush Forever sites are within one kilometre of the study area, and another one is within two kilometres of it. The first four sites are 268, Mandogalup Road Bushland, to the west, 269, The Spectacles, to the south-west, 270, Sandy Lake and Adjacent Bushland, to the south, and 347, Wandi Nature Reserve and Anketell Road Bushland, to the south-east. The other, more distant site is 392, Harry Waring Marsupial Reserve, to the north-west. The landform element listed in *Bush Forever* (Government of Western Australia, Volume 2, pp. 516–519) for all five Bush Forever sites is Bassendean Dunes, but descriptions of the sites also include the Spearwood Dunes landform element for Sites 268, 269, 270 and 392.

1.3 Legislation

1.3.1 Flora

Declared Rare Flora (DRF) is flora that has been adequately surveyed and is considered to be in danger of extinction, rare or otherwise in need of special protection within Western Australia. DRF species are protected under the *Wildlife Conservation Act 1950* (as amended).

In Western Australia there are four categories of Priority Flora, which are not specifically covered under current legislation, but their conservation status warrants some protection. Three categories of Priority Flora are allocated to species that are poorly known (Priority 1 to 3). These require more information to be assessed for inclusion as DRF. The categories are arranged to give an indication of the priority for undertaking further surveys based on the number of known sites, and the degree of threat to those populations. A fourth category of priority flora (Priority 4) is included for those species that have been adequately surveyed and are considered to be rare but not currently threatened.

Some flora species have additional protection under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In Western Australia, the species that are Threatened Flora Species under the EPBC Act are predominantly DRF species also. Penalties apply for any damage to individuals, populations or habitats of protected species.

1.3.2 Other Flora Species of Conservation Significance

Guidance Statement 51 (EPA, 2004) lists species of conservation significance (other than DRF and Priority Flora) if a species has:

- A keystone role.
- Relictual status.
- Anomalous features indicating a potential new discovery.
- A representation of a species range (range extensions, extremes or an outlier population).
- Status as a restricted subspecies, variety, or naturally occurring hybrid.
- Poor reservation.
- Status as a local endemic or has a restricted distribution.

Guidance Statement 51 states that conservation significance includes these criteria, but is not limited to them. In this instance, it includes flora that are poorly represented in the Western Australian Herbarium (WAH) and flora with few known populations. Flora species that hold conservation significance for the Perth Metropolitan Region according to the points listed above are listed in Bush Forever (Western Australian Planning Commission, 2000).

1.3.3 Threatened Ecological Communities (TECs)

Within Western Australia, TECs are defined by the Department of Conservation and Environment (DEC) as those which are found to fit into one of the categories in Table 1. The categories 'Data Deficient' and 'Lower Risk' can be used to provide a list of communities not classified as threatened, but that require more information. Within Western Australia, TECs have limited protection under the *Wildlife Conservation Act 1950* and the *Environmental Protection Act 1986* (as amended). TECs will be protected by the proposed Biodiversity Conservation Act (in preparation).

The EPBC Act provides protection for TECs under federal legislation, which are defined as those communities which are:

- **Critically Endangered** (if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future).

- **Endangered** (if, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future).

- **Vulnerable** (if, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future).

Table 1: Threatened Ecological Communities Category of Threat
(English and Blyth, 1997)

Category	Definition
Presumed Totally Destroyed (PD)	An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies: A) Records within the last fifty years have not been confirmed despite thorough searches or known or likely habitats, or: B) All occurrences recorded within the last 50 years have since been destroyed.
Critically Endangered (CR)	An ecological community will be listed as **Critically Endangered** when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting **any one or more** of the following criteria: A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and **either or both** of the following apply: ▪ Geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately five years). ▪ Modification throughout its range is continuing such that in the immediate future (within approximately five years) the community is unlikely to be capable of being substantially rehabilitated. B) Current distribution is limited, and **one or more** of the following apply: ▪ Geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately five years). ▪ There are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes. ▪ There may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C) The ecological community exists only as highly modified occurrences which may be capable of being rehabilitated if such work begins in the immediate future (within approximately five years).

Category	Definition
Endangered (EN)	An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 70% and either or both of the following apply: ▪ Geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term (within approximately ten years). ▪ Modification throughout its range is continuing such that in the short term future (within approximately ten years) the community is unlikely to be capable of being substantially restored or rehabilitated. B) Current distribution is limited, and one or more of the following apply: ▪ Geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately ten years). ▪ There are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes. ▪ There may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C) The ecological community exists only as highly modified occurrences which may be capable of being rehabilitated if such work begins in the short term future (within approximately ten years).
Vulnerable (VU)	An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction in the medium to long-term future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A) The ecological community exists largely as modified occurrences which are likely to be capable of being substantially restored or rehabilitated. B) The ecological community can be modified or destroyed and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. C) The ecological community may still be widespread but is believed likely to move into a category of higher threat in the medium to long-term future because of existing or impending threatening processes.
Data Deficient (DD)	An ecological community which has not been adequately evaluated with respect to status or where there is currently insufficient information to assign it to a particular category. (An ecological community with poorly known distribution or biology that is suspected to belong to any of the above categories. These ecological communities have a high priority for survey and/or research.)
Lower Risk (LR)	An ecological community that has been adequately surveyed and does not qualify for any of the above categories of threat and appears unlikely to be under threat of significant modification or destruction in the short to medium term future.

1.3.4 Other Vegetation of Conservation Significance

1.3.4.1 Priority Ecological Communities

Possible TECs that do not meet survey criteria or that are not adequately defined are added to CALM's Priority Ecological Community List under Priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as TECs. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened (P1, 2 or 3), or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in Priority 5.

1.3.4.2 Floristic Community Types

Each vegetation community/complex identified in the Survey of the Southern Swan Coastal Plain (Gibson et al., 1994) was given a Reservation Status and a Conservation Status. Reservation Status and Conservation Status are described in Tables 2 and 3.

Table 2: Reservation Status Categories
(Gibson et al., 1994)

Reservation Status	Description
Well Reserved	Known from two or more A class National Parks or Nature Reserves
Poorly Reserved	Known from a single A class National Park or Nature Reserve
Unreserved	Not known to occur in any A class National Park or Nature Reserve.

Table 3: Conservation Status Categories
(Gibson et al., 1994)

Conservation Status	Description
Presumed Destroyed	A community that is totally destroyed or so extensively modified that it is unlikely to re-establish ecosystem processes in the foreseeable future.
Critical	A community with most or all of its known occurrences facing severe modification or destruction in the immediate future.
Endangered	A community in danger of severe modification or destruction throughout its range, if causal factors continue operating.
Vulnerable	A community likely to move into the endangered category in the near future if the causal factors continue operating.
Susceptible	A community of concern because there is evidence that it can be modified or destroyed by human activities or would be vulnerable to new threatening process.
Low Risk	A community that does not qualify for one of the above categories
Insufficiently Known	A community for which there is inadequate data to assign to one of the above categories.

1.4 Objectives

The principal objectives of this study were to:

- Provide descriptions of flora and vegetation units of the study area.
- Assess the health (condition) of the vegetation units.
- Determine the presence of Declared Rare Flora (DRF), endangered, priority and other significant species, Floristic Community Types/Threatened Ecological Communities (TEC) and other significant vegetation units.
- Provide a vegetation map of the area showing significant vegetation.
- Meet the requirements of the Environmental Protection Authority's Guidance Statement for the Assessment of Environmental Factors for Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (*Guidance No. 51*).

2.0 METHODS

The EPA's *Guidance No. 51* (Environmental Protection Authority 2004) was used in the design of the study and in the preparation of the report. As the anticipated scale and nature of the proposed development's impact on native vegetation and flora in the study area will be high, a three-stage Level 2 Detailed Survey, as described on Page 39 of *Guidance No. 51*, was undertaken. It involved the following stages:

- Background research or 'desktop' study. Review of literature and metadata and preparation for field work, including consultations, the gathering and collation of available information from a range of sources, and interpretation of aerial photography.
- Reconnaissance survey. Field work to describe vegetation, to determine parameters, distributions and condition of vegetation units
- Detailed survey. Field work to set up and sample 10 m by 10 m quadrats and to search for rare and other significant flora.
- Follow-up work, including identification and herbarium confirmations of plants recorded and collected during field work. Quadrat data was also then subject to multivariate analysis to assign Floristic Community Types and help determine conservation significance of the vegetation.
- Preparation of the report.

2.1 Preparation for Field Work

Preparation for field work entailed provisional description, listing and mapping of vegetation units of the study area and preparing a table of rare flora to be searched for during field work. Methods for field work were chosen during this preparation stage, which also included a preliminary visit to the Wandi/Mandogalup Proposed Urban Development Area.

2.1.1 Significant Flora

The first phase of the significant flora search was preparation of a table of taxa of Declared Rare and Priority Flora with distributions and locations that may include the broad area. This table was compiled from results of searches of three databases carried out by the Wildlife Branch of Department of Conservation and Land Management in August and September 2004. These three Department of Conservation and Land Management (CALM) databases are *Threatened (Declared Rare) Flora* (Summary of Threatened Flora Data), *Declared Rare and Priority Flora List* and *Western Australian Herbarium Specimen* (WAHERB). The searches were for Declared Rare and Priority

Flora taxa recorded in the general vicinity of Wandi and up to 10 km from the Wandi/Mandogalup Proposed Development Area. The parameters used for the searches are:

- Coordinates: 32◦09'00', 32◦15'00', 115◦49'00' and 115◦55'00'.
- Names: Anketell, Banganup, Banjup, Casuarina, Kwinana, Mandogalup, Modong, Oakford, Spectacles, Wandi, Wattleup.

Table 1-1 in Appendix 1 lists taxa that were identified in the rare flora database searches. The table also lists conservation codes, distributions, localities, growth forms, habitats and flowering times.

The second phase of the preparation for field work, determining which species and other taxa listed in Table A1 might occur in the study area, was assessed by comparing information in Table A1 (and in supplementary sources), particularly about habitats, with vegetation and map information referred to in Section 2.1.

2.1.2 Vegetation

Provisional description and mapping of vegetation of the survey area was based upon reconnaissance survey, aerial photography and relevant publications and maps.

Aerial photography examined was in the form of digital printouts at various scales.

Reports, publications and maps used in provisional description, listing, mapping and understanding of vegetation and habitats of the study area include Beard (1979, 1981), Heddle et al. (1980), Churchward and McArthur (1980), Gozzard (1983) and Gibson *et al*. (1994).

Provisional locations for setting up 10 m by 10 m quadrats were selected (in 2006).

2.2 Field Work

The field work component of the survey was carried out by Arthur Weston and Martin Henson on several days between early September and late November 2004, by Martin Henson, Vanessa Yeomans, Kelli McCreery and Angela Mercier in November 2006 and by Arthur Weston and assistants in March 2007. Spring searches for significant flora, including the DRF spider orchid *Caladenia huegelii* were undertaken in September and early October 2004.

Flora, vegetation units and their condition were recorded. Provisional vegetation descriptions and map boundaries were confirmed and revised. Recording of vegetation types and condition used the methodology of *Bush Forever* as presented in Appendix 4.

The most accurate way to determine which floristic community types (FCTs) are in a metropolitan region Swan Coastal Plain study area is to select, sample and analyse Gibson-type, 10 m by 10 m quadrats (plots) using the techniques described by Gibson et al. (1994) and Keighery (1994). Seventeen such quadrats were selected, set up and sampled, and the samples were analysed by E.A. Griffin & Associates; the Griffin & Associates report is attached to Appendix 2 of this report. The locations of the quadrats and the relevé are shown in Figure 1, and the coordinates of the locations are listed in Table 2-2 of Appendix 2.

The majority of plants were identified in the field by experienced botanists. Voucher specimens of uncommon and possibly significant plants along with any plants that were not readily identifiable in the field were collected and pressed.

2.3 Analysis

2.3.1 Flora

Plant specimens that were collected during fieldwork were pressed, dried and housed according to Western Australian Herbarium protocol. The specimens were identified by checking them against a variety of keys and descriptions in floras and taxonomic works including Marchant et al. (1987), Hussey et al. (1997), other floras and articles in journals, by consulting other botanists, and, after fumigation, by comparing them with specimens in collections in the Western Australian Herbarium in South Perth.

The list of identified flora for the survey area was checked against the tables in Appendix 1 and other lists of significant flora, including Atkins (2004, 2005 and 2006) and the *Bush Forever* list of significant flora of the Perth Metropolitan Area (Government of Western Australia 2000, Volume 2, Table 13).

The species list for each of the quadrats across the survey area were sent to E.A. Griffin & Associates for subsequent analysis using the appropriate PATN programs and databases to ascertain which floristic community types they are closest to and whether or not they were likely to represent any known Threatened Ecological Community. The lists of species sent to E.A. Griffin & Associates is also presented in Appendix 2 of this report.

2.3.2 Vegetation

The provisional vegetation descriptions and boundaries were revised, refined and finalised, and the significance of vegetation units, vegetation complexes and floristic community types in the study area were assessed in terms of conservation significance and reservation status.

Maps were drawn to show boundaries and condition of vegetation units in the study area and locations of 10 m by 10 m floristic community type sampling quadrats.

To assess the conservation and reservation status of vegetation in the survey area Gibson et al. (1994), *Bush Forever* (Government of Western Australia 2000) and English and Blyth (1997) were consulted for Floristic Community Types and Threatened Ecological Communities. *Bush Forever* (Government of Western Australia 2000) was consulted for the reservation status of vegetation complexes.

Bush Forever tabulates the Gibson et al. (1994) and English and Blyth (1999) status information (Government of Western Australia 2000, Volume 2, Table 10) and also provides information about conservation and reservation status of vegetation complexes (Government of Western Australia 2000, Volume 1, Table 4), in the Perth Metropolitan Region. *Guidance No. 10* (Environmental Protection Authority 2003, pp. 54–56) provides similar information about vegetation complexes of the southern Swan Coastal Plain.

2.3.3 Assessment of Conservation Significance

The study area is within the Bush Forever project area of the Swan Coastal Plain (SCP). The criteria used in Bush Forever (Government of Western Australia, 2000) for assessing the significance of flora and vegetation is summarised below.

2.3.3.1 Flora

Flora considered to have conservation significance include:

- Declared Rare Flora (DRF) and Priority flora as listed under the *Wildlife Conservation Act, 1950.*
- Threatened Flora as listed under the Environmental Protection Biodiversity Conservation (EPBC) Act, 1999.
- Flora at the northern of southern limit of their known geographic range.
- Flora populations disjunct from their known geographic range.
- Flora considered to be poorly reserved (applies to all DRF and Priority flora).
- Flora that is assumed to be extinct.
- SCP endemics.
- SCP within the Perth Metropolitan Region (PMR).
- Distinctive local forms not currently recognised.

2.3.3.2 Vegetation

The criteria used in Bush Forever project for identifying regionally significant natural areas were:

Representation of Ecological Communities (assessment largely undertaken within the Bush Forever project area, which includes the survey area of this report). Also includes areas identified under national or international significance. In relation to flora and vegetation this includes sites listed under:

- The Register of the National Estate.
- A Directory of Important Wetlands in Australia.
- RAMSAR.

Diversity. Areas with a high diversity of flora and/or fauna species or communities in close association. Includes areas with high diversity of flora species and/or a high diversity of plant associations.

Rarity. Areas containing rare or threatened communities or species, or species of restricted distribution (see Section 1.1). Additionally, Threatened Ecological Communities (TECs) as listed under the *Wildlife Conservation Act, 1950* (as amended) have limited protection under this act and the *Environmental Protection Act, 1986 (as amended)(Clearance of Native Vegetation Regulations)*. Federally listed TECs are protected under the EPBC Act, 1999.

Maintaining Ecological Processes or Natural Systems. Maintenance of ecological processes or natural systems. Includes large areas in natural condition and substantive wildlife corridors connecting bushland areas (Greenways).

Scientific or Evolutionary Importance. criteria relevant include relictual flora and/or vegetation and long-term scientific monitoring sites.

General Criteria for Protection of Wetland, Streamline and Estuarine Fringing Vegetation and Coastal Vegetation. Relevant criteria include Conservation Category Wetlands (CCW) and their native vegetation (including fringing vegetation) and associated upland vegetation and fringing vegetation (streams, rivers, estuarine).

3.0 RESULTS

3.1 Flora

The taxa (species, subspecies, varieties and forms) recorded in the Wandi/Mandogalup study area are listed in Appendix 3. Approximately 230 taxa of vascular plants have been recorded in the study area. The native taxa recorded in the Wandi/Mandagolup study area are estimated to constitute at least 70% of the native flora there, and the alien taxa recorded are estimated to constitute more than half of the alien flora.

No Declared Rare or Priority Flora taxa as listed in Table A1 was found in the study area There was some habitat that did appear to be potentially suitable for the DRF orchids *Caladenia huegelii* and *Drakaea elastica*. However the occurrence of these orchids is unlikely as the detailed spring searches conducted in September and October 2004 did not detect any.

One species of Priority Flora was found, the Priority Three (P3) sedge *Cyathochaeta teretifolia*. It was found only in the spring wetland and in the wetland's Quadrat WS03. This is a taxa that is known from limited populations in swamps and along creek edges in coastal areas from Perth to Walpole. Some of these populations on the Swan Coastal Plain are protected however the species is being kept under consideration for Declared Rare Flora status.

Two other species listed in *Bush Forever* (Government of Western Australia 2000, Volume 2, Table 13, p. 54) as significant were also found: *Dielsia stenostacha* (e) and *Lysinema elegans*. (p, s, e). The *Dielsia* was found in several quadrats and vegetation units, but it was most robust in the spring wetland ErOf vegetation. The *Lysinema* was found in the south-western corner of the banksia (-jarrah) woodland to open forest in Lot 678 west of Lyon Road and Bodeman Road. Both the *Lysinema* and the *Dielsia* were formerly species of Priority Flora.

3.2 Vegetation

The remnant native vegetation of Satterley's part of the Wandi/Mandogalup Proposed Urban Development Area is described in this section in terms of mapped vegetation units and the vegetation complexes and floristic community types they represent. The condition of the vegetation is also presented.

3.2.1 Vegetation Units and Condition

Figure 2 shows the distribution of thirty-one vegetation units (plant associations) in the survey area. Each mapped occurrence of a unit or, in a few cases a group or mosaic of units has three assigned codes: an upper, yellow set for the vegetation unit (or units) (made up of dominant species and structural formation), a middle, white set for the vegetation condition (or range of conditions) and a lower, pale blue set to indicate whether or not the occurrence is dampland, other wetland or upland. Each mapped occurrence (or group or mosaic) is uniquely defined by its code combination.

The legend accompanying the figure gives definitions of the map codes and descriptive names of the vegetation units. Most names in the legend have two components: (1) dominant species and (2) structure, and condition (or range of condition) is indicated by symbols. The definition of terms used for describing vegetation structure and condition are in tables in Appendix 4.

The vegetation units are in the following four groups:

- *Eucalyptus rudis* and/or paperbark woodlands and forests.
- *Banksia* low open woodlands, woodlands and open forests.
- *Kunzea glabrescens* scrubs and heaths.
- Austrostipa ?compressa grassland (and Hypolaena – Schoenus sedgeland).

These four groups and 'Weeds and Cleared' are described below.

3.2.1.1 *Eucalyptus rudis* and/or Paperbark Woodlands and Forests

Fifteen of the Figure 2 polygons are wetlands with open woodlands to closed forests dominated by flooded gums (*Eucalyptus rudis*) and/or paperbark trees (*Melaleuca preissiana, M. rhaphiophylla*). In general, the condition of this vegetation, based on assessments of understorey as well as of overstorey, ranges from Degraded to Very Good, with a few, relatively small areas of Excellent and larger areas rated Completely Degraded. Some of the *Eucalyptus rudis* and *Melaleuca* vegetation units have overstoreys that are dense and in Excellent condition, but most of their understoreys are assessed as Good to Degraded to Completely Degraded. **Pennisetum clandestinum, *Paspalum dilatatum, *Cynodon dactylon* and other alien species are prominent in them, though in some places the plants are still largely natives with *Pteridium esculentum* often dominant.

Two polygons have wetland vegetation assessed as Excellent condition: ErMpr (E-VG) and ErOF (E). The first borders the eastern side of the freeway, next to the drain, and the second is on the western edge of the study area north of the drain. The first unit is mapped as a resource enhancement wetland (described below) and the latter is of high conservation significance. ErOF is described in more detail in the section on Significant Vegetation.

ErMpr

Eucalyptus rudis - Melaleuca preissiana - M. rhaphiophylla Woodland, over Kunzea glabrescens – Aotus gracillima Closed to Open Tall Scrub; with Gastrolobium ebracteolatum, Melaleuca teretifolia and Lepidosperma longitudinale.

The ErMpr vegetation is next to the east side of the freeway and the south side of the main drain through the study area. It is in Lot 680.

The condition of this ErMpr vegetation was assessed as Excellent to Very Good. The vegetation is regenerating after a hot fire burnt through it in 2003 or 2004.

Gozzard (1983) shows the site as Sandy Silt Swamp Deposits (Ms_5). It is the northeastern end of a sumpland that both Hill et al. (1996) and the most recent Department of Environment and Conservation (2006) mapping show to be a Resource Enhancement Category Wetland.

Wetland vegetation on the north side and adjacent to Darling Chase has relatively poor condition assessments but still has intact dense tree canopy. This area is mapped as a Conservation Category Wetland (Department of Environment and Conservation 2006). This vegetation is also described in more detail in the section on Significant Vegetation.

3.2.1.2 Banksia Low Open Woodlands, Woodlands and Open Forests

The majority of the remnant upland, dry land mature native vegetation is *Banksia attentuata – B. menziesii* Low Woodland, with Jarrah (*Eucalyptus marginata*), *Eucalyptus todtiana, Banksia ilicifolia* and *Xanthorrhoea preissii* prominent parts. Twelve of the Figure 2 polygons are mapped as having low open woodlands to low open forests dominated by *Banksia* trees.

Most of the *Banksia* Low Woodland in the survey is in condition assessed as Degraded to Good, though some stands are rated Very Good with pockets rated Completely Degraded. The two occurrences of BLW-OF(J) shown in Figure 2 have unburnt vegetation in them that is, at least in part, in Excellent condition and with relatively few weeds. They are in Lots 678 and 679 and the adjoining part of Lot 680, which are in the eastern part of the study area between the drain north-west of Wandi Drive and the cleared strip north of Darling Chase. These two occurrences are described in more detail below.

BLW-OF(J) (E-VG)

Banksia attenuata – B. menziesii Low Woodland to Open Forest, with scattered healthy *Eucalyptus marginata* and *Allocasuarina fraseriana* trees, over *Hibbertia hypericoides - Leucopogon conostephioides - Brachyloma preissii* Low Shrubland over mixed Very Open Sedgeland and Very Open Herbland

The BLW-OF(J) vegetation that has been assessed as Excellent to Very Good Condition is in the central part of the Wandi part of the study area, just north of the BLW-OF(J) vegetation that is assessed as being in Very Good to Excellent Condition. It is in Lot 680.

A list of species recorded in the WS08 quadrat, which was set up in this BLW-OF(J) vegetation unit, is in Table 2-3, Appendix 2, and the coordinates of the location of the quadrat are listed in Table 2-2. This vegetation unit is on upland slopes that are mainly gentle. Gozzard (1983) shows the site as Bassendean Sand (S_8).

This BLW-OF(J) vegetation is long-unburnt and has relatively few weeds.

Plate 2 has a photograph of the BLW-OF(J) (E-VG) vegetation.

BLW-OF(J) (VG-E)

Banksia attenuata - B. menziesii Low Woodland to Open Forest, with scattered *Eucalyptus marginata* and *Allocasuarina fraseriana* trees, over *Leucopogon* sp. - *Allocasuarina humilis - Acacia pulchella*. Open Heath, over *Hibbertia hypericoides* Low Shrubland

The BLW-OF(J) vegetation that has been assessed as Very Good to Excellent Condition is in the central part of the Wandi part of the study area, just north of the BLW-OF(J) vegetation that is assessed as being in Excellent to Very Good Condition. It is in Lots 678 and 679.

A list of species recorded in the WS09 quadrat set up in the BLW-OF(J) (VG-E) vegetation unit is in Table 2-3, Appendix 2, and the coordinates of the location of the quadrat are listed in Table 2-2.

The significant species *Lysinema elegans* was recorded in this vegetation unit, in its south-western corner. The *Lysinema* and two species found in the northern part of this vegetation unit, *Hakea prostrata* and *Persoonia saccata*, were found nowhere else in the study area.

This vegetation unit is on upland slopes that are mainly gentle. Gozzard (1983) shows the site as Bassendean Sand (S_8).

This BLW-OF(J) vegetation is long-unburnt and has relatively few weeds.

Plate 2 has a photograph of the BLW-OF(J) (VG-E) vegetation.

3.2.1.3 *Kunzea glabrescens* Scrubs and Heaths

Three of the Figure 2 polygons are mapped as having Spearwood (*Kunzea glabrescens*) as the dominant. It is often, when not burnt for many years, over 3 m tall and frequently, whether recently burnt or not, with a cover of over 70%. The densest spearwood scrubs and heaths in the study area have few weeds and little understorey and are assessed, for the most part, as being in conditions of Degraded or Good to Degraded. There are scattered emergents of *Melaleuca preissiana, Banksia menziesii, B. ilicifolia* and *Allocasuarina fraseriana*. In a few places there are mosaics of the *Kunzea* scrubs or heaths and other vegetation, e.g. dominated by *Melaleuca preissiana, Hypocalymma angustifolium* or *Astartea ?scoparia*.

The mapped scrubs and heaths of *Kunzea glabrescens* are on low-lying, though not necessarily wetland, sites that appear previously to have had trees. It is likely that trees have declined due to repeated fires enabling *Kunzea glabrescens* to grow en masse from seeds forming dense scrubs.

The species present in stands of Spearwood scrubs and heaths suggest that at least some of this vegetation is wetland vegetation and that some of it is probably upland vegetation. Furthermore, *Kunzea glabrescens* is known to be a common tall shrub species in both wetland and upland vegetation: e.g. in wetland woodlands and open forests dominated by *Eucalyptus rudis, Melaleuca preissiana* and/or *M. rhaphiophylla* and in upland low open woodlands to low open forests dominated by species of *Banksia*.

3.2.1.4 *Austrostipa ?compressa* Grassland (and *Hypolaena - Schoenus* Sedgeland)

Only one Figure 2 polygon is mapped as having the AcG vegetation unit: *Austrostipa ?compressa - Hypolaena exsulca - Schoenus* sp. Grassland/Sedgeland. It is on the east side of the study area between Wandi Drive and the drain north-west of Wandi Drive. It was probably a quite different vegetation unit before fire burnt it around 2002 or 2003, and it will be different when it is mature, when e.g., *Hypocalymma angustifolium* shrubs will be more prominent and the *Austrostipa* will have disappeared.

3.2.1.5 Weeds and Cleared

More than fifty per cent of the native vegetation of the study area has been cleared, either intentionally or by grazing, by relatively frequent burning or by combinations of these factors. The cleared native vegetation has been replaced by crops or, for the most part, by weeds. Some of the weedy areas still have a few, mainly scattered or clumped native plants.

3.2.2 Floristic Community Types

In the assignment of FCTs to the survey area following PATN analysis, Griffin (2007) concludes that the samples of the dry land quadrats come closest to FCTs 21c and 23a and that the samples of the wet land quadrats come closest to FCT 11. Griffin's assignments to the samples in each quadrat (plot) are listed in Table 2-2 of Appendix 2.

It should also be possible, according to Neil Gibson (pers. comm.) and *Bush Forever* (Government of Western Australia 2000, Vol. 2, p. 487), to infer, at least tentatively, which floristic community types, at least of the original 43 described by Gibson et al. (1994), occur in a study area. For instance, inferences of which FCTs occur in particular Bush Forever sites have been made from 'information on the floristics of the area and the area's geographic location' (Government of Western Australia 2000, Vol. 2, p. 487).

FCTs have not been mapped for the study area, nor for anywhere nearby, but their representation in the study area is tentatively inferred here from comparisons of the FCT species lists and distribution maps in Appendix 1 of Gibson et al. (1994) and the descriptions in *Bush Forever* (Government of Western Australia 2000, Volume 2) of Bush Forever Sites 268, 269, 270, 347 and 392.

It is inferred that two or more of Floristic Community Types 21a, 21c, 22 and 23a are the FCTs represented by most of the dry land vegetation in the study area and that the wetland vegetation is probably FCT 4, FCT 5 and/or FCT 11.

All FCTs listed in Bush *Forever* (Government of Western Australia 2000, Volume 2) for the four Bush Forever sites nearest the study area - 268, 269, 270, 347 - have been inferred, except FCT 23a, which was identified from samples in Site 347. The only FCT inferred for one of these four sites that is not listed as a possible for the study area is FCT 25, Southern *Eucalyptus gomphocephala - Agonis flexuosa* woodlands; it was inferred for Site 268. There are also another seven FCTs that can be inferred for the remaining vegetation, five of which are not recorded for any of the Bush Forever sites nearest the survey area; these are FCTs 13, 15, 17, S17 and 24. The fourteen FCTs inferred for the survey area are listed in Table B1.

The name, reservation status and conservation status of each of these floristic community types is listed in Appendix 2 Table 2-1. The information in the table is taken from *Bush Forever* (Government of Western Australia 2000, Volume 2, Table 6, pp. 29–30) and Gibson et al. (1994, Appendix 1).

3.2.3 Significant Vegetation

Quadrat WS06 in the ErOf-OW/MrLC-OF vegetation unit, potentially represents (according to the assignment by Griffin (2007)) a state listed Threatened Ecological Community (TEC) *TEC21: SCP15 Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain*, which is listed as Vulnerable under the Wildlife Conservation Act, 1950 (as amended) as a result is considered significant based on 'rarity', refer to Figure 4. Vulnerable means that it 'has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction in the medium to long-term future'. This Floristic Community Type (FCT) is not listed under the Federal *EPBC Act (1999)* as a TEC.

The wetland vegetation in the southern end of the Wandi part of the study area, between Darling Chase and the cropped cleared land north of it, is in one of three areas in the study area currently classified by the Department of Environment and Conservation (2006), and is in *Bush Forever* (Government of Western Australia 2000, Volume 1, Map 5, p. 98), as a Conservation Category Wetland, refer to Figure 4. These areas are considered significant based on the criteria 'General Criteria for Protection of Wetland, Streamline and Estuarine Fringing Vegetation and Coastal Vegetation'. This area was originally classified as a Resource Enhancement Category Wetland (Hill et al. 1996).

The vegetation in this wetland is in a degraded state due to repeated fires, human disturbance and weed invasion. This warrants further investigation to determine what management is required to ensure the long-term viability of these CCWs and possible Vulnerable Floristic Community.

Vegetation in four survey area polygons described to be in E, E-VG or VG-E condition, could potentially be considered significant for the role in 'Maintaining ecological processes or natural systems'. However, EPA Guidance Statement 51 recommends that the significance of an area of vegetation is dependent upon the size and / or condition of remnant vegetation within an approximately 15 km radius. For this site there are over forty Bush Forever sites within 15 km and fourteen sites within 5 km. This includes:

- 367 ha BF Site 391 (3 km to north-west).
- 272 ha BF Site 392 (2 km to north-west).
- 350 ha BF Site 269 (1 km south west).
- 412 ha BF Site 347 (0.6 km east).
- 96 ha linkage BF Site 268 (0.5 km west).

Vegetation units BLW-OF and ErMpr (described above), total approximately 17 ha in three parcels. On the basis of the over 1500 ha areas of regionally significant vegetation already captured through the *Bush Forever* process within 5 km of the project area, these vegetation units are not considered to meet the 'Maintaining Ecological Processes or Natural Systems' significance criteria. A similar conclusion seems to have been reached through the *Bush Forever* process as this site was not nominated as a regionally significant stand of vegetation worthy of protection.

A description of the significant vegetation unit ErOF is provided below.

3.2.3.1 ErOF

Eucalyptus rudis Open Forest in soak/spring, with *Melaleuca preissiana* and *M. rhaphiophylla* tall trees, over *Pteridium esculentum - Cyathochaeta teretifolia - Baumea articulata* Closed Herbland-Sedgeland.

The stand of vegetation was considered significant on the basis of 'Rarity'. It is of the best condition in the study area west of the freeway, located in Lot 683, in the north-western part of the study area, Figure 4. This is very healthy, long-unburnt *Eucalyptus rudis* Open Forest with large *Melaleuca preissiana* and *M. rhaphiophylla* paperbark trees and a variety of native sedges, including the Priority 3 species *Cyathochaeta teretifolia*. *Hemarthria uncinata, Hibbertia perfoliata*, particularly robust *Dielsia stenostachya* plants, *Lepidosperma longitudinale* and several native species of grasses and sedges that are uncommon or absent elsewhere in the study area are also common. There are few weeds or other alien species in most of this vegetation.

This ErOF (Quadrat WS03) vegetation has a suite of species, including the Priority 3 *Cyathochaeta teretifolia* unique to this location within the study area.

A list of species recorded in the WS03 quadrat set up in the ErOF vegetation unit is in Table 2-3, Appendix 2, and the coordinates of the location of the quadrat are listed in Table 2-2.

Poa serpentum, Hemarthria uncinate, Baumea vaginalis and *Cyathochaeta teretifolia* were found during the study area vegetation surveys only in the spring wetland vegetation while *Baumea articulata* and *Hibbertia perfoliata* were found only in Quadrat WS03 and in one other site.

The condition of this ErOF vegetation was assessed as Excellent. The ErOF vegetation is watered by a spring (or soak) which is the head of a small, intermittent creek that flows westward. The 1:50 000 scale environmental geology map of Gozzard (1983) shows the site as the only Peaty Clay Swamp Deposit (Cps) in the study area, and Hill et al. (1996) shows it as in or near the eastern edge of a dampland that is a Multiple Use Category Wetland.

Plate 1 has photographs of the ErOF vegetation in Quadrat WS03 and next to it.

4.0 LIMITATIONS OF THE SURVEY

4.1 Flora

A number of species of plants which were not in flower at the times of the surveys could not be identified or, in some cases, even found. Identification of species that are very similar when they are vegetative, e.g. several species of Iridaceae, can be confirmed only when they are in flower, generally in early spring. And some herbaceous plants, such as many orchids, flower briefly, then disappear, and, furthermore, some do not appear every year.

Other taxa could be added to the list, especially if more field work were undertaken during winter and early spring and, as was done, e.g. by Keighery et al. (1997), during three flowering seasons in consecutive years.

Additional flora species (including DRF, Priority Flora, or flora species of other conservation significance) could also be detected in the future if a survey was to be conducted in an average rainfall year. The coastal areas from Geraldton to Perth experienced their lowest rainfall on record in 2006 (Bureau of Meteorology, 2007) which would have impacted on the completeness of the flora inventory complied in this survey or indeed the majority of botanical work conducted on the Swan Coastal Plain in 2007.

4.2 Vegetation Units and Condition

Delimiting units of vegetation and assigning names to them is much more arbitrary and subjective than identifying plants, because stands of vegetation often do not have clear boundaries or consistent features. Assessing condition is also more arbitrary and subjective.

Structure, dominance and condition of vegetation are best described and assessed when vegetation is in an advanced stage of succession, but much of the vegetation in the study area was in early to middle stages of succession, mainly pyroseres, at the times of the field work.

4.3 Floristic Community Types

Although Griffin (2007) notes that the species richness of the study area quadrat samples is moderate, he observes that the number of species from families often overlooked in sampling (e.g. *Liliaceae, Haemodoraceae, Orchidaceae, Stylidiaceae* and *Asteraceae*) appeared a little lower than that of quadrat samples in the Gibson et al. (1994) Swan Coastal Plain dataset for similar vegetation. This deficiency is probably due, at least in large part, to the single and relatively late sampling of each quadrat; the setting out and sampling of quadrats was in November, which is normally late spring, but, in a dry year such as 2006 was, when the sampling was undertaken, it was more like summer than spring.

Griffin (2007) also notes that most of the study area samples apparently related to wetland Floristic Community Types (FCTs) had high dissimilarity values, which suggests that the relationships are only modest.

Griffin (2007) notes that the Swan Coastal Plain FCTs described by Gibson et al. (1994) provide the basis for the definitions of all but two of the Threatened Ecological Communities (TECs) listed by English and Blyth (1997) for vegetation on the Swan Coastal Plain. Griffin further notes '…that there is a need for a major 'upgrade' to the floristic analysis of the vegetation of the Swan Coastal Plain to provide a more detailed floristic classification that considers not only more of the variation present, but explicitly recognises more of the variation present in formally described units.' He argues that the limited size of the data set used in the original Gibson et al. (1994) Swan Coastal Plain analysis and the relatively small number of floristic community types defined from it have resulted in inadequate precision in definition of floristic community types and in significant variation not having been sampled.

Griffin continues 'It has been found in earlier projects that the addition of new sites to the SCP survey data set to produce a combined classification disrupts the original classification. The more data added, the higher the level of the disruption. This is particularly the case with wetland sites, partly because there are relatively few of these in the SCP data set and these communities are often very distinctive. This problem can make it difficult to assign Floristic Community Types to new sites using this method.

'Secondly, it is common for new data to group to their cohorts. In some cases this has proven to result from common deficiencies in the data, i.e. whole groups of species missing. This absence tends to draw them together. The more sites in the added batch, the tighter they draw together'.

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FIGURES

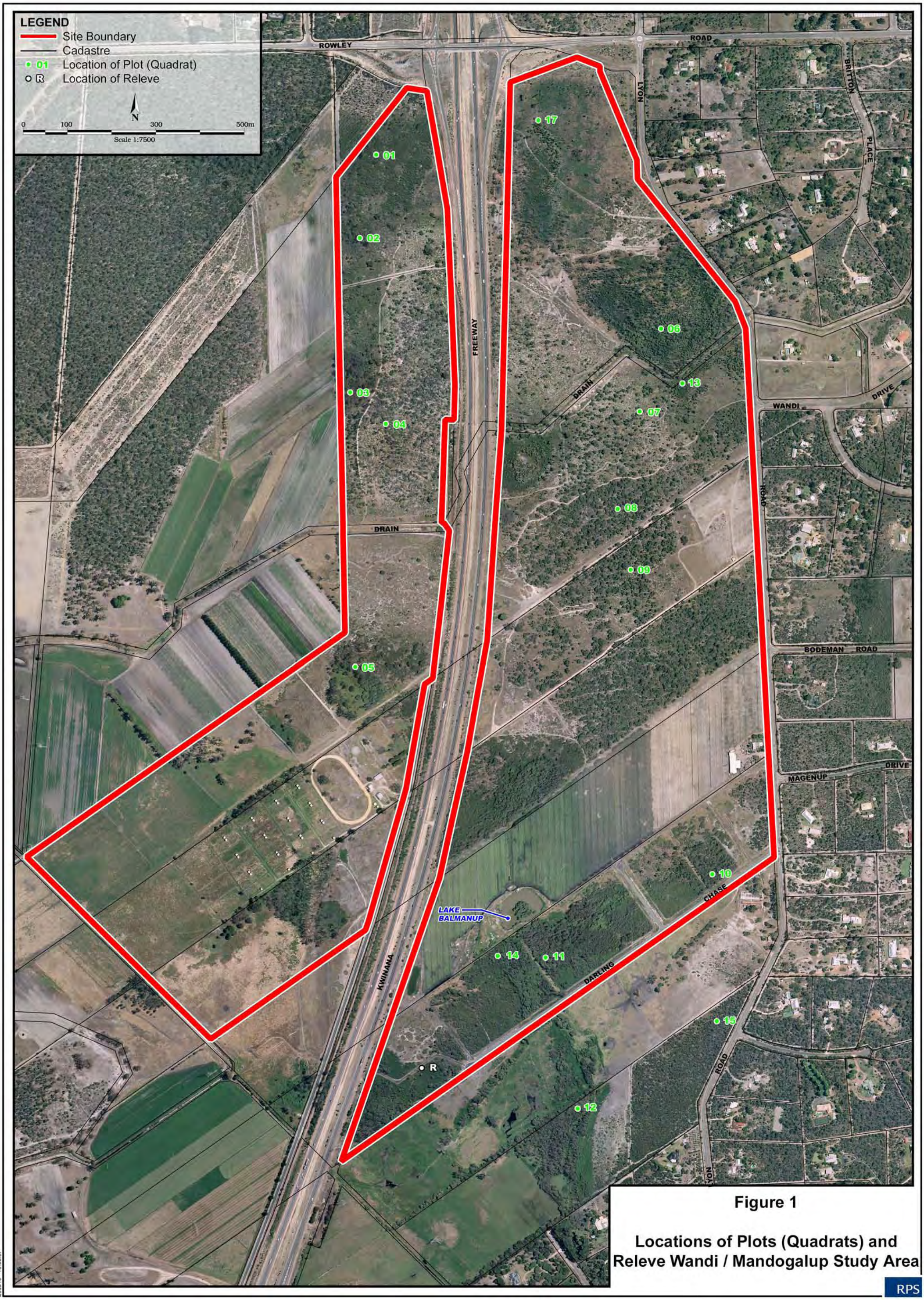

Figure 1

Locations of Plots (Quadrats) and Releve Wandi / Mandogalup Study Area

RPS

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LEGEND
Site Boundary
Cadastre
Vegetation Unit Boundary

N

0 100 300 500m
Scale 1:7500

Note: Vegetation legend is on separate sheet

ROWLEY ROAD
WEEDS CD
BLWAc D-CD
KgCT-TO G-VG NW
WEEDS CD
BLOW(J) G-D NW
ErOF E Spring W
BLW(J) VG-D U
WEEDS CD
DRAIN
WEEDS CD
ErW G-CD W
ErW D-CD W
Cleared
KpTO(Mp) CD-G D
ErOF-W / MrpLC-OF VG-D W
BLOW CD-G U
WEEDS CD
ErOF-OW / MrLC-OF D-G W
BLOW CD-G U
WEEDS CD
DRAIN
ErMpr E-VG W
BLW D-VG U
BiLW/Kg E-D U
BLW-OF(J) E-VG U
MpLW CD-D D
WEEDS CD
WEEDS CD
WEEDS CD
BLW D-G U
BLW-OF(J) VG-E U
WEEDS CD
ErMrpW D-VG W
Cleared
WEEDS CD
ErOW CD W
ErW D-G W
KgCTS G-D W-NW?
Mp G-D W
LAKE BALMANUP
ErWKg G-CD W
MrpW-LOF G-D W
WEEDS CD
BLW G-D U
ErWKg G-CD W
WEEDS CD
BLW G-D U
BLW G-D U
BiPe D N
ErOF-W / MpLC-OF G-D W
FREEWAY
KWINANA
DARLING
LYON
ROAD
BRITTON
PLACE
MpErLOF-W CD-G W
AcG G-D D
WANDI
DRIVE
BODEMAN ROAD
MAGENUP
DRIVE
BLOW CD U
ErW D-G W
ErOW CD W
KgCTS G-D W-NW?
DRIVE
ROAD
LYON

Figure 2

Vegetation Units and Condition
Wandi / Mandogalup Study Area

RPS

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Vegetation Symbols Unit	Condition	Vegetation Unit
Cleared	CD	Cleared of native vegetation; plowed or graded; often cropped; sometimes built upon
Weeds	CD	Fields of established aliens, in some places with scattered natives; apparently not recently plowed or cropped
AcG	G-D	***Austrostipa ?compressa – Hypolaena exsulca - Schoenus* sp. Grassland/Sedgeland**, with *Kunzea glabrescens, Hypocalymma angustifolium, Euchilopsis linearis, Phlebocarya ciliata,* and few *Eucalyptus rudis* and *Melaleuca preissiana* trees; burnt ca. 2002-03
BiLW/Kg	E-D	Intergrading mixed vegetation, principally of ***Banksia ilicifolia* Low Woodland and *Kunzea glabrescens* Scrubs**
BiPe	D	***Banksia ilicifolia* Open Woodland and *Pteridium esculentum* Closed Herbland**; trees mostly dead or unhealthy ; regenerating and with *Kunzea glabrescens*
BLOW	CD-G	***Banksia attenuata - B. menziesii* Low Open Woodland**, with few *Eucalyptus marginata* trees; understories mainly dominated by aliens but with *Xanthorrhoea preissii, Jacksonia furcellata* and *Stirlingia latifolia* shrubs; burnt ca. 2004
BLOW	CD	***Banksia attenuata - B. menziesii* Low Open Woodland** regenerated after clearing; weedy; with thickets of *Adenanthos cygnorum* Scrubs and Heaths
BLOW(J)	G-D	***Banksia attenuata - B. menziesii – B. ilicifolia* Low Open Woodland, with *Eucalyptus marginata***, *Dasypogon bromeliifolius*, *Phlebocarya ciliata*, local *Melaleuca preissiana*, *Pultenaea reticulata* and *Hypocalymma angustifolium*, some other natives and, commonly, weeds
BLW	D-VG	***Banksia attenuata - B. menziesii* Low Woodland**, with prominent *Jacksonia furcellata, Xanthorrhoea preissii, Macrozamia fraseri, Dasypogon bromeliifolius, Patersonia occidentalis*, other natives and many weeds; regenerating after fire ca. 2004
BLW	D-G	***Banksia attenuata - B. menziesii* Low Woodland**, with *Eucalyptus todtiana*; weedy
BLW	G-D	***Banksia attenuata - B. menziesii* Low Woodland**, with prominent *Banksia ilicifolia* and *Xanthorrhoea preissii*
BLW(J)	VG-D	***Banksia attenuata - B. menziesii* Low Woodland, with *Eucalyptus marginata***, *Allocasuarina fraseriana* and understoreys of *Xanthorrhoea preissii, Adenanthos cygnorum, Acacia pulchella, Stirlingia latifolia* and other natives, and of weeds; much of it regenerating after 2004 fire
BLWAc	D-CD	***Banksia attenuata - B. menziesii* Low Woodland, with thickets of *Adenanthos cygnorum***
BLW-OF(J)	E-VG	***Banksia attenuata - B. menziesii* Low Woodland to Open Forest**, with scattered healthy *Eucalyptus marginata* and *Allocasuarina fraseriana* trees, over *Hibbertia hypericoides - Leucopogon conostephioides - Brachyloma preissii* Low Shrubland over mixed Very Open Sedgeland and Very Open Herbland; unburnt for years and with few weeds
BLW-OF(J)	VG-E	***Banksia attenuata - B. menziesii* Low Woodland to Open Forest**, with scattered *Eucalyptus marginata* and *Allocasuarina fraseriana* trees, over *Leucopogon* sp. - *Allocasuarina humilis - Acacia pulchella.* Open Heath, over *Hibbertia hypericoides* Low Shrubland
ErMpr	E-VG	***Eucalyptus rudis - Melaleuca preissiana - M. rhaphiophylla* Woodland**, over *Kunzea glabrescens – Aotus gracillima* Closed to Open Tall Scrub; with *Gastrolobium ebracteolatum, Melaleuca teretifolia* and *Lepidosperma longitudinale*; regenerating after fire ca. 2004
ErMrpW	D-VG	***Eucalyptus rudis – Melaleuca rhaphiophylla – M. preissiana* Woodland to Low Woodland**; weedy
ErOF	E	***Eucalyptus rudis* very healthy Open Forest in soak/spring**, with *Melaleuca preissiana* and *M. rhaphiophylla* tall trees, over *Pteridium esculentum - Cyathochaeta teretifolia - Baumea articulata* Closed Herb-Sedgeland; with *Lepidosperma longitudinale, Hemarthria uncinata, Hibbertia perfoliata, Dielsia stenostachya, Baumea vaginalis, Poa serpentum*; few aliens
ErOF-OW/ MrLC-OF	D-G	***Eucalyptus rudis* Open Forest to Open Woodland and *Melaleuca rhaphiophylla* Low Closed Forest to Low Open Forest**, over understories varying from largely native to largely weedy; with local *M. preissiana* and *Acacia saligna, Juncus pallidus, Lepidosperma longitudinale, *Phalaris aquatica* and **Holcus lanatus* in the understories; mostly regenerating after fire ca. 2004, which severely damaged the trees
ErOF-W/ MrpLC-OF	VG-D	***Eucalyptus rudis* Open Forest to Woodland and *Melaleuca rhaphiophylla - M. preissiana* Low Closed Forest to Low Open Forest**, with *Melaleuca teretifolia*, over understories varying from largely native to largely weedy, regenerating after fire ca. 2004
ErOF-W/ MpLC-OF	G-D	***Eucalyptus rudis* Open Forest to Woodland and *Melaleuca preissiana* Low Closed Forest to Open Forest**, with *Pteridium esculentum* Closed Herbland
ErOW	CD	***Eucalyptus rudis* Open Woodland** over *Kunzea glabrescens* and weeds, including *Ficus carica*
ErW	D-G	***Eucalyptus rudis* Woodland** over *Kunzea glabrescens* Scrubs and, mainly, weeds
ErW	G-CD	***Eucalyptus rudis*** (largely leafless) **Woodland (to Open Forest)** over *Kunzea glabrescens* and *Astartea* sp. Closed Tall Scrubs, dense *Pteridium esculentum* and weeds; locally with healthy *Eucalyptus marginata* and *Melaleuca preissiana* trees
ErW	D-CD	***Eucalyptus rudis*** (largely leafless) **Woodland (to Open Forest)** over dense *Pteridium esculentum* and over **Zantedeschia aethiopica* and other aliens
ErWKg	G-CD	***Eucalyptus rudis* Woodland to Open Woodland, over *Kunzea glabrescens* Closed to OpenTall Scrub**; with *Melaleuca teretifolia, Pteridium esculentum, *Pennisetum clandestinum* and **Cortaderia selloana* and with *Baumea articulata* and other native sedges
KgCTS	G-D	***Kunzea glabrescens* Closed Tall Scrub**, over *Pteridium esculentum* Herblands, Grasslands of **Pennisetum clandestinum* and other aliens and Sedgelands; also *Astartea ?scoparia* tall shrubs, some *Banksia ilicifolia* and local *Melaleuca preissiana*
KgCT-TO	G-VG	***Kunzea glabrescens* Closed Tall to Tall Open Scrub**; with, in more open sites, *Dasypogon bromeliifolius, Phlebocarya ciliata, Euchilopsis linearis* and other natives; some weedy Degraded areas and many dead shrubs over 1 m tall
KgTO(Mp)	CD-G	***Kunzea glabrescens*** regenerating to **Tall Open Scrub** after fire ca. 2004; over *Lepidosperma longitudinale* and *Dielsia stenostachya* Sedgelands, **with enclaves of *Melaleuca preissiana* Low Open Forest**; also *Pultenaea reticulata, Astartea ?scoparia, Dasypogon bromeliifolius, Phlebocarya ciliata, Euchilopsis linearis,* some other natives, including a few *Eucalyptus rudis* trees, and weeds
Mp	G-D	***Melaleuca preissiana* Low Open Forest**, with *M. rhaphiophylla*, over *Carex appressa* Sedgeland and **Cortederia selloana* Grassland on island in Lake Balmanup
MpErLOF-W	CD-G	***Melaleuca preissiana – Eucalyptus rudis* Low Open Forest to Woodland**, regenerating after fire
MpLW	CD-D	***Melaleuca preissiana* Low Woodland to Low Open Woodland** over *Kunzea glabrescens* Open Heath over **Carpobrotus edulis* Herbland; weedy and regenerating after fire ca. 2004
MrpW-LOF	G-D	***Melaleuca rhaphiophylla – M. preissiana* Woodland to Low Open Forest** over mixed mosaic of *Pteridium esculentum* ferns, **Pennisetum clandestinum* and **Cortaderia selloana* grasses, *Baumea articulata* and other native sedges and **Zantedeschia aethiopica* herbs; with *Eucalyptus rudis* (few) trees, *Juncus pallidus* rushes, *Hibbertia perfoliata* herbs and weeds and recently burnt patches

Condition

CD	Completely Degraded	G	Good	E	Excellent
D	Degraded	VG	Very Good	P	Pristine

Wetlands

U	Upland	W+NW?	Wetland and Not Wetland?	W	Wetland
NW	Not Wetland	D	Dampland		

Figure 3

Vegetation Units and Condition
Wandi / Mandogalup Study Area
Legend

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RPS

LEGEND
Site Boundary
Cadastre
Vegetation Unit Boundary
Significant Vegetation
N
0 100 300 500m
Scale 1:7500
Note: Vegetation legend is on separate sheet

ROWLEY ROAD
WEEDS CD
BLWAc D-CD
KgCT-TO G-VG NW
WEEDS CD
BLOW(J) G-D NW
ErOF E Spring W
BLW(J) VG-D U
FREEWAY
LYON
BRITTON PLACE
KpTO(Mp) CD-G D
ErOF-W / MrpLC-OF VG-D W
BLOW CD-G U
WEEDS CD
ErOF-OW / MrLC-OF D-G W
MpErLOF-W CD-G W
BLOW CD-G U
WEEDS CD
DRAIN
AcG G-D D
WANDI DRIVE
BLW D-VG U
BiLW/Kg E-D U
ErMpr E-VG W
BLW-OF(J) E-VG U
MpLW CD-D D
WEEDS CD
WEEDS CD DRAIN
WEEDS CD
WEEDS CD
WEEDS CD
BLW D-G U
BLW-OF(J) VG-E U
ErW G-CD W
WEEDS CD
BODEMAN ROAD
MAGENUP DRIVE
ErMrpW D-VG W
Cleared
Cleared
BLOW CD U
WEEDS CD
ErW D-G W
ErOW CD W
WEEDS CD
KgCTS G-D W-NW?
Mp G-D W
LAKE BALMANUP
ErWKg G-CD W
MrpW-LOF G-D W
WEEDS CD
KWINANA FREEWAY
DARLING RANGE
BLW G-D U
ErWKg G-CD W
WEEDS CD
BLW G-D U
BiPe D N
ErOF-W / MpLC-OF G-D W
BLW G-D U
ErW D-CD W
LYON ROAD

Figure 4

Areas of Significant Vegetation

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PLATES

PLATES

A. Near Plot WS03. (Photograph MO 1664)

B. Plot WS03. (Photograph VY N0027)

Plate 1: Vegetation Unit ErOF: Very healthy *Eucalyptus rudis* Open Forest, with *Melaleuca preissiana* and *M. rhaphiophylla* tall trees, over *Pteridium esculentum* - *Cyathochaeta teretifolia* - *Baumea articulata* Closed Herb-Sedgeland

A. Plot WS08. Condition E-VG. (Photograph VY N0031)

B. Plot WS09. Condition VG-E. (Photograph MH 2000)

Plate 2: Vegetation Unit BLW-OF(J): *Banksia attenuata - B. menziesii* Low Woodland to Open Forest

APPENDIX I

Rare Flora with Distributions and Habitats which may Include the Wandi / Mandogalup Study Area

APPENDIX 1: Rare Flora with Distributions and Habitats which May Include the Wandi/Mandogalup Study Area

(Compiled September 2004; updated March 2007)

Introduction

Table 1-1 lists nine taxa (species, subspecies and varieties) of Declared Rare (DRF) and Priority (P) Flora recorded in the broader vicinity of the Wandi/Mandogalup area. The taxa listed in the table are the principal taxa searched for in the Wandi/Mandogalup study area in September-November 2004, and subsequently. The table also provides information about conservation codes, distributions, locality records, growth forms, habitats and flowering times for these taxa. The information about distributions, localities, growth forms, habitats and flowering times is not always comprehensive, but information about habitat is at least indicative and should help in assessing how likely rare flora is to occur in the study area.

The table lists four DRF® taxa (gazetted Declared Rare Flora), one P1 taxon, one P3 taxon and three P4 taxa.

The Table 1-1 list of taxa was compiled mainly from printouts of the results of searches of three databases carried out by the Wildlife Branch of Department of Conservation and Land Management in August and September 2004. These three Department of Conservation and Land Management (CALM) databases are *Threatened (Declared Rare) Flora* (Summary of Threatened Flora Data), *Declared Rare and Priority Flora List* and *Western Australian Herbarium Specimen* (WAHERB). The searches were for Declared Rare and Priority Flora taxa recorded in the broad vicinity of Wandi and Anketell.

The CALM databases were searched twice in August and once in September 2004, first at the request of RPS Environment and Planning Pty Ltd (then RPS Bowman Bishaw Gorham) and later at the request of Arthur Weston. All of the taxa in the results of the first set of searches were also in the second set.

During preparation of this report, lists in Atkins (2005) and Atkins (2006) were searched for additions to and deletions from CALM's *Declared Rare and Priority Flora List* and name, conservation code and other changes. None were found.

The parameters requested for the first set of searches are the approximate latitudes and longitudes of the corners of the Wandi/Anketell survey area (no location name was given in the request) are:

- North-west corner: -32.18, 115.84
- North-east corner: -32.18, 115.87
- South-east corner: -32.23, 115.87
- South-west corner: -32.23, 115.85

The parameters used for the second and third sets of searches are:

Anketell-Oakford-Wandi:

- Coordinates: 32◦09'00", 32◦15'00", 115◦49'00" and 115◦55'00"
- Names: Anketell, Banganup, Casuarina, Kwinana, Mandogalup, Modong, Oakford, Spectacles, Wandi, Wattleup

Wandi-Anketell:

- Coordinates: 32o09'00" - 32o15'00" and 115o49'00" - 115o55'00"
- Names: Anketell, Banganup, Banjup, Casuarina, Kwinana, Mandogalup, Modong, Oakford, Spectacles, Wandi, Wattleup

The printouts also provided some information about conservation codes, localities and distributions, habitats and flowering times. Additional information in the table was obtained from examination of herbarium specimens and their labels in the Western Australian Herbarium, consultations with other botanists, and information in Atkins (2004), Paczkowska and Chapman (2000), Marchant et al. (1987), Brown et al. (1998), Hoffman and Brown (1998) and relevant parts of the *Flora of Australia* and *How to Know Western Australian Wildflowers*. These references are listed in the report to which this is Appendix A.

Conservation Codes Definitions

Department of Conservation and Land Management definitions of the Conservation Codes (Atkins 2004) in Table A1 are:

R: Declared Rare Flora – Extant Taxa
Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.

1: Priority One – Poorly Known Taxa
Taxa which are known from one or a few (generally <5) populations which are under threat, .Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

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

3: Priority Three – Poorly Known Taxa
Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.

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

The need for further survey of poorly known taxa is prioritised into the Priority 1, 2 and 3 categories depending on the perceived urgency for determining the conservation status of those taxa, as indicated by the apparent degree of threat to the taxa based on current information.

Table 1-1: Declared Rare and Priority Flora Recorded in the Broad Vicinity of the Wandi/Mandogalup Study area[i]

Taxon Name	Cons. Code	Distribution	Flower Period	Fam. No.	*Plant Form and Features* and Habitat
Aotus cordifolia	P3	Witchcliffe–Upper Swan, Banjup	Aug–Dec	165	Erect to straggly glabrous shrub to > 1.5 m; lvs 3, whorled, sessile, ovate-cordate; fls small, standard yellow. Swamps; soil often peaty.
Aponogeton hexatepalus	P4	Nannup–Perth	Aug–Sep	025	Rooted aquatic herb with straplike leaves, the floating part of which is broader than the submerged part; Shallow winter pools on clayey soils, rivers, clay-pans.
Caladenia huegelii	R	Capel–Perth, Banjup	Aug–Oct	066	Large, few-flowered spider orchid with large labellum which is dark red and has long, often divided, usually white fringing hairs. Sandy soils in banksia and eucalypt woodlands and low open forests which are, usually, low in the landscape.
Diuris micrantha	R	Manjimup–Medina, Bowelling, Meelon	Aug–Sep	066	A dwarf bee orchid closely related to *Diuris laxiflora* but with much smaller, paler flowers. Small, winter wet, shallowly inundated, sandy clayey flats in short sedgeland, usually predominantly of *Lepidosperma longitudinale* at least nearby.
Diruis purdiei	R	Perth–Waroona–Busselton, Canning Vale, Mandurah?	Sep–Oct	066	Slender donkey orchid with 5-10 narrow, spirally twisted leaves. Seasonally wet, burnt, sand over clay, shrublands, usually of *Regelia* and *Pericalymma*.
Dodonaea hackettiana	P4	Gingin–Wattleup	Jul–Oct	207	Small tree or large shrub. Often on limestone or in margins of wetlands.
Drakaea elastica	R	Albany–Busselton–Gingin, Mandogalup	Oct–Nov	066	Hammer orchid w. a prominently hairy section in its upper labellum and a distinctively shiny, bright green, heart-shaped leaf which is flat on the ground. Deep sand low in landscape, usually under spearwood and banksias next to winter-wet swamp.
Tripterococcus paniculatus	P1	Armadale–Upper Swan, Jandakot	Nov	202	Glabrous, several-stemmed herb similar to *T. brunonis* but fls later and spikes have > 1 fl. Grey sand, winter damp flats; open patches in heath with *Mel. Preissiana.*
Verticordia lindleyi subsp. *lindleyi*	P4	Gillingarra–Forrestdale, near Serpentine	Nov–Jan	273	Shrub <1 m tall, often open, sometimes straggly; stem lvs narrowly obovate to elliptic, slightly concave, shortly mucronate and ciliate; fls in spike-like groups, pale to deep pink. Sandy, often clayey, winter wet flats.

[i] Table A1 lists all except six species in the results of searches of three databases by CALM on 18 August, 27 August and 28 September 2004 for the Wandi-Anketell-Oakford area. The databases searched are *Declared Rare and Priority Species List, Threatened (Declared Rare) Flora* and *Western Australian Herbarium Specimen*. The search parameters used for the third, most comprehensive search are:

- Coordinates: 32°09'00", 32°15'00", 115°49'00" and 115°55'00"
- Names:Anketell, Banganup, Banjup, Casuarina, Kwinana, Mandogalup, Modong, Oakford, Spectacles, Wandi, Wattleup

The six species that are in the results of the CALM searches but which are not in Table A1 are not in the broader Perth area or south of it. Each of the six was in the results because it has the location name 'Casuarina', 'Anketell' or 'Wandina'. The 'Casuarina' and 'Anketell' are not the same as the ones in the Perth Metropolitan Area. The six species are *Banksia scabrella, Grevillea stenostachya, Lechenaultia longiloba, Pityrodia canaliculata, Scholtzia* sp. Binnu and *Verticordia luteola* var. *luteola*.

The information about distributions, localities, growth forms, habitats and flowering times is not always comprehensive. For instance, the localities are often selections and do not always include all of the localities given for a listed species in the CALM printouts, which themselves are also often only selections. Information about growth form and habitat is at least indicative and should be useful in assessing how likely rare flora is to occur at particular locations.

Ideally, any search for rare flora should be undertaken at a time when rare orchids and most of the other species listed in Table A1 are in flower and identifiable. However, some plants flower erratically and some do not flower every year. For instance, plants of some species appear and flower rarely except after summer fires.

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APPENDIX 2

Floristic Community Types, Quadrats and the Releve in the Wandi / Mandogalup Study Area

APPENDIX 2: Floristic Community Types, Quadrats and the Relevé in the Wandi/Mandogalup Study Area

Appendix 2 has three tables. The first table, Table 2-1, is a list of the fourteen Floristic Community Types (FCTs) that have been assigned from analysis and/or inferred as possibly being represented in the Wandi/Mandogalup study area. The second table, Table 2-2, lists the seventeen quadrats and single releve that were sampled during the Wandi/Mandogalup study, and the third, Table 2-3, lists the species that were recorded in each quadrat during the November 2006 quadrat sampling.

The 2007 report by E.A. Griffin & Associates on analysing plot samples and assigning floristic community types to them is an attachment to Appendix 2.

Table 2-1: Floristic Community Types that may be Represented in the Wandi/Mandogalup Study Area

Code FCT	Descriptive Name	Distribution[1]	Ave. Spp. Richness	Reservation Status	Conservation Status
4	*Melaleuca preissiana* damplands	>PMR/C	33 spp.	Well reserved	Low risk
5	Mixed shrub damplands	PMR+	38 spp.	Well reserved	Low risk
11	Wet forests and woodlands	>PMR/C	28 spp.	Well reserved	Low risk
12	*Melaleuca teretifolia* and/or *Astartea* aff. *fascicularis* shrublands	> PMR/N	27 spp.	Well reserved	Low risk
13	Deeper wetlands on heavy soils	>PMR/C	17 spp.	Well reserved	Low risk
15	Forests and woodlands of deep seasonal wetlands	>PMR/C	17 spp.	Well reserved	Vulnerable[1]
17	*Melaleuca rhaphiophylla - Gahnia trifida* seasonal wetlands	> PMR/N*	13 spp.	Well reserved	Low risk
S17	*Eucalyptus rudis/Agonis linearifolia* wetlands in Bassendean Dunes	(PMR)	15 spp.	?	?
21a	Central *Banksia attenuata - Eucalyptus marginata* woodlands	PMR/N	52 spp.	Well reserved	Low risk
21c	Low lying *Banksia attenuata* woodlands or shrublands	PMR+	39 spp.	Well reserved	Susceptible
22	*Banksia ilicifolia* woodlands	>PMR/C	30 spp.	Poorly reserved	Susceptible
23a	Central *Banksia attenuata - Banksia menziesii* woodlands	PMR	59 spp.	Well reserved	Low risk
24	Northern Spearwood shrublands and woodlands	PMR*	39 spp.	Well reserved	Susceptible
28	Spearwood *Banksia attenuata* or *Banksia attenuata - Eucalyptus* woodlands	> PMR/S	55 spp.	Well reserved	Low risk

[1] 'PMR' = confined to PMR, and +, >, /C, /S, /N and * mean 'predominantly in PMR', 'distribution goes well beyond the PMR', 'PMR is central to distribution', 'the Southernmost - or Northernmost - location is in the PMR' and 'except for isolated occurrences outside normal range', respectively. The PMR distributions are from *Bush Forever* (Volume 2 Table 6).

[1] Listed in TEC database as Vunerable. 'An ecological community will be listed as **Vulnerable** when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction in the medium to long term future'.

Table 2-2: Coordinates of NW Corner of Wandi Plots (Grid Zone 50H) (RPS L06316)

Plot[1] (WS)	mE	mN	Map Datum (Accuracy)	Photo (from NW Corner, Except Plot R)	Date Recorder(s)[2]	Vegetation Unit (Condition)		FCT Assignment by Griffin (2007) 'Conclusion'
01	0392052	6438724	GDA	MH 1943, 44	10/11/06 MH	KgCT-TO	(G-VG)	21c/23a
02	0392013	6438535	GDA	9045 & 46	14/11/06 MH AM	BLOW(J)	(G-VG)	21c/23a
03	0391992	6438186	WGS84	VY 26	22/11/06 VY	ErOF	(E)	11
04	0392074	6438115	GDA	MH 1983, 84	22/11/06 MH	BLW(J)	(VG-D)	23a/21a
05	0392004	6437564	GDA	MH 1985-90 (some of surrounds)	22/11/06 MH VY	ErW	(G-CD)	11/17/12
06	0392697	6438330	GDA	MH 1991	22/11/06 MH	ErOF-OW/MrLC-OF	(D-G)	?17/15/11
07	0392648	6438141	WGS84	VY28	22/11/06 VY	BLW	(D-VG)	21c/24
08	0392598	6437921	WGS84	VY31	23/11/06 VY	BLW-OF(J)	(E-VG) (E-VG)	23a/24
09	0392626	6437783	GDA	MH 1997-2000	23/11/06 MH	BLW-OF(J)	(VG-E) (VG- E)	28/23a
10	0392814	6437094	GDA? (+/- 7.1)	RPS 1101-1102	23/11/06 KM, AM	KgCTS	(G-D)	11
11	0392435	6436906	GDA? (+/- 4.9)	RPS 1104-1105	23/11/06	MrpW-LOF	(D)	?13/11
12	0392509	6436565	GDA? (+/- 9)	VY 33	24/11/06 VY, AM	South of study area		11
13	0392744	6438206	GDA	MH 2000-2004	23/11/06 MH, VY	MpErLOF-W	(CD-G)	11/4
14	0392327	6436909	GDA	2005-2011	23/11/06 MH, VY	MpErLOF-W or ErWKg	(G-CD)	?17/11
15	0392823	6436762	GDA	MH 212-215	23/11/06 MH, VY	South of study area		21c/23a
16	0392276	6435693	GDA	VY 35 and 36	24/11/06 VY, AM	South of study area		21c/21a
17	0392419	6438802	WGS84 (+/- 5)	VY 37	24/11/06 VY, AM	KgTO(Mp)	(CG-G)	4/11
R Releve	0392155	6436657	WGS84 (+/-4.5)	VY 34	24/11/06 VY	BLW (or BiPe)	(GD (or D))	---

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[1] Plots WS12, WS15 and WS16 are not in the Wandi/Mandogalup study area.
[2] The recorders were Angela Mercier (AM), Kelli McCreery (KM), Martin Henson (MH) and Vanessa Yeomans (VY).

Table 2-3: Lists of Species Recorded in Plots (10 m by 10 m Quadrats) in the Wandi / Mandogalup Study Area and Nearby

Plot	Collection	Notes
WS01	Eucalyptus marginata	
	Banksia attenuata	
	Xanthorrhoea preissii	
	Kunzea glabrescens	
	Phlebocarya ciliata	
	Dasypogon bromeliifolius	
	Euchilopsis linearis	
	Hypocalymma angustifolium	
	Trachymene pilosa	
	*Aira elegans	
	*Briza maxima	
	Bossiaea eriocarpa	
	Jacksonia furcellata	
	*Gladiolus caryophyllaceus	
	Siloxerus humifusus	
	*Aira praecox	
	Phyllangium paradoxum	
	Levenhookia ?preissii	
	Crassula colorata var. acuminata	
	*Hypochaeris glabra	
	Quinetia urvillei	
	*Ehrharta calycina	
	Austrostipa compressa	
	Lepidosperma aff. squamatum	
	Hypolaena exsulca	
	Hypocalymma robustum	
	Petrophile linearis	
	Trichoryne elatior	
	Lomandra caespitosa	
	Leucopogon conostephioides	
	Dianella revoluta	
	Dampiera linearis	
	*Hypochaeris radicata	
	*Ursinia anthemoides	
	Gompholobium tomentosum	
	Trachymene pilosa	
	Podolepis lessonii	

Plot	Collection	Notes
WS02	Eucalyptus marginata	
	Banksia ilicifolia	
	Xanthorrhoea preissii	
	Kunzea glabrescens	
	Acacia pulchella	
	Phlebocarya ciliata	
	*Briza maxima	
	Banksia menziesii	
	Hypocalymma angustifolium	
	Lepidosperma sp. Margaret River (BJ Lepschi 1841)	aff. L costale or L squamatum?
	Dasypogon bromeliifolius	
	Boronia crenulata subsp. crenulata	
	Melaleuca ?thymoides	
	Dianella revoluta	
	*Hypochaeris glabra	
	Jacksonia furcellata	
	*Gladiolus caryophyllaceus	
	*Ehrharta calycina	
	Trachymene pilosa	
	Gompholobium tomentosum	
	Platysace filiformis	
	Conostylis juncea	
WS03	Eucalyptis rudis	
	Melaleuca rhaphiophylla	
	Eucalyptus marginata	
	Xanthorrhoea preissii	
	Taxandria linearifolia	
	Gastrolobium ebracteolatum	= Oxylobium lineare
	Pteridium esculentum	
	Lepidosperma longitudinale	
	*Briza minor	
	Acacia pulchella	
	*Paspalum distichum	
	Hibbertia perfoliata	
	*Holcus lanatus	
	*Sonchus oleraceus	
	Lobelia alata	
	*Bromus diandrus	
	*Ehrharta longiflora	

Plot	Collection	Notes
	*Vulpia bromoides	
	*Hypochaeris glabra	
	Centella asiatica	
	Cassytha racemosa	
	Leucopogon australis	
	*Zantedeschia aethiopica	
	Cyathochaeta teretifolia	P3
	Macrozamia fraseri	
	Baumea articulata	
	*Cortaderia selloana	
	Astartea ?scoparia	
WS04	Allocasuarina fraseriana	
	Banksia menziessii	
	Banksia attenuata	
	Eucalyptus marginata	
	Acacia pulchella	
	Stirlingia latifolia	
	Xanthorrhoea preissii	
	Platysace filiformis	
	Petrophile linearis	
	Gompholobium tomentosum	
	*Ehrharta calycina	
	Hibbertia hypericoides	
	*Briza maxima	
	Desmocladus flexuosus	
	Lepidosperma obtusum	aff. L scabrum, L leptostachyum or L sp (coastal terete)?
	Adenanthos cygnorum subsp. cygnorum	
	Gastrolobium capitatum	
	Conostylis aculeata subsp. ?aculeata	
	Scholtzia involucrata	
	Dampiera linearis	
	Kennedia prostrata	
	Hardenbergia comptoniana	
	Patersonia occidentalis	
	Acacia stenoptera	
	Burchardia umbellata	=Burchardia congesta
	Kunzea glabrescens	
	Tetraria octandra	

Plot	Collection	Notes
	Synaphea petiolaris subsp. petiolaris	
	Austrodanthonia sp.	
	Amphipogon turbinatus	
	Conostephium pendulum	
	Leucopogon conostephioides	
	Hardenbergia comptoniana	
	*Carpobrotus edulis	
	Trachymene pilosa	
	Basal white	
	Podolepis lessonii	
	*Hypochaeris glabra	
WS05	Patersonia occidentalis	
	Lobelia alata	
	Pultenaea reticulata	
	Astartea ?scoparia	
	Xanthorrhoea preissii	
	Melaleuca rhaphiophylla	
	Viminaria juncea	
	*Zantedeschia aethiopica	
	*Lotus uliginosus	
	Tetraria capillaris	
	*Holcus lanatus	
	*Briza maxima	
	*Hypochaeris	
	*Paspalum distichum	
	*Lolium rigidum	
	Juncus pallidus	
	?Dielsia stenostachya	=Restio stenostachyus
	Centella asiatica	
	*Sonchus oleraceus	
	*Carduus ?pycnocephalus.	
	Lepidosperma longitudinale	
	*Cyperus tenuiflorus	
	Meeboldina scariosa	=Leptocarpus scariosus
WS06	Lepidosperma longitudinale	
	Juncus pallidus	
	Melaleuca rhaphiophylla	
	Eucalyptus rudis	
	*Gomphocarpus fruiticosus	

Plot	Collection	Notes
	*Holcus lanatus	
	Pelargonium littorale	
	*Solanum nigrum	
	*Lotus uliginosus	
	*Bromus diandrus	
	*Physalis peruviana	
	*Paspalum distichum	
	Acacia pulchella	
	*Sonchus oleraceus	
	*Phytolacca octandra	
	*Phalaris aquatica	
	Melaleuca ?teretifolia	
	*Phalaris aquatica	
WS07	Banksia ilicifolia	
	Banksia attenuata	
	Jacksonia furcellata	
	Xanthorrhoea preissii	
	*Ehrharta calycina	
	*Briza maxima	
	Lepidosperma obtusum	aff. L scabrum, L leptostachyum or L sp (coastal terete)?
	Platysace filiformis	
	Burchardia umbellata	
	Patersonia occidentalis	
	Dasypogon bromeliifolius	
	Scholtzia involucrata	
	Desmocladus flexuosus	
	Macrozamia fraserii	
	Acacia pulchella	
	Schoenus curvifolius	
	Gompholobium tomentosum	
	Phlebocarya ciliata	
	Gonocarpus pithyoides	
	Philotheca spicatus	
	Acacia huegelii	
	Bossiaea eriocarpa	
	Leucopogon australis	
	Hibbertia racemosa	
	Petrophile linearis	

Plot	Collection	Notes
	Dampiera linearis	
	*Ursinia anthemoides	
	Lomandra hermaphrodita	
	Leptospermum spinescens	
WS08	Banksia attenuata	
	Banksia menziesii	
	Allocasuarina fraseriana	
	Xanthorrhoea preissii	
	Hibbertia hypericoides	
	*Ehrharta calycina	
	*Gladiolus caryophyllaceus	
	Gompholobium tomentosum	
	Petrophile linearis	
	Burchardia umbellata	=Burchardia congesta
	Tetraria capillaris	
	Desmocladus flexuosus	
	Calytrix flavescens	
	Leucopogon conostephioides	
	Stylidium brunonianum	
	Lepidosperma australis	
	Acacia pulchella	
	Mesomelaena pseudostygia	
	*Briza maxima	
	Conostephium pendulum	
	Amphipogon turbinatus	
	Brachyloma preissii	
	Laxmannia squarrosa	
	Xanthosia huegelii	
	Tricoryne elatior	
	Hovea trisperma var. trisperma	
	Bossiaea eriocarpa	
	Hybanthus calycinus	
	Lomandra hermaphrodita	
	Scaevola canescens	
	Lepidosperma sp. Scarp compact (A. Markey 1163)	aff. L angustatum or L squamatum?
	Hypocalymma angustifolium	
	Anigozanthos ?manglesii subsp. manglesii	
	Stylidium piliferum	
	Calectasia narragara	

Plot	Collection	Notes
	Dasypogon bromeliifolius	
	Austrodanthonia sp.	
	Synaphea petiolaris subsp. petiolaris	
	Brachyloma preissii	
	Astroloma pallidum	
	Dianella revoluta	
	Patersonia occidentalis	
WS09	Eucalyptus marginata	
	Banksia menziesii	
	Brachyloma preissii	
	Jacksonia furcellata	
	Acacia pullchella	
	Xanthorrhoea preissii	
	Hibbertia hypericoides	
	Laxmannia squarrosa	
	Hovea pungens	
	*Ehrharta calycina	
	*Gladiolus caryophyllaceus	
	Stylidium repens	
	Bossiaea eriocarpa	
	Baeckea camphorosmae	
	Mesomelaena pseudostygia	
	Conostylis setigera subsp. setigera	
	Synaphea petiolaris subsp. petiolaris	
	*Briza maxima	
	Chamaescilla corymbosa var. corymbosa	
	Stylidium saxifragoides	=Stylidium ciliatum sens lat
	*Ursinia anthemoides	
	Austrodanthonia sp.	
	Burchardia umbellata	=Burchardia congesta
	Acacia stenoptera	
	Lomandra hermaphrodita	
	Amphipogon turbinatus	
	Platysace filiformis	
	Desmocladus flexuosus	
	Dianella revoluta	
	Lomandra caespitosa	
	Calectasia narragara	
	Xanthosia huegelii	

Plot	Collection	Notes
	Tetraria octandra	
WS10	Eucalyptus rudis	
	Pultenaea reticulata	
	Kunzea glabrescens	
	Melaleuca preissiana	
	Astartea ?scoparia	
	Dielsia stenostachya	=Restio stenostachyus
	*Carpobrotus edulis	
	Cassytha racemosa	
	*Ehrharta longiflora	
	Burchardia bairdii	
	Leucopogon australis	
	*Briza maxima	
	*Sonchus oleraceus	
	*Cortaderia selloana	
	*Solanum nigrum	
	*Ehrharta calycina	
	Pteridium esculentum	
	Xanthorrhoea preissii	
	*Ficus carica	
WS11	Melaleuca rhaphiophylla	
	Melaleuca preissiana	
	*Cortaderia selloana	
	*Zantedeschia aethiopica	
	Eucalyptus rudis	
	Pteridium esculentum	
	*Solanum nigrum	
	Baumea preissii subsp. preissii	
	Baumea preissii subsp. laxa	
	Carex appressa	
	*Holcus lanatus	
	Juncus pallidus	
	*Lotus uliginosus	
	Tetraria capillaris	
	Hibbertia perfoliata	
	*Phytolacca octandra	
WS12	Centella asiatica	
	*Zantedeschia aethiopica	
	Pteridium esculentum	

Plot	Collection	Notes
	*Hypochaeris glabra	
	Taxandria linearifolia	
	Eucalyptis rudis	
	*Holcus lanatus	
	*Lotus uliginosus	
	*Carduus ?pycnocephalus	
	*Solanum nigrum	
	Juncus planifolius	
	*Phytolacca octandra	
	*Anagallis arvensis var. arvensis	
	*Rumex conglomeratus	
	Juncus pallidus	
	Microtis media subsp. media	
WS13	Melaleuca preissiana	
	Eucalyptus rudis	
	Xanthosia huegelii	
	Cassytha racemosa	
	*Vulpia myuros var. megalura	
	Stylidium junceum	
	Hypolaena exsulca	
	*Aira elegans	
	Lepidosperma longitudinale	
	Astartea ?scoparia	
	*Carpobrotus edulis	
	Dampiera linearis	
	Acacia pulchella	
	Melaleuca rhaphiophylla	
	Kunzea glabrescens	
	Brachyloma preissii	
	Acacia longifolia subsp. longifolia	
	*Avena barbata/fatua	
	*Briza maxima	
	Comesperma calymega	
	Aotus gracillima	
	Viminaria juncea	
	Xanthorrhoea preissii	
	*Hypochaeris glabra	
WS14	Melaleuca teretifolia	
	Baumea articulata	

Plot	Collection	Notes
	Melaleuca rhaphiophylla	
	*Lotus uliginosus	
	Eucalyptis rudis	
	Pteridium esculentum	
	Lobelia alata	
	Lepidosperma longitudinale	
	*Holcus lanatus	
	*Zantedeschia aethiopica	
	Banksia littoralis	
	Kunzea glabrescens	
WS15	Arnocrinum preissii	
	Hibbertia racemosa	
	Cassytha flava	
	Lyginia ?imberbis	
	Conostylis aculeata subsp. preissii	
	Adenanthos cygnorum	
	Scholtzia involucrata	
	*Ehrharta calycina	
	Hypocalymma angustifolium	
	Banksia menziesii	
	Nuytsia floribunda	
	Desmocladus flexuosus	
	*Briza maxima	
	Leucopogon conostephioides	
	Amphipogon turbinatus	
	*Gladiolus caryophyllaceus	
	Lechenaultia floribunda	
	Stirlingia latifolia	
	Anigozanthos ?manglesii subsp. manglesii	
	Laxmannia squarrosa	
	Hovea pungens	
	Lomandra caespitosa	
	Scholtzia involucrata	
	Brachyloma preissii	
	Scholtzia involucrata	
	Gompholobium tomentosum	
	Schoenus curvifolius	
	Calytrix flavescens	
	Kunzea glabrescens	

Plot	Collection	Notes
	Schoenus clandestinus	
	Dasypogon bromeliifolius	
WS16	Banksia menziesii	
	Conostylis aculeata	
	Brachyloma preissii	
	*Ehrharta calycina	
	Hibbertia hypericoides	
	Jacksonia furcellata	
	Acacia pulchella	
	Kunzea glabrescens	
	*Hypochaeris glabra	
	Hypolaena pubescens	
	*Brachypodium distachyon	
	Acacia stenoptera	
	Acacia huegelii	
	Daviesia triflora	
	Banksia attenuata	
	*Romulea rosea	
	*Ursinia anthemoides	
	Burchardia umbellata	
	Gompholobium tomentosum	
	Gastrolobium capitatum	
	Patersonia occidentalis	
	Phlebocarya ciliata	
WS17	Dasypogon bromelifolius	
	Lepidosperma longitudinale	
	Austrodanthonia sp	
	Dielsia stenostachya	=Restio stenostachyus
	Kunzea glabrescens	
	Pultenaea reticulata	
	Melaleuca preissiana	
	*Ehrharta calycina	
	Dampiera linearis	
	Xanthorrhoea preissii	
	Astartea fascicularis	
	Hypocalymma angustifolium	
	Amphipogon laguroides	
	Lomandra caespitosa	
	Phlebocarya ciliata	

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1.0 INTRODUCTION

1.1 Purpose of this report

The current report is intended to help clarify the assignment of Floristic Community type (FCT) designation to vegetation community (site) data. FCTs were defined by Gibson et al (1994) based on site data collected from vegetation on the Swan Coastal Plain. In particular, the potential that a Threatened Ecological Community (English and Blyth 1997) is represented by the data collected needs to be clarified.

1.2 Location of Wandi Sites

The sites were in the along the Kwinana Freeway area.

1.3 Brief background to floristic analysis of vegetation on the Swan Coastal Plain

Floristic analysis (ie., analysis of variation in vegetation based on the species present, rather than description of structural variation and dominance) as a significant component of the understanding of the variation present in the native vegetation of the Swan Coastal Plain dates to Gibson *et al* (1994 – all references to the SCP survey in the current report refer to this publication), the first publication to document the floristics of the vegetation of a large part of the Swan Coastal Plain. While the SCP survey is based on a very significant amount of work, it must be viewed as a "first pass" survey, limited, in the context of the great variety of vegetation present in the very large area surveyed, by the relatively limited number (509) of sites (quadrats) it is based on. To a limited degree, this limitation has subsequently been addressed in an "update" to the work of the SCP survey (which describes additional units). However, there is no detailed publication of the results of this update available and the additional data used are not readily available in an appropriate form (ie., one that would enable ready comparison of new data to the overall data set).

The units described by the SCP survey are a series of "floristic community types", a "unit" whose rank is defined by the use within a study. The SCP survey surveyed a very large survey area and defined a relatively small number of floristic community types. Consequently, the floristic community types they have described are of a very high order (see Trudgen 1999, volume 1, for further discussion of this point). This is an extremely important point to fully grasp in interpreting the analysis presented by the SCP survey and in understanding the meaning of analysis of other data sets when they are compared to the floristic community types of the SCP survey.

The important effects of the limited size data set used by the SCP survey and of the relatively small number of floristic community types defined by them, can be summarised by the following points:

1. the definition of all but two of the Threatened Ecological Communities for vegetation on the Swan Coastal Plain (English and Blyth 1997) has been based on the floristic community types of the SCP survey. It therefore follows, that with two exceptions, only vegetation units from one study that are different at a very high order of floristics are treated as rare by Government. No account is taken of other important differences, such as differences in structure and dominance;

2. for the definition of floristic community types to be robust, a sufficient sized database is needed to give adequate precision in their definition. About half of the floristics community types (or sub types) of the SCP survey are based on less than 10 sites. It is likely that with a larger data set there would be significant alteration in the classification of those floristic community types from the SCP survey based on small numbers of sites.

3. as noted above, many (if not most) of the floristic community types defined by the SCP survey are very broad. They contain very significant variation in floristics, structure and

dominance. Some (or in more highly cleared parts of the Swan Coastal Plain much) of this variation may be rare by any reasonable definition, but it is currently "buried" within larger groups;

4. there is likely to be significant variation not sampled by the SCP survey. This includes some variation at a high level of floristic difference (see Trudgen 1999, volume 1, for an example of this) and undoubtedly quite significant (large!) amounts of variation at "medium" and "low" levels.

5. the document, and its use by Government, has focussed attention in the environmental impact assessment process on the high level of units described, deflecting attention from the layers of variation beneath these units that also have significant conservation value.

From these points it is obvious that there is a need for a major "upgrade" to the floristic analysis of the vegetation of the Swan Coastal Plain to provide a more detailed floristic classification that considers not only more of the variation present, but explicitly recognises more of the variation present in formally described units.

Obviously, such a reworking would have some effect on what vegetation is considered rare on the Swan Coastal Plain. It needs to be stressed that it would be very unlikely to find that any of the vegetation currently considered to be rare on the basis of the SCP survey*'s* classification was not rare. On the other hand, it is likely that such a review would very probably consider to be rare some vegetation which is not currently considered rare.

1.4 Data provided

It is very important in comparing different sets of floristic data that they are comparable in the application of names, in the intensity of the survey (ie., the effort of searching resulting in similar proportion of the flora at sites being recorded) and in the size of the site recorded. If the data from different data sets is not comparable in these ways, it reduces the clarity of the results of the analyses carried out. If the discrepancy in the comparability of the data sets is large, the results may become meaningless.

It was difficult to determine if the quadrats appeared to have a "reasonable" number of species. The richness of quadrats shown in Figure 1 is quite variable.

2.0 METHODS

2.1 Data Preparation

The data from the Wandi sites were provided in a spreadsheet. These were incorporated into a standard MS Access based database designed for this type of data. One virtue of the database is that the species recorded at each site are stored against standard codes (numbers, those used by the Western Australian Herbarium) for each species. This facilitates ready comparison of data from different surveys stored in the same system.

After the data were incorporated into the database, a process of reconciliation of flora species names with those used in the SCP survey was undertaken. This step was necessary at least because of changes in nomenclature over the last ten years and the potential of survey specific variations in the application of names. The reconciliation involved:

- reducing some infra-specific names to the relevant species name, and
- combining some taxa where confusion is known to have occurred in field observations and identifications.

The reconciliation process was relatively straightforward as most of the names had already been standardised. Most reconciliation was to conform with the methods that the SCP survey used to manage confusing taxa plus some nomenclatural changes (Appendix).

2.2 Comparability of datasets

It was concluded that the quadrat datasets were probably reasonably compatible in nomenclature. The richness of sites are moderate (see extract of dendrogram in results.) However, the number of species from families often overlooked (eg Liliaceae, Haemodoraceae, Orchidaceae, Stylidiaceae and Asteraceae) appeared a little lower than that of quadrats in SCP dataset for similar vegetation.

2.3 Comparisons made

The data therefore from the ten quadrats plus the 509 sites from the SCP survey of the southern part of the Swan Coastal Plain (south of Gingin) were combined. This enabled various analyses to be performed.

The main purpose was intended to assign the individual sites to the Floristic Community Types (FCTs) defined in the SCP survey. These data are provided in BBG_Wandi.mdb.)

2.4 Analyses carried out

The approach was the use of numerical classification techniques (PATN) based on the similarity of the floristic composition of the Wandi quadrats to sites in the SCP survey data set.

2.4.1 PATN

Several modules of the numerical classification package PATN (Belbin 1987) were used for the analyses. The parameter values were the same as used by the SCP survey to ensure consistency of analysis with that study.

The PATN modules used were ASO (calculation of similarity matrix), FUSE (classification based on the results of ASO), DEND (representation of classification) and NNB (determination of sites most similar to each site – nearest neighbours). The results of the analyses were imported into a database (BBG_ Med_Springs.mdb) so that site characteristics and previous classifications (eg., Floristic Community Types derived in earlier classifications) could be associated and various analyses based on these data could be performed.

The attempted assignment of floristic community types to the Wandi quadrats was made by summarising the results of two different methods:

- the classification, and
- the ten nearest neighbours.

Experience demonstrates that the results of these are likely to vary, but that from nearest neighbours is likely to make more sense for it is not directly influenced by group membership. On the other hand the nearest neighbour analysis often is ambiquous as it provides several options.

To the classification dendrogram of the combined dataset, the FCT assigned by the SCP survey was associated with the SCP survey sites. The apparent FCTs were assigned to the Wandi quadrats by interpreting the position of these sites in the dendrogram (particularly by the way they joined to the SCP sites).

The 10 sites in the combined data set that were most similar to each of the Wandi quadrats were obtained from the nearest neighbour method (NNB). By associating those nearest neighbours from the SCP survey, the most likely FCTs from this method for each of the Wandi quadrats were determined.

It is common for there to appear tob inconsistencies in the affinietie indicated by these methods. Classification can be strongly influenced by the membership of groups which can "draw" a site "away" from another that it appears similar to. An attempt was then made to reconcile these different assignments of a Floristic Community Type. The relevant portion of the site by species matrix was examined to seek clarity in some cases.

3.0 LIMITATIONS

It has been found in earlier projects that the addition of new sites to the SCP survey data set to produce a combined classification disrupts the original classification. The more data added, the higher the level of the disruption. This is particularly the case with wetland sites, partly because there are relatively few of these in the SCP data set and these communities are often very distinctive. This problem can make it difficult to assign Floristic Community Types to new sites using this method.

Secondly, it is common for new data to group to their cohorts. In some cases this has proven to result from common deficiencies in the data, ie. whole groups of species missing. This absence tends to draw them together. The more sites in the added batch, the tighter they draw together. This is probably what has happened more than "deficiencies" in the data.

The analyses are conducted without personal knowledge of the sites. No data was provided on the condition of the sites.

4.0 RESULTS

4.1 Determination of floristic community type by classification

The Wandi sites were clustered in two different parts of the dendrogram. This suggests a degree of survey dependant data, be it the intensity of the survey or the condition of the vegetation. A number of quadrats were in areas indicated by mapping as modified by European land management.

One cluster of new sites were related to sites from FCTs 21c, 24 and 28, though the latter two FCTs were represented by just one site each. Thus it is more likely that 21c is more likely for these sites.

The other cluster is with FCT 11 sites.

Figure 1. Relevant portions of Dendrogram

site	FCT	NO	data
DEJONG-c	21c	41	
WS15		31	
FL-5	21c	41	
FL-6	21c	38	
hymus03	21c	30	
THOM-2	24	46	
WS07		29	
WS01		37	
WS02		22	
WS04		38	
WS16		22	
TRIG-4	28	40	
WS08		42	
WS09		33	
AUSTB-3	11	27	
TWIN-11	11	23	
BULL-12	11	25	
hymus05	11	30	
hymus06	11	32	
CAPEL-6	12	36	
CAPEL-8	12	41	
CAPEL-9	12	26	
FL-10	12	17	
RIVD-1	12	10	
C71-1	11	51	
MODO-3	11	16	
WS13		24	
HARRY-6	11	25	
WS10		19	
WS17		15	
CARAB-3	11	30	
rowe01	11	15	
hymus01	11	21	
hymus02	11	24	
low10b	11	24	
WS03		28	
WS05		23	
WS06		18	
WS14		12	
WS11		16	
WS12		16	

4.2 Determination of floristic community type using Nearest Neighbour method

The nearest neighbour analysis suggested that the quadrats have affinities with a number of different communities even though they were more similar to each other than any SCP sites by a modest amount. Some of the similarity values for sites from the SCP data sets were low enough (values less than about 0.55) to give confidence in this method being useful (Table 1).

By this analysis the Wandi site were largely related to sites from FCT 21c, 23a and 11. Most of those apparently related to wet land FCTs had high dissimilarity values suggesting only modest relationships. The degree of disturbance of the sites needs to be considered before accepting the FCTs indicated.

Table 1. Results of Nearest Neighbour analysis

s	s1	fct1	v1	s2	fct2	v2	s3	fct3	v3	s4	fct4	v4	s5	fct5	v5
WS01	WS02		0.4737	MODO-2	21c	0.5429	hurst01	23a	0.56	hurst03	23a	0.58	MELA-5	22	0.589
WS02	WS01		0.4737	WS07		0.6078	WS04		0.61	WS09		0.62	WS16		0.6364
WS03	WS05		0.5686	WS14		0.6	WS10		0.61	HARRY-6	11	0.62	WS06		0.6364
WS04	WS08		0.5405	WS16		0.5439	WS07		0.56	WAND-1	23a	0.56	NINE-1	21a	0.5733
WS05	WS03		0.5686	WS06		0.641	WS12		0.64	WS14		0.65	hymus01	11	0.6818
WS06	WS11		0.5484	WS14		0.5714	WS12		0.62	WS03		0.63	WS05		0.641
WS07	FL-5	21c	0.4857	THOM-2	24	0.52	HARRY-4	23a	0.52	FL-6	21c	0.55	MILT-6	21a	0.5625
WS08	WS09		0.4648	hurst03	23a	0.5283	THOM-2	24	0.52	BANK-3	23a	0.53	WS04		0.5405
WS09	WS08		0.4648	WS04		0.5821	SHENT-1	28	0.58	TRIG-4	28	0.61	WS02		0.6296
WS10	WS17		0.5758	WS03		0.617	WS13		0.62	hymus01	11	0.7	WS11		0.7059
WS11	WS12		0.4839	WS06		0.5484	WS14		0.55	MILT-2	13	0.6	WS03		0.6744
WS12	WS11		0.4839	WS06		0.625	WS05		0.64	WS14		0.64	WS03		0.6818
WS13	MODO-3	11	0.6	WS10		0.6279	MODO-6	4	0.65	low14a	4	0.66	welr 01	9	0.68
WS14	WS11		0.5556	WS06		0.5714	WS03		0.6	WS12		0.64	WS05		0.6571
WS15	DEJONG-c	21c	0.5143	FL-5	21c	0.5143	low01	21c	0.57	WAND-1	23a	0.58	FL-6	21c	0.5821
WS16	WS04		0.5439	FL-6	21c	0.6	WS07		0.60	FL-5	21c	0.61	WS02		0.6364
WS17	WS10		0.5758	WS02		0.6667	WS01		0.67	CAPEL-3	4	0.67	MELA-1	4	0.6757

Table 1 (cont)

s	s6	fct6	v6	s7	fct7	v7	s8	fct8	v8	s9	fct9	v9	s10	fct10	v10
WS01	CAPEL-7	21a	0.6145	WS08		0.6216	WS07		0.625	TAM-1	21a	0.625	YULE-1	23a	0.6264
WS02	WS08		0.6393	MODO-2	21c	0.6491	HARRY-4	23a	0.6563	NINE-2	21a	0.6579	WS17		0.6667
WS03	low10b	11	0.6538	WS11		0.6744	WS12		0.6818	WS13		0.6923	LESCH-6	17	0.7273
WS04	THOM-2	24	0.5802	KING-2	28	0.5814	WS09		0.5821	WELL-2	21a	0.5849	SHENT-1	28	0.6049
WS05	WS11		0.6842	LESCH-6	17	0.6923	RIVD-1	12	0.697	WS13		0.7021	hymus02	11	0.7021
WS06	cool 04	17	0.7576	TWIN-5	15	0.7714	ELLIS-1	17	0.7857	PAGA-5	17	0.7857	PAGA-2	13	0.7931
WS07	WS04		0.5625	MPK01	23b	0.5765	BANK-3	23a	0.5876	hurst04	23a	0.5904	NINE-2	21a	0.5904
WS08	WAND-1	23a	0.5417	TRIG-4	28	0.5443	WIRR-1	23a	0.5478	NINE-2	21a	0.5484	FL-5	21c	0.55
WS09	WS07		0.6393	WAND-1	23a	0.6404	HARRY-2	28	0.6421	FL-5	21c	0.6438	NINE-2	21a	0.6512
WS10	MODO-3	11	0.7143	WS05		0.7143	HARRY-6	11	0.7273	hymus02	11	0.7674	low10b	11	0.7674
WS11	WS05		0.6842	WS10		0.7059	PAGA-2	13	0.7143	ELLIS-1	17	0.7778	hymus01	11	0.7778
WS12	hymus01	11	0.7297	CARAB-3	11	0.7826	low10b	11	0.8	HARRY-6	11	0.8049	rowe01	11	0.8065
WS13	C71-1	11	0.68	WS17		0.6842	WS03		0.6923	MANEA-1	9	0.6944	C58-1	4	0.7
WS14	LESCH-6	17	0.7143	low10b	11	0.7222	MILT-2	13	0.7273	TWIN-10	15	0.7273	CAPEL-9	12	0.7368
WS15	WS08		0.5882	WS04		0.625	YULE-2	23a	0.6279	hymus03	21c	0.661	low13b	23a	0.6632
WS16	WS09		0.6667	TAM-1	21a	0.6716	THOM-2	24	0.6765	SHENT-1	28	0.6765	WAND-1	23a	0.6962
WS17	WS13		0.6842	KOOLJ-1	4	0.7059	rowe02	4	0.7188	C58-1	4	0.72	low14a	4	0.72

s – the site being compared
s1 to s20 – the 1st to 20th most similar sites from SCP or TEC
f1 to f20 – the FCT of the similar sites (only for SCP sites)
v1 to v20 – the dissimilarity value between the site and the similar sites (values above 0.6 tend to indicate low similarity)

4.3 Combining the results

It is common for the classification to indicate a simple result and the nearest neighbour analysis to be less conclusive. This is more a product of the classification process than of inconsistency of the analyses.

Table 3 is the product of the attempt to reconcile these differences. Some uncertainty exists in this assignment as indicated. However, it seems most likely that the Wandi site is most likely to be related to FCT29a.

Table 3 Summary of FCT assignment

s	Dendrogram	Nearest Neighbour	Conclusion
WS01	21c/24/28	21c/23a/22	21c/23a
WS02	21c/24/28	21c/23a/21a	21c/23a
WS03	11	11	11
WS04	21c/24/28	23a/21a/24	23a/21a
WS05	11	11/17/12	11/17/12
WS06	11	?17/15	?17/15/11
WS07	21c/24/28	21c/24/23a	21c/24
WS08	21c/24/28	23a/24	23a/24
WS09	21c/24/28	28/23a	28/23a
WS10	11	11	11
WS11	11	13	?13/11
WS12	11	11	11
WS13	11	11/4	11/4
WS14	11	?17/11	?17/11
WS15	21c	21c/23a	21c/23a
WS16	21c/24/28	21c/21a	21c/21a
WS17	11	4	4/11

5.0 REFERENCES

Belbin, L. (1987) *PATN Reference Manual* (313p), *Users Guide* (79p), *Command Manual* (47p), and *Example Manual* (108p). CSIRO Division of Wildlife and Ecology, Lynham, ACT.

English, V., and Blyth, J. (1997) *Identifying and conserving threatened ecological communities (TECs) in the South West Botanical Province*. ANCA National Reserves System Cooperative Program: Project Number N702, Australian National Conservation Agency, Canberra

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

Trudgen, M.E. (1999). *A flora and vegetation survey of Lots 46 and 47 Maralla Road and Lexia Avenue, Ellenbrook.* Volumes 1-4. Unpublished report prepared for the Crown Solicitors Office, Government of Western Australia. December 1999.

APPENDIX1

Names combined for reconciliation

FCOD	Species_LUP.name	Species_LUP_1.name
	Basal white	Omitted
016A	Macrozamia fraseri	Macrozamia riedlei
031	Aira elegans	Aira caryophyllea/cupaniana group
031	Austrodanthonia sp.	Omitted
031	Holcus lanatus	Holcus setiger
031	Vulpia myuros var. megalura	Vulpia myuros
032	Baumea preissii subsp. laxa	Baumea juncea
032	Baumea preissii subsp. preissii	Baumea juncea
032	Cyathochaeta teretifolia	Cyathochaeta avenacea
032	Lepidosperma aff. squamatum	Lepidosperma angustatum/squamatum
032	Lepidosperma australis	Omitted
032	Lepidosperma obtusum	Lepidosperma scabrum
032	Lepidosperma sp. Margaret River (B.J.	Lepidosperma angustatum/squamatum
032	Lepidosperma sp. Scarp compact (A.	Lepidosperma angustatum/squamatum
032	Lepidosperma squamatum	Lepidosperma angustatum/squamatum
039	Leptocarpus scariosus	Meeboldina scariosa
039	Lyginia imberbis	Lyginia barbata
054C	Calectasia narragara	Calectasia cyanea
054F	Chamaescilla corymbosa var.	Chamaescilla spiralis/corymbosa
054J	Burchardia umbellata	Burchardia umbellata/congesta
055	Anigozanthos manglesii subsp.	Anigozanthos manglesii
055	Conostylis aculeata subsp. aculeata	Conostylis aculeata
055	Conostylis aculeata subsp. preissii	Conostylis aculeata
055	Conostylis setigera subsp. setigera	Conostylis setigera
066	Microtis media subsp. media	Microtis media
090	Adenanthos cygnorum subsp.	Adenanthos cygnorum
090	Synaphea petiolaris subsp. petiolaris	Synaphea petiolaris
103	Rumex conglomeratus	Rumex acetosella
149	Crassula colorata var. acuminata	Crassula colorata
165	Lotus uliginosus	Lotus suaveolens
165	Nemcia capitata	Gastrolobium capitatum
165	Oxylobium lineare	Gastrolobium ebracteolatum
175	Boronia crenulata subsp. crenulata	Boronia crenulata
273	Astartea fascicularis	Astartea aff. fascicularis
273	Astartea scoparia	Astartea aff. fascicularis
273	Kunzea glabrescens	Kunzea aff. micrantha (BJK & NG 040)
281	Centella asiatica	Centella cordifolia
281	Platysace filiformis	Platysace tenuissima
293	Anagallis arvensis var. arvensis	Anagallis arvensis
315	Physalis peruviana	Omitted
343	Levenhookia preissii	Levenhookia pusilla
345	Hypochaeris	Hypochaeris glabra
345	Hypochaeris radicata	Hypochaeris glabra

APPENDIX 3

Wandi / Mandogalup Flora

APPENDIX 3: Wandi / Mandogalup Flora

Introduction

Table 3-1 (compiled February–March 2007) lists native and established alien taxa (families, species, subspecies and varieties) of vascular plants recorded during botanical field work in the Wandi/Mandogalup study area.

The table lists the approximately 220 taxa in order of family code. The table was compiled using the Western Australian Herbarium database Max, Version 3.1.2.215.

No taxon of Declared Rare Flora has been found in the Wandi/Mandogalup study area, but one Priority Three Flora taxon was found there: *Cyathochaeta teretifolia*. Two other species listed in *Bush Forever* (Government of Wester Australia 2000, Volume 2, Table 13, p. 54) as significant were also found: *Dielsia stenostachya* and *Lysinema elegans*.

The native taxa recorded in the Wandi/Mandogalup study area are estimated to constitute at least 70% of the native flora, and the alien taxa are estimated to constitute more than half of the alien flora. Other taxa could be added to the list, especially if more field work were undertaken during winter and early spring and, as was done, e.g. by Keighery et al. (1997), during three flowering seasons in consecutive years.

Legend to Table 3-1

Column 1 Taxon Name

A list of families, species, subspecies and varieties of vascular plants, in order of family code, which have been recorded in the study area.

An * asterisk preceding a taxon name indicates the taxon is an established alien (a weed).

Column 2 Family Code

The family code indicates the family's position in the order in which collections of dried and pressed plant specimens are filed in the Western Australian Herbarium.

Column 3 Id No.

Each Id number indicates the position in which the taxon is listed in Arthur Weston's Wandi '07 table in his copy of the Western Australian Herbarium's Max database.

Column 4 Notes

An '=' precedes names that have been previously used for the listed taxon.

'Priority' indicates Priority Flora. Priority 3 Taxa are taxa which are known from several populations, and the taxa are not believed to be under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.

Significant taxa are listed in *Bush Forever* (Government of Western Australia 2000, Volume 2, pp. 51-55, Table 13). Definitions of the Significance Codes used for taxa in Bush Forever's Table 13 and the table below are:

e Taxa endemic to the Swan Coastal Plain.
p Taxa considered to be poorly reserved.
s Significant populations (the reason why populations are significant is not specified).

Table 3-1 Vascular Plant Flora Recorded in Wandi/Mandogalup Study Area

Taxon name	Family Code	Id no.	Notes
MONOCOTYLEDONAE			
DENNSTAEDTIACEAE	011C		
Pteridium esculentum		1	
ZAMIACEAE	016A		
Macrozamia ?riedlei		2	or M. fraseri
Typhaceae	020		
***Typha orientalis**		197	
POACEAE	031		
*Aira elegans		3	
*Aira praecox		4	
Amphipogon laguroides		114	
Amphipogon turbinatus		115	
Austrodanthonia sp.		117	
Austrostipa ?compressa		113	
*Avena barbata/fatua		5	
*Brachypodium distachyon		118	
*Briza maxima		6	
*Briza minor		7	
*Bromus diandrus		8	
*Cortaderia selloana		9	
*Cynodon dactylon		207	
*Ehrharta calycina		10	
*Ehrharta longiflora		11	
*Eragrostis curvula		196	
Hemarthria uncinata var. uncinata		209	
*Holcus lanatus		119	
*lagurus ovatus		200	
*Lolium rigidum		12	
Neurachne alopecuroidea		192	
*Paspalum dilatatum		191	
*Paspalum distichum		120	
*Pennisetum clandestinum		205	
*Phalaris aquatica		13	
*Vulpia bromoides		14	
*Vulpia myuros var. megalura		130	
*Vulpia myuros var. myuros		15	

Taxon name	Family Code	Id no.	Notes
CYPERACEAE	032		
Baumea articulata		16	
Baumea preissii subsp. laxa ms		121	
Baumea preissii subsp. preissii ms		122	
Carex appressa		123	
*Carex divisa		226	
Cyathochaeta teretifolia (P3)		124	Priority 3; Significance codes: p, s. Plot WS03, a dominant sedge in the spring wetland, Vegetation Unit ErOF
*Cyperus tenuiflorus		125	
Lepidosperma angustatum		126	
Lepidosperma longitudinale		17	
Lepidosperma obtusum		128	
Lepidosperma aff. squamatum		171	
Lepidosperma sp. Margaret River		127	
Lepidosperma sp. Scarp compact		181	
Lepidosperma sp.		215	
Mesomelaena pseudostygia		18	
Schoenus clandestinus		129	
Schoenus curvifolius		19	
Schoenus sp.		214	
Tetraria capillaris		131	an unusually thin-stemmed form
Tetraria octandra		132	
Araceae	035		
*Zantedeschia aethiopica		20	
Restionaceae	039		
Desmocladus flexuosus		21	
Dielsia stenostachya		133	Significance code: e. Several Plots and vegetation units; especially robust in the spring wetland, Vegetation Unit ErOF
Hypolaena exsulca		134	
Hypolaena pubescens		135	
Lyginia imberbis		22	
Meeboldina scariosa		136	
JUNCACEAE	052		
Juncus pallidus		146	
Juncus planifolius		147	
DASYPOGONACEAE	054C		
Calectasia narragara		25	

Taxon name	Family Code	Id no.	Notes
Dasypogon bromeliifolius		26	
Lomandra caespitosa		137	
Lomandra hermaphrodita		27	
XANTHORRHOEACEAE	054D		
Xanthorrhoea preissii		28	
PHORMIACEAE	054E		
Dianella revoluta		29	
ANTHERICACEAE	054F		
Arnocrinum preissii		30	
Chamaescilla corymbosa var. corymbosa		138	
Corynotheca micrantha var. micrantha		31	
Laxmannia sp.		35	
Laxmannia squarrosa		141	
Sowerbaea laxiflora		190	
Thysanotus sparteus		139	
Tricoryne elatior		32	
ASPHODELACEAE	054G		
***ASPHODELUS FISTULOSUS**		211	
COLCHICACEAE	054J		
Burchardia bairdiae		140	
Burchardia umbellata		33	=B. congesta
HAEMODORACEAE	055		
Anigozanthos humilis		218	
Anigozanthos manglesii		23	
Conostylis aculeata		142	
Conostylis aculeata subsp. preissii		143	
Conostylis juncea		144	
Conostylis setigera subsp. setigera		145	
Phlebocarya ciliata		24	
IRIDACEAE	060		
*Gladiolus caryophyllaceus		36	
Patersonia occidentalis		37	
*Romulea rosea		148	
ORCHIDACEAE	066		
Caladenia flava		182	
Caladenia latifolia		34	
*Disa bracteata		216	
Diuris sp.		184	

Taxon name	Family Code	Id no.	Notes
Microtis media subsp. media		38	
Pterostylis vittata		183	
DICOTYLEDONAE			
CASUARINACEAE	070		
Allocasuarina fraseriana		39	
Allocasuarina humilis		149	
MORACEAE	087		
*Ficus carica		40	
PROTEACEAE	090		
Adenanthos cygnorum subsp. cygnorum		41	
Banksia attenuata		42	
Banksia grandis		43	
Banksia ilicifolia		44	
Banksia littoralis		45	
Banksia menziesii		46	
Hakea prostrata		198	
Persoonia saccata		199	
Petrophile linearis		47	
Stirlingia latifolia		48	
Synaphea petiolaris subsp. petiolaris		49	
Xylomelum occidentale		185	
LORANTHACEAE	097		
Nuytsia floribunda		50	
POLYGONACEAE	103		
Persicaria decipiens		212	
*Rumex conglomeratus		161	
*Rumex crispus		193	
PHYTOLACCACEAE	109		
*Phytolacca octandra		162	
AIZOACEAE	110		
*Carpobrotus edulis		51	
LAURACEAE	131		
Cassytha flava		163	
Cassytha racemosa		164	
BRASSICACEAE	138		
***BRASSICA TOURNEFORTII**		217	
DROSERACEAE	143		

Taxon name	Family Code	Id no.	Notes
DROSERA SP.		206	
CRASSULACEAE	149		
Crassula colorata var. acuminata		166	
MIMOSACEAE	163		
Acacia alata		151	
Acacia huegelii		52	
*Acacia longifolia subsp. longifolia		53	
Acacia pulchella		54	
Acacia stenoptera		55	
PAPILIONACEAE	165		
Aotus gracillima		152	
Bossiaea eriocarpa		56	
Daviesia triflora		154	
Euchilopsis linearis		153	
Gastrolobium capitatum		57	=Nemcia capitata
Gastrolobium ebracteolatum		155	=Oxylobium lineare
Gompholobium tomentosum		58	
Hardenbergia comptoniana		59	
Hovea pungens		60	
Hovea trisperma var. trisperma		61	
Jacksonia furcellata		62	
Jacksonia sternbergiana		63	
Kennedia prostrata		64	
*Lotus uliginosus		156	
Mirbelia dilatata		157	
Pultenaea reticulata		65	
Viminaria juncea		160	
GERANIACEAE	167		
*Pelargonium capitatum		158	
Pelargonium littorale		159	
RUTACEAE	175		
Boronia crenulata var. crenulata		170	
Philotheca spicata		66	
Meliaceae	178		
*Melia azedarach		195	
POLYGALACEAE	183		
Comesperma calymega		67	
Euphorbiaceae	185		

Taxon name	Family Code	Id no.	Notes
*Euphorbia peplus		187	
*Euphorbia terracina		188	
Monotaxis occidentalis		221	
DILLENIACEAE	226		
Hibbertia hypericoides		68	
Hibbertia perfoliata		69	
Hibbertia racemosa		70	
Hibbertia vaginata		167	
VIOLACEAE	243		
HYBANTHUS CALYCINUS		219	
MYRTACEAE	273		
Astartea fascicularis		71	
Astartea scoparia		72	
Baeckea camphorosmae		73	
Calytrix flavescens		74	
Corymbia calophylla		78	=Eucalyptus calophylla
Eucalyptus gomphocephala		76	
Eucalyptus marginata		75	
Eucalyptus rudis		77	
Eucalyptus todtiana		79	
Hypocalymma angustifolium		80	
Hypocalymma robustum		81	
Kunzea glabrescens		82	=K. ericifolia, K. vestita
Leptospermum erubescens		189	
Leptospermum laevigatum		201	
Leptospermum spinescens		83	
Melaleuca preissiana		84	
Melaleuca rhaphiophylla		85	
Melaleuca teretifolia		86	
Melaleuca thymoides		87	
Scholtzia involucrata		88	
Taxandria linearifolia ms		89	=Agonis linearifolia
HALORAGACEAE	276		
Gonocarpus pithyoides		172	
APIACEAE	281		
Centella asiatica		90	
Platysace filiformis		173	
Trachymene pilosa		91	

Taxon name	Family Code	Id no.	Notes
Xanthosia huegelii		92	
EPACRIDACEAE	288		
Astroloma pallidum		93	
Brachyloma preissii		94	
Conostephium pendulum		95	
Leucopogon australis		175	
Leucopogon conostephioides		96	
Lysinema elegans		193	Significance codes: p, s, e. BLW-OT(J) W of Bodeman Rd.
PRIMULACEAE	293		
*Anagallis arvensis		97	
LOGANIACEAE	302		
Phyllangium paradoxum		174	
ASCLEPIADACEAE	305		
*Gomphocarpus fruticosus		98	
SOLANACEAE	315		
*Physalis peruviana		168	
*Solanum nigrum		99	
OROBANCHACEAE	320		
***OROBANCHE MINOR**		210	
MYOPORACEAE	326		
MYOPORUM CAPRARIOIDES		220	
RUBIACEAE	331		
OPERCULARIA HISPIDULA		208	
LOBELIACEAE	340		
Lobelia alata		100	
GOODENIACEAE	341		
Dampiera coronata		223	
Dampiera linearis		101	
Lechenaultia floribunda		102	
Scaevola calliptera		150	
Scaevola canescens		103	
STYLIDIACEAE	343		
Levenhookia ?preissii		176	
Stylidium brunonianum		104	
Stylidium saxifragoides		177	=S. ciliatum sens lat.
Stylidium junceum		105	
Stylidium piliferum		106	
Stylidium repens		107	

Taxon name	Family Code	Id no.	Notes
ASTERACEAE	345		
*Arctotheca calendula		186	
*Carduus ?pycnocephalus		108	
*Conyza parva		203	
*Conyza sumatrensis		204	
Hyalosperma cotula		109	
*Hypochaeris glabra		110	
*Hypochaeris radicata		194	
*Lactuca serriola		202	
Lagenophora huegelii		179	
Podolepis lessonii		178	
Quinetia urvillei		222	
*Senecio diaschides		180	
Siloxerus humifusus		169	
*Sonchus oleraceus		111	
*Ursinia anthemoides		112	

ASW 16/03/07

RPS

APPENDIX 4

Vegetation Structure Classes and Condition Scale Tables

APPENDIX 4: Vegetation Structure Classes and Condition Scale Tables

Vegetation Structure Classes (Layers)

These vegetation structure classes are the ones defined and used in Bush Forever (2000, Volume 2, Table 11 and p. 493) to describe vegetation in Bush Forever sites, except that (1) a bracketed name refers to a dominant that has fewer plants and provides significantly less cover than others, and that (2) 'scattered' refers to trees, low trees, tall shrubs and low shrubs that have <2% cover). 'Sedges' are in Table 11 but not on p. 493.

Life Form/ Height Class	Canopy Cover (percentage)			
	100%–70%	**70%–30%**	**30%–10%**	**10%–2%**
Trees 10–30 m Trees < 10 m	Closed Forest Low Closed Forest	Open Forest Low Open Forest	Woodland Low Woodland	Open Woodland Low Open Woodland
Shrub Mallee	Closed Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs > 2 m Shrubs 1–2 m Shrubs <1 m	Closed Tall Scrub Closed Heath Closed Low Heath	Tall Open Scrub Open Heath Open Low Heath	Tall Shrubland Shrubland Low Shrubland	Tall Open Shrubland Open Shrubland Low Open Shrubland
Grasses	Closed Grassland	Grassland	Open Grassland	Very Open Grassland
Herbs	Closed Herbland	Herbland	Open Herbland	Very Open Herbland
Sedges	Closed Sedgeland	Sedgeland	Open Sedgeland	Very Open Sedgeland

Vegetation Condition Scale

This condition scale is the one used in *Bush Forever* (2000, Volume 2, Table 12 and p. 494) to describe condition of vegetation in Bush Forever sites. Assessment of condition is at least as much of understorey strata as of overstorey

P	Pristine	No Obvious Signs of Disturbance
E	Excellent	Vegetation structure intact, disturbance affecting individual species (plants?); weeds are non-aggressive species
V, VG	Very Good	Vegetation structure altered; obvious signs of disturbance
G	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance; basic vegetation structure or ability to regenerate it is retained
D	Degraded	Basic vegetation structure severely impacted by disturbance; scope for regeneration but not to a state approaching good (sic) condition without intensive management
C, CD	Completely Degraded	Vegetation structure not intact; the area completely or almost completely without native species ('parkland cleared').

ASW 8/03/07

Appendix 6
Threatened Flora Survey

Our Reference: CO-0008-2013

21 March 2014

Julia Morgan
Associate
Strategen Environmental Consultants
Level 2, 322 Hay St
Subiaco WA 6008

Targeted Declared Rare Flora Survey of Proposed Mandogalup Development Site

Dear Julia,

Woodman Environmental Consulting Pty Ltd (Woodman Environmental) were requested by Strategen Environmental Consultants (Strategen) in 2013 to conduct a survey of remnant vegetation on private property at a proposed development site at Mandogalup, located in the southern Perth metropolitan region (Figure 1). The survey was specifically to search for the orchid species ***Drakaea elastica*** and ***Caladenia huegelii,*** both of which are listed as Declared Rare Flora (DRF) under the Western Australian ***Wildlife Conservation Act 1950,*** and as Endangered under the Federal ***Environment Protection and Biodiversity Conservation Act 1999,*** as potential habitat for these species had been identified during a survey of the development site by Cardno BSD Pty Ltd in 2005.

A large amount of remnant vegetation on the property had previously been surveyed for these taxa in 2012 by Plantecology Consulting. However, some remnant vegetation in the area had not been surveyed for either species. Woodman Environmental were therefore contracted to undertake survey for ***Drakaea elastica*** over all remnant vegetation on the property during a time suitable for survey for this species, and survey for ***Caladenia huegelii*** habitat (and leaves if present) over all remnant vegetation during this time, with the view of conducting a follow-up survey should appropriate habitat or leaves be recorded. The results of this survey, as well as the previous survey by Plantecology Consulting, are presented in this letter.

Survey Methods and Results

Plantecology Consulting surveyed an area of remnant vegetation on the property for ***Drakaea elastica, Caladenia huegelii*** and several other taxa of conservation significance on October 23rd and 24th 2012. The area surveyed is shown on Figure 1 (attached), and is referred to as Area 1. Experienced botanists walked closely spaced transects through all remnant vegetation, with transect spacing varying between 5 m in likely ***Drakaea elastica*** habitat, to 10 m in other woodland habitats. Location details and number of individuals of any conservation significant flora encountered were recorded. No individuals of ***Drakaea elastica*** or ***Caladenia huegelii*** were recorded during the survey. No other taxa listed as DRF were recorded, however 1

location of the DPaW-classified Priority species ***Jacksonia sericea*** (P4) was recorded, with a single individual noted. This location is shown on Figure 1.

Experienced botanists from Woodman Environmental surveyed Area 1 for ***Drakaea elastica*** on the 30th August 2013. DPaW advises that searches for ***Drakaea elastica*** are required to be undertaken in late July – August, as the leaves of this species, which are diagnostic and are the most visible part of the plant, are most visible during this period. Additionally, Area 1 and 2 other small areas of remnant vegetation were inspected on this date to determine if these areas constituted suitable habitat for ***Caladenia huegelii***, and to conduct detailed searching for ***Drakaea elastica*** in the 2 other areas of remnant vegetation if suitable habitat was identified. These areas are also shown on Figure 1, and are referred to as Areas 2 and 3.

Wandering transects were walked through all areas to initially determine suitability of habitat. Closely spaced transects (between 5 and 10 m apart) were then walked in areas deemed potentially suitable for ***Drakaea elastica.*** Location details and number of individuals of any conservation significant flora encountered were recorded.

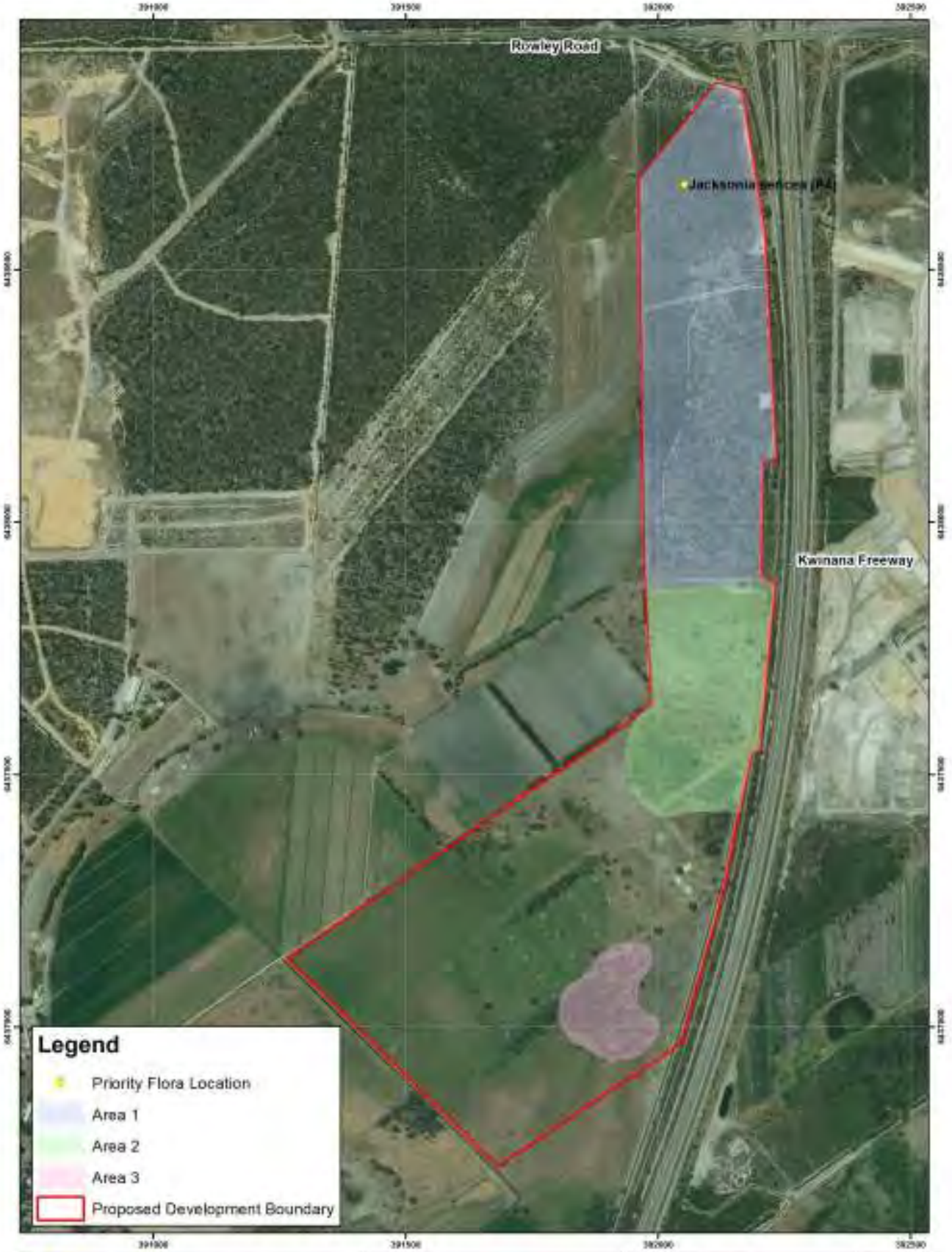
No individuals of ***Drakaea elastica*** were recorded in Area 1 by Woodman Environmental. No leaves or plants with flower buds that potentially represented ***Caladenia huegelii*** were recorded in Area 1. Following inspection of Areas 2 and 3, the majority of the vegetation in both areas was determined as inappropriate for both ***Drakaea elastica*** and ***Caladenia huegelii,*** as it consisted of dense ***Eucalyptus rudis*** forest over introduced species. A small section of Area 2 may have represented appropriate habitat for both orchids, with mixed ***Banksia attenuata, Banksia menziesii*** and ***Eucalyptus marginata*** woodland, however this section was highly degraded, with virtually no native understorey remaining. This section was therefore also deemed inappropriate habitat for both species. Given that Area 1 has previously been surveyed for ***Caladenia huegelii*** by Plantecology Consulting at an appropriate time of year, it was determined that no further survey for this species would be required in this area. It was also determined that no further survey for ***Caladenia huegelii*** in Areas 2 and 3 would be required, based on the absence of any appropriate habitat.

Conclusion

In summary, ***Drakaea elastica*** and ***Caladenia huegelii*** have not been recorded in any remnant vegetation within the proposed development site at Mandogalup, despite detailed searching of appropriate habitat. One conservation significant taxon, ***Jacksonia sericea*** (P4), has been recorded in the proposed development site, with a single individual recorded. Removal of the individual of this species during future development is not considered to constitute a significant impact to this taxon.

Yours Sincerely,

David Coultas
Senior Botanist
Woodman Environmental Consulting Pty Ltd



woodmanenvironmentalconsulting	Orchid Search Mandogalup Proposed Development Site	Author: David Coultas	Figure 1
		WEC Ref: Strategen13-32-01	
		Filename: Strategen13-32-01-f01.mxd	
This map should only be used in conjunction with WEC report Strategen13-32-01	Revision: A - September 2013	Scale: 1:6,500 (A3) Grid: MGA Zone 50	

Appendix 7
Mandogalup Urban Development Site
Lyon Road, Mandogalup Tree Survey
(Paperbark Technologies, 2014)

Mandogalup Urban Development Site
Lyon Rd, Mandogalup

Tree survey

July 2014

Andrew Morrissey
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Paperbark Technologies Pty Ltd
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BRIEF:

Strategen has commissioned this consultant to inspect and submit a report in respect of 26 nominated trees located within Lot 9500, Pt Lot 9006 and Pt Lot 9002 Lyon Rd Mandogalup in accordance with the Mandogalup Local Structural Plan (LSP) as indicated on the aerial map SK0004 Mandogalup – Trees of Importance dated 13/05/2014.

The objective of the survey was to undertake an inspection of each tree to confirm the trees species, height and canopy spread, health of the tree, structure of the tree, diameter taken at breast height (DBH), age of the tree, identify tree problems and if any recommended works are required. In addition to the visual tree assessment, tree protection zones (TPZ) and structural root zone (SRZ) details have been provided to assist designing around the retained trees. Finally each tree has been assessed in relation to inclusion in an urban setting and whether the tree/species and structural condition is considered suitable.

The inspection consisted of several parts.

- Examination, observation and documenting the health, the condition and tree inventory details.
- Provide TPZ and SRZ radius details for each tree recommended to be retained.
- Provide advice as to whether each tree is considered suitable for inclusion in an urban development based upon species characteristics, health and structural condition.

This consultant confirms that the site inspections were carried out between the 3rd of July and 8th of July 2014 with a total number of 26 trees audited.

FORM AND APPROACH:

This consultant referred to the aerial photo of the site SK0004 Mandogalup – Trees of Importance dated 13/05/2014 and, with assistance, located and tagged each of the 26 trees. Where tags corresponding with the number of the tree as noted on the aerial photo of the site were available they were used, otherwise tags numbering 376 - 394 were used and the appropriate designated numerical character was then documented within the tree survey data to assist identification.

Below are the definitions for the captured information provided.

Botanical and common name Information:

Botanical names are listed detailing the generic name followed by the specific epithet. The variety is named where applicable. The common name for each tree is also provided and is the name of a species that is not its botanical or scientific name. The common name is a general name given to a tree species and each species may have many common names depending on its location and language. Only the scientific and botanical names should be accepted to identify an exact tree species.

Tree Age:

Tree age is based on the age of the tree that would be considered typical for the species in the general area. It is not based on the health of the tree.

Young
The tree has recently been planted or self-sown (within the last 3 – 5 years).

Semi mature
The tree has become established in the site and may be approaching its expected mature size. If correctly maintained the specimen will continue to grow to maturity.

Mature
Usually the tree will have reached the expected size for the species in the site.

Post mature
The tree has passed the mature stage of its life and is characterized by both a very slow growth rate and by intolerance to disturbances. The post-mature tree has limited energy reserves to fight invading diseases and insects, especially pruning wounds. Removal of live tissue is something to avoid.

Severe decline
The tree is in its final stages of life, the tree is beginning to lose its ability to defend itself. It is at this stage that the tree becomes susceptible to pests and disease. The tree will be assessed for hazards and may require reduction pruning or removal.

Note
It is important to note that tree age is not directly related to tree health. For example: It is possible for a young tree to have very poor health and a mature tree to have good health.

Tree health:

Good
The tree is demonstrating good or exceptional growth for the species. The tree should exhibit a full canopy of foliage, and have only minor pest or diseases problems. Foliage colour, size and density should be typical of a healthy specimen of that species.

Fair
The tree is in reasonable condition and growing well for the species. The tree should exhibit an adequate canopy of foliage. There may be some dead wood present in the crown, some grazing by insects or animals may be evident and/or foliage colour, size or density may be atypical for a healthy specimen of that species.

Poor
The tree is not growing to its full capacity; extension growth of the laterals may be minimal. The canopy may be thinning or sparse. Large amounts of dead wood may be evident throughout the crown. Significant pest and disease problems may be evident or symptoms of stress indicating tree decline.

Very poor
The tree appears to be in a state of decline and the canopy may be very thin and sparse. A significant volume of deadwood may be present in the canopy or pest and disease problems may be causing a severe decline in tree health.

Dead
The tree is dead.

Tree Structure:

Each tree surveyed was examined in detail to ascertain its overall structural condition.

The assessed tree was then placed into one of five categories:

- ***Good:*** The tree has a well-defined and balanced crown. Branch unions appear to be strong, with no defects evident in the trunk or the branches. Major limbs are well defined. The tree would be considered a good example of the species. Probability of significant failure is highly unlikely.

- ***Fair:*** The tree has some minor problems in the structure of the crown. The crown may be slightly out of balance, and some branch unions or branches may be exhibiting minor structural faults. If the tree is single trunked, this may be on a slight lean or be exhibiting minor defects. Probability of significant failure is low.

- ***Poor:*** The tree may have a poorly structured crown. The crown may be unbalanced or exhibit large gaps. Major limbs may not be well defined. Branches may be rubbing or crossing over. Branch unions may be poor or faulty at the point of attachment. The tree may have suffered major root damage. Probability of significant failure is moderate.

- ***Very Poor:*** The tree has a poorly structured crown. The crown is unbalanced or exhibits large gaps. Major limbs are not well defined. Branch unions may be poor or faulty at the point of attachment. A section of the tree has failed or is in imminent danger of failure. Active failure may be present or failure is probable in the immediate future.

- ***Has Failed:*** A significant section of the tree or the whole tree has failed.

Suitable for retention
The tree is considered suitable to retain within an urban development due to its current health and structural condition. The characteristics of the tree are considered appropriate for inclusion within a high use area.

Not suitable for retention
The tree is not considered suitable to retain within an urban development due to its poor health or poor structural condition. The characteristics of this tree are considered inappropriate for inclusion within a high use area due to being a very large tree or species prone to shedding limbs.

Possibly suitable for retention
The tree may be suitable for retention however this is dependent on the final design around the tree and what target is within falling distance of the tree. This tree would require re-assessment once the design stage is completed. This is due to the tree being a large sized tree or the species has an increased propensity to shed limbs or the tree displays some structural issues such as decay. The tree may be able to be retained in public open space or large verge areas. The tree was in fair health and fair structural condition at the time of inspection displaying some problems. Some trees which have been noted as possibly suitable are potential habitat specimens.

TPZ – Tree Protection zone
As per the Australian Standards AS 4970-2009 ***Protection of trees on development sites*** the tree protection zone (TPZ) is the principal means of protecting trees on development sites. The TPZ is a combination of the root area and crown area requiring protection. It is an area isolated from construction disturbance, so that the tree remains viable.

The radius of the TPZ is calculated for each tree by multiplying its DBH x 12.
Eg. DBH is 0.5m x 12 = 6m radius (TPZ = 6m measured from the centre of the trunk at ground level.)
If the proposed encroachment is greater than 10% into the TPZ or SRZ the project Arborist must demonstrate that the tree(s) would remain viable. Once the design is completed the project Arborist may need to re-inspect selected trees to ensure the trees are adequately protected. The purpose of this is to determine the potential impact on trees proposed to be retained.

SRZ – Structural Root zone
This consultant advises that a structural root zone area of a tree is required for tree stability. Using Australian Standards AS 4970-2009 ***Protection of trees on development sites*** the structural root zone area can be calculated when major encroachment into a TPZ is proposed. An indicative SRZ radius can be determined from the trunk diameter measured immediately above the buttress using the following formula. SRZ radius = $(D \times 50)^{0.42} \times 0.64$ or using the following guide from AS 4970-2009. Eg. Diameter at root flare is 0.8m (red circle) and using the graph below a 3m SRZ radius is required. This is measured from the centre of the trunk at ground level.

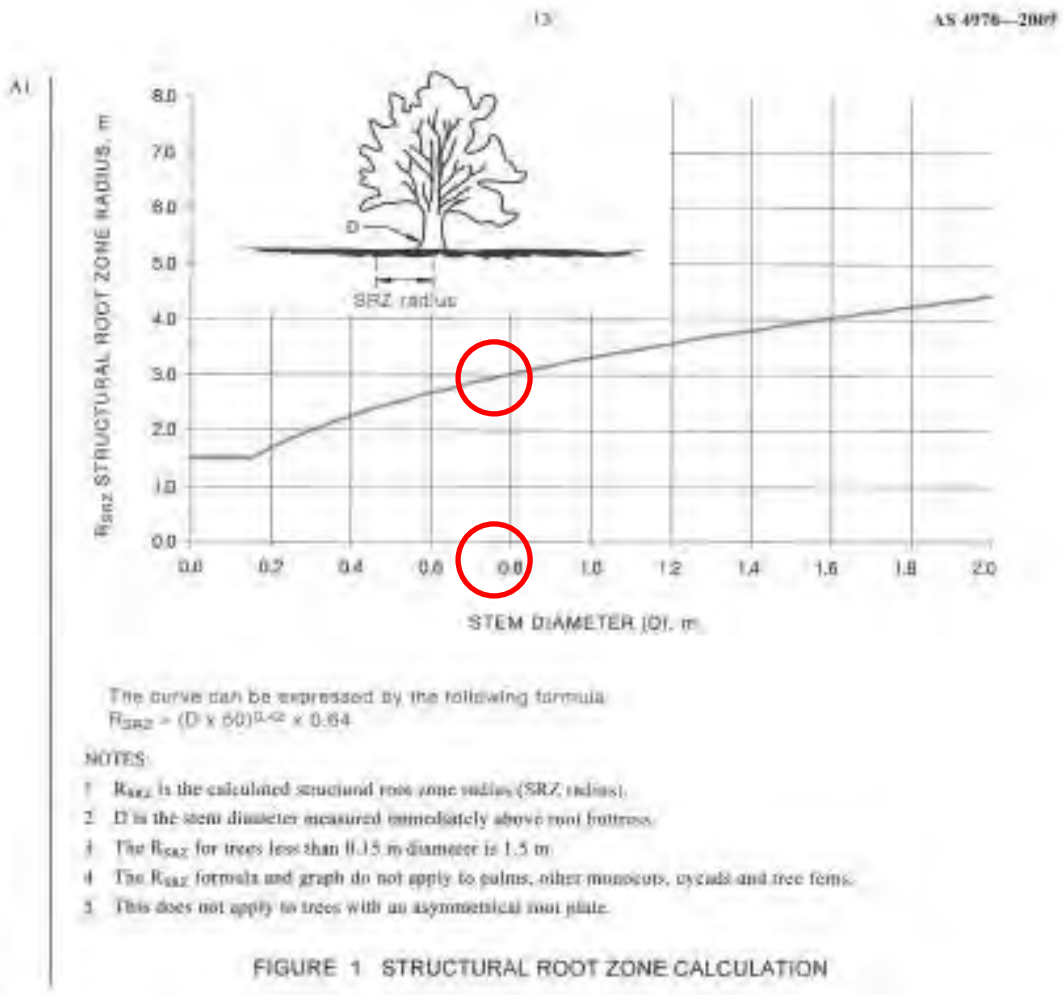
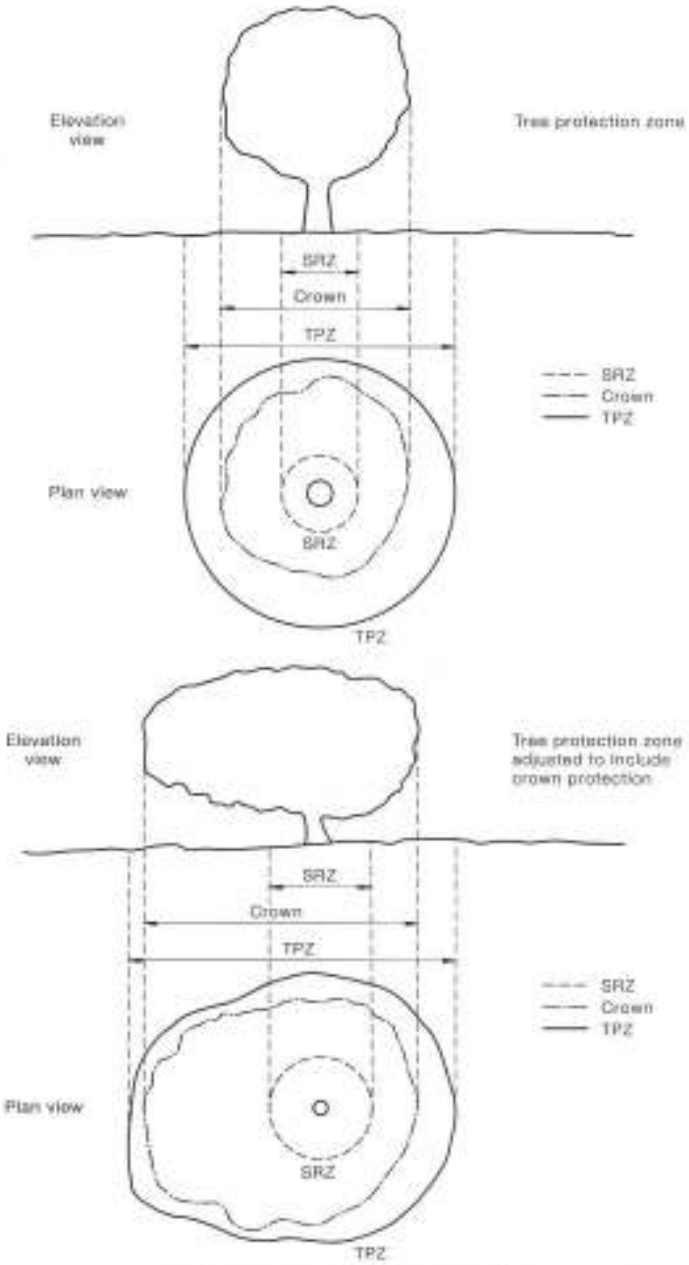


FIGURE 1 STRUCTURAL ROOT ZONE CALCULATION

The SRZ is only required to be used when major encroachment into a TPZ is proposed. The SRZ radius is not a calculation in which all roots outside the SRZ radius can be severed otherwise to do so will cause the tree to become structurally unstable and a high risk of whole tree failure. Encroachment within the TPZ and SRZ which may adversely affect root systems requires approval from the Project Arborist to ensure the tree remains structurally stable.

Below is a diagram of an indicative tree protection zone



NOTE: Refer to Clause 3.2 for calculation of TPZ.

FIGURE 2 INDICATIVE TREE PROTECTION ZONE

Example of Tree Protection fencing

It is recommended that tree protection fencing be erected around the tree protection zone.

LEGEND:
1 Chain wire mesh panels with shade cloth (if required) attached, held in place with concrete feet.
2 Alternative plywood or wooden paling fence panels. This fencing material also prevents building materials or soil entering the TPZ.
3 Mulch installation across surface of TPZ (at the discretion of the project arborist). No excavation, construction activity, grade changes, surface treatment or storage of materials of any kind is permitted within the TPZ.
4 Bracing is permissible within the TPZ. Installation of supports should avoid damaging roots.

FIGURE 3 PROTECTIVE FENCING FROM AS 4970-2009

Tree Survey Details over leaf.

Tree No. (tag #)	Botanical and Common name	Approx. Height (m)	Canopy Spread (m)	DBH (cm)	DRF (cm)	Age class	Health & Structural Condition	TPZ (m) (radius)	SRZ (m) (radius)	Comments and Recommendations
71(71)	*Eucalyptus marginata* Jarrah	14	9.5	66.5	73.5	Mature	Fair health and fair structural condition displaying previous fire damage and basal cavity. Leaning. Suckers developing around the base. Canopy displays a healthy foliage cover. Major dead wood. Bark wound and hollows visible.	8.0	2.9	Not suitable for retention due to size and structural condition.
72(72)	*Eucalyptus marginata* Jarrah	17.5	12.5	82.5	103	Mature	Good health and poor structural condition displaying a significant fire damage and open basal cavity and prominent basal flare. Upper canopy displays healthy foliage and extension growth. Major dead wood held throughout. Central cavities within first order limbs visible.	9.9	3.4	Not suitable for retention due to size and structural condition.
73(73)	*Eucalyptus marginata* Jarrah	17.5	14.0	83.5	104	Mature	Good health and poor structural condition displaying significant fire damage and an open basal cavity. A suitable cover of healthy foliage held in the upper canopy, some minor epicormic growth. Major dead wood held throughout. Leaning. Central cavities evident within major limbs.	10.0	3.4	Not suitable for retention due to size and structural condition.

77(77)	*Eucalyptus marginata* Jarrah	23.5	12.0	115	140.5	Mature	Good health and fair structural condition displaying significant fire damage with an open basal cavity and prominent basal flare. Deadwood held throughout, some of a size and weight to represent a hazard. Previous major limb failure Central cavities within major limbs evident.	13.8	3.8	Not suitable for retention due to size and structural condition.
80(80)	*Eucalyptus marginata* Jarrah	18.0	10.5	82.5	94	Mature	Good health and fair structural condition displaying a suitable canopy of healthy foliage and healthy extension growth. Some dieback evident and epicormic growth is developing throughout. Fire damage and a significant open cavity at the base of the tree extend several metres up the trunk. Bird damage is evident within major limb forks and the previous failure of second order limbs is evident. Dead wood is predominantly held within the upper canopy.	9.9	3.2	Possibly suitable for retention within a within a POS. Major dead wood removal required.
91(91)	*Eucalyptus marginata* Jarrah	13.5	11.0	72	76.5	Mature	Fair health and poor structural condition displaying canopy dieback and epicormic growth held throughout and developing close to the base of the tree. Leaning. Mechanical wounding of the trunk and previous significant limb failure evident. No visible evidence of decay.	8.6	3	Not suitable for retention due to size and structural condition.

95(95)	*Eucalyptus marginata* Jarrah	24.5	8.0	143.5	164	Post mature	This tree is in decline with limited canopy structure remaining. Significant fire damage and an open basal cavity which extends up much of the trunk are evident. Major dead wood. Active bees. Termite damage and active termites evident.	17.2	4.1	Possibly suitable for retention as a habitat tree only if located in a low target area within the POS. Canopy reduction pruning, major dead wood removal and termite treatment required.
96(96)	*Eucalyptus marginata* Jarrah	18.5	11.5	84	91.5	Mature	Good health and fair structural condition displaying a suitable canopy density and healthy foliage and healthy extension growth. Mature epicormic growth has developed within the lower canopy. Codominant stems. Major dead wood. Previous major limb failure. Evidence of central cavity/nesting hollows within major limbs.	10.1	3.2	Possibly suitable for retention within POS with major dead wood removal.
101(386)	*Eucalyptus rudis* Flooded Gum	21.5	8.5	107	145	Mature	Good health and fair structural condition with twin stems and holding a small amount of dead wood some of a size and weight to represent a hazard. Limited epicormic growth.	12.9	3.9	Suitable for retention.

103(384)	*Eucalyptus rudis* Flooded Gum	12.5	9.5	79	96.5	Mature	Poor health and fair structural condition displaying a poorly formed canopy with significant dieback, previous major limb failure, major deadwood held throughout and epicormic growth developing in the lower and central canopy.	9.5	3.3	Possibly suitable retention within a POS with canopy reduction and major dead wood removal.
105(382)	*Eucalyptus rudis* Flooded Gum	20.0	11.0	105	119.5	Mature	Fair health and poor structural condition displaying multiple stems forming narrow included forks. Multiple previous limb failure evident on the northern side.	12.6	3.6	Possibly suitable retention within low target areas of a POS with canopy reduction with canopy reduction and major dead wood removal.
106(385)	*Eucalyptus rudis* Flooded Gum	19.0	11.5	73	88	Mature	Fair health and fair structural condition with codominant stems, previous limb failure from the central canopy, some deadwood held in the lower canopy and limited epicormic growth.	8.8	3.1	Possibly suitable for retention within a POS.
107(380)	*Eucalyptus marginata* Jarrah	23.0	13.0	180	215	Mature	Post mature tree in decline displaying extensive fire damage at the base and extending up the trunk and previous significant limb failure. Active termites and fungal fruiting bodies evident on the trunk.	21.6	4.6	Not suitable for retention due to structural condition.

108(381)	*Eucalyptus rudis* Flooded Gum	21.0	11.5	67.5	73	Mature	Good health and good structural condition displaying a sound branch structure and codominant stems supporting a full and healthy canopy holding a small amount of minor deadwood.	8.1	2.9	Suitable for retention.
110(376)	*Eucalyptus rudis* Flooded Gum	20.0	12.0	87	101	Mature	Poor health and poor structural condition displaying significant canopy dieback and holding major deadwood. Epicormic growth developing throughout.	10.4	3.3	Possibly suitable for retention within a POS with canopy reduction with canopy reduction and major dead wood removal.
111(378)	*Eucalyptus rudis* Flooded Gum	20.0	13.0	98	125	Mature	Good health and fair structural condition displaying twin stems supporting a healthy canopy with sporadic predominantly minor dead wood. Leaning in a northerly direction.	11.8	3.6	Suitable for retention.
112(379)	*Eucalyptus rudis* Flooded Gum	19.0	8.5	70	85	Mature	Good health and fair structural condition displaying a sound limb structure, holding a small amount of predominantly minor deadwood and limited epicormic growth. Leaning in a westerly direction.	8.4	3.1	Suitable for retention.
144(388)	*Eucalyptus marginata* Jarrah	10	6.5	87	104	Mature	This tree is dead. Open cavities and decay extending up the trunk and to major limbs was evident.	NA	NA	Not suitable for retention.

149(389)	*Eucalyptus rudis* Flooded Gum	15	9.5	87	93.5	Mature	Poor health and poor structural condition displaying codominant stems, significant dieback and canopy decline with major dead wood held in the lower canopy. Northern stem appears overextended. Termite damage visible.	10.4	3.2	Possibly suitable for retention within a POS with canopy reduction with canopy reduction and major dead wood removal.
153(390)	*Eucalyptus rudis* Flooded Gum	10.5	6.0	95	117	Mature	This tree is dead. Active termites were evident within the outer wood and at the base of the tree.	NA	NA	Not suitable for retention.
156(391)	*Eucalyptus rudis* Flooded Gum	12.5m	7.5	64	71	Mature	Good health and fair structural condition. Leaning. Previous lower limb removal from the southern side and some canopy dieback evident and dead wood predominantly held in the upper canopy. Some major deadwood.	7.7	2.9	Possibly suitable for retention within a POS with major dead wood removal.
163(392)	*Eucalyptus rudis* Flooded Gum	16	12.0	115	146.5	Mature	Fair health and structural condition with multiple stems forming a crowded cluster, significantly included stem forks and major deadwood. No visible cavities or evidence of decay. Epicormic growth developing throughout.	14	3.9	Possibly suitable for retention within a POS with canopy reduction and major dead wood removal.
164(393)	*Eucalyptus rudis* Flooded Gum	15.0	6.5	91.5	106.5	Mature	Fair health and structural condition with secondary stems forming narrow included forks. Dieback evident with deadwood held throughout, some of a size and weight to represent a hazard.	11	3.4	Possibly suitable for retention within a POS with canopy reduction and major dead wood removal.

102(387)	*Eucalyptus rudis* Flooded Gum	18.0	12.0	112	134	Mature	Multi stemmed tree in poor health and structural condition displaying significant canopy decline with major dead wood held throughout and visible cavities within major limbs. Limited epicormic growth.	13.5	3.7	Possibly suitable for retention within a POS with canopy reduction and major dead wood removal.
104(383)	*Eucalyptus rudis* Flooded Gum	22.0	8.5	75.5	91	Mature	Fair health and structural condition displaying a secondary stem developing at the base and codominant stems forming the canopy structure. Previous major limb failure evident, some canopy dieback and epicormic growth developing in the lower and central canopy.	9.1	3.2	Possibly suitable for retention within a POS.
109(377)	*Eucalyptus rudis* Flooded Gum	19.0	10.5	89	104	Mature	Poor health and poor structural condition with decline and dieback of major limbs in the upper canopy evident and holding major deadwood. Some epicormic growth developing.	10.7	3.4	Possibly suitable for retention within a POS with canopy reduction and major dead wood removal.

Summary

This consultant's inspection of the trees within Lot 9500, Pt Lot 9006 and Pt Lot 9002 Lyon Rd, Mandogalup revealed that they were predominantly in fair health, however two trees have died and a number of trees displayed very poor structural condition.

The tree audit identified out of the 26 specimens audited;

- 3 trees are recommended for removal due to poor structural condition or they have died.
- 5 trees are noted as not suitable to retain within the new development
- 14 trees are noted as possibly suitable. These are predominantly located within or close to areas of proposed POS and will require re-assessment in relation to the final design.
- 4 trees **are** considered suitable to retain within the new development.
- 12 trees have been recommended for remedial pruning works which consists predominantly of major deadwood pruning, however depending on the targets, minor deadwood pruning may be required at a later stage on more trees.

It is advised that all remedial tree surgery works be carried out by a competent Arborist to the relevant Australian Standards - Pruning of amenity trees 4373-2007.

The future management, maintenance and condition of the trees have a considerable bearing on their location, with safety to property and persons the main priority. Therefore each tree retained is recommended to be re-inspected in relation to its location within the target zone annually to ensure that the level of risk is deemed acceptable.

Established trees of good vigour and structure represent an asset to any development site. Trees are living organisms that require certain environmental conditions in order to maintain their value as an asset. Damage must be avoided or minimized during the development process and procedures to ensure the protection of trees must be in place at all stages.

Andrew Morrissey - Arboricultural Consultant
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Quantified Tree Risk Assessor Lic-1082/3442
Diploma of Horticulture/Arboriculture

Limitation of liability

Trees can be managed, but they cannot be controlled. To live or work near a tree involves a degree of risk.

This report only covers identifiable defects present at the time of inspection. Paperbark Technologies accepts no responsibility and cannot be held liable for any structural defect or unforeseen event/situation or adverse weather conditions that may occur after the time of inspection.

Paperbark Technologies cannot guarantee that the tree/s contained within this report will be structurally sound under all circumstances, and is not able to detect every condition that may possibly lead to the structural failure of a tree. Paperbark Technologies cannot guarantee that the recommendations made will categorically result in the tree being made safe.

Unless specifically mentioned this report will only be concerned with above ground inspections, as such all observations have been visually assessed from ground level. Trees are living organisms and as such cannot be classified as safe under any circumstances. Trees fail in ways that the arboriculture industry does not fully understand.

The recommendations are made on the basis of what can be reasonably identified at the time of inspection therefore Paperbark Technologies accepts no liability for any recommendations made.

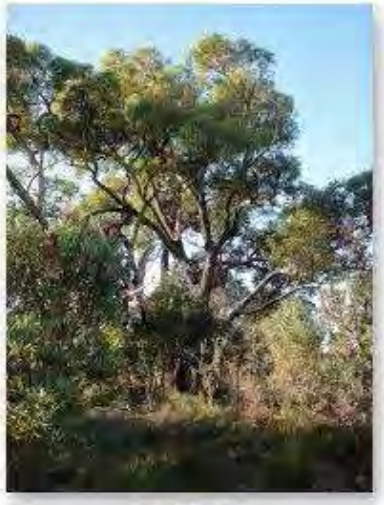
All care has been taken to obtain information from reliable sources, however Paperbark Technologies can neither guarantee or be responsible for the accuracy of information provided by others.

In the event that re inspection of the tree/s is recommended it is the client's responsibility to make arrangements with Paperbark Technologies.

Map of the site showing the location of the trees

Photos

Tree 71.JPG



Tree 72.JPG

Tree 73.JPG

Tree 77.JPG

Tree 80.JPG

Tree 91.JPG

Tree 95.JPG

Tree 96.JPG

Tree 101(386).JPG

Tree 103(384).JPG

Tree 105(382).JPG

Tree 106(385).JPG

Tree107(380).JPG

Tree108(381).JPG

Tree110(376).JPG

Tree111(378).JPG

Tree112(379).JPG

Tree144(388).JPG

Tree 149(389).JPG

Tree 153(390).JPG

Tree 156(391).JPG

Tree 163(392).JPG

Tree 164(393).JPG

Tree 102(387).JPG

Tree 104(383).JPG

Tree 109(377).JPG

Appendix 8
Assessment of Melaleuca: Mandogalup
(Arborlogic March 2016)

Rev_0; March 10, 2016

Satterley Property Group Pty Ltd
PO Box 410
South Perth WA 6951

Attention: **John Hirdman**
Cc: **Dehlia Goundrey (Strategen)**

RE: **Assessment of *Melaleuca*; Mandogalup**

Dear John,

Further to your request, please find attached my comments on the identified trees at Mandogalup.

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

Yours sincerely

JASON ROYAL

Dip. Arboriculture (UK)
Tech. Arbor A

1. Terminology

The following terms have been commonly used in this document.

"Trees" meaning the *Melaleuca* trees identified in the Stategen plan provided

"AS 4970" meaning Australian Standards 4970; Protection of Trees on Development Sites

"AS 4373" meaning Australian Standards 4373; Pruning of Amenity Trees

2. Assessment Methodology Applied

The identified Trees were assessed in accordance with 'visual tree assessment' methods[1] and principles.

This is a method based on the sciences of tree biology, physiology, tree structure, and tree bio-mechanics. It is a method widely used by arborists worldwide to identify visible signs on trees that provide an indication as to its health and structural properties at the time of inspection.

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.

The structural integrity of each tree was determined from a visual inspection of its main stem, primary (and secondary) branch unions to determine the presence of any areas considered to be a structural 'defect' or 'imperfection' such as unions with included bark, swelling, or noticeable splitting at them. Symptoms of decay, growth patterns and defects are identified and assessed as to their potential to cause whole tree, part tree or branch failure, and 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.

Species suitability for use in an urban area, and if the identified Tree is of a species that can be subject to the sudden branch failure phenomenon, or shows evidence of a history of branch failure, or looks to be a potentially problematic based its current structural condition was also considered as part of the assessment process when considering the Tree's suitability to the proposed development.

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.

[1] Field Guide for Visual Tree Assessment (VTA); The Body Language of Trees, A Handbook for Failure Analysis; C Matteck, H Breloer

3. Summary of Findings

3.1 General Comments

Two species were identified on the Site; Stout Paperbark (*Melaleuca preissiana*) and Swamp Paperbark (*Melaleuca raphiophylla*).

The health of the majority of the Trees was considered to be excellent at this time and no pest or disease pathogen that could have a major impact on their health was visible at the time of inspection.

The structural condition of the majority of the Trees was considered to be good/typical for specimens of this species. Many were noted to have multiple main stem structures from ground/near ground level which is fairly typical for specimens of these species.

A large clump of the Trees were noted to extent east-west and effectively form the one canopy. In amongst the larger Trees, a large number of smaller diameter trees of the same species were also noted to be present; creating a dense area of trees.

The table attached to this report provides further information on each of the Trees inspected.

3. Summary of Findings

3.2 Identify individual / stands of trees that are suitable for retention as a *Melaleuca* community and are not dependent on other existing environmental factors such as surrounding stands of trees which may be creating specific microclimates resulting in the trees current vitality (excluding the maintenance of groundwater levels).

Trees #134 through to #171 form a large group of trees and a large number of smaller diameter trees was noted in amongst them. Within this group there are a few individual good quality trees that could be retained as individuals. However, the development of the majority has clearly been influenced by adjacent Trees as such they are quite possibly partially reliant on the protection that they provide.

These trees are therefore recommended to be retained a group; either in its entirety or in sections should Site design require the removal of some of the Trees.

In the event that areas of the group are removed, the maintaining the density of vegetation in remaining areas (including retaining all of the smaller trees in amongst the larger ones) is seen as critical to the success of their retention and minimising impact of the sudden exposure that's likely to result.

Trees #175-#180 form their own small group of Trees and could be retained separate to the larger group nearby. Within this group Trees # 175, #178, #179 and #180 could actually be retained as individual trees in their own right.

Trees #134, #135, #137, #138, #160, #180, #181, #182, #183, #188, #190, #191 are all considered to be trees that could be retained as induvial specimens in their own right. Some impact to these trees is likely to occur as a result of clearly of surrounding vegetation, although with the correct care and management during the development process they should be anticipated to survive and adapt to the changes to their surrounds.

The aerial below highlights those Trees considered suitable to be retained as individual trees (in green).

N

3. Summary of Findings

3.3 Identify individual / stands of trees which are not considered <u>unsuitable</u> for retention based on their health and/or structural condition.

Trees #136, #138, #163, #172, #184, #185, #186 and #189 are all considered to have a low retention value due to its structural form.

Conversely Trees #134, #137, #160, #175, #178, #180, #181, 182, #191 and #198 were all considered to be very good specimens of their species, showed good health and structural form and were considered to have a 'high' retention value.

All of the other Trees including the majority in the larger area were considered to have a 'medium' retention value.

The aerial below shows the Trees with their 'retention' value overlaid.

3.4 Provide Root Protection zone distances for each tree in accordance with AS 4970 guidelines.

Root protection zones are provided on the table attached to this report.

The TPZ of all Trees are strongly recommended to be overlaid onto <u>all</u> drawings and designs of the proposed development, including ALL underground services (power, gas, water, telecommunications etc.), drainage, road pavement, cut/fill.

3. Summary of Findings

3.5 Identify any individual trees that may be suitable for transplanting within the site area.

Both species of *Melaleuca* found on this site are known to be able to be transplanted.

Of the trees on the site a large number were however **not** considered **suitable** for relocation due to their structural form (multiple main stems from ground/near ground level), or proximity to other trees and probable reliance on being retained as a group.

Trees #134, #139, #141, #148, #160, #179, #191 and #198 were however all considered to be suitable for transplanting.

Trees #165, #166, #167 were also considered suitable for transplanting, although two of these Trees would probably need to be sacrificed to enable the one to be relocated (due to extent of excavation required and probable impact to the other tree during the process).

Similarly, Trees #137, #156, #187, #195 was also considered suitable for transplanting, although adjacent Trees would probably need to be sacrificed to enable them to be relocated.

Trees #180 and #190 are possibly able to be transplanted subject to further inspection and verification from a transplant company.

The aerial below highlights those Trees considered suitable for transplanting (in green), and possibly suitable (in orange).

N

3. Summary of Findings

Melaleuca will typically require a 3-6 month preparation time frame before being relocated.

Without sufficient preparation the risk increases that the relocation process will result in the decline of the Tree shortly after being moved.

It is also generally required that the preparation phase includes a growing season (i.e. spring/summer period), and should be accounted for in any site development planning process.

Maintaining soil moisture during the preparation phase will be of critical importance to the success of their relocation, and will need to be allowed for.

Ideally relocation would occur during cooler periods of the year (i.e. late autumn through winter).

3.6 Recommend the minimum distance requirement from the canopy drip line of each tree proposed to be retained that a retaining wall of maximum 0.5m height above existing ground level (and acknowledge below ground footings) may be placed without impacting on the long term viability of the tree.

Without undertaking exploratory excavations around each tree to verify the full extent and spread of each tree's root zone at this time it is recommended to align/delineate all retaining wall and other structures outside of designated TPZ areas.

Where encroachments into a designated TPZ are found to be required, further discussion with an experienced independent arboricultural consultant is an important part of the tree protection process.

3.7 Recommended maximum levels of imported soil that can be placed within the future proposed Public Open Space, and proximity / exclusion area for imported soil to base of retained trees.

This species of tree will tolerate an extent of fill being placed over part of their root zone areas.

Typically, up to 200mm of fill is likely to have limited impact to trees of these species that are in good health; depending on the extent of each Tree's TPZ that requires the fill.

Strategies are available to allow for greater volumes of fill to be placed over the root zone of trees and mitigate the impact.

However which strategy to use would need to be based on aspects of detailed design such as level of fill required and final landscape of the area above the fill.

3.8 Provide recommendations for the ongoing monitoring principles during construction phases onsite.

It will remain important to maintain ground water and any seasonal water table fluctuations that the Trees are accustomed to during the works.

In the event that dewatering works or changes to the natural drainage of the area around the Trees is anticipated to occur then measures will be required to undertake supplementary watering to help maintain soil moisture and plant functions.

Piezometers may need to be installed within areas of the Site to monitor ground water.

3. Summary of Findings

3.9 Protection During Development; Design Stages

Effective protection of trees as part of any development must start at the design stages so that protection during physical construction stages will remain viable and achievable within the parameters of the approved design.

The TPZ of all Trees are strongly recommended to be overlaid onto all drawings and designs of the proposed development, including ALL underground services (power, gas, water, telecommunications etc.), drainage, road pavement, cut/fill.

Where encroachments into a designated TPZ are found to be required, further discussion with an experienced independent arboricultural consultant is an important part of the tree protection process.

It is of critical importance that this aspect occurs at the design stage so that any potential issues or conflicts can be recognised and addressed before construction works commence on Site.

3.10 Protection During Development; Construction Stages

3.10.1 Protective fencing

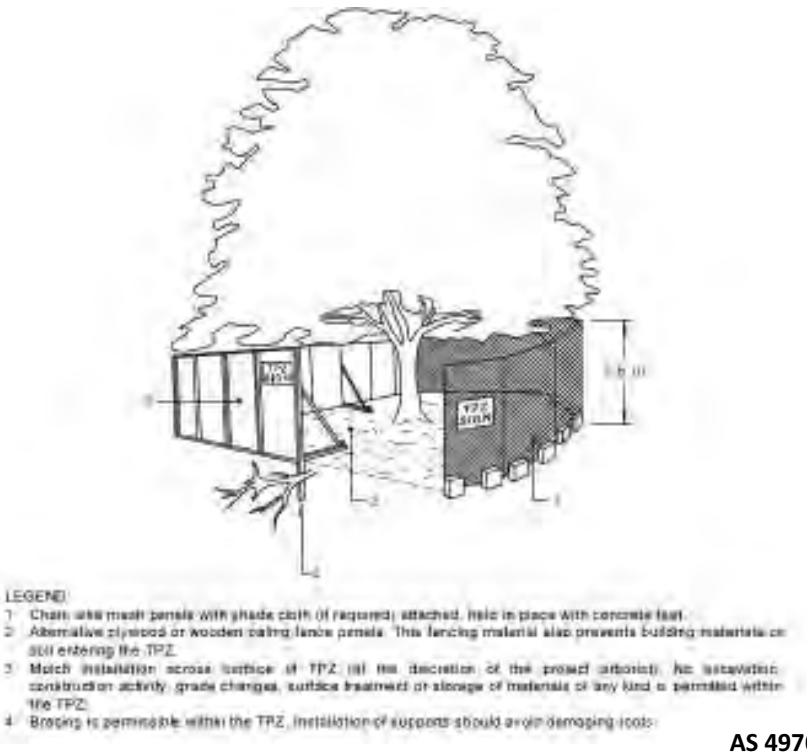
The TPZ of any Tree is recommended to be fenced off in accordance with AS 4970 guidelines PRIOR to any site clearing works.

In instances where TPZ areas overlap, a single larger TPZ is recommended to be fenced off incorporating all Trees present.

TPZ fencing is to remain in situ and undisturbed for the duration of the development.

In the event that works are required to occur within a TPZ area, and fencing is required to be altered then further discussion with the arboricultural consultant will be required.

Fig. 1 TPZ Fencing Requirements



AS 4970 guidelines

3. Summary of Findings

3.10.2 Site Clearing Works

Site clearing works are to be undertaken in a manner that does not impact on any part of any Tree's above, or below ground parts or TPZ area.

Site clearing is not to be undertaken within a TPZ area without prior discussion and approval from the arboricultural consultant.

No contact with the upper canopy of any of the Trees is to occur during site clearing works.

In the event that branches from the canopy of any Tree require removal to enable demolition works to occur, then canopy pruning will need to be undertaken prior to the demolition works occurring. All canopy pruning works must comply with AS 4373 (2007); *Pruning of Amenity Trees*. Canopy pruning works are to only be undertaken by qualified and experienced persons; minimum AQF certificate 3 arboriculture.

In the event that other trees are required to be removed adjacent a Tree that is to be retained, then the removal of the trees is to be undertaken in a manner that does not cause any damage to the above or below ground parts of the Tree being retained.

In the event that Works are required to occur in a TPZ area, further discussion with the arboricultural consultant will be required.

TPZ fencing is NOT to be altered without prior discussion and consent from the arboricultural consultant.

3.10.3 Protection during Works

The TPZ of each Tree will need to be protected in accordance with AS 4970 guidelines at all times during the works.

Once set-up, the TPZ of the Tree is to remain undisturbed during development process and treated in accordance with AS 4970 and as detailed below:

The TPZ must not at any time be utilised for the purposes of:

- Traversing and/or parking of plant machinery or vehicles
- Storage for construction or deleterious materials
- Vehicle refuelling
- Storage of surplus fill
- Preparation of chemicals and/or cement products (or within 15 metres of the TPZ)
- Areas to dump construction and general waste
- Wash down or cleaning
- Locations for site offices or toilets
- Or any activity that may harm or injure the tree above or below ground parts

All contractors involved with any part of the Works are to be made aware of the Trees, their TPZ and their protection requirements.

No Works are to occur within the TPZ without prior discussion and approval of the arboricultural consultant.

In the event that works are required to occur within a TPZ area, further discussion with the arboricultural consultant will be required.

3. Summary of Findings

3.11 Canopy Works

No canopy works are considered necessary at this time on any of the Trees in view of risk management requirements.

In the event that greater vertical clearance is required for purposes of development, further discussion will be required with the arboricultural consultant before any occur; **particularly for the Trees with low canopy form where retention of the low canopy would be important to maintain the integrity of the Tree.**

Alternative measures to canopy pruning are to be explored further before looking at undertaking canopy works.

In the event that branches from the canopy of any Tree are required to be removed then all canopy pruning works must comply with AS 4373 (2007); *Pruning of Amenity Trees*.

Canopy pruning works are to only be undertaken by qualified and experienced persons; minimum AQF certificate 3 arboriculture.

3.12 Monitoring during Works

Provision is to be made for the arboricultural consultant to be able to conduct regular periodic inspections of the Tree and its TPZ to monitor its progress and or modify its TPZ and/or ongoing maintenance schedule as necessary.

Full access and co-operation is expected from all parties involved in the development process without impediment to the arboricultural consultant's requirements.

Frequency of inspections to be determined pending the set-up of the TPZ and compliance of the contractor to its protection.

Attachments to this Report

Attachment 1; Table of Information on the Identified Trees

Attachment 2; Company Information & Disclaimer

Attachment 1; Table of Information on the Identified Trees

Attachment 2; 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;	Vero	$5 million
Personal Protection;	Macquarie	

Office/Contact Details

Postal Address:	PO Box 1025, Balcatta WA 6914
Physical Office Address:	4c/5 Mumford Place, Balcatta
Ph:	(08) 9240 7555
Fax:	(08) 9240 7522

Consultant Details

Consultant Contact: Jason Royal
Dip. Arboriculture (UK)
Tech. Arbor A

MEMBER ISA — J. Royal; 172723
Arboriculture Australia — Member No. 1254
QTRA Registered User — Lic. No. 1743

Ph:	(08) 9240 7555
Mobile:	0409 105 745
Email:	jason@arborlogic.com.au

Disclaimer

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

The contents of this Report should be read in full, and at no time shall any part of the Report be referred to unless taken in full context with the remainder of the document.

The contents of this Report may not be reissued to another party or published in part or full without Arbor logic's written permission.

Arbor logic does not accept liability arising out of loss or damage that results from: -

- Material information not being provided by the Client to Arbor logic at the time this advice was prepared.
- 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 tree(s) that are the subject of this advice.

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 9
Significant Tree Assessment: Mandogalup (Arborlogic October 2016)

October 13, 2016

Strategen Environmental
PO Box 243
Subiaco WA 6904

Attention: **Dehlia Goundrey**

RE: **Significant Tree Assessment; Mandogalup**

Dear Dehlia,

Further to your request, the following is a summary of my assessment for significant trees within the proposed local structure plan area of Mandogalup.

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

Yours sincerely

JASON ROYAL

Dip. Arboriculture (UK)
Tech. Arbor A

Significant Tree Assessment; Local Structure Plan area of Mandogalup

Prepared For

Strategen Environmental

Prepared By

ARBOR logic

Contents

1. Particulars to the Assessment

1.1 Terms Used

The following terms have been used in this report:

'Site' meaning the Local Structure Plan area of Mandogalup that was included in this particular assessment

'Tree' meaning any tree identified on Site that has then been included in the assessment

'AS 4970' meaning Australian Standards guideline 4970 (2009); Protection of trees on development sites

'AS 4373' meaning Australian Standards guideline 4373 (2007); Pruning of amenity trees

'TPZ' meaning Tree Protection Zone; the area where the majority of the given Tree's root mass is considered likely to be found, and the area that is recommended to be protected during any development or landscape activity

1.2 Limitations and Particulars of this Assessment

The information and opinions provided in this document are based on the findings from the visual observations of the Trees on the Site during the inspections undertaken September 27 and 28, 2016.

All observations of all of the Trees were undertaken from ground level.

In accordance with City of Kwinana Local Planning Policy No.1 any trees on the Site with a main stem diameter of 50cm or greater have been included in this assessment.

Any trees found to have a main stem diameter less than 50cm were excluded from this assessment.

No exploratory excavations were undertaken as part of this particular assessment to verify the actual root spread of any given Tree.

As such the allocation of TPZ for each Tree has at this stage been based on AS 4970 guidelines, with some amendments being made for the physical size and canopy dimensions of the Tree, its condition, the known root zone morphology of its given species in the sort of soil profile considered to be typical to this area of Western Australia.

2. Scope of Works

At the request of Satterley Property Group I have been commissioned to undertake an inspection of all of the trees found on the Site to identify any trees that meet the definition of a significant tree under the guidelines of City of Kwinana Local Planning Policy No. 1.

Information on any tree that met the Policy guideline requirements was to be collected with details of each Tree's species, physical size (height, main stem calliper, canopy width, health condition, and structural condition), recommended zone of protection, and any comments deemed pertinent to the identified tree (i.e. any hazards, defects, issues etc.).

3. Tree Assessment Methodology

3.1 Methodology of the Assessment

All trees on the Site were visually inspected from ground level.

Any tree found to have a main stem diameter of 50cm or greater was subsequently included in the assessment.

All of these Trees were then assessed in accordance with visual tree assessment ("VTA") methods and principles. The VTA method is based on the sciences of tree biology, physiology, tree structure, and tree bio-mechanics. It is a method widely used by arborists worldwide to identify visible signs on trees that indicate any health or potential structural issues that in turn could increase the risks associated with the given tree.

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.

The structural integrity of each Tree was determined from a visual inspection of its main stem, primary (and secondary) branch unions to determine the presence of any areas considered to be a structural 'defect' or 'imperfection' such as unions with included bark, swelling, or noticeable splitting at them.

Symptoms of decay, growth patterns and defects are identified and assessed as to their potential to cause whole tree, part tree or branch failure, and 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.

The Tree's root plate area was also inspected to identify any visible signs of root plate, movement, cracking or heave from which a determination of the in-ground stability of the Tree can be ascertained. It is however important to note that there are limitations in verifying the in-ground stability of a tree based on a 'one-off' cursory visual observation; particularly in a forest type habitat where ground cover and leaf litter prevent or limit visual observations, and particularly if the inspection is undertaken during a period of 'fine' weather with little to no wind; as was the case over the period of this assessment.

With regards to any future development the known natural species traits of the given tree and its 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 or is known to be potentially problematic in terms of self-sowing (weed) issues, was also considered as part of the assessment process.

The Tree's species 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.

4. Summary of Key Findings of the Assessment

4.1 No of Trees Identified

A total of 171 Trees were identified during the assessment that met City of Kwinana Local Planning Policy No.1 guidelines for a significant tree.

A guide to their location has been provided in attachment 1 of this report.

4.2 Species Identified

11 different species of tree were identified on the Site.

Seven species were identified as West Australian native species, with the remaining four species native to eastern parts of Australia.

All of the species were considered to be common species for the Perth metropolitan area.

Flooded Gum (*Eucalyptus rudis*) were by far the most common species of tree on this Site with 81 specimens, followed by Jarrah (*Eucalyptus marginata*).

Table 1; List of Species of Significant Tree

Species	No of	Origin
Bangalay (*Eucalyptus botryoides*)	2	Aus native
Candle Banksia (*Banksia attenuata*)	1	WA native
Common Sheoak (*Allocasuarina fraseriana*)	3	WA native
Flooded Gum (*Eucalyptus rudis*)	81	WA native
Freshwater Paperbark (*Melaleuca rhaphiophylla*)	18	WA native
Jarrah (*Eucalyptus marginata*)	31	WA native
Lemon Scented Gum (*Corymbia citriodora*)	1	Aus native
River Red Gum (*Eucalyptus camaldulensis 'Camaldulensis'*)	1	Aus native
Stout Paperbark (*Melaleuca preissiana*)	21	WA native
Tasmanian Blue Gum (*Eucalyptus globulus*)	7	Aus native
West Australian Christmas Tree (*Nuytsia floribunda*)	5	WA native

4. Summary of Key Findings of the Assessment

4.3 Health Condition

The health of the Trees identified was noted to vary.

22 of the Trees were found to be dead with no live leaf mass remaining within their canopy.

This includes 12 Flooded Gum (*Eucalyptus rudis*), eight Jarrah (*Eucalyptus marginata*), and two Tasmanian Blue Gum (*Eucalyptus globulus*).

A further 31 Trees were considered to be in a poor health condition and look likely to have limited life span remaining. This includes 30 Flooded Gum (*Eucalyptus rudis*), and one Jarrah (*Eucalyptus marginata*).

These Trees are considered unlikely to survive the extent of disturbance and changes to their surrounds that typically occurs as a result of a development process.

A further 46 Trees were considered to be in a 'fair' health condition at this time. The cause of the reduced vigour looks (at this stage) to be more associated with environmental factors rather than any pest or disease pathogen.

Some (if not all) of these Trees may recover over time depending on seasonal rainfalls, and treatment during a develop process.

This includes 32 Flooded Gum (*Eucalyptus rudis*), 10 Jarrah (*Eucalyptus marginata*), four Stout Paperbark (*Melaleuca preissiana*) and one West Australian Christmas Tree (*Nuytsia floribunda*).

The remaining 71 Trees showed to be in good health or better at this time and I could see no visible evidence of any pest or disease pathogen that could have a major impact to their health at the time of my inspection.

Whilst a number showed to have varying amounts of varying diameter sized deadwood in their canopy, it looks to have occurred as part of the natural growth processes of tree's rather than being caused by any pest or disease pathogen, and whilst a number showed to have some minor pest/disease issues they were considered unlikely to have a major impact to the future health of these Trees.

4.4 Structural Condition

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

Whilst a number of the Trees 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) for the most part any structural defect or imperfections were not considered to be of any major concern at this time.

The development and structural form of some of the Trees was noted to have been affected and influenced by the proximity of adjacent Trees, with some having grown on a lean, and other having developed 'leggy' canopy form with high bending movement in winds and little to no lower canopy mass. For the most part this was not considered to be of any major concern at this time although issues may arise should surrounding Trees be removed and exposure to wind forces be increased; particularly in the wetland areas.

Branch failures were observed to have occurred on nine of the Trees. All of the failures were considered to have occurred as a result of force loading (i.e. wind/storm damage) as opposed to any predisposition for failure.

4. Summary of Key Findings of the Assessment

Areas of decay were observed in a number of the Trees, particularly some of the larger older Jarrah.

For the most part did not look to be to an extent where the structural integrity of the Tree has been compromised as a result, although the decay in a small number of the Trees does look to be at a point where its structural integrity is becoming questionable, particularly for the Tasmanian Blue Gum (*Eucalyptus globulus*) specimens which are prone to failure as a result of decay.

The structural form of 25 Trees was considered to be questionable, including 15 of the dead Trees and three of the Trees in poor health.

The remaining seven Tree's with questionable structure showed good /excellent health. However the extent of decay present in their structure suggests an increased potential for failure to occur.

A structural form of a further four Trees was considered to be poor and there looks to be a high probability for failure to occur in those specimens.

The structural form of six of the dead Trees (and 23 of the Trees in poor health) was considered to be acceptable at this time.

However natural decay pathogens will likely to continue to impact their structural integrity over time; quite possibly to a point where it becomes compromised as a result.

4.5 Suitability for inclusion into an area of Development

Retention value of the various tree species and even individual tree 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.

Conversely, dead or declining trees, or tree species known (or considered) to be problematic in terms of having a propensity for branch failures, or ones that could self-seed freely, or one that display low aesthetic traits would typically be considered to have a low retention value.

Whilst all of these trees may have high environmental benefits (particularly any with visible signs of potential habitat hollows) as part of ascertaining the suitability for inclusion into a development other aspects of the tree must be considered; primarily its structural form and suitability for inclusion into an urbanised area with high volumes of potential targets (such as people, structures etc.), and its potential to cope with changes to its soil and surrounding environment that typically occur as part of a development process; even if it is only to be landscape works.

In many respects with the exception of the dead, declining and those with potentially hazardous structural form, the majority of the identified Trees were considered suitable for retention and inclusion into urban areas such as public open space.

However retention of some of the Trees will however be somewhat dependent on aspects of design and what potential targets (people, structures etc.) will be introduced into the fall zone of those Trees as part of development in view of the risk management responsibilities that are generally associated with trees.

Should targets be introduced into the fall zone of these Trees, then retention may become questionable.

Some of the better quality Trees would be suitable for retention into areas of Lot, or road side verge; providing development design can accommodate protection of sufficient volume of their root zone area.

4. Summary of Key Findings of the Assessment

The following classification was used during this assessment for retention value.

High Retention Value; Generally a good/very good specimen that shows good health, structural and aesthetic form. Trees with High retention value are generally strongly recommended to be retained as part of development and would generally would be suitable for POS or even in some circumstances road reserve and/or Lot situation depending on detailed design and ability to maintain/protect sufficient area of its TPZ.

29 of the Trees on this Site were considered to have a High retention value (although due to their proximity to each other three of these Trees are considered to have a High retention value collectively as opposed to individual trees).

Medium Retention Value; Reasonably good specimen of its species and worth retaining as part of development. These trees may have reduced health/vigour, or structural imperfections that (whilst within the realms and scope of management) may have higher management and maintenance requirements. Such trees are generally suitable for road reserve, POS or even Lot situation depending on detailed design and ability to maintain/protect sufficient area of its TPZ.

48 of the Trees were considered to have a Medium retention value.

Low Retention Value; Ok specimen. This typically includes trees that indicate a declining health or have structural imperfections that are assessed to be starting to affect the structural integrity of the tree. Can also include trees that are of species that generally do not tolerate development/disturbance to their root zone (i.e. Banksia). Retention of such trees within a Road reserve or Lot would NOT be recommended due to potential impact from development, and/or a risk management perspective. Low retention value trees may have high environmental benefits, but their structure may limit their potential for retention other than in areas of POS where the risks associated with the Tree can then be better managed by way of good design.

36 Trees were considered to have a Low retention value.

Very Low Retention Value; These are generally poor quality trees that are typically suggested to be removed from a risk management perspective. Typically includes dead trees and trees with poor structural form that look to have a high probability for failure. Such trees may have high environmental benefit, but retention even within an area of open space would be highly questioned from a risk management responsibility UNLESS design of the area around them was able to prevent potential targets from entering into their fall zone.

58 Trees were considered to have a Very Low retention value.

Attachment 2 of this report provides an aerial view of the Site with the retention value of each Tree overlaid and colour coded for ease of reference.

5. Table of Information on the Trees identified during the Assessment

The following pages provide further information on the Trees identified during this assessment.

Explanation of Fields of Information in the Table

Tree ID. Provides an identification number for the identified Tree corresponding to its tree tag number on Site

Species Provides the botanical and most commonly used species name of the Tree.

Height Provides the height of the Tree (in metres) to the nearest metre.

DBH (Trunk Calliper) Provides the diameter of the Tree's main stem (trunk) in centimetres, and generally measured at 1.4 metres above ground level as per the industry standard. Should lower canopy formation start below 1.4 metres above ground level, the DBH is estimated at the point below the furcation of its main stem. In instances where the tree has multiple main stem structures, the DBH of all has been provided.

Estimated Canopy Spread Provides an estimated spread of the Tree's canopy; provided in metres diameter. Both north-south and east – west canopy dimensions have been provided.

Health Condition Provides a view of the Tree's health/vigour condition at the time of inspection based on a number of predetermined criteria.

Health Rating	Explanation
Excellent	Shows to have typical foliage condition and amount of foliage mass for a specimen of the species. May have a minor amount of deadwood, but no signs of any pest or disease factor that may affect its health.
Good	Shows to have typical foliage condition. Canopy foliage may be slightly chlorotic, or it may have a slightly higher percentage of deadwood than usual, or exhibit signs of being affected by environmental conditions. May have a minor pest or disease present that could start to affect its health.
Fair	Shows to have a relatively high percentage of deadwood than considered typical for a specimen of the given species and/or a low volume of live canopy leaf mass for a specimen of the given species. Apical sections of the canopy (may also be) dead. Signs of a pest or disease factor evident.
Poor	Canopy mass and foliage condition shows to be in a poor state for a specimen of the species. Has a high percentage of deadwood material in its canopy and a low volume of live canopy mass (typically <20%).
Dead	Shows to have either no live tissue within its structure, or at best has <5% live foliage mass remaining in its canopy.

5. Table of Information on the Trees identified during the Assessment

Structural Form Provides a view of the Tree's structural form at the time of inspection based on a number of predetermined criteria.

Structure Rating	Explanation
Good	Shows typical structural form for a specimen of the species. Branch unions show typical form at the point of attachment. May have a small number of minor structural defects; but are within the scope of tree surgery management to rectify. Shows to be root-stable.
Acceptable	Shows an acceptable form, but may have a number of structural defects present i.e. bi-furcation (but with no major swelling or movement), or areas of stem cavities, but structure remains within the scope of management at this stage; albeit with a higher risk/management requirement. Can include previously lopped trees that are known to have good points of attachment of any regrowth that occurs.
Questionable	Shows an undesirable structure for a specimen of the species. Structural condition likely to cause future issues in regards to the potential for branch or even complete tree failure to occur. Generally includes previously lopped trees, trees with large areas of cavity and/or associated decay that may be starting to affect its structural integrity, trees with bi-furcated unions with notable included bark and swelling that are considered to have an increased potential to fail.
Poor	Major structural defects evident. May have very large stem cavities, extensive termite damage, or noticeable movement in main stem, branch unions or root plate area.

Comment Provides any additional information (seen as relevant in the context of this report) to the Tree. Comments are (generally) self-explanatory.

An explanation of arboricultural terms has been provided as an attachment to this document.

TPZ Meaning the Tree's protection zone; the area where the majority of the given Tree's root mass is considered likely to be found.

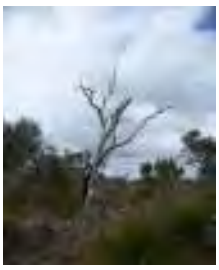
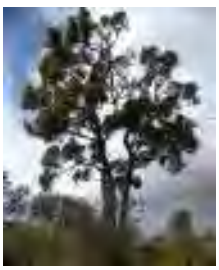
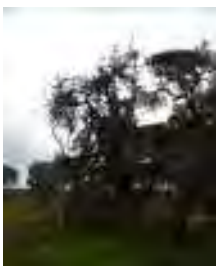
Any works required in this zone are considered likely to have some potential to impact the Tree.

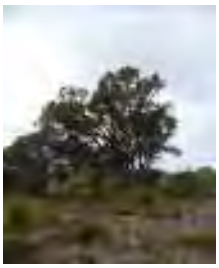
Habitat Hollows Provides an indication of any potential hollows identified in the Tree that may be able to be used by habitat (birds) for nesting

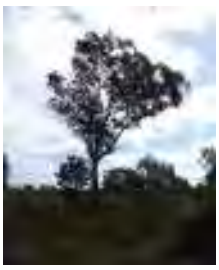
Previous Tag # Provides the Tag ID number of the Tree that a number of the Trees were found to have during the assessment that were included in an earlier report undertaken on some of the Trees by Paperbark Technologies. Note: The tags were removed as part of this assessment and a new unique ID number assigned.

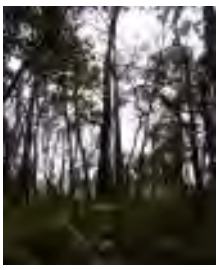
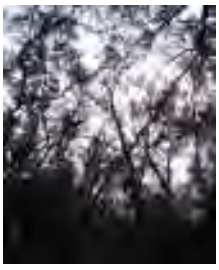
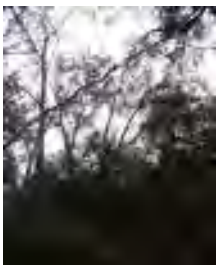
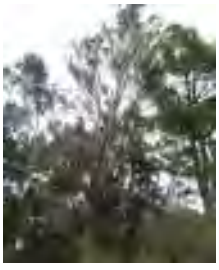
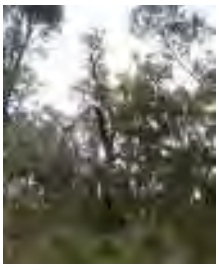
Retention Value Provides an overall 'opinion' on the quality of the Tree and its suitability for retention as part of the development.

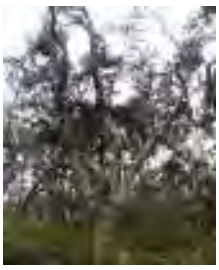
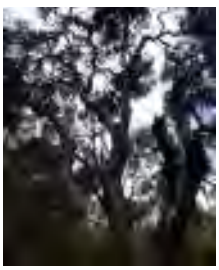
This opinion rating has been colour-coded for ease of reference.

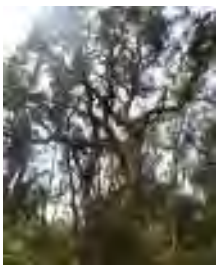
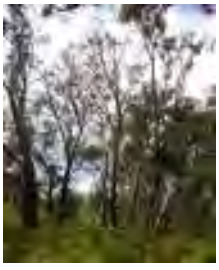
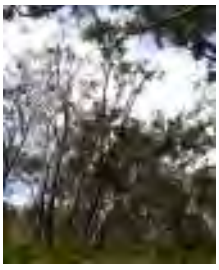
Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
1	Jarrah (*Eucalyptus marginata*)	14	76	10-11	8-9	Good	Good		Canopy is slightly sparse but what leaf mass is present shows good condition and form. Main stem bi-furcates but union looks to be Ok at this stage.	6.84			**High**
2	Candle Banksia (*Banksia attenuata*)	8.5	55	5-6	4-5	Good	Acceptable		Canopy is slightly sparse but what leaf mass is present shows good condition and form. Bark damage to base of main stem structure. Probably more suited for POS	4.95			Medium
3	Jarrah (*Eucalyptus marginata*)	12	69	10-11	5-6	Dead	Acceptable		Dead tree, which looks to have died since PB inspection. Has grown on a lean but not considered to be of any issue at this time to its structural or in-ground integrity although structure likely to deteriorate over time now that it is dead.	n/a		91	Very Low
4	Jarrah (*Eucalyptus marginata*)	12	76	5-6	4-5	Dead	Questionable		Dead tree. Area of decay and cavity noted and could be impacting structural integrity to some extent.	n/a	3-4 potential habitat hollows		Very Low
5	West Australian Christmas Tree (*Nuytsia floribunda*)	9	53, 52	6-7	5-6	Excellent	Good		Good mature specimen. Main stem bi-furcates but union looks to be Ok at this stage.	4.77	3-4 potential habitat hollows		**High**
6	Jarrah (*Eucalyptus marginata*)	11	54	5-6	5-6	Good	Acceptable		Reasonably good specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Bark damage to base of main stem structure. Possibly regrowth around an old stump	4.86			Medium
7	West Australian Christmas Tree (*Nuytsia floribunda*)	8	52	4-5	3-4	Excellent	Good		Good mature specimen. Main stem bi-furcates but union looks to be Ok at this stage.	4.68			Medium

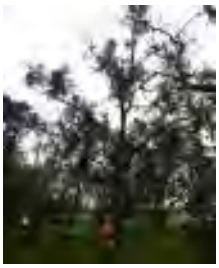
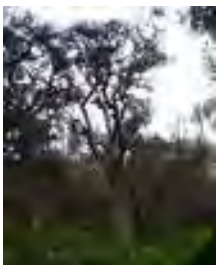
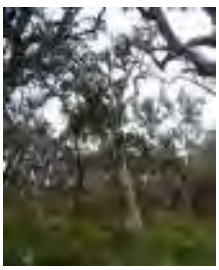
Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
8	Jarrah (*Eucalyptus marginata*)	13	59	7-8	6-7	Good	Good		Good mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form.	5.31			Medium
9	Jarrah (*Eucalyptus marginata*)	14	63	7-8	6-7	Fair	Good		Canopy condition suggests it may have limited life span remaining. Canopy is sparse and apical sections are dead. Better suited to POS	6.3			High
10	Jarrah (*Eucalyptus marginata*)	12	66	9-10	6-7	Fair	Acceptable		Canopy is slightly sparse but what leaf mass is present shows good condition and form. Has grown on a lean but not considered to be of any issue at this time to its structural or in-ground integrity. Area of decay noted but not of a major concern at this time to its structural integrity. Effectively forms the one canopy with the adjacent tree; High retention if adjacent Trees are retained; otherwise would have a Low retention value on its own	6.6		71	High Low
11	Jarrah (*Eucalyptus marginata*)	14	80	11-12	11-12	Good	Acceptable		Canopy is slightly sparse but what leaf mass is present shows good condition and form. Main stem bi-furcates but union looks to be Ok at this stage. Area of decay and cavity noted but not of a major concern at this time to its structural integrity. Basal cavity. Effectively forms the one canopy with the adjacent tree. Better suited to POS. High retention if adjacent Trees are retained; otherwise would have a Medium retention value on its own	8	2 potential habitat hollows.	72	High Medium
12	Jarrah (*Eucalyptus marginata*)	13	84	10-11	8-9	Good	Acceptable		Ok specimen. Has grown on a lean but not considered to be of any issue at this time to its structural or in-ground integrity. Area of decay and cavity noted but not of a major concern at this time to its structural integrity. Basal cavity. Effectively forms the one canopy with the adjacent tree. Better suited to POS. High retention if adjacent Trees are retained; otherwise would have a Medium (possibly even Low) retention value on its own	7.56	2 potential habitat hollows.	73	High Medium
13	Common Sheoak (*Allocasuarina fraseriana*)	9	57, 46	6-7	7-8	Excellent	Acceptable		Reasonably good specimen. Main stem bi-furcates but union looks to be Ok at this stage.	5.13			Medium
14	Common Sheoak (*Allocasuarina fraseriana*)	11	50	6-7	6-7	Excellent	Acceptable		Reasonably good specimen. Looks to be regrowth off/around an old stump/original tree.	4.5			Medium

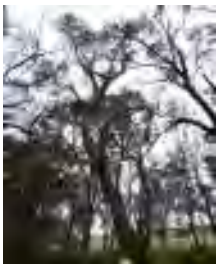
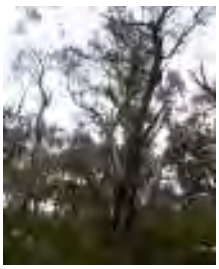
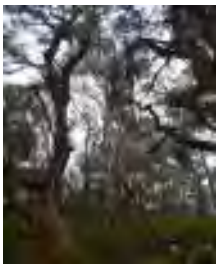
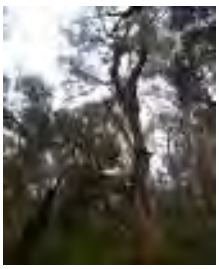
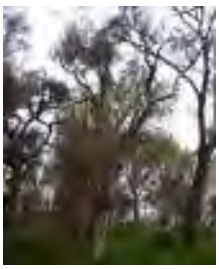
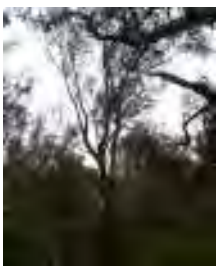
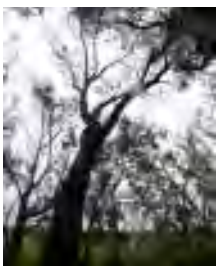
Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
15	Jarrah (*Eucalyptus marginata*)	16	92	10-11	10-11	Good	Good		Reasonably good specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Main stem bi-furcates but union looks to be Ok at this stage.	8.28			**High**
16	Jarrah (*Eucalyptus marginata*)	12	54	6-7	6-7	Fair	Good		Ok specimen. Canopy is sparse.	5.4			Medium
17	Jarrah (*Eucalyptus marginata*)	15	75	11-12	11-12	Good	Good		Good mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Good aesthetic form/value.	6.75			**High**
18	Flooded Gum (*Eucalyptus rudis*)	14	50	9-10	9-10	Excellent	Good		Good mature specimen. Canopy is ever-so slightly sparse but what leaf mass is present shows good condition and form. Good aesthetic form/value.	4.5			**High**
19	Jarrah (*Eucalyptus marginata*)	18	111	13-15	11-12	Excellent	Acceptable		Good mature specimen. Area of decay and cavity noted but not of a major concern at this time to its structural integrity. Large basal cavity. Probably better suited to POS	9.99	2 potential habitat hollows.	77	**High**
20	Jarrah (*Eucalyptus marginata*)	19	83	11-12	13-15	Excellent	Good		Large mature specimen. Canopy is ever-so slightly sparse but what leaf mass is present shows good condition and form. One sided (north) due to proximity of adjacent tree but not of any concerns probably better suited to POS	7.47		96	**High**
21	Jarrah (*Eucalyptus marginata*)	25	145	11-12	13-15	Excellent	Questionable		Large mature specimen. Canopy is ever-so slightly sparse but what leaf mass is present shows good condition and form. Major column of decay in main stem visible. Numerous bee hives noted. Suited to a low (no) Target area of POS IF retained	13.05	3-4 potential habitat hollows	95	Low

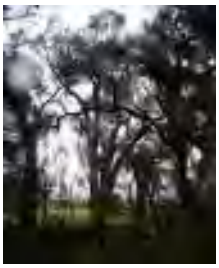
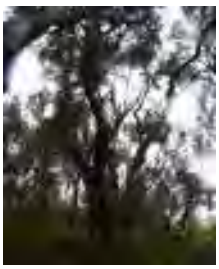
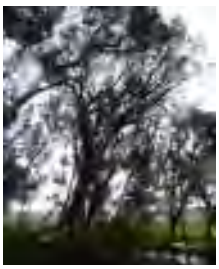
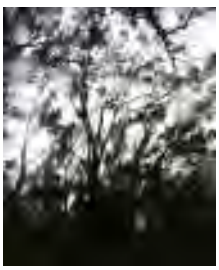
Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
22	Flooded Gum (*Eucalyptus rudis*)	17	55	10-11	13-15	Fair	Acceptable		Ok specimen. Canopy is sparse and suggests that it may be starting to decline in health. Canopy is one sided (north). Part of a group; suggest only retain with surrounding trees	5.5			Low
23	Flooded Gum (*Eucalyptus rudis*)	15	50	9-10	9-10	Fair	Acceptable		Ok specimen. Canopy is sparse and suggests that it may be starting to decline in health. Has grown on a lean but not considered to be of any issue at this time to its structural or in-ground integrity. Canopy is one sided (west). Part of a group; suggest only retain with surrounding trees	5			Low
24	Flooded Gum (*Eucalyptus rudis*)	17	52	8-9	8-9	Fair	Acceptable		Ok specimen. Canopy is sparse but what leaf mass is present shows good condition and form. Has grown on a lean but not considered to be of any issue at this time to its structural or in-ground integrity. Canopy is one sided (south) part of a group; suggest only retain with surrounding trees	5.2			Low
25	Flooded Gum (*Eucalyptus rudis*)	18	50	10-11	10-11	Fair	Good		Reasonably good specimen. Canopy is sparse but what leaf mass is present shows good condition and form. Main stem bi-furcates but union looks to be Ok at this stage. Part of a group; suggest only retain with surrounding trees	5			Low
26	Jarrah (*Eucalyptus marginata*)	11	60	6-7	5-6	Fair	Acceptable		Reasonably good specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Area of decay and cavity noted but not of a major concern at this time to its structural integrity. Basal cavity. Canopy is one sided (north) due to proximity of adjacent tree; only retain if adjacent tree is retained!	6	1 potential habitat hollow		Low
27	Flooded Gum (*Eucalyptus rudis*)	24	66	9-10	9-10	Excellent	Good		Large mature specimen. Main stem bi-furcates but union looks to be Ok at this stage.	5.94			Medium
28	Jarrah (*Eucalyptus marginata*)	22	180	12-13	9-10	Fair	Acceptable		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Area of decay and cavity noted but not of a major concern at this time to its structural integrity. Major basal cavity noted. Better suited to POS	18	4 potential habitat hollows	380 (107)	Low

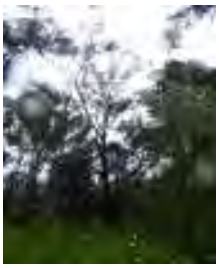
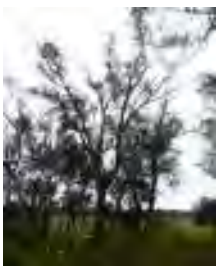
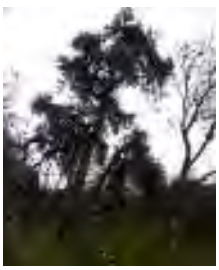
Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
29	Flooded Gum (*Eucalyptus rudis*)	25	77	10-11	10-11	Fair	Acceptable		Large mature specimen. Canopy is sparse and suggests that it may be starting to decline in health. Main stem bi-furcates but union looks to be Ok at this stage.	7.7	1 potential habitat hollow	377 (109)	Low
30	Stout Paperbark (*Melaleuca preissiana*)	13	69	8-9	7-8	Good	Good		Large mature specimen. Main stem bi-furcates but union looks to be Ok at this stage.	6.21			High
31	Stout Paperbark (*Melaleuca preissiana*)	10	84	9-10	9-10	Excellent	Good		Very good specimen of its species. Good aesthetic form/value.	7.56			High
32	Flooded Gum (*Eucalyptus rudis*)	16	72	9-10	9-10	Poor	Acceptable		Canopy is sparse and suggests it may have limited life span remaining. Basal cavity noted.	8.64		376 (110)	Very Low
33	Stout Paperbark (*Melaleuca preissiana*)	11	60	6-7	7-8	Good	Good		Good mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form.	5.4			High
34	Stout Paperbark (*Melaleuca preissiana*)	11	61	7-8	7-8	Good	Good		Good mature specimen. Has grown on a lean but not considered to be of any issue at this time to its structural or in-ground integrity.	5.49			High
35	Stout Paperbark (*Melaleuca preissiana*)	13	68	7-8	7-8	Good	Good		Good mature specimen. Main stem bi-furcates but union looks to be Ok at this stage.	6.12			High

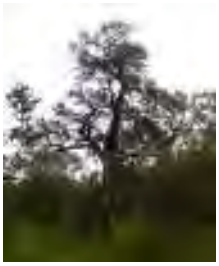
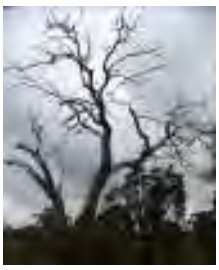
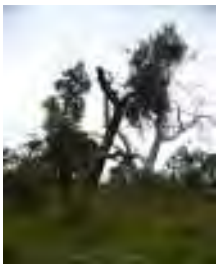
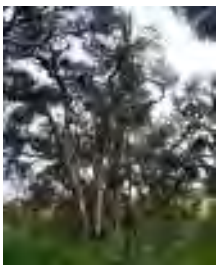
Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
36	Stout Paperbark (*Melaleuca preissiana*)	10	73, 50	7-8	9-10	Good	Good		Good mature specimen. Multi-stemmed from ground level possibly more than the one tree. Good aesthetic form/value.	6.57			High
37	Stout Paperbark (*Melaleuca preissiana*)	10	57	6-7	6-7	Good	Good		Good mature specimen.	5.13			High
38	Stout Paperbark (*Melaleuca preissiana*)	11	69	6-7	6-7	Good	Good		Good mature specimen. Has grown on a lean but not considered to be of any issue at this time to its structural or in-ground integrity.	6.21			High
39	Stout Paperbark (*Melaleuca preissiana*)	11	73	6-7	6-7	Fair	Good		Canopy is slightly sparse but what leaf mass is present shows good condition and form.	7.3			Medium
40	Stout Paperbark (*Melaleuca preissiana*)	10	56	4-5	4-5	Fair	Good		Canopy is slightly sparse but what leaf mass is present shows good condition and form.	5.6			Medium
41	Flooded Gum (*Eucalyptus rudis*)	20	53, 47, 42	9-10	11-12	Fair	Good		Canopy is slightly sparse but what leaf mass is present shows good condition and form. Multi-stemmed from ground level possibly more than the one tree.	5.3			Low
42	Flooded Gum (*Eucalyptus rudis*)	20	50	8-9	8-9	Fair	Good		Canopy is slightly sparse but what leaf mass is present shows good condition and form. Has grown on a lean but not considered to be of any issue at this time to its structural or in-ground integrity. Main stem bi-furcates but union looks to be Ok at this stage.	5			Low

Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
43	Flooded Gum (*Eucalyptus rudis*)	24	88, 54	15-16	9-10	Good	Good		Large mature specimen. Multi-stemmed from ground level. Main stem bi-furcates and evidence of included bark at the union. Union looks to be ok at this time Canopy is one sided (east) due to proximity of adjacent tree	7.92		386 (101)	Medium
44	Flooded Gum (*Eucalyptus rudis*)	24	67, 63, 49	15-16	9-10	Poor	Good		Large mature specimen. Canopy is sparse and suggests it may have limited life span remaining. Main stem furcates into three Some larger dead sections	8.04		387 (102)	Very Low
45	Flooded Gum (*Eucalyptus rudis*)	19	60	12-13	12-13	Fair	Good		Large mature specimen. Canopy is sparse and suggests that it may be starting to decline in health.	6			Low
46	Stout Paperbark (*Melaleuca preissiana*)	11	72	8-9	7-8	Good	Good		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Good aesthetic form/value.	6.48			Medium
47	Stout Paperbark (*Melaleuca preissiana*)	11	71	8-9	7-8	Good	Good		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Good aesthetic form/value.	6.39			Medium
48	Stout Paperbark (*Melaleuca preissiana*)	11	71	8-9	7-8	Good	Good		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Good aesthetic form/value.	6.39			Medium
49	Flooded Gum (*Eucalyptus rudis*)	15	50	8-9	8-9	Fair	Acceptable		Ok specimen. Has grown on a lean but not considered to be of any issue at. Canopy is slightly sparse but what leaf mass is present shows good condition and form.	5			Low

Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
50	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	13	50	5-6	5-6	Good	Good		Ok specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form.	4.5			Medium
51	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	15	52, 47	5-6	9-10	Good	Good		Ok specimen. Main stem bi-furcates but union looks to be Ok at this stage. Canopy is slightly sparse but what leaf mass is present shows good condition and form.	4.68			Medium
52	Stout Paperbark (*Melaleuca preissiana*)	17	58	6-7	8-9	Good	Good		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Part of a large group	5.22			Medium
53	Stout Paperbark (*Melaleuca preissiana*)	11	70	6-7	6-7	Good	Good		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Has grown on a lean but not considered to be of any issue at this time to its structural or in-ground integrity. Part of a large group	6.3			Medium
54	Stout Paperbark (*Melaleuca preissiana*)	9	71	6-7	6-7	Good	Questionable		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Area of decay and cavity noted and could be impacting structural integrity to some extent. Large basal cavity	6.39			Medium
55	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	11	53	6-7	6-7	Good	Good		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Has grown on a lean but not considered to be of any issue at this time to its structural or in-ground integrity.	4.77			Medium
56	Flooded Gum (*Eucalyptus rudis*)	23	80	11-12	10-11	Fair	Good		Large mature specimen. Canopy is sparse and suggests that it may be starting to decline in health.	8		378 (111)	Low

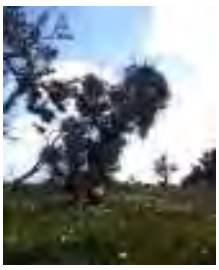
Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
57	Flooded Gum (*Eucalyptus rudis*)	23	70	10-11	10-11	Fair	Good		Large mature specimen. Canopy is sparse and suggests that it may be starting to decline in health. Has grown on a lean but not considered to be of any issue at this time to its structural or in-ground integrity.	7		379 (112)	Low
58	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	15	81	7-8	7-8	Good	Acceptable		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Main stem bi-furcates and evidence of included bark and swelling at the union. Union looks to be ok at this time	7.29			Medium
59	Flooded Gum (*Eucalyptus rudis*)	16	58	9-10	7-8	Fair	Acceptable		Ok specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Has grown on a lean but not considered to be of any issue at this time to its structural or in-ground integrity. Canopy is one sided south	5.8			Low
60	Flooded Gum (*Eucalyptus rudis*)	19	59	11-12	7-8	Fair	Good		Canopy is sparse but what leaf mass is present shows good condition and form. Main stem bi-furcates but union looks to be Ok at this stage. Evidence of previous branch failures (>200mm diameter).	5.9		385 (106)	Low
61	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	15	50, 39	9-10	9-10	Good	Good		Canopy is slightly sparse but what leaf mass is present shows good condition and form. Main stem bi-furcates but union looks to be Ok at this stage.	4.5			Medium
62	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	15	57	8-9	8-9	Good	Good		Canopy is slightly sparse but what leaf mass is present shows good condition and form.	5.13			Medium
63	Flooded Gum (*Eucalyptus rudis*)	18	72	10-11	9-10	Poor	Good		Canopy is very sparse and suggests it may have limited life span remaining. Evidence of previous branch failures (100-200mm diameter).	8.64		382 (105)	Very Low

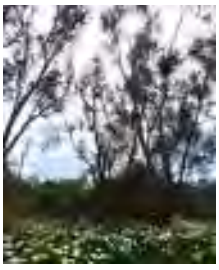
Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
64	Flooded Gum (*Eucalyptus rudis*)	18	62	10-11	10-11	Fair	Good		Large mature specimen. Canopy is sparse but what leaf mass is present shows good condition and form.	6.2			Medium
65	Flooded Gum (*Eucalyptus rudis*)	15	70	9-10	9-10	Fair	Acceptable		Area of decay noted but not of a major concern at this time to its structural integrity. Canopy is sparse but what leaf mass is present shows good condition and form.	7			Medium
66	Flooded Gum (*Eucalyptus rudis*)	16	53, 53	9-10	9-10	Dead	Acceptable		Near dead tree. Canopy is sparse and suggests it may have limited life span remaining.	n/a			Very Low
67	Flooded Gum (*Eucalyptus rudis*)	23	73	11-12	11-12	Poor	Acceptable		Canopy condition suggests it may have limited life span remaining. Main stem bi-furcates but union looks to be Ok at this stage. Evidence of previous branch failures (100-200mm diameter).	8.76		383 (104)	Very Low
68	Jarrah (*Eucalyptus marginata*)	16	52	7-8	7-8	Dead	Acceptable		Dead tree. Few epicormic shoots at base but original main stem/part of the tree is dead	n/a			Very Low
69	Jarrah (*Eucalyptus marginata*)	20	89	11-12	10-11	Good	Acceptable		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Area of decay and cavity noted but not of a major concern at this time to its structural integrity. Basal cavity	8.01		80	Medium
70	West Australian Christmas Tree (*Nuytsia floribunda*)	10	53	5-6	4-5	Excellent	Good		Good mature specimen. Good aesthetic form/value.	4.77			**High**

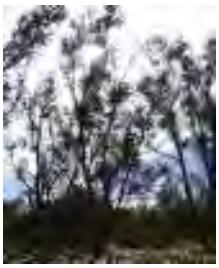
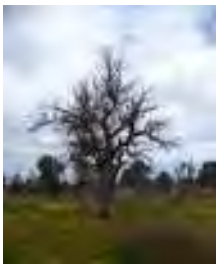
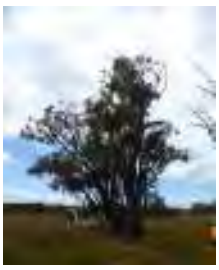
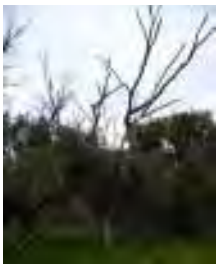
Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
71	West Australian Christmas Tree (*Nuytsia floribunda*)	8	58	4-5	4-5	Good	Good		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Main stem bi-furcates but union looks to be Ok at this stage.	5.22	Potential habitat hollows		**High**
72	Jarrah (*Eucalyptus marginata*)	20	189	13-15	9-10	Dead	Questionable		Dead tree. Area of decay and cavity noted and could be impacting structural integrity to some extent. Major basal cavity	n/a	7 potential habitat hollows		Very Low
73	West Australian Christmas Tree (*Nuytsia floribunda*)	7	51, 42, 20	4-5	4-5	Fair	Good		Ok specimen. Canopy is sparse and suggests that it may be starting to decline in health. Multi-stemmed from near ground level.	5.1			Low
74	Stout Paperbark (*Melaleuca preissiana*)	11	65	7-8	5-6	Good	Acceptable		Large mature specimen. Area of decay and cavity noted but not of a major concern at this time to its structural integrity. Main stem bi-furcates and evidence of included bark at the union. Probably better suited to POS	5.85			Medium
75	Stout Paperbark (*Melaleuca preissiana*)	11	68	7-8	7-8	Good	Acceptable		Large mature specimen. Area of decay and cavity noted but not of a major concern at this time to its structural integrity. Basal cavity Probably better suited to POS	6.12			**High**
76	Stout Paperbark (*Melaleuca preissiana*)	10	73, 32	7-8	7-8	Good	Acceptable		Large mature specimen. Multi-stemmed from ground level. Section of its canopy is dead. Remainder ok Probably better suited to POS	6.57			Medium
77	Flooded Gum (*Eucalyptus rudis*)	14	50, 47	11-12	12-13	Good	Good		Reasonably good specimen. Main stem bi-furcates but union looks to be Ok at this stage. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Low spreading canopy	4.5			Medium

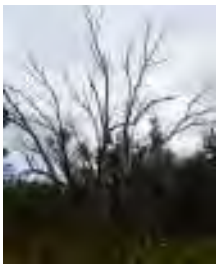
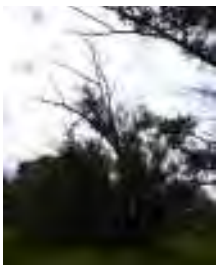
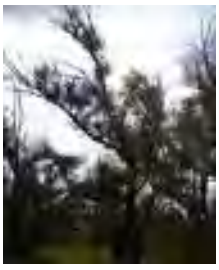
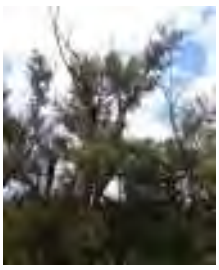
Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
78	Jarrah (*Eucalyptus marginata*)	10	52, 27	7-8	7-8	Poor	Acceptable		Multi-stemmed from ground level. Area of decay noted but not of a major concern at this time to its structural integrity. Upper section of its canopy is dead. Suited to POS only	6.24			Low
79	Jarrah (*Eucalyptus marginata*)	14	64	7-8	7-8	Dead	Questionable		Dead tree. Area of decay and cavity noted and could be impacting structural integrity to some extent. Basal cavity	n/a	5 potential habitat hollows		Very Low
80	Common Sheoak (*Allocasuarina fraseriana*)	11	54, 32	7-8	5-6	Excellent	Poor		Multi-stemmed from ground level. Area of decay noted and could be impacting structural integrity to some extent. Section of its canopy have already failed	4.86			Low
81	Jarrah (*Eucalyptus marginata*)	17	87	9-10	8-9	Dead	Questionable		Dead tree. Area of decay and cavity noted but not of a major concern at this time to its structural integrity.	n/a	4 potential habitat hollows	388 (144)	Very Low
82	Flooded Gum (*Eucalyptus rudis*)	20	53	6-7	8-9	Poor	Acceptable		Canopy condition suggests it may have limited life span remaining. Canopy is sparse and apical section of its canopy are dead	6.36			Very Low
83	Flooded Gum (*Eucalyptus rudis*)	22	61	7-8	10-11	Poor	Acceptable		Canopy condition suggests it may have limited life span remaining. Canopy is sparse and apical section of its canopy are dead	7.32			Very Low
84	Flooded Gum (*Eucalyptus rudis*)	18	50	7-8	10-11	Dead	Acceptable		Near dead tree. 90% dead/defoliated	n/a			Very Low

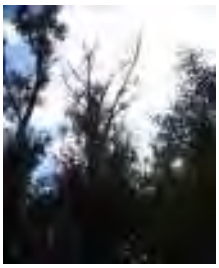
Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
85	Flooded Gum (*Eucalyptus rudis*)	22	61	6-7	6-7	Poor	Acceptable		Canopy condition suggests it may have limited life span remaining. Canopy is sparse and apical sections of its canopy are dead	7.32			Very Low
86	Flooded Gum (*Eucalyptus rudis*)	22	63	6-7	8-9	Poor	Acceptable		Canopy condition suggests it may have limited life span remaining. Area of decay noted but not of a major concern at this time to its structural integrity. Fungal bracket on main stem. Canopy is sparse and apical sections of its canopy are dead	7.56			Very Low
87	Flooded Gum (*Eucalyptus rudis*)	18	69	8-9	8-9	Fair	Good		Canopy is relatively sparse but shows signs of recovery although all leaf mas is epicormic shoots	6.9			Low
88	Flooded Gum (*Eucalyptus rudis*)	22	56, 45, 41	11-12	10-11	Poor	Acceptable		Large mature specimen. Multi-stemmed from ground level. Canopy is sparse and apical sections of its canopy are dead	6.72			Very Low
89	Flooded Gum (*Eucalyptus rudis*)	23	55, 54, 50, 46	11-12	10-11	Poor	Acceptable		Large mature specimen. Multi-stemmed from ground level. Canopy condition suggests it may have limited life span remaining. Canopy is sparse and apical sections of its canopy are dead	6.6			Very Low
90	Flooded Gum (*Eucalyptus rudis*)	16	55	9-10	9-10	Dead	Questionable		Dead tree.	n/a			Very Low
91	Flooded Gum (*Eucalyptus rudis*)	17	52, 35	7-8	9-10	Fair	Acceptable		Near dead tree. Main stem bi-furcates and evidence of included bark at the union. Apical sections of its canopy are dead	5.2			Low

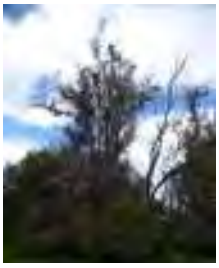
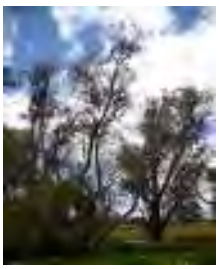
Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
92	Flooded Gum (*Eucalyptus rudis*)	17	59	7-8	7-8	Poor	Acceptable		Near dead tree. Canopy is 80-90% dead	7.08			Very Low
93	Flooded Gum (*Eucalyptus rudis*)	17	61	9-10	7-8	Dead	Questionable		Dead tree.	n/a	3 potential habitat hollows		Very Low
94	Flooded Gum (*Eucalyptus rudis*)	16	53, 47	11-12	13-15	Fair	Good		Canopy is slightly sparse but what leaf mass is present shows good condition and form. Main stem bi-furcates but union looks to be Ok at this stage. looks to recovering canopy although some larger deadwood	5.3			Low
95	Flooded Gum (*Eucalyptus rudis*)	16	54	6-7	6-7	Poor	Acceptable		Canopy condition suggests it may have limited life span remaining. Area of decay noted but not of a major concern at this time to its structural integrity. Top 50% of its canopy is dead	6.48			Very Low
96	Jarrah (*Eucalyptus marginata*)	8	116	3-4	3-4	Fair	Poor		Canopy condition suggests it may have limited life span remaining. Major basal cavity main stem has previously snapped only 15-20% holding wood remaining	11.6			Low
97	Jarrah (*Eucalyptus marginata*)	17	97	8-9	9-10	Fair	Acceptable		Canopy condition suggests it may have limited life span remaining. Canopy is slightly sparse and suggests that it may be starting to decline in health. Area of decay and cavity noted and could be impacting structural integrity to some extent. Major basal cavity large section of main stem has previously snapped fire damage	9.7			Low
98	Jarrah (*Eucalyptus marginata*)	11	56	8-9	7-8	Fair	Acceptable		Ok specimen. Fire damage but looks to be recovering well	5.6			Low

Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
99	Flooded Gum (*Eucalyptus rudis*)	16	73	10-11	9-10	Dead	Questionable		Dead tree.	n/a			Very Low
100	Flooded Gum (*Eucalyptus rudis*)	22	81	16-18	16-18	Good	Good		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Main stem bi-furcates and evidence of included bark at the union. Union looks to be ok at this time	7.29			Medium
101	Flooded Gum (*Eucalyptus rudis*)	21	56, 55, 46, 42	16-18	16-18	Fair	Good		Large mature specimen. Canopy is slightly sparse and suggests that it may be starting to decline in health. Multi-stemmed from near ground level. Sections of its canopy are dead. Remainder sparse but showing some signs of recovery. Area of decay in base but not of any concerns at this time	5.6			Low
102	Flooded Gum (*Eucalyptus rudis*)	21	59, 50	11-12	10-11	Fair	Good		Large mature specimen. Multi-stemmed from ground level. Sections of its canopy are dead. Remainder sparse but showing some signs of recovery	5.9			Low
103	Flooded Gum (*Eucalyptus rudis*)	21	53, 49	10-11	10-11	Poor	Good		Large mature specimen. Multi-stemmed from ground level. Canopy condition suggests it may have limited life span remaining. Sections of its canopy are dead. Remainder sparse and only minor signs of recovery	6.36			Very Low
104	Flooded Gum (*Eucalyptus rudis*)	18	56, 46	9-10	10-11	Poor	Acceptable		Large mature specimen. Main stem bi-furcates and evidence of included bark at the union. Union looks to be ok at this time. Canopy is sparse and only minor signs of recovery	6.72			Very Low
105	Flooded Gum (*Eucalyptus rudis*)	16	55, 38	9-10	10-11	Poor	Acceptable		Large mature specimen. Multi-stemmed from near ground level. Canopy is sparse and only minor signs of recovery	6.6			Very Low

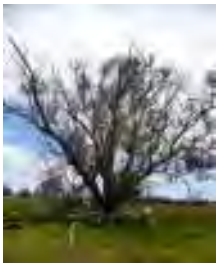
Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
106	Flooded Gum (*Eucalyptus rudis*)	18	52, 46	10-11	8-9	Poor	Acceptable		Main stem bi-furcates but union looks to be Ok at this stage. Canopy is sparse and only minor signs of recovery at this time	6.24			Very Low
107	Jarrah (*Eucalyptus marginata*)	14	53, 46, 24, 22	9-10	9-10	Good	Acceptable		Multi-stemmed from ground level. Looks to be regrowth off/around an old stump/original tree. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Recovering well from recent fire	4.77			Medium
108	Jarrah (*Eucalyptus marginata*)	13	59	8-9	8-9	Dead	Acceptable		Dead tree.	n/a			Very Low
109	Jarrah (*Eucalyptus marginata*)	16	160	8-9	8-9	Good	Questionable		Large mature specimen. Evidence of previous branch failures (>200mm diameter). Major basal cavity; 80% hollow. Large section of canopy has already failed. Suitable for a low (no) Target area only	14.4			Medium
110	Jarrah (*Eucalyptus marginata*)	15	88	9-10	10-11	Fair	Good		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Looks to be recovering well from recent fire	8.8			Medium
111	Flooded Gum (*Eucalyptus rudis*)	14	68	9-10	8-9	Poor	Acceptable		Ok specimen. Upper section of its canopy is dead. Lower canopy ok but mostly epicormic shoots	8.16			Very Low
112	Flooded Gum (*Eucalyptus rudis*)	11	64	6-7	6-7	Dead	Questionable		Dead tree. Area of decay noted and could be impacting structural integrity to some extent.	n/a			Very Low

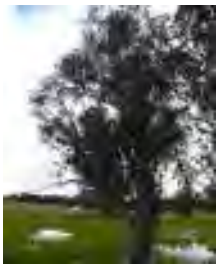
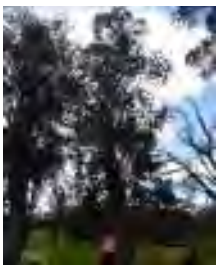
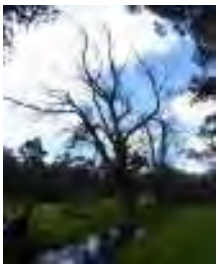
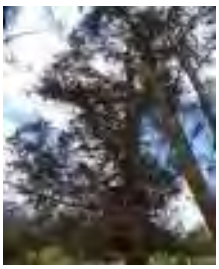
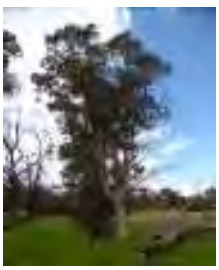
Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
113	Flooded Gum (*Eucalyptus rudis*)	17	79, 75	13-15	12-13	Dead	Questionable		Dead tree. Main stem bi-furcates but union looks to be Ok at this stage. Area of decay noted but not of a major concern at this time to its structural integrity.	n/a			Very Low
114	Flooded Gum (*Eucalyptus rudis*)	18	70	11-12	9-10	Poor	Acceptable		. Top section of its canopy is dead. Lower canopy ok but mostly epicormic shoots	8.4			Very Low
115	Flooded Gum (*Eucalyptus rudis*)	22	94	11-12	9-10	Poor	Acceptable		Large mature specimen. Main stem bi-furcates but union looks to be Ok at this stage. Apical section of its canopy is dead and remaining leaf mass is all epicormic shoots. May recover ok given time	11.28		389 (149)	Very Low
116	Flooded Gum (*Eucalyptus rudis*)	22	67	12-13	9-10	Poor	Acceptable		Large mature specimen. Evidence of previous branch failures (>200mm diameter). Apical sections of its canopy are dead and remaining leaf mass is all epicormic shoots. May recover ok given time Better suited to POS	8.04			Very Low
117	Flooded Gum (*Eucalyptus rudis*)	23	75, 73	10-11	18-20	Fair	Acceptable		Large mature specimen. Multi-stemmed from near ground level. Apical sections of its canopy are dead and remaining leaf mass is all epicormic shoots. May recover ok given time. Better suited to POS	7.5			Low
118	Stout Paperbark (*Melaleuca preissiana*)	10	68	6-7	9-10	Fair	Good		Large mature specimen. Canopy is sparse and suggests that it may be starting to decline in health. Better suited to POS	6.8			Low
119	Flooded Gum (*Eucalyptus rudis*)	14	62, 59	10-11	15-16	Dead	Questionable		Dead tree. Multi-stemmed from near ground level. Area of decay noted and could be impacting structural integrity to some extent.	n/a			Very Low

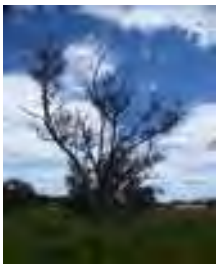
Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
120	Flooded Gum (*Eucalyptus rudis*)	22	65	8-9	9-10	Poor	Acceptable		Large mature specimen. Canopy condition suggests it may have limited life span remaining. Top section of its canopy is dead. Lower canopy sparse	7.8			Very Low
121	Flooded Gum (*Eucalyptus rudis*)	22	50	5-6	7-8	Poor	Questionable		Large mature specimen. Canopy condition suggests it may have limited life span remaining. Area of decay noted but not of a major concern at this time to its structural integrity. Top section of its canopy is dead. Lower canopy sparse. Upper canopy has grown on an angle east	6			Very Low
122	Flooded Gum (*Eucalyptus rudis*)	22	52	7-8	4-5	Poor	Acceptable		Large mature specimen. Top section of its canopy is dead. Lower canopy sparse but may recover over time	6.24			Very Low
123	Flooded Gum (*Eucalyptus rudis*)	22	96	5-6	13-15	Dead	Questionable		Dead tree. Area of decay noted and could be impacting structural integrity to some extent.	n/a			Very Low
124	Flooded Gum (*Eucalyptus rudis*)	21	59	6-7	10-11	Poor	Acceptable		Large mature specimen. Main stem bi-furcates but union looks to be Ok at this stage. Upper section of its canopy is dead. Remainder ok but sparse. May recover over time	7.08			Very Low
125	Stout Paperbark (Melaleuca preissiana)	9	59	6-7	6-7	Fair	Good		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form.	5.9			Medium
126	Flooded Gum (*Eucalyptus rudis*)	18	64	6-7	6-7	Fair	Acceptable		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Has grown on a lean but not considered to be of any issue at this time to its structural or in-ground integrity.	6.4		391 (156)	Low

Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
127	Flooded Gum (*Eucalyptus rudis*)	14	55, 35, 30	9-10	9-10	Dead	Acceptable		Dead tree. Multi-stemmed from ground level.	n/a			Very Low
128	Flooded Gum (*Eucalyptus rudis*)	22	95	11-12	12-13	Fair	Acceptable		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Some section of its canopy are dead. Remainder ok at this time	9.5			Low
129	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	8	57	3-4	4-5	Good	Good		Reasonably good specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form.	5.13			Medium
130	Flooded Gum (*Eucalyptus rudis*)	18	77	6-7	12-13	Fair	Good		Large mature specimen. Main stem bi-furcates but union looks to be Ok at this stage. Apical section of its canopy is dead. Remainder ok and may recover over time	7.7			Low
131	Flooded Gum (*Eucalyptus rudis*)	16	63	6-7	11-12	Fair	Good		Large mature specimen. Canopy is sparse	6.3			Low
132	Flooded Gum (*Eucalyptus rudis*)	17	89	6-7	10-11	Fair	Good		Large mature specimen. Canopy is sparse but may recover over time	8.9		393 (164)	Low
133	Flooded Gum (*Eucalyptus rudis*)	16	72	8-9	8-9	Poor	Good		Large mature specimen. Top section of its canopy is dead. Lower canopy ok but mostly epicormic shoots	8.64			Very Low

Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
134	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	8	55	6	8	Excellent	Good		Good mature specimen. Good individual tree as well as being on edge of the larger group of trees	4.95			**High**
160	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	8	55	7	8	Excellent	Good		Very good mature specimen. Good individual tree as well as being on the edge of the larger group	4.95			**High**
172	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	8	50	5	5	Excellent	Good		Multi-stemmed from ground level. One stem looks to have recently failed. **Low retention value**	4.5			Low
173	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	8	50	6	6	Excellent	Good		Ok mature specimen. Sections of canopy are slightly sparse. Looks to have previously snapped	4.5			Medium
175	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	11	65	10	8	Excellent	Good		Reasonably good specimen. Effectively forms part of a group with 176-179; suggest retain as a group	5.85			**High**
179	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	11	50	7	7	Excellent	Good		Good mature specimen. Effectively forms part of a group with 175-178; suggest retain as a group but this one could be an individual tree if necessary	4.5			Medium
180	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	11	80	9	8	Excellent	Good		Good mature specimen. On edge of 175-179 group. Branch failure has occurred but overall ok	7.2			**High**

Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
181	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	11	100 (approx .)	11	10	Excellent	Good		Large mature very good specimen. Good individual tree. Structure probably limits potential for transplanting	9			**High**
182	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	9	100 (approx .)	9	9	Excellent	Good		Good mature specimen. Multi-stemmed from ground level and one stem has failed but otherwise ok	9			**High**
183	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	9	60, 30 x30	8	7	Excellent	Good		Good mature specimen. Canopy is slightly sparse but otherwise ok	5.4			Medium
190	Freshwater Paperbark (*Melaleuca rhaphiophylla*)	10	65	8	9	Excellent	Good		Good mature specimen. Canopy could be raised in this instance if required	5.85			Medium
301	Flooded Gum (*Eucalyptus rudis*)	11	56	7-8	7-8	Fair	Good		Reasonably good specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form.	5.6			Medium
302	Flooded Gum (*Eucalyptus rudis*)	14	58	9-10	7-8	Fair	Good		Reasonably good specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Looks to be recovering ok	5.8			Medium
303	Flooded Gum (*Eucalyptus rudis*)	18	181	13-15	13-15	Poor	Questionable		Large mature specimen. Area of decay and cavity noted and could be impacting structural integrity to some extent. Canopy is sparse and large sections of its canopy are dead. Major basal cavity	15	2 potential habitat hollows		Very Low

Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
304	Tasmanian Blue Gum (*Eucalyptus globulus*)	15	52	7-8	8-9	Good	Questionable		Canopy is slightly sparse and suggests that it may be starting to decline in health. Has grown on a lean and its lean could be a concern to its structural or in-ground stability. Low retention value	4.68			Very Low
305	Tasmanian Blue Gum (*Eucalyptus globulus*)	17	69	8-9	8-9	Good	Questionable		Canopy is slightly sparse and suggests that it may be starting to decline in health. Has grown on a lean and its lean could be a concern to its structural or in-ground stability. Low retention value	6.21			Very Low
306	Tasmanian Blue Gum (*Eucalyptus globulus*)	15	88	8-9	11-12	Dead	Questionable		Dead tree. Has grown on a lean and its lean could be a concern to its structural or in-ground stability.	n/a			Very Low
307	Tasmanian Blue Gum (*Eucalyptus globulus*)	16	76	7-8	10-11	Dead	Questionable		Dead tree. Main stem bi-furcates but union looks to be Ok at this stage.	n/a			Very Low
308	Tasmanian Blue Gum (*Eucalyptus globulus*)	23	89	7-8	8-9	Good	Good		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form.	8.01			Very Low
309	Tasmanian Blue Gum (*Eucalyptus globulus*)	23	84	7-8	8-9	Good	Questionable		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Has grown on a lean and its lean could be a concern to its structural or in-ground stability to its structural or in-ground stability. Main stem bi-furcates. Low retention value	7.56			Very Low
310	Tasmanian Blue Gum (*Eucalyptus globulus*)	21	72	7-8	9-10	Good	Questionable		Large mature specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Has grown on a lean and its lean could be a concern to its structural or in-ground stability to its structural or in-ground stability. Main stem bi-furcates. Termites and decay in base of main stem. Low retention value	6.48			Very Low

Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
311	Flooded Gum (*Eucalyptus rudis*)	13	85	5-6	9-10	Fair	Poor		Canopy condition suggests it may have limited life span remaining. Area of decay and cavity noted and could be impacting structural integrity to some extent. Major basal cavity and large section of its canopy has already failed	8.5			Very Low
312	Flooded Gum (*Eucalyptus rudis*)	19	77, 69	13-15	12-13	Dead	Questionable		Dead tree. Main stem bi-furcates but union looks to be Ok at this stage. Just outside existing fence	n/a			Very Low
313	Flooded Gum (*Eucalyptus rudis*)	13	59	9-10	9-10	Poor	Acceptable		Near dead tree with <10% live leaf mass remaining	7.08			Very Low
314	Lemon Scented Gum (*Corymbia citriodora*)	19	63, 57	16-18	16-18	Excellent	Acceptable		Large mature specimen. Good aesthetic form/value. Main stem bi-furcates and evidence of included bark and swelling at the union. Union looks to be ok at this time but may cause issues longer term. Probably better suited to POS	5.67			**High**
315	Bangalay (*Eucalyptus botryoides*)	17	91	13-15	15-16	Excellent	Acceptable		Large mature specimen. Good aesthetic form/value. Evidence of previous branch failures (100-200mm diameter). Looks to have been storm damage. Probably better suited to POS	8.19			Medium
316	Flooded Gum (*Eucalyptus rudis*)	17	102	12-13	13-15	Poor	Good		Large mature specimen. Canopy is sparse. Large sections of its canopy are dead	12.24			Very Low
317	Flooded Gum (*Eucalyptus rudis*)	15	72	3-4	3-4	Dead	Poor		Dead tree. Leaning into adjacent tree and possibly partially collapsed	n/a	1 potential habitat hollow		Very Low

Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
318	Flooded Gum (*Eucalyptus rudis*)	15	72	9-10	10-11	Fair	Good		Large mature specimen. Canopy is sparse but what leaf mass is present shows good condition and form. Area of decay noted but not of a major concern at this time to its structural integrity.	7.2			Medium
319	Flooded Gum (*Eucalyptus rudis*)	19	129, 85	15-16	20-22	Poor	Acceptable		Large mature specimen. Evidence of previous branch failures (>200mm diameter). Two trees in close proximity that effectively form the one canopy. Both very sparse with large section of deadwood	15			Very Low
320	Flooded Gum (*Eucalyptus rudis*)	12	66, 61	9-10	9-10	Fair	Acceptable		Ok specimen. Main stem bi-furcates but union looks to be Ok at this stage. Canopy is sparse and lot of leaf insect damage. Bees noted in potential habitat hollow	6.6	1 potential habitat hollow		Medium
321	Flooded Gum (*Eucalyptus rudis*)	12	69, 65, 49	9-10	7-8	Poor	Questionable		Near dead tree. Area of decay noted and could be impacting structural integrity to some extent. Evidence of previous branch failures (>200mm diameter). Main stem furcates into three. Canopy is sparse and lot of Lerp damage	8.28			Very Low
322	Flooded Gum (*Eucalyptus rudis*)	14	54	7-8	7-8	Good	Good		Good mature specimen. Good aesthetic form/value. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Lerp damage but should recover over time	4.86			Medium
323	Bangalay (*Eucalyptus botryoides*)	16	57, 46, 42	12-13	9-10	Excellent	Acceptable		Ok specimen. Main stem bi-furcates and evidence of included bark and swelling at the union. Evidence of a broken (hanging) branch in the canopy. Union looks to be ok at this time but may cause issues longer term	5.13			Medium
324	River Red Gum (*Eucalyptus camaldulensis 'Camaldulensis'*)	16	75	8-9	8-9	Good	Good		Reasonably good specimen. Canopy is slightly sparse but what leaf mass is present shows good condition and form.	6.75			Medium

Tree ID	Species	Approx. Height (metres)	DBH (cm)	Canopy Spread (metres diameter)		Health	Structure	Image	Comments	TPZ (metres RADIUS)	Potential Habitat Hollows Noted	Previous Tag#	Retention Value
				N-S	E-W								
325	Jarrah (*Eucalyptus marginata*)	18	77	10-11	9-10	Dead	Questionable		Dead tree. Area of decay noted and could be impacting structural integrity to some extent.	n/a	1 potential habitat hollow		Very Low
326	Flooded Gum (*Eucalyptus rudis*)	8	69	9-10	9-10	Good	Good		Reasonably good specimen. Main stem bi-furcates but union looks to be Ok at this stage. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Low canopy	6.21			Medium
327	Flooded Gum (*Eucalyptus rudis*)	12	62, 56	12-13	11-12	Fair	Good		Reasonably good specimen. Multi-stemmed from near ground level. Canopy is slightly sparse but what leaf mass is present shows good condition and form. Low canopy. Section of its canopy is dead but remainder ok	6.2			Low

6. Further Considerations; Development Design and Construction

6.1 Protection of Trees as part of Development

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

The retention of the existing current ground level and soil profile within a Tree's designated TPZ will however be of paramount and key importance in the success of the retention of any Tree.

Effective tree protection must also begin with good design and specifications, so that protection during the construction/landscape stages of a development will be achievable and practicably possible.

As an initial recommendation:

1. Efforts are recommended to be spent on the inclusion of the Trees with high retention value.
2. The Very Low and Low retention value Trees are recommended to be excluded from the development and removed as part of development works unless the design of the area around them takes sufficient measures to address the potential risks associated with those Trees, in which case they may be able to be retained for purposes of habitat if desired.
3. The TPZ of each Tree is strongly recommended to be overlaid onto all drawings and designs of the proposed development where the Tree is proposed to be retained.

   Where encroachments into a designated TPZ are found to be required, further discussion with an experienced independent arboricultural consultant is an important part of the tree protection process.

   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 a 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 given Tree will be, and what design modifications or measures may need to be implemented to mitigate any potential negative impact on the given Tree.

   If considered necessary, some exploratory excavation works may also be required to verify actual root spread and determine what impact could occur.

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

During the design process further arboricultural input will likely be required to discuss:

- Current existing ground levels and proposed resulting levels of the various areas of the Site. Note: As previously mentioned, retaining and maintaining current existing ground levels within the designated TPZ of any tree is of paramount importance to the success of tree retention.
- Delineation of <u>any</u> underground services pipework including drainage, sewerage, water, gas, electricity, telecommunications and the like; specifically should they pass through any designated TPZ.
- Location of any drainage near to the Trees and their TPZ.
- Any site remediation requirements within TPZ areas as part of the Site clearing process.

6. Further Considerations; Development Design and Construction

6.2 Physical Protection of Trees during Development

Physical protection measures in accordance with AS 4970 will also be required for any Tree selected for retention; details of any measures to be implemented will be very much dependent on the final detailed design.

It will be of critical importance that the appropriate protection measures are set up and maintained from the outset; i.e. before any Site clearing/demolition works commence.

Implementing tree protection measures after damage has occurred from works is often of little to no value other than affording some protection from further damages occurring.

6.3 Canopy Works

Canopy works are likely to be required on a number of the Trees as part of the development process.

The extent of canopy works on each Tree is however very much dependent on the eventual landscape around the Tree and what potential targets (people, structures etc.) may eventually be within the given Tree's projected fall zone.

At this stage canopy works are likely to be restricted to the removal of any larger diameter deadwood (i.e. any dead branches 50mm or greater in diameter) and/or the raising of canopy's where necessary to provide clearances for future footpaths, structures and/or roads.

Other canopy works may be required pending results of detailed design and what targets will be within the given Tree's projected fall zone.

All canopy works are recommended to be undertaken by suitably qualified and experienced tree surgeons, who possess a minimum qualification of AQF certificate 3 arboriculture, or recognised equivalent qualification.

All canopy pruning works must also comply with Australian Standards 4373; Pruning of Amenity Trees.

Attachments to this Report

Attachment 1; Tree Location Guide

Attachment 2; Tree Location Guide with retention value overlaid

Attachment 3; Glossary of Arboricultural Terms

Attachment 4; Company Information & Disclaimer

Attachment 2; Tree Location Guide

All Trees located to GDA 1994 MGA Zone 50 datum

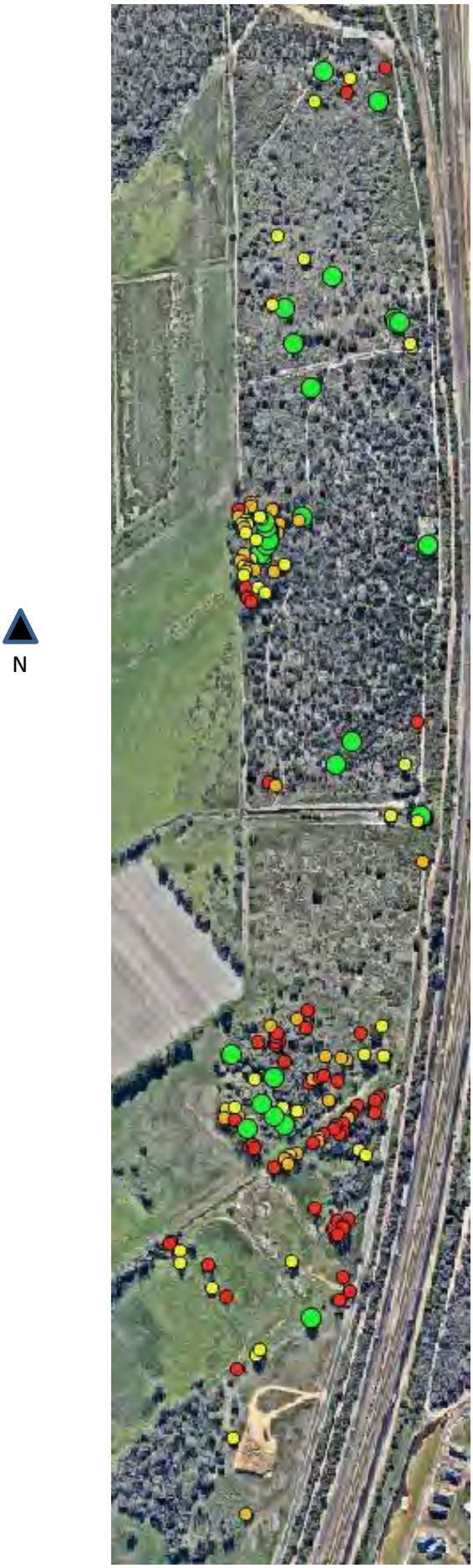
All Trees have been tagged on Site with a metal identification plate referring to its corresponding data within the table provided in this report

Aerial Source; Nearmap.com

Attachment 2; Tree Location Guide (with retention value overlaid)

Key

●	High Retention Value	Tree of particular note due to size, age, condition, species
●	Medium Retention Value	Reasonably good/good Tree
●	Low Retention Value	Trees displaying reduced health and/or questionable structural form but considered ok for low target areas of POS
●	Very Low Retention Value	Trees with poor structure, possibly limited life span remaining, undesirable species



Aerial Source; Nearmap.com

Attachment 3; 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 4; Company Information & Disclaimer

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

Insurance Details:

General Liability;	QBE	$20 million
Professional Indemnity;	Vero	$10 million
Personal Protection;	Macquarie, Asteron	

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Disclaimer

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

The contents of this Report should be read in full, and at no time shall any part of the Report be referred to unless taken in full context with the remainder of the document.

The contents of this Report may not be reissued to another party or published in part or full without Arbor logic's written permission.

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- Material information not being provided by the Client to Arbor logic at the time this advice was prepared.
- 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 tree(s) that are the subject of this advice.

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 10
Nature Map Search

NatureMap Species Report

Created By Guest user on 29/11/2016

Kingdom	Plantae
Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	115° 51' 19" E,32° 11' 10" S
Buffer	5km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	11731	***Acacia browniana var. browniana***			
2.	3262	***Acacia cochlearis (Rigid Wattle)***			
3.	3282	***Acacia cyclops (Coastal Wattle)***			
4.	3374	***Acacia huegelii***			
5.	17861	***Acacia longifolia***	Y		
6.	3502	***Acacia pulchella (Prickly Moses)***			
7.	15481	***Acacia pulchella var. glaberrima***			
8.	30032	***Acacia saligna subsp. saligna***			
9.	3557	***Acacia stenoptera (Narrow Winged Wattle)***			
10.	3581	***Acacia trigonophylla***			
11.	3602	***Acacia willdenowiana (Grass Wattle)***			
12.	6203	***Actinotus glomeratus***			
13.	1775	***Adenanthos cygnorum (Common Woollybush)***			
14.	11837	***Adenanthos cygnorum subsp. cygnorum (Common Woollybush)***			
15.	1791	***Adenanthos obovatus (Basket Flower)***			
16.	17202	***Agonis flexuosa var. flexuosa***			
17.	184	***Aira caryophyllea (Silvery Hairgrass)***	Y		
18.		***Aira caryophyllea/cupaniana group***			
19.	185	***Aira cupaniana (Silvery Hairgrass)***	Y		
20.	187	***Aira praecox (Early Hairgrass)***	Y		
21.	1728	***Allocasuarina fraseriana (Sheoak, Kondil)***			
22.	198	***Amphipogon laguroides***			
23.	20184	***Amphipogon laguroides subsp. laguroides***			
24.	200	***Amphipogon turbinatus***			
25.	7833	***Angianthus preissianus***			
26.	1409	***Anigozanthos humilis (Catspaw)***			
27.	11434	***Anigozanthos humilis subsp. humilis***			
28.	1411	***Anigozanthos manglesii (Mangles Kangaroo Paw, Kurulbrang)***			
29.		***Anigozanthos sp.***			
30.	3688	***Aotus gracillima***			
31.	3692	***Aotus procumbens***			
32.	7838	***Arctotheca calendula (Cape Weed, African Marigold)***	Y		
33.	1264	***Arnocrinum preissii***			
34.	8779	***Asparagus asparagoides (Bridal Creeper)***	Y		
35.	20283	***Astartea scoparia***			
36.	7851	***Asteridea pulverulenta (Common Bristle Daisy)***			
37.	6334	***Astroloma pallidum (Kick Bush)***			
38.	2471	***Atriplex prostrata (Hastate Orache)***	Y		
39.	17234	***Austrostipa compressa***			
40.	17240	***Austrostipa flavescens***			
41.	17245	***Austrostipa mollis***			
42.	17253	***Austrostipa semibarbata***			
43.	37421	***Austrostipa sp. Marchagee (B.R. Maslin 1407)***			
44.	233	***Avena barbata (Bearded Oat)***	Y		
45.	36441	***Babingtonia camphorosmae (Camphor Myrtle)***			
46.	1800	***Banksia attenuata (Slender Banksia, Piara)***			
47.	32580	***Banksia dallanneyi var. dallanneyi***			
48.	1822	***Banksia ilicifolia (Holly-leaved Banksia)***			
49.	1830	***Banksia littoralis (Swamp Banksia, Pungura)***			
50.	1834	***Banksia menziesii (Firewood Banksia)***			
51.	32077	***Banksia sessilis var. cygnorum***			
52.	1852	***Banksia telmatiaea (Swamp Fox Banksia)***			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
53.	741	***Baumea articulata (Jointed Rush)***			
54.	743	***Baumea juncea (Bare Twigrush)***			
55.	749	***Bolboschoenus caldwellii (Marsh Club-rush)***			
56.	4413	***Boronia crenulata (Aniseed Boronia)***			
57.	16636	***Boronia crenulata subsp. viminea***			
58.	11503	***Boronia crenulata var. crenulata***			
59.	4417	***Boronia dichotoma***			
60.	11381	***Boronia ramosa subsp. anethifolia***			
61.	3710	***Bossiaea eriocarpa (Common Brown Pea)***			
62.	6341	***Brachyloma preissii (Globe Heath)***			
63.	30142	***Brachyloma preissii subsp. obtusifolium***			
64.	30136	***Brachyloma preissii subsp. preissii***			
65.	8661	***Brachypodium distachyon (False Brome)***	Y		
66.	3000	***Brassica tournefortii (Mediterranean Turnip)***	Y		
67.	244	***Briza maxima (Blowfly Grass)***	Y		
68.	245	***Briza minor (Shivery Grass)***	Y		
69.	12770	***Burchardia congesta***			
70.	1276	***Caesia micrantha (Pale Grass Lily)***			
71.	1277	***Caesia occidentalis***			
72.		***Caesia sp.***			
73.	15330	***Caladenia arenicola***			
74.	1586	***Caladenia discoidea (Dancing Orchid)***			
75.	1592	***Caladenia flava (Cowslip Orchid)***			
76.	1596	***Caladenia huegelii (Grand Spider Orchid)***		T	
77.	1599	***Caladenia latifolia (Pink Fairy Orchid)***			
78.	15361	***Caladenia longicauda subsp. calcigena***			
79.	2848	***Calandrinia corrigioloides (Strap Purslane)***			
80.	19309	***Calectasia narragara***			
81.	34942	***Callitriche brutia subsp. brutia***	Y		
82.	36600	***Callitris pyramidalis (Swamp Cypress)***			
83.	5411	***Calothamnus hirsutus***			
84.	5415	***Calothamnus lateralis***			
85.		***Calytrix ?flavescens***			Y
86.	5439	***Calytrix angulata (Yellow Starflower)***			
87.	5458	***Calytrix flavescens (Summer Starflower)***			
88.	5460	***Calytrix fraseri (Pink Summer Calytrix)***			
89.	5476	***Calytrix sapphirina***			
90.	2795	***Carpobrotus edulis (Hottentot Fig)***	Y		
91.	1162	***Cartonema philydroides***			
92.	2951	***Cassytha flava (Dodder Laurel)***			
93.	2957	***Cassytha racemosa (Dodder Laurel)***			
94.	11799	***Cassytha racemosa forma racemosa***			
95.	41568	***Cenchrus setaceus (Fountain Grass)***	Y		
96.	6542	***Centaurium tenuiflorum***	Y		
97.	1125	***Centrolepis drummondiana***			
98.	1134	***Centrolepis polygyna (Wiry Centrolepis)***			
99.	2889	***Cerastium glomeratum (Mouse Ear Chickweed)***	Y		
100.	18156	***Chamaecytisus palmensis (Tagasaste)***	Y		
101.	1280	***Chamaescilla corymbosa (Blue Squill)***			
102.	2490	***Chenopodium glaucum (Glaucous Goosefoot)***	Y		
103.	7937	***Cirsium vulgare (Spear Thistle, Scotch Thistle)***	Y		
104.	4550	***Comesperma calymega (Blue-spike Milkwort)***			
105.	4555	***Comesperma integerrimum***			
106.	15611	***Conospermum stoechadis subsp. stoechadis (Common Smokebush)***			
107.	6348	***Conostephium pendulum (Pearl Flower)***			
108.	6349	***Conostephium preissii***			
109.	1418	***Conostylis aculeata (Prickly Conostylis)***			
110.	11826	***Conostylis aculeata subsp. aculeata***			
111.	1436	***Conostylis juncea***			
112.	1454	***Conostylis setigera (Bristly Cottonhead)***			
113.	11597	***Conostylis setigera subsp. setigera***			
114.	7939	***Conyza bonariensis (Flaxleaf Fleabane)***	Y		
115.		***Conyza sp.***			
116.	20074	***Conyza sumatrensis***	Y		
117.	277	***Cortaderia selloana (Pampas Grass)***	Y		
118.	1285	***Corynotheca micrantha (Sand Lily)***			
119.	7945	***Cotula coronopifolia (Waterbuttons)***	Y		
120.	3137	***Crassula colorata (Dense Stonecrop)***			
121.	11709	***Crassula colorata var. acuminata***			
122.	11563	***Crassula colorata var. colorata***			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
123.	16245	***Cyathochaeta teretifolia***		P3	
124.	19625	***Cymbalaria muralis subsp. muralis***	Y		
125.	806	***Cyperus polystachyos (Bunchy Sedge)***	Y		
126.	816	***Cyperus tenuiflorus (Scaly Sedge)***	Y		
127.	7454	***Dampiera linearis (Common Dampiera)***			
128.	7462	***Dampiera pedunculata***			
129.	35618	***Darwinia sp. Karonie (K. Newbey 8503)***			
130.	1218	***Dasypogon bromeliifolius (Pineapple Bush)***			
131.	3807	***Daviesia divaricata (Marno)***			
132.	3832	***Daviesia physodes***			
133.	3845	***Daviesia triflora***			
134.	16595	***Desmocladus flexuosus***			
135.	299	***Deyeuxia quadriseta (Reed Bentgrass)***			
136.	1259	***Dianella revoluta (Blueberry Lily)***			
137.	17838	***Dielsia stenostachya***			
138.	9027	***Diplolaena drummondii***			
139.	19649	***Disa bracteata***	Y		
140.		***Diuris corymbosa/magnifica***			
141.	12939	***Diuris magnifica***			
142.	12938	***Diuris micrantha***		T	
143.	4763	***Dodonaea hackettiana (Hackett's Hopbush)***		P4	
144.	1639	***Drakaea elastica (Glossy-leaved Hammer Orchid)***		T	
145.	3095	***Drosera erythrorhiza (Red Ink Sundew)***			
146.	3098	***Drosera glanduligera (Pimpernel Sundew)***			
147.	3106	***Drosera macrantha (Bridal Rainbow)***			
148.	14298	***Drosera macrantha subsp. macrantha***			
149.	3109	***Drosera menziesii (Pink Rainbow)***			
150.	13216	***Drosera menziesii subsp. penicillaris***			
151.	3117	***Drosera paleacea (Dwarf Sundew)***			
152.	13188	***Drosera paleacea subsp. paleacea***			
153.	3118	***Drosera pallida (Pale Rainbow)***			
154.	29178	***Drosera porrecta***			
155.		***Drosera sp. "climbing"***			
156.	3135	***Drosera zonaria (Painted Sundew)***			
157.		***Ehrharta ?longiflora***			Y
158.	347	***Ehrharta calycina (Perennial Veldt Grass)***	Y		
159.	349	***Ehrharta longiflora (Annual Veldt Grass)***	Y		
160.		***Ehrharta sp.***			
161.	1643	***Elythranthera brunonis (Purple Enamel Orchid)***			
162.	1645	***Epiblema grandiflorum (Babe-in-a-cradle)***			
163.	6133	***Epilobium hirtigerum (Hairy Willow Herb)***			
164.	13950	***Eremaea asterocarpa subsp. asterocarpa***			
165.	5541	***Eremaea pauciflora***			
166.	14104	***Eremaea pauciflora var. pauciflora***			
167.	6219	***Eryngium pinnatifidum (Blue Devils)***			
168.	15446	***Eryngium pinnatifidum subsp. pinnatifidum***			
169.	5615	***Eucalyptus decipiens (Limestone Marlock, Moit)***			
170.	5708	***Eucalyptus marginata (Jarrah, Djara)***			
171.	13547	***Eucalyptus marginata subsp. marginata (Jarrah)***			
172.	5763	***Eucalyptus rudis (Flooded Gum, Kulurda)***			
173.	13511	***Eucalyptus rudis subsp. rudis***			
174.		***Eucalyptus sp.***			
175.	5790	***Eucalyptus todtiana (Coastal Blackbutt)***			
176.	3872	***Euchilopsis linearis (Swamp Pea)***			
177.	20014	***Euphorbia hyssopifolia***	Y		
178.	4638	***Euphorbia peplus (Petty Spurge)***	Y		
179.	4648	***Euphorbia terracina (Geraldton Carnation Weed)***	Y		
180.	3880	***Eutaxia virgata***			
181.	1747	***Ficus carica (Common Fig)***	Y		
182.	2969	***Fumaria capreolata (Whiteflower Fumitory)***	Y		
183.		***Fumaria sp.***			
184.	7323	***Galium murale (Small Goosegrass)***	Y		
185.	20475	***Gastrolobium capitatum***			
186.	20483	***Gastrolobium linearifolium***			
187.	3936	***Genista linifolia (Flaxleaf Broom)***	Y		
188.	1520	***Gladiolus caryophyllaceus (Wild Gladiolus)***	Y		
189.	6587	***Gomphocarpus fruticosus (Narrowleaf Cottonbush)***	Y		
190.	3957	***Gompholobium tomentosum (Hairy Yellow Pea)***			
191.	6161	***Gonocarpus pithyoides***			
192.	7538	***Goodenia pulchella***			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
193.	14282	***Gratiola pubescens***			
194.		***Haemodorum sp.***			
195.	1475	***Haemodorum spicatum (Mardja)***			
196.	2197	***Hakea prostrata (Harsh Hakea)***			
197.	2216	***Hakea varia (Variable-leaved Hakea)***			
198.	3961	***Hardenbergia comptoniana (Native Wisteria)***			
199.	29594	***Helichrysum luteoalbum (Jersey Cudweed)***			
200.	6710	***Heliotropium europaeum (Common Heliotrope)***	Y		
201.	6839	***Hemiandra pungens (Snakebush)***			
202.	38320	***Hemiandra sp. Jurien (B.J. Conn & M.E. Tozer BJC 3885)***			
203.	1293	***Hensmania turbinata***			
204.	5134	***Hibbertia huegelii***			
205.	5135	***Hibbertia hypericoides (Yellow Buttercups)***			
206.	45534	***Hibbertia hypericoides subsp. hypericoides***			
207.	5162	***Hibbertia racemosa (Stalked Guinea Flower)***			
208.	5173	***Hibbertia subvaginata***			
209.	5176	***Hibbertia vaginata***			
210.	444	***Holcus lanatus (Yorkshire Fog)***	Y		
211.	6222	***Homalosciadium homalocarpum***			
212.	3966	***Hovea pungens (Devil's Pins, Puyenak)***			
213.	12859	***Hovea trisperma var. trisperma***			
214.	12741	***Hyalosperma cotula***			
215.	5216	***Hybanthus calycinus (Wild Violet)***			
216.	5817	***Hypocalymma angustifolium (White Myrtle, Kudjid)***			
217.	35070	***Hypocalymma angustifolium subsp. Swan Coastal Plain (G.J. Keighery 16777)***			
218.	5825	***Hypocalymma robustum (Swan River Myrtle)***			
219.	8086	***Hypochaeris glabra (Smooth Catsear)***	Y		
220.	9352	***Hypochaeris radicata (Flat Weed, Cats-ear)***	Y		
221.	1070	***Hypolaena exsulca***			
222.	17841	***Hypolaena pubescens***			
223.		***Iridaceae sp.***			Y
224.	20200	***Isolepis cernua var. setiformis***			
225.	917	***Isolepis marginata (Coarse Club-rush)***			
226.	3992	***Isotropis cuneifolia (Granny Bonnets)***			
227.	4012	***Jacksonia furcellata (Grey Stinkwood)***			
228.	20462	***Jacksonia gracillima***		P3	
229.	4029	***Jacksonia sternbergiana (Stinkwood, Kapur)***			
230.	1178	***Juncus bufonius (Toad Rush)***	Y		
231.	1186	***Juncus microcephalus***	Y		
232.	1188	***Juncus pallidus (Pale Rush)***			
233.	1190	***Juncus planifolius (Broadleaf Rush)***			
234.	4044	***Kennedia prostrata (Scarlet Runner)***			
235.	5832	***Kunzea ericifolia (Spearwood, Pondil)***			
236.	15498	***Kunzea glabrescens (Spearwood)***			
237.	20019	***Lachnagrostis filiformis***			
238.	8096	***Lactuca serriola (Prickly Lettuce)***	Y		
239.	18585	***Lagenophora huegelii***			
240.	467	***Lagurus ovatus (Hare's Tail Grass)***	Y		
241.	4052	***Latrobea tenella***			
242.	1307	***Laxmannia ramosa (Branching Lily)***			
243.	11911	***Laxmannia ramosa subsp. ramosa***			
244.	11464	***Laxmannia sessiliflora subsp. australis***			
245.	1309	***Laxmannia squarrosa***			
246.	7572	***Lechenaultia expansa***			
247.	7574	***Lechenaultia floribunda (Free-flowering Leschenaultia)***			
248.	44490	***Leontodon rhagadioloides***	Y		
249.	925	***Lepidosperma angustatum***			
250.	937	***Lepidosperma longitudinale (Pithy Sword-sedge)***			
251.	940	***Lepidosperma pubisquameum***			
252.	944	***Lepidosperma scabrum***			
253.		***Lepidosperma sp. terete***			
254.	945	***Lepidosperma squamatum***			
255.	946	***Lepidosperma striatum***			
256.	1653	***Leporella fimbriata (Hare Orchid)***			
257.	1077	***Leptocarpus canus (Hoary Twine-rush)***			
258.	1080	***Leptocarpus scariosus***			
259.	2342	***Leptomeria cunninghamii***			
260.	2344	***Leptomeria empetriformis***			
261.	2350	***Leptomeria pauciflora (Sparse-flowered Currant Bush)***			
262.	5850	***Leptospermum laevigatum (Coast Teatree)***	Y		

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
263.	6360	***Leucopogon australis (Spiked Beard-heath)***			
264.	6374	***Leucopogon conostephioides***			
265.	6436	***Leucopogon propinquus***			
266.	7676	***Levenhookia pusilla (Midget Stylewort)***			
267.		***Levenhookia pusilla/stipitata***			
268.	7677	***Levenhookia stipitata (Common Stylewort)***			
269.	9289	***Lobelia anceps (Angled Lobelia)***			
270.	7408	***Lobelia tenuior (Slender Lobelia)***			
271.	6515	***Logania vaginalis (White Spray)***			
272.	478	***Lolium rigidum (Wimmera Ryegrass)***	Y		
273.		***Lomandra ?caespitosa***			
274.		***Lomandra ?hermaphrodita***			Y
275.		***Lomandra ?nigricans***			Y
276.		***Lomandra ?preissii***			
277.		***Lomandra ?suaveolens***			Y
278.	1223	***Lomandra caespitosa (Tufted Mat Rush)***			
279.		***Lomandra caespitosa/suaveolens***			Y
280.	1228	***Lomandra hermaphrodita***			
281.	1232	***Lomandra micrantha (Small-flower Mat-rush)***			
282.	1234	***Lomandra nigricans***			
283.	1239	***Lomandra preissii***			
284.	1243	***Lomandra sericea (Silky Mat Rush)***			
285.		***Lomandra sp.***			
286.	1246	***Lomandra suaveolens***			
287.	8564	***Lotus subbiflorus***	Y		
288.	1198	***Luzula meridionalis (Field Woodrush)***			
289.	1097	***Lyginia barbata***			
290.		***Lyginia barbata/imberbis***			
291.	18049	***Lyginia imberbis***			
292.	1656	***Lyperanthus serratus (Rattle Beak Orchid)***			
293.	36375	***Lysimachia arvensis (Pimpernel)***	Y		
294.	6456	***Lysinema ciliatum (Curry Flower)***			
295.	5281	***Lythrum hyssopifolia (Lesser Loosestrife)***	Y		
296.	2838	***Macarthuria apetala***			
297.	2839	***Macarthuria australis***			
298.	18119	***Macrozamia fraseri***			
299.	85	***Macrozamia riedlei (Zamia, Djiridji)***			
300.	4079	***Medicago polymorpha (Burr Medic)***	Y		
301.	5900	***Melaleuca cuticularis (Saltwater Paperbark)***			
302.	13271	***Melaleuca huegelii subsp. huegelii***			
303.	13273	***Melaleuca incana subsp. incana***			
304.	5926	***Melaleuca lateritia (Robin Redbreast Bush)***			
305.	5946	***Melaleuca pauciflora***			
306.	5952	***Melaleuca preissiana (Moonah)***			
307.	5964	***Melaleuca seriata***			
308.	18598	***Melaleuca systena***			
309.	5978	***Melaleuca teretifolia (Banbar)***			
310.	5980	***Melaleuca thymoides***			
311.	4085	***Melilotus indicus***	Y		
312.	953	***Mesomelaena graciliceps***			
313.	955	***Mesomelaena pseudostygia***			
314.	957	***Mesomelaena tetragona (Semaphore Sedge)***			
315.	485	***Microlaena stipoides (Weeping Grass)***			
316.	1658	***Microtis atrata (Swamp Mignonette Orchid)***			
317.	10954	***Microtis media (Tall Mignonette Orchid)***			
318.	15419	***Microtis media subsp. media***			
319.	4666	***Monotaxis occidentalis***			
320.	6189	***Myriophyllum crispatum***			
321.	6199	***Myriophyllum tillaeoides***			
322.	492	***Neurachne alopecuroidea (Foxtail Mulga Grass)***			
323.	6974	***Nicotiana glauca (Tree Tobacco)***	Y		
324.	2401	***Nuytsia floribunda (Christmas Tree, Mudja)***			
325.	6140	***Oenothera mollissima***	Y		
326.	18255	***Opercularia vaginata (Dog Weed)***			
327.	36177	***Ornduffia albiflora***			
328.	4113	***Ornithopus compressus (Yellow Serradella)***	Y		
329.	7090	***Parentucellia viscosa (Sticky Bartsia)***	Y		
330.	527	***Paspalum dilatatum***	Y		
331.	1550	***Patersonia occidentalis (Purple Flag, Koma)***			
332.	30471	***Patersonia occidentalis var. angustifolia***			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
333.	30472	***Patersonia occidentalis var. occidentalis***			
334.	4343	***Pelargonium capitatum (Rose Pelargonium)***	Y		
335.	4346	***Pelargonium littorale***			
336.	6006	***Pericalymma ellipticum (Swamp Teatree)***			
337.	16477	***Pericalymma ellipticum var. ellipticum***			
338.	2273	***Persoonia saccata (Snottygobble)***			
339.	2299	***Petrophile linearis (Pixie Mops)***			
340.	2301	***Petrophile macrostachya***			
341.	2312	***Petrophile striata***			
342.	18529	***Philotheca spicata (Pepper and Salt)***			
343.	1478	***Phlebocarya ciliata***			
344.	16177	***Phyllangium paradoxum***			
345.	4675	***Phyllanthus calycinus (False Boronia)***			
346.	2793	***Phytolacca octandra (Red Ink Plant)***	Y		
347.	5237	***Pimelea calcicola***		P3	
348.	18117	***Pimelea rosea subsp. rosea***			
349.	8163	***Pithocarpa corymbulosa (Corymbose Pithocarpa)***		P3	
350.	6249	***Platysace compressa (Tapeworm Plant)***			
351.	6253	***Platysace filiformis***			
352.	4524	***Platytheca galioides***			
353.		***Poaceae sp.***			
354.	8175	***Podolepis gracilis (Slender Podolepis)***			
355.	8182	***Podotheca angustifolia (Sticky Longheads)***			
356.	8183	***Podotheca chrysantha (Yellow Podotheca)***			
357.	8184	***Podotheca gnaphalioides (Golden Long-heads)***			
358.		***Podotheca sp.***			
359.	2905	***Polycarpon tetraphyllum (Fourleaf Allseed)***	Y		
360.	582	***Polypogon monspeliensis (Annual Beardgrass)***	Y		
361.	4691	***Poranthera microphylla (Small Poranthera)***			
362.		***Poranthera microphylla/moorokatta***			
363.	1670	***Prasophyllum drummondii (Swamp Leek Orchid)***			
364.	10853	***Prasophyllum plumiforme***			
365.	1693	***Pterostylis recurva (Jug Orchid)***			
366.	12217	***Pterostylis sanguinea***			
367.	11260	***Ptilotus drummondii var. drummondii (Pussytail)***			
368.	4177	***Pultenaea ochreata***			
369.	4181	***Pultenaea reticulata***			
370.	16367	***Pyrorchis nigricans (Red beaks, Elephants ears)***			
371.	8195	***Quinetia urvillei***			
372.	6012	***Regelia ciliata***			
373.	13300	***Rhodanthe citrina***			
374.	14485	***Romulea flava var. minor***	Y		
375.	1556	***Romulea rosea (Guildford Grass)***	Y		
376.	14924	***Romulea rosea var. communis***	Y		
377.	40426	***Rytidosperma occidentale***			
378.	11647	***Samolus repens var. repens***			
379.	7603	***Scaevola canescens (Grey Scaevola)***			
380.	978	***Schoenus brevisetis***			
381.	982	***Schoenus clandestinus***			
382.	984	***Schoenus curvifolius***			
383.	986	***Schoenus efoliatus***			
384.	992	***Schoenus grandiflorus (Large Flowered Bogrush)***			
385.	1017	***Schoenus subbulbosus***			
386.	16251	***Schoenus subflavus subsp. long leaves (K.L. Wilson 2865)***			
387.	6033	***Scholtzia involucrata (Spiked Scholtzia)***			
388.	6	***Selaginella gracillima (Tiny Clubmoss)***			
389.	25884	***Senecio pinnatifolius var. latilobus***			
390.	2909	***Silene gallica (French Catchfly)***	Y		
391.	8225	***Siloxerus humifusus (Procumbent Siloxerus)***			
392.		***Siloxerus humifusus/filifolius***			
393.	7020	***Solanum linnaeanum (Apple of Sodom)***	Y		
394.	7022	***Solanum nigrum (Black Berry Nightshade)***	Y		
395.	8230	***Sonchus asper (Rough Sowthistle)***	Y		
396.	9367	***Sonchus hydrophilus (Native Sowthistle)***			
397.	8231	***Sonchus oleraceus (Common Sowthistle)***	Y		
398.	1312	***Sowerbaea laxiflora (Purple Tassels)***			
399.	4211	***Sphaerolobium vimineum (Leafless Globe Pea)***			
400.	2316	***Stirlingia latifolia (Blueboy)***			
401.	25831	***Stylidium araeophyllum (Stilt Walker)***			
402.		***Stylidium araeophyllum/neurophyllum***			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
403.	7693	***Stylidium brunonianum (Pink Fountain Triggerplant)***			
404.	7696	***Stylidium calcaratum (Book Triggerplant)***			
405.	7699	***Stylidium carnosum (Fleshy-leaved Triggerplant)***			
406.	25829	***Stylidium neurophyllum (Coastal Plain Triggerplant)***			
407.	25800	***Stylidium paludicola***		P3	
408.	7774	***Stylidium piliferum (Common Butterfly Triggerplant)***			
409.	7785	***Stylidium repens (Matted Triggerplant)***			
410.	25806	***Stylidium scariosum***			
411.	7798	***Stylidium schoenoides (Cow Kicks)***			
412.	1260	***Stypandra glauca (Blind Grass)***			
413.	25902	***Symphyotrichum squamatum (Bushy Starwort)***	Y		
414.	2329	***Synaphea spinulosa***			
415.	15532	***Synaphea spinulosa subsp. spinulosa***			
416.	11143	***Thelymitra graminea***			
417.		***Thelymitra sp.***			
418.		***Thysanotus ?arbuscula***			Y
419.	1318	***Thysanotus arbuscula***			
420.	1319	***Thysanotus arenarius***			
421.	1338	***Thysanotus manglesianus (Fringed Lily)***			
422.		***Thysanotus manglesianus/patersonii complex***			
423.	1339	***Thysanotus multiflorus (Many-flowered Fringe Lily)***			
424.	1343	***Thysanotus patersonii***			
425.		***Thysanotus sp.***			
426.	1351	***Thysanotus sparteus***			
427.	1357	***Thysanotus thyrsoideus***			
428.	1358	***Thysanotus triandrus***			
429.	6280	***Trachymene pilosa (Native Parsnip)***			
430.	1361	***Tricoryne elatior (Yellow Autumn Lily)***			
431.	1363	***Tricoryne tenella***			
432.	1038	***Tricostularia neesii***			
433.	17145	***Trifolium angustifolium var. angustifolium***	Y		
434.	14738	***Trifolium resupinatum var. resupinatum***	Y		
435.	44444	***Tripterococcus sp. Brachylobus (A.S. George 14234)***		P4	
436.	4360	***Tropaeolum majus (Garden Nasturtium)***	Y		
437.		***Unknown Annual Grasses***			
438.	8254	***Urospermum picroides (False Hawkbit)***	Y		
439.	8255	***Ursinia anthemoides (Ursinia)***	Y		
440.	38388	***Ursinia anthemoides subsp. anthemoides***	Y		
441.	15432	***Verticordia densiflora var. densiflora***			
442.	14714	***Verticordia lindleyi subsp. lindleyi***		P4	
443.	4320	***Vicia hirsuta (Hairy Vetch)***	Y		
444.	11474	***Vicia sativa subsp. nigra***	Y		
445.	722	***Vulpia bromoides (Squirrel Tail Fescue)***	Y		
446.		***Vulpia sp.***			
447.	7384	***Wahlenbergia capensis (Cape Bluebell)***	Y		
448.	7389	***Wahlenbergia preissii***			
449.		***Wahlenbergia sp.***			
450.	8282	***Waitzia suaveolens (Fragrant Waitzia)***			
451.	1251	***Xanthorrhoea brunonis***			
452.	1256	***Xanthorrhoea preissii (Grass tree, Palga)***			
453.	6289	***Xanthosia huegelii***			
454.	2331	***Xylomelum occidentale (Woody Pear, Djandin)***			
455.	1049	***Zantedeschia aethiopica (Arum Lily)***	Y		

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Appendix 11
Dieback Assessment

Satterley

Mandogalup

Phytophthora Dieback occurrence assessment

GLEVAN CONSULTING

Disclaimer

This report has been prepared in accordance with the scope of work agreed between the Client and Glevan Consulting and contains results and recommendations specific to the agreement. Results and recommendations in this report should not be referenced for other projects without the written consent of Glevan Consulting.

Procedures and guidelines stipulated in various Department of Environment and Conservation and Dieback Working Group manuals are applied as the base methodology used by Glevan Consulting in the delivery of the services and products required by this scope of work. These guidelines, along with overarching peer review and quality standards ensure that all results are presented to the highest standard.

Glevan Consulting has assessed areas based on existing evidence presented at the time of assessment. The Phytophthora pathogen may exist in the soil as incipient disease. Methods have been devised and utilised that compensate for this phenomenon; however, very new centres of infestation, that do not present any visible evidence, may remain undetected during the assessment.

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Author Glevan Consulting

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1 Summary

Glevan Consulting conducted an assessment of the proposed Mandogalup development area for the presence of Phytophthora Dieback. The Project Area covered 85 hectares, of which 37.6 hectares was assessed.

The assessment was conducted on the 6th of November by Simon Robinson. The study area had not previously been assessed for the presence of Phytophthora Dieback.

Much of the study area was observed to be either heavily disturbed (unmappable), or completely void of vegetation (excluded). The disturbance and clearing appears to be largely related to horticultural/agricultural activity. Some of the sections within the unmappable category, were technically uninterpretable, but have been classified within the unmappable area to simplify management. These sections were primarily wetland areas containing thickets of *Kunzea ericifolia*.

There are no confirmed infestations within the study area, however some wetland areas exhibited a pattern of vegetation decline consistent with Phytophthora Dieback infestation, and are almost certainly infested. The areas thought to be infested were typically located in low-lying areas, subject to seasonal inundation and characterised by scattered *X. preissii* deaths. Disturbance levels, and the low interpretability of the vegetation within the affected areas, meant that the extent of any infestations could not be accurately mapped, and these areas have been included in the unmappable category.

A single uninfested protectable area was identified and demarcated during the assessment. The area exhibited some signs of vegetation decline, however representative samples were taken, and recorded negative results for the presence of *Phytophthora cinnamomi*.

The hygiene boundaries demarcated during the assessment are valid for 12 months and will expire on the 6th of November 2014.

2 Introduction

2.1 Background

Glevan Consulting was commissioned by Stratagen to conduct an assessment of the proposed Mandogalup development area for the presence of Phytophthora Dieback. The assessment is part of a broader environmental survey being conducted to determine the environmental attributes of the area prior to the commencement of proposed housing development.

2.2 Location of Project Area.

The study area is located adjacent to the western side of the Kwinana Freeway, immediately south of Rowley Road, in the locality of Mandogalup. The study area covers approximately 85 ha, 37.6 ha of which can be assessed for the presence of Phytophthora Dieback.

Figure 1 - Project Area

2.3 Historical land use and previous disturbances.

The study area is a mosaic of cleared/partially cleared agricultural land, and remnant vegetation exhibiting varying degrees disturbance. Much of the cleared land appears to be currently unused, but the study area has been used historically for cattle grazing and agistment/horse training.

There is disturbance to the remnant vegetation associated with the construction of power lines, firebreaks, and several vehicle tracks which appear to have been used regularly by members of the public. The disturbance caused by these factors has resulted in significant weed invasion.

2.4 Study team

The assessment was conducted by Simon Robinson of Glevan Consulting in November of 2013. Mr Robinson is accredited by the Department of Parks and Wildlife in the detection, diagnosis and mapping of the Dieback disease. This accreditation recognises the skills and experience of Mr Robinson.

3 Methods

3.1 Pre survey desktop study

Known databases of *Phytophthora* locations retained by Vegetation Health Services (Department of Environment and Conservation) were searched to determine previous recoveries of *Phytophthora* within the project area.

3.2 Interpretation

During the assessment, the personnel involved in the field work will determine the presence of Phytophthora Dieback based on symptoms and disease signatures displayed in susceptible vegetation. These symptoms may be supported through the recovery of Phytophthora from soil and tissue samples taken during the assessment.

The detection of the plant pathogen Phytophthora Dieback involves the observation and interpretation of plant deaths (or reduction of biomass or perceived temporal change in vegetation structure) using a logical assessment of factors that imply pathogen presence above other possible causes of plant deaths or vegetation change. A combination of the following factors may indicate the presence of disease caused by *Phytophthora* Dieback or other *Phytophthora* species.

Deaths of disease indicating species:

An indicator species is a plant species, which is reliably susceptible to Phytophthora Dieback (i.e. will die). Common indicators include several species of *Banksia, Patersonia*, *Persoonia*, and *Xanthorrhoea*. The distribution and composition of indicator species will vary from place to place according to vegetation types.

Chronology of deaths:

As the pathogen spreads through an area, some or all susceptible plants become infected and die. Consequently there will be an age range from more recent deaths with yellowing or brown leaves through to older leafless stags to remnant stumps in the ground.

Pattern of deaths:

The topography, soil type, vegetation type and drainage characteristics of an area together with the influence of climatic patterns and disturbances will influence the shape or pattern of an infested area over time. A typical recent infestation may show a small cluster of dead indicator species which, in time, will spread to become a small circular shape 'the ulcer effect' and then begin lengthening towards natural drainage channels. A fringe of recent deaths is often seen around the edge of the infested area. Patterns may be further highlighted by a paucity of ground cover within the infested area.

Environmental factors:

Sites will vary in the way that disease is expressed both spatially and temporally. Environmental conditions can either favour or disfavour the growth and spread of the pathogen. Sites that are moist but not saturated are most favourable, sites that are well drained and mostly dry are least favourable.

Other causes of indicator species death:

Phytophthora cinnamomi is not the only agent to cause death of native vegetation. Other agents include, but are not limited to:

- other *Phytophthora* spp, *Armillaria luteobubalina*, various cankers, insects;
- drought, wind scorch, frost, salinity, water logging, fire and lightning;
- senescence, competition, physical damage;
- herbicides, chemical spills (for example fuel).

Based on the field assessment, the Project Area can be distributed to the following occurrence categories.

Table 1 - Phytophthora Dieback occurrence categories

Vegetated area	Infested	Areas that have plant disease symptoms consistent with the presence of Phytophthora Dieback
	Uninfested	Areas free of plant disease symptoms that indicate the presence of Phytophthora Dieback.
	Uninterpretable	Areas where indicator plants are absent or too few to determine the presence or absence of Phytophthora Dieback.

	Unmappable	Areas that are sufficiently disturbed so that Phytophthora Dieback occurrence mapping is not possible at the time of inspection.
	Not yet resolved	Areas where the interpretation process has not confidently determined the status of the vegetation.
Non-vegetated area	Excluded	Areas devoid of vegetation are excluded from the assessment area.

3.3 Landform and vegetation complexes.

Landform and vegetation types were taken into consideration when conducting the assessment, as both of these factors can significantly influence disease presence and distribution. Low-lying areas, and areas with highly susceptible vegetation are more likely to be infested, and are therefore targeted during the assessment. On the Swan coastal Plain this means targeting interdunal depressions and Banksia woodland.

3.4 Demarcation of hygiene boundaries

The unmappable boundaries were denoted with black and pink tiger tape. The taped boundaries were positioned approximately 10m outside the unmappable areas, to provide the required buffer zone, and placed approximately 10 -15m apart.

3.5 Soil and tissue sampling

Suspicious sites can have a representative soil and tissue sample taken to assist with the interpretation process. The laboratory result can confirm the presence of the *P. cinnamomi* pathogen. A negative result does not necessarily prove that the pathogen isn't present at the site, and should be supported by the field interpretation.

Sampling was conducted using the following procedure:

- All digging implements used were thoroughly sterilised prior to use with methylated spirits. The implements were then allowed to dry so that the integrity of the sample was not compromised.

- The area around the base of the plant/s to be sampled was cleared of vegetative matter to aid the digging process.
- The plant was dug to a satisfactory depth so that the tissue with the highest moisture content was obtained.
- Sections of the roots and stem base from all sides of the plant were taken and placed in a plastic bag. If any lesion was noticed on the tissue, it was also placed in the bag. A few handfuls of sand from various depths were also deposited in the plastic bag.
- The sample bags were irrigated with distilled water to try and simulate the optimum conditions for the *Phytophthora* to survive.
- Details, such as the date, sample number and interpreters were written on an aluminium tag, which was left at the site. The tag was demarcated with a strip of day-glow orange flagging tape.
- All digging implements used were again sterilised after each sample was taken to ensure that infected soil was not transported to the next sample site.

3.6 Mapping

Subsequent to hygiene boundary demarcation, the boundaries were again walked and recorded utilising a handheld GPS. The recorded data was then transferred to a desktop computer and used to produce the relevant maps.

3.7 Limitations of disease mapping

The assessment for the disease caused by Phytophthora Dieback is based on interpreting the vegetation for symptoms which can be ascribed to the disease presence. These observable factors must be present during the assessment period. Management recommendations may be included if it is considered that the disease may be cryptic, or the project area displays evidence of activities that are considered a high risk of introducing the disease.

The validity of the hygiene boundaries mapped for this project is twelve months from the completion of this project. All boundaries should be reassessed by 11/2014 if activities are still occurring beyond this time.

4 Results

4.1 Phytophthora Dieback occurrence distribution

Table 2 - Area Summary

Category	Area (ha)	% of total area
Infested (with *P. cinnamomi*)	0.0 ha	0%
Unmappable	32.0 ha	37%
Uninfested	5.6 ha	7%
Excluded	47.4 ha	56%
TOTAL AREA	85.0 ha	

4.2 Soil and tissue samples

Table 3 – Project Area Sample Summary

Sample	Plant sampled	Easting	Northing	Result
1	***Xanthorrhoea preissii***	**392098**	**6438129**	**negative**
2	***Xanthorrhoea gracilis***	**392137**	**6438284**	**negative**

5 Discussion

5.1 Phytophthora Dieback occurrence distribution

No Phytophthora Dieback infestations were mapped during the assessment, and no previous *Phytophthora* recoveries were found in the VHS database for the area. However, some wetland sections of the study area are almost certainly infested. Due to disturbance and the low interpretability of the vegetation associated with the affected areas, it was not possible to determine the extent of the infestations, and therefore the disease boundaries could not be delineated. As a result, the sections believed to be infested were included within the unmappable category.

The first area observed that appears likely to be infested occurred towards the western boundary of the study area, between the uninfested section and the neighbouring private property (map 1.1). The disease symptoms appeared to be confined to the low-lying area that has historically been subject to seasonal inundation/waterlogging.

The second of the areas likely to be infested is also a wetland area that is located between the paddock historically used for cattle grazing, and the horse training facility to the south (map 1.1). The wetland itself was again uninterpretable due to disturbance and the low interpretability of the vegetation (*Melaleuca preissiana* with an understorey infested with Arum Lily).

5.2 Disease expression

The first of the suspected infestations was characterised by scattered *X. preissii* deaths throughout the low-lying, water-gaining section, with the most recent deaths towards the edge of the water-gaining area.

Within the second of the suspected infestations, there was no expression within the actual wetland due to a lack of indicator species. However, within the heavily disturbed fringes of the wetland (where susceptible plants were located), a significant number of *X. preissii*

deaths were observed. The deceased plants exhibited notable chronology, and a pattern of deaths typical of that normally associated with Phytophthora Dieback.

5.3 Disease impact

Within the first of the suspected infestations, the impact of the disease appears to be quite low, as there is a relatively small amount of susceptible species present. Disease impact appears to be confined to the understorey, with no over storey impact observed (due to an absence of the susceptible tree species *Eucalyptus marginata*).

Disease impact at the second of the suspected infestations was also minor within the wetland area, however there was significant impact around the fringes of the wetland where the majority of the *X. preissii* specimens present, appeared to be deceased.

5.4 Soil and tissue sampling strategies

Within the section that has now been mapped as uninfested, it was noted that some areas were exhibiting signs of vegetation decline. The decline was not consistent with that normally associated with Phytophthora Dieback however, and samples were taken to confirm that the decline was related to causes other than Phytophthora Dieback. Both samples returned a negative result for the presence of *P. cinnamomi*, resulting in the area being mapped as uninfested.

Samples were not taken in the two areas believed to be infested, because even if the presence of the pathogen was confirmed through sampling, it would still not have been possible to delineate the disease boundaries or map the extent of the infested area.

5.5 Unmappable Areas

A significant portion (37%) of the study area was observed to be unmappable due to disturbance, and an associated lack of indicator species. Some of the areas were technically uninterpretable (naturally void of reliable indicators), particularly those containing dense thickets of *Kunzea ericifolia*. These areas have been included within the unmappable category to simplify hygiene management.

Much of the disturbance that contributed to the unmappable classification was associated with weed infestation, particularly Perennial Veldt grass (*Erharta calycina*), which has replaced much of the natural understorey vegetation. The section of the study area north of the uninfested area (map 1.1) contained several sections that appeared to be uninfested, but these sections were small and highly fragmented (by unmappable sections heavily infested with weeds), and would not qualify as protectable area.

In addition to the unmappable areas, an even larger portion (56%) of the study area was actually excluded from the assessment due to being void of vegetation. Detection and mapping of Phytophthora Dieback cannot be conducted in areas void of vegetation.

6 Recommendations

The following recommendations are made:

- Soil and plant material of infested or unknown dieback status should not be introduced to uninfested or unmappable sections of the study area.

- Soil and plant material should not be transported from the infested or unmappable sections of the study area for use at any other protectable site.

- Soil movement within each category is permissible, but should not occur across category boundaries, except where the source is uninfested.

- Vehicles and machinery should be clean upon entry into any of the site categories, and when moving across category boundaries. Moving from uninfested areas into other categories does not require clean down measures.

- Restrict access, where possible, to dry soil conditions only. Where vehicles or machinery are required to access the area during, or shortly after rainfall, they must carry clean down equipment, and remove any soil or plant material at designated hygiene points.

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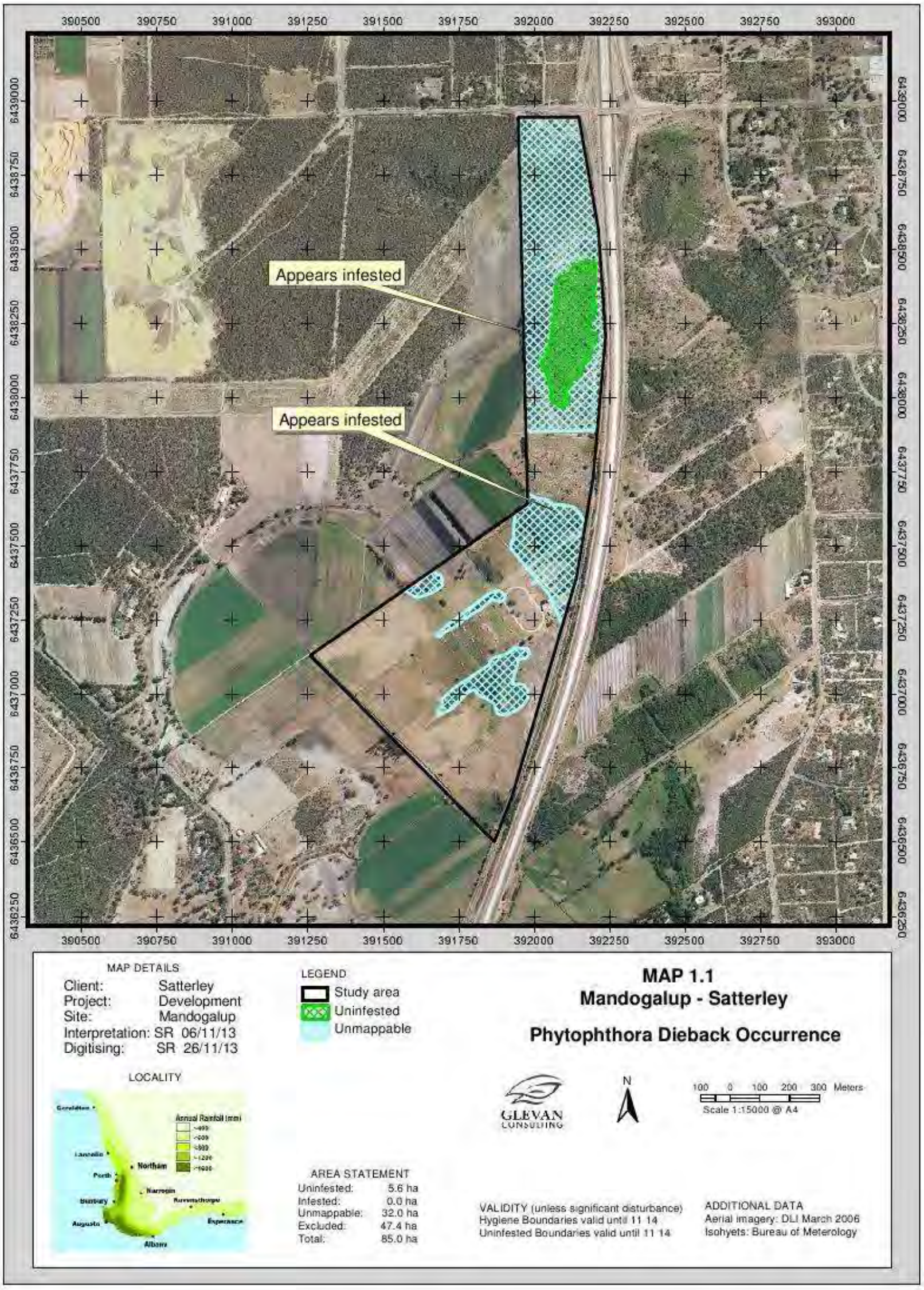
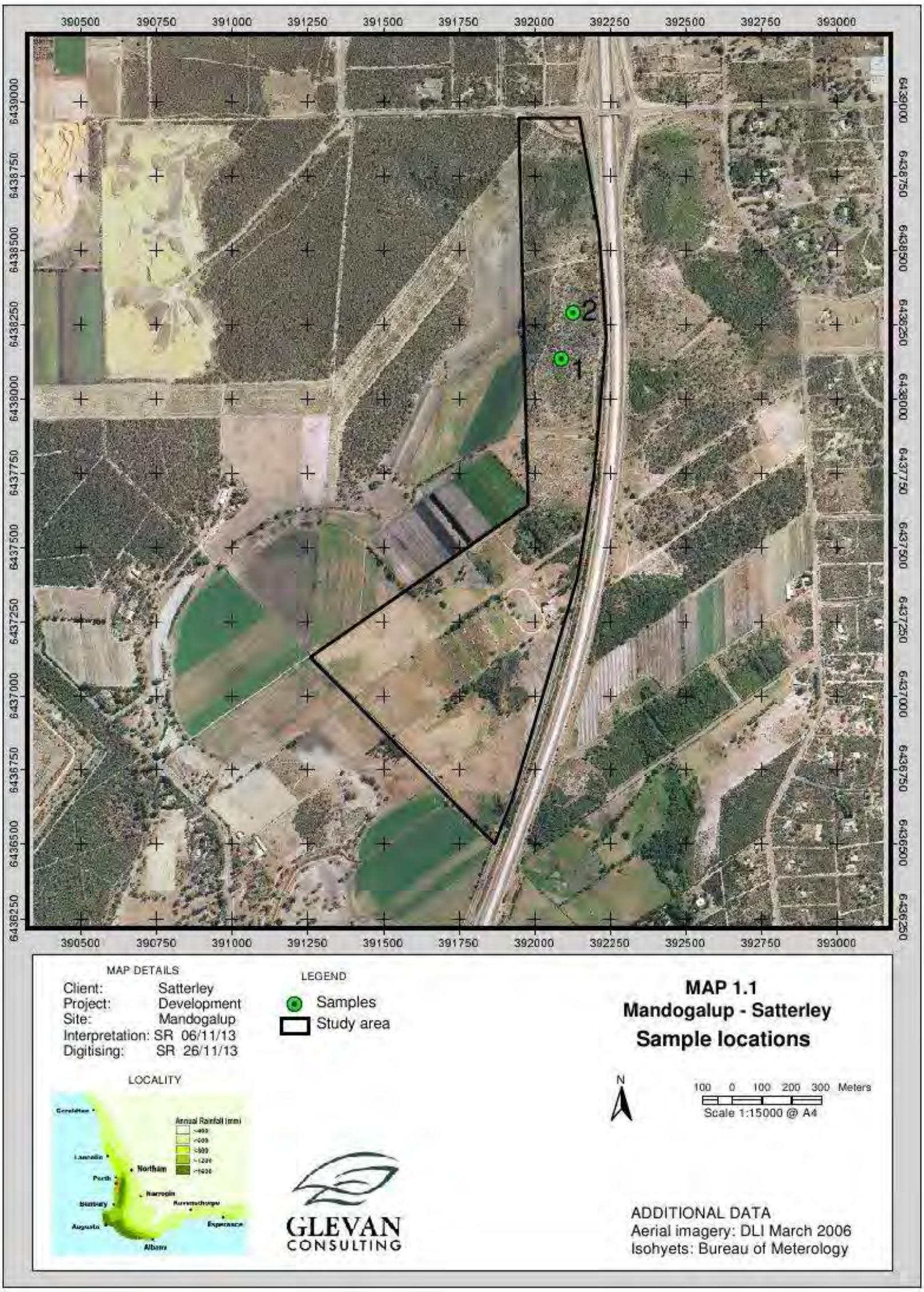
8 Appendix – Phytophthora occurrence map



9 Appendix – Sample locations map



10 Appendix – Introduction to Phytophthora

Phytophthora Dieback is the name generally used in Western Australia to describe the disease symptoms of, and the causal agent, *Phytophthora cinnamomi*. This introduced soil-borne pathogen is a major threat to Australian vegetation, and in particular, the vegetation and dependent biota within the south west botanical province. This disease is listed as a key threatening process under the Environment Protection and Biodiversity Conservation Act 1999, with a subsequent threat abatement plan introduced in 2001 (Environment Australia 2001).

It is generally believed that Phytophthora Dieback was introduced to Australia during the early European settlement. From 1921, patches of healthy jarrah forest were observed to be dying, with Frank Podger and George Zentmyer establishing in 1964 that *Phytophthora cinnamomi* was the causal agent for the forest decline (DWG 2011).

The impact of the disease on the vegetation is dependent on climatic conditions along with host plant species and suitable soils (Keane and Kerr 1997). This relationship, shown in Figure 1, describes all aspects required to create the disease.

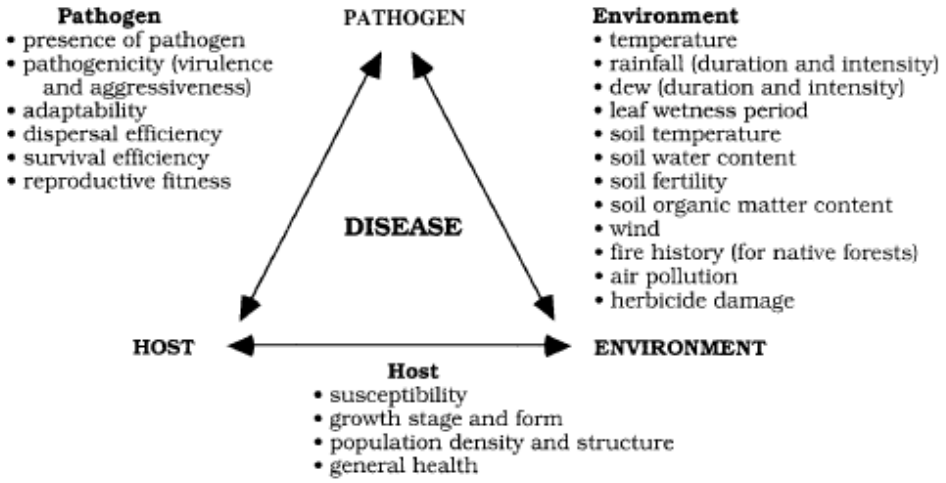


Figure 2 - Disease Triangle

This relationship is also described in Management of *Phytophthora cinnamomi* for Biodiversity Conservation in Australia Part 2 - National Best Practice Guidelines / Appendix 3

as the disease pyramid (O'Gara, et al. 2005). This figure includes the additional element of time to demonstrate the progressive impact of the disease on susceptible vegetation.

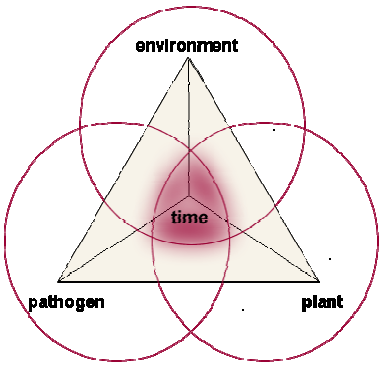


Figure 3 - Disease pyramid

It is recognised that Phytophthora Dieback has a greater and more widespread impact in areas of Western Australia where the average annual rainfall exceeds 600mm and the soil structure has a more acidic composition (Hardy, et al. 2001). The impact of the disease can be significant (but less widespread) in areas of lower rainfall if there are extra-ordinary rainfall events, or the pathogen is situated in a rainfall aggregating site, e.g. creek lines, water shedding from granite outcrops.

The impact of the pathogen on the Australian economy is significant, and is estimated to cost between $160 million (Carter 2004) and $200 million annually (EPA 2011).

The impact of the disease on animals is less understood, however the greatest impact is likely to be on those species that require relatively dense species-rich shrub lands or have restricted diets. There is a growing body of evidence that the dramatic impact of Phytophthora Dieback infestations on plant communities can result in major declines in some animal species due to the loss of shelter or food sources.

Appendix 12
Significant tree and landscape feature summary and assessment

Tree Tag No.	Species	Health	Structure	Approx Height (metres)	DBH (cm)	TPZ (metres RADIUS)	Retention Value	Easting	Northing	Cut Depth (m)	Fill Depth (m)	Ability to retain @ current design	Retention outcome
1	Jarrah (Eucalyptus marginata)	Good	Good	14	76	6.8	High	392150.636	6438784.736		0.75	Isoloated tree located in centre of Lot located in fill exceeding 0.5m	Removed
5	West Australian Christmas Tree (Nuytsia floribu	Excellent	Good	9	53	4.8	High	392080.809	6438823.972	0.5		On lot/ easement boundary located in an area of cut	Removed
9	Jarrah (Eucalyptus marginata)	Fair	Good	14	63	7.6	High	392090.553	6438562.51		0.75	Potentially retain in rebated lot rain garden - requires redesign of lo configuration and placement in rebated Lot	Retained subject to Design outcomes at subdivision stage
10	Jarrah (Eucalyptus marginata)	Fair	Acceptable	12	66	7.9	High	392170.311	6438507.549	0.5-1		Unable to be retained due to cut requirement	Removed
11	Jarrah (Eucalyptus marginata)	Fair	Acceptable	14	80	9.6	High	392171.324	6438504.724	0.5-1		Unable to be retained due to cut requirement	Removed
12	Jarrah (Eucalyptus marginata)	Excellent	Acceptable	13	84	7.6	High	392177.153	6438502.684	0.5-1		Unable to be retained due to cut requirement	Removed
15	Jarrah (Eucalyptus marginata)	Good	Good	16	92	8.3	High	392030.6	6438520.788		1	Retention is subject to future site design of the education site	Retained subject to Design outcomes at subdivision stage
17	Jarrah (Eucalyptus marginata)	Good	Good	15	75	6.8	High	392041.631	6438476.275		1	Retention is subject to future site design of the education site	Retained subject to Design outcomes at subdivision stage
18	Flooded Gum (Eucalyptus rudis)	Excellent	Good	14	50	4.5	High	392064.067	6438420.553	0.5		Retention is subject to future site design of the education site	Retained subject to Design outcomes at subdivision stage
19	Jarrah (Eucalyptus marginata)	Excellent	Acceptable	18	111	10	High	392211.779	6438220.933	1-1.5		Unable to retain tree in location of cut	Removed
20	Jarrah (Eucalyptus marginata)	Excellent	Good	19	83	7.5	High	392052.944	6438255.168	n/a	n/a	Retained in POS	Retained
30	Stout Paperbark (Melaleuca preissiana)	Good	Good	13	69	6.2	High	391997.834	6438209.236	n/a	n/a	Retained in POS	Retained
31	Stout Paperbark (Melaleuca preissiana)	Excellent	Good	10	84	7.6	High	392008.482	6438219.933	n/a	n/a	Retained in POS	Retained
33	Stout Paperbark (Melaleuca preissiana)	Good	Good	11	60	5.4	High	392006.808	6438235.139	n/a	n/a	Retained in POS	Retained
34	Stout Paperbark (Melaleuca preissiana)	Good	Good	11	61	5.5	High	392009.048	6438237.439	n/a	n/a	Retained in POS	Retained
35	Stout Paperbark (Melaleuca preissiana)	Good	Good	13	68	6.1	High	392011.039	6438232.395	n/a	n/a	Retained in POS	Retained
36	Stout Paperbark (Melaleuca preissiana)	Good	Good	10	73	6.6	High	392010.367	6438227.667	n/a	n/a	Retained in POS	Retained
37	Stout Paperbark (Melaleuca preissiana)	Good	Good	10	57	5.1	High	392007.126	6438242.689	n/a	n/a	Retained in POS	Retained
38	Stout Paperbark (Melaleuca preissiana)	Good	Good	11	69	6.2	High	392005.33	6438249.235	n/a	n/a	Retained in POS	Retained
70	West Australian Christmas Tree (Nuytsia floribu	Excellent	Good	10	53	4.8	High	392094.848	6437941.636		n/a	Retained in POS	Retained
71	West Australian Christmas Tree (Nuytsia floribu	Good	Good	8	58	5.2	High	392115.211	6437970.938		1.5-1	Isolated mid lot and with fill exceeding 0.5m runable to be retained	Removed
75	Stout Paperbark (Melaleuca preissiana)	Good	Acceptable	11	68	6.1	High	392203.591	6437876.167	n/a	n/a	Retained in POS	Retained
180	Melaleuca rhaphiophylla	Excellent	Good	11	80	7.2	High	392017.3	6437493.9	n/a	n/a	Retained in POS	Retained
314	Lemon Scented Gum (Corymbia citriodora)	Excellent	Acceptable	19	63	5.7	High	392063.533	6437237.406		1.5	Species no retained by the City of Kwinana	Removed
134	Melaleuca rhaphiophylla		Good mature specimen	8	55	4.95	High	391963.7	6437572.5	n/a	n/a	Retained in POS	Retained
160	Melaleuca rhaphiophylla		Very good mature spec	8	55	4.95	High	392017.3	6437543.3	n/a	n/a	Retained in POS	Retained
175	Melaleuca rhaphiophylla		Reasonably good specir	11	65	5.85	High	392030.9	6437483.6	n/a	n/a	Retained in POS	Retained
180	Melaleuca rhaphiophylla		Good mature specimen	11	80	7.2	High	392017.3	6437493.9	n/a	n/a	Retained in POS	Retained

Tree Tag No.	Species	Health	Structure	Approx Height (metres)	DBH (cm)	TPZ (metres RADIUS)	Retention Value	Easting	Northing	Cut Depth (m)	Fill Depth (m)	Ability to retain @ current design	Retention outcome
181	Melaleuca rhaphiophylla		Large mature very gooc	11	100 (approx.)	9	High	392000	6437510.2	n/a	n/a	Retained in POS	Retained
182	Melaleuca rhaphiophylla		Good mature specimen	9	100 (approx.)	9	High	391983.5	6437477.4		1-1.5	Retention is subject to future site design of the Group housing site	Retained subject to Design outcomes at subdivision stage
2	Candle Banksia (Banksia attenuata)	Good	Acceptable	8.5	55	5	Medium	392114.102	6438813.329	1		Located in road resourve and cut, medium value and risk to road reserve use, not able to be retained	Removed
6	Jarrah (Eucalyptus marginata)	Good	Acceptable	11	54	4.9	Medium	392067.895	6438784.591	1		Located in lot and cut, medium value and risk to road reserve use, not able to be retained	Removed
7	West Australian Christmas Tree (Nuytsia floribu	Excellent	Good	8	52	4.7	Medium	392021.914	6438613.985	n/a	n/a	Retention is subject to future site design of the education site	Retained subject to Design outcomes at subdivision stage
8	Jarrah (Eucalyptus marginata)	Good	Good	13	59	5.3	Medium	392054.916	6438584.021		0.5	Potentially retain in road reserve, retention subject to future road and service design	Retained subject to Design outcomes at subdivision stage
13	Common Sheoak (Allocasuarina fraseriana)	Excellent	Acceptable	9	57	5.1	Medium	392192.05	6438472.516	0.5-1		Unable to be retained due to cut requirement	Removed
14	Common Sheoak (Allocasuarina fraseriana)	Excellent	Acceptable	11	50	4.5	Medium	392191.019	6438477.691	0.5-1		Unable to be retained due to cut requirement	Removed
16	Jarrah (Eucalyptus marginata)	Fair	Good	12	54	6.5	Medium	392014.211	6438525.245	n/a	n/a	Retention is subject to future site design of the education site	Retained subject to Design outcomes at subdivision stage
27	Flooded Gum (Eucalyptus rudis)	Excellent	Good	24	66	5.9	Medium	392030.018	6438195.376	n/a	n/a	Retained in POS	Retained
39	Stout Paperbark (Melaleuca preissiana)	Fair	Good	11	73	8.8	Medium	392001.488	6438253.995	n/a	n/a	Retained in POS	Retained
40	Stout Paperbark (Melaleuca preissiana)	Fair	Good	10	56	6.7	Medium	391998.481	6438255.855	n/a	n/a	Retained in POS	Retained
43	Flooded Gum (Eucalyptus rudis)	Good	Good	24	88	7.9	Medium	391976.406	6438263.462	n/a	n/a	Retained in POS	Retained
46	Stout Paperbark (Melaleuca preissiana)	Good	Good	11	72	6.5	Medium	391980.057	6438251.71	n/a	n/a	Retained in POS	Retained
47	Stout Paperbark (Melaleuca preissiana)	Good	Good	11	71	6.4	Medium	391982.315	6438246.708	n/a	n/a	Retained in POS	Retained
48	Stout Paperbark (Melaleuca preissiana)	Good	Good	11	71	6.4	Medium	391975.786	6438246.431	n/a	n/a	Retained in POS	Retained
50	Freshwater Paperbark (Melaleuca rhaphiophylla	Good	Good	13	50	4.5	Medium	391980.072	6438236.089	n/a	n/a	Retained in POS	Retained
51	Freshwater Paperbark (Melaleuca rhaphiophylla	Good	Good	15	52	4.7	Medium	391993.82	6438226.143	n/a	n/a	Retained in POS	Retained
52	Stout Paperbark (Melaleuca preissiana)	Good	Good	17	58	5.2	Medium	391990.748	6438195.854	n/a	n/a	Retained in POS	Retained
53	Stout Paperbark (Melaleuca preissiana)	Good	Good	11	70	6.3	Medium	391987.394	6438201.387	n/a	n/a	Retained in POS	Retained
54	Stout Paperbark (Melaleuca preissiana)	Good	Questionable	9	71	6.4	Medium	391983.984	6438196.339	n/a	n/a	Retained in POS	Retained
55	Freshwater Paperbark (Melaleuca rhaphiophylla	Good	Good	11	53	4.8	Medium	391978.95	6438200.612	n/a	n/a	Retained in POS	Retained
58	Freshwater Paperbark (Melaleuca rhaphiophylla	Good	Acceptable	15	81	7.3	Medium	391979.62	6438193.685	n/a	n/a	Retained in POS	Retained
61	Freshwater Paperbark (Melaleuca rhaphiophylla	Good	Good	15	50	4.5	Medium	391980.096	6438185.506	n/a	n/a	Retained in POS	Retained
62	Freshwater Paperbark (Melaleuca rhaphiophylla	Good	Good	15	57	5.1	Medium	391978.594	6438182.772	n/a	n/a	Retained in POS	Retained
64	Flooded Gum (Eucalyptus rudis)	Fair	Good	18	62	7.4	Medium	391997.356	6438165.876	n/a	n/a	Retained in POS	Retained
65	Flooded Gum (Eucalyptus rudis)	Fair	Acceptable	15	70	8.4	Medium	392004.996	6438158.982	n/a	n/a	Retained in POS	Retained
69	Jarrah (Eucalyptus marginata)	Good	Acceptable	20	89	8	Medium	392183.031	6437942	n/a	n/a	Retained in POS	Retained
74	Stout Paperbark (Melaleuca preissiana)	Good	Acceptable	11	65	5.9	Medium	392207.203	6437878.716	n/a	n/a	Retained in POS	Retained
76	Stout Paperbark (Melaleuca preissiana)	Good	Acceptable	10	73	6.6	Medium	392200.077	6437870.352	n/a	n/a	Retained in POS	Retained
77	Flooded Gum (Eucalyptus rudis)	Good	Good	14	50	4.5	Medium	392164.369	6437876.706	n/a	n/a	Retained in POS	Retained

Tree Tag No.	Species	Health	Structure	Approx Height (metres)	DBH (cm)	TPZ (metres RADIUS)	Retention Value	Easting	Northing	Cut Depth (m)	Fill Depth (m)	Ability to retain @ current design	Retention outcome
100	Flooded Gum (Eucalyptus rudis)	Good	Good	22	81	7.3	Medium	391955.301	6437502.063		1-1.5	Retention is subject to future site design of the Group housing site	Retained subject to Design outcomes at subdivision stage
107	Jarrah (Eucalyptus marginata)	Good	Acceptable	14	53	4.8	Medium	392132.197	6437572.092		0.5	currently on lot - unable to retain	Removed
109	Jarrah (Eucalyptus marginata)	Good	Questionable	16	160	14.4	Medium	392153.21	6437608.974		1-1.5	currently on lot with fill exceeding 0.5m - unable to retain	Removed
110	Jarrah (Eucalyptus marginata)	Fair	Good	15	88	10.6	Medium	392157.321	6437571.017		0.5	currently on lot - unable to retain	Removed
125	Stout Paperbark (Melaleuca preissiana)	Good	Good	9	59	7.1	Medium	392072.824	6437466.345		1.5	Isolated medium retention value tree surrounded by lo to very low retention value trees. Not retained	Removed
129	Freshwater Paperbark (Melaleuca rhaphiophylla	Good	Good	8	57	5.1	Medium	392037.402	6437443.626		1.5	Isolated medium retention value tree surrounded by lo to very low retention value trees. Not retained	Removed
173	Melaleuca rhaphiophylla	Excellent	Acceptable	8	50	4.5	Medium	392045.8	6437499.9	n/a	n/a	Retained in POS	Retained
179	Melaleuca rhaphiophylla	Excellent	Good	11	50	4.5	Medium	392028.1	6437505	n/a	n/a	Retained in POS	Retained
183	Melaleuca rhaphiophylla	Good	Good	9	60, 30 x30	5.4	Medium	391968	6437505.8	n/a	n/a	Retained in POS	Retained
190	Melaleuca rhaphiophylla	Excellent	Good	10	65	5.9	Medium	391991.5	6437540	n/a	n/a	Retained in POS	Retained
301	Flooded Gum (Eucalyptus rudis)	Fair	Good	11	56	6.7	Medium	392123.998	6437451.204		1.5	Unable to be retained due to fill exceeding 0.5m	Removed
302	Flooded Gum (Eucalyptus rudis)	Fair	Good	14	58	7	Medium	392133.908	6437444.133		1.5	Unable to be retained due to fill exceeding 0.5m	Removed
315	Bangalay (Eucalyptus botryoides)	Excellent	Acceptable	17	91	8.2	Medium	392039.326	6437309.002		1-1.5	Unable to be retained due to fill exceeding 0.5m	Removed
318	Flooded Gum (Eucalyptus rudis)	Fair	Good	15	72	8.6	Medium	391896.705	6437323.851		1	Unable to be retained due to fill exceeding 0.5m	Removed
320	Flooded Gum (Eucalyptus rudis)	Fair	Acceptable	12	66	7.9	Medium	391938.756	6437275.085		1-1.5	Located on outskirt of POS retention subject to further design due to fill requirement exceeding 0.5m Retention is subject is subject to future site design of the Group housing site	Retained subject to Design outcomes at subdivision stage
322	Flooded Gum (Eucalyptus rudis)	Good	Good	14	54	4.9	Medium	391898.29	6437307.985		1	Potentially retain in road reserve, retention subject to future road and service design	Retained subject to Design outcomes at subdivision stage
323	Bangalay (Eucalyptus botryoides)	Excellent	Acceptable	16	57	5.1	Medium	391994.418	6437190.913		1	Unable to be retained due to fill exceeding 0.5m	Removed
324	River Red Gum (Eucalyptus camaldulensis 'Cama	Good	Good	16	75	6.8	Medium	391998.105	6437196.359		1	Unable to be retained due to fill exceeding 0.5m	Removed
326	Flooded Gum (Eucalyptus rudis)	Good	Good	8	69	6.2	Medium	391964.278	6437084.2		0.5-1	Potentially retain in road reserve, retention subject to future road and service design	Retained subject to Design outcomes at subdivision stage

Tree Tag No.	Species	Health	Structure	Approx Height (metres)	DBH (cm)	TPZ (metres RADIUS)	Retention Value	Easting	Northing	Cut Depth (m)	Fill Depth (m)	Ability to retain @ current design	Retention outcome
21	Jarrah (Eucalyptus marginata)	Excellent	Questionable	25	145	13.1	Low	392049.049	6438251.715			Retained in POS	Retained
22	Flooded Gum (Eucalyptus rudis)	Fair	Acceptable	17	55	6.6	Low	392017.843	6438265.275			Retained in POS	Retained
23	Flooded Gum (Eucalyptus rudis)	Fair	Acceptable	15	50	6	Low	392014.265	6438264.2			Retained in POS	Retained
24	Flooded Gum (Eucalyptus rudis)	Fair	Acceptable	17	52	6.2	Low	392020.584	6438247.678			Retained in POS	Retained
25	Flooded Gum (Eucalyptus rudis)	Fair	Good	18	50	6	Low	392023.846	6438246.479			Retained in POS	Retained
26	Jarrah (Eucalyptus marginata)	Fair	Acceptable	11	60	7.2	Low	392021.083	6438236.076			Retained in POS	Retained
28	Jarrah (Eucalyptus marginata)	Fair	Acceptable	22	180	15	Low	392017.665	6438186.737			Retained in POS	Retained
29	Flooded Gum (Eucalyptus rudis)	Fair	Acceptable	25	77	9.2	Low	392005.351	6438204.279			Retained in POS	Retained
41	Flooded Gum (Eucalyptus rudis)	Fair	Good	20	53	6.4	Low	391988.404	6438275.281			Retained in POS	Retained
42	Flooded Gum (Eucalyptus rudis)	Fair	Good	20	50	6	Low	391987.671	6438270.715			Retained in POS	Retained
45	Flooded Gum (Eucalyptus rudis)	Fair	Good	19	60	7.2	Low	391972.688	6438257.043			Retained in POS	Retained
49	Flooded Gum (Eucalyptus rudis)	Fair	Acceptable	15	50	6	Low	391979.012	6438243.769			Retained in POS	Retained
56	Flooded Gum (Eucalyptus rudis)	Fair	Good	23	80	9.6	Low	391978.669	6438207.926			Retained in POS	Retained
57	Flooded Gum (Eucalyptus rudis)	Fair	Good	23	70	8.4	Low	391974.379	6438199.002			Retained in POS	Retained
59	Flooded Gum (Eucalyptus rudis)	Fair	Acceptable	16	58	7	Low	391985.042	6438191.38			Retained in POS	Retained
60	Flooded Gum (Eucalyptus rudis)	Fair	Good	19	59	7.1	Low	391992.517	6438188.63			Retained in POS	Retained
73	West Australian Christmas Tree (Nuytsia floribu	Fair	Good	7	51	6.1	Low	392019.939	6437913.699			Low retention value located outside POS, not retained	Removed
78	Jarrah (Eucalyptus marginata)	Poor	Acceptable	10	52	6.2	Low	392206.677	6437817.882			Low retention value located outside POS, not retained	Removed
80	Common Sheoak (Allocasuarina fraseriana)	Excellent	Poor	11	54	4.9	Low	392047.203	6437617.374			Low retention value located outside POS, not retained	Removed
87	Flooded Gum (Eucalyptus rudis)	Fair	Good	18	69	8.3	Low	392011.951	6437608.41			Low retention value located outside POS, not retained	Removed
91	Flooded Gum (Eucalyptus rudis)	Fair	Acceptable	17	52	6.2	Low	392066.371	6437540.844			Low retention value located outside POS, not retained	Removed
94	Flooded Gum (Eucalyptus rudis)	Fair	Good	16	53	6.4	Low	392086.132	6437514.811			Low retention value located outside POS, not retained	Removed
96	Jarrah (Eucalyptus marginata)	Fair	Poor	8	116	13.9	Low	392108.875	6437565.128			Low retention value located outside POS, not retained	Removed
97	Jarrah (Eucalyptus marginata)	Fair	Acceptable	17	97	11.6	Low	392101.659	6437568.413			Low retention value located outside POS, not retained	Removed
98	Jarrah (Eucalyptus marginata)	Fair	Acceptable	11	56	6.7	Low	392081.619	6437570.193			Low retention value located outside POS, not retained	Removed
101	Flooded Gum (Eucalyptus rudis)	Fair	Good	21	56	6.7	Low	391953.657	6437492.54			Low retention value located outside POS, not retained	Removed
102	Flooded Gum (Eucalyptus rudis)	Fair	Good	21	59	7.1	Low	391970.804	6437494.757			Low retention value located outside POS, not retained	Removed
117	Flooded Gum (Eucalyptus rudis)	Fair	Acceptable	23	75	9	Low	392111.446	6437493.578			Low retention value located outside POS, not retained	Removed

Tree Tag No.	Species	Health	Structure	Approx Height (metres)	DBH (cm)	TPZ (metres RADIUS)	Retention Value	Easting	Northing	Cut Depth (m)	Fill Depth (m)	Ability to retain @ current design	Retention outcome
118	Stout Paperbark (Melaleuca preissiana)	Fair	Good	10	68	8.2	Low	392110.664	6437491.023			Low retention value located outside POS, not retained	Removed
126	Flooded Gum (Eucalyptus rudis)	Fair	Acceptable	18	64	7.7	Low	392073.598	6437462.658			Low retention value located outside POS, not retained	Removed
128	Flooded Gum (Eucalyptus rudis)	Fair	Acceptable	22	95	11.4	Low	392045.577	6437446.203			Low retention value located outside POS, not retained	Removed
130	Flooded Gum (Eucalyptus rudis)	Fair	Good	18	77	9.2	Low	392035.826	6437438.08			Low retention value located outside POS, not retained	Removed
131	Flooded Gum (Eucalyptus rudis)	Fair	Good	16	63	7.6	Low	392030.741	6437440.726			Low retention value located outside POS, not retained	Removed
132	Flooded Gum (Eucalyptus rudis)	Fair	Good	17	89	10.7	Low	392034.377	6437433.295			Low retention value located outside POS, not retained	Removed
172	Melaleuca rhaphiophylla	Excellent	Acceptable	8	50	4.5	Low	392050	6437500.3			Retained in POS	Retained
327	Flooded Gum (Eucalyptus rudis)	Fair	Good	12	62	7.4	Low	391981.854	6436987.617			Potentially retain in road reserve, retention subject to future road and service design	Retained subject to Design outcomes at subdivision stage
3	Jarrah (Eucalyptus marginata)	Dead	Acceptable	12	69	3	Very Low	392159.07	6438827.82			Very low retention value not retained due to structural risk and location	Removed
4	Jarrah (Eucalyptus marginata)	Dead	Questionable	12	76	3	Very Low	392110.024	6438795.937			Very low retention value not retained due to structural risk and location	Removed
32	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	16	72	8.6	Very Low	392003.188	6438228.734			Retained in POS	Retained
44	Flooded Gum (Eucalyptus rudis)	Poor	Good	24	67	8	Very Low	391972.261	6438265.33			Retained in POS	Retained
63	Flooded Gum (Eucalyptus rudis)	Poor	Good	18	72	8.6	Very Low	391980.274	6438165.24			Very low retention value not retained due to structural risk and location	Removed
66	Flooded Gum (Eucalyptus rudis)	Dead	Acceptable	16	53	3	Very Low	391982.658	6438151.682			Very low retention value not retained due to structural risk and location	Removed
67	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	23	73	8.8	Very Low	391986.637	6438147.596			Very low retention value not retained due to structural risk and location	Removed
68	Jarrah (Eucalyptus marginata)	Dead	Acceptable	16	52	3	Very Low	392198.605	6437994.436			Very low retention value not retained due to structural risk and location	Removed
72	Jarrah (Eucalyptus marginata)	Dead	Questionable	20	189	3	Very Low	392009.938	6437919.231			Very low retention value not retained due to structural risk and location	Removed
79	Jarrah (Eucalyptus marginata)	Dead	Questionable	14	64	3	Very Low	392060.431	6437629.352			Very low retention value not retained due to structural risk and location	Removed
81	Jarrah (Eucalyptus marginata)	Dead	Questionable	17	87	3	Very Low	392058.131	6437606.207			Very low retention value not retained due to structural risk and location	Removed

Tree Tag No.	Species	Health	Structure	Approx Height (metres)	DBH (cm)	TPZ (metres RADIUS)	Retention Value	Easting	Northing	Cut Depth (m)	Fill Depth (m)	Ability to retain @ current design	Retention outcome
82	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	20	53	6.4	Very Low	392023.157	6437587.981			Very low retention value not retained due to structural risk and location	Removed
83	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	22	61	7.3	Very Low	392019.158	6437584.7			Very low retention value not retained due to structural risk and location	Removed
84	Flooded Gum (Eucalyptus rudis)	Dead	Acceptable	18	50	3	Very Low	392019.038	6437588.861			Very low retention value not retained due to structural risk and location	Removed
85	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	22	61	7.3	Very Low	392020.055	6437594.889			Very low retention value not retained due to structural risk and location	Removed
86	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	22	63	7.6	Very Low	392020.468	6437599.706			Very low retention value not retained due to structural risk and location	Removed
88	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	22	56	6.7	Very Low	391995.647	6437587.847			Very low retention value not retained due to structural risk and location	Removed
89	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	23	55	6.6	Very Low	392029.267	6437562.561			Very low retention value not retained due to structural risk and location	Removed
90	Flooded Gum (Eucalyptus rudis)	Dead	Questionable	16	55	3	Very Low	392061.028	6437536.326			Very low retention value not retained due to structural risk and location	Removed
92	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	17	59	7.1	Very Low	392074.367	6437542.208			Very low retention value not retained due to structural risk and location	Removed
93	Flooded Gum (Eucalyptus rudis)	Dead	Questionable	17	61	3	Very Low	392080.03	6437545.96			Very low retention value not retained due to structural risk and location	Removed
95	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	16	54	6.5	Very Low	392098.723	6437539.477			Very low retention value not retained due to structural risk and location	Removed
99	Flooded Gum (Eucalyptus rudis)	Dead	Questionable	16	73	3	Very Low	391965.605	6437575.093			Very low retention value not retained due to structural risk and location	Removed
103	Flooded Gum (Eucalyptus rudis)	Poor	Good	21	53	6.4	Very Low	391966.642	6437490.454			Very low retention value not retained due to structural risk and location	Removed
104	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	18	56	6.7	Very Low	391985.278	6437455.108			Very low retention value not retained due to structural risk and location	Removed
105	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	16	55	6.6	Very Low	391989.574	6437457.808			Very low retention value not retained due to structural risk and location	Removed
106	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	18	52	6.2	Very Low	391992.865	6437453.031			Very low retention value not retained due to structural risk and location	Removed
108	Jarrah (Eucalyptus marginata)	Dead	Acceptable	13	59	3	Very Low	392127.618	6437599.268			Very low retention value not retained due to structural risk and location	Removed

Tree Tag No.	Species	Health	Structure	Approx Height (metres)	DBH (cm)	TPZ (metres RADIUS)	Retention Value	Easting	Northing	Cut Depth (m)	Fill Depth (m)	Ability to retain @ current design	Retention outcome
111	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	14	68	8.2	Very Low	392148.435	6437518.286			Very low retention value not retained due to structural risk and location	Removed
112	Flooded Gum (Eucalyptus rudis)	Dead	Questionable	11	64	3	Very Low	392144.687	6437513.733			Very low retention value not retained due to structural risk and location	Removed
113	Flooded Gum (Eucalyptus rudis)	Dead	Questionable	17	79	3	Very Low	392145.212	6437499.276			Very low retention value not retained due to structural risk and location	Removed
114	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	18	70	8.4	Very Low	392123.156	6437506.226			Very low retention value not retained due to structural risk and location	Removed
115	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	22	94	11.3	Very Low	392116.292	6437497.806			Very low retention value not retained due to structural risk and location	Removed
116	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	22	67	8	Very Low	392115.816	6437495.187			Very low retention value not retained due to structural risk and location	Removed
119	Flooded Gum (Eucalyptus rudis)	Dead	Questionable	14	62	3	Very Low	392103.469	6437484.375			Very low retention value not retained due to structural risk and location	Removed
120	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	22	65	7.8	Very Low	392104.492	6437473.382			Very low retention value not retained due to structural risk and location	Removed
121	Flooded Gum (Eucalyptus rudis)	Poor	Questionable	22	50	6	Very Low	392100.853	6437471.101			Very low retention value not retained due to structural risk and location	Removed
122	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	22	52	6.2	Very Low	392095.822	6437481.836			Very low retention value not retained due to structural risk and location	Removed
123	Flooded Gum (Eucalyptus rudis)	Dead	Questionable	22	96	3	Very Low	392092.309	6437477.2			Very low retention value not retained due to structural risk and location	Removed
124	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	21	59	7.1	Very Low	392080.7	6437471.319			Very low retention value not retained due to structural risk and location	Removed
127	Flooded Gum (Eucalyptus rudis)	Dead	Acceptable	14	55	3	Very Low	392067.2	6437460.808			Very low retention value not retained due to structural risk and location	Removed
133	Flooded Gum (Eucalyptus rudis)	Poor	Good	16	72	8.6	Very Low	392016.282	6437428.383			Very low retention value not retained due to structural risk and location	Removed
303	Flooded Gum (Eucalyptus rudis)	Poor	Questionable	18	181	15	Very Low	392069.312	6437376.359			Very low retention value not retained due to structural risk and location	Removed
304	Tasmanian Blue Gum (Eucalyptus globulus)	Good	Questionable	15	52	4.7	Very Low	392090.632	6437350.904			Very low retention value not retained due to structural risk and location	Removed
305	Tasmanian Blue Gum (Eucalyptus globulus)	Good	Questionable	17	69	6.2	Very Low	392092.557	6437351.349			Very low retention value not retained due to structural risk and location	Removed

Tree Tag No.	Species	Health	Structure	Approx Height (metres)	DBH (cm)	TPZ (metres RADIUS)	Retention Value	Easting	Northing	Cut Depth (m)	Fill Depth (m)	Ability to retain @ current design	Retention outcome
306	Tasmanian Blue Gum (Eucalyptus globulus)	Dead	Questionable	15	88	3	Very Low	392098.923	6437360.185			Very low retention value not retained due to structural risk and location	Removed
307	Tasmanian Blue Gum (Eucalyptus globulus)	Dead	Questionable	16	76	3	Very Low	392111.287	6437363.753			Very low retention value not retained due to structural risk and location	Removed
308	Tasmanian Blue Gum (Eucalyptus globulus)	Good	Good	23	89	8	Very Low	392104	6437354.724			Very low retention value not retained due to structural risk and location	Removed
309	Tasmanian Blue Gum (Eucalyptus globulus)	Good	Questionable	23	84	7.6	Very Low	392104.264	6437351.847			Very low retention value not retained due to structural risk and location	Removed
310	Tasmanian Blue Gum (Eucalyptus globulus)	Good	Questionable	21	72	6.5	Very Low	392097.978	6437343.517			Very low retention value not retained due to structural risk and location	Removed
311	Flooded Gum (Eucalyptus rudis)	Fair	Poor	13	85	10.2	Very Low	392105.315	6437288.913			Very low retention value not retained due to structural risk and location	Removed
312	Flooded Gum (Eucalyptus rudis)	Dead	Questionable	19	77	3	Very Low	392113.509	6437271.482			Very low retention value not retained due to structural risk and location	Removed
313	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	13	59	7.1	Very Low	392100.594	6437260.946			Very low retention value not retained due to structural risk and location	Removed
316	Flooded Gum (Eucalyptus rudis)	Poor	Good	17	102	12.2	Very Low	391886.474	6437334.437			Very low retention value not retained due to structural risk and location	Removed
317	Flooded Gum (Eucalyptus rudis)	Dead	Poor	15	72	3	Very Low	391884.218	6437331.778			Very low retention value not retained due to structural risk and location	Removed
319	Flooded Gum (Eucalyptus rudis)	Poor	Acceptable	19	129	15	Very Low	391934.687	6437305.106			Very low retention value not retained due to structural risk and location	Removed
321	Flooded Gum (Eucalyptus rudis)	Poor	Questionable	12	69	8.3	Very Low	391955.513	6437264.613			Very low retention value not retained due to structural risk and location	Removed
325	Jarrah (Eucalyptus marginata)	Dead	Questionable	18	77	3	Very Low	391968.918	6437172.765			Very low retention value not retained due to structural risk and location	Removed

Appendix 13
Level 1 Fauna Assessment Report

Wandi Proposed Urban Development Area:

Threatened Fauna Assessment

Ms J.A. Wilcox and Mr R. King

Wetland vegetation on the site, near Figg Rise.

Prepared for: RPS Bowman Bishaw Gorham
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Prepared by: Western Wildlife
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7th February 2007

Introduction

Urban development is proposed for an area of bushland and farmland in the suburb of Wandi, to the east of the Kwinana Freeway. Western Wildlife has been asked by RPS Bowman Bishaw Gorham to assess the fauna values of the proposed urban development area.

The aim of the site visit and this report are to provide a list of fauna of conservation significance that have the potential to occur in the area, discuss the importance of the area to fauna, and make recommendations of ways to minimise the impact of the proposed works on fauna.

Methods

This report is classified as a Level 1 survey (a background research or 'desk-top' study with a site visit) according to the EPA Position Statement No.3 (Environmental Protection Authority 2002) and Guidance Statement 56 (Environmental Protection Authority 2004). This was the level of assessment commissioned by the client. The site was visited on the 9th November 2006, and the area was traversed on foot. All vertebrate fauna encountered was recorded and notes were made on the fauna habitats present on the site.

Personnel

Ms Jenny Wilcox (*BSc.Biol./Env.Sci., Hons.Biol.*) and Mr Richard King (*BSc.Env. Biol.*) carried out the site inspection and prepared this report.

Sources of Information

The threatened fauna expected to occur in the study area were identified using information from a number of sources. These included publications that provide information on general patterns of distribution of frogs (Tyler *et al.* 2000), reptiles (Storr *et al.* 1983, 1990, 1999 and 2002), birds (Barrett *et al.* 2003; Johnstone and Storr 1998; Johnstone and Storr 2004), and mammals (Menkhorst and Knight 2001; Strahan 1995). In addition, the databases listed below in Table 1 were searched for specimen or observational records.

As far as possible, expected species are those that are likely to utilise the study area, or be affected by changes to the study area. The lists exclude species that have been recorded in the general region as vagrants or for which suitable habitat is absent.

Table 1. Databases used in the preparation of this report.

Database	Type of records held on database	Area searched
Faunabase (WA Museum)	Records of specimens held in the WA Museum. Includes historical data.	32°09' to 32°15'S and 115°47' to 115°55'E
DEC's Threatened and Priority Fauna Database	Information and records on Threatened and Priority species in Western Australia	32°09' to 32°15'S and 115°47' to 115°55'E
Birds Australia's New Atlas Database	Observational bird records from 1998 to present.	32°09' to 32°15'S and 115°47' to 115°55'E
EPBC Protected Matters Search Tool	Records on matters protected under the EPBC Act, including threatened species.	32°09' to 32°15'S and 115°47' to 115°55'E

Taxonomy and nomenclature for fauna species used in this report generally follow the WA Museum (2001) with alternative bird taxonomy from Christidis and Boles (1994) given in parentheses.

Assessment of conservation significance

Three levels of conservation significance are recognised in this report:

Conservation Significance 1:
- Species listed under State or Commonwealth Acts.

Conservation Significance 2:
- Species not listed under State or Commonwealth Acts, but listed in publications on threatened fauna or as Priority species by DEC.

Conservation Significance 3:
- Species not listed under State or Commonwealth Acts or in publications on threatened fauna or as Priority species by DEC, but considered of local significance because of their pattern of distribution.

At the highest level of conservation significance (Conservation Significance 1) are those species that are protected under State or Commonwealth legislation.

The *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) is the Commonwealth Government's primary piece of environmental legislation. Listed under Part 3 of the EPBC Act are 'matters of National Environmental Significance' that include threatened species and ecological communities and migratory species, among others: IUCN categories are used to categorise threatened species as 'extinct', 'extinct in the wild', 'critically endangered', 'endangered', 'vulnerable' and 'conservation dependent', with all categories except 'extinct' and 'conservation

dependent' listed as matters of National Environmental Significance. A list of migratory species is also maintained, containing mostly bird and marine species. The migratory species listed are those recognised under China-Australia Migratory Bird Agreement (CAMBA), the Japan-Australia Migratory Bird Agreement (JAMBA) or species listed under the Bonn Convention for which Australia is a range state. Species listed in JAMBA are also protected under Schedule 3 of the *Western Australian Wildlife Conservation Act* 1950.

The *Western Australian Wildlife Conservation Act* 1950 (WA Wildlife Conservation Act) is State legislation for fauna protection administered by the Department of Environment and Conservation (DEC). The WA Wildlife Conservation Act lists species under a set of Schedules, where threatened species are listed as Schedule 1. Schedule 1 species are further categorised by DEC into the IUCN categories 'extinct', 'extinct in the wild', 'critically endangered', 'endangered', 'vulnerable' and 'conservation dependent' species. The schedules and categories are further described in Appendix 1.

At the second-highest level of conservation significance (Conservation Significance 2) are species that are listed under publications on threatened species, or are listed as Priority species by DEC.

Reports on the conservation status of most vertebrate fauna species have been produced by the Department of the Environment and Heritage (DEH) in the form of Action Plans. An Action Plan is a review of the conservation status of a taxonomic group against IUCN categories. Action Plans have been prepared for amphibians (Tyler 1998), reptiles (Cogger *et al.* 1993), birds (Garnett and Crowley 2000), monotremes and marsupials (Maxwell *et al.* 1996), rodents (Lee 1995) and bats (Duncan *et al.* 1999). These publications also use categories similar to those used by the EPBC Act. The information presented in some of the earlier Action Plans may be out of date due to changes since publication.

In Western Australia, DEC has also produced a list of Priority Fauna made up of species that are not considered Threatened under the *WA Wildlife Conservation Act*, but for which DEC feels there is cause for concern. Levels of Priority are described in Appendix One.

At the third-highest level of conservation significance (Conservation Significance 3) are species that are not recognised under Federal or State legislation, listed in publications by DEH or listed as Priority species by DEC. These are species considered to be of local significance in the study area because they are at the limit of their distribution in the area, they have a very restricted range or they occur in breeding colonies (e.g. some waterbirds). This level of significance has no legislative or published recognition and is based on interpretation of information on the species patterns of distribution. The WA Department of Environmental Protection (2000) used this sort of interpretation to identify significant bird species in the Perth metropolitan area as part of Bush Forever. Recognition of such species is consistent with the aim of preserving regional biodiversity.

Site description

The Wandi proposed urban development area is situated to the east of the Kwinana Freeway, between Rowley Rd to the north, Darling Chase to the south and Lyon Rd to the east. This area is indicated in Figure 1. The area is a mixture of native vegetation (both wetland and upland) and farmland. The following description of the site has been summarised from the description of the vegetation given in Weston (2005) and observations during the site visit.

The area is mainly composed of open Eucalypt/Banksia woodland in the upland areas and Eucalypt/Melaleuca vegetation near wetlands, often with a dense understorey. Overall, this vegetation is in good condition, although individual patches of vegetation range from very degraded to very good. Open degraded areas and cleared areas contain mostly introduced weeds and grasses.

The proposed urban development area is near (but not adjacent to) Jandakot Regional Park (Bush Forever Site 347) less than 1km to the south-east, the Spectacles Wetlands (Bush Forever Site 269) less than 2km to the south-west and Bush Forever Site 270 about 1km to the south.

Results

The results of the database searches are given in Appendices 2, 3, 4 and 5. These lists include all species identified by the searches, but are not complete lists of all species that may occur on the proposed development site. All amphibians, reptiles, birds and mammals of conservation significance that are likely to occur on the site are listed and discussed below.

Amphibians

The frog species likely to occur on the site are those typical of the Swan Coastal Plain. This includes burrowing species such as the Moaning Frog (*Heleioporus eyrei*) that breed in wetlands but also use upland vegetation. Most frog species will be associated with the wetland areas for at least part of their life-cycle.

There are no frogs of conservation significance likely to occur in the study area.

Reptiles

Two reptile species were observed during the site visit, the Fence Skink (*Cryptoblepharus plagiocephalus*) and the Bobtail (*Tiliqua rugosa*). Areas of native vegetation that are in relatively good condition are likely to support a relatively intact reptile community. Areas that are very degraded are likely to support only a few common species that are tolerant of disturbance. Wetland areas, such as Lake Balmanup near Figg Rise, may support the Long-necked Tortoise (*Chelodina oblonga*). Most reptiles are unable to survive in urban developments, and the few species that do are likely to be common species that are tolerant of disturbance.

There are four reptiles of conservation significance that may occur in the area, as listed and discussed below.

Conservation Significance 1

- **Carpet Python** *Morelia spilota imbricata*

The south-west population of this python is listed under Schedule 4 (other specially protected fauna) of the WA Wildlife Conservation Act, and as Priority 4 by DEC.

The South-west Carpet Python could occur anywhere on the site where native vegetation remains, but does require dense vegetation or tree hollows for shelter. On the Swan Coastal Plain, the Carpet Python tends to favour areas of heath over limestone (Bush *et al.* 1995), which is not present on the site. If present in the area, this species is likely to be at relatively low densities. However, the Carpet Python may be locally extinct on the site, although there is a record from Warnbro in 2006 (DEC's Threatened and Priority Fauna Database).

Conservation Significance 2

- **Jewelled Ctenotus** *Ctenotus gemmula*

This skink is listed as Priority 3 by DEC.

- **Perth Lined Lerista** *Lerista lineata*

This skink is listed as Priority 3 by DEC.

- **Black-striped Snake** *Neelaps calonotus*

This snake is listed as Priority 3 by DEC.

The Jewelled Ctenotus occurs in isolated populations and is scarce on the Swan Coastal Plain (Bush *et al.* 1995, Storr *et al.* 1999). It generally inhabits heathlands associated with banksia, on pale sandy soils (Bush *et al.* 1995) and may occur in parts of the site with remnant upland native vegetation. The Jewelled Ctenotus has been recorded in the area on Faunabase (Appendix 4). This species would not persist within an urban development unless significant areas of appropriate habitat were retained.

The Perth Lined Lerista is a small fossorial skink that normally inhabits heathlands and shrublands on pale sands (Bush *et al.* 1995). This skink has a very limited distribution, restricted to the coastal plain between the southern suburbs of Perth and Yalgorup (Bush *et al.* 1995, Davis and Bamford 2005, Youngson and Harold 1989). The Perth Lined Lerista is likely to occur on the site, particularly where upland native vegetation remains, and this species may persist in suburban gardens.

The Black-striped Snake has a limited distribution, inhabiting sandy heathlands and banksia/eucalypt woodlands on the Swan Coastal Plain (Bush *et al.* 1995). This snake is likely to occur on the site in areas where upland native vegetation remains. This species would not persist within an urban development unless significant areas of appropriate habitat were retained.

Birds

A total of 28 species of birds were observed during the site visit (Table 2). Most of these species are common and widespread in the south-west of Western Australia. Some species, such as the Splendid Fairy-wrens and Grey Fantails, are unlikely to persist on the site after the development, as they do not generally inhabit urban gardens. Species such as the Willie Wagtail and Australian Raven are likely to use suburban environments, and may be favoured by the development.

A total of 133 birds are listed on the Birds Australia New Atlas Database for the area (Appendix 5). This list can be taken as a general list of species for the Swan Coastal Plain, and many of these species are likely to occur on the site. The list contains a number of wetland dependant species such as ducks, herons, cormorants, grebes and shorebirds. Some of these species may occur in association with the wetlands present on the site, but other species are more likely to be associated with other, larger wetlands in the area, such as The Spectacles Wetlands, located to the south-west of the site.

The wetlands on the site are unlikely to support large numbers of wetland dependant species, but may support breeding of some species (e.g. ducks) during winter and spring.

Most birds on the site would be associated with areas of native vegetation. Cleared and very degraded areas are likely to support very few species, although even degraded areas may contain trees with hollows suitable for hollow-nesting species. Birds that may nest in tree hollows on the site include pardalotes, parrots, kingfishers and Tree Martins.

There are 30 bird species of conservation significance that have the potential to occur and use the study area, as discussed below.

Conservation Significance 1

- **Carnaby's (Short-billed) Black-Cockatoo** *Calyptorhynchus latirostris*

This cockatoo is listed under Schedule 1 (Endangered) of the WA Wildlife Conservation Act and as Endangered under the EPBC Act.

- **Baudin's (Long-billed) Black-Cockatoo** *Calyptorhynchus baudinii*

This cockatoo is listed under Schedule 1 (Endangered) of the WA Wildlife Conservation Act and as Vulnerable under the EPBC Act.

- **Peregrine Falcon** *Falco peregrinus*

This falcon is listed under Schedule 4 (other specially protected fauna) of the WA Wildlife Conservation Act.

Table 2. Birds observed in or near the study area during the site visit.

Bird Species	
Threskionithidae (ibis and spoonbills)	
Australian White Ibis	*Threskiornis molucca*
Straw-necked ibis	*Threskiornis spinicollis*
Ardeidae (herons, egrets and bitterns)	
White-faced Heron	*Ardea novaehollandiae*
Accipitridae (kites, goshawks, eagles and harriers)	
Swamp Harrier	*Circus approximans*
Columbidae (pigeons and doves)	
Laughing Turtle-Dove	*Streptopelia senegalensis*
Spotted Turtle-Dove	*Streptopelia chinensis*
Common Bronzewing	*Phaps chalcoptera*
Cacatuidae (cockatoos)	
Galah	*Cacatua roseicapillus*
Psittacidae (parrots, lorikeets and rosellas)	
Australian Ringneck	*Barnardius zonarius*
Red-capped Parrot	*Purpureicephalus spurius*
Elegant Parrot	*Neophema elegans*
Cuculidae (parasitic cuckoos)	
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*
Maluridae (fairy-wrens)	
Splendid Fairy-wren	*Malurus splendens*
Pardalotidae (pardalotes, thornbills, gerygones and allies)	
Weebill	*Smicrornis brevirostris*
Western Gerygone	*Gerygone fusca*
Inland Thornbill	*Acanthiza apicalis*
Meliphagidae (honeyeaters and chats)	
Brown Honeyeater	*Lichmera indistincta*
Western Spinebill	*Acanthorhynchus superciliosus*
Pachycephalidae (whistlers, shrike-thrushes and allies)	
Grey Shrike-thrush	*Colluricincla harmonica*
Rufous Whistler	*Pachycephala rufiventris*
Dicruridae (flycatchers, magpie-larks and fantails)	
Willie Wagtail	*Rhipidura leucophrys*
Grey Fantail	*Rhipidura fuliginosa*
Campephagidae (cuckoo-shrikes and trillers)	
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
Artamidae (woodswallows, butcherbirds, magpies)	
Grey Butcherbird	*Cracticus torquatus*
Corvidae (ravens and crows)	
Australian Raven	*Corvus coronoides*
Hirundinidae (swallows and martins)	
Welcome Swallow	*Hirundo neoxena*
Tree Martin	*Hirundo nigricans*
Zosteropidae (white-eyes)	
Silvereye	*Zosterops lateralis*

Baudin's Black-Cockatoo may forage in the area, although this species is generally associated with Darling Scarp in the Perth metropolitan area. Baudin's Black-Cockatoo feeds on the seeds of *Eucalyptus* and *Banksia*. Development of the area may result in the loss of some feeding habitat for this species.

Carnaby's Black-Cockatoo has been recorded in the area in the Birds Australia new Atlas Database (Appendix 5). This species has declined due to loss of breeding habitat in the wheatbelt and of non-breeding habitat along the west coast, partly due to urban expansion. While small areas of foraging habitat around the metropolitan area support only small numbers of birds for short periods of time, the progressive loss of these small areas is an ongoing concern for this species. Carnaby's Black-Cockatoo is likely to feed on species of *Eucalyptus* and *Banksia* in the area, and development of the area will result in the loss of some feeding habitat for this species. This cockatoo species has also started breeding in areas further west than its traditional breeding range, including areas on the Swan Coastal Plain. It is possible that this species may breed in the area at present or in the future. However, this species requires large hollows in eucalypts for nesting and the majority of the Jarrah and Marri trees present on site were too small to support hollows of sufficient size.

The Peregrine Falcon may forage over the site, and may nest on the site in a tall tree. If the Peregrine Falcon is present on the site, the site would only be a part of a larger home range for a pair of birds. The Peregrine Falcon has been recorded in the area in the Birds Australia new Atlas Database (Appendix 5).

Conservation Significance 1 – Species listed as migratory under the EPBC Act

- **Rainbow Bee-eater** *Merops ornatus*
- **Fork-tailed Swift** *Apus pacificus*
- **White-bellied Sea-Eagle** *Haliaeetus leucogaster*

The Rainbow Bee-eater is a common summer visitor to Perth, where it breeds in sandy banks. This species can utilise relatively degraded areas as well as natural bushland, and is likely to forage and breed on the site. Development of the site is likely to result in the loss of some breeding habitat for this species.

The Fork-tailed Swift is a largely aerial species and the effect of the development on this species is likely to be negligible. The White-bellied Sea-Eagle may forage in the local area, but is unlikely to nest at the development site.

Although a range of migratory shorebirds listed under the EPBC Act may occur in the general area, they have not been discussed at length in this report. The site has a number of small wetlands, but none are likely to support significant numbers of migratory shorebirds.

Conservation Significance 2

- **Masked Owl** *Tyto novaehollandiae novaehollandiae*

This owl is listed as Priority 3 by CALM and as 'near threatened' by Garnett and Crowley (2000).

The Masked Owl relies on large hollows in mature eucalypts for breeding. There did not appear to be any hollows large enough for this species on the site. It is unlikely that the owl breeds on the site, but it is possible they may forage over the site if there is a nesting pair nearby.

Conservation Significance 3	
• **Whistling Kite**	*Haliastur sphenurus*
• **Brown Goshawk**	*Accipiter fasciatus*
• **Collared Sparrowhawk**	*Accipiter cirrhocephalus*
• **Wedge-tailed Eagle**	*Aquila audax*
• **Little Eagle**	*Hieraaetus morphnoides*
• **Brown Falcon**	*Falco berigora*
• **Painted Button-quail**	*Turnix varia*
• **Common Bronzewing**	*Phaps chalcoptera*
• **Splendid Fairy-wren**	*Malurus splendens*
• **Spotted Pardalote**	*Pardalotus punctatus*
• **White-browed Scrubwren**	*Sericornis frontalis*
• **Weebill**	*Smicrornis brevirostris*
• **Inland Thornbill**	*Acanthiza apicalis*
• **Western Thornbill**	*Acanthiza inornata*
• **Yellow-rumped Thornbill**	*Acanthiza chrysorrhoa*
• **Western Wattlebird**	*Anthochaera lunulata*
• **White-naped Honeyeater**	*Melithreptus lunatus*
• **New Holland Honeyeater**	*Phylidonyris novaehollandiae*
• **White-cheeked Honeyeater**	*Phylidonyris nigra*
• **Tawny-crowned Honeyeater**	*Phylidonyris melanops*
• **Scarlet Robin**	*Petroica multicolour*
• **Varied Sittella**	*Daphoenositta chrysoptera*
• **Grey Shrike-thrush**	*Colluricincla harmonica*

A total of 23 bird species are listed as being of conservation significance 3, with most of these being species listed in Bush Forever (Department of Environmental Protection 2000). These are species that are listed as having a reduced population on the Swan Coastal Plain in Bush Forever (Government of Western Australia 2000), although many of them are common outside of the metropolitan area. Some of these species were recorded during the site visit, including the Common Bronzewing, Splendid Fairy-wren, Weebill, Inland Thornbill and Grey Shrike-Thrush (Table 2). Most of these species require areas of native vegetation for all or most of their needs, and are unlikely to persist in a suburban area.

Mammals

The only mammals observed during the site visit, were the introduced European Rabbit (*Oryctolagus cuniculus*) and the Quenda (*Isoodon obesulus*), which was recorded in Bush Forever Site 270, to the south of the proposed development area. Parts of the site that are cleared or very degraded are unlikely to support significant populations of native mammals, but may support introduced species such as the House Mouse (*Mus musculus*) and Black Rat (*Rattus rattus*). Parts of the site that have native vegetation in relatively good condition may support some native species such as the Brushtail Possum (*Trichosurus vulpecula*) and Honey Possum (*Tarsipes rostratus*).

There are five mammals of conservation significance that may occur in the area. Each species is listed and discussed below.

Conservation Significance 2	
• **Quenda (Southern Brown Bandicoot)**	*Isoodon obesulus*
The Quenda is listed as Priority 5 by DEC.	
• **Brush Wallaby**	*Macropus irma*
This wallaby is listed as Priority 4 by DEC.	
• **Western False Pipistrelle**	*Falsistrellus mackenziei*
This bat is listed as Priority 4 by DEC.	
• **Water Rat (Rakali)**	*Hydromys chrysogaster*
This species is listed as Priority 4 by DEC.	

The Quenda favours areas with dense understorey, and is often particularly common in dense wetland vegetation. This species is likely to be present on the site in any areas with a dense understorey and have been recorded nearby on DEC's Threatened and Priority Fauna Database and was observed nearby in Bush Forever Site 270 during the site visit. Development of the site may result in some loss of habitat for this species.

The Brush Wallaby is likely to occur in areas of forest or woodland where there is a dense, shrub understorey. The Brush Wallaby has been recently recorded near the site, in Casuarina (DEC's Threatened and Priority Fauna Database) and may range onto the southern end of the site.

The Western False Pipistrelle is a small insectivorous bat that inhabits forests and woodlands. These bats roost in groups in tree hollows (Churchill 1998) and have been recorded nearby at Harry Waring Marsupial Reserve in 1993 (DEC's Threatened and Priority Fauna Database). This bat may forage or roost in the site, particularly in the Eucalypt/Banksia woodland.

The Water Rat is generally associated with permanent wetlands, but may move into seasonal wetlands when they hold water. This species is unlikely to be present on the site all year round, but may sometimes be present in the larger wetlands on the site.

Conservation Significance 3	
• **Honey Possum**	*Tarsipes rostratus*

The Honey Possum is a small marsupial that feeds on nectar and pollen. It may occur in larger areas of Banksia woodland on the site. This species can move considerable distances, but is vulnerable to habitat isolation and feral predators. The Honey Possum is common in other parts of its range, but is uncommon on the Swan Coastal Plain where areas of remnant vegetation tend to be small and patchy. It is known to occur in larger areas of native vegetation on the Swan Coastal Plain such as in Whiteman Park and Jandakot Airport (pers. obs.).

Some threatened species that were listed on databases for the area (Appendices 2 – 4) have not been included in this section as no suitable habitat is present to support them, or they are known to be locally extinct.

Summary and recommendations

The parts of the proposed urban development site at Wandi that are already cleared have little value for native fauna, but the areas of native vegetation are likely to support a range of fauna species typical of Banksia/Eucalypt woodland on the Swan Coastal Plain. The proposed urban development site at Wandi is likely to support some species of conservation significance. The site may support one reptile and six birds of conservation significance 1, three reptiles, one bird and four mammals of conservation significance 2 and 23 birds and one mammal of conservation significance 3.

Development of the area is likely to result in the loss of habitat for species of conservation significance. In particular, the Eucalypt/Banksia woodland is likely to be used as foraging habitat by Carnaby's Black-Cockatoo. Although the site represents a small proportion of the Bassendean Vegetation Complex – central and south in the Perth metropolitan region (approximately 0.3% according to RPS BBG [2007]), it is the on-going loss of small areas of foraging habitat that is of concern for this species. In addition, areas of wetland and areas of woodland with a dense understorey are likely to be used by the Quenda. Although the site represents a small proportion of the Herdsman Vegetation Complex in the Perth metropolitan region (approximately 1.4% according to RPS BBG [2007]), not all these areas are likely to be occupied by the Quenda, as they have become locally extinct in many built-up areas.

The development of the area is also likely to increase the isolation of areas of native vegetation outside of the site. In particular, the site forms part of a non-contiguous link from the north-west to south-east between Bush Forever Site 392 and 347. Such links are unlikely to be used by small ground-dwelling fauna, but are likely to be used by more mobile species such as birds.

In order to preserve or enhance some of the fauna values of the site and surrounding area, the following recommendations are made:

- The proposed urban development should minimise the amount of existing native vegetation cleared. Most native fauna species rely on native vegetation for all or most of their feeding, breeding and shelter needs.

- Areas of native vegetation to be retained should be as large as possible (fewer larger areas are more desirable than many small areas) and should be linked to other areas of native vegetation. Preference should be given to retaining areas around wetlands and areas of Eucalypt/Banksia woodland (Carnaby's Cockatoo feeding habitat) that are in good condition.

- Any verge or street tree plantings should be of species that naturally occur on the site, and residents of the future development should be given incentives to plant local native plants that have value for fauna.

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Appendix 1. Categories used in the assessment of conservation status.

Environmental Protection and Biodiversity Conservation (EPBC) Act and/or the WA Wildlife Conservation Act

Schedule 1: Fauna that are rare or likely to become extinct.
Schedule 2: Fauna presumed to be extinct.
Schedule 3: Migratory birds that are listed under JAMBA.
Schedule 4: Other specially protected fauna.

Extinct: Taxa not definitely located in the wild during the past 50 years.
Extinct in the wild: Taxa known to survive only in captivity.
Critically Endangered: Taxa facing an extremely high risk of extinction in the wild in the immediate future.
Endangered: Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable: Taxa facing a very high risk of extinction in the wild in the medium-term future.
Near Threatened: Taxa that risk becoming Vulnerable in the wild.
Conservation Dependent: Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classed as Vulnerable or more severely threatened.
Data Deficient: Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern: Taxa that are not Threatened.

WA Department of Environment and Conservation Priority species (species not listed under the Conservation Act, but for which there is some concern).

Priority 1: Taxa with few, poorly known populations on threatened lands.
Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority 2: Taxa with few, poorly known populations on conservation lands.
Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority 3: Taxa with several, poorly known populations, some on conservation lands.
Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority 4: Taxa in need of monitoring.
Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.

Priority 5: Taxa in need of monitoring.
Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Appendix 2. Species listed for the area 32°09' to 32°15'S and 115°47' to 115°55'E on the EPBC Protected Matters Search Tool, excluding listed marine species.

Species	Status	Author's Comment
Baudin's Black-Cockatoo *Calyptorhynchus baudinii*	Vulnerable	May occur. Limited foraging habitat and no breeding habitat available on site.
Carnaby's Black-Cockatoo *Calyptorhynchus latirostris*	Endangered	May occur. Some foraging habitat and little/no breeding habitat available on site.
Red-tailed Phascogale *Phascogale calura*	Endangered	Locally extinct.
Quokka *Setonix brachyurus*	Vulnerable	Locally extinct.
Chuditch *Dasyurus geoffroii*	Vulnerable	Locally extinct.
White-bellied Sea-Eagle *Haliaeetus leucogaster*	Migratory	May overfly area.
Rainbow Bee-eater *Merops ornatus*	Migratory	Likely to forage and breed on site.

Appendix 3. Species listed for the area 32°09' to 32°15'S and 115°47' to 115°55'E on the DEC Threatened and Priority Fauna Database.

Species	Status	Author's Comment
Numbat *Myrmecobius fasciatus*	Schedule 1: Vulnerable	Locally extinct.
Carnaby's Black-Cockatoo *Calyptorhynchus latirostris*	Schedule 1: Endangered	Likely to occur. Not likely to breed on site, but likely to forage. Recorded from Modong Nature Reserve in 1997.
Carpet Python *Morelia spilota imbricata*	Schedule 4 & Priority 4	May possibly occur. Record from Warnbro in 2006.
Masked Owl *Tyto novaehollandae*	Priority 3	May possibly occur. Record from Henderson in 2005.
Western False Pipistrelle *Falsistrellus mackenziei*	Priority 4	May occur. Record from Haring Waring Reserve in 1993.
Western Brush Wallaby *Macropus irma*	Priority 4	May possibly occur. Records from Casuarina in 1999 and 2005.
Water Rat (Rakali) *Hydromys chrysogaster*	Priority 4	May possibly occur seasonally.
Southern Brown Bandicoot (Quenda) *Isoodon obesulus*	Priority 5	Observed at Bush Forever Site 270. Records from Modong Nature Reserve (1999), Parmelia/Bertram (2001) and Hope Valley/Postans (2004).

Appendix 4. Specimens listed for the area 32°09' to 32°15'S and 115°47' to 115°55'E on Faunabase (WA Museum). Note that this list represents specimens collected in the area and not a complete list of the fauna that occur in the area.

Reptiles

Agamidae	
Pogona minor	Bearded Dragon
Rankinia adelaidensis	Western Heath Dragon
Elapidae	
Brachyurophis semifasciata	Southern Shovel-nosed Snake
Demansia psammophis	Yellow-faced Whipsnake
Neelaps bimaculatus	Black-naped Snake
Neelaps colonotus	Black-striped Snake
Notechis scutatus	Tiger Snake
Parasuta gouldii	Gould's Hooded Snake
Pseudonaja affinis	Dugite
Pseudonaja nuchalis	Gwardar
Simoselaps bertholdi	Jan's Banded Snake
Simoselaps littoralis	West Coast Banded Snake
Pygopodidae	
Delma fraseri	Fraser's Legless Lizard
Lialis burtonis	Burton's Legless Lizard
Pletholax gracilis	Keeled Legless Lizard
Pygopus lepidopodus	Common Scaly-foot
Scincidae	
Acritoscincus trilineatum	South-west Cool Skink
Cryptoblepharus plagiocephalus	Fence Skink
Ctenotus australis	West Coast Ctenotus
Ctenotus gemmula	Jewelled Ctenotus
Hemiergis quadrilineata	5-toed Earless Skink
Lerista elegans	West Coast 4-toed Lerista
Lerista lineata	Perth Lined Lerista
Menetia greyii	Dwarf Skink
Morethia lineoocellata	Western Pale-flecked Morethia
Tiliqua occipitalis	Western Bluetongue
Tiliqua rugosa	Bobtail
Typhlopidae	
Ramphotyphlops australis	Southern Blind Snake

Amphibians

Myobatrachidae	
Heleioporus eyrei	Moaning Frog
Limnodynastes dorsalis	Pobblebonk
Myobatrachus gouldii	Turtle Frog

Mammals

Dasyuridae	
Phascogale tapoatafa	Brush-tailed Phascogale
Muridae	
Hydromys chrysogaster	Water Rat
Peramelidae	
Isoodon obesulus	Southern Brown Bandicoot
Suidae	
Sus scrofa	Pig
Tarsipedidae	
Tarsipes rostratus	Honey Possum

Appendix 5. Birds listed for the area 32°09' to 32°15'S and 115°47' to 115°55'E on the Birds Australia New Atlas. Note that this list represents observations of birds present in the general area and not necessarily a complete list of the birds that occur in the area.

Common name	Scientific name	No of sightings from 278 surveys
Brown Quail	*Coturnix ypsilophora*	1
Blue-billed Duck	*Oxyura australis*	27
Musk Duck	*Biziura lobata*	31
Freckled Duck	*Stictonetta naevosa*	2
Black Swan	*Cygnus atratus*	55
Australian Shelduck	*Tadorna tadornoides*	66
Radjah Shelduck	*Tadorna radjah*	1
Australian Wood Duck	*Chenonetta jubata*	32
Pacific Black Duck	*Anas superciliosa*	128
Australasian Shoveler	*Anas rhynchotis*	43
Grey Teal	*Anas gracilis*	76
Pink-eared Duck	*Malacorhynchus membranaceus*	21
Hardhead	*Aythya australis*	43
Australasian Grebe	*Tachybaptus novaehollandiae*	29
Hoary-headed Grebe	*Poliocephalus poliocephalus*	16
Great Crested Grebe	*Podiceps cristatus*	1
Darter	*Anhinga melanogaster*	9
Little Pied Cormorant	*Phalacrocorax melanoleucos*	53
Pied Cormorant	*Phalacrocorax varius*	1
Little Black Cormorant	*Phalacrocorax sulcirostris*	8
Great Cormorant	*Phalacrocorax carbo*	3
Australian Pelican	*Pelecanus conspicillatus*	24
White-faced Heron	*Egretta novaehollandiae*	91
Little Egret	*Egretta garzetta*	3
White-necked Heron	*Ardea pacifica*	34
Great Egret	*Ardea alba*	33
Cattle Egret	*Ardea ibis*	1
Nankeen Night Heron	*Nycticorax caledonicus*	30
Glossy Ibis	*Plegadis falcinellus*	6
Australian White Ibis	*Threskiornis molucca*	107
Straw-necked Ibis	*Threskiornis spinicollis*	77
Yellow-billed Spoonbill	*Platelea flavipes*	33
Osprey	*Pandion haliaetus*	1
Black-shouldered Kite	*Elanus notatus*	19
Whistling Kite	*Haliastur sphenurus*	39
Swamp Harrier	*Circus approximans*	50
Brown Goshawk	*Accipiter fasciatus*	13
Collared Sparrowhawk	*Accipiter cirrhocephalus*	16
Wedge-tailed Eagle	*Aquila audax*	16
Little Eagle	*Hieraaetus morphnoides*	30
Brown Falcon	*Falco berigora*	4
Australian Hobby	*Falco longipennis*	11
Peregrine Falcon	*Falco peregrinus*	3
Nankeen Kestrel	*Falco cenchroides*	39
Buff-banded Rail	*Gallirallus philippensis*	6
Baillon's Crake	*Porzana pusilla*	6
Australian Spotted Crake	*Porzana fluminea*	1
Spotless Crake	*Porzana tabuensis*	16

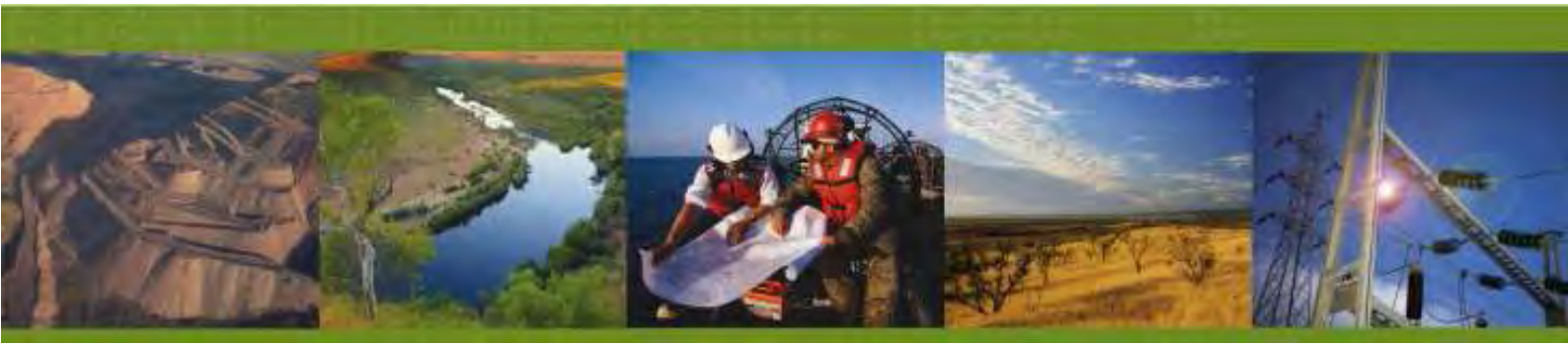
Appendix 5 (cont.)

Common name	Scientific name	No of sightings from 278 surveys
Purple Swamphen	*Porphyrio porphyrio*	111
Dusky Moorhen	*Gallinula tenebrosa*	47
Eurasian Coot	*Fulica atra*	64
Painted Button-quail	*Turnix varia*	2
Common Greenshank	*Tringa nebularia*	8
Red-necked Stint	*Calidris ruficollis*	4
Sharp-tailed Sandpiper	*Calidris acuminata*	3
Curlew Sandpiper	*Calidris ferruginea*	3
Black-winged Stilt	*Himantopus himantopus*	21
Banded Stilt	*Cladorhynchus leucocephalus*	3
Red-necked Avocet	*Recurvirostra novaehollandiae*	4
Red-capped Plover	*Charadrius ruficapillus*	11
Black-fronted Dotterel	*Elseyornis melanops*	11
Banded Lapwing	*Vanellus tricolor*	3
Silver Gull	*Larus novaehollandiae*	20
Caspian Tern	*Sterna caspia*	1
Rock Dove	*Columba livia*	3
Laughing Turtle-Dove	*Streptopelia senegalensis*	95
Spotted Turtle-Dove	*Streptopelia chinensis*	67
Common Bronzewing	*Phaps chalcoptera*	62
Crested Pigeon	*Ocyphaps lophotes*	16
Short-billed Black-Cockatoo	*Calyptorhynchus latirostris*	8
Galah	*Cacatua roseicapilla*	70
Little Corella	*Cacatua sanguinea*	3
Rainbow Lorikeet	*Trichoglossus haematodus*	19
Regent Parrot	*Polytelis anthopeplus*	15
Western Rosella	*Platycercus icterotis*	3
Australian Ringneck	*Barnardius zonarius*	132
Red-capped Parrot	*Purpureicephalus spurius*	111
Elegant Parrot	*Neophema elegans*	13
Pallid Cuckoo	*Cuculus pallidus*	15
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	12
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*	2
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*	29
Southern Boobook	*Ninox novaeseelandiae*	2
Barn Owl	*Tyto alba*	2
Tawny Frogmouth	*Podargus strigoides*	5
Laughing Kookaburra	*Dacelo novaeguineae*	58
Sacred Kingfisher	*Todiramphus sanctus*	39
Rainbow Bee-eater	*Merops ornatus*	25
Splendid Fairy-wren	*Malurus splendens*	162
Spotted Pardalote	*Pardalotus punctatus*	18
Striated Pardalote	*Pardalotus striatus*	107
White-browed Scrubwren	*Sericornis frontalis*	46
Weebill	*Smicrornis brevirostris*	48
Western Gerygone	*Gerygone fusca*	150
Inland Thornbill	*Acanthiza apicalis*	117

Appendix 5 (cont.)

Common name	Scientific name	No of sightings from 278 surveys
Western Thornbill	*Acanthiza inornata*	15
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	90
Red Wattlebird	*Anthochaera carunculata*	144
Little Wattlebird	*Anthochaera chrysoptera*	38
Singing Honeyeater	*Lichenostomus virescens*	60
White-naped Honeyeater	*Melithreptus lunatus*	9
Brown Honeyeater	*Lichmera indistincta*	146
New Holland Honeyeater	*Phylidonyris novaehollandiae*	143
White-cheeked Honeyeater	*Phylidonyris nigra*	9
Tawny-crowned Honeyeater	*Phylidonyris melanops*	4
Western Spinebill	*Acanthorhynchus superciliosus*	32
White-fronted Chat	*Ephthianura albifrons*	2
Scarlet Robin	*Petroica multicolor*	50
Red-capped Robin	*Petroica goodenovii*	10
Hooded Robin	*Melanodryas cucullata*	2
Varied Sittella	*Daphoenositta chrysoptera*	12
Golden Whistler	*Pachycephala pectoralis*	9
Rufous Whistler	*Pachycephala rufiventris*	116
Grey Shrike-thrush	*Colluricincla harmonica*	51
Magpie-Lark	*Grallina cyanoleuca*	115
Grey Fantail	*Rhipidura fuliginosa*	170
Willie Wagtail	*Rhipidura leucophrys*	98
Black-faced Cuckoo-Shrike	*Coracina novaehollandiae*	77
White-winged Triller	*Lalage sueurii*	2
Black-faced Woodswallow	*Artamus cinereus*	11
Dusky Woodswallow	*Artamus cyanopterus*	3
Grey Butcherbird	*Cracticus torquatus*	125
Australian Magpie	*Gymnorhina tibicen*	121
Grey Currawong	*Strepera versicolor*	13
Australian Raven	*Corvus coronoides*	179
Richard's Pipit	*Anthus novaeseelandiae*	6
Mistletoebird	*Dicaeum hirundinaceum*	3
Welcome Swallow	*Hirundo neoxena*	73
Tree Martin	*Hirundo nigricans*	101
Fairy Martin	*Hirundo ariel*	1
Clamorous Reed-Warbler	*Acrocephalus stentoreus*	13
Little Grassbird	*Megalurus gramineus*	13
Silvereye	*Zosterops lateralis*	169

Appendix 14
Cockatoo Habitat Assessment



Mandogalup Black Cockatoo Habitat Survey

Prepared for
Satterley Property Group
by Strategen

August 2013

STRATEGEN
environmental consultants

Mandogalup Black Cockatoo Habitat Survey

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August 2013

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Client: Satterley Property Group

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
				Form	Date
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Final Report	B	For client	TS/DW	Electronic	6/08/13

Filename: SPG11153.09 R001 A0 - 6 August 2013

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1. Introduction

Strategen Environmental Consultants (Strategen) in conjunction with Bamford Consulting Ecologists (Bamford) were commissioned by Satterley Property Group to assess the proposed Mandogalup development area (the site) for significant fauna values, with a focus on black-cockatoos (particularly Carnaby's Black-Cockatoo, ***Calyptorhynchus latirostris*** and Forest Red-tailed Black-Cockatoo, ***C. banksii naso;*** but possibly also Baudin's Black-Cockatoo ***C. baudinii***). The assessment was undertaken over two stages; an initial assessment of significant trees at the site by Strategen in June, followed by a survey in July 2013 by Bamford to assess the potential of the site to provide foraging, roosting and nesting habitat for black-cockatoos.

The purpose of this report is to provide summarised results from both assessments on the quality of the habitat at the proposed Mandogalup development area. The results of this report will inform a referral to the Department of Sustainability, Environment, Water, Populations and Communities DSEWPaC) under the ***Environmental Protection and Biodiversity Conservation Act 1999*** (EPBC Act).

1.1 Description of project area

The site is located in the shire of Mandogalup, west of the Kwinana Freeway and between Rowley Road and Anketell Road, approximately 25 kilometres south of the centre of Perth (see Figure 1and Figure 2). It contains three major patches of remnant vegetation. The northern vegetation remnant is approximately 20 ha, 15 ha of which is banksia woodland (***Banksia menziesii***, ***B. attenuata***, and ***B. ilicifolia***) which is suitable foraging habitat for black cockatoos, and scattered eucalypts (***Eucalyptus marginata***, ***E. rudis*** and ***E. gomphocephala***), which may provide roosting or breeding habitat; the remaining 5 ha have fewer banksias but more eucalypts. The central vegetation remnant is about 3.5 ha of eucalypt woodland with a degraded understorey; many of the trees are large and may provide roosting habitat or nesting hollows. The southernmost remnant (~3 ha) is similar to the central remnant containing large trees and a degraded understorey. The remainder of the site is mostly cleared farmland with some small patches of eucalypts.

1.2 Significant species

Aside from black-cockatoos (described in Appendix 1), the site may also provide habitat for the Quenda or Southern Brown Bandicoot (***Isoodon obesulus fusciventer***). While not formally listed under federal or state legislation, the Quenda is recognised as a priority species by the Western Australian Department of Parks and Wildlife (DPaW). It is ranked as 'Priority 5'; taxa in need of monitoring (conservation dependent). It is of concern because habitat clearing and fragmentation, fire, and predation by foxes, cats and domestic dogs threaten this species.

Figure 1 Location of the proposed Mandogalup development site

Scale 1:200,000 at A4

0 1 2 3 4 5 km

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 31/07/2013
Author: JCrute
Source: Topography: Geoscience Australia 2011.

Legend

- Town
- Major road
- Minor road
- Major river
- Lakes
- Native vegetation
- Site boundary

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Figure 2 The proposed Mandogalup development site

Scale 1:10,000 at A4

0 50 100 150 200 250 m

N

Legend

Site boundary

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 31/07/2013
Author: JCrute
Source: Aerial image: Landgate, flown 29/01/2013, downloaded 30/05/2013.

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2. Method

2.1 Initial assessment by Strategen

2.1.1 Survey date and personnel

The project area was inspected on 28 June 2013 by

- Daniel Panickar (BSc Hons)
- Tegan Stehbens (BSc Hons)

2.1.2 Vegetation description

As per preliminary site investigations detailed in Strategen (2013), the site was divided into three sections (A, B and C) of remnant vegetation for the assessment. A vegetation description and condition assessment was undertaken for each of the three sections.

2.1.3 Significant tree assessment

Significant trees are defined as those with a diameter at breast height (DBH) which was greater than or equal to 500 mm (DSEWPaC 2012). Table 1 lists tree species which are considered to be potential breeding trees by DSEWPaC. The locations of such trees were recorded using a Global Positioning System (GPS) device. In addition to the location and DBH, the height and species of each tree was also recorded.

Table 1 Black cockatoo potential breeding tree species (DSEWPaC 2012)

Scientific name	Common name
Eucalyptus salmonophloia	Salmon gum
Eucalyptus wandoo	Wandoo
Eucalyptus gomphocephala	Tuart
Eucalyptus marginata	Jarrah
Eucalyptus rudis	Flooded gum
Eucalyptus loxophleba	York Gum
Eucalyptus accedens	Powderbark
Eucalyptus diversicolor	Karri
Corymbia calophylla	Marri
Eucalyptus megacarpa	Bullich
Eucalyptus patens	Blackbutt

2.2 Additional assessment by Bamford

2.2.1 Survey date and personnel

The project area was inspected on 2 and 4 July 2013 by:

- Dr Mike Bamford (BSc Hons, Ph.D.) (2 July)
- Mr Robert Browne-Cooper (BSc) (2 and 4 July)
- Ms Katherine Chuk (BSc Hons) (2 and 4 July)

2.2.2 Black cockatoo foraging habitat

The suitability of the site for black-cockatoo foraging was assessed by inspecting the entire site, on foot, and determining the presence of preferred forage plants (as set out in Table ii of Appendix 1). Transect and quadrat surveys were used to quantify the major food species (***Banksia*** spp. trees).

Eleven 20 x 20 m (i.e. 400 m^2) quadrats were placed at regular intervals throughout the banksia woodland. GPS coordinates and locations of each quadrat within the project area are shown in Figure 3 and Appendix 2. In each quadrat the number of each ***Banksia*** species was recorded to gain an estimate of tree density, black-cockatoo foraging signs were counted to demonstrate foraging frequency, and inflorescences were counted to provide additional information on the productivity of the banksias. Between each quadrat a 10 m x 100 m transect (Figure 3 and Appendix 2) was walked and all foraging signs counted, to provide additional information on use of the site by black-cockatoos. These data were used in food resource calculations (see Section 2.2.3).

2.2.3 Black cockatoo food resource calculations

The potential food resource of the project area was measured using a technique adapted from Valentine and Stock (2008). This is based upon studies carried out by Cooper et al. (2002) who found that 11 cones of ***B. attenuata*** provide enough food (energy) to support one Carnaby's Black-Cockatoo for one day. Tree density and the number of cones produced per year by each tree can therefore be used to estimate the black-cockatoo carrying capacity of a site.

Inflorescences were counted during the site visit (to estimate cone production) and previously published estimates were used for calculations. The number of inflorescences can vary annually and therefore single counts can yield deceptive data.

Bamford and Bamford (2004) conducted a study near Jandakot and found the average number of inflorescences (translating to annual cone production) per tree to be 6.7 for ***B. attenuata*** and 6.5 for ***B. menziesii*** (with average tree density per ha to be 333 for ***B. attenuata*** and 167 for ***B. menziesii***). Valentine and Stock (2008) worked in the Gnangara region and counted an average of 12 unopened cones (this figure includes annual production and unopened cones from previous years) per B***. attenuata tree***, with a density of 268 trees per ha.

Tree density at the site was multiplied by these average cones-per-tree values to yield cones per hectare per year. This value was then divided by 4015 (the total number of cones required by a black-cockatoo in one year; 11 cones per day multiplied by 365) to give the number of black-cockatoos potentially supported (by the food resource) per hectare per year.

It should be noted that while ***B. ilicifolia*** also occurred within the project area (and is a known food source for Carnaby's Black-Cockatoo); difficulties in counting its flower/cone production (and no published data) meant that it was not considered in the food resource estimates.

Several assumptions have been made during the food resource estimations. It is assumed that:

- cones of ***B. menziesii*** provide the same amount of food content as cones of ***B. attenuata***
- the average density of trees in the site area is assumed to be the same as the average density of trees within the quadrats sample
- all seeds in each cone are consumed by cockatoos
- all mature ***B. attenuata*** produce cones each year.

In reality, the birds do not eat all the annual seed production of the banksia trees, while annual seed production varies with annual rainfall and time since fire. Thus the final value is likely to over-estimate of the carrying capacity of the site.

Figure 3 Location of 20 x 20 metre banksia survey quadrats (blue) and 100 x 10 m transects (green)

Scale 1:10,000 at A4

0 50 100 150 200 250 m

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 31/07/2013
Author: JCrute
Source: Aerial image: Landgate, flown 29/01/2013, downloaded 30/05/2013.

Legend

- Banksia survey quadrats
- Transects
- Site boundary

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2.2.4 Black cockatoo roosting habitat

The methodology of Kabat et al. (2012), which broadly encompasses DSEWPaC guidelines (DSEWPaC 2012a, 2012b, 2012c, 2012d), was used to detect roosting activity by black-cockatoos. Two roost survey were conducted in the half hour after sunset (c. 18:50 to 19:20; sunset 18:55, civil twilight end 19:20) on 2 and 4 July 2013. Personnel were positioned on high ground overlooking the project area and surrounds. All observed movements of black cockatoos in the general area were recorded. The Great Cocky Count database (Birdlife & DPaW 2013) was searched for known Carnaby's Black-Cockatoo roosts in the area.

2.2.5 Black cockatoo breeding habitat

Consistent with the recommendations of DSEWPaC (2010, 2011, 2012a, 2012b, 2012c, 2012d), a survey for potential hollow-bearing (nest) trees were conducted within the project area. The entire site was examined for the presence of suitable nest trees; tree species known to be used for nesting in the area (Table 1) and with a DBH greater than 500 mm (Appendix 1). Trees recorded in the initial assessment were re-visited to obtain additional data on presence of hollows and likely value of breeding sites.

For any tree that met these criteria:

- DBH was measured;
- trees were assessed (from the ground) for presence of hollows suitable for black-cockatoos (entrance diameter greater than 100 mm);
- trees were given a score based on their likely value as a breeding site (see below); and
- tree location was recorded (UTM, zone 50, datum WGS84).

The score given to trees with a DBH >500mm to reflect their likely value for breeding has been developed by Bamford Consulting Ecologists and ranges from 1 to 5 (Table 2).

Table 2 Potential breeding tree scoring

Score	Description
1	Active nest observed; adult (or immature) bird seen entering or emerging from hollow.
2	Hollow of suitable size and angle (i.e. near-vertical) visible with chew marks around entrance. While it cannot with certainty be assumed that such chew marks were made by a black-cockatoo, they indicate activity of a parrot at a hollow potentially suitable for use by black-cockatoos.
3	Potentially suitable hollow visible but no chew marks present; or potentially suitable hollow present (as suggested by structure of tree, such as large, vertical trunk broken off at a height of >10m).
4	Tree with large hollows or broken branches that might contain large hollows but hollows or potential hollows are not vertical or near-vertical; thus a tree with or likely to have hollows of sufficient size but not to have hollows of the angle preferred by black-cockatoos.
5	Tree lacking large hollows or broken branches that might have large hollows; a tree with more or less intact branches and a spreading crown.

2.2.6 Quenda and other significant fauna

The presence of a number of species of conservation significance can be detected through searching for evidence such as scats, tracks, nests, diggings and feeding signs. Quenda leave distinctive foraging diggings. The project area was inspected for this evidence.

3. Results and Discussion

3.1 Black cockatoo presence and foraging habitat

3.1.1 Vegetation description and condition assessment

Section A (Figure 5) comprised the largest area (19.86 ha) and contained four different vegetation units as defined by RPS (2007). Most of this area was in good – excellent condition. One area is considered particularly significant as it is comprised of wetland/spring-like vegetation, containing large trees over a dense understorey of ferns and mixed shrubs and would provide a water source to local fauna Fresh signs of black cockatoo foraging were observed in this section, with chewed ***Banksia*** spp. cones noted at several locations throughout the site.

Section B (3.71 ha, Figure 5) was comprised of high densities of ***Eucalyptus rudis*** and ***Melaleuca preissiana*** over mixed shrubs and weeds which is indicative of its location adjacent to cleared agricultural land. This section was rated in good – degraded condition.

Section C (2.92 ha Figure 5) was the smallest of the Sections and was comprised of ***Eucalyptus rudis*** over ferns and weeds in a degraded – completely degraded condition.

3.1.2 Carnaby' s Black-Cockatoo

Three main food species were present: ***Banksia attenuata***, ***B. menziesii*** and ***B. ilicifolia***. Other species were present which may be used for foraging such as Jarrah and Marri, however they were present in lower densities and are not easily assessed. The results (raw data) of the tree density quadrat surveys are presented in Table iii of Appendix 2. The mean density of live ***Banksia*** species for the banksia woodland was 150 ***B. menziesii*** per ha, 45 ***B. attenuata*** per ha and 14 ***B. ilicifolia*** per ha, which is lower than average for such woodlands on the Swan Coastal Plain. Valentine and Stock (2008) had ***B. attenuata*** densities of 268 trees per ha and Bamford and Bamford (2004) had tree densities for the Jandakot region at 333 ***B. attenuata*** per ha, 167 ***B. menziesii*** per ha.

Carnaby's Black-Cockatoo foraging signs (cone follicle fragments and discarded cones) were present at 24% of ***Banksia menziesii***, 40% of ***B. attenuata*** and 33% of ***B. attenuata*** trees within the banksia quadrats. Most of the discarded cones appeared to be quite fresh, indicating that the site was used for foraging within the last few weeks (Figure 4). The birds were eating not only seeds, but were breaking open the cones to extract beetle larvae.

3.1.3 Forest Red-tailed Black-Cockatoo

No Forest Red-tailed Black-Cockatoos were recorded during the site inspection. The low numbers of preferred native food sources (such as of Jarrah, see Appendix 1) at the site means that it is unsuitable for foraging by this species. Thus the site is unlikely to be potential foraging habitat for Forest Red-tailed Black-Cockatoo, although birds may occasionally pass through the site.

3.1.4 Baudin' s Black-Cockatoo

Baudin's Black-Cockatoo is not expected (the project area is outside this species' usual range) and was not recorded. Thus the site is not considered to be potential foraging habitat for Baudin's Black-Cockatoo.

Figure 4 Recent foraging signs on a ***Banksia attenuata*** cone

3.2 Black cockatoo food resource calculations

With an annual cone production per tree of 6.7 for ***B. attenuata*** and 6.5 for ***B. menziesii*** (from Bamford &Bamford 2004), the average tree densities outlined above equate to an annual cone production of 975 cones/ha for ***B. menziesii*** and 305 cones/ha for B. attenuata (total 1280 cones/ha). If the daily cone requirements of Cooper et al. (2002) hold (as described in Section2.2.2), the estimated carrying capacity of the banksia woodland is 0.32 Carnaby's Black-Cockatoos per hectare per year (Table v of Appendix 2).

These values are lower than those reported in other studies on the Swan Coastal Plain; both Valentine and Stock (2008) and Bamford and Bamford (2004) had an average of c. 0.8 cockatoos/ha/year.

Given that the site contains about 15 ha of foraging habitat, the site could potentially support about 4.8 Carnaby's Black-Cockatoos per year, although this is likely to be an over-estimation (see Section 2.2.2).

3.3 Black cockatoo roosting habitat

No black-cockatoos were seen or heard in the area during the roost survey or the site inspection. The presence of damplands/drainage lines, foraging habitat (for Carnaby's Black-Cockatoos) and large trees make the site appear desirable for roosting by black-cockatoos. The site may provide potential roosting habitat for black-cockatoo species. There is a known Carnaby's Black-Cockatoo roost 1.3 km east of the site, at the intersection of Satinover Way and Wandi Drive (Birdlife and DPaW 2013).

3.4 Black cockatoo breeding habitat

There were 98 stems (most trees were single-stemmed but some had 2-4 stems) within the site which were scored for their potential to provide breeding habitat (location details are presented in Figure 5 and Appendix 3). The majority of the trees (83 stems) large enough to provide potential breeding habitat did not have hollows but may develop suitable hollows in the future. There were five trees with hollows that did not appear suitable but may become suitable in the future (BC score 4), seven trees had suitable-looking hollows with no signs of recent use (BC score 3) and three trees had suitable-looking hollows with chew marks around the entrance (BC score 2; Table 1, Figures 6 - 9). These hollows were possibly not large enough for black-cockatoos, and it is not certain that the chew marks were made by black-cockatoos, but they indicate parrot activity at large hollows. No active nests were detected.

Table 3 Potential black cockatoo breeding trees

Black cockatoo score	Number of trees
1 – Trees with active nest	0
2 – Trees with large, suitable hollows bearing recent chew-marks	3
3 – Trees with possible suitable hollows visible, or assumed from structure of tree (such as a high, vertical spout)	7
4 – Trees that are large with some small hollows, possibly some concealed larger hollows but no vertical spouts	5
5 – Trees that meet the DBH criterion but have intact crowns and are therefore unlikely to have current suitable hollows	83
TOTAL	**98**

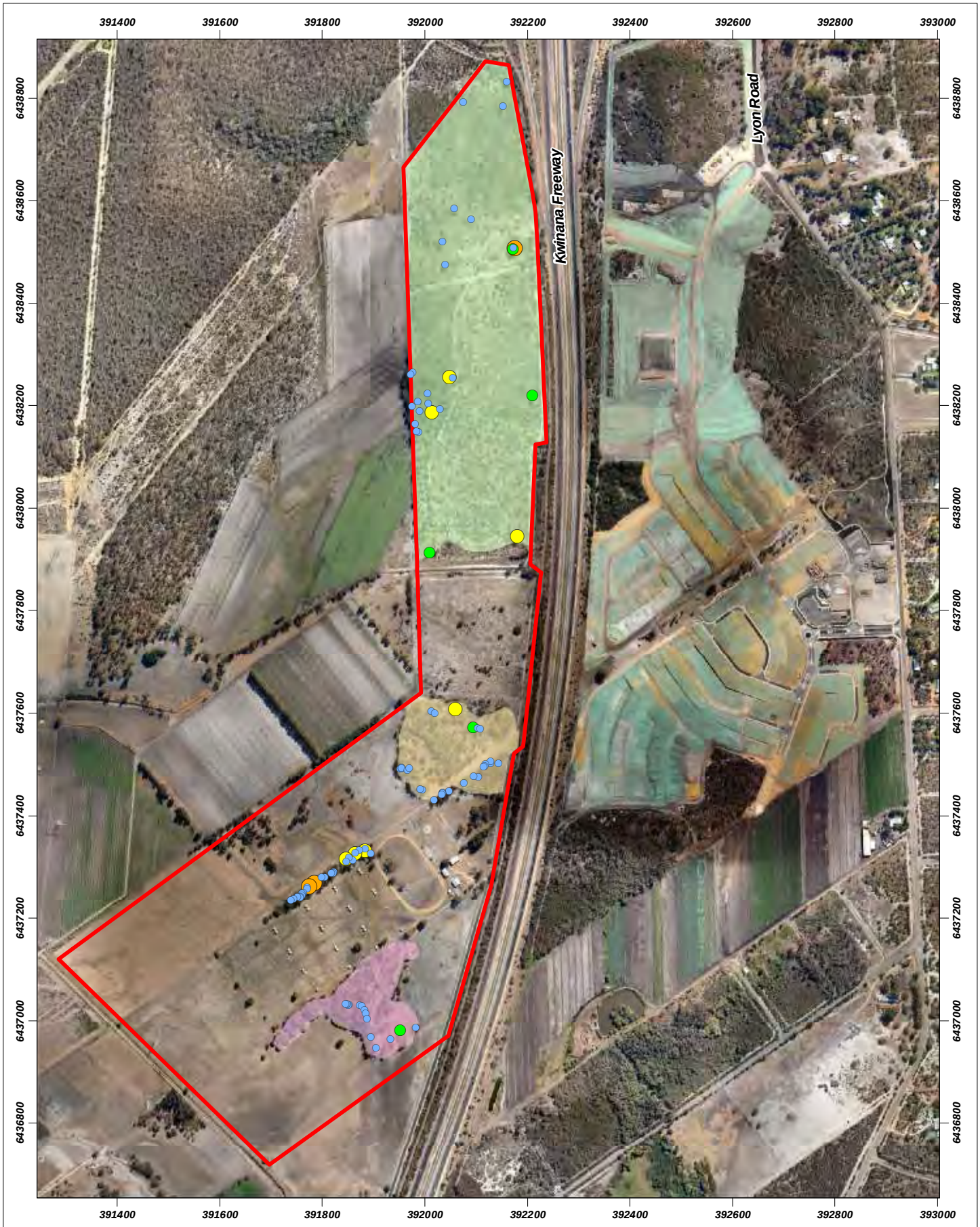

Figure 5 Significant trees recorded within the site and black-cockatoo nesting potential score

Legend

Potential nesting tree scores

- 2
- 3
- 4
- 5

- Site boundary
- Section A
- Section B
- Section C

Scale 1:10,000 at A4

0 50 100 150 200 250 m

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 31/07/2013
Author: JCrute
Source: Aerial image: Landgate, flown 29/01/2013, downloaded 30/05/2013.

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Figure 6 BC Score 2 ***Eucalyptus marginata*** (tree number 3)

Figure 7 Hollow with chew marks (tree number 3)

Figure 8 BC Score 2 ***Eucalyptus rudis*** (tree number 72)

Figure 9 Hollow with chew marks (tree number 72)

3.5 Quenda

Recent diggings were present in the banksia woodland indicating the presence of this species within the project area.

4. Conclusion

An assessment of significant impact risk to Carnaby's Black-Cockatoos against relevant DSEWPaC referral criteria is presented in Table 4.

Table 4 Assessment of significant impact risk Carnaby's Black-Cockatoo (CBC) (DSEWPaC 2012)

Actions leading to a risk of significant impact	Assessment	Comment
Clearing of any known nest tree	Potential risk of significant impact	The proposal area occurs within the modelled distribution of CBC and contains three trees with potential nest hollows and additional trees which may develop suitable hollows in the next 50 years.
Clearing or degradation of any part of a vegetation community known to contain breeding habitat	Potential risk of significant impact	The proposal area occurs within the modelled distribution of CBC and may contain breeding habitat.
Clearing of more than 1 ha of quality foraging habitat	Potential significant impact	The site comprises approximately 18.89 ha of moderate to good quality habitat for foraging which may support up to 4.8 CBC per year.
Clearing or degradation (including pruning the top canopy) of a known night roosting site	Potential risk of significant impact, survey required	The proposal area comprises suitable habitat for foraging, is close to water sources, occurs within the modelled distribution of CBC and contains trees that may be used for roosting.
Creating a gap of greater than 4 km between patches of black cockatoo habitat (breeding, foraging or roosting)	Unlikely to cause significant impact	Five Bush Forever sites (268, 269, 270, 347 and 392) are located within 2 km of the site. These are areas which are designated to remain as bush in perpetuity.

The banksia woodland at the site supports foraging by Carnaby's Black-Cockatoo, with evidence of recent foraging. Given the banksia tree densities recorded during the site inspection, it is estimated that the total carrying capacity (with respect to foraging resources) of the banksia woodland is approximately 4.8 Carnaby's Black-Cockatoo per year. The quality of the foraging habitat in the banksia woodland is moderate as the vegetation is mostly in reasonable condition, although with the density of banksia it is lower than at other sites in the general region.

There was no evidence to support foraging by Forest Red-tailed Black-Cockatoos or Baudin's Black-Cockatoos, and the project area is not considered to be potential foraging habitat for these species, although birds (particularly the Forest Red-tailed Black-Cockatoo) may pass through the site occasionally.

No roosting or breeding was observed by any species of black-cockatoos on site, though the habitat appears suitable for roosting and there are many large trees (approximately 98 stems), three of which have large hollows with chew marks.

Given foraging diggings in the banksia woodland it is likely that Quenda are resident within this section of the project area.

5. Recommendations

The following recommendations are provided:

- the site be referred to DSEWPaC under the EPBC Act prior to clearing activities and development.
- where possible, significant trees designated a score of two or three (Figure 5) should be retained in order to minimise impacts to black-cockatoos within the area.

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Appendix 1
Black cockatoos

Black cockatoo ecology, habitat requirements and threats

The three south-western Western Australian taxa of black cockatoo are listed in Table i. All species are listed under both the Commonwealth ***Environment Protection and Biodiversity Conservation Act 1999*** (EPBC Act) and the Western Australian ***Wildlife Conservation Act 1950*** (WC Act), as indicated in Table i. Two of these are likely to occur in the vicinity of the project area (Forest Red-tailed and Carnaby's Black-Cockatoo), with Baudin's Black-Cockatoo not expected (in the Perth area this species is generally restricted to the Darling Range and/or the very eastern edge of the Swan Coastal Plain).

Table i. Black cockatoos likely to occur in the vicinity of the project area

Species	EPBC Act 1999	WC Act 1950
Calyptorhynchus banksii naso (Forest Red-tailed Black-Cockatoo)	Vulnerable	Schedule 1 (Vulnerable)
Calyptorhynchus latirostris (Carnaby's Black-Cockatoo)	Endangered	Schedule 1 (Endangered)
Calyptorhynchus baudinii (Baudin's Black-Cockatoo)	Vulnerable	Schedule 1 (Endangered)

There is considerable published information on the ecology of, and threats to, these black cockatoo species. Key references include:

- Action plans (Garnett et al. 2010);
- Recovery plans (Cale 2003; DEC 2007);
- EPBC guidelines (DEWHA 2010);
- Commonwealth listing and conservation advice (DEWHA 2009a, b);
- The federal Department of Sustainability, Environment, Water, Population and Communities' (SEWPaC, formerly DEWHA) Species Profile and Threats (SPRAT) Database (DSEWPaC 2012a, 2012b, 2012c);
- Scientific literature (Davies 1966; Saunders 1974, 1979a, 1979b, 1980; Saunders et al. 1982; Saunders 1986; Johnstone and Storr 1998; Higgins 1999; Johnstone and Kirkby 1999, 2008); and
- Major reports (Johnstone et al. 2011; Kabat et al. 2012).

Much of this information has been compiled by DSEWPaC (2012a, 2012 b, 2012c, 2012d). Summarising this work further, there are several salient points for assessing the potential value of the project area for black cockatoos:

Key ecology

1. All species are long-lived with low annual reproduction rates and cannot, therefore, rapidly increase their population size.
2. Carnaby's and Baudin's Black-Cockatoos undergo regular, seasonal migration between breeding and non-breeding areas.
3. Forest Red-tailed Black-Cockatoos are currently considered not to undergo regular migration. In recent years there appears to have been a distinct expansion of the range of this species on to the Swan Coastal Plain, including many suburbs within the Perth metropolitan area.
4. In recent years there have been considerable shifts in the breeding ecology, distribution and movement patterns of Forest Red-tailed and Carnaby's Black-Cockatoos. These may be a response to habitat degradation/clearing and/or climatic factors.

Key habitat requirements

1. All species are reliant on large tree-hollows in eucalypts, in which they breed. Each species has its own preference for nesting tree species and its own geographical breeding range (although these overlap between species). There is a solid understanding of these preferences (see Table ii for summary).

2. All species primarily feed on plant seeds and flowers, but also consume wood-boring insect larvae when available. Each species has its own preference for food plant species (with considerable overlap). There is a solid understanding of these preferences (see Table ii for summary).

Key threats

1. Key threatening processes include illegal shooting, habitat loss, habitat degradation, nest hollow shortage, competition for available nest hollows from other parrots and feral Honeybees (***Apis mellifera***), and illegal trade.

Nesting tree size and hollow dimensions

1. Black-cockatoos require tree hollows that have an entrance diameter of more than 100 mm (Whitford 2001). Internal dimensions may be more important than entrance diameter, although these are much more difficult to assess (Whitford 2001; Gibbons and Lindenmayer 2002; Whitford and Williams 2002). For Forest Red-tailed Black-Cockatoos, the minimum height of a nesting hollow was 4.4 m above the ground (Whitford 2001). The minimum diameter at breast height (DBH) of a nesting tree was 608 mm and the minimum age of an actual nesting tree was 214 years (Whitford 2002). In the study by Whitford and Williams (2002) the youngest tree to bear a hollow that was potentially suited to Forest Red-tailed Black-Cockatoos was 131 years (although this was not used). In general, hollows of sufficient size to support black-cockatoos do not form until trees at least 230 years old, and the majority of nests are found in 300-500 year old trees (Johnstone 2006).
2. DSEWPaC (2010, 2011, 2012a, b, c, d) recommend that surveys for potential hollow-bearing trees should identify trees greater than 500 mm DBH (to include trees that are likely to become hollow-bearing in the next 50 years).

Table ii. Plants known to be used for foraging, roosting and nesting by black-cockatoos in south-western Western Australia.

Plant Species	Plant Status	FRTBC	CBC	BBC
Acacia baileyana (Cootamundra Wattle)	AN		F	
Acacia pentadenia (Karri Wattle)			F	
Acacia saligna (Orange Wattle)			F	
Agonis flexuosa (Peppermint Tree)			F	
Allocasuarina fraseriana (Sheoak)		F		F
Anigozanthos flavidus (Tall Kangaroo Paw)				F
Araucaria heterophylla (Norfolk Island Pine)	E		F	
Banksia ashbyi (Ashby's Banksia)			F	
Banksia attenuata (Slender Banksia)			F	
Banksia baxteri (Baxter's Banksia)			F	
Banksia carlinoides (Pink Dryandra)			F	
Banksia coccinea (Scarlet Banksia)			F	
Banksia dallanneyi (Couch Honeypot Dryandra)			F	
Banksia ericifolia (Heath-leaved Banksia)	AN		F	
Banksia fraseri (Dryandra)			F	
Banksia gardneri (Prostrate Banksia)			F	
Banksia grandis (Bull Banksia)			F	F
Banksia hookeriana (Hooker's Banksia)			F	
Banksia ilicifolia (Holly Banksia)			F	F
Banksia kippistiana (Dryandra)			F	
Banksia leptophylla			F	
Banksia lindleyana (Porcupine Banksia)				F
Banksia littoralis (Swamp Banksia)			F	F
Banksia menziesii (Firewood or Menzie's Banksia)			F	
Banksia mucronulata (Swordfish Dryandra)			F	
Banksia nivea (Honeypot Dryandra)			F	
Banksia nobilis (Golden Dryandra)			F	
Banksia praemorsa (Cut-leaf Banksia)			F	F
Banksia prionotes (Acorn Banksia)			F	
Banksia quercifolia (Oak-leaved Banksia)			F	F
Banksia sessilis (Parrot Bush)			F	F
Banksia speciosa (Showy Banksia)			F	
Banksia squarrosa (Pingle)			F	F
Banksia tricuspis (Lesueur Banskia or Pine Banksia)			F	
Banksia undata (Urchin or Cut-leaf Dryandra)			F	
Banksia verticillata (Granite Banksia)			F	
Brassica campestris (Canola, Rape)	E		F	
Callistemon spp.				F
Callistemon viminalis (Captain Cook Bottlebrush)	AN		F	
Callitris sp.			F	
Carya illnoinensis (Pecan)	E		F	F

Plant Species	Plant Status	FRTBC	CBC	BBC
Casuarina cunninghamiana (River Sheoak)	AN		F	
Citrullus lanatus (Pie or Afghan Melon)	E		F	
Corymbia calophylla (Marri)		F,N	F,n,R	F,n
Corymbia ficifolia (Red Flowering Gum)			F	
Corymbia haematoxylon (Mountain Marri)			F	
Corymbia maculata (Spotted Gum)			R	
Darwinia citriodora (Lemon-scented Darwinia)	AN		F	F
Diospryros sp. (Sweet Persimmon)	E		F	F
Eremophila glabra (Tarbush)			F	
Erodium aureum (Corkscrew Grass or Storksbill)	E		F	
Erodium botrys (Corkscrew Grass or Storksbill)	E		F	F
Eucalyptus caesia (Silver Princess)			F	
Eucalyptus camaldulensis (River Red Gum)	AN		R	
Eucalyptus citriodora (Lemon Scented Gum)	AN	F	F,R	F
Eucalyptus diversicolor (Karri)		n	n	N
Eucalyptus globulus (Tasmaniam Blue Gum)	AN		R	
Eucalyptus gomphocephala (Tuart)		n	F,n,R	
Eucalyptus grandis (Flooded Gum, Rose Gum)	AN		R	
Eucalyptus longicornis (Red Morrell)			n	
Eucalyptus loxophleba (York Gum)			F,n	
Eucalyptus marginata (Jarrah)		F,N	F,n,R	F
Eucalyptus megacapa (Bullich)		n		n
Eucalyptus occidentalis (Swamp Yate)			n	
Eucalyptus patens (Blackbutt)		F	F,R	
Eucalyptus pleurocarpa (Tallerack)			F	
Eucalyptus preissiana (Bell-fruited Mallee)			F	
Eucalyptus robusta (Swamp Mahogany)			F,R	
Eucalyptus rudis (Flooded Gum)			R	
Eucalyptus salmonophloia (Salmon Gum)			F,N	
Eucalyptus salubris (Gimlet)			n	
Eucalyptus todtiana (Coastal Blackbutt or Prickley Bark)			F	
Eucalyptus wandoo (Wandoo)			F,N,R	F,n
Ficus sp. (Fig)			F	
Grevillea armigera (Prickly Toothbrushes)			F	
Grevillea bipinnatifida (Fuschia Grevillea)			F	
Grevillea hookeriana (Red Toothbrushes)			F	
Grevillea hookeriana subsp. ***apiciloba*** (Black Toothbrushes)			F	
Grevillea paniculata (Kerosene Bush)			F	
Grevillea paradoxa (Bottlebrush Grevillea)			F	
Grevillea petrophiloides (Pink Poker)			F	
Grevillea robusta (Silky Oak)			F	
Grevillea wilsonii (Native Fuchsia)				F
Hakea auriculata			F	

Plant Species	Plant Status	FRTBC	CBC	BBC
Hakea candolleana			F	
Hakea circumalata (Coastal Hakea)			F	
Hakea commutata			F	
Hakea conchifolia			F	
Hakea costata (Ribbed Hakea)			F	
Hakea cristata (Snail Hakea)			F	F
Hakea cucullata (Snail Hakea)			F	
Hakea cyclocarpa (Ramshorn)			F	
Hakea eneabba			F	
Hakea erinacea (Hedgehog Hakea)			F	F
Hakea falcata (Sickle Hakea)			F	
Hakea flabellifolia (Fan-leaved Hakea)			F	
Hakea gilbertii			F	
Hakea incrassata (Golfball or Marble Hakea)			F	
Hakea lasiantha (Woolly Flowered Hakea)			F	
Hakea lasianthoides			F	F
Hakea laurina (Pin-cushion hakea)			F	
Hakea lissocarpha (Honeybush)			F	F
Hakea marginata				F
Hakea megalosperma (Lesueur Hakea)			F	
Hakea multilineata (Grass Leaf Hakea)			F	
Hakea obliqua (Needles and Corks)			F	
Hakea oleifolia (Dungyn or Olive-leaved Hakea)			F	
Hakea pandanicarpa subsp. ***crassifolia*** (Thick-leaved Hakea)			F	
Hakea petiolaris (Sea Urchin Hakea)			F	
Hakea polyanthema			F	
Hakea preissii (Needle Tree)			F	
Hakea prostrata (Harsh Hakea)			F	F
Hakea psilorrhyncha			F	
Hakea ruscifolia (Candle Hakea)			F	F
Hakea scoparia (Kangaroo Bush)			F	
Hakea smilacifolia			F	
Hakea spathulata			F	
Hakea stenocarpa (Narrow-fruited Hakea)			F	F
Hakea sulcata (Furrowed Hakea)			F	
Hakea trifurcata (Two-leaved Hakea)			F	F
Hakea undulata (Wavy-leaved Hakea)			F	
Hakea varia (Variable-leaved Hakea)			F	F
Helianthus annuus (Sunflower)	E		F	
Hibiscus sp. (Hibiscus)	E		F	
Isopogon scabriusculus			F	
Jacaranda mimosifolia (Jacaranda)	E		F	F
Jacksonia furcellata (Grey Stinkwood)			F	

Plant Species	Plant Status	FRTBC	CBC	BBC
Kingia australis (Kingia)				F
Lambertia inermis (Chittick)			F	
Lambertia multiflora (Many-flowered Honeysuckle)			F	
Liquidamber styraciflua (Liquid Amber)	E		F	
Lupinus sp. (Lupin)	E		F	
Macadamia integrifolia (Macadamia)	E		F	F
Malus domestica (Apple)	E		F	F
Melaleuca leuropoma			F	
Melia azedarach (Cape Lilac or White Cedar)	E	F	F	
Mesomeleana sp.			F	
Persoonia longifolia (Snottygobble)		F		
Pinus canariensis (Canary Island Pine)	E		F	
Pinus caribea (Caribbean Pine)	E		F	
Pinus pinaster (Pinaster or Maritime Pine)	E		F,R	
Pinus radiata (Radiata Pine)	E		F,R	F
Protea 'Pink Ice'	E		F	
Protea repens	E		F	
Prunus amygdalus (Almond Tree)	E		F	
Pyrus communis (European Pear)	E			F
Quercus spp. (Oak spp.)	E			F
Raphanus raphanistrum (Wild Radish)	E		F	
Reedia spathacea				F
Tipuana tipu (Tipu or Rosewood Tree)	E		F	
Xanthorrhoea preissii (Grass Tree)			F	F

FRTBC = Forest Red-tailed Black-Cockatoo, CBC = Carnaby's Black-Cockatoo, BBC = Baudin's Black-Cockatoo (see Table i for scientific names).

Plant status: blank = Western Australian native, AN = Australian native (but not naturally occurring in Western Australia), E = exotic (i.e. not native to Australia).

F = foraging, R = roosting, N or n = nesting (main and less commonly used species, respectively).

Data compiled from the literature (Davies 1966; Saunders 1974, 1979a, b, 1980; Saunders et al. 1982; Saunders 1986; Johnstone and Storr 1998; Higgins 1999; Johnstone and Kirkby 1999, 2008; Groom 2011; Johnstone et al. 2011; DSEWPaC 2012a, b; c, R. Johnstone pers. comm.).

Appendix 2

Raw data: Foraging assessment

Table i. Banksia quadrat coordinates

Quadrat	Easting	Northing
1	392204	6438520
2	392196	6438409
3	392189	6438306
4	392190	6438205
5	392199	6438120
6	392180	6438021
7	392101	6437935
8	392120	6438034
9	392114	6438152
10	392105	6438264
11	392105	6438351

Table ii. Foraging sign transect coordinates

Transect	Start Easting	Start Northing	End Easting	End Northing
1	392204	6438520	392196	6438409
2	392196	6438409	392189	6438306
3	392189	6438306	392190	6438205
4	392190	6438205	392199	6438120
5	392199	6438120	392180	6438021
6	392180	6438021	392178	6437912
7	392101	6437935	392120	6438034
8	392120	6438034	392114	6438152
9	392114	6438152	392105	6438264
10	392105	6438264	392105	6438351
11	392105	6438351	392105	6438465

Table iii. Raw data from the banksia quadrats

Quadrat	Species	Trees	Flowers	Foraging signs
1	***B. menziesii***	8	85	1
1	***B. attenuata***	2	10	1
1	***B. ilicifolia***	0	0	0
2	***B. menziesii***	6	6	2
2	***B. attenuata***	2	2	0
2	***B. ilicifolia***	0	0	0
3	***B. menziesii***	2	1	0
3	***B. attenuata***	1	1	0
3	***B. ilicifolia***	0	0	0
4	***B. menziesii***	7	63	3
4	***B. attenuata***	0	0	0
4	***B. ilicifolia***	0	0	0
5	***B. menziesii***	4	109	3
5	***B. attenuata***	0	0	0
5	***B. ilicifolia***	0	0	0
6	***B. menziesii***	5	1	0
6	***B. attenuata***	1	40	1
6	***B. ilicifolia***	0	0	0
7	***B. menziesii***	9	66	1
7	***B. attenuata***	0	0	0
7	***B. ilicifolia***	3	51	1
8	***B. menziesii***	8	143	3
8	***B. attenuata***	0	0	0
8	***B. ilicifolia***	0	0	0
9	***B. menziesii***	7	22	1
9	***B. attenuata***	4	130	3
9	***B. ilicifolia***	1	30	0
10	***B. menziesii***	6	56	1
10	***B. attenuata***	10	59	3
10	***B. ilicifolia***	0	0	0
11	***B. menziesii***	4	39	1
11	***B. attenuata***	0	0	0
11	***B. ilicifolia***	2	25	1
	Total	**92**	**939**	**26**

Table iv. Raw data from the foraging sign transects

Transect	B. menziesii	B. attenuata	B. ilicifolia	Total
1	6	1	0	7
2	11	1	0	12
3	6	3	0	9
4	9	1	0	10
5	4	2	1	7
6	1	3	3	7
7	6	0	0	6
8	7	0	0	7
9	2	2	0	4
10	5	1	1	7
11	5	2	2	9
Total	62	16	7	85

Table v. Food resource calculations

	B. menziesii	B. attenuata	B. ilicifolia	Total
Trees in 0.44 ha	66	20	6	92
Trees/ha	150	45.5	13.6	209.1
Cones/ha/yr	975	304.5		1279.5
Cockatoos/ha/yr	0.2	0.1		0.3
Cockatoos in 15 ha				4.8

Appendix 3

Raw data: significant tree assessment

Table i. Raw data for potential nesting trees

Stem ID	Species	Easting	Northing	BC Score*
1	Jarrah	392152	6438784	5
2	Jarrah	392172	6438506	4
3	Jarrah	392175	6438507	2
4	Jarrah	392173	6438509	5
5	Jarrah	392210	6438221	4
6	Jarrah	392181	6437945	3
7	Jarrah	392090	6438563	5
8	Jarrah	392058	6438585	5
9	Jarrah	392075	6438793	5
10	Tuart	392160	6438833	5
11	Jarrah	392040	6438476	5
12	Jarrah	392034	6438520	5
13	Jarrah	392049	6438256	3
14	Jarrah	392055	6438255	5
15	Rudis	391976	6438265	5
16	Rudis	391973	6438261	5
17	Rudis	391987	6438149	5
18	Rudis	391984	6438151	5
19	Rudis	391981	6438165	5
20	Rudis	391990	6438191	5
21	Jarrah	392014	6438188	3
22	Rudis	392029	6438194	5
23	Rudis	392006	6438204	5
24	Rudis	392005	6438225	5
25	Rudis	391986	6438208	5
26	Rudis	391975	6438199	5
27	Jarrah	392009	6437914	4
28	Rudis	392144	6437503	5
29	Rudis	392129	6437503	5
30	Rudis	392128	6437507	5
31	Rudis	392118	6437501	5
32	Rudis	392117	6437498	5
33	Rudis	392114	6437496	5
34	Rudis	392104	6437476	5
35	Rudis	392095	6437479	5
36	Rudis	392076	6437464	5
37	Rudis	392047	6437449	5
38	Rudis	392034	6437445	5
39	Rudis	392034	6437444	5
40	Rudis	392033	6437442	5
41	Rudis	392018	6437432	5
42	Rudis	391995	6437452	5
43	Rudis	391991	6437453	5
44	Rudis	391952	6437493	5
45	Rudis	391954	6437493	5

Stem ID	Species	Easting	Northing	BC Score*
46	Rudis	391955	6437495	5
47	Rudis	391955	6437494	5
48	Rudis	391966	6437490	5
49	Rudis	391970	6437494	5
50	Rudis	391956	6437507	
51	Rudis	392013	6437604	5
52	Rudis	392019	6437600	5
53	Jarrah	392060	6437608	3
54	Jarrah	392094	6437573	4
55	Jarrah	392103	6437571	5
56	Jarrah	392108	6437570	5
57	Rudis	391883	6437336	5
58	Rudis	391884	6437333	3
59	Rudis	391895	6437327	5
60	Rudis	391872	6437334	5
61	Rudis	391865	6437329	5
62	Rudis	391864	6437328	3
63	Rudis	391859	6437314	5
64	Rudis	391852	6437320	5
65	Rudis	391847	6437316	3
66	Rudis	391847	6437311	5
67	Rudis	391823	6437292	5
68	Rudis	391821	6437290	5
69	Rudis	391817	6437290	5
70	Rudis	391805	6437281	5
71	Rudis	391798	6437281	5
72	Rudis	391784	6437269	2
73	Rudis	391775	6437261	2
74	Rudis	391771	6437261	5
75	Rudis	391770	6437259	5
76	Rudis	391763	6437250	5
77	Rudis	391761	6437249	5
78	Rudis	391760	6437245	5
79	Rudis	391758	6437243	5
80	Rudis	391757	6437241	5
81	Rudis	391752	6437243	5
82	Rudis	391744	6437239	5
83	Rudis	391739	6437236	5
84	Rudis	391852	6437033	5
85	Rudis	391851	6437032	5
86	Rudis	391848	6437033	5
87	Rudis	391848	6437034	5
88	Rudis	391846	6437034	5
89	Rudis	391874	6437032	5
90	Rudis	391877	6437029	5
91	Rudis	391882	6437022	5

Stem ID	Species	Easting	Northing	BC Score*
92	Rudis	391885	6437015	5
93	Rudis	391887	6437005	5
94	Rudis	391895	6436970	5
95	Rudis	391905	6436948	5
96	Rudis	391933	6436964	5
97	Rudis	391952	6436982	4
98	Rudis	391982	6436988	5

*BC Score:
1 – Tree with active nest.
2 – Tree with large, suitable hollow bearing recent chew-marks.
3 – Tree with possible suitable hollow visible, or assumed from structure of tree (such as a high, vertical spout).
4 – Tree that is large with some small hollows, possibly some concealed larger hollows but no vertical spout.
5 – Tree that meets the DBH criterion but has an intact crown and is therefore unlikely to have current suitable hollow.

APPENDIX 4

BUSHFIRE MANAGEMENT PLAN

ROWEGROUP

intelligent outcomes | respected experience

Bushfire Management Plan

Mandogalup East Local Structure Plan

Prepared for
Satterley Property Group
by Strategen

November 2016

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ENVIRONMENTAL

Bushfire Management Plan

Mandogalup East Local Structure Plan

Strategen is a trading name of
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ACN: 056 190 419

November 2016

Limitations

Scope of services

This report ("the report") has been prepared by Strategen Environmental Consultants Pty Ltd (Strategen) in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, Strategen has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, Strategen has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen has also not attempted to determine whether any material matter has been omitted from the data. Strategen will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen. The making of any assumption does not imply that Strategen has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

Client: Satterley Property Group

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
				Form	Date
Draft Report	Rev A	For review by client	P Molinari / D Panickar / R Banks	Electronic (email)	23 Sept 2016
Draft Report	Rev B	For review by client	P Molinari / D Panickar / R Banks	Electronic (email)	25 Nov 2016
Draft Report	Rev 0	For review by client	P Molinari / D Panickar / R Banks	Electronic (email)	30 Nov 2016

Filename: SPG16422_01 R001 Rev C0 - 30 November 2016

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1. Introduction

1.1 Background

Satterley Property Group (Satterley) is proposing a residential development on Lot 9029 (Plan 407811), part Lot 9006 (Plan 70124), part Lot 9002 (Plan 69132), part Lot 11 (Plan 76538), Mandogalup (the project area). SPG has commissioned Strategen to prepare a Bushfire Management Plan (BMP) in support of their Mandogalup East Local Structure Plan (MELSP) application prior to subsequent subdivision and development to demonstrate bush fire risk is not a limiting factor to development approval. The Structure Plan concept plan is depicted in Figure 1.

The majority of the project area is designated as bushfire prone on the WA *Map of Bush Fire Prone Areas* (DFES 2016) due to the extent of on-site and adjacent vegetation. As a result, Strategen has prepared this Bushfire Management Plan (BMP) to inform strategic planning and fulfil the following key objective:

1. Accompany the proposed Structure Plan submission made to Western Australian Planning Commission (WAPC) in order to meet planning requirements triggered under *State Planning Policy 3.7 Planning in Bushfire-Prone Areas* (SPP 3.7; WAPC 2015a).

The following information is required as part of this BMP to address SPP 3.7 Policy Measure 6.3:

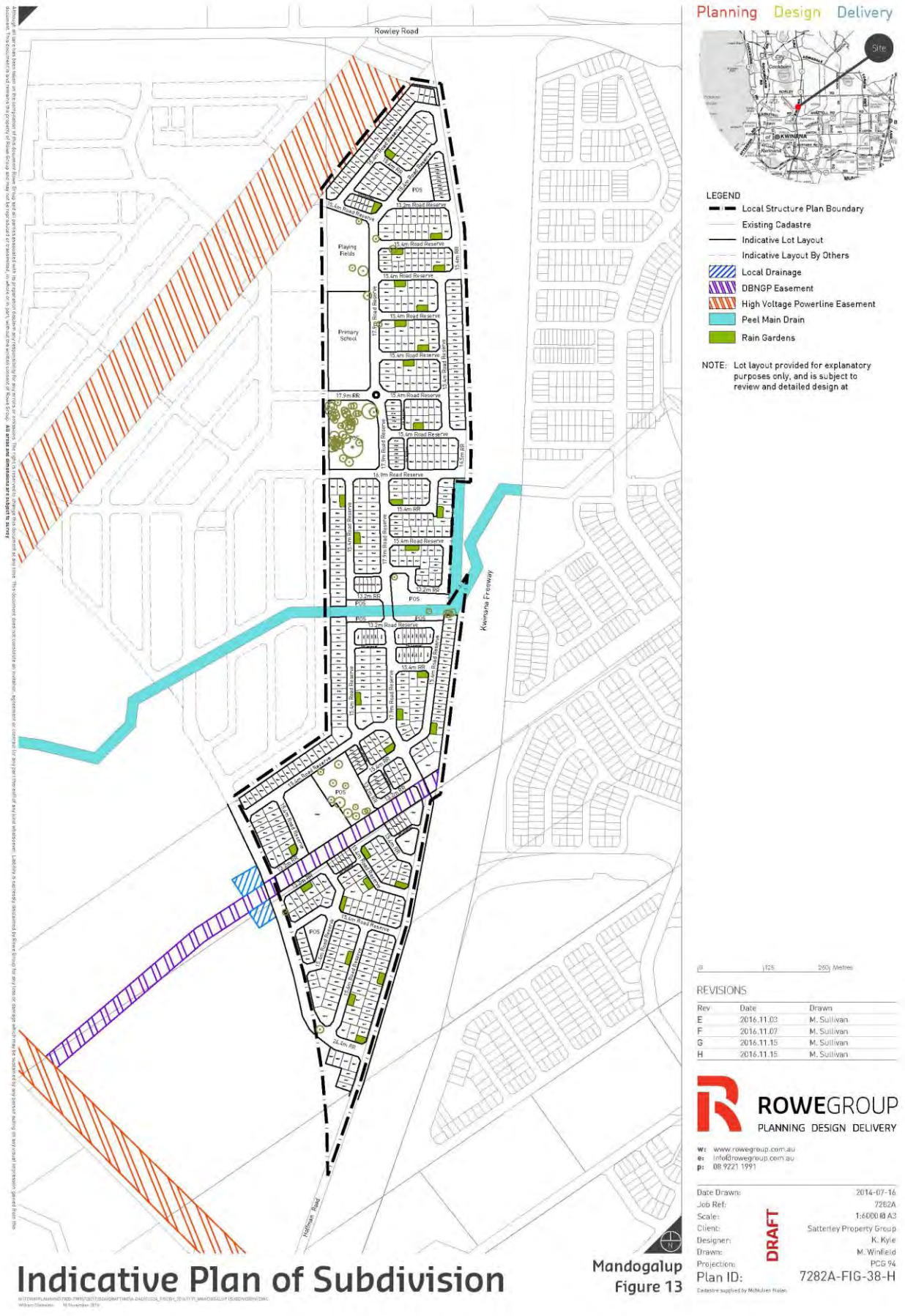
- results of a Bushfire Hazard Level (BHL) assessment determining the applicable hazard level(s) across the subject land in accordance with methodology set out in the Guidelines – refer to Section 2.3 and
- Figure 4
- identification of any bushfire hazard issues arising from the relevant assessment – refer to Section 2
- clear demonstration that compliance with the bushfire protection criteria in the Guidelines can be achieved in subsequent planning stages – refer to Section 3 and Table 4.

This BMP has been prepared in accordance with the Guidelines and addresses all of the above information requirements to satisfy SPP 3.7 specific to the strategic planning stage for this project.

Strategen also acts on behalf of Qube Property Group in regard to the adjacent Mandogalup West Local Structure Plan (MWLSP). We confirm the assessment and outcomes of the BMP's for both the MELSP and MWLSP are consistent and compatible.

1.2 Purpose and application of the plan

The purpose of this BMP is to provide strategic level guidance on how to plan for and manage the bushfire risk to future assets of the project area through a commitment to implement a range of bushfire management measures at future planning stages. The BMP outlines how future on-site assets can be protected during the summer months when the threat from bushfire is at its peak. This is particularly relevant when existing fire appliances in the area may be unable to offer an immediate emergency suppression response; therefore, development planning and design should aim to provide mitigation strategies that protect future life and property from bushfire as a priority.



Source: Rowe Group 2016

Figure 1: Structure Plan Concept

2. Spatial consideration of bushfire threat

2.1 Existing site characteristics

2.1.1 Location

The project area occupies approximately 42.67 ha and is contained within Lot 9029 (Plan 407811), part Lot 9006 (Plan 70124), part Lot 9002 (Plan 69132), part Lot 11 (Plan 76538) in the City of Kwinana (CoK, Figure 2). The project area also includes the following infrastructure corridors:

- Western Power overhead power line easement orientated northeast-southwest adjacent to the northwest boundary of the project area
- Peel Main Drain easement orientated east-west through the central portion of the project area.
- Dampier to Bunbury Natural Gas Pipeline orientated northeast-southwest adjacent through the southern portion of the project area.

The project area is bound by the following, as depicted in Figure 2:

- bushland including a high voltage powerline easement Rowley Road to the north
- agricultural land to the west
- road reserve bushland, Hoffman road and Kwinana freeway to the east
- agricultural land, road reserve bushland, Hoffman road and Kwinana freeway to the south.

Another development company is proposing a large subdivision to the west of the project area, comprising the MWLSP. The progression of that subdivision will result in land to the west of the project area being cleared for development.

2.1.2 Zoning and land use

The site is currently zoned as a combination of 'Development' and 'Rural A' under the CoK Town Planning Scheme No. 2 (TPS 2). The site is zoned 'Urban' and 'Urban Deferred' under the MRS. These zoning classifications are suitable to progress proposed development as per the Structure Plan.

The project area currently consists of the following land uses:

- undeveloped and fully vegetated land to the north of the Peel Main Drain
- predominantly cleared land with partial retention of vegetation south of the Peel Main Drain. The cleared land was previously used for agriculture and equine training.

Clearing and development within the project area and adjacent landholdings to the west will eventually result in a densely populated urban area accompanied by gradual removal of the vegetation extent and associated bushfire risk. However, this means that bushfire management measures will need to be implemented to manage the bushfire risk from temporary vegetation during development staging within the project area and adjacent development sites.

2.1.3 Assets

There are currently no existing life, property or infrastructure assets within the project area with the exception of small amounts of degraded fencing. Proposed urban development will significantly intensify these critical assets by increasing the number of residents, visitors and built assets across the project area. The underground Dampier to Bunbury Gas Pipeline traverses the southern portion of the project area.

2.1.4 Access

The project area is currently accessed via a formal entry off Hoffman road to the east (southern half of the project area) and informally (dirt tracks and firebreaks) via Rowley road to the north.

2.1.5 Water and power supply

The project area is not currently connected to reticulated mains water or power supplies by virtue of the undeveloped nature of the site. Strategen understands reticulated water and underground power supply provisions will be available to the project area through extension of existing services adjacent to the project area.

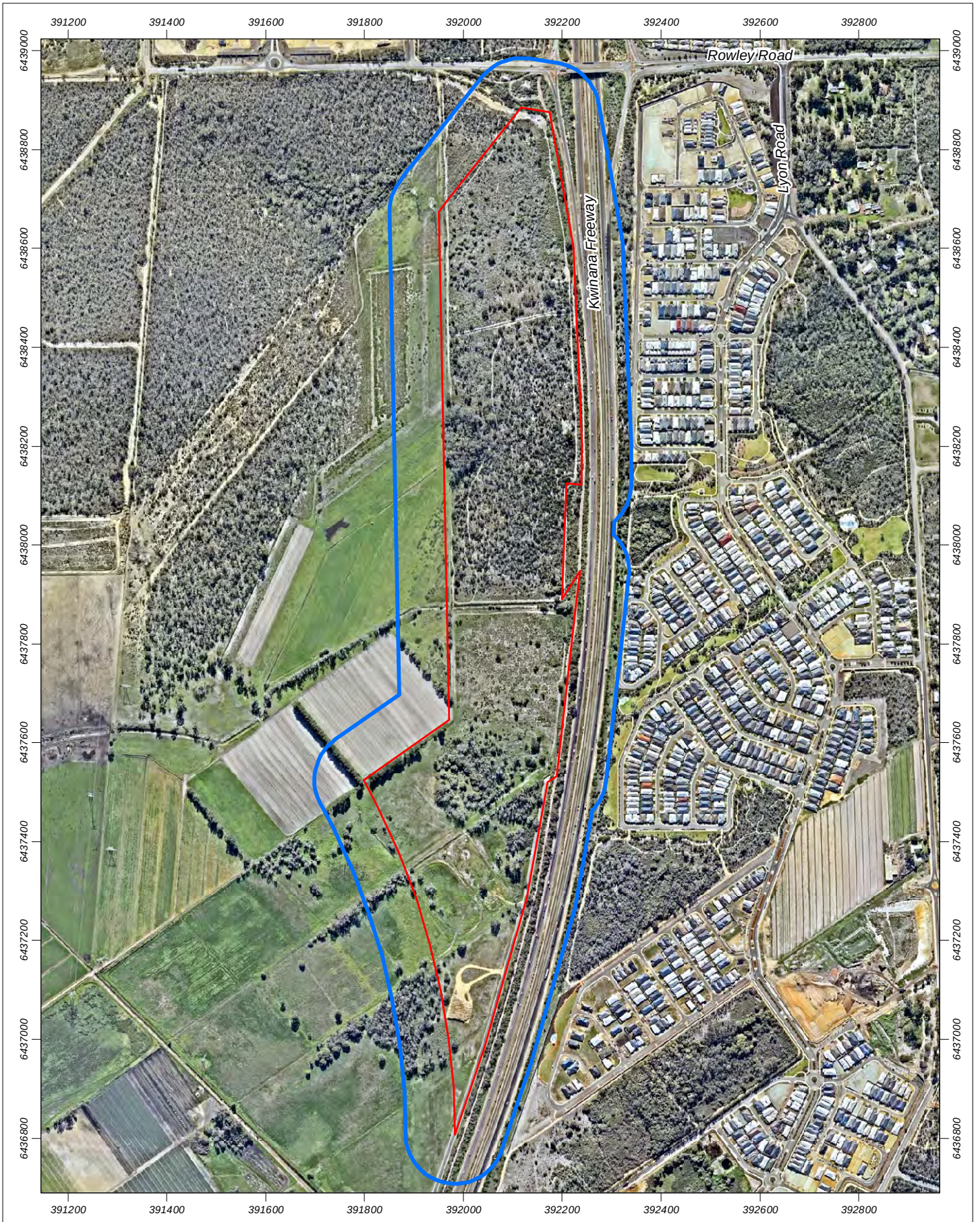


Figure 2: Site overview

Scale 1:10,327 at A4

0 50 100 150 200 250 m

N

Legend

- Project area
- 100m wide assessment area

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 24/11/2016
Author: DWhite
Source: Aerial: Nearmap, flown 06/2016; Boundary: Client 09/2016.

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2.2 Existing fire environment

2.2.1 Vegetation class

Strategen assessed the pre-development vegetation classes present within the project area and adjacent 100 m through on-ground site investigation on 15 September 2016. Strategen has ensured consistency with vegetation classification outlined in the Qube Residential Estate BMP.

The project area currently comprises a mixture of forest, woodland, shrubland, scrub and grassland vegetation. Land within the surrounding 100 m currently contains a mixture of forest, woodland, shrubland, scrub and grassland vegetation associated with the surrounding agricultural land uses to the west and south and road reserve vegetation (Kwinana Freeway) to the east. Additionally, non-vegetated areas associated with Hoffman road, Kwinana freeway, Rowley road and a cycle path also exist within the 100 m of land to the east of the project area.

Vegetation within the project area and surrounding 100 m of land is currently comprised of the following vegetation classes assessed in accordance with methodology contained within *AS 3959–2009 Construction of Buildings in Bushfire-Prone Areas* (AS 3959; SA 2009) and the *Visual Guide for Bushfire Risk in Western Australia* (DoP 2016):

- Class A forest vegetation (Plate 1, Plate 2)
- Class B woodland vegetation (Plate 3, Plate 4, Plate 14)
- Class C shrubland vegetation (Plate 2, Plate 5)
- Class D scrub vegetation (Plate 6, Plate 7, Plate 8)
- Class G grassland vegetation (Plate 9, Plate 10, Plate 11)
- exclusions under Clause 2.2.3.2 (f) of AS 3959–2009) (Plate 12, Plate 13).

Vegetation classes as described above and photograph locations and direction (Plate 1–Plate 14) are depicted in Figure 3.

Strategen emphasises that the majority of current vegetation within the project area and land within 100 m to the west of the project area (as part of a separate development) will be cleared. Consequently, a reassessment of vegetation classes will be included in subsequent BMPs which will be prepared at the subdivision application stage or development application stage of planning. A 3 m wide firebreak is also proposed to be constructed along the eastern boundary of the project area which will result in some of the current vegetation being cleared.

2.2.2 Effective slope

Strategen has assessed site topography and effective slope under classified vegetation within the project area and adjacent 100 m through on-ground verification in accordance with AS 3959-2009 (Figure 3).

The project area has a low, gently undulating topography ranging from 12 mAHD in the southwest to 28 mAHD in the north. Topography within the 100 m of land surrounding the project area is consistent with the project area in that land to the west of the project area is down-slope at an angle between 0–5 degrees, while land to the north and east is either flat or upslope at an angle of 0–5 degrees. Effective slope under classified vegetation within 100 m of the project area is displayed in Figure 3.

The indicative concept structure plan also contains numerous areas of public open space (POS). As the landscape concept plans for the POS areas are not yet finalised, the worst case bushfire scenario has been used. This approach is consistent with precautionary principle outlined in the Guidelines. For the purposes of this BMP, a slope under vegetation of down-slope 0–5 degrees relative to proposed lots has been used for the POS areas.

Strategen reiterates that a revised BMP will be required to support future planning stages once the lot layout has been finalised and the landscaping plans for the POS area is known, at which stage the effective slope under any classified vegetation within the project area will be reassessed.

The following information summarises the slope characteristics under the classified vegetation to inform the BAL assessment outlined in Section 2.5 and displayed in Figure 5:

- slope under vegetation to the west and south of the project area is down-slope at an angle between 0–5 degrees relative to the proposed lots
- slope under vegetation to the west and south of the project area is either flat or upslope relative to the proposed lots
- slope under vegetation along the eastern and northern boundaries of the POS areas is either flat land or upslope relative to the proposed lots
- slope under vegetation along the western and southern boundaries of the POS areas is down-slope at an angle of 0–5 degrees relative to proposed.

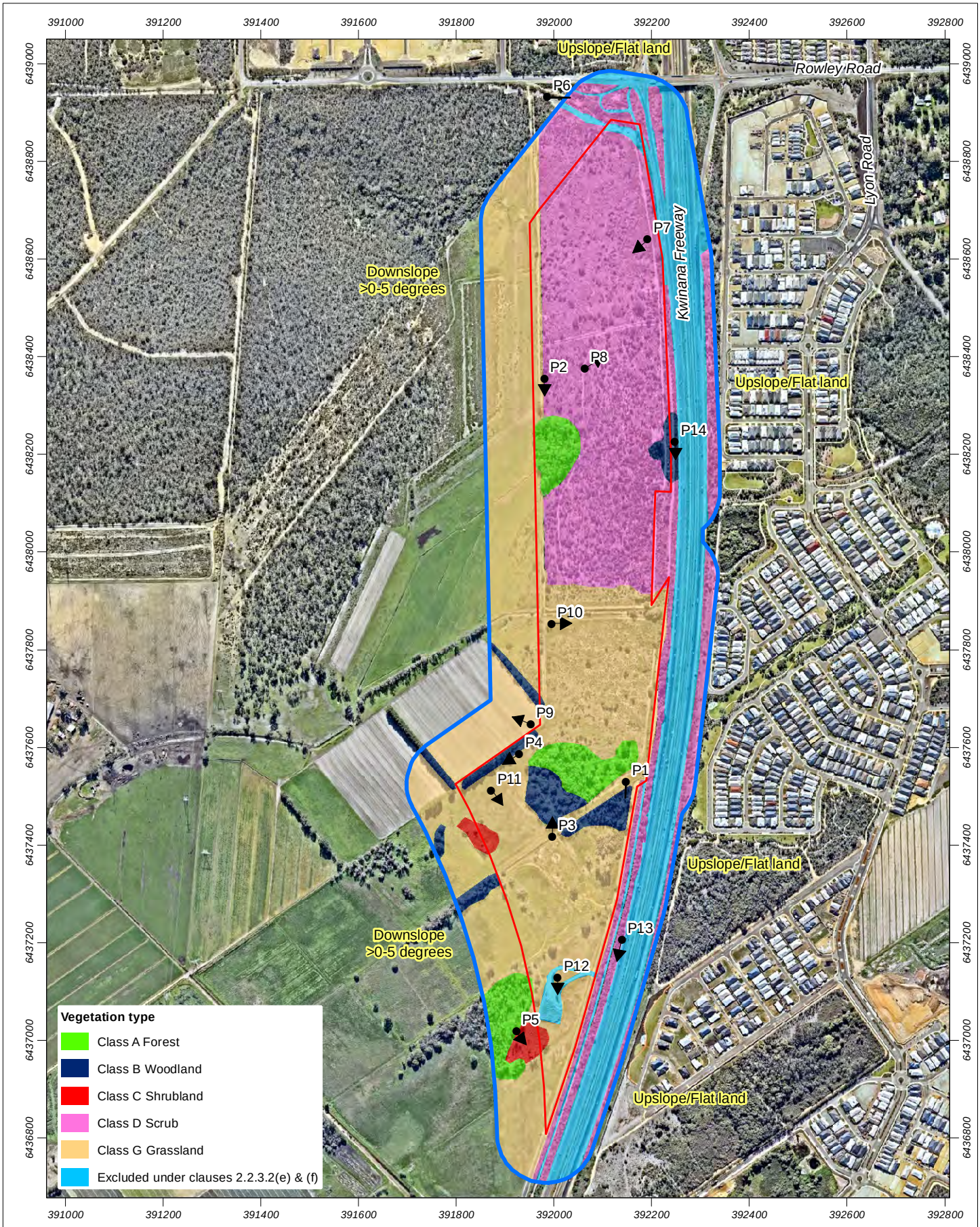

Figure 3: Vegetation class and effective slope

Scale 1:10,500 at A4

0 50 100 150 200 250 m

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 24/11/2016
Author: DWhite
Source: Aerial: Nearmap, flown 06/2016; Boundary: Client 09/2016.

Legend

- Photo location and direction
- Project area
- 100m wide assessment area

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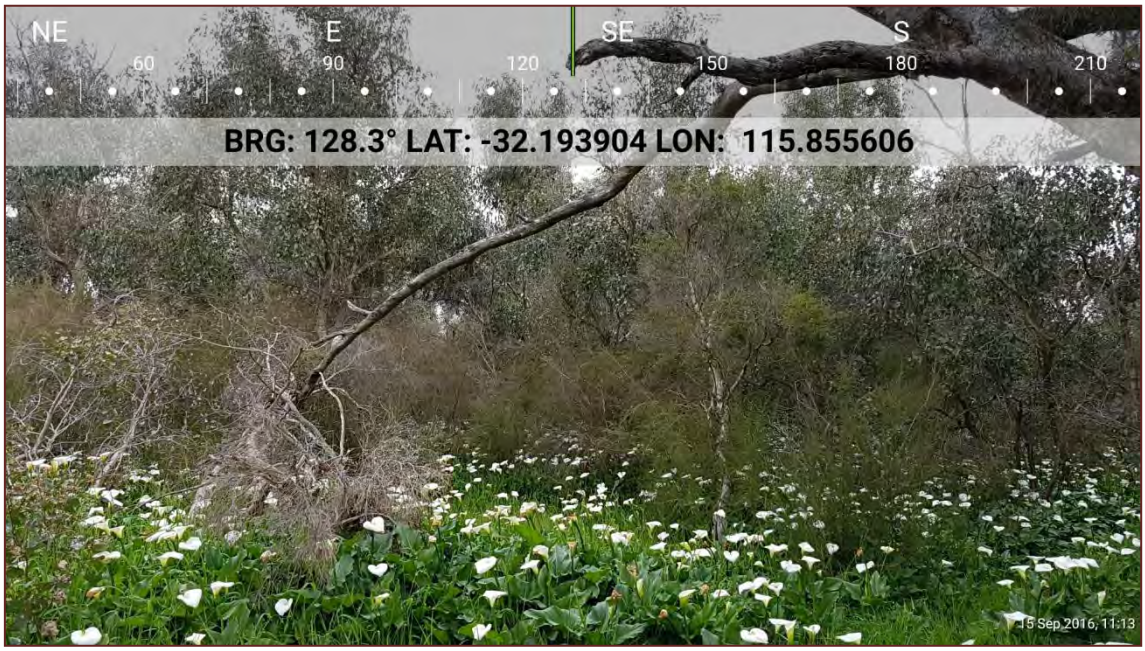

Plate 1: Photo Point 1: Class A forest vegetation

Plate 2: Photo Point 2: Class A forest vegetation (background) and Class C shrubland (foreground)

Plate 3: Photo Point 3: Class B woodland vegetation (background)

Plate 4: Photo Point 4: Class B woodland vegetation

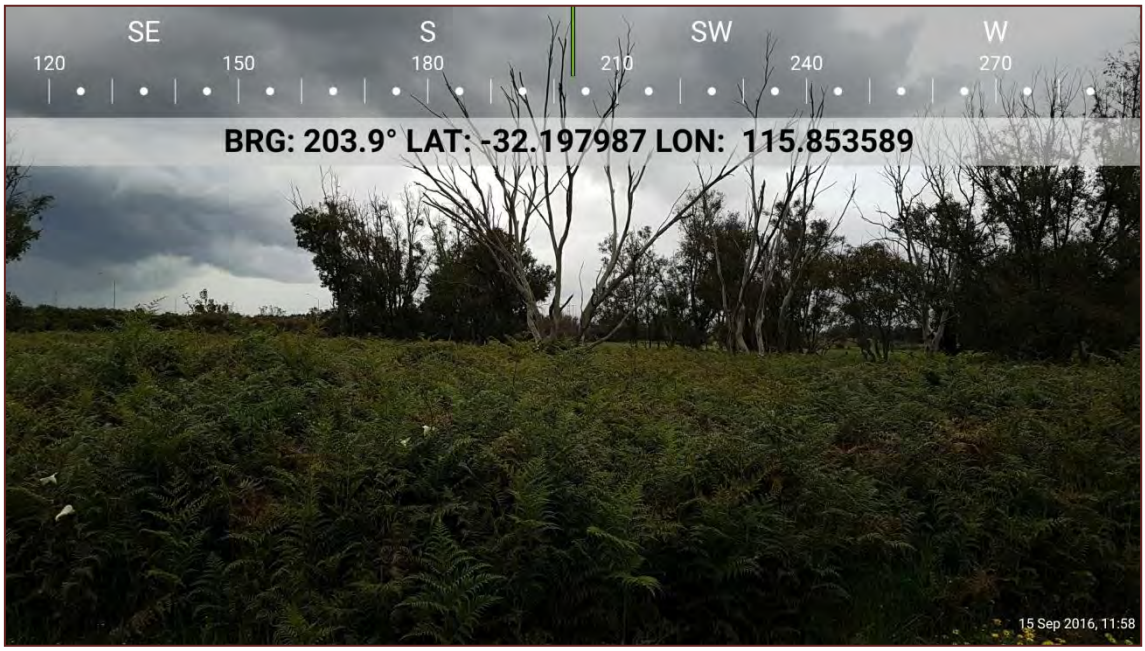

Plate 5: Photo Point 5: Class C shrubland vegetation

Plate 6: Photo Point 6: Class D scrub vegetation

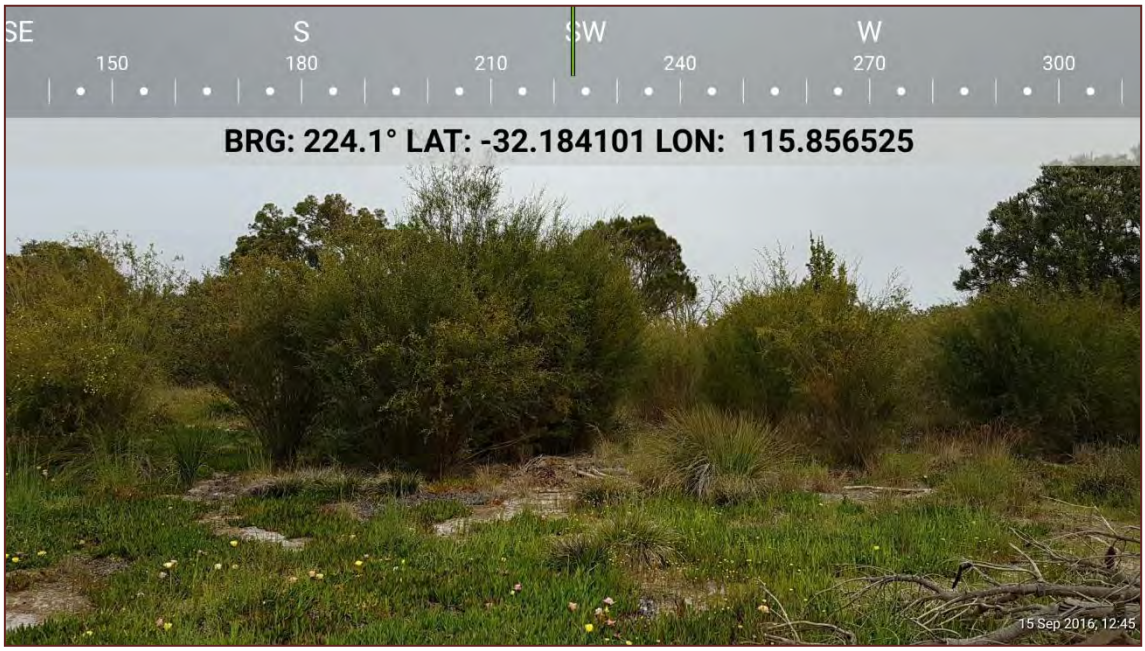

Plate 7: Photo Point 7: Class D scrub vegetation

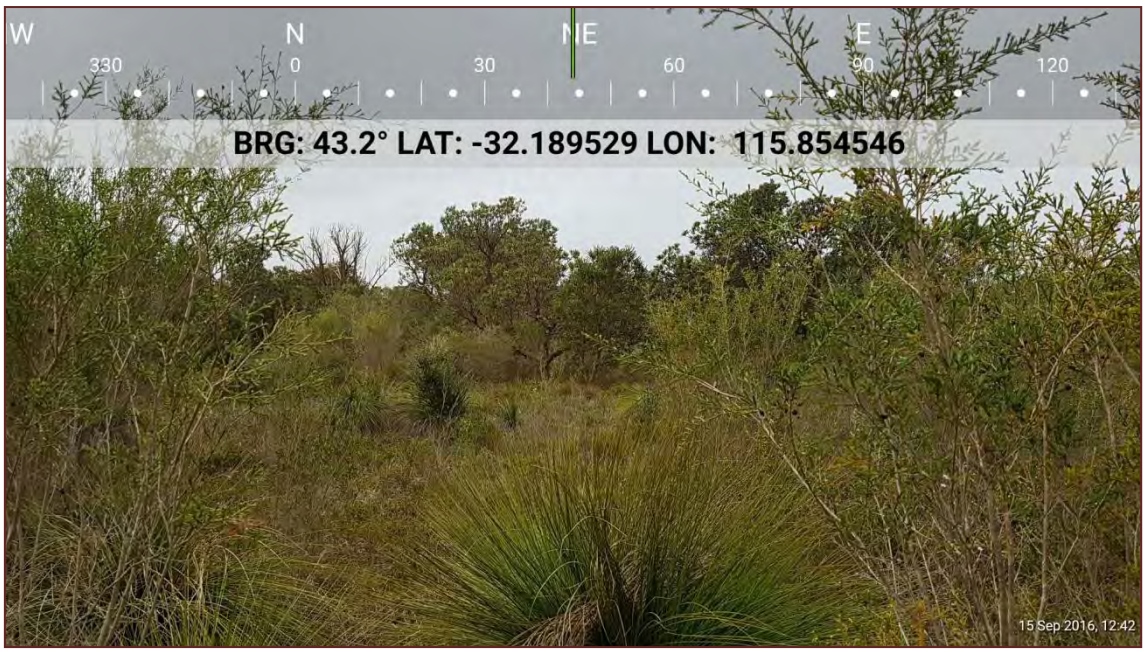

Plate 8: Photo Point 8: Class D scrub vegetation

Plate 9: Photo Point 9: Class G grassland vegetation

Plate 10: Photo Point 10: Class G grassland vegetation

Plate 11: Photo Point 11: Class G grassland vegetation

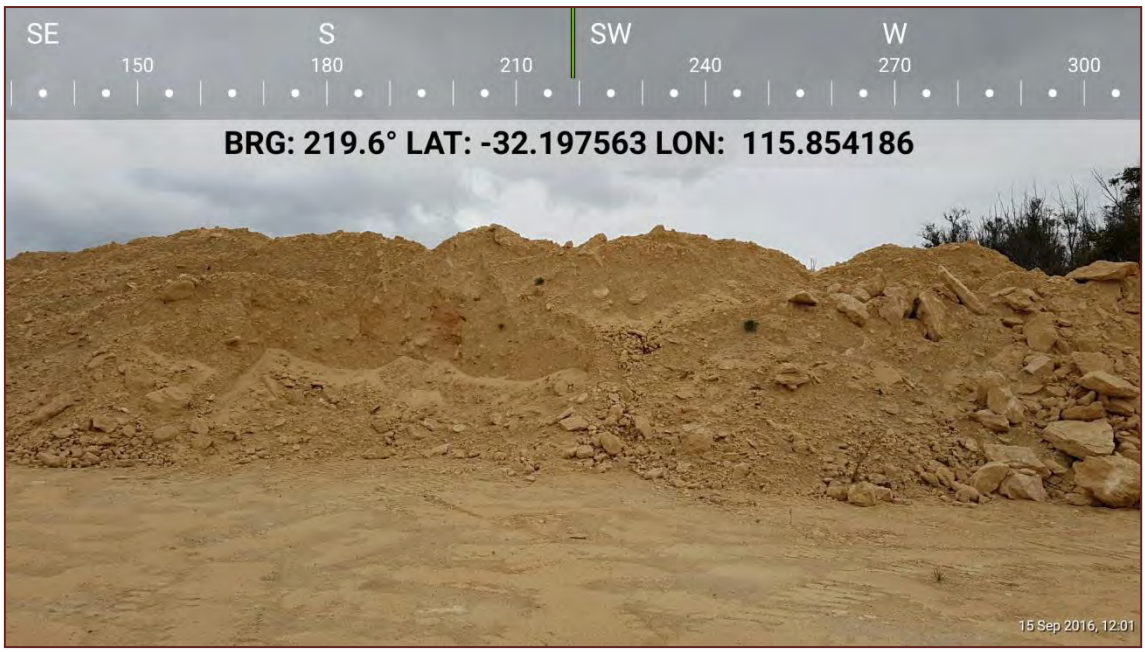

Plate 12: Photo Point 12: excluded from classification under Clause 2.2.3.2 (e) of AS 3959–2009

Plate 13: Photo Point 13: excluded from classification under Clause 2.2.3.2 (e) of AS 3959–2009

Plate 14: Photo Point 14: the Kwinana Freeway bike path excluded from classification under Clause 2.2.3.2 (e) of AS 3959–2009 (Class B Woodland vegetation either side)

2.2.3 2.2.3 Bushfire weather conditions

Worst case bushfire weather conditions

Southwest Western Australia generally experiences a cool to mild growing season in the months of August through to November of each year, followed by four months of summer drought conditions, which is when the potential for bushfire occurrence is at its peak. Worst case (adverse) bushfire weather conditions can occur during this dry period when a low pressure trough forms off the west coast and strong winds develop from the north or northeast. These conditions are sometimes associated with 'Extreme' or 'Catastrophic' fire dangers, which are consistent with very high temperatures, low relative humidity and very strong winds. Based on the predominant summer climatic conditions of the local area, 'Extreme' and 'Catastrophic' fire dangers normally occur less than 5% of the time during the designated bushfire season, which equates to around six days between December and March (McCaw & Hanstrum 2003).

Predominant bushfire weather conditions

Predominant bushfire weather conditions are those that occur 95% of the time during the designated bushfire season. For Mandogalup, these generally correlate with average January climatic conditions.

Mean January 9:00 am and 3:00 pm wind profiles for Medina Research Centre (approximately 4.5 km southwest of the project area) are contained in Appendix 1. These illustrate that the predominant winds during the designated bushfire season are from the east and southeast in the morning averaging around 12.7 km/h and from the southwest in the afternoon averaging around 20.8 km/h (BoM 2016).

Mean January 9:00 am and 3:00 pm relative humidity for Medina Research Centre is approximately 53% and 42% respectively, with the January mean maximum temperature peaking at around 30.9°C (BoM 2016). The predominant bushfire weather conditions discussed above correlate with an average Fire Danger Index (FDI) rating of 'High', as determined using the Commonwealth Science and Industrial Research Organisation (CSIRO) Fire Danger and Fire Spread Calculator (CSIRO 1999).

2.2.4 Bushfire history, fuel age, risk of ignition and potential ignition source

Bushfire history in the project area is infrequent and there is a lack of recent fire evidence over the majority of the project area; however, recent bushfires in the Perth Hills in 2011 and Stoneville/Parkerville in 2013 have highlighted the need to consider bushfire planning in future developments in the metropolitan region.

Available fuel loads within areas of classified vegetation are patchy and inconsistent due to variations in vegetation density, litter depth and trash height.

Since most bushfires in developed to semi-developed areas are ignited by humans; the current ignition risk is low due to the low levels of residency, public access and visitation throughout the site and surrounding rural landholdings. However, Strategen considers that the ignition risk, particularly within the project area, may increase following development intensification and increased levels of public access and resident occupancy at the bushland interface.

The potential sources of ignition in the area are expected to be from:

- deliberately lit fire (i.e. arson)
- lightning strike
- accidental causes, such as vehicle accidents and sparks from vehicle exhausts/machinery
- escapes from fuel hazard reduction burning
- pole-top fires
- incorrect disposal of cigarettes.

2.3 Bushfire hazard level assessment

Bushfire hazard levels have been assessed for this site in accordance with methodology contained within the Guidelines. Strategen has mapped the bushfire hazard levels within the project area and adjacent 100 m as per the pre-development conditions discussed in Section 2.2.1 and Section 2.2.2. A summary of results is provided below and depicted in Figure 4:

- all areas of Class A forest represent an extreme bushfire hazard level
- all areas of Class B woodland represent moderate bushfire hazard levels with the exception of one pocket adjacent to Class A forest vegetation in the centre of the project area, which represents an extreme bushfire hazard level
- all areas of Class D scrub represent moderate bushfire hazard levels
- all areas of Class G grassland vegetation represent moderate bushfire hazard levels
- all areas that are currently excluded from classification under Clause 2.2.3.2 (d), (e) and (f) of AS 3959 represent low bushfire hazard levels
- all areas located within 100 m of moderate or extreme bushfire hazards areas represent a moderate bushfire hazard level by default to reflect the increased level of risk and 100 m wide Hazard Separation Zone (HSZ) requirements (WAPC 2015b).

2.4 Identification of bushfire hazard issues

Strategen considers that the worst case bushfire scenario that could affect future assets of the project area is from the temporary vegetation currently existing to the northwest of the project area (proposed to be developed as part of a neighbouring development). A head fire approaching the project area from the west under standard afternoon summer conditions is expected to exhibit elevated levels of radiant heat and ember attack by virtue of the relatively long fire run through intact Banksia woodland vegetation on undulating terrain. The neighbouring lot is proposed to be developed at some future stage; however, the bushfire risk to the project area from this vegetation will need to be adequately managed until such time that this vegetation is removed. This may be achieved through delayed development, application of AS 3959/Asset Protection Zones (APZs) or provision of a temporary low fuel buffer within and along the interfacing boundary of the neighbouring property. However, since this land is not owned by Satterley, landowner agreements and clearing approval will need to be sought prior to any temporary buffer being established within the neighbouring property.

A similar issue occurs with the current grassland vegetation to the west of the project area. This land is proposed to be cleared for development as part of Qube's Residential Estate; however, in its current uncleared state, this site presents a bushfire risk to future assets of the project area. As mentioned above, the bushfire risk to the project area from this vegetation will need to be adequately managed until such time that this vegetation is removed. This may be achieved through delayed development, application of AS 3959/APZs or provision of a temporary low fuel buffer within and along the interfacing boundary of the Satterley landholdings. Formal landowner agreements and clearing approval will need to sought prior to any temporary buffer being established the neighbouring property.

The thin strips of scrub and woodland vegetation on the eastern side of Kwinana Freeway, to the east of the project area, are patchy in nature and contain very short bushfire runs. Therefore, Strategen does not consider these thin strips of vegetation to be significant bushfire hazard issues as the short fire runs will not enable a bushfire to exhibit elevated levels of radiant heat and ember attack.

The on-site vegetation extent is proposed to be cleared to enable development of a significant urban built footprint amongst areas of landscaped/managed Public Open Space (POS) and various easements. Therefore, for the purposes of strategic level planning to guide the Structure Plan process, Strategen does not consider the current on-site vegetation extent to be a bushfire hazard issue since these hazards will be managed through a staged clearing process and ongoing fuel management that will be undertaken in and around individual development stages.

On the basis of the above information, Strategen considers that the bushfire hazards within and adjacent to the project area and the associated bushfire risk is readily manageable through standard management responses and compliance with acceptable solutions outlined in the Guidelines and AS 3959. These management measures will need to be factored in to subdivision design as early as possible to ensure a suitable, compliant and effective bushfire management outcome is achieved to ensure protection of future life and property assets.

Demonstration of compliance with the relevant requirements of SPP 3.7, the Guidelines and AS 3959 at future planning stages will predominantly depend on Satterley's ability to coordinate the timing and staging of clearing and development works within the project area with those developments proposed on adjacent landholdings in the aim of avoiding bushfire impacts from temporary vegetation.

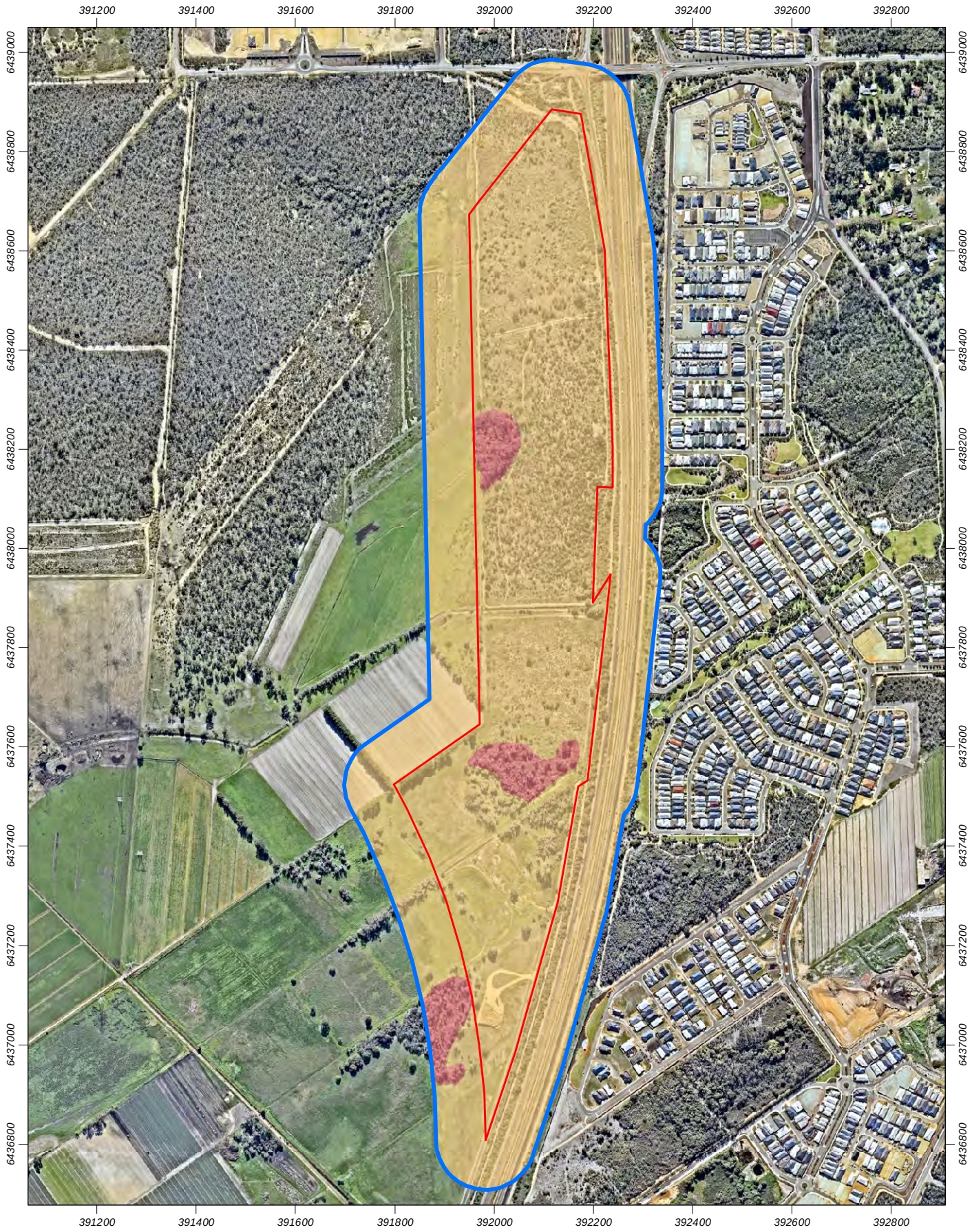

Figure 4: Bushfire hazard level assessment

Scale 1:10,500 at A4

0 50 100 150 200 250 m

N

Legend

- Project area
- 100m wide assessment area

Bushfire hazard level

- Extreme
- Moderate

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 24/11/2016
Author: DWhite
Source: Aerial: Nearmap, flown 06/2016; Boundary: Client 09/2016.

Path: Q:\Consult\2016\SPG\SPG16422\ArcMap_documents\R001\Rev0\SPG16422_01_R001_Rev0_F004.mxd

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2.5 BAL assessment

Vegetation with a 'Moderate' or 'Extreme' bushfire hazard level is considered bushfire prone and any proposed development within 100 m of the bushfire prone vegetation extent will require application of Australian Standard *AS 3959–2009 Construction of Buildings in Bushfire-prone Areas* (SA 2009) via implementation of increased building construction standards in response to the assessed Bushfire Attack Level (BAL).

In anticipation of the project area being largely cleared for the development, the BAL assessment has been completed using the most recent indicative plan of subdivision to provide an indication of the overall fire risk to the proposed subdivision. A large separate development is also forecast to be developed on the land to the west of the project area, comprising the MWLSP. Although this will result in that land being predominantly cleared, it is yet to commence and therefore the classified vegetation on that land has been included in the BAL assessment. The BAL contours will be reassessed during future planning stages.

The indicative plan of subdivision also contains numerous areas of public open space (POS). As the concept plan for the POS is not yet finalised, the worst case bushfire scenario has been used. This approach is consistent with precautionary principle outlined in the Guidelines. For the purposes of this BMP, the current remnant vegetation present in the POS areas and a slope under vegetation summarised in Section 2.5.3 has been used for the BAL assessment. The resulting BALs surrounding these areas of POS will be reassessed as landscaping plans are finalised during future planning stages.

As the current Structure Plan Concept Plan Stands (Figure 1), POS area 2 is proposed to be utilised as playing fields. These playing fields will consist of lawn and will be reticulated and managed in a low fuel state. This is consistent with Clause 2.2.3.2 (f) of AS 3959–2009 and subsequently POS 2 has not been classified as a bushfire threat.

As the vegetation currently exists, POS area 6 has been assessed as containing classified vegetation. As the subdivision to the west of the project area progresses, vegetation will be cleared to enable development. POS area 6 is less than 1 ha in size and once the vegetation to the west has been cleared will not be within 100 m of other areas of vegetation being classified. Consequently, post clearing to the west of the project area, POS area 6 will be excluded from classification under Clause 2.2.3.2 (b) of AS 3959–2009. While currently shown as containing classified vegetation in this BAL assessment, the BAL contours for POS area 6 will be reassessed during future planning stages.

The indicative structure plan also details areas containing rain gardens. These are areas of drainage and will be planted using fire retardant species (e.g. Lomandra and Cacti) and will be separated by crushed rock mulch. These areas will be managed in perpetuity in a low fuel state and subsequently these areas have been classified in this BAL assessment as low threat in accordance with Clause 2.2.3.2 (f) of AS 3959–2009.

Based on the current extent of vegetation, a number of the proposed development areas will be located within 100 m of vegetation assessed as having an 'Extreme' or 'Moderate' bushfire hazard level, which will require a BAL response in accordance with AS 3959–2009 (Figure 5). This is largely consistent with findings of the *WA State Map of Bush Fire Prone Areas*.

The Method 1 procedure for calculating the BAL (as outlined in AS 3959–2009) incorporates the following factors:

- state-adopted FDI rating
- vegetation class
- slope under classified vegetation
- distance maintained between proposed development areas and the classified vegetation.

Based on the specified BAL, construction/separation requirements for proposed buildings can then be assigned.

2.5.1 Fire Danger Index

A blanket rating of FDI 80 is adopted for Western Australian environments, as outlined in AS 3959–2009 and endorsed by Australasian Fire and Emergency Service Authorities Council.

2.5.2 Vegetation class

Vegetation class is described in Section 2.2.1 and depicted in Figure 3 and consists of forest (Class A), woodland (Class B), shrubland (Class C), scrub (Class D) and grassland (Class G). Where BAL contours differ based on the different BAL application distances associated with the two vegetation classifications, the highest BAL has been applied (e.g. BAL 12.5 in Class B woodland vs. BAL 19 in Class C shrubland – BAL 19 would be the end result).

2.5.3 Slope under classified vegetation

Slope under classified vegetation is assessed in Section 2.2.2, with a summary provided as follows on the basis of the surface elevations depicted in Figure 3:

- slope under vegetation to the west and south of the project area is down-slope at an angle between 0–5 degrees relative to the proposed lots
- slope under vegetation to the west and south of the project area is either flat or upslope relative to the proposed lots
- slope under vegetation within the POS areas is down-slope at an angle between 0–5 degrees relative to the proposed lots.

2.5.4 Distance between proposed development areas and the classified vegetation

Strategen has assessed and identified the separation distances between future buildings and the classified vegetation extent, as summarised in Table 1.

2.5.5 Method 1 BAL calculation

A Method 1 BAL calculation has been completed for each proposed lot in accordance with AS 3959–2009 (Table 1). The BAL rating gives an indication of the level of bushfire attack (i.e. the radiant heat flux) that may be received by the proposed dwelling and subsequently informs the standard of building construction required for that dwelling to withstand such impacts.

The proposed development site is totally cleared, with the exception of the POS areas, to enable development of a significant built and landscaped footprint.

With the vegetation in its current pre-development state, a portion of the development site will be located within 100 m of vegetation assessed as having an ‘Extreme’ or ‘Moderate’ bushfire hazard level, which will require implementation of AS 3959–2009 and increased building construction standards for proposed built assets (refer to Figure 5). Strategen reiterates that this is subject to change pending clearing for adjacent development and the finalisation of the lot layout and POS design. The current ‘Extreme’ bushfire hazard applies to all Class A forest vegetation and an area of Class B woodland vegetation adjacent to forest vegetation in the centre of the project area. The ‘Moderate’ bushfire hazard applies to the remaining classified vegetation. Vegetation to the south, west and within the POS areas is located down-slope of the project area, while vegetation to the north and east is located at equal elevation or upslope to the project area. Vegetation within the project area has been classified as being down-slope of the project area as a precaution.

BALs for proposed built assets within 100 m of this vegetation are outlined in Table 1. The resulting hazard separation distances around dwellings will be provided in the form of Asset Protection Zones (APZs).

Table 1: Determination of Bushfire Attack Level

Vegetation class	Bushfire attack level (BAL)				
	BAL FZ	BAL 40	BAL 29	BAL 19	BAL 12.5
	Distance (m) of the site from the predominant vegetation class				
Vegetation is down-slope (>0 to 5 degrees)					
Class A Forest	<20 m	20–<27 m	27–<37 m	37–<50 m	50–<100 m
Class B Woodland	0–<13m	13-<17m	17–<25m	25–<35m	35–<100m
Class C Shrubland	0–<7m	7–<10m	10–<15m	15–<22m	22–<100m
Class D Scrub	0–<11 m	11–<15 m	15–<22 m	22–<31 m	31–<100 m
Class G Grassland	0–<7 m	7–<9 m	9–<14 m	14–<20 m	20–<50 m
Vegetation is upslope or on flat land (0 degrees)					
Class B Woodland	0–<10	10-<14	14–<20	20–<29	29–<100
Class D Scrub	<10 m	10–<13 m	13–<19 m	19–<27 m	27–<100 m

Note: Distances between proposed lots and vegetation classified as bushfire prone have been provided as a range as the final lot design is yet to be determined

3. Bushfire management measures

This BMP has been prepared as a strategic guide to demonstrate how development compliance will be delivered at future planning stages in accordance with the Guidelines. In this respect, Strategen has outlined a range of bushfire management measures that Satterley will need to commit to implementing at future planning stages once an adequate level of detail is available to confirm the location and design of such measures.

Strategen considers that on implementation of the proposed management measures outlined in the following subsections, the project area will be able to be developed with a manageable level of bushfire risk whilst maintaining full compliance with the Guidelines and AS 3959.

3.1 Separation distances and fuel management

3.1.1 Asset Protection Zones (APZs)

Asset Protection Zones (APZs) will be implemented at all interfaces where proposed development abuts classified vegetation to ensure future assets are afforded an appropriate level of low fuel defendable space to prevent development in high risk areas such as BAL–FZ and BAL–40.

The width of the APZ should be sufficient enough for proposed development areas to achieve a Bushfire Attack Level (BAL) of BAL–29 or lower, which will meet compliance with acceptable solutions A1.1 and A2.1. There are a couple of lots that do have areas with BAL FZ or BAL 40 ratings within them; however, these lots are adjacent to areas of land that are proposed to be cleared for future development or landscaped as part of POS. No development will occur in any area with a BAL FZ or BAL 40 rating which will be confirmed at a later stage of planning when landscape plans and neighbouring development has progressed.

The potential range of APZ widths relevant to the project area are provided in Table 2 and the final alignment and width of the APZ will depend on the class and effective slope of the interfacing vegetation.

Table 2: Potential range of APZ widths relevant to the project area

Classified vegetation	Effective slope	Minimum APZ width to achieve BAL–29 or lower
Class A forest	Down-slope >0 to 5 degrees	27 m
Class B woodland	Up-slope and flat land	14 m
	Down-slope >0 to 5 degrees	17 m
Class C shrubland	Down-slope >0 to 5 degrees	10 m
Class D scrub	Up-slope and flat land	13 m
	Down-slope >0 to 5 degrees	15 m
Class G grassland	Down-slope >0 to 5 degrees	9 m

The fuel load throughout the APZ is required to be maintained at less than 2 tonnes per hectare on a regular and ongoing basis (e.g. through regular slashing and weed control). Individual trees can be retained within the APZ; however, a minimum of 10 m separation between tree canopies is generally required. APZs are required to meet the criteria for low threat vegetation managed in a minimal fuel condition in accordance with Clause 2.2.3.2 (f) of AS 3959 and this can be achieved most effectively through the use of one or a combination of the following:

- existing/proposed sealed roads and managed road verges (roads can be most effective for use within an APZ as they also provide public and emergency access at the vegetation interface)
- regularly managed/landscaped lawns, gardens or low fuel/managed Public Open Space (POS)
- other sealed areas including driveways and car parks
- building setbacks.

No buildings are permitted within the APZ. The alignment and width of APZs for this site will be determined once lot layout is finalised. Strategen reiterates that no development will occur within areas of BAL FZ or BAL 40 which will be confirmed via an updated BMP or BMP addendum prepared to accompany the development application or subdivision application where appropriate.

3.1.2 Hazard Separation Zones (HSZs)

Formal HSZs in accordance with acceptable solution A 2.2 of the Guidelines will not be required around APZs for this site since the APZs will be sufficient enough for proposed development to achieve a rating of BAL–29 or lower and building construction within each proposed lot will meet the standard appropriate to the BAL for that location (WAPC 2015b).

3.1.3 On-site staging buffers

Should proposed development be staged across the site then vegetation clearing will occur throughout the project area on a staged basis and in advance where necessary to ensure building construction is not inhibited by a temporary vegetation extent located on an adjacent development stage that is yet to be cleared. This can be achieved by ensuring each approved stage subject to construction is surrounded by a 100 m wide, on-site cleared or low threat vegetation buffer prior to development (not including any vegetation proposed to be retained). Once the buffers are created, they will need to be maintained on a regular and ongoing basis at a fuel load less than 2 t/ha to achieve a low threat minimal fuel condition all year round until such time that the buffer area is developed as part of the next development stage. This will manage the bushfire risk from on-site temporary vegetation during development staging. This measure will be confirmed following confirmation of proposed lot layout and development staging provisions (if proposed) and if required, will be documented in a brief addendum to this BMP to accompany the structure plan or subdivision application where appropriate.

3.1.4 Temporary buffers to adjacent landholdings

Should development stages be constructed prior to removal of bushfire hazards on adjoining landholdings (i.e. to the west), then one or a combination of the following options will need to be implemented prior to construction to ensure development is not situated within BAL–FZ or BAL–40 areas and a sufficient APZ can be established:

- delay development in those areas subject to BAL–FZ and BAL–40 until such time that the adjacent hazard is removed and a rating of BAL–29 or lower can be achieved for all proposed lots
- establish a temporary APZ within and along the boundary of the project area at the vegetation interface to enable development to occur in areas of BAL–29 or lower and ensure development is excluded within areas of BAL–FZ and BAL–40 (the APZ is to be managed on a regular basis until such time that the adjacent hazard is removed [this measure is intrinsically linked to the above point])
- create a temporary cleared or low fuel managed buffer managed on a regular basis within and along the interfacing boundary of the adjacent landholdings to enable a rating of BAL–29 or lower to be achieved for all proposed lots until such time that the buffer area is developed on by the adjacent landowner (formal landowner agreements and clearing approval will need to be in place prior to establishing the temporary buffer on the adjacent landholding [a 100 m wide buffer would enable a BAL–Low rating to be achieved for all proposed lots]).

This measure will be confirmed following confirmation of proposed lot layout and development staging provisions and will be documented in a brief addendum to this BMP to accompany future subdivision applications where appropriate.

3.1.5 Fuel management within on-site POS

The location and concept for on-site POS will be determined in concert with the proposed lot layout.

Should POS areas be created that reduce the bushfire hazard to the proposed lots or nearby clearing result in POS area 6 being excluded from classification, then the BALs for the lots surrounding the POS will be reassessed. Should POS areas be created that result in retention or introduction of on-site vegetation, then these areas may trigger application of AS 3959 and require the provision of APZs and increased building construction standards for adjacent development areas.

Any subsequent bushfire management measures that need to be implemented in response to the proposed POS concept will be documented in a brief addendum to this BMP or within an updated BMP to accompany the structure plan or subdivision application where appropriate.

3.2 BAL assessment and increased building construction standards

The level of vegetation proposed to be retained on site is yet to be confirmed due to the current early stage in the planning process. In addition, the adjacent vegetation extent is likely to be modified following proposed clearing of land to the west of the project area to enable a large neighbouring development.

Once the proposed lot layout and on-site and adjacent vegetation extent is confirmed (i.e. during the subdivision design stage), BAL contours will need to be assessed to inform the indicative BAL impact over the site, as well as the necessary APZ separation requirements for proposed development areas. This process will inform those lots that require increased building construction standards.

Development design will be undertaken to ensure a rating of BAL 29 or lower is achieved by incorporating the necessary APZs discussed in Section 3.1.1, which will meet the necessary performance criteria of Element 1 and Element 2 of the Guidelines. BAL contours and APZs will be depicted in a brief addendum to this BMP or an updated BMP to accompany the subdivision application where appropriate.

3.3 Vehicular access

3.3.1 Public roads

A finalised proposed road network is not yet known; however, this will be confirmed as part of subdivision design whereby a minimum of two different vehicular access routes will be provided. An indicative fire emergency access plan has been provided to demonstrate how a minimum of two different access routes will be achieved for the development within the current indicative subdivision plan. This has been provided in Appendix 3 and demonstrates that access routes will connect to the surrounding public road network, provide safe access and egress to two different destinations and are available to all residents/the public at all times and under all weather conditions. This meets the criteria of acceptable solution A3.1 and is not seen as a significant challenge for proposed development given the extensive nature of the existing public road network surrounding the site in the form of Rowley road to the north and Hoffman road to the east which connects to Anketell Road to the south. Future development to the west will also provide potential access options.

Should any cul-de-sacs be proposed, acceptable solution A3.3 will be met to ensure the cul-de-sac/s are restricted to a maximum length of 200 m and the cul-de-sac head/s meet a minimum 17.5 m diameter. Should any battle-axe lots be proposed, acceptable solution A3.4 will be met to ensure battle-axe legs are a maximum length of 600 m and a minimum width of 6 m. Should any private driveways longer than 50 m be proposed, acceptable solution A3.5 will be met to ensure requirements of the Guidelines are complied with. No emergency access ways or fire service access routes will be proposed/required as part of the development as sufficient access will be provided through the proposed road network. A 3 m wide firebreak will be constructed adjacent t the eastern boundary of the development, in some circumstances this will be the existing cycle path/footpath.

Technical requirements for vehicular access components that may form part of proposed development will be met in accordance with Table 3. Vehicular access components of proposed development will be confirmed as part of subdivision design. Demonstration of compliance with the relevant acceptable solutions for Element 3 of the Guidelines will be documented in a brief addendum to this BMP to accompany the subdivision application.

Table 3: Vehicular access technical requirements

Technical requirement	Public road	Cul-de-sac	Battle-axe legs and private driveways longer than 50 m
Minimum trafficable surface (m)	6*	6	4
Horizontal distance (m)	6	6	6
Vertical clearance (m)	4.5	N/A	4.5
Maximum grade <50 m	1 in 10	1 in 10	1 in 10
Minimum weight capacity (t)	15	15	15
Maximum crossfall	1 in 33	1 in 33	1 in 33
Curves minimum inner radius	8.5	8.5	8.5
* Refer to E3.2 Public roads: Trafficable surface			

Source: WAPC 2015b

3.4 Reticulated water supply

All proposed development areas will be provided a reticulated water supply through extension of adjacent services. The reticulated system will ensure an all year round supply of water is provided for each lot to meet minimum domestic and emergency water supply requirements.

A network of hydrants will also be provided along the internal road network at locations which meet relevant water supply authority and DFES requirements, in particular the Water Corporation Design Standard DS 63 'Water Reticulation Standard Design and Construction Requirements for Water Reticulation Systems up to DN250'. This standard will guide construction of the internal reticulated water supply system and fire hydrant network, including spacing and positioning of fire hydrants so that the maximum distance between a hydrant and the rear of a building envelope (or in the absence of a building envelope, the rear of the lot) shall be 120 m and the hydrants shall be no more than 200 m apart.

3.5 Additional measures

Strategen makes the following additional recommendations to inform ongoing development stages:

1. Notification on Title: notification is to be placed on the Title of all proposed lots with a designated BAL rating (either through condition of subdivision or other head of power) to ensure all landowners/proponents and prospective purchasers are aware that their lot is currently in a designated bushfire prone area and that increased building construction standards may apply to future buildings as determined by this BMP or any future addendum. The notification on title is also to include that the site is subject to a Bushfire Management Plan.
2. BMP addendum: this BMP is a strategic level guide to demonstrate how development compliance will be met at future planning stages. Once an appropriate level of detail is available to demonstrate development compliance, which is expected to be at the subdivision design stage, a brief addendum to this BMP or updated BMP containing the necessary development and bushfire planning detail will need to be lodged with the structure plan or subdivision application (where appropriate) to the City of Kwinana.
3. Compliance with current City of Kwinana annual firebreak notice: the developer/land manager and prospective land purchasers are to comply with the current City of Kwinana annual firebreak notice as outlined in Appendix 2.
4. Vulnerable land uses: Bushfire Emergency Evacuation Plans will need to be prepared for any vulnerable land uses (such as schools or aged care facilities) that are located in areas subject to BAL–12.5 to BAL–29 to address requirements of SPP 3.7 Policy Measure 6.6. This is to be completed at the DA or building permit stage once an adequate level of detail is available to inform such plan.

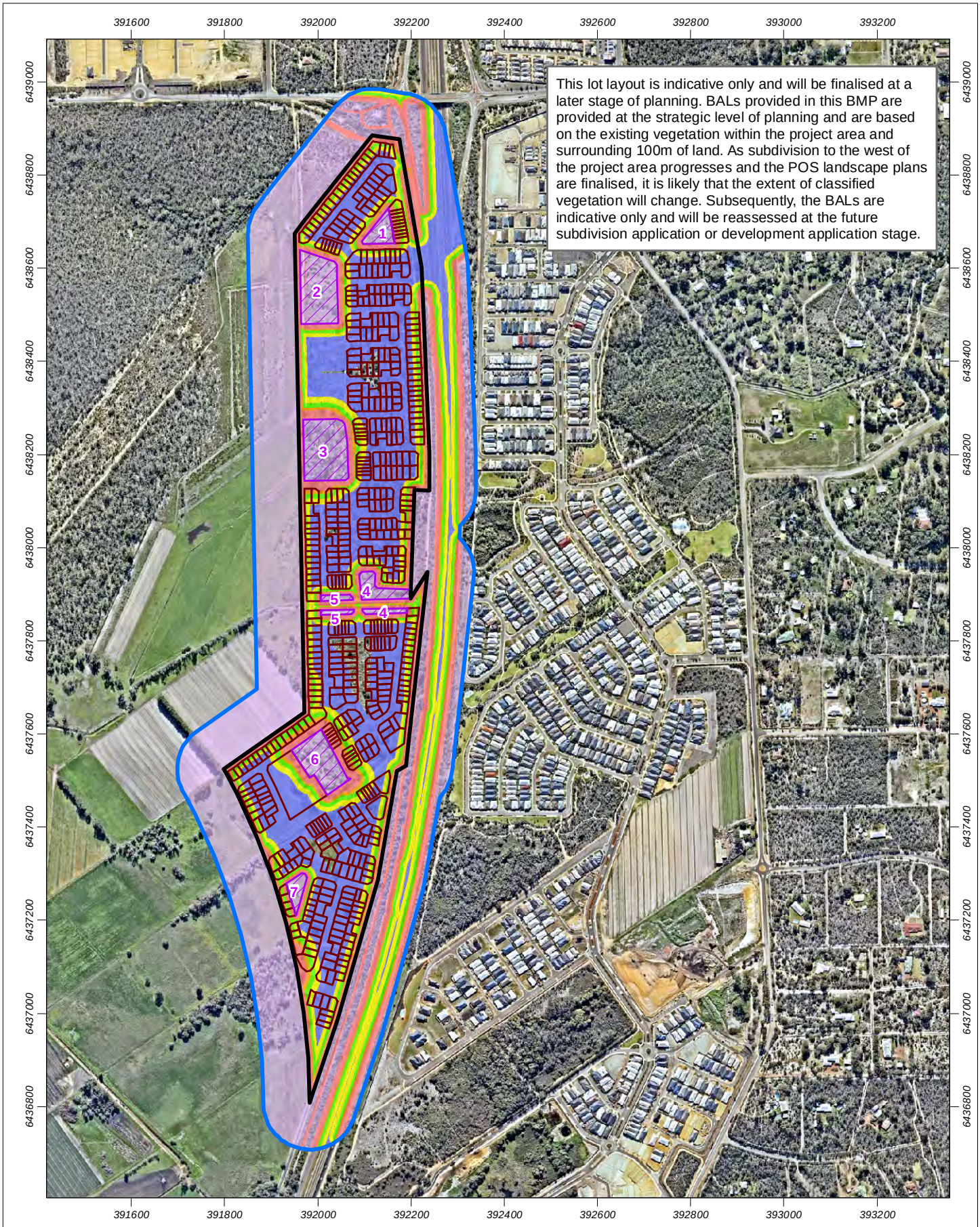

Figure 5: BAL assessment

Scale 1:11,000 at A4

0 50 100 150 200 250 m

N

Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 24/11/2016

Author: DWhite

Source: Aerial: Nearmap, flown 06/2016.

Subdivision plan: Client 11/2016.

Path: Q:\Consult\2016\SPG\SPG16422\ArcMap_documents\R001\Rev0\SPG16422_01_R001_Rev0_F005.mxd

Legend

- Project area
- POS/Landscaped areas
- Subdivision layout
- 100m wide assessment area
- Classified vegetation

BAL contours

- BAL FZ
- BAL 40
- BAL 29
- BAL 19
- BAL 12.5

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4. Proposal compliance and justification

Proposed development within the project area is required to comply with SPP 3.7 under the following policy measures:

6.2 Strategic planning proposals, subdivision and development applications

a) Strategic planning proposals, subdivision and development applications within designated bushfire prone areas relating to land that has or will have a Bushfire Hazard Level (BHL) above low and/or where a Bushfire Attack Level (BAL) rating above BAL-LOW apply, are to comply with these policy measures.

b) Any strategic planning proposal, subdivision or development application in an area to which policy measure 6.2 a) applies, that has or will, on completion, have a moderate BHL and/or where BAL-12.5 to BAL-29 applies, may be considered for approval where it can be undertaken in accordance with policy measures 6.3, 6.4 or 6.5.

c) This policy also applies where an area is not yet designated as a bushfire prone area but is proposed to be developed in a way that introduces a bushfire hazard, as outlined in the Guidelines.

6.3 Information to accompany strategic planning proposals

Any strategic planning proposal to which policy measure 6.2 applies is to be accompanied by the following information prepared in accordance with the Guidelines:

a) (i) the results of a BHL assessment determining the applicable hazard level(s) across the subject land, in accordance with the methodology set out in the Guidelines. BHL assessments should be prepared by an accredited Bushfire Planning Practitioner; or

a) (ii) where the lot layout of the proposal is known, a BAL Contour Map to determine the indicative acceptable BAL ratings across the subject site, in accordance with the Guidelines. The BAL Contour Map should be prepared by an accredited Bushfire Planning Practitioner; and

b) the identification of any bushfire hazard issues arising from the relevant assessment; and

c) clear demonstration that compliance with the bushfire protection criteria in the Guidelines can be achieved in subsequent planning stages.

This information can be provided in the form of a Bushfire Management Plan or an amended Bushfire Management Plan where one has been previously endorsed.

Implementation of this BMP is expected to meet the following objectives of SPP 3.7:

5.1 Avoid any increase in the threat of bushfire to people, property and infrastructure. The preservation of life and the management of bushfire impact are paramount.

5.2 Reduce vulnerability to bushfire through the identification and consideration of bushfire risks in decision-making at all stages of the planning and development process.

5.3 Ensure that higher order strategic planning documents, strategic planning proposals, subdivision and development applications take into account bushfire protection requirements and include specified bushfire protection measures.

5.4 Achieve an appropriate balance between bushfire risk management measures and, biodiversity conservation values, environmental protection and biodiversity management and landscape amenity, with consideration of the potential impacts of climate change.

In response to the above requirements of SPP 3.7, the bushfire management measures, as outlined in Section 3, have been devised for the proposed development in accordance with acceptable solutions of the Guidelines to meet compliance with bushfire protection criteria. An ‘acceptable solutions’ assessment is provided in Table 4 to assess the proposed bushfire management measures against each bushfire protection criteria in accordance with the Guidelines and demonstrate that the measures proposed meet the intent of each element of the bushfire protection criteria.

Table 4: Acceptable solutions assessment against bushfire protection criteria

Bushfire protection criteria	Intent	Acceptable solutions	Proposed bushfire management measures	Compliance statement
Element 1: Location	To ensure that strategic planning proposals, subdivision and development applications are located in areas with the least possible risk of bushfire to facilitate the protection of people, property and infrastructure	A1.1 Development location The strategic planning proposal, subdivision and development application is located in an area that is or will, on completion, be subject to either a moderate or low bushfire hazard level, or BAL–29 or below.	Refer to Section 3.1 and 3.2, which demonstrate that development will only occur in areas of BAL–29 or lower. No development will occur in BAL–FZ or BAL–40 areas. This will be confirmed as part of the revised BMP or an addendum to this BMP to accompany the subdivision application.	The measures proposed are considered to comply and meet the intent of Element 1 Location.
Element 2: Siting and design of development	To ensure that the siting and design of development minimises the level of bushfire impact	A2.1 Asset Protection Zone Every building is surrounded by an APZ, depicted on submitted plans, which meets detailed requirements (refer to the Guidelines for detailed APZ requirements).	Refer to Section 3.1, which demonstrates that an APZ will be provided at all development-vegetation interfaces. This will be confirmed as part of the revised BMP or an addendum to this BMP to accompany the subdivision application.	The measures proposed are considered to comply and meet the intent of Element 2 Siting and design of development
		A2.2 Hazard Separation Zone Every building and its contiguous APZ is surrounded by an HSZ, depicted on submitted plans, that meets detailed requirements (refer to the Guidelines for detailed HSZ requirements). An HSZ may not be required if the proposed construction meets the standard appropriate to the BAL for that location, and does not exceed BAL–29.	HSZs are not proposed since individual building construction will meet the standard appropriate to the BAL for that location (i.e. BAL–29 or lower). This will be confirmed as part of the revised BMP or an addendum to this BMP to accompany the subdivision application.	
Element 3: Vehicular access	To ensure that the vehicular access serving a subdivision/development is available and safe during a bushfire event	A3.1 Two access routes Two different vehicular access routes are provided, both of which connect to the public road network, provide safe access and egress to two different destinations and are available to all residents/the public at all times and under all weather conditions.	Refer to Section 3.3, which demonstrates that a minimum of two different vehicular access routes will be provided for the proposed development at all times via the internal road network. The indicative fire emergency access plan in Appendix 3 illustrates how this is possible with the current indicative subdivision plan. These access points will be confirmed as part of the revised BMP or an addendum to this BMP to accompany the subdivision application.	The measures proposed are considered to comply and meet the intent of Element 3 Vehicular access
		A3.2 Public road A public road is to meet the requirements in Table 4 Column 1 of the Guidelines.	Refer to Section 3.3, which demonstrates that all proposed public roads will meet requirements of the Guidelines (refer to Table 2). This will be confirmed as part of the revised BMP or an addendum to this BMP to accompany the subdivision application.	

		A3.3 Cul-de-sac (including a dead-end-road) A cul-de-sac and/or a dead end road should be avoided in bushfire prone areas. Where no alternative exists (i.e. the lot layout already exists and/or will need to be demonstrated by the proponent), detailed requirements will need to be achieved as per Table 4 Column 2 of the Guidelines.	Refer to Section 3.3, which demonstrates that any cul-de-sacs (if proposed) will meet requirements of the Guidelines (refer to Table 2). Cul-de-sacs will be avoided and will only be proposed if they are unavoidable as part of the development. This will be confirmed as part of the revised BMP or an addendum to this BMP to accompany the subdivision application.	
		A3.4 Battle-axe Battle-axe access legs should be avoided in bushfire prone areas. Where no alternative exists, (this will need to be demonstrated by the proponent) detailed requirements will need to be achieved as per Table 4 Column 3 of the Guidelines.	Refer to Section 3.3, which demonstrates that any battle-axe lots (if proposed) will meet requirements of the Guidelines (refer to Table 2). Battle-axe blocks will be avoided and will only be proposed if they are unavoidable as part of the development. This will be confirmed as part of the revised BMP or an addendum to this BMP to accompany the subdivision application.	
		A3.5 Private driveway longer than 50 m A private driveway is to meet detailed requirements as per Table 4 Column 3 of the Guidelines.	Refer to Section 3.3, which demonstrates that any private driveways longer than 50 m (if proposed) will meet requirements of the Guidelines (refer to Table 2). This will be confirmed as part of the revised BMP or an addendum to this BMP to accompany the subdivision application.	
		A3.6 Emergency access way An access way that does not provide through access to a public road is to be avoided in bushfire prone areas. Where no alternative exists (this will need to be demonstrated by the proponent), an emergency access way is to be provided as an alternative link to a public road during emergencies. An emergency access way is to meet detailed requirements as per Table 4 Column 4 of the Guidelines.	N/A No emergency access ways will be required as part of the development.	
		A3.7 Fire service access routes (perimeter roads) Fire service access routes are to be established to provide access within and around the edge of the subdivision and related development to provide direct access to bushfire prone areas for fire fighters and link between public road networks for fire fighting purposes. Fire service access routes are to meet detailed requirements as per Table 4 Column 5 of the Guidelines.	N/A No fire service access routes will be required as part of the development.	

		A3.8 Firebreak width Lots greater than 0.5 hectares must have an internal perimeter firebreak of a minimum width of three metres or to the level as prescribed in the local firebreak notice issued by the local government	Refer to Section 3.3, which demonstrates that no firebreaks will be required for individual residential lots and that a 3 m wide firebreak will be constructed and maintained adjacent to the eastern boundary of the site. This will be confirmed as part of the revised BMP or an addendum to this BMP to accompany the subdivision application.	
Element 4: Water	To ensure that water is available to the subdivision, development or land use to enable people, property and infrastructure to be defended from bushfire.	A4.1 Reticulated areas The subdivision, development or land use is provided with a reticulated water supply in accordance with the specifications of the relevant water supply authority and Department of Fire and Emergency Services.	Refer to Section 3.4, which demonstrates that all proposed lots will be provided a reticulated water supply and network of hydrants in accordance with local water authority, Shire and DFES requirements.	The measures proposed are considered to comply and meet the intent of Element 4 Water
		A4.2 Non-reticulated areas Water tanks for fire fighting purposes with a hydrant or standpipe are provided and meet detailed requirements (refer to the Guidelines for detailed requirements for non-reticulated areas)	N/A The proposed development will not occur within a non-reticulated area.	
		A4.3 Individual lots within non-reticulated areas (only for use if creating 1 additional lot and cannot be applied cumulatively) Single lots above 500 square metres need a dedicated static water supply on the lot that has the effective capacity of 10 000 litres.	N/A The proposed development will not occur within a non-reticulated area.	

5. Implementation, enforcement and review

This pre-development BMP has been prepared as a strategic guide to demonstrate how development compliance will be delivered at future planning stages in accordance with the Guidelines. In this respect, the management measures documented in Section 3, where applicable, will be incorporated into development design as early as possible and confirmed through subdivision design. Therefore, aside from the revision of this BMP or preparation of a BMP addendum to accompany the subdivision application, there are no further items to implement, enforce or review at this stage of the planning process.

The revised BMP or addendum to this BMP will meet the relevant commitments outlined in this strategic level BMP, address the relevant requirements of SPP 3.7 (i.e. Policy Measure 6.4) and demonstrate in detail how the proposed development will incorporate the relevant acceptable solutions to meet the performance requirements of the Guidelines. The revised BMP or BMP addendum will include the following detailed information:

- proposed lot layout
- post development vegetation class, effective slope and separation distance
- post development bushfire hazard level and 100 m wide HSZ/BAL application requirements
- BAL contour map demonstrating that proposed development areas will achieve a rating of BAL–29 or lower
- width and alignment of compliant APZs
- how bushfire management will be addressed during development staging (if applicable)
- fuel management or AS 3959 application in response to on-site POS (if and where required)
- vehicular access provisions, including demonstration that a minimum of two access routes will be achieved in accordance with acceptable solution A3.1
- water supply provisions with regards to reticulated water
- acceptable solutions assessment against the bushfire protection criteria
- proposed works program outlining all measures requiring implementation and the appropriate timing and responsibilities for implementation
- document review protocol
- summary of stakeholder consultation (if applicable).

On the basis of the information contained in this BMP, Strategen considers the bushfire hazards within and adjacent to the project area and the associated bushfire risk is readily manageable through standard management responses outlined in the Guidelines and AS 3959. Strategen considers that on implementation of the proposed management measures, the project area will be able to be developed with a manageable level of bushfire risk whilst maintaining full compliance with the Guidelines and AS 3959.

6. References

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Western Australian Planning Commission (WAPC) 2015b, *Guidelines for Planning in Bushfire-Prone Areas*, Western Australian Planning Commission, Perth.

Appendix 1
January wind profiles for Medina Research Centre

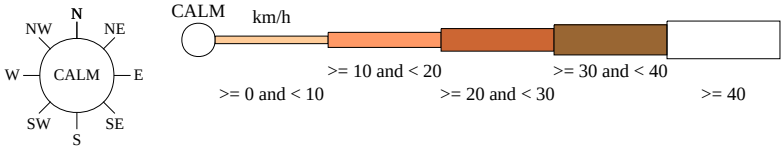
Rose of Wind direction versus Wind speed in km/h (01 Apr 1983 to 24 Sep 2013)

Custom times selected, refer to attached note for details

MEDINA RESEARCH CENTRE

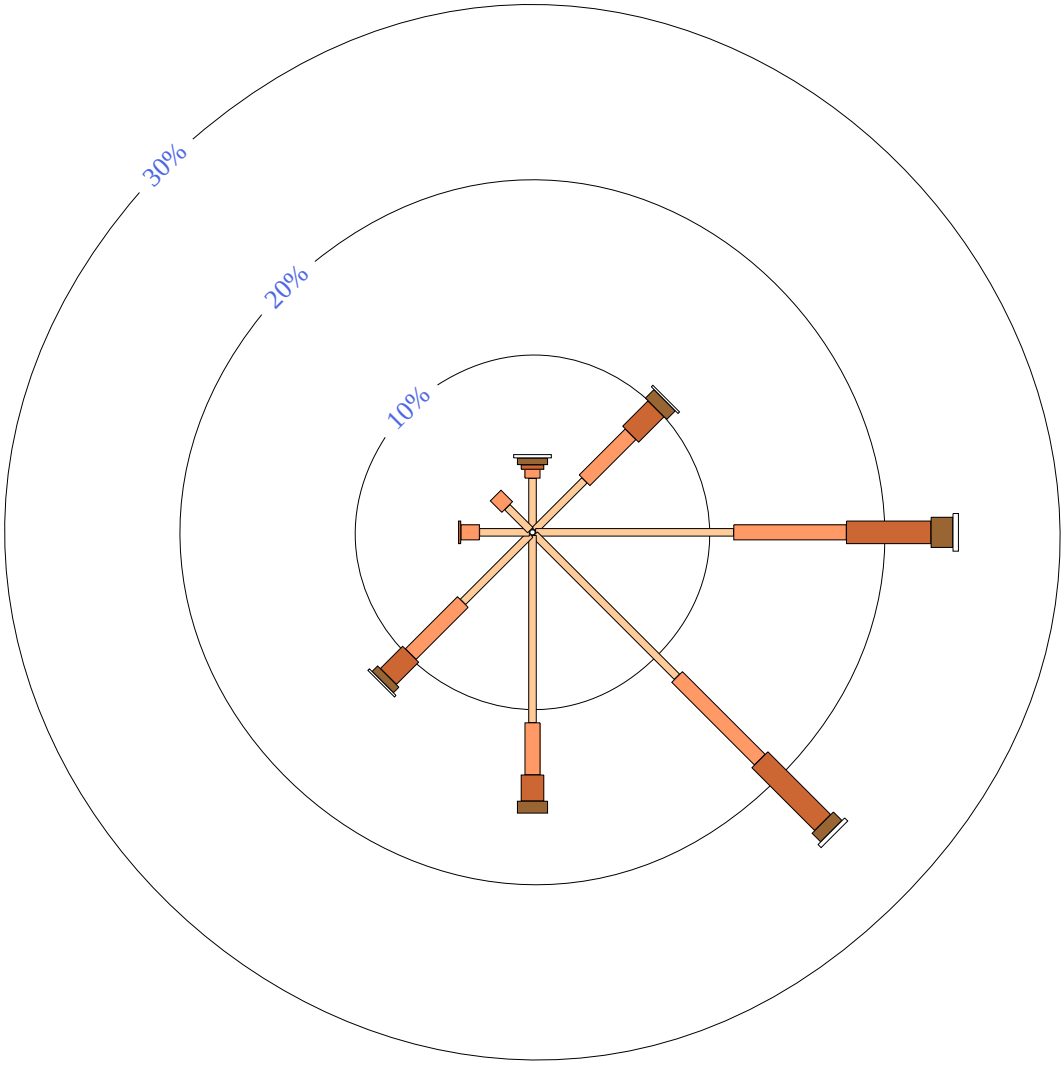
Site No: 009194 • Opened Apr 1983 • Still Open • Latitude: -32.2208° • Longitude: 115.8075° • Elevation 14m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am Jan
796 Total Observations

Calm 1%



Rose of Wind direction versus Wind speed in km/h (01 Apr 1983 to 24 Sep 2013)

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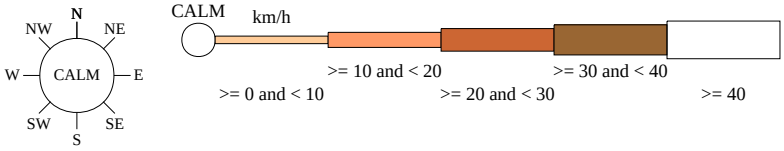
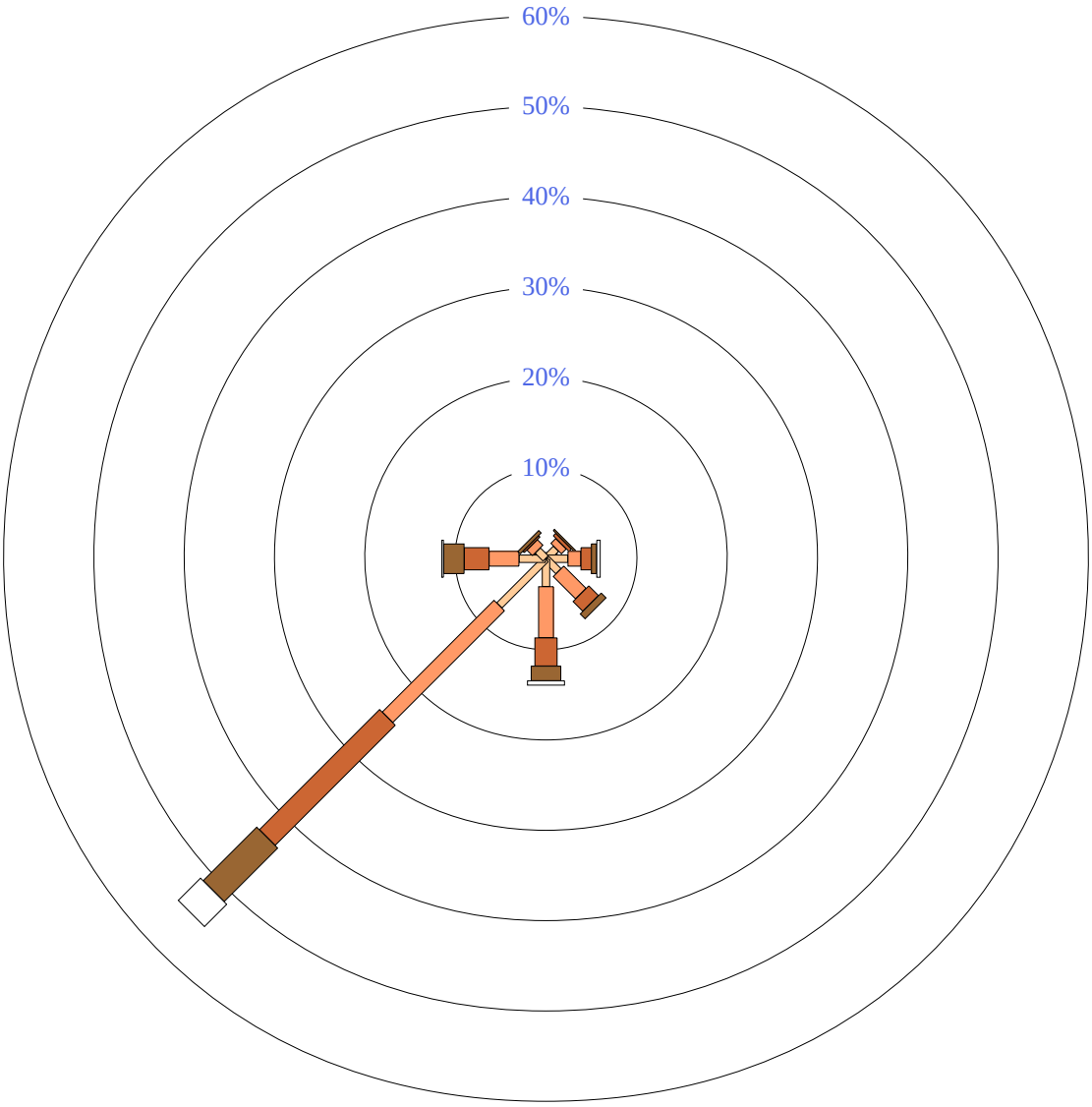


3 pm Jan
532 Total Observations

Calm *



Appendix 2
City of Kwinana 2015/2016 notice

City of Kwinana

Bush Fires Act 1954

Fire Breaks Notice 2016/17

Pursuant to the powers contained in Section 33 of the Bushfires Act 1954 (as amended), as the property owner or occupier of land within the City of Kwinana, you are hereby required to comply with the requirements set out in this notice.

The applicable works outlined below must be completed before 1 December 2016 and maintained up to and including 31 March 2017.

Land area – 3,001m² or greater

You are required to:

- construct bare earth firebreaks three (3) metres wide inside and along all boundaries of land in a continuous form, including on boundaries adjacent to roads, rail and drain reserves and all public open space reserves, with all overhanging branches, trees, limbs etc. to be trimmed back from over the firebreak area to a minimum height of four (4) metres;

- remove all flammable matter except living trees, shrubs, plants under cultivation and lawns, three (3) metres wide and minimum height of four (4) metres immediately surrounding all buildings situated on the land;
- firebreaks three (3) metres in width and minimum height of four (4) metres are to be cleared immediately surrounding any place where wood or timber piles, hay stacks, tyres, vehicles, flammable liquids, chemicals and gas products are kept on the land; and
- maintained and living lawns are acceptable in conjunction with or in lieu of mineral earth firebreaks, provided that the same minimum width and height requirements for a firebreak are maintained.

Land area – 3,000m² or less

You are required to:

- have all flammable material such as long dry grass, weeds, etc. slashed, mowed or trimmed down by other means to a height no greater than 50mm across the entire property.

Bare earth fire breaks are not necessary on properties that are 3,000m² or less in areas where slashing, mowing or living and maintained garden beds or lawn is established.

Fire break variations

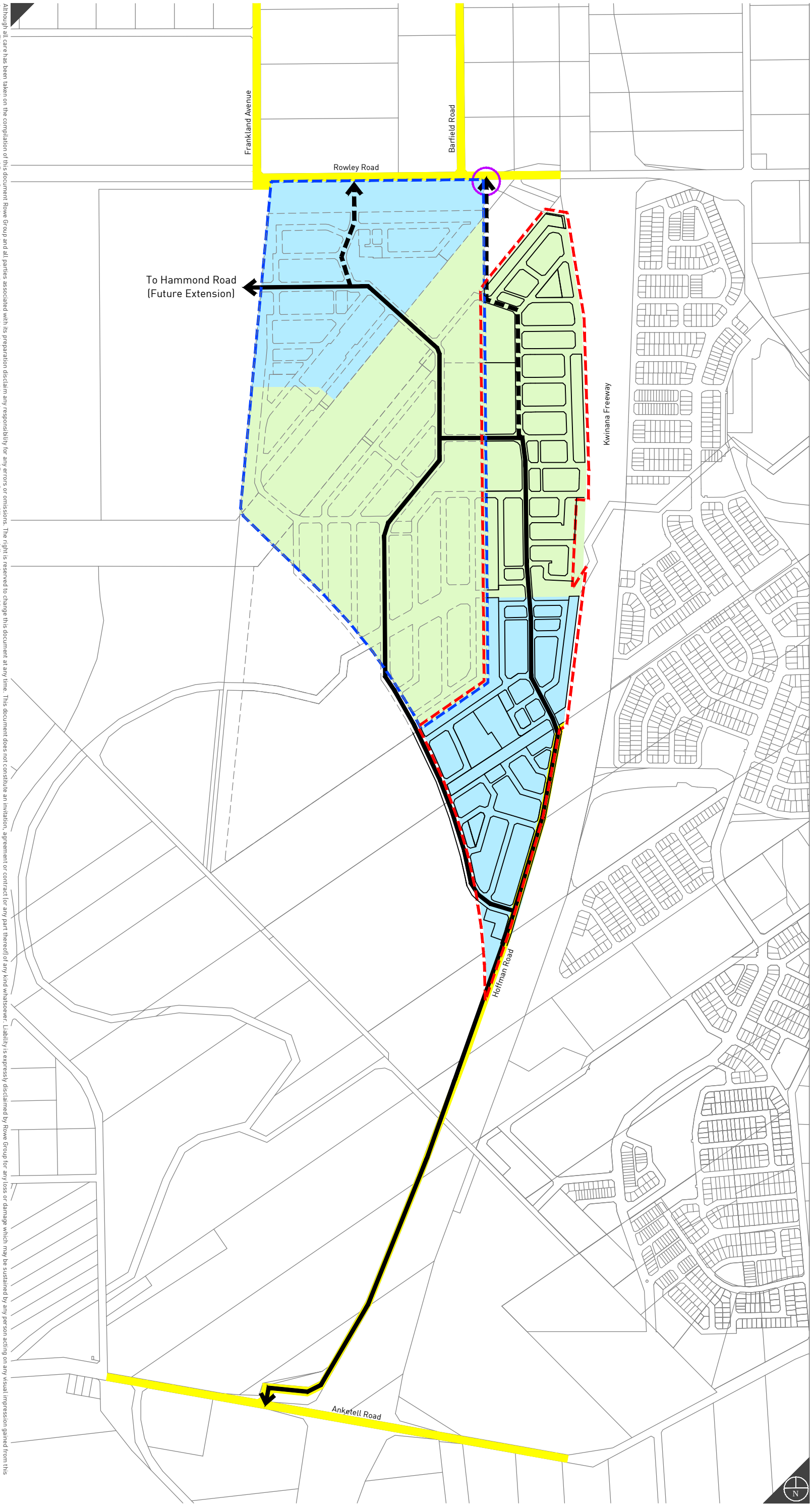
If it is impractical to install a firebreak immediately inside a property boundary, for environmental or any other reasons, you are required to apply to the City of Kwinana in writing by 1 October 2016 to obtain approval to install fire breaks in an alternative position.

Previously approved fire break variations do not need to be reapplied for unless circumstances have changed.

Joanne Abbiss

CHIEF EXECUTIVE OFFICER

Appendix 3
Indicative fire emergency access figure



Planning Design Delivery

LEGEND

- Local Structure Plan Boundary
- Local Structure Plan by others (QUBE)
- Existing Cadastre
- Indicative Lot Layout
- Indicative Lot Layout By Others
- Indicative Fire & Emergency Access Route (Permanent)
- Interim Emergency Access (Short Term)
- Controlled Gated Emergency Access
- Existing Gazetted Road (Public Access)
- Phase One Development (2017 / 2018)
- Phase Two Development (2018+)

NOTES:

1. Emergency access route to follow 300 diameter water main. Water main to be constructed as part of Stage 1 works.
2. Emergency access to be constructed to a minimum 6 metre wide trafficable surface.
3. Interim emergency access to be closed upon completion of initial stages of development of adjacent landholdings.
4. Layout shown for explanatory purposes only. Subject to review and detailed design at subdivision stage.

0 250 500 Metres

REVISIONS

Rev	Date	Drawn
A	2014.05.06	K. Trenberth
B	2016.09.07	M. Sullivan
C	2016.11.29	M. Sullivan

ROWEGROUP
PLANNING DESIGN DELIVERY

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Date Drawn:	2014.05.06
Job Ref:	7282A
Scale:	1:10,000 @ A3
Client:	Satterley
Designer:	R. Cumming
Drawn:	K. Trenberth
Projection:	PCG 94
Plan ID:	7282A-FIG-25-C

Cadastre supplied by McMullen Nolan. Access routes supplied by Peritas Group.

Indicative Fire & Emergency Access

Mandogalup
Figure 9

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_FIG25C_20161129_MANDOGALUP (FIRE & EMERGENCY ACCESS).DWG
Matt Sullivan 30 November 2016

APPENDIX 5

ACOUSTIC REPORT

ROWEGROUP

Road & Railway Noise Assessment

Mandogalup East Local Structure Plan, Mandogalup

Satterley Property Group

Project No.: ATP140414

Project Name: Mandogalup Estate

Document No.: ATP140414-R-TNIA-05

December 2016

Document Control Record

Prepared by:	Sam Fraser
Position:	Engineer - Acoustics
Signed:	
Date:	12 December 2016

Approved by:	Sasho Temelkoski RPEQ 13551
Position:	Managing Director & Principal Engineer
Signed:	
Date:	12 December 2016

REVISION STATUS

Revision No.	Description of Revision	Date	Approved
0	Issue 1	22.05.2014	S. Temelkoski
1	Issue 2 – Amended Layout	21.07.2014	S. Temelkoski
2	Issue 3 – New Layout	29.09.2016	S. Temelkoski
3	Issue 4 – New Layout	23.11.2016	S. Temelkoski
4	Issue 5 – Response to MRWA Comments	12.12.2016	S. Temelkoski

Recipients are responsible for eliminating all superseded documents in their possession.

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Executive Summary

ATP Consulting Engineers was engaged by Satterley Property Group to prepare an acoustic assessment (road and railway noise assessment) for the proposed Mandogalup East Local Structure Plan for the land described as Part Lot 9002 Hoffman Road, Part Lot 9006 Hoffman Road, and Lot 9019 Rowley Road in Mandogalup.

This report addresses the potential noise impacts on the proposed residential subdivision from the road traffic on the Kwinana Freeway as well as from the Perth to Mandurah railway corridor, and presents the noise management strategy for the overall Mandogalup East Local Structure Plan.

Within a planning horizon of 20 years (year 2037), without noise mitigation measures, the traffic noise from Kwinana Freeway and railway noise from the Perth to Mandurah railway line, has the potential to impact on the proposed development. The dominant noise source is traffic on Kwinana Freeway, with lesser noise emissions from the Perth to Mandurah railway line, thus the noise mitigation measures are based on the requirement for the control of road traffic noise emissions.

In keeping with the accepted transport noise mitigation strategies implemented for other large scale subdivisions along this transport corridor, a 4.0m high noise barrier wall along the entire eastern boundary with Kwinana Freeway was considered as the primary noise mitigation measure. The 4.0m height of the noise barrier wall is determined relative to the finished surface level of the allotments in the first row along Kwinana Freeway. The noise barrier wall should be designed and constructed in accordance with Section 5.3.2 of the SPP 5.4 Implementation Guidelines. The wall must be constructed of a material having minimum surface density of 15kg/m^2.

The 4.0m high boundary noise barrier wall is highly effective in reducing traffic noise levels for low-set (single storey) houses but two storey houses in the first row of allotments will be affected by traffic noise. There is also residual traffic noise in the interior of the development, hence further noise mitigation measures are required to achieve compliance with indoor noise criteria. In addition, protection for at least one outdoor living area is required by appropriate building orientation to achieve the ‘noise target’ from SPP 5.4.

Residual transport noise can be managed through further planning noise mitigation measures such as notification under certificate of title and specification of a type of dwelling to be constructed on the noise affected allotments as per the ‘acceptable treatment packages’ from Section 6.3 of SPP 5.4 Implementation Guidelines. The allotments subject to ‘acceptable treatment packages’ for low-set and upper floors of high-set houses, are presented in Tables 7.2 and 7.3 of this report.

Other control measures were also investigated with the aim to broaden the options for selection of traffic noise mitigation best suited to the detailed design of various stages of the development.

There are several potential alternative traffic noise mitigation strategies based on various combination of buildings and noise barrier walls, which will be investigated further and refined as part of the detailed design of the subdivision under the overall Mandogalup East Local Structure Plan.

Table of Contents

Tables

Figures

Appendices

Acoustics Glossary

A-weighting	Correction to sound levels to mimic the response of the human ear at low sound frequencies.
dB (A)	The A-weighted sound pressure level.
$L_{Aeq,T}$	Average sound level for describing sound that varies over time. $L_{Aeq,T}$ is the A-weighted sound pressure level, calculated over time period T, that has the same sound energy as the time varying sound over the whole period T.
$L_{A01,T}$	Measure of the maximum sound level. $L_{A01,T}$ is a statistical parameter that is the A-weighted sound pressure level that is exceeded for 1% of the measurement time T.
$L_{A10,T}$	$L_{A10,T}$ is a statistical parameter that is the A-weighted sound pressure level that is exceeded for 10% of the measurement time T.
$L_{A90,T}$	Background sound level. $L_{A90,T}$ is a statistical parameter that is the A-weighted sound pressure level that is exceeded for 90% of the measurement time T.
L_{Amax}	Maximum A-weighted sound pressure level that is measured during a noise event.
Noise	Unwanted sound.
Rating Background Level (RBL)	Lowest tenth percentile of the $L_{A90,T}$ background noise levels over an assessment period.
Sound power	The sound energy radiated per unit time by a sound source, measured in Watts (W).
Sound Power Level, L_w (SWL)	Logarithmic measure of sound power on a decibel scale, referenced to the human hearing threshold of 1×10^{-12} W.
Sound pressure	The fluctuations in air, measured in Pascals (Pa).
Sound Pressure Level, L_p (SPL)	Logarithmic measure of sound pressure on a decibel scale, referenced to the human hearing threshold of 2×10^{-5} Pa.

1. Introduction

1.1 Background

ATP Consulting Engineers was engaged by Satterley Property Group to prepare an acoustic assessment (road and railway noise assessment) for the proposed Mandogalup East Local Structure Plan for the land described as Part Lot 9002 Hoffman Road, Part Lot 9006 Hoffman Road, and Lot 9019 Rowley Road in Mandogalup.

This report addresses the potential noise impacts on the proposed residential subdivision from the road traffic on the Kwinana Freeway as well as from the Perth to Mandurah railway corridor, and presents the noise management strategy for the overall Mandogalup East Local Structure Plan.

1.2 Study Objectives

The study objectives are as follows:

- Site specific noise measurements to obtain information about the existing noise amenity at the proposed subdivision.
- Validation of the SoundPLAN traffic noise calculation model based on the site specific traffic noise measurements. SoundPLAN calculates traffic noise as per the procedure specified in the UK DoT Welsh Office '*Calculation of Road Traffic Noise'* (CoRTN'88).
- Consideration of the outdoor noise criteria as per the requirements specified in *State Planning Policy 5.4 – 'Road and Rail Transport Noise and Freight Considerations in Land Use Planning'* (SPP 5.4) dated 22 September 2009.
- Calculation of the future $L_{Aeq(16\text{-}hour)}$ and $L_{Aeq(8\text{-}hour)}$ traffic noise levels over the subject site considering predicted traffic flows on Kwinana Freeway (north & southbound) and Rowley Road within a planning horizon of 15 years (year 2031).
- Evaluation of the noise impacts from the Mandurah rail line considering current operating conditions with allowance for changes in frequency, type, length (number of cars), and speed of all railway vehicles over the 15 year planning horizon.
- Recommendation of appropriate noise mitigation measures including noise barrier walls and 'Quiet House' design to ensure that the indoor noise levels from SPP 5.4 are met at the future dwellings and allotments.

1.3 Site Description

The Mandogalup East Local Structure Plan is located within the metropolitan south west corridor, within the municipality of the City of Kwinana. The site is situated approximately 24 km south of Perth Central Area, and is accessible via the Kwinana Freeway. The Kwinana town centre is located approximately 8 km south and the Spectacle Regional Reserve approximately 4 km from the subject site.

The subject site has historically been used for agricultural purposes including grazing, cropping and horse agistment. There is one existing dwelling situated on the subject site, with associated outbuildings, fences and other structures. These are intended to be demolished and removed as part of the development of the site.

The subject site is bound by the Kwinana Freeway to the east and Rowley Road to the north. Land to the immediate west of the site is zoned urban and urban deferred. The location of the proposed development site is presented in Figure 1.1.

Figure 1.1 Site Locality Plan

1.4 Description of the Development

The Local Structure Plan area comprises approximately 42.67 hectares of land situated west of the Kwinana Freeway, immediately south of Rowley Road. The site is currently accessed by Hoffman Road, which runs parallel to the Kwinana Freeway and connects to Anketell Road in the south.

The proposed layout includes provision for approximately 606 residential allotments, a primary school, public open spaces, and an internal road network. The proposed layout is presented in Appendix A.

2. Existing Noise Amenity

2.1 Noise Measurement Location

Unattended noise measurements were carried out at the subject site to obtain information for validation of the SoundPLAN traffic noise calculation model. The equipment was set up on site on Thursday, 4 July 2013 and collected on Thursday, 18 July 2013. The logger was programmed to collect noise samples at 15-minute intervals to obtain representative information about the existing $L_{A10(18\text{-hour})}$, $L_{Aeq(16\text{-hour})}$ and $L_{Aeq(8\text{-hour})}$ traffic noise levels.

The location of the noise logger is presented in Figure 2.1.

Figure 2.1 Noise Measurement Location

2.2 Equipment Used

Noise levels were measured using the following equipment:

- EL-316 Environmental Noise Logger by Acoustic Research Laboratories, AS1259 Type 1, AS 2064 Class A.
- Sound Level Calibrator, Rion, NC-74, 94dB/1000Hz.

The noise measurement instruments conform to ASIEC61672.1-2004 and the measurements were undertaken in general accordance with AS1055–1997 and AS2702-1984. Calibration was undertaken during set up and downloading of the data from the noise logger. The maximum calibration drift recorded was <0.1dB(A).

2.3 Noise Measurement Results

Noise measurements were carried out over a 7 day period, however only normal workdays (Monday to Friday) with full 24 hour noise data and with fine weather were considered as per the requirements from the *Implementation Guidelines for State Planning Policy 5.4: Road and Rail Transport Noise and Freight Considerations in Land Use Planning* (SPP 5.4 Implementation Guidelines).

The results of the traffic noise measurements recorded near Kwinana Freeway from Monday, 8 July 2013 to Friday, 12 July 2013 are presented in Table 2.1 and in Appendix B.

Table 2.1 Traffic Noise Measurement Results – Kwinana Freeway

Date	$L_{A10(18\text{-hour})}$* dB(A)	$L_{Aeq(16\text{-hour})}$* dB(A)	$L_{Aeq(8\text{-hour})}$* dB(A)
8 July 2013 (Monday)	63	62	56
9 July 2013 (Tuesday)	64	63	55
10 July 2013 (Wednesday)	63	62	55
11 July 2013 (Thursday)	63	62	54
12 July 2013 (Friday)	63	61	55
Average	**63**	**62**	**55**

**Free-field*

3. Road Transport Noise Criteria

3.1 Outdoor Noise Criteria

The transport noise criteria were derived from SPP 5.4. Since the proposed development is a new noise-sensitive development in the vicinity of a major transport corridor (road and passenger rail), the outdoor noise criteria from Table 1 of the policy is applicable. Under the policy the same outdoor noise criteria are applicable for road and rail transport.

The outdoor noise criteria are presented in Table 3.1.

Table 3.1 Outdoor Noise Criteria

Time of Day	Noise Target	Noise Limit
Day 6:00am – 10:00pm	$L_{Aeq(Day)}$ = 55dB(A)*	$L_{Aeq(Day)}$ = 60dB(A)*
Night 10:00pm – 6:00am	$L_{Aeq(night)}$ = 50dB(A)*	$L_{Aeq(night)}$ = 55dB(A)*

**Façade adjusted*

3.2 Internal Design Noise Levels

Section 5.3.1 of SPP 5.4 specifies indoor noise levels for residential buildings in cases where indoor spaces will face outdoor areas that are above the noise limit. The indoor noise levels for residential buildings are presented in Table 3.2.

Table 3.2 Indoor Noise Levels (Residential Buildings)

Indoor Area	Noise Level
Living and Work Areas	40dB(A) $L_{Aeq(Day)}$
Bedrooms	35dB(A) $L_{Aeq(Night)}$

3.3 Quiet House Design

For allotments where the outdoor noise target cannot be met, any noise sensitive buildings should be constructed using the 'Quiet House' design principles. The SPP 5.4 Implementation Guidelines require implementation of the following noise amelioration measures:

- Provision of at least one protected outdoor living area; and
- Minimisation of the extent of noise insulation needed to meet the indoor noise level standards.

To reduce the extent of noise insulation, SPP 5.4 Implementation Guidelines recommend interior layout whereby the bedrooms, entertainment rooms and living areas are situated away from the noise source.

Where practical, the service areas such as garages, store rooms, bathrooms and laundries should be situated between the noise source and the habitable rooms.

The other option for reduction of the requirements for noise insulation, is reduction of the size of the openings (windows, sliding doors) facing the noise source.

The upgrade of the building envelope is the final measure to achieve the internal noise limits. The building envelope upgrade (acoustic design) includes the following:

- Provision of mechanical ventilation or air-conditioning so windows can remain closed (bypassing of the windows when providing air exchange in the habitable rooms);
- Upgraded glazing using denser laminated glass;
- Solid core doors that open from habitable rooms to outdoors, or in case of sliding glass doors upgraded glazing using denser laminated glass; and
- Provision of roof insulation.

4. Road Transport Noise

4.1 Calculation Methodology

The road transport noise levels, within a planning horizon of 15 years (year 2031[1]), were calculated using the noise propagation software SoundPLAN. Calculations are based on the procedures developed by the U.K. Department of Transport, Welsh Office, issued as '*Calculation of Road Traffic Noise'* (CoRTN'88).

CoRTN'88 calculates traffic noise in terms of the $L_{A10(18\text{-hour})}$ descriptor. In contrast, the SPP 5.4 noise criteria is defined in terms of $L_{Aeq(16\text{-hour})}$ and $L_{Aeq(8\text{-hour})}$. Conversion factors from $L_{A10(18\text{-hour})}$ to $L_{Aeq(16\text{-hour})}$ and $L_{Aeq(8\text{-hour})}$ were derived from the site-specific noise measurements as presented in Table 2.1. Use of noise measurements to convert from L_{A10} to L_{Aeq} is the method recommended in the SPP 5.4 Implementation Guidelines. Based on site-specific noise measurements the following conversion factors are applicable:

$$L_{Aeq(16\text{-hour})} = L_{A10(18\text{-hour})} - 1 \text{ dB(A)}^2$$

$$L_{Aeq(8\text{-hour})} = L_{A10(18\text{-hour})} - 8 \text{ dB(A)}^3$$

4.2 SoundPLAN Model Validation

Validation of the SoundPLAN model was carried out based on the traffic noise levels ($L_{10(18\text{-hour})}$) measured at the subject site and considering the traffic flows along Kwinana Freeway at the time the noise measurements were carried out (July 2013).

[1] The Regional Operations Model (ROM24) developed by Main Roads WA provides traffic volume estimates up to the year 2031.
[2] Conversion factor is the difference between the measured $L_{A10\ (18\text{-hour})}$ and the measured $L_{Aeq\ (16\text{-hour})}$ levels as presented in Table 2.1.
[3] Conversion factor is the lesser of the differences between the measured $L_{A10\ (18\text{-hour})}$ and the measured $L_{Aeq\ (8\text{-hour})}$ levels as presented in Table 2.1.

The traffic noise levels measured at the subject site were used to validate the accuracy of the SoundPLAN traffic noise calculation model prior to undertaking calculations of the future road traffic noise levels for the 2031 planning horizon.

The traffic flows along Kwinana Freeway and Rowley Road, at the time of the noise measurements, was sourced from actual Main Roads traffic count for the 2013/2014 period.

The traffic flow data for 2013/2014, as considered in the SoundPLAN traffic noise validation model, is presented in Table 4.1.

Table 4.1 Traffic Flow Data for Validation

Road Segment	2013/14 Traffic Flow AAWT[4]	Heavy Vehicles (%)
Kwinana Freeway Northbound, south of Rowley Road	47,495	9.0
Kwinana Freeway Southbound, south of Rowley Road	49,700	9.0
Kwinana Freeway Northbound, under Rowley Road overpass	44,058	11.0
Kwinana Freeway Southbound, under Rowley Road overpass	40,000	11.0
On Ramp, Rowley Road to Kwinana Freeway Southbound	1,298	9.0
Off Ramp, Kwinana Freeway Northbound to Rowley Road	1,000	9.0
Rowley Road, west of Kwinana Freeway	5,820	15.0
Rowley Road, at overpass	5,820	15.0
Rowley Road, east of Kwinana Freeway	5,820	15.0

Hourly traffic count data, as published in the Main Roads traffic count, was used to determine the traffic flows for the 18 hour period from 6:00am to midnight, which is required for the CoRTN method.

The following factors were considered in the validation model:

- The speed of the vehicles on the Kwinana Freeway and the on/off ramps is 100 km/h.
- The speed of vehicles on Rowley Road is 70 km/h.
- The road surface on Kwinana Freeway past the subject site is Open Graded Asphalt (OGA) which requires an adjustment of -2.5dB(A) to be applied to the calculated road noise emissions (WAPC, 2009).
- The noise data was recorded at a free field location with a microphone height of 1.2m above ground level.
- Correction factor of -1.7dB has been applied to correct the CoRTN noise levels to Australian conditions.

The noise measurement results and the SoundPLAN validation results are presented in Table 4.2 and in Appendix C.

[4] Sourced from Main Roads WA Traffic Map.

Table 4.2 Traffic Noise Model Validation Results

Calculation Point	Measured* $L_{10(18\text{-hour})}$ dB(A)	Calculated* $L_{10(18\text{-hour})}$ dB(A)	Difference dB(A)	Validation Factor
Kwinana Freeway	63	63	-	N/A

**Free-field.*

The calculated road traffic noise levels are within the acceptable calibration drift of ±2dB(A) therefore no validation factor is required.

4.3 Traffic Noise Calculation Model

A digital terrain model of the subject site was developed using the existing natural surface levels obtained from LiDAR survey.

Future traffic flow estimates for the year 2031 were supplied by Main Roads WA planning division. The data is calculated from the ROM24 base case[5]. The ROM24 model provides accurate future traffic estimates based on factors such as population growth and land use planning. ATP Consulting is not aware of any traffic estimates beyond the year 2031. The year 2031 corresponds to a 15 year planning horizon, which is recommended for noise assessment purposes in accordance with SPP 5.4.

The traffic flows for the ultimate planning horizon of 2031 as considered in the noise calculation model are presented in Table 4.3.

[5] The Regional Operations Model (ROM24) is a traffic simulation model used by Main Roads WA.

Table 4.3 Traffic Flow Data for Noise Calculation

Description	2031[6] Traffic Flow AAWT	2031[7] Traffic Flow (18-hour)	Heavy Vehicles, % AAWT
Kwinana Freeway Northbound, south of Rowley Road	60700	53667	8
Kwinana Freeway Southbound, south of Rowley Road	58200	54660	8
Kwinana Freeway Northbound, under Rowley Road overpass	58000	51025	8
Kwinana Freeway Southbound, under Rowley Road overpass	56200	52924	8
On Ramp, Rowley Road to Kwinana Freeway Southbound	2700	2549	4
Off Ramp, Kwinana Freeway Northbound to Rowley Road	2000	1909	4
Rowley Road Westbound, west of Kwinana Freeway	10300	9651	14
Rowley Road Eastbound, west of Kwinana Freeway	9900	9666	17
Rowley Road Westbound, at overpass	13100	12274	13
Rowley Road Eastbound, at overpass	8100	7908	10
Rowley Road Westbound, east of Kwinana Freeway	12000	11244	10
Rowley Road Eastbound, east of Kwinana Freeway	11800	11521	10

The following additional factors were considered in the model:

- Noise emission line for passenger vehicles (Austroads Class 1 and 2) is 0.5m above road surface.
- Noise emission line for heavy vehicles (Austroads Class 3 and up) engine noise is 1.5m above road surface. CoRTN correction factor of -0.8dB is applicable to the heavy vehicle engine noise source.
- Noise emission line for heavy vehicles (Austroads Class 3 and up) exhaust noise is 3.6m above road surface. CoRTN correction factor of -8.0dB is applicable to the heavy vehicle exhaust noise source.
- Percentage of heavy vehicles is not available as hourly data, therefore the percentage of heavy vehicles for the CoRTN 18 hour period (6:00am to midnight) is taken to be the same as the % heavy vehicles across the whole 24 hours (AAWT).
- The speed of the vehicles on the Kwinana Freeway and Kwinana Freeway on/off ramps is 100 km/h.

[6] Traffic flow along Kwinana Freeway (AAWT in 24-hour period) for 2037 calculated using growth rates of 2.39% per annum for Northbound and 3.01% per annum for Southbound based on observed traffic growth rate between July 2007 and June 2012. Traffic flows for Rowley Road and Kwinana Freeway on ramp estimated using a growth rate of 3.0% per annum from data presented in Table 4.1.

[7] 18 hour traffic flow is calculated from the 24 hour traffic flows, based on hourly traffic data from the most recent Main Roads WA census.

- The road surface on Kwinana Freeway past the subject site is Open Graded Asphalt (OGA) which requires an adjustment of -2.5dB(A) to be applied to the calculated road noise emissions (WAPC, 2009).
- The road surface on the Kwinana Freeway on and off ramps is Dense Graded Asphalt (DGA) which requires no adjustment to be application in the noise calculation model.
- Kwinana Freeway is 3 lanes in each direction by the year 2031.
- The road surface for Rowley Road is Open Graded Asphalt (OGA), which is expected to be laid during the Rowley Road extension project.
- Rowley Road is 2 lanes in each direction by the year 2031.
- The speed of the vehicles on Rowley Road is 80km/h after completion of the Rowley Road extension project.
- The ground absorption factor is 0.6 (60%) at the development site[8].
- All the houses were modelled as low-set (single storey) with 4m height.
- Although the house structures were modelled as 4m high to simulate the shielding provided by a typical low-set house, the receivers were allocated to ground and potential upper floors in case of two-storey houses.
- Receivers were located on the most exposed façades of the future low-set houses at an elevation of 1.4m above the finished floor level of each floor.
- Façade adjustment of +2.5dB(A) is applied to the noise levels for receivers located at the building facades to account for façade reflection.
- Correction factor of -1.7dB has been applied to correct the CoRTN noise levels to Australian conditions.

4.4 Road Transport Noise Mitigation

Based on the extensive traffic noise modelling that was carried out for the Honeywood Estate on the opposite side of Kwinana Freeway, ATP Consulting Engineers is aware that there will be a requirement for engineering noise control measures at this site.

The Honeywood Estate development incorporated a noise barrier wall along the entire boundary with the Kwinana Freeway transport corridor. This was shown to help reduce transport noise levels at building facades to more manageable levels.

Based on the experience with the Honeywood Estate, the SoundPLAN traffic noise propagation model was run considering the following two scenarios:

- No transport noise mitigation measures; and

- Transport noise mitigation measures in the form of a 4.0 metre high noise barrier wall along the length of the eastern boundary between the subject site and the Kwinana Freeway transport corridor.

[8] Ground absorption factor of 0 represents hard, reflective surface that absorbs 0% of sound. Ground absorption factor of 1 represents soft ground that absorbs 100% of sound.

5. Railway Noise

5.1 Railway Noise Calculation Methodology

The railway noise levels, within a planning horizon of 15 years (year 2031), were calculated using SoundPLAN noise propagation software. Calculations are based on the *Nordic Rail Prediction Methodology (Kilde Report 130)* (Ringheim 1984) algorithms for rail traffic.

The *Kilde Report 130* method calculates railway noise in terms of both $L_{Aeq,24hour}$ and L_{Amax} noise descriptors which are typically used for railway noise prediction in Australia. These can also be modified to express the calculated noise levels in terms of $L_{Aeq(16\text{-}hour)}$ and $L_{Aeq(8\text{-}hour)}$ in accordance with the criteria from SPP 5.4.

Where future planning information is not available, the SPP 5.4 Implementation Guidelines recommend allowing for an increase of +2 dB(A) to the calculated or measured railway noise levels to account for changes in volume, speed, vehicle type, and track construction over the 15-20 year planning horizon (MRWA, 2009).

5.2 Railway Noise Calculation Model

The railway traffic on the Perth to Mandurah railway line was considered in the model as per the current 2016 situation. The track is currently only serviced by TransPerth's "B-series" three car Electric Multiple Units which can be coupled into six car sets.

The total number of three car and six car trains currently servicing the section of the Mandurah railway line between Cockburn Central Station and Kwinana Station (both directions) was considered in the model as presented in Table 5.1.

Table 5.1 Current Railway Traffic

Time of Day	Northbound		Southbound	
	3-car	6-car	3-car	6-car
Day 6:00am – 10:00pm	33	43	33	42
Night 10:00pm – 6:00am	7	1	9	0

The following additional factors were considered in the model:

- The noise source height for the railway was considered at a height of 0.8m above the elevation of the railway tracks (allowing for height of ballast bed and rail head);
- The *TransPerth B-Series EMU* (train that services the Mandurah railway line) was modelled travelling at its maximum speed of 130km/h;
- The three car set is 73 metres in length while the six car set is 146 metres in length;
- The Nordic Kilde Report 130 method calculates railway noise over the 24-hour period ($L_{eq,24hour}$). To calculate railway noise levels in terms of $L_{eq,16hour}$ and $L_{eq,8hour}$, the number of trains for the relevant time period was extrapolated over the whole 24-hour period;
- All the houses were modelled as low-set (single storey) with 4m height.

- Although the house structures were modelled as 4m high to simulate the shielding provided by a typical low-set house, the receivers were allocated to ground and potential upper floors in case of two-storey houses.
- Receivers were located on the most exposed façades of the future low-set houses at an elevation of 1.5m above the finished floor level of each floor.
- SoundPLAN adds +2.5dB(A) to the calculated traffic noise levels when the receiver is attached to the building; and
- An additional +2 dB (A) was applied to the calculated railway noise levels to account for increase in emissions over the 15 year planning horizon.

5.3 Railway Noise Mitigation

The railway noise propagation model was run considering the same two scenarios as for the road transport noise mitigation, as follows:

- No transport noise mitigation measures; and
- Transport noise mitigation measure in the form of a 4.0 metre high noise barrier wall along the length of the eastern boundary between the subject site and the Kwinana Freeway transport corridor.

6. Combined Road and Rail Noise

The road and rail noise levels were logarithmically summed to determine the combined transport noise levels.

The calculated transport noise levels (SoundPLAN result tables) are presented in Appendix D.

The noise contours (SoundPLAN Grid Noise Maps) showing the transport noise propagation over the entire development site are presented in Appendix E.

The results show that the night time noise levels are 7dB lesser than the day time noise levels. Under SPP 5.4, the night time Outdoor Noise Criteria are 5dB lesser than the day time criteria, as presented in Table 3.1. Therefore, relative to the Outdoor Noise Criteria, the day time noise levels are the most critical and determine what the applicable Acceptable Treatment Packages are for each allotment.

7. Discussion and Recommendations

The road and railway noise propagation modelling indicates that, without noise mitigation measures, the traffic noise from Kwinana Freeway and railway noise from the Perth to Mandurah railway line, within a planning horizon of 15 years (year 2031), has the potential to impact on the proposed development. The dominant noise source is traffic on Kwinana Freeway, with lesser noise emissions from the Perth to Mandurah railway line.

SPP 5.4 specifies two objectives for protection of new noise-sensitive developments in the vicinity of an existing or future major road and/or rail corridor. These objectives are as follows:

- Compliance with applicable indoor design noise level criteria (as presented in Table 3.2); and
- Achieve noise target in at least one outdoor living area on each residential lot.

To achieve compliance with the above two objectives, consideration of appropriate transport noise mitigation strategies in the master planning and design of the proposed residential estate is required.

In keeping with the accepted transport noise mitigation strategies, implemented for other large scale subdivisions[9] along this transport corridor, a 4.0m high noise barrier wall along the boundary with Kwinana Freeway was considered as the primary noise mitigation measure. The 4.0m height of the noise barrier wall is determined relative to the finished surface level of the allotments in the first row along Kwinana Freeway.

The noise barrier wall should be designed and constructed in accordance with Section 5.3.2 of the SPP 5.4 Implementation Guidelines. The wall must be constructed of a material having minimum surface density of 15kg/m^2. There should be no gaps in the wall, except for drainage. Where access points for cycleways and/or pedestrian walkways are required through the recommended noise barrier wall, overlapping of adjacent barrier sections shall be used. The recommended arrangements for overlapping of noise barrier sections are presented in Appendix F (Figure 1).

The 4.0m high boundary noise barrier wall is highly effective in reducing traffic noise levels for low-set (single storey) houses, but two storey houses in the first row of allotments will be affected by traffic noise. There is also residual traffic noise in the interior of the development, hence further noise mitigation measures are required to achieve compliance with indoor noise criteria. In addition, protection for at least one outdoor living area is required by appropriate building orientation to achieve the 'noise target' from SPP 5.4.

Residual transport noise can be managed through planning noise mitigation measures such as: - notification under certificate of title; and specification of a type of dwelling to be constructed on noise affected allotments.

[9] ATP Consulting had carried out transport noise impact assessment for the Honeywood Estate, located on opposite side of Kwinana Freeway in Wandi.

The 'Quiet House' design principles from the SPP 5.4 Implementation Guidelines present advice on building design, layout, and orientation to help minimise noise impacts where transport noise levels are predicted to be above the 'noise targets'. These principles will ensure the following:

- Provision of at least one protected outdoor living area that will fall within the 'noise target' levels; and
- Minimal amount of treatment required to the building envelope including wall and roof insulation, upgraded glazing, and provision of mechanical ventilation.

Where the quiet house design principles fail to achieve these objectives, SPP 5.4 Implementation Guidelines proposes 'acceptable treatment packages'. These are conservatively selected construction specifications for the building envelope of the houses affected by traffic noise.

The three 'acceptable treatment packages' are presented in Table 7.1.

Table 7.1 Acceptable Treatment Packages

Treatment Package	Criteria to Apply	Noise Levels
No Treatment Required	When external façade adjusted noise levels are : *Equal to or less than Noise Target*	$L_{Aeq,Day}$: ≤ 55 dB(A) $L_{Aeq,Night}$: ≤ 50 dB(A)
Package A	When external façade adjusted noise levels are : *Between Noise Target and Noise Limit*	$L_{Aeq,Day}$: 56 – 60 dB(A) $L_{Aeq,Night}$: 51 – 55 dB(A)
Package B	When external façade adjusted noise levels are : *Up to Noise Limit + 3dBA*	$L_{Aeq,Day}$: 61 – 63 dB(A) $L_{Aeq,Night}$: 56 – 58 dB(A)
Package C	When external façade adjusted noise levels are : *Up to Noise Limit + 5dBA*	$L_{Aeq,Day}$: 64 – 65 dB(A) $L_{Aeq,Night}$: 59 – 60 dB(A)
Specialist acoustic advice	When external façade adjusted noise levels are : *Exceeding Noise Limit + 5dBA*	$L_{Aeq,Day}$: > 65 dB(A) $L_{Aeq,Night}$: > 60 dB(A)

What 'acceptable treatment packages' are applicable depends on the type of houses to be constructed and the calculated traffic noise levels. For low-set houses, or ground floors of high-set houses, the calculated traffic noise levels are lower. This is a result of the lower noise propagation height and the loss of energy due to screening by the noise barrier wall and the structures of the houses in the front rows of allotments.

The upper floors of two-storey houses, particularly in areas with mainly low-set houses, are more exposed to traffic noise. Because of the higher average propagation height, the screening effects by the noise barrier walls and building structures are lesser, thus higher noise levels.

7.1 Allotments Subject to 'Acceptable Treatment Packages'

7.1.1 Low-set Houses & Ground Floors of High-set Houses

The allotments subject to the 'acceptable treatment packages', as determined with consideration of low-set houses, or ground floors of high-set houses, are presented in Table 7.2.

Table 7.2 Allotments Subject to 'Acceptable Treatment Packages' – Low Set Houses

Allotment Number	Noise Mitigation Measures
Lot 231	No treatment required.
Lot 1 to 13, 15, 17 to 27, 38 to 48, 66 to 68, 82 to 92, 105 to 115, 122 to 136, 142 to 158, 163 to 169, 185 to 194, 198 to 208, 232 to 279, 295 to 296, 298, 300 to 306, 315 to 327, 330 to 366, 368 to 380, 406 to 407, 410, 470 to 476, 479 to 489, 503 to 518	Allotments subject to construction as per Acceptable Treatment Package 'A'.
Lot 14, 16, 21, 28 to 37, 49 to 55, 69 to 75, 78 to 81, 93 to 97, 100 to 104, 116 to 117, 120 to 121, 137 to 139, 141, 159 to 162, 170 to 184, 195 to 197, 201 to 206, 209, 212 to 216, 218 to 221, 223 to 225, 228 to 229, 258 to 259, 280 to 294, 297, 299, 307 to 314, 328 to 329, 367, 381 to 397, 400 to 405, 408 to 409, 411 to 426, 436 to 441, 444 to 458, 467 to 469, 477 to 478, 490 to 495, 500 to 502, 519 to 546, 560, 562 to 564	Allotments subject to construction as per Acceptable Treatment Package 'B'.
Lot 56 to 65, 76 to 77, 98 to 99, 118 to 119, 140, 210 to 211, 217, 222, 226 to 227, 230, 398 to 399, 427 to 435, 442 to 443, 459 to 466, 496 to 499, 547 to 559, 561, 565 to 568	Allotments subject to construction as per Acceptable Treatment Package 'C'.
None	Allotments subject to specialist acoustic advice.

7.1.2 Upper Floors of High-set Houses

The allotments subject to the 'acceptable treatment packages', as determined with consideration of upper floors of high-set houses, are presented in Table 7.3.

Table 7.3 Allotments Subject to 'Acceptable Treatment Packages' – High Set Houses

Allotment Number	Noise Mitigation Measures
None	No treatment required.
Lot 128, 148 to 151, 231, 339 to 347	Allotments subject to construction as per Acceptable Treatment Package 'A'.
Lot 1 to 10, 38 to 50, 66, 86 to 89, 108 to 112, 126 to 127, 129 to 134, 144 to 147, 152 to 157, 164 to 169, 185 to 193, 232 to 273, 315 to 338, 348 to 364, 368 to 374, 470 to 476, 479 to 488, 512 to 518	Allotments subject to construction as per Acceptable Treatment Package 'B'.
Lot 11 to 19, 22 to 27, 36 to 37, 51 to 52, 67 to 71, 82 to 85, 90 to 93, 105 to 107, 113 to 115, 122 to 125, 135 to 137, 142 to 143, 158, 163, 194, 197 to 207, 274 to 277, 295 to 314, 365 to 367, 375 to 393, 404 to 405, 449 to 452, 477 to 478, 489 to 491, 505 to 511, 519 to 530, 562	Allotments subject to construction as per Acceptable Treatment Package 'C'.
Lot 20 to 21, 28 to 35, 53 to 65, 72 to 81, 94 to 104, 116 to 121, 138 to 141, 159 to 162, 170 to 184, 195 to 196, 208 to 230, 278 to 294, 394 to 403, 406 to 448, 453 to 469, 492 to 504, 531 to 561, 563 to 568	Allotments subject to specialist acoustic advice.

The details of the 'acceptable treatment packages' from SPP 5.4 Implementation Guidelines are presented in Appendix G.

7.2 Allotments Requiring Protected Outdoor Living Area

The SPP 5.4 states the following requirements for outdoor areas:

- Allotments where the noise target is met require no noise mitigation measures.
- Allotments subject to noise levels within the *5dB margin* (i.e. between *noise target* and *noise limit* – see Table 3.1), require mitigation measures to achieve the *noise target* in at least one outdoor living area.
- Allotments subject to noise levels exceeding the *noise limit* require mitigation measures to achieve the *noise target* (or if not practicable, the *noise limit*) in at least one outdoor living area.

Based on the above selection criteria, the allotments that require protection for at least one outdoor living area on the ground floor were identified.

Protection for at least one outdoor living area is required at the allotments presented in Table 7.4.

Table 7.4 Allotments Requiring Protection for Outdoor Living Area

Allotment Number	Requirement
Lot 1 to 13, 15, 17 to 27, 38 to 48, 66 to 68, 82 to 92, 105 to 115, 122 to 136, 142 to 158, 163 to 169, 185 to 194, 198 to 208, 232 to 279, 295 to 296, 298, 300 to 306, 315 to 327, 330 to 366, 368 to 380, 406 to 407, 410, 470 to 476, 479 to 489, 503 to 518	Allotments subject to noise levels within the *5dB margin* on the most exposed façade. At least one protected outdoor living area must be provided to achieve the *noise target*.
Lot 14, 16, 21, 28 to 37, 49 to 65, 69 to 81, 93 to 104, 116 to 121, 137 to 141, 159 to 162, 170 to 184, 195 to 197, 201 to 206, 209 to 230, 258 to 259, 280 to 294, 297, 299, 307 to 314, 328 to 329, 367, 381 to 405, 408 to 409, 411 to 469, 477 to 478, 490 to 502, 519 to 568	Allotments subject to noise levels exceeding the *noise limit* on the most exposed façade. At least one protected outdoor living area must be provided to achieve the *noise limit*.

For protection of one outdoor living area, the recommended strategies in accordance with SPP 5.4 Guidelines, are as follows:

- Appropriate building orientation to locate one outdoor living area along a protected façade of the building.

  Note: "Protected façade" means the building façade located in the opposite side of the building from the transport corridor. At the proposed development, the protected façade is generally the western façade.

- Where it is impractical to locate the outdoor living area along a protected façade, the following alternative strategies can be adopted:

  - Provide screening to the outdoor living area with a solid continuous fence as per the specifications under the relevant 'acceptable treatment packages'; or
  - Locate the outdoor living area behind solid structures such as a garage.

7.2.1 Outdoor Living Area – Protected Façade

The results of noise modelling indicate the following:

- At all allotments subject to noise levels within the *5dB margin* (on the most exposed façade), the noise levels on the most protected façade is within the *noise target*; and
- At all allotments subject to noise levels exceeding the *noise limit* (on the most exposed façade), the noise levels on the most protected façade is within the *noise limit*.

Therefore, the structure of the houses themselves will provide acceptable level of protection for outdoor areas. Typical layout showing outdoor living area located on the protected façade is presented in Figure 7.1.

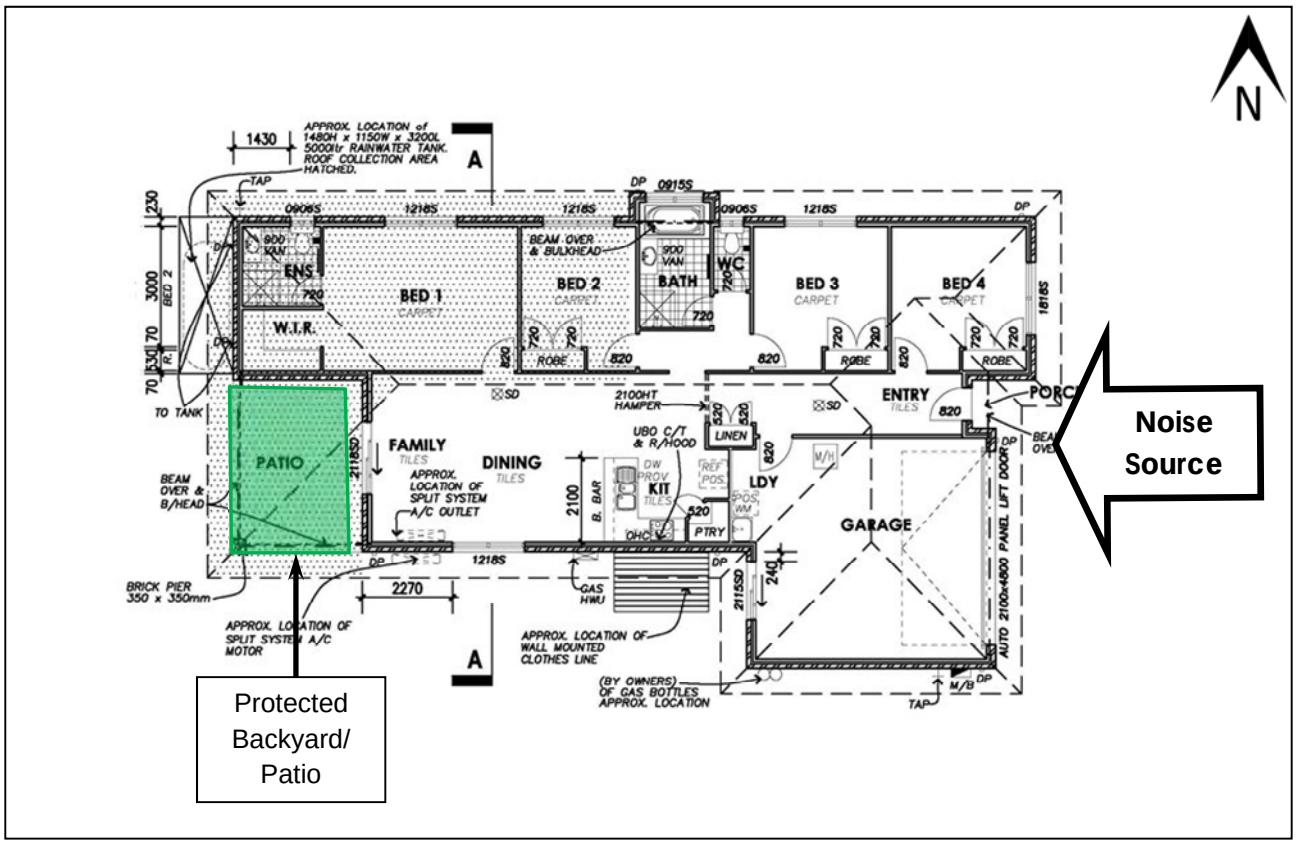

Figure 7.1 Outdoor Living Area on Protected Facade

7.2.2 Outdoor Living Area – Behind Noise Barrier Wall

For allotments which are adjacent to the proposed 4.0m high noise barrier wall, the outdoor living area is allowed to be located directly behind the noise barrier wall on the ground floor, as per the layout shown in Figure 7.2.

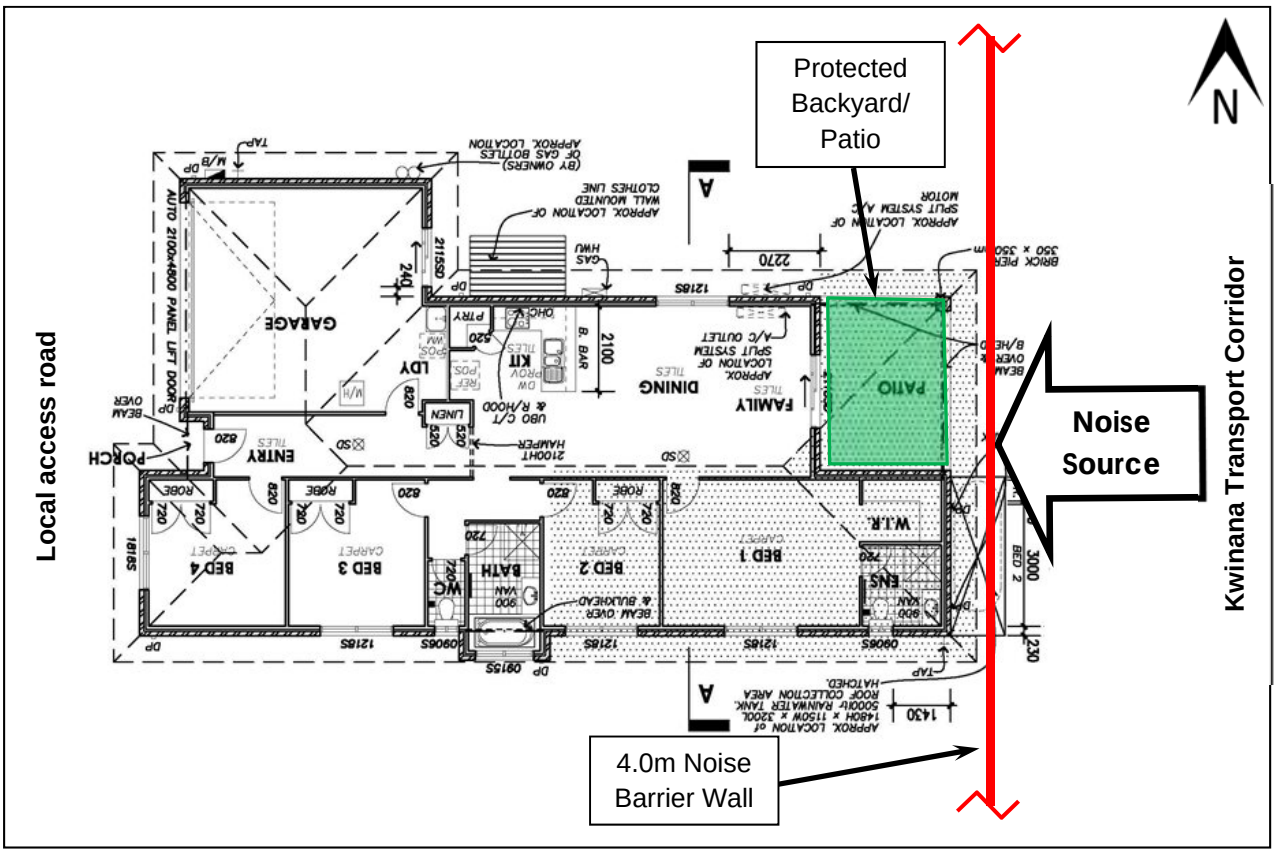

Figure 7.2 Outdoor Living Area behind Noise Barrier Wall

Allotments where this strategy can be implemented are listed as follows:

Allotment number: 21, 170 to 184, 406 to 410

Note that this strategy only works for allotments directly abutting the noise barrier, where the outdoor living area can be located directly behind the noise barrier wall. This strategy does not work for other first row allotments which are separated from the noise barrier by a roadway. With increased distance from the noise barrier the noise barrier offers less protection.

Figure 7.3 presents the allotments where the outdoor living area can be located behind the noise barrier wall with no need for additional screening.

Figure 7.3 Protection by Noise Barrier Wall

7.3 Alternative Noise Mitigation Strategies

The noise mitigation measures presented above represent the primary transport noise control strategy based on the measures adopted for similar residential subdivisions along the Kwinana Freeway.

Other control measures were also investigated with the aim to broaden the options for selection of traffic noise mitigation best suited to the detailed design of various stages of the development. There are several potential alternative traffic noise mitigation strategies based on various combination of buildings and noise barrier walls.

7.3.1 Option 1: Row of High-set Houses

Since visual impacts and aesthetics should be considered in determining an optimal height of a noise wall, a practical alternative to continuous very high noise wall is to utilise building structures as noise barriers. The main elements of this traffic noise mitigation option, are as follows:

- The two-storey houses will be specifically designed to engage with the neighbourhood to the front of the house with the back facing the transport corridor;
- The noise sensitive internal areas, such as bedrooms and living areas and outdoor living areas, will be situated away from the noise source, while service areas such as garages, store rooms, bathrooms and laundries will be located to the back of the house;
- The facades facing the transport corridor will be articulated to enhance the visual appearance, when viewed from Kwinana Freeway or the railway line, but will have no windows or only small acoustically treated windows for the bathrooms and laundries; and
- There will be no noise barrier wall along the site boundary, but the gaps between the adjoining houses will be enclosed by 4.0m high noise walls.

With an effective height of 8m, the two storey houses on the first row of allotments will provide better than 8dB(A) noise reduction due to screening by the building structures. An illustration of Option 1 noise mitigation is presented in Appendix H (Figure 1).

7.3.2 Option 2: Row of High-set Houses and Boundary Noise Walls

This scenario is a variant of the previous one, with construction of high-set houses in the first row of allotments where the terrain and the development layout allows. Wherever practical, a 4.0m high noise barrier wall will be considered between the adjacent houses. In the areas where there are larger gaps between the residential allotment clusters, a 4.0m high noise walls will be constructed along the eastern boundary.

The transition between the high density buildings and the noise wall will be designed to provide adequate overlapping in accordance with Section 5.3 of SPP 5.4 Implementation Guidelines. An illustration of Option 2 noise mitigation is presented in Appendix H (Figure 2).

7.3.3 Option 3: Continuous Row of High-set Houses

Under this scenario, the whole interface of the Mandogalup subdivision with the Kwinana Freeway can be designed as a combination of noise barrier walls of moderate height with building structures of increasing height located in the first row of allotments. The main elements under this strategy are:

- Noise barrier wall (2.5m high) along the full eastern boundary that will reduce the initial energy of the traffic noise emissions and will delineate the subdivision from the transport noise corridor;
- A laneway will run along the full length of the noise barrier wall that will provide access to the first row of allotments which will be of long and narrow design;
- The first structures on the allotments will be free-standing double garages (4.0m high) that will provide protection from noise to the outdoor living areas located between the garages and the high-set (two-storey) houses at the back of the allotments;
- The ground floors of the houses will also be protected from traffic noise by the 4.0m high structure of the garages, thus creating opportunity for transition from the ground floor living/dining areas to the quiet outdoor living area; and

- The upper floors of the two-storey houses will be designed with store rooms and bathrooms along the traffic noise impacted eastern façade with no, or small, windows.

Under this scenario, the noise reduction potential of the high-set houses (8m high), will be combined with a visual transition to the 4.0m high garage structures and finally to the 2.5m high noise barrier wall along the transport corridor boundary.

An illustration of Option 3 noise mitigation is presented in Appendix H (Figure 3).

The effectiveness of the alternative noise mitigation strategies was considered during the noise propagation modelling, with all three options achieving similar noise reduction. The alternative noise mitigation strategies will be investigated further and refined as part of the detailed design of the subdivision under the overall Mandogalup East Local Structure Plan.

8. Conclusions

Based on the results of the road and railway noise assessment for the proposed Mandogalup East Local Structure Plan in Mandogalup, the following is concluded:

- Within a planning horizon of 15 years (year 2031), without noise mitigation measures, the traffic noise from Kwinana Freeway and railway noise from the Perth to Mandurah railway line, has the potential to impact on the proposed development.
- The dominant noise source is traffic on Kwinana Freeway, with lesser noise emissions from the Perth to Mandurah railway line, thus the noise mitigation measures are based on the requirement for the control of road traffic noise emissions.
- In keeping with the accepted transport noise mitigation strategies implemented for other large scale subdivisions along this transport corridor, a 4.0m high noise barrier wall along the entire eastern boundary with Kwinana Freeway was considered as the primary noise mitigation measure.
- The 4.0m height of the noise barrier wall is determined relative to the finished surface level of the allotments in the first row along Kwinana Freeway.
- The noise barrier wall should be designed and constructed in accordance with Section 5.3.2 of the SPP 5.4 Implementation Guidelines. The wall must be constructed of a material having minimum surface density of 15kg/m^2.
- The 4m high boundary noise barrier wall is highly effective in reducing traffic noise levels for low-set (single storey) houses but two storey houses in the first row of allotments will be affected by traffic noise.
- There is also residual traffic noise in the interior of the development, hence further noise mitigation measures are required to achieve compliance with indoor noise criteria. In addition, protection for at least one outdoor living area is required by appropriate building orientation to achieve the 'noise target' from SPP 5.4.
- Residual transport noise can be managed through further planning noise mitigation measures such as notification under certificate of title and specification of a type of dwelling to be constructed on the noise affected allotments as per the 'acceptable treatment packages' from Section 6.3 of SPP 5.4 Implementation Guidelines.
- The allotments subject to 'acceptable treatment packages' for low-set and upper floors of high-set houses are presented in Tables 7.2 and 7.3 of this report.
- Other control measures were also investigated with the aim to broaden the options for selection of traffic noise mitigation best suited to the detailed design of various stages of the development.
- There are several potential alternative traffic noise mitigation strategies based on various combination of buildings and noise barrier walls, which will be investigated further and refined as part of the detailed design of the subdivision under the overall Mandogalup East Local Structure Plan.

9. References

- Standard Australia (1997) *AS1055.1-1997* (*Acoustics - Description and Measurement of Environmental Noise Part 1: General Procedures*)

- Standards Australia (1984) *AS2702-1984* (*Acoustics – Methods for the measurement of road traffic noise*)

- Standards Australia (1989) *AS3671-1989* (*Acoustics – Road Traffic Noise Intrusion – Building siting and construction*)

- Standards Australia (2004) *ASIEC61672.1-2004* (*Electroacoustics - Sound level meters – Specifications*)

- Western Australian Planning Commission (2009) *State Planning Policy 5.4: Road and Rail Transport Noise and Freight Considerations in Land Use Planning*

- Western Australian Planning Commission (2014) *Implementation Guidelines for State Planning Policy 5.4: Road and Rail Transport Noise and Freight Considerations in Land Use Planning*

Appendix A – Mandogalup Structure Plan

Rowley Road

1

Kwinana Freeway

Planning Design Delivery

LEGEND

- Combined Mandogalup Strutcture Plan Boundary
- Existing Boundaries
- Proposed Boundaries
- Residential (R20 - R80)
- POS
- School
- Local Centre
- Planning Control Area
- DBNGP Easement
- High Voltage Powerline Easement
- Peel Main Drain
- 1 Investigation Area - Proposed Local Playing Fields
- Proposed WTCPA 1.5km Buffer
- Drainage

0 125 Metres

REVISIONS

Rev	Date	Drawn
G	2016.09.07	M. Sullivan
H	2016.09.28	M. Sullivan
I	2016.10.03	M. Sullivan
J	2016.11.08	M. Sullivan

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Date Drawn:	2016-03-16
Job Ref:	7282A
Scale:	1:2,500@ A1
Client:	Satterley Property Group
Designer:	R. Cumming
Drawn:	M. Sullivan
Projection:	PCG94
Plan ID:	7282A-CON-08-J

-

Mandogalup Overall Concept Plan

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_CON08J_20161108_MANDOGALUP (CONCEPT RC).DWG
Matt Sullivan 8 November 2016

Mandogalup

Planning Design Delivery

RESIDENTIAL
- Residential (R30-R80)

PUBLIC PURPOSE
- PS Educational/Institutional
  - PS Primary School

PARKS,RECREATION & CONSERVATION
- Parks, Recreation and Drainage
- Drainage

TRANSPORT
- Access Street - Local Road
- Primary Distributor Road
- District Distributor Integrator A
- Neighbourhood Connector
- Temporary Neighbourhood Connector
- Indicative Cycleway Access

OTHER
- Structure Plan Boundary

ADDITIONAL INFORMATION
- Proposed WTCPA - 1.5km Buffer
- DBNGP Easement
- Western Power Easement
- 1 Investigation Area - Local Playing Fields
- Existing Lot Boundaries
- Planning Control Area No.112
- Indicative Neighbourhood Centre

0 200 400 Metres

REVISIONS

Rev	Date	Drawn
E	2016.07.27	W. Clements
F	2016.09.06	M. Sullivan
G	2016.11.03	M. Sullivan
H	2016.11.08	M. Sullivan

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p: 08 9221 1991

Date Drawn:	2016-03-17
Job Ref:	7282A
Scale:	1:7500 @ A3
Client:	Satterley Property Group
Designer:	R. Cumming
Drawn:	M. Sullivan
Projection:	PCG 94
Plan ID:	7282A-STR-05-H

Mandogalup Local Structure Plan

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_STR05H_20161108 MANDOGALUP (WAPC - PROPOSED).DWG
Matt Sullivan 8 November 2016

Planning Design Delivery

LEGEND

- Structure Plan Boundary
- Existing Boundaries
- Proposed Boundaries
- Indicative Boundaries
- Residential (R20 - R80)
- POS
- School
- Planning Control Area
- Local Drainage
- DBNGP Easement
- High Voltage Powerline Easement
- Peel Main Drain
- 1 Investigation Area - Local Playing Fields
- Proposed WTCPA 1.5km Buffer

1

Kwinana Freeway

0 125 Metres

REVISIONS

Rev	Date	Drawn
G	2016.09.07	M. Sullivan
H	2016.09.28	M. Sullivan
I	2016.10.03	M. Sullivan
J	2016.11.08	M. Sullivan

ROWEGROUP
PLANNING DESIGN DELIVERY

w: www.rowegroup.com.au
e: info@rowegroup.com.au
p: 08 9221 1991

Date Drawn:	2016-03-16
Job Ref:	7282A
Scale:	1:2,500@ A1
Client:	Satterley Property Group
Designer:	R. Cumming
Drawn:	M. Sullivan
Projection:	PCG94
Plan ID:	7282A-CON-08-J

-

Mandogalup East Concept Plan

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_CON08J_20161108_MANDOGALUP (CONCEPT RC).DWG
Matt Sullivan 8 November 2016

Mandogalup

Planning Design Delivery

LEGEND

- Local Structure Plan Boundary
- Existing Cadastre
- Indicative Lot Layout
- Indicative Layout By Others
- Local Drainage
- DBNGP Easement
- High Voltage Powerline Easement
- Peel Main Drain

NOTE: Lot layout provided for explanatory purposes only, and is subject to review and detailed design at subdivsion stage.

0 125 250 Metres

REVISIONS

Rev	Date	Drawn
C	2016.09.12	M. Sullivan
D	2016.09.23	M. Sullivan
E	2016.11.03	M. Sullivan
F	2016.11.08	M. Sullivan

ROWEGROUP
PLANNING DESIGN DELIVERY

w: www.rowegroup.com.au
e: info@rowegroup.com.au
p: 08 9221 1991

Date Drawn:	2014-07-16
Job Ref:	7282A
Scale:	1:6000 @ A3
Client:	Satterley Property Group
Designer:	K. Kyle
Drawn:	M. Winfield
Projection:	PCG 94
Plan ID:	7282A-FIG-38-F

Cadastre supplied by McMullen Nolan

Indicative Plan of Subdivision

Mandogalup
Figure 13

N:\TOWN PLANNING\7000-7999\7282\7282A\DRAFTING\A-CAD\7282A_FIG38F_20161108_MANDOGALUP (SUBDIVISION).DWG
Matt Sullivan 8 November 2016

Appendix B – Noise Measurement Results

ATP140414
Mandogalup Estate
Traffic Noise

Use for average	Date	Day	L10 18hr day (6am-12am)	L10 1hr max 6am-10pm	Time for L10 1hr max 6am -10pm	L10 1hr max 10pm-6am	Time for L10 1hr max 10pm -6am	L90 18hr (6am-12am)	L90 8hr (10pm-6am)	Leq 16hr (6am-10pm)	Leq 8hr (10pm-6am)
√	8/07/2013	Monday	63	66	7:45	63	5:45	56	46	62	56
√	9/07/2013	Tuesday	64	68	18:45	63	5:45	58	45	63	55
√	10/07/2013	Wednesday	63	65	11:45	63	5:45	56	46	62	55
√	11/07/2013	Thursday	63	65	8:45	62	5:45	56	46	62	54
√	12/07/2013	Friday	63	65	7:45	60	22:45	56	47	61	55
AVERAGE			63	66		62		56	46	62	55

Acoustic Research Laboratories Pty Ltd - Type 1 Environmental Noise Logger

Logger Serial Number	16-707-017
Measurement Title	Field Reading.
Measurement started at	7/04/2013 8:54
Measurement stopped at	18/07/2013 5:39
Frequency Weighting	A
Time Averaging	Fast
Statistical Interval	15 minutes
Auxiliary Power	Disabled
Tape Recorder	Disabled
Short Term Leq	Disabled
Short Term Leq Length	N/A
Start Trigger	N/A
Stop Trigger	N/A
Master Timer	N/A
Sub Timer	N/A
Pre-measurement Reference	94
Post-measurement Reference	94
Engineering Units	dB SPL

Appendix C – Traffic Noise Model Validation (SoundPLAN)

Mandogalup Estate
Assessed Receiver Levels
Traffic Noise Model Validation 2013 Situation

Receiver	SPL L10(18-hour) dB(A)
EL316 Noise Logger	63

Appendix D – Transport Noise Levels (SoundPLAN Tables)

Allotments subject to Acceptable Treatment Packages - Most exposed façade

Ground Floor

	Day			Night			SPP 5.4 Criteria
Receiver	Road_Max Leq(16h) Day	Rail_Max Leq(16h) Day	Combined_Max Leq(16h) Day	Road_Max Leq(8h) Night	Rail_Max Leq(8h) Night	Combined_Max Leq(8h) Night	Acceptable Treatment Package_SPP5.4
Lot 001	57	52	58	50	41	50	A
Lot 002	57	52	58	50	41	50	A
Lot 003	57	52	58	50	41	50	A
Lot 004	57	53	58	50	42	50	A
Lot 005	57	53	58	50	42	51	A
Lot 006	57	53	58	50	42	51	A
Lot 007	58	53	59	51	42	51	A
Lot 008	58	54	59	51	43	52	A
Lot 009	58	54	59	51	43	51	A
Lot 010	58	54	59	51	43	52	A
Lot 011	58	54	59	51	43	52	A
Lot 012	58	55	60	51	44	52	A
Lot 013	59	54	60	52	44	52	A
Lot 014	59	55	60	52	44	52	B
Lot 015	59	54	60	52	43	52	A
Lot 016	59	54	60	52	43	52	B
Lot 017	59	54	60	52	43	52	A
Lot 018	58	53	59	51	42	51	A
Lot 019	58	53	59	51	42	52	A
Lot 020	59	54	60	52	43	52	A
Lot 021	60	54	61	53	43	53	B
Lot 022	57	53	59	50	42	51	A
Lot 023	57	53	58	50	42	50	A
Lot 024	58	54	59	51	43	52	A
Lot 025	58	54	59	51	43	51	A
Lot 026	58	54	59	51	43	52	A
Lot 027	59	54	60	52	43	52	A
Lot 028	59	54	60	52	43	53	B
Lot 029	60	54	61	53	43	53	B
Lot 030	61	53	61	54	42	54	B
Lot 031	62	54	62	55	43	55	B
Lot 032	61	55	62	54	44	54	B
Lot 033	61	55	62	54	44	54	B
Lot 034	61	55	62	54	45	54	B
Lot 035	61	55	61	54	44	54	B
Lot 036	60	55	61	53	44	54	B
Lot 037	60	55	61	53	44	53	B
Lot 038	59	54	60	52	43	52	A
Lot 039	57	53	58	50	42	50	A
Lot 040	56	54	58	49	43	50	A
Lot 041	56	53	57	49	42	49	A
Lot 042	56	53	57	49	42	49	A
Lot 043	56	53	57	49	42	50	A
Lot 044	55	52	57	48	41	49	A
Lot 045	56	52	57	49	41	49	A
Lot 046	56	52	57	49	41	49	A
Lot 047	59	53	60	52	42	52	A
Lot 048	58	52	58	51	41	51	A
Lot 049	59	55	60	52	44	53	B
Lot 050	59	55	60	52	44	53	B
Lot 051	60	55	61	53	44	53	B
Lot 052	60	55	61	53	44	53	B
Lot 053	62	55	63	55	44	55	B
Lot 054	62	55	63	55	44	55	B
Lot 055	62	55	63	55	44	56	B
Lot 056	62	55	63	55	44	56	C
Lot 057	63	55	63	56	44	56	C
Lot 058	63	55	63	56	44	56	C
Lot 059	63	55	63	56	44	56	C
Lot 060	63	55	63	56	44	56	C
Lot 061	63	55	63	56	44	56	C
Lot 062	63	55	63	56	44	56	C
Lot 063	63	55	63	56	44	56	C
Lot 064	63	55	63	56	45	56	C
Lot 065	63	55	63	56	45	56	C
Lot 066	56	54	58	49	43	50	A
Lot 067	57	55	59	50	44	51	A
Lot 068	58	55	59	51	44	51	A
Lot 069	59	55	60	52	44	52	B
Lot 070	59	55	60	52	44	53	B
Lot 071	60	55	61	53	44	53	B
Lot 072	60	55	61	53	44	53	B
Lot 073	60	56	61	53	45	54	B
Lot 074	60	56	61	53	45	54	B
Lot 075	61	57	62	54	46	54	B
Lot 076	63	57	64	56	46	57	C
Lot 077	63	56	64	56	46	57	C
Lot 078	60	56	62	53	46	54	B
Lot 079	59	57	61	52	46	53	B
Lot 080	59	57	61	52	46	52	B
Lot 081	58	57	60	51	46	52	B

Lot 082	58	56	60	51	45	51	A
Lot 083	57	56	59	50	45	51	A
Lot 084	57	56	59	50	45	51	A
Lot 085	56	55	59	49	44	50	A
Lot 086	57	55	59	50	44	51	A
Lot 087	57	55	59	50	44	51	A
Lot 088	57	55	59	50	44	51	A
Lot 089	58	56	60	51	45	52	A
Lot 090	58	55	59	51	44	51	A
Lot 091	58	55	60	51	44	52	A
Lot 092	58	55	60	51	44	52	A
Lot 093	59	55	60	52	44	52	B
Lot 094	59	55	60	52	44	53	B
Lot 095	60	56	61	53	45	53	B
Lot 096	60	56	61	53	45	54	B
Lot 097	61	56	62	54	45	54	B
Lot 098	63	56	64	56	45	56	C
Lot 099	64	57	64	57	46	57	C
Lot 100	60	57	62	53	46	54	B
Lot 101	60	57	61	53	46	53	B
Lot 102	59	56	61	52	45	53	B
Lot 103	59	56	60	52	45	52	B
Lot 104	58	56	60	51	45	52	B
Lot 105	57	55	59	50	44	51	A
Lot 106	56	55	58	49	44	50	A
Lot 107	56	54	58	49	43	50	A
Lot 108	55	53	57	48	42	49	A
Lot 109	56	54	58	49	43	50	A
Lot 110	56	54	58	49	43	50	A
Lot 111	57	55	59	50	44	51	A
Lot 112	58	54	59	51	44	51	A
Lot 113	58	55	59	51	44	52	A
Lot 114	58	55	60	51	44	52	A
Lot 115	58	55	60	51	44	52	A
Lot 116	59	56	61	52	45	53	B
Lot 117	60	56	61	53	45	53	B
Lot 118	62	58	64	55	47	56	C
Lot 119	62	57	63	55	46	56	C
Lot 120	62	57	63	55	46	55	B
Lot 121	61	57	63	54	46	55	B
Lot 122	57	55	59	50	44	51	A
Lot 123	57	55	59	50	44	51	A
Lot 124	57	55	59	50	44	51	A
Lot 125	57	55	59	50	44	51	A
Lot 126	56	54	58	49	43	50	A
Lot 127	56	54	58	49	43	50	A
Lot 128	55	52	57	48	42	49	A
Lot 129	55	53	57	48	42	49	A
Lot 130	56	53	57	49	42	49	A
Lot 131	56	54	58	49	43	50	A
Lot 132	56	52	57	49	42	50	A
Lot 133	57	54	58	50	43	50	A
Lot 134	57	54	59	50	43	51	A
Lot 135	58	55	60	51	44	52	A
Lot 136	58	55	60	51	44	52	A
Lot 137	59	56	60	52	45	52	B
Lot 138	61	58	63	54	47	55	B
Lot 139	61	57	62	54	46	55	B
Lot 140	62	58	63	55	47	55	C
Lot 141	61	57	62	54	46	55	B
Lot 142	58	56	60	51	45	52	A
Lot 143	56	54	58	49	43	50	A
Lot 144	56	54	58	49	43	50	A
Lot 145	55	53	57	48	42	49	A
Lot 146	55	53	57	48	42	49	A
Lot 147	55	52	56	48	42	48	A
Lot 148	54	51	56	47	40	48	A
Lot 149	54	51	55	47	40	48	A
Lot 150	53	51	55	46	40	47	A
Lot 151	54	52	56	47	41	48	A
Lot 152	56	52	57	49	41	49	A
Lot 153	56	52	57	49	41	49	A
Lot 154	56	53	58	49	42	50	A
Lot 155	56	53	58	49	42	50	A
Lot 156	57	54	59	50	43	51	A
Lot 157	57	54	59	50	43	51	A
Lot 158	58	55	60	51	44	52	A
Lot 159	61	57	63	54	46	55	B
Lot 160	61	57	62	54	46	55	B
Lot 161	61	56	62	54	45	54	B
Lot 162	61	56	62	54	45	54	B
Lot 163	57	55	59	50	44	51	A
Lot 164	56	53	58	49	42	50	A
Lot 165	56	53	57	49	42	50	A
Lot 166	55	52	57	48	41	49	A
Lot 167	55	52	57	48	42	49	A
Lot 168	54	52	56	47	41	48	A
Lot 169	55	51	56	48	40	48	A
Lot 170	60	55	61	53	44	53	B

Lot 171	59	55	61	52	44	53	B
Lot 172	59	55	60	52	44	53	B
Lot 173	60	55	61	53	44	53	B
Lot 174	60	54	61	53	43	53	B
Lot 175	60	55	61	53	44	53	B
Lot 176	59	54	60	52	43	53	B
Lot 177	60	55	61	53	44	53	B
Lot 178	60	55	61	53	44	53	B
Lot 179	60	54	61	53	43	53	B
Lot 180	60	54	60	53	43	53	B
Lot 181	60	54	61	53	43	53	B
Lot 182	60	54	60	53	43	53	B
Lot 183	59	54	60	52	43	53	B
Lot 184	59	54	60	52	43	53	B
Lot 185	57	54	59	50	43	51	A
Lot 186	57	54	58	50	43	51	A
Lot 187	57	54	59	50	43	51	A
Lot 188	57	54	59	50	43	51	A
Lot 189	57	54	59	50	44	51	A
Lot 190	57	55	59	50	44	51	A
Lot 191	58	55	59	51	44	51	A
Lot 192	56	54	58	49	43	50	A
Lot 193	56	54	58	49	43	50	A
Lot 194	56	54	58	49	43	50	A
Lot 195	61	57	62	54	46	55	B
Lot 196	61	57	62	54	46	54	B
Lot 197	58	56	60	51	45	52	B
Lot 198	58	55	59	51	44	51	A
Lot 199	57	55	59	50	44	51	A
Lot 200	58	55	60	51	44	52	A
Lot 201	59	55	60	52	44	52	B
Lot 202	59	56	61	52	45	53	B
Lot 203	59	55	60	52	44	52	B
Lot 204	59	56	61	52	45	53	B
Lot 205	60	56	62	53	46	54	B
Lot 206	61	57	62	54	46	55	B
Lot 207	57	56	59	50	45	51	A
Lot 208	58	56	60	51	45	52	A
Lot 209	58	57	60	51	46	52	B
Lot 210	62	58	63	55	47	55	C
Lot 211	63	58	64	56	47	56	C
Lot 212	62	56	63	55	45	55	B
Lot 213	62	56	62	55	45	55	B
Lot 214	61	56	62	54	45	55	B
Lot 215	62	56	63	55	45	55	B
Lot 216	62	56	63	55	45	55	B
Lot 217	62	56	63	55	45	56	C
Lot 218	61	55	62	54	44	54	B
Lot 219	62	55	62	55	44	55	B
Lot 220	62	56	63	55	45	55	B
Lot 221	62	56	63	55	45	55	B
Lot 222	62	56	63	55	45	56	C
Lot 223	61	55	62	54	44	55	B
Lot 224	62	55	62	55	44	55	B
Lot 225	62	56	63	55	45	55	B
Lot 226	62	56	63	55	45	56	C
Lot 227	63	56	63	56	46	56	C
Lot 228	62	55	62	55	44	55	B
Lot 229	62	55	63	55	44	55	B
Lot 230	62	56	63	55	45	56	C
Lot 231	54	50	55	47	39	47	None
Lot 232	55	52	57	48	42	49	A
Lot 233	57	53	58	50	42	50	A
Lot 234	57	53	58	50	42	51	A
Lot 235	57	53	58	50	43	51	A
Lot 236	57	53	58	50	42	51	A
Lot 237	57	54	59	50	43	51	A
Lot 238	57	53	58	50	43	51	A
Lot 239	57	54	59	50	43	51	A
Lot 240	57	53	59	50	43	51	A
Lot 241	57	53	59	50	42	51	A
Lot 242	58	54	59	51	43	51	A
Lot 243	58	53	59	51	42	51	A
Lot 244	57	51	58	50	41	50	A
Lot 245	59	54	60	52	43	52	A
Lot 246	54	53	56	47	42	48	A
Lot 247	55	52	57	48	42	49	A
Lot 248	55	53	57	48	42	49	A
Lot 249	57	55	59	50	44	51	A
Lot 250	58	55	60	51	44	52	A
Lot 251	58	55	60	51	44	52	A
Lot 252	58	55	60	51	44	52	A
Lot 253	58	55	60	51	44	52	A
Lot 254	58	55	60	51	44	52	A
Lot 255	58	55	60	51	44	52	A
Lot 256	58	55	60	51	44	52	A
Lot 257	59	55	60	52	44	52	A
Lot 258	59	55	60	52	44	52	B
Lot 259	59	55	60	52	44	52	B

Lot 260	58	53	59	51	42	52	A
Lot 261	58	53	59	51	42	51	A
Lot 262	58	53	59	51	42	51	A
Lot 263	57	53	59	50	42	51	A
Lot 264	57	54	58	50	43	50	A
Lot 265	57	54	58	50	43	50	A
Lot 266	57	54	58	50	43	50	A
Lot 267	57	54	58	50	43	50	A
Lot 268	57	54	58	50	43	50	A
Lot 269	56	54	58	49	43	50	A
Lot 270	56	54	58	49	43	50	A
Lot 271	56	54	58	49	43	50	A
Lot 272	56	54	58	49	43	50	A
Lot 273	56	54	58	49	43	50	A
Lot 274	56	54	58	49	43	50	A
Lot 275	57	55	59	50	44	51	A
Lot 276	57	55	59	50	44	51	A
Lot 277	57	55	59	50	45	51	A
Lot 278	58	56	60	51	45	51	A
Lot 279	58	56	60	51	45	51	A
Lot 280	61	55	62	54	44	54	B
Lot 281	61	56	62	54	45	55	B
Lot 282	62	56	62	55	45	55	B
Lot 283	62	56	63	55	45	55	B
Lot 284	62	56	63	55	45	55	B
Lot 285	62	55	62	55	45	55	B
Lot 286	62	55	62	55	44	55	B
Lot 287	62	55	63	55	45	55	B
Lot 288	62	56	63	55	45	55	B
Lot 289	60	55	61	53	44	54	B
Lot 290	59	56	61	52	45	53	B
Lot 291	59	56	61	52	46	53	B
Lot 292	59	57	61	52	46	53	B
Lot 293	59	57	61	52	46	53	B
Lot 294	59	56	60	52	45	52	B
Lot 295	58	56	60	51	45	52	A
Lot 296	58	55	60	51	45	52	A
Lot 297	58	56	60	51	45	52	B
Lot 298	58	56	60	51	45	51	A
Lot 299	59	55	60	52	44	52	B
Lot 300	57	55	59	50	44	51	A
Lot 301	57	55	59	50	44	51	A
Lot 302	57	55	59	50	44	51	A
Lot 303	57	55	59	50	44	51	A
Lot 304	57	55	59	50	44	51	A
Lot 305	57	55	59	50	44	51	A
Lot 306	57	56	59	50	45	51	A
Lot 307	60	57	61	53	46	53	B
Lot 308	60	57	61	53	46	54	B
Lot 309	60	56	61	53	46	54	B
Lot 310	60	56	61	53	45	54	B
Lot 311	60	56	62	53	45	54	B
Lot 312	61	56	62	54	45	54	B
Lot 313	61	56	62	54	45	54	B
Lot 314	61	56	62	54	45	55	B
Lot 315	56	51	57	49	40	49	A
Lot 316	59	54	60	52	43	52	A
Lot 317	58	54	59	51	43	52	A
Lot 318	58	54	59	51	43	51	A
Lot 319	58	54	59	51	43	51	A
Lot 320	58	54	59	51	43	51	A
Lot 321	58	54	59	51	43	51	A
Lot 322	58	54	59	51	43	51	A
Lot 323	58	54	59	51	43	52	A
Lot 324	58	54	59	51	44	52	A
Lot 325	58	54	59	51	43	52	A
Lot 326	58	54	60	51	43	52	A
Lot 327	59	54	60	52	43	52	A
Lot 328	59	54	60	52	44	53	B
Lot 329	60	55	61	53	44	53	B
Lot 330	58	53	59	51	42	52	A
Lot 331	58	52	59	51	42	52	A
Lot 332	58	52	59	51	41	52	A
Lot 333	58	52	59	51	41	52	A
Lot 334	58	52	59	51	41	51	A
Lot 335	58	52	59	51	41	51	A
Lot 336	58	51	58	51	41	51	A
Lot 337	57	51	58	50	40	51	A
Lot 338	57	51	58	50	40	51	A
Lot 339	57	51	58	50	40	51	A
Lot 340	57	51	58	50	40	50	A
Lot 341	57	51	58	50	40	50	A
Lot 342	56	50	57	49	40	50	A
Lot 343	56	50	57	49	39	49	A
Lot 344	56	50	56	49	39	49	A
Lot 345	55	52	57	48	41	49	A
Lot 346	55	52	56	48	41	48	A
Lot 347	55	52	57	48	41	49	A
Lot 348	55	52	57	48	41	49	A

Lot 349	56	52	57	49	41	49	A
Lot 350	56	52	58	49	41	50	A
Lot 351	57	52	58	50	41	51	A
Lot 352	57	52	58	50	41	50	A
Lot 353	57	53	58	50	42	51	A
Lot 354	59	54	60	52	43	52	A
Lot 355	58	53	59	51	42	52	A
Lot 356	58	53	59	51	42	52	A
Lot 357	58	53	59	51	42	52	A
Lot 358	58	53	59	51	42	51	A
Lot 359	58	53	59	51	42	51	A
Lot 360	58	52	59	51	41	51	A
Lot 361	57	54	59	50	43	51	A
Lot 362	57	54	59	50	43	51	A
Lot 363	57	54	59	50	43	51	A
Lot 364	57	54	59	50	43	51	A
Lot 365	57	54	59	50	43	51	A
Lot 366	56	54	58	49	43	50	A
Lot 367	60	55	61	53	44	53	B
Lot 368	57	55	59	50	44	51	A
Lot 369	57	55	59	50	44	51	A
Lot 370	57	54	59	50	44	51	A
Lot 371	57	54	59	50	43	51	A
Lot 372	57	54	59	50	43	51	A
Lot 373	57	54	59	50	43	51	A
Lot 374	57	54	59	50	43	51	A
Lot 375	57	54	59	50	43	51	A
Lot 376	57	54	59	50	43	51	A
Lot 377	57	54	59	50	44	51	A
Lot 378	57	54	59	50	43	51	A
Lot 379	59	54	60	52	43	52	A
Lot 380	59	53	60	52	42	52	A
Lot 381	60	56	62	53	45	54	B
Lot 382	60	56	61	53	45	54	B
Lot 383	60	56	61	53	45	53	B
Lot 384	60	56	61	53	45	53	B
Lot 385	60	56	61	53	45	53	B
Lot 386	60	56	61	53	45	53	B
Lot 387	59	56	61	52	45	53	B
Lot 388	59	56	61	52	45	53	B
Lot 389	60	56	61	53	45	53	B
Lot 390	60	56	61	53	45	53	B
Lot 391	60	56	61	53	45	53	B
Lot 392	60	56	61	53	45	53	B
Lot 393	59	55	60	52	44	53	B
Lot 394	59	55	61	52	44	53	B
Lot 395	59	56	61	52	45	53	B
Lot 396	59	56	60	52	45	53	B
Lot 397	59	56	61	52	45	53	B
Lot 398	62	57	63	55	46	56	C
Lot 399	62	58	64	55	47	56	C
Lot 400	60	56	61	53	46	54	B
Lot 401	60	56	61	53	45	53	B
Lot 402	59	56	61	52	45	53	B
Lot 403	59	55	60	52	45	52	B
Lot 404	59	56	60	52	45	52	B
Lot 405	59	56	61	52	45	53	B
Lot 406	59	53	59	52	42	52	A
Lot 407	59	53	60	52	42	52	A
Lot 408	59	54	60	52	43	52	B
Lot 409	59	54	60	52	43	52	B
Lot 410	59	55	60	52	44	52	A
Lot 411	59	56	60	52	45	52	B
Lot 412	58	56	60	51	45	52	B
Lot 413	59	56	60	52	45	52	B
Lot 414	59	56	60	52	45	52	B
Lot 415	59	56	61	52	45	53	B
Lot 416	59	56	61	52	45	53	B
Lot 417	59	56	61	52	45	53	B
Lot 418	59	56	61	52	45	53	B
Lot 419	62	56	63	55	45	55	B
Lot 420	61	58	63	54	47	55	B
Lot 421	61	58	63	54	47	55	B
Lot 422	61	58	63	54	47	55	B
Lot 423	61	58	63	54	47	55	B
Lot 424	58	56	60	51	45	52	B
Lot 425	61	58	63	54	47	55	B
Lot 426	60	56	61	53	45	54	B
Lot 427	63	56	63	56	45	56	C
Lot 428	62	56	63	55	45	56	C
Lot 429	63	56	63	56	45	56	C
Lot 430	63	56	63	56	45	56	C
Lot 431	63	56	63	56	45	56	C
Lot 432	62	56	63	55	45	56	C
Lot 433	63	56	63	56	45	56	C
Lot 434	63	56	63	56	45	56	C
Lot 435	63	56	63	56	45	56	C
Lot 436	59	56	61	52	45	53	B
Lot 437	59	56	60	52	45	52	B

Lot 438	59	56	60	52	45	52	B
Lot 439	59	56	61	52	45	53	B
Lot 440	60	56	61	53	45	53	B
Lot 441	60	56	61	53	45	53	B
Lot 442	63	56	64	56	45	56	C
Lot 443	63	56	64	56	45	56	C
Lot 444	61	56	62	54	45	54	B
Lot 445	61	56	62	54	45	54	B
Lot 446	61	56	62	54	45	54	B
Lot 447	61	55	62	54	44	54	B
Lot 448	61	55	62	54	44	54	B
Lot 449	60	56	61	53	45	53	B
Lot 450	60	56	61	53	45	53	B
Lot 451	60	56	61	53	45	53	B
Lot 452	60	56	61	53	45	53	B
Lot 453	60	56	61	53	45	53	B
Lot 454	60	57	61	53	46	54	B
Lot 455	60	57	62	53	46	54	B
Lot 456	60	57	61	53	46	54	B
Lot 457	59	57	61	52	46	53	B
Lot 458	60	57	61	53	47	54	B
Lot 459	63	56	64	56	45	56	C
Lot 460	63	56	64	56	45	57	C
Lot 461	63	56	64	56	45	57	C
Lot 462	64	57	65	57	46	57	C
Lot 463	64	57	65	57	46	57	C
Lot 464	64	57	65	57	46	57	C
Lot 465	64	57	65	57	46	57	C
Lot 466	64	57	65	57	46	57	C
Lot 467	59	55	60	52	45	52	B
Lot 468	59	56	61	52	45	53	B
Lot 469	61	57	62	54	47	55	B
Lot 470	56	53	58	49	42	50	A
Lot 471	55	52	56	48	41	49	A
Lot 472	55	52	56	48	41	48	A
Lot 473	56	53	57	49	42	50	A
Lot 474	56	53	58	49	42	50	A
Lot 475	57	53	58	50	42	50	A
Lot 476	58	52	59	51	42	52	A
Lot 477	59	55	61	52	44	53	B
Lot 478	59	55	60	52	44	53	B
Lot 479	59	53	60	52	42	52	A
Lot 480	57	54	59	50	43	51	A
Lot 481	57	54	59	50	43	51	A
Lot 482	57	54	59	50	43	51	A
Lot 483	57	53	58	50	42	50	A
Lot 484	58	55	59	51	44	51	A
Lot 485	58	55	59	51	44	52	A
Lot 486	58	55	59	51	44	52	A
Lot 487	58	55	59	51	44	52	A
Lot 488	58	55	59	51	44	51	A
Lot 489	59	54	60	52	43	52	A
Lot 490	59	55	60	52	44	52	B
Lot 491	59	55	60	52	44	52	B
Lot 492	59	55	60	52	44	53	B
Lot 493	60	56	61	53	45	53	B
Lot 494	60	56	61	53	45	53	B
Lot 495	61	56	62	54	45	54	B
Lot 496	64	57	65	57	46	57	C
Lot 497	64	57	65	57	46	57	C
Lot 498	64	57	65	57	46	57	C
Lot 499	64	57	65	57	46	57	C
Lot 500	60	57	61	53	46	54	B
Lot 501	59	56	61	52	45	53	B
Lot 502	59	56	60	52	45	53	B
Lot 503	58	55	60	51	44	52	A
Lot 504	58	55	60	51	44	52	A
Lot 505	58	55	59	51	44	51	A
Lot 506	57	54	58	50	43	50	A
Lot 507	57	54	59	50	43	51	A
Lot 508	58	54	59	51	44	51	A
Lot 509	57	55	59	50	44	51	A
Lot 510	57	55	59	50	44	51	A
Lot 511	57	55	59	50	44	51	A
Lot 512	56	54	58	49	43	50	A
Lot 513	56	54	58	49	43	50	A
Lot 514	56	54	58	49	43	50	A
Lot 515	55	53	57	48	42	49	A
Lot 516	57	55	59	50	44	51	A
Lot 517	57	55	59	50	44	51	A
Lot 518	56	53	57	49	42	49	A
Lot 519	60	56	61	53	45	53	B
Lot 520	60	56	61	53	46	53	B
Lot 521	60	57	61	53	46	54	B
Lot 522	60	57	62	53	46	54	B
Lot 523	60	57	62	53	46	54	B
Lot 524	60	57	62	53	46	54	B
Lot 525	60	57	62	53	46	54	B
Lot 526	60	57	62	53	46	54	B

Lot 527	60	57	62	53	46	54	B
Lot 528	60	57	62	53	46	54	B
Lot 529	60	57	62	53	46	54	B
Lot 530	60	57	62	53	46	54	B
Lot 531	61	56	62	54	45	54	B
Lot 532	60	57	62	53	46	54	B
Lot 533	60	57	62	53	46	54	B
Lot 534	60	57	62	53	47	54	B
Lot 535	60	58	62	53	47	54	B
Lot 536	61	57	62	54	46	54	B
Lot 537	61	58	62	54	47	54	B
Lot 538	61	58	62	54	47	54	B
Lot 539	61	57	62	54	47	54	B
Lot 540	60	57	62	53	47	54	B
Lot 541	60	57	62	53	46	54	B
Lot 542	60	57	62	53	46	54	B
Lot 543	60	57	62	53	46	54	B
Lot 544	58	56	60	51	45	52	B
Lot 545	59	55	60	52	44	52	B
Lot 546	60	56	61	53	45	53	B
Lot 547	63	56	64	56	45	57	C
Lot 548	63	56	64	56	45	57	C
Lot 549	63	56	64	56	46	57	C
Lot 550	63	56	64	56	45	57	C
Lot 551	64	56	64	57	46	57	C
Lot 552	64	57	64	57	46	57	C
Lot 553	64	57	64	57	46	57	C
Lot 554	64	57	64	57	46	57	C
Lot 555	64	57	64	57	46	57	C
Lot 556	64	57	64	57	46	57	C
Lot 557	64	57	65	57	46	57	C
Lot 558	64	57	65	57	46	57	C
Lot 559	64	57	64	57	46	57	C
Lot 560	61	56	62	54	45	54	B
Lot 561	64	57	65	57	46	57	C
Lot 562	59	54	60	52	43	52	B
Lot 563	59	55	61	52	44	53	B
Lot 564	60	55	61	53	44	53	B
Lot 565	63	56	64	56	45	56	C
Lot 566	63	55	63	56	45	56	C
Lot 567	63	56	64	56	45	56	C
Lot 568	63	55	63	56	45	56	C

Acceptable Treatment

1	None
270	A
230	B
67	C
0	Specialist acoustic advice
568	Total

Upper Floor

	Day			Night			SPP 5.4 Criteria
Receiver	Road_Max Leq(16h) Day	Rail_Max Leq(16h) Day	Combined_Max Leq(16h) Day	Road_Max Leq(8h) Night	Rail_Max Leq(8h) Night	Combined_Max Leq(8h) Night	Acceptable Treatment Package_SPP 5.4 Criteria
Lot 001	59.8	51.5	60	53	41	53	B
Lot 002	60	51.5	61	53	41	53	B
Lot 003	60.3	52.5	61	53	42	54	B
Lot 004	60.5	52.5	61	54	42	54	B
Lot 005	60.8	52.5	61	54	42	54	B
Lot 006	61.1	52.5	62	54	43	54	B
Lot 007	61.4	53.5	62	54	43	55	B
Lot 008	61.6	53.5	62	55	43	55	B
Lot 009	61.8	53.5	62	55	43	55	B
Lot 010	62.1	54.5	63	55	44	55	B
Lot 011	62.4	54.5	63	55	44	56	C
Lot 012	62.6	54.5	63	56	44	56	C
Lot 013	62.8	54.5	63	56	44	56	C
Lot 014	63	54.5	64	56	44	56	C
Lot 015	63.2	54.5	64	56	44	56	C
Lot 016	63.5	54.5	64	57	44	57	C
Lot 017	63.6	54.5	64	57	44	57	C
Lot 018	63.9	54.5	64	57	44	57	C
Lot 019	64.2	55.5	65	57	45	57	C
Lot 020	64.5	55.5	65	58	45	58	Specialist acoustic advice
Lot 021	64.7	55.5	65	58	46	58	Specialist acoustic advice
Lot 022	62.8	55.5	64	56	45	56	C
Lot 023	63.2	55.5	64	56	45	56	C
Lot 024	63.5	56.5	64	57	46	57	C
Lot 025	63.8	56.5	65	57	46	57	C
Lot 026	64.1	56.5	65	57	46	57	C
Lot 027	64.3	56.5	65	57	46	58	C
Lot 028	64.5	56.5	65	58	46	58	Specialist acoustic advice
Lot 029	64.5	56.5	65	58	46	58	Specialist acoustic advice
Lot 030	65.4	57.5	66	58	47	59	Specialist acoustic advice

Lot 031	66.1	58.5	67	59	48	59	Specialist acoustic advice
Lot 032	65.3	57.5	66	58	47	59	Specialist acoustic advice
Lot 033	65.1	57.5	66	58	47	58	Specialist acoustic advice
Lot 034	64.7	57.5	65	58	47	58	Specialist acoustic advice
Lot 035	64.4	57.5	65	57	47	58	Specialist acoustic advice
Lot 036	64	56.5	65	57	47	57	C
Lot 037	63.5	56.5	64	57	46	57	C
Lot 038	62.1	54.5	63	55	45	55	B
Lot 039	61.9	54.5	63	55	44	55	B
Lot 040	61.6	54.5	62	55	44	55	B
Lot 041	61.4	54.5	62	54	44	55	B
Lot 042	61.2	54.5	62	54	44	55	B
Lot 043	60.8	53.5	62	54	43	54	B
Lot 044	60.5	53.5	61	54	43	54	B
Lot 045	60.7	53.5	61	54	43	54	B
Lot 046	61	54.5	62	54	44	54	B
Lot 047	61.3	54.5	62	54	44	55	B
Lot 048	61.4	54.5	62	54	44	55	B
Lot 049	61.8	55.5	63	55	45	55	B
Lot 050	62	55.5	63	55	45	55	B
Lot 051	62.4	55.5	63	55	45	56	C
Lot 052	62.7	55.5	63	56	45	56	C
Lot 053	67.7	60.5	68	61	50	61	Specialist acoustic advice
Lot 054	68	61.5	69	61	51	61	Specialist acoustic advice
Lot 055	68.2	61.5	69	61	51	62	Specialist acoustic advice
Lot 056	68.3	61.5	69	61	52	62	Specialist acoustic advice
Lot 057	68.4	62.5	69	61	52	62	Specialist acoustic advice
Lot 058	68.5	62.5	69	62	52	62	Specialist acoustic advice
Lot 059	68.5	62.5	69	62	52	62	Specialist acoustic advice
Lot 060	68.6	62.5	70	62	52	62	Specialist acoustic advice
Lot 061	68.7	62.5	70	62	52	62	Specialist acoustic advice
Lot 062	68.7	62.5	70	62	52	62	Specialist acoustic advice
Lot 063	68.8	62.5	70	62	52	62	Specialist acoustic advice
Lot 064	68.9	62.5	70	62	52	62	Specialist acoustic advice
Lot 065	69	62.5	70	62	52	62	Specialist acoustic advice
Lot 066	61.8	56.5	63	55	46	55	B
Lot 067	61.9	56.5	63	55	46	55	C
Lot 068	62.1	56.5	63	55	46	56	C
Lot 069	62.5	56.5	63	56	47	56	C
Lot 070	63.2	57.5	64	56	47	57	C
Lot 071	63.8	58.5	65	57	48	57	C
Lot 072	64.5	58.5	65	58	48	58	Specialist acoustic advice
Lot 073	65.3	59.5	66	58	49	59	Specialist acoustic advice
Lot 074	66	60.5	67	59	50	59	Specialist acoustic advice
Lot 075	67.2	60.5	68	60	50	61	Specialist acoustic advice
Lot 076	68.4	62.5	69	61	52	62	Specialist acoustic advice
Lot 077	68.6	62.5	70	62	52	62	Specialist acoustic advice
Lot 078	67.1	61.5	68	60	51	61	Specialist acoustic advice
Lot 079	65.8	60.5	67	59	50	59	Specialist acoustic advice
Lot 080	64.9	59.5	66	58	49	58	Specialist acoustic advice
Lot 081	64.2	58.5	65	57	49	58	Specialist acoustic advice
Lot 082	63.6	58.5	65	57	48	57	C
Lot 083	63.1	58.5	64	56	48	57	C
Lot 084	62.6	57.5	64	56	47	56	C
Lot 085	62.2	56.5	63	55	47	56	C
Lot 086	61.2	56.5	62	54	46	55	B
Lot 087	61.4	56.5	63	54	46	55	B
Lot 088	61.6	56.5	63	55	46	55	B
Lot 089	61.7	56.5	63	55	46	55	B
Lot 090	62.1	57.5	63	55	47	56	C
Lot 091	62.6	57.5	64	56	48	56	C
Lot 092	63	58.5	64	56	48	57	C
Lot 093	63.5	59.5	65	57	49	57	C
Lot 094	64.1	59.5	65	57	49	58	Specialist acoustic advice
Lot 095	64.6	60.5	66	58	50	58	Specialist acoustic advice
Lot 096	65.3	60.5	67	58	50	59	Specialist acoustic advice
Lot 097	66.4	61.5	68	59	51	60	Specialist acoustic advice
Lot 098	67.9	61.5	69	61	52	61	Specialist acoustic advice
Lot 099	68.5	63.5	70	62	53	62	Specialist acoustic advice
Lot 100	66.9	61.5	68	60	51	60	Specialist acoustic advice
Lot 101	65.9	60.5	67	59	50	59	Specialist acoustic advice
Lot 102	65.2	60.5	66	58	50	59	Specialist acoustic advice
Lot 103	64.6	59.5	66	58	49	58	Specialist acoustic advice
Lot 104	64.1	59.5	65	57	49	58	Specialist acoustic advice
Lot 105	62.6	57.5	64	56	48	56	C
Lot 106	62.2	57.5	63	55	47	56	C
Lot 107	61.8	57.5	63	55	47	55	C
Lot 108	59.3	55.5	61	52	45	53	B
Lot 109	59.7	55.5	61	53	45	53	B
Lot 110	60	55.5	61	53	46	54	B
Lot 111	60.5	55.5	62	54	46	54	B
Lot 112	61.6	56.5	63	55	46	55	B
Lot 113	61.8	57.5	63	55	47	55	C
Lot 114	62.2	58.5	64	55	48	56	C
Lot 115	62.6	58.5	64	56	48	56	C
Lot 116	64.3	59.5	66	57	49	58	Specialist acoustic advice
Lot 117	65	60.5	66	58	50	59	Specialist acoustic advice
Lot 118	66.7	60.5	68	60	50	60	Specialist acoustic advice
Lot 119	66.1	60.5	67	59	50	60	Specialist acoustic advice

Lot 120	65.5	59.5	66	59	49	59	Specialist acoustic advice
Lot 121	64.9	59.5	66	58	49	58	Specialist acoustic advice
Lot 122	63.5	59.5	65	57	49	57	C
Lot 123	62.9	58.5	64	56	48	56	C
Lot 124	62.5	58.5	64	56	48	56	C
Lot 125	62.3	57.5	64	55	47	56	C
Lot 126	61	56.5	62	54	46	55	B
Lot 127	60.7	56.5	62	54	46	54	B
Lot 128	58.5	53.5	60	52	43	52	A
Lot 129	58.7	54.5	60	52	44	52	B
Lot 130	58.8	54.5	60	52	44	52	B
Lot 131	58.9	54.5	60	52	44	52	B
Lot 132	59.9	55.5	61	53	45	53	B
Lot 133	61	55.5	62	54	46	55	B
Lot 134	61.2	56.5	62	54	46	55	B
Lot 135	62.6	57.5	64	56	47	56	C
Lot 136	63	58.5	64	56	48	57	C
Lot 137	63.6	58.5	65	57	49	57	C
Lot 138	64.8	59.5	66	58	49	58	Specialist acoustic advice
Lot 139	64.5	59.5	66	58	49	58	Specialist acoustic advice
Lot 140	65.2	59.5	66	58	49	59	Specialist acoustic advice
Lot 141	64.6	59.5	66	58	49	58	Specialist acoustic advice
Lot 142	63.8	58.5	65	57	48	57	C
Lot 143	62	57.5	63	55	47	56	C
Lot 144	61.6	56.5	63	55	46	55	B
Lot 145	60	55.5	61	53	45	54	B
Lot 146	60.3	55.5	62	53	45	54	B
Lot 147	59.2	54.5	60	52	45	53	B
Lot 148	58	53.5	59	51	43	52	A
Lot 149	58.1	53.5	59	51	43	52	A
Lot 150	58.2	52.5	59	51	43	52	A
Lot 151	58.3	52.5	59	51	43	52	A
Lot 152	59.5	54.5	61	53	44	53	B
Lot 153	59.5	54.5	61	53	44	53	B
Lot 154	60.3	55.5	62	53	45	54	B
Lot 155	60.5	56.5	62	54	46	54	B
Lot 156	61.7	56.5	63	55	46	55	B
Lot 157	61.7	56.5	63	55	46	55	B
Lot 158	63.5	57.5	64	57	47	57	C
Lot 159	64.8	58.5	66	58	48	58	Specialist acoustic advice
Lot 160	64.5	58.5	65	58	48	58	Specialist acoustic advice
Lot 161	64.3	58.5	65	57	48	58	Specialist acoustic advice
Lot 162	64.2	58.5	65	57	48	58	Specialist acoustic advice
Lot 163	62.8	57.5	64	56	47	56	C
Lot 164	61	56.5	62	54	46	55	B
Lot 165	61.1	56.5	62	54	46	55	B
Lot 166	59.9	55.5	61	53	45	53	B
Lot 167	60	55.5	61	53	45	54	B
Lot 168	59.1	55.5	61	52	45	53	B
Lot 169	59.3	54.5	61	52	44	53	B
Lot 170	71.1	65.5	72	64	55	65	Specialist acoustic advice
Lot 171	70.8	65.5	72	64	55	64	Specialist acoustic advice
Lot 172	70.5	65.5	72	64	55	64	Specialist acoustic advice
Lot 173	71	65.5	72	64	55	64	Specialist acoustic advice
Lot 174	70.2	64.5	71	63	54	64	Specialist acoustic advice
Lot 175	70	64.5	71	63	54	63	Specialist acoustic advice
Lot 176	69.5	64.5	71	63	54	63	Specialist acoustic advice
Lot 177	70.6	64.5	72	64	54	64	Specialist acoustic advice
Lot 178	69.7	64.5	71	63	54	63	Specialist acoustic advice
Lot 179	69.5	64.5	71	63	54	63	Specialist acoustic advice
Lot 180	68.9	63.5	70	62	53	62	Specialist acoustic advice
Lot 181	70	64.5	71	63	54	63	Specialist acoustic advice
Lot 182	69.4	64.5	71	62	54	63	Specialist acoustic advice
Lot 183	69.4	64.5	71	62	54	63	Specialist acoustic advice
Lot 184	69.5	64.5	71	63	54	63	Specialist acoustic advice
Lot 185	60.1	55.5	61	53	45	54	B
Lot 186	60.1	55.5	61	53	45	54	B
Lot 187	60.2	55.5	61	53	45	54	B
Lot 188	60.3	55.5	62	53	45	54	B
Lot 189	60.5	55.5	62	54	46	54	B
Lot 190	60.6	56.5	62	54	46	54	B
Lot 191	60.9	56.5	62	54	46	54	B
Lot 192	61.3	56.5	63	54	46	55	B
Lot 193	61.5	57.5	63	55	47	55	B
Lot 194	61.8	57.5	63	55	48	56	C
Lot 195	63.9	58.5	65	57	48	57	Specialist acoustic advice
Lot 196	63.9	59.5	65	57	49	57	Specialist acoustic advice
Lot 197	63	58.5	64	56	48	57	C
Lot 198	62.6	57.5	64	56	47	56	C
Lot 199	62.3	57.5	64	55	47	56	C
Lot 200	61.9	57.5	63	55	47	55	C
Lot 201	62.3	57.5	64	55	48	56	C
Lot 202	62.7	58.5	64	56	48	56	C
Lot 203	62	58.5	64	55	48	56	C
Lot 204	62.3	58.5	64	55	48	56	C
Lot 205	62.9	58.5	64	56	48	56	C
Lot 206	63.3	58.5	65	56	48	57	C
Lot 207	63.3	58.5	65	56	48	57	C
Lot 208	63.8	59.5	65	57	49	57	Specialist acoustic advice

Lot 209	64.2	59.5	65	57	49	58	Specialist acoustic advice
Lot 210	65.3	59.5	66	58	49	59	Specialist acoustic advice
Lot 211	66	60.5	67	59	50	59	Specialist acoustic advice
Lot 212	65.3	60.5	67	58	50	59	Specialist acoustic advice
Lot 213	64.5	60.5	66	58	50	58	Specialist acoustic advice
Lot 214	63.9	59.5	65	57	49	57	Specialist acoustic advice
Lot 215	66.5	60.5	67	60	50	60	Specialist acoustic advice
Lot 216	66.8	60.5	68	60	51	60	Specialist acoustic advice
Lot 217	67.4	61.5	68	60	51	61	Specialist acoustic advice
Lot 218	65.9	60.5	67	59	50	59	Specialist acoustic advice
Lot 219	66.4	60.5	67	59	50	60	Specialist acoustic advice
Lot 220	66.8	61.5	68	60	51	60	Specialist acoustic advice
Lot 221	67.2	61.5	68	60	51	61	Specialist acoustic advice
Lot 222	67.9	62.5	69	61	52	61	Specialist acoustic advice
Lot 223	66.4	61.5	68	59	51	60	Specialist acoustic advice
Lot 224	67	61.5	68	60	51	60	Specialist acoustic advice
Lot 225	67.4	61.5	68	60	51	61	Specialist acoustic advice
Lot 226	67.8	62.5	69	61	52	61	Specialist acoustic advice
Lot 227	68.4	62.5	69	61	52	62	Specialist acoustic advice
Lot 228	66.7	61.5	68	60	51	60	Specialist acoustic advice
Lot 229	67.4	61.5	68	60	51	61	Specialist acoustic advice
Lot 230	68.2	62.5	69	61	52	62	Specialist acoustic advice
Lot 231	58.9	52.5	60	52	42	52	A
Lot 232	59.1	53.5	60	52	43	53	B
Lot 233	59.1	53.5	60	52	43	53	B
Lot 234	59.3	53.5	60	52	43	53	B
Lot 235	59.3	53.5	60	52	43	53	B
Lot 236	59.4	53.5	60	52	43	53	B
Lot 237	59.4	53.5	60	52	43	53	B
Lot 238	59.6	53.5	61	53	43	53	B
Lot 239	59.6	53.5	61	53	43	53	B
Lot 240	59.7	53.5	61	53	43	53	B
Lot 241	59.9	53.5	61	53	43	53	B
Lot 242	60	53.5	61	53	43	53	B
Lot 243	60.1	53.5	61	53	43	53	B
Lot 244	60.1	53.5	61	53	43	53	B
Lot 245	60.4	54.5	61	53	44	54	B
Lot 246	59.6	54.5	61	53	44	53	B
Lot 247	59.9	54.5	61	53	44	53	B
Lot 248	60.3	55.5	62	53	45	54	B
Lot 249	60.6	55.5	62	54	45	54	B
Lot 250	60.7	55.5	62	54	45	54	B
Lot 251	60.8	55.5	62	54	45	54	B
Lot 252	60.9	55.5	62	54	45	54	B
Lot 253	61	55.5	62	54	46	55	B
Lot 254	61.1	56.5	62	54	46	55	B
Lot 255	61.2	55.5	62	54	46	55	B
Lot 256	61.3	55.5	62	54	46	55	B
Lot 257	61.4	55.5	62	54	46	55	B
Lot 258	61.6	56.5	63	55	46	55	B
Lot 259	61.8	56.5	63	55	46	55	B
Lot 260	61.9	55.5	63	55	45	55	B
Lot 261	61.5	55.5	62	55	45	55	B
Lot 262	61.3	55.5	62	54	45	55	B
Lot 263	60.9	54.5	62	54	44	54	B
Lot 264	61	55.5	62	54	45	54	B
Lot 265	60.8	55.5	62	54	45	54	B
Lot 266	60.8	55.5	62	54	45	54	B
Lot 267	60.6	54.5	62	54	45	54	B
Lot 268	60.5	54.5	61	54	45	54	B
Lot 269	60.4	54.5	61	53	45	54	B
Lot 270	60.3	54.5	61	53	45	54	B
Lot 271	60.2	54.5	61	53	45	54	B
Lot 272	60.1	54.5	61	53	44	54	B
Lot 273	60	54.5	61	53	44	53	B
Lot 274	61.6	57.5	63	55	47	55	C
Lot 275	62.1	57.5	63	55	47	56	C
Lot 276	62.6	58.5	64	56	48	56	C
Lot 277	63.2	58.5	64	56	48	57	C
Lot 278	63.9	58.5	65	57	48	57	Specialist acoustic advice
Lot 279	64.8	59.5	66	58	49	58	Specialist acoustic advice
Lot 280	66	60.5	67	59	50	59	Specialist acoustic advice
Lot 281	66.4	60.5	67	59	51	60	Specialist acoustic advice
Lot 282	66.7	61.5	68	60	51	60	Specialist acoustic advice
Lot 283	66.9	61.5	68	60	51	60	Specialist acoustic advice
Lot 284	67.1	61.5	68	60	51	61	Specialist acoustic advice
Lot 285	67.3	61.5	68	60	51	61	Specialist acoustic advice
Lot 286	67.4	61.5	68	60	51	61	Specialist acoustic advice
Lot 287	67.4	61.5	68	60	51	61	Specialist acoustic advice
Lot 288	67	61.5	68	60	51	60	Specialist acoustic advice
Lot 289	65.4	59.5	66	58	49	59	Specialist acoustic advice
Lot 290	65.5	59.5	66	59	49	59	Specialist acoustic advice
Lot 291	65.4	59.5	66	58	49	59	Specialist acoustic advice
Lot 292	65.2	59.5	66	58	49	59	Specialist acoustic advice
Lot 293	65	59.5	66	58	49	58	Specialist acoustic advice
Lot 294	64.6	58.5	66	58	48	58	Specialist acoustic advice
Lot 295	63.5	58.5	65	57	48	57	C
Lot 296	62.9	58.5	64	56	48	56	C
Lot 297	62.3	57.5	64	55	47	56	C

Lot 298	62.2	57.5	63	55	47	56	C
Lot 299	63.1	57.5	64	56	47	57	C
Lot 300	63	57.5	64	56	47	56	C
Lot 301	62.9	57.5	64	56	47	56	C
Lot 302	62.8	57.5	64	56	47	56	C
Lot 303	62.7	57.5	64	56	47	56	C
Lot 304	62.6	57.5	64	56	47	56	C
Lot 305	62.4	57.5	64	55	47	56	C
Lot 306	62.3	57.5	64	55	47	56	C
Lot 307	63.1	58.5	64	56	48	57	C
Lot 308	63.3	58.5	65	56	48	57	C
Lot 309	63.4	58.5	65	56	48	57	C
Lot 310	63.5	58.5	65	57	48	57	C
Lot 311	63.6	58.5	65	57	48	57	C
Lot 312	63.7	58.5	65	57	48	57	C
Lot 313	63.8	58.5	65	57	48	57	C
Lot 314	63.8	58.5	65	57	48	57	C
Lot 315	60.3	54.5	61	53	44	54	B
Lot 316	60.7	55.5	62	54	45	54	B
Lot 317	60.6	54.5	62	54	44	54	B
Lot 318	60.6	54.5	62	54	44	54	B
Lot 319	60.7	54.5	62	54	44	54	B
Lot 320	60.8	54.5	62	54	44	54	B
Lot 321	60.8	54.5	62	54	44	54	B
Lot 322	60.9	54.5	62	54	44	54	B
Lot 323	61	54.5	62	54	44	54	B
Lot 324	61	54.5	62	54	44	54	B
Lot 325	61.1	54.5	62	54	44	54	B
Lot 326	61.3	54.5	62	54	45	55	B
Lot 327	61.3	54.5	62	54	44	55	B
Lot 328	61.5	54.5	62	55	45	55	B
Lot 329	61.7	55.5	63	55	45	55	B
Lot 330	60.4	55.5	62	53	45	54	B
Lot 331	60.3	54.5	61	53	44	54	B
Lot 332	60.2	54.5	61	53	44	54	B
Lot 333	60.1	54.5	61	53	44	54	B
Lot 334	59.9	53.5	61	53	44	53	B
Lot 335	59.8	53.5	61	53	43	53	B
Lot 336	59.5	53.5	60	53	43	53	B
Lot 337	59.3	52.5	60	52	42	53	B
Lot 338	59.2	52.5	60	52	42	53	B
Lot 339	59	52.5	60	52	42	52	A
Lot 340	58.9	51.5	60	52	42	52	A
Lot 341	58.8	51.5	60	52	41	52	A
Lot 342	58.7	51.5	59	52	41	52	A
Lot 343	58.6	51.5	59	52	41	52	A
Lot 344	58.4	51.5	59	51	41	52	A
Lot 345	58.8	51.5	60	52	42	52	A
Lot 346	59	52.5	60	52	42	52	A
Lot 347	59.1	52.5	60	52	42	52	A
Lot 348	59.2	52.5	60	52	42	53	B
Lot 349	59.4	52.5	60	52	42	53	B
Lot 350	59.6	52.5	60	53	42	53	B
Lot 351	59.7	52.5	60	53	42	53	B
Lot 352	59.9	53.5	61	53	43	53	B
Lot 353	60.1	53.5	61	53	43	53	B
Lot 354	60.3	53.5	61	53	43	54	B
Lot 355	60	53.5	61	53	43	53	B
Lot 356	59.8	52.5	61	53	43	53	B
Lot 357	59.7	52.5	60	53	43	53	B
Lot 358	59.6	52.5	60	53	42	53	B
Lot 359	59.4	52.5	60	52	42	53	B
Lot 360	59.2	52.5	60	52	42	53	B
Lot 361	61.2	55.5	62	54	45	55	B
Lot 362	61.5	56.5	63	55	46	55	B
Lot 363	61.6	56.5	63	55	46	55	B
Lot 364	61.8	56.5	63	55	46	55	B
Lot 365	61.9	56.5	63	55	46	55	C
Lot 366	62	56.5	63	55	46	55	C
Lot 367	62.4	56.5	63	55	46	56	C
Lot 368	61.7	55.5	63	55	45	55	B
Lot 369	61.7	55.5	63	55	45	55	B
Lot 370	61.7	55.5	63	55	45	55	B
Lot 371	61.7	55.5	63	55	45	55	B
Lot 372	61.8	55.5	63	55	45	55	B
Lot 373	61.9	55.5	63	55	45	55	B
Lot 374	62	55.5	63	55	46	55	B
Lot 375	62	56.5	63	55	46	55	C
Lot 376	62.1	56.5	63	55	46	56	C
Lot 377	62.2	55.5	63	55	46	56	C
Lot 378	62.3	56.5	63	55	46	56	C
Lot 379	62.4	56.5	63	55	46	56	C
Lot 380	62.8	56.5	64	56	46	56	C
Lot 381	63.2	57.5	64	56	47	57	C
Lot 382	63	57.5	64	56	47	56	C
Lot 383	62.9	57.5	64	56	47	56	C
Lot 384	62.9	57.5	64	56	47	56	C
Lot 385	62.8	56.5	64	56	47	56	C
Lot 386	62.7	56.5	64	56	46	56	C

Lot 387	62.6	56.5	64	56	46	56	C
Lot 388	62.5	56.5	63	56	46	56	C
Lot 389	62.5	56.5	63	56	46	56	C
Lot 390	62.5	56.5	63	56	46	56	C
Lot 391	62.4	56.5	63	55	46	56	C
Lot 392	62.3	56.5	63	55	46	56	C
Lot 393	63.5	58.5	65	57	48	57	C
Lot 394	64.1	58.5	65	57	48	58	Specialist acoustic advice
Lot 395	64.6	59.5	66	58	49	58	Specialist acoustic advice
Lot 396	65.2	59.5	66	58	49	59	Specialist acoustic advice
Lot 397	65.9	60.5	67	59	50	59	Specialist acoustic advice
Lot 398	67.1	60.5	68	60	50	60	Specialist acoustic advice
Lot 399	67.1	60.5	68	60	50	60	Specialist acoustic advice
Lot 400	66.1	60.5	67	59	50	60	Specialist acoustic advice
Lot 401	65.4	59.5	66	58	49	59	Specialist acoustic advice
Lot 402	64.9	59.5	66	58	49	58	Specialist acoustic advice
Lot 403	64.3	58.5	65	57	48	58	Specialist acoustic advice
Lot 404	63.8	58.5	65	57	48	57	C
Lot 405	63.8	58.5	65	57	48	57	C
Lot 406	71.6	65.5	73	65	55	65	Specialist acoustic advice
Lot 407	71.3	65.5	72	64	55	65	Specialist acoustic advice
Lot 408	71.2	65.5	72	64	55	65	Specialist acoustic advice
Lot 409	71.1	65.5	72	64	55	65	Specialist acoustic advice
Lot 410	71.4	65.5	72	64	55	65	Specialist acoustic advice
Lot 411	64.1	58.5	65	57	48	58	Specialist acoustic advice
Lot 412	64.1	58.5	65	57	48	58	Specialist acoustic advice
Lot 413	64.2	58.5	65	57	48	58	Specialist acoustic advice
Lot 414	64.2	58.5	65	57	48	58	Specialist acoustic advice
Lot 415	64.3	58.5	65	57	48	58	Specialist acoustic advice
Lot 416	64.4	58.5	65	57	48	58	Specialist acoustic advice
Lot 417	64.5	58.5	65	58	48	58	Specialist acoustic advice
Lot 418	65	59.5	66	58	49	58	Specialist acoustic advice
Lot 419	65.7	59.5	67	59	49	59	Specialist acoustic advice
Lot 420	65.4	59.5	66	58	49	59	Specialist acoustic advice
Lot 421	65.4	59.5	66	58	49	59	Specialist acoustic advice
Lot 422	65.3	59.5	66	58	49	59	Specialist acoustic advice
Lot 423	65.2	59.5	66	58	49	59	Specialist acoustic advice
Lot 424	64.6	58.5	66	58	48	58	Specialist acoustic advice
Lot 425	65.4	59.5	66	58	49	59	Specialist acoustic advice
Lot 426	67.5	60.5	68	61	51	61	Specialist acoustic advice
Lot 427	69	63.5	70	62	53	62	Specialist acoustic advice
Lot 428	68.6	62.5	70	62	52	62	Specialist acoustic advice
Lot 429	68.6	62.5	70	62	52	62	Specialist acoustic advice
Lot 430	68.8	62.5	70	62	52	62	Specialist acoustic advice
Lot 431	68.9	62.5	70	62	52	62	Specialist acoustic advice
Lot 432	68.7	62.5	70	62	52	62	Specialist acoustic advice
Lot 433	68.8	62.5	70	62	52	62	Specialist acoustic advice
Lot 434	68.9	62.5	70	62	52	62	Specialist acoustic advice
Lot 435	69.1	63.5	70	62	53	63	Specialist acoustic advice
Lot 436	64.7	58.5	66	58	49	58	Specialist acoustic advice
Lot 437	64.5	58.5	65	58	48	58	Specialist acoustic advice
Lot 438	65	59.5	66	58	49	58	Specialist acoustic advice
Lot 439	65.5	59.5	66	59	49	59	Specialist acoustic advice
Lot 440	66.1	59.5	67	59	50	60	Specialist acoustic advice
Lot 441	67	60.5	68	60	50	60	Specialist acoustic advice
Lot 442	68.2	61.5	69	61	52	62	Specialist acoustic advice
Lot 443	67.9	61.5	69	61	51	61	Specialist acoustic advice
Lot 444	66.7	60.5	68	60	50	60	Specialist acoustic advice
Lot 445	66	59.5	67	59	49	59	Specialist acoustic advice
Lot 446	65.5	59.5	66	59	49	59	Specialist acoustic advice
Lot 447	65.1	59.5	66	58	49	59	Specialist acoustic advice
Lot 448	64.6	58.5	66	58	48	58	Specialist acoustic advice
Lot 449	63.5	56.5	64	57	47	57	C
Lot 450	63.6	57.5	65	57	47	57	C
Lot 451	63.8	57.5	65	57	47	57	C
Lot 452	64	57.5	65	57	47	57	C
Lot 453	64.2	57.5	65	57	47	58	Specialist acoustic advice
Lot 454	64.4	58.5	65	57	48	58	Specialist acoustic advice
Lot 455	64.6	58.5	66	58	48	58	Specialist acoustic advice
Lot 456	64.9	58.5	66	58	48	58	Specialist acoustic advice
Lot 457	65.1	58.5	66	58	49	59	Specialist acoustic advice
Lot 458	65.6	59.5	67	59	49	59	Specialist acoustic advice
Lot 459	66.4	60.5	67	59	50	60	Specialist acoustic advice
Lot 460	67	60.5	68	60	50	60	Specialist acoustic advice
Lot 461	67.5	61.5	68	61	51	61	Specialist acoustic advice
Lot 462	68	61.5	69	61	51	61	Specialist acoustic advice
Lot 463	68.4	61.5	69	61	51	62	Specialist acoustic advice
Lot 464	68.6	62.5	70	62	52	62	Specialist acoustic advice
Lot 465	68.7	62.5	70	62	52	62	Specialist acoustic advice
Lot 466	68.4	61.5	69	61	51	62	Specialist acoustic advice
Lot 467	64.7	58.5	66	58	48	58	Specialist acoustic advice
Lot 468	65.3	59.5	66	58	49	59	Specialist acoustic advice
Lot 469	66	59.5	67	59	49	59	Specialist acoustic advice
Lot 470	59.2	54.5	60	52	44	53	B
Lot 471	59	54.5	60	52	44	53	B
Lot 472	59	54.5	60	52	44	53	B
Lot 473	61	54.5	62	54	44	54	B
Lot 474	61.2	54.5	62	54	44	55	B
Lot 475	61.4	54.5	62	54	44	55	B

Lot 476	61.7	54.5	62	55	45	55	B
Lot 477	62.4	55.5	63	55	45	56	C
Lot 478	62.4	55.5	63	55	45	56	C
Lot 479	62.1	55.5	63	55	45	55	B
Lot 480	61.7	54.5	62	55	44	55	B
Lot 481	61.5	54.5	62	55	44	55	B
Lot 482	61.2	54.5	62	54	44	55	B
Lot 483	59.4	55.5	61	52	45	53	B
Lot 484	59.7	55.5	61	53	45	53	B
Lot 485	59.9	55.5	61	53	45	53	B
Lot 486	59.9	55.5	61	53	45	53	B
Lot 487	60	55.5	61	53	45	54	B
Lot 488	60.1	55.5	61	53	46	54	B
Lot 489	63.2	56.5	64	56	46	57	C
Lot 490	63.7	57.5	65	57	47	57	C
Lot 491	64.1	57.5	65	57	47	57	C
Lot 492	64.6	58.5	66	58	48	58	Specialist acoustic advice
Lot 493	65.1	58.5	66	58	48	58	Specialist acoustic advice
Lot 494	65.6	59.5	67	59	49	59	Specialist acoustic advice
Lot 495	66.5	60.5	67	60	50	60	Specialist acoustic advice
Lot 496	68.5	61.5	69	62	51	62	Specialist acoustic advice
Lot 497	68.3	61.5	69	61	51	62	Specialist acoustic advice
Lot 498	68.4	61.5	69	61	52	62	Specialist acoustic advice
Lot 499	68.3	61.5	69	61	52	62	Specialist acoustic advice
Lot 500	66.9	60.5	68	60	50	60	Specialist acoustic advice
Lot 501	66	59.5	67	59	49	59	Specialist acoustic advice
Lot 502	65.4	59.5	66	58	49	59	Specialist acoustic advice
Lot 503	64.8	58.5	66	58	48	58	Specialist acoustic advice
Lot 504	64.3	57.5	65	57	47	58	Specialist acoustic advice
Lot 505	63.8	57.5	65	57	47	57	C
Lot 506	63.5	56.5	64	57	46	57	C
Lot 507	63.4	56.5	64	56	46	57	C
Lot 508	62.9	56.5	64	56	46	56	C
Lot 509	63	56.5	64	56	46	56	C
Lot 510	63	56.5	64	56	46	56	C
Lot 511	62.9	55.5	64	56	46	56	C
Lot 512	60.6	57.5	62	54	47	54	B
Lot 513	60.6	57.5	62	54	47	54	B
Lot 514	60.5	57.5	62	54	47	54	B
Lot 515	60.5	56.5	62	54	46	54	B
Lot 516	60.3	56.5	62	53	46	54	B
Lot 517	60.4	56.5	62	53	46	54	B
Lot 518	60.4	56.5	62	53	46	54	B
Lot 519	63	55.5	64	56	45	56	C
Lot 520	63.2	56.5	64	56	46	57	C
Lot 521	63.4	56.5	64	56	46	57	C
Lot 522	63.5	56.5	64	57	46	57	C
Lot 523	63.5	56.5	64	57	46	57	C
Lot 524	63.6	56.5	64	57	46	57	C
Lot 525	63.7	56.5	64	57	46	57	C
Lot 526	63.7	56.5	64	57	46	57	C
Lot 527	63.8	57.5	65	57	47	57	C
Lot 528	63.9	57.5	65	57	47	57	C
Lot 529	64	57.5	65	57	47	57	C
Lot 530	64	57.5	65	57	47	57	C
Lot 531	66.2	59.5	67	59	49	60	Specialist acoustic advice
Lot 532	66.1	59.5	67	59	49	59	Specialist acoustic advice
Lot 533	66	59.5	67	59	49	59	Specialist acoustic advice
Lot 534	65.9	59.5	67	59	49	59	Specialist acoustic advice
Lot 535	65.8	59.5	67	59	49	59	Specialist acoustic advice
Lot 536	65.8	59.5	67	59	49	59	Specialist acoustic advice
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Lot 538	65.6	59.5	67	59	49	59	Specialist acoustic advice
Lot 539	65.6	58.5	66	59	49	59	Specialist acoustic advice
Lot 540	65.5	58.5	66	59	49	59	Specialist acoustic advice
Lot 541	65.5	58.5	66	59	48	59	Specialist acoustic advice
Lot 542	65.4	58.5	66	58	48	59	Specialist acoustic advice
Lot 543	65.3	58.5	66	58	48	59	Specialist acoustic advice
Lot 544	64.3	57.5	65	57	47	58	Specialist acoustic advice
Lot 545	65	58.5	66	58	48	58	Specialist acoustic advice
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Lot 548	67.5	61.5	68	61	51	61	Specialist acoustic advice
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Lot 550	67.6	61.5	69	61	51	61	Specialist acoustic advice
Lot 551	67.7	61.5	69	61	51	61	Specialist acoustic advice
Lot 552	67.8	61.5	69	61	51	61	Specialist acoustic advice
Lot 553	67.8	61.5	69	61	51	61	Specialist acoustic advice
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Lot 555	67.8	61.5	69	61	51	61	Specialist acoustic advice
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Lot 558	68.1	61.5	69	61	51	61	Specialist acoustic advice
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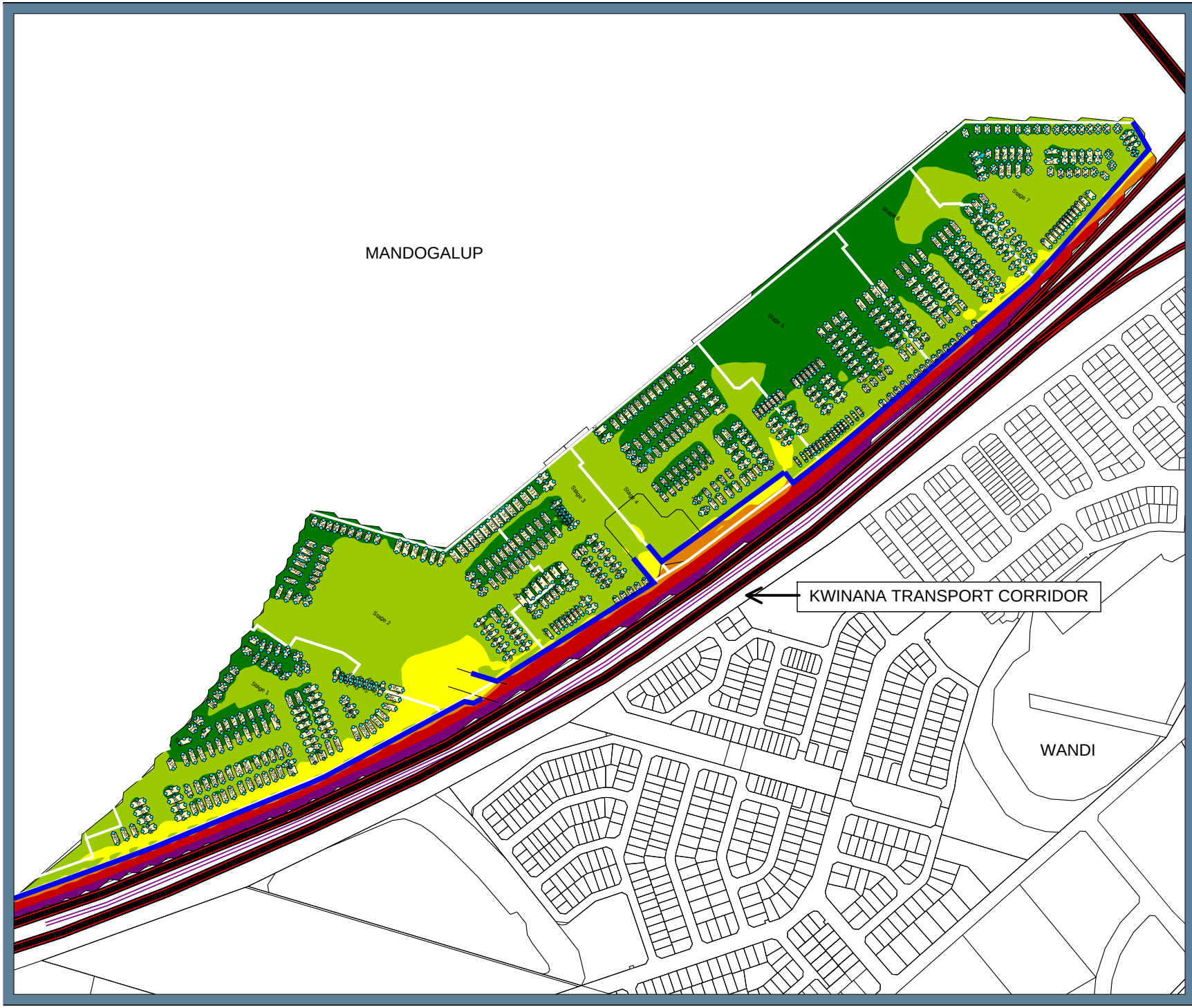
Lot 560	67.1	60.5	68	60	50	60	Specialist acoustic advice
Lot 561	68.4	61.5	69	61	52	62	Specialist acoustic advice
Lot 562	63.9	56.5	65	57	46	57	C
Lot 563	64.5	57.5	65	58	47	58	Specialist acoustic advice
Lot 564	65.7	58.5	66	59	48	59	Specialist acoustic advice

Lot 565	67	60.5	68	60	50	60	Specialist acoustic advice
Lot 566	66.7	60.5	68	60	50	60	Specialist acoustic advice
Lot 567	66.6	60.5	68	60	50	60	Specialist acoustic advice
Lot 568	66.6	60.5	68	60	50	60	Specialist acoustic advice

Acceptable Treatment		
	0	None
	15	A
	180	B
	138	C
	235	Specialist acoustic advice
	568	Total

Appendix E – Transport Noise Contours (SoundPLAN Grid Noise Maps)



APPENDIX E
FIGURE 1

Traffic Noise Impact 2037 With 4m Noise Barrier Wall

Ground Floor Noise Levels Day Time (6am to 10pm)

Leq,16h at 1.4m AGL
in dB(A), Facade-adjusted

	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	<= 75
75 <	

Legend

- Road emission line
- Road surface
- Building
- 4m Noise barrier wall
- Point receiver

Grid Spacing: 10m
Project Engineer: Sam Fraser
Created: 12/12/2016
Processed with SoundPLAN 7.2

SCALE @ A4 1:8000

0 25 50 100 150 200 250 m

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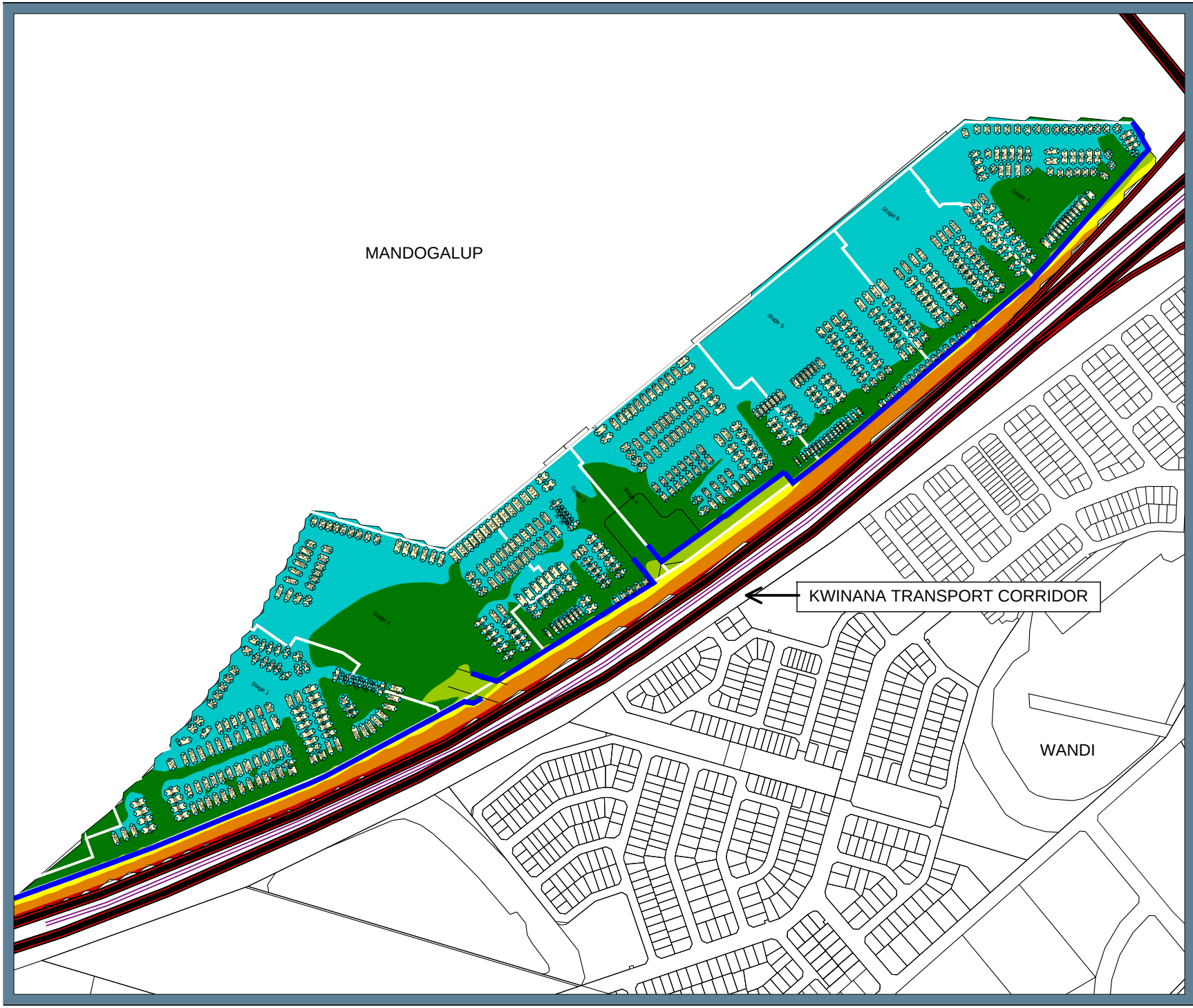

APPENDIX E
FIGURE 2

Traffic Noise Impact 2037 With 4m Noise Barrier Wall

Ground Floor Noise Levels Night Time (10pm to 6am)

Leq,8h at 1.4m AGL
in dB(A), Facade-adjusted

	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	<= 75
75 <	

Legend

- Road emission line
- Road surface
- Building
- 4m Noise barrier wall
- Point receiver

Grid Spacing: 10m
Project Engineer: Sam Fraser
Created: 12/12/2016
Processed with SoundPLAN 7.2

SCALE @ A4 1:8000

0 25 50 100 150 200 250 m

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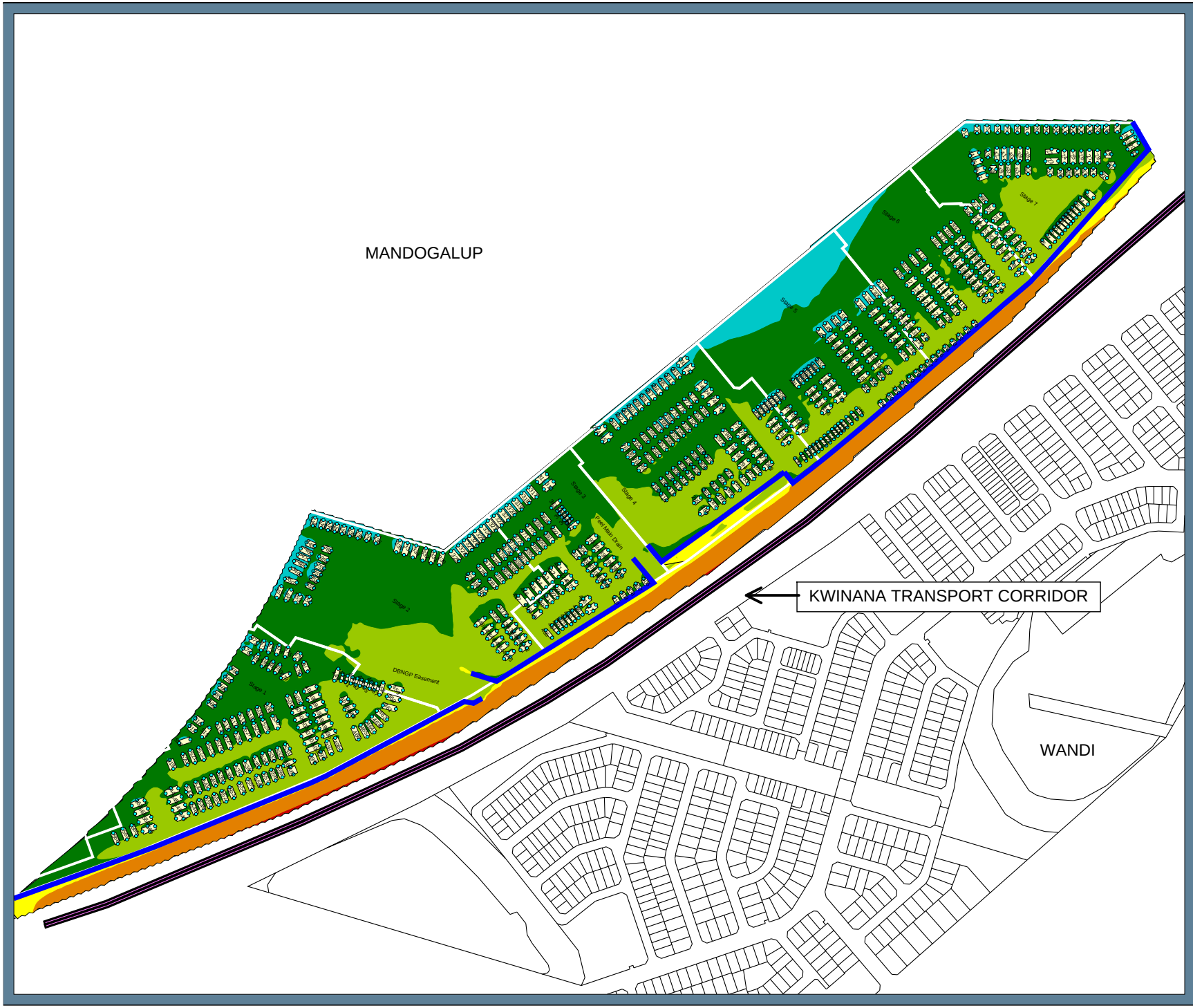

APPENDIX E
FIGURE 3

Railway Noise Impact 2037 With 4m Noise Barrier Wall

Ground Floor Noise Levels Day Time (6am to 10pm)

Leq,16h at 1.4m AGL
in dB(A), Facade-adjusted

	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	<= 75
75 <	

Legend

- Railway emission line
- Building
- 4m Noise barrier wall
- Point receiver

Grid Spacing: 4m
Project Engineer: Sam Fraser
Created: 12/12/2016
Processed with SoundPLAN 7.2

SCALE @ A4 1:8000

0 25 50 100 150 200 250 m

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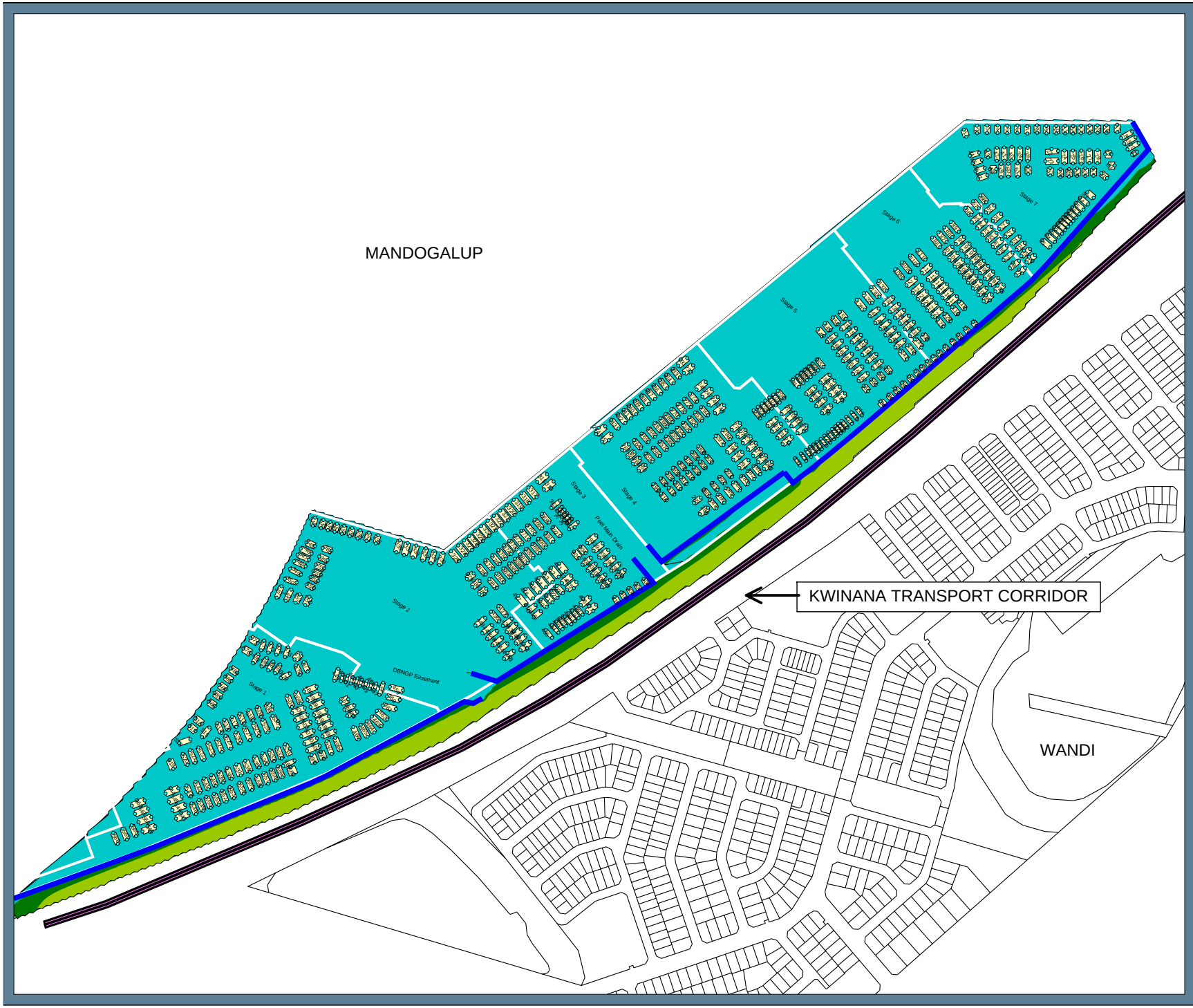

APPENDIX E
FIGURE 4

Railway Noise Impact 2037 With 4m Noise Barrier Wall

Ground Floor Noise Levels Night Time (10pm to 6am)

Leq,8h at 1.4m AGL
in dB(A), Facade-adjusted

	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	<= 75
75 <	

Legend

- Railway emission line
- Building
- 4m Noise barrier wall
- Point receiver

Grid Spacing: 4m
Project Engineer: Sam Fraser
Created: 12/12/2016
Processed with SoundPLAN 7.2

SCALE @ A4 1:8000

0 25 50 100 150 200 250 m

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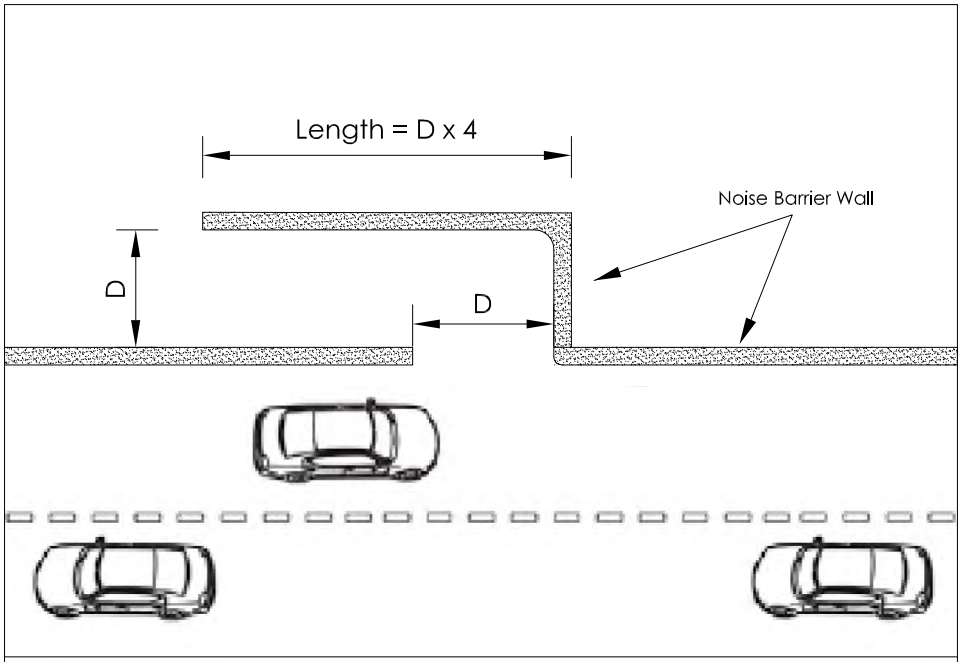
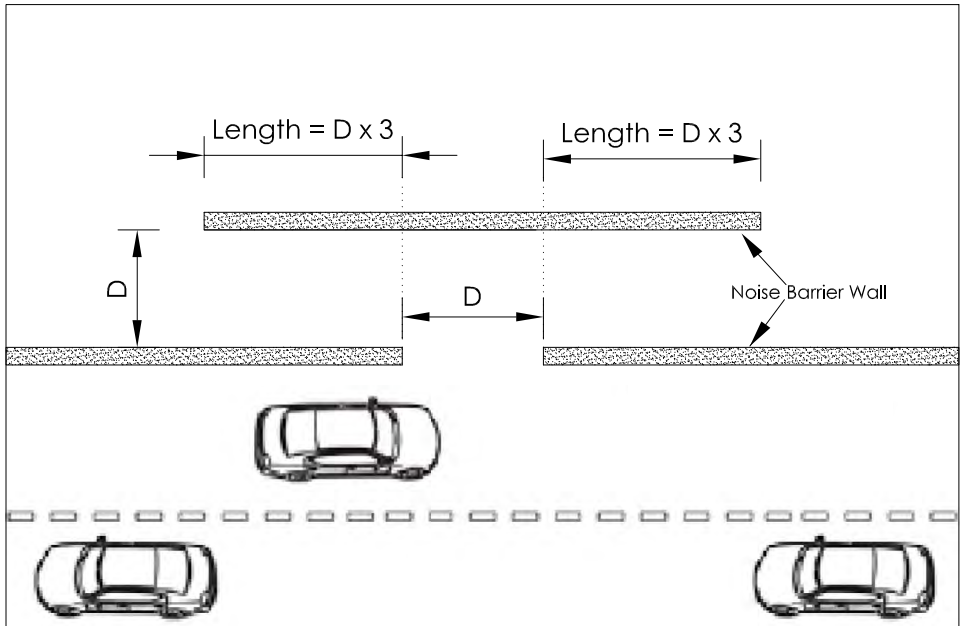
Appendix F – Barrier Overlap Detail



Arrangement # 1:
Overlapping gaps in Noise Barrier Walls - As per specifications of
Western Australia *State Planning Policy 5.4 - Guidelines*



Arrangement # 2:
Overlapping gaps in Noise Barrier Walls - As per specifications of
Western Australia *State Planning Policy 5.4 - Guidelines*

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Project: Mandogalup Subdivision	Drawing Ref: Appendix H_Figure 1
Client: Satterly Property Group	Drawing Ref: Not to Scale

Barrier overlay detail to cover access gaps in Noise Barrier Walls

DRAWN: J.S	CHECKED: S.T
DATE: Sept 2016	Rev: 0
JOB No: 140414	

Appendix G – Acceptable Treatment Packages

(Extract from SPP 5.4 Implementation Guidelines)

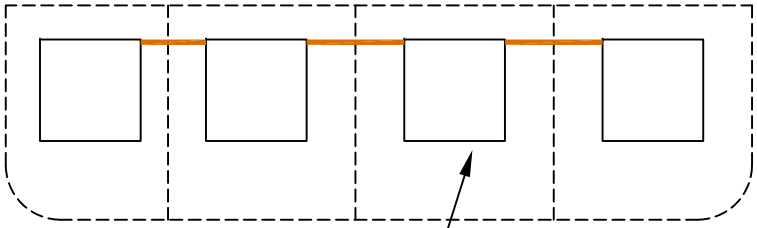
Table 6.3: Acceptable treatment packages

Area	Orientation to road or rail corridor	Package A $L_{Aeq,Day}$ up to 60dB $L_{Aeq,Night}$ up to 55dB	Package B $L_{Aeq,Day}$ up to 63dB $L_{Aeq,Night}$ up to 58dB	Package C $L_{Aeq,Day}$ up to 65dB $L_{Aeq,Night}$ up to 60dB
Bedrooms	Facing	• Walls to R_w+C_{tr} 45dB • Windows and external door systems: Minimum R_w+C_{tr} 28dB (Table 6.4), total glazing area up to 40% of room floor area. [if R_w+C_{tr} 31dB: 60%] [if R_w+C_{tr} 34dB: 80%] • Roof and ceiling to R_w+C_{tr} 35dB (1 layer 10mm plasterboard) • Mechanical ventilation as per Section 6.3.1	• Walls to R_w+C_{tr} 50dB • Windows and external door systems: Minimum R_w+C_{tr} 31dB (Table 6.4), total glazing area up to 40% of room floor area. [if R_w+C_{tr} 34dB: 60%] • Roof and ceiling to Rw+Ctr 35dB (1 layer 10mm plasterboard) • Mechanical ventilation as per Section 6.3.1	• Walls to R_w+C_{tr} 50dB • Windows and external door systems: Minimum R_w+C_{tr} 34dB (Table 6.4), total glazing area limited to 40% of room floor area [if 20% of floor area or less, R_w+C_{tr} 31dB] • Roof and ceiling to R_w+C_{tr} 40dB (2 layers 10mm plasterboard) • Mechanical ventilation as per Section 6.3.1
	Side-on	• As above, except glazing Rw+Ctr values for each package may be 3dB less, or max % area increased by 20%		
	Opposite	• No requirements	• As per Package A 'Side On'	• As per Package A 'Facing'
Indoor living and work areas	Facing	• Walls to R_w+C_{tr} 45dB • Windows and external door systems: Minimum R_w+C_{tr} 25dB (Table 6.4), total glazing area limited to 40% of room floor area. [if R_w+C_{tr} 28dB: 60%] [if R_w+C_{tr} 31dB: 80%] • External doors other than glass doors to R_w+C_{tr} 26dB (Table 6.4) • Mechanical ventilation as per Section 6.3.1	• Walls to R_w+C_{tr} 50dB • Windows and external door systems: Minimum R_w+C_{tr} 28dB (Table 6.4), total glazing area up to 40% of room floor area. [if R_w+C_{tr} 31dB: 60%] [if R_w+C_{tr} 34dB: 80%] • External doors other than glass doors to R_w+C_{tr} 26dB (Table 6.4) • Mechanical ventilation as per Section 6.3.1	• Walls to R_w+C_{tr} 50dB • Windows and external door systems: Minimum R_w+C_{tr} 31dB (Table 6.4), total glazing area up to 40% of room floor area. [if R_w+C_{tr} 34dB: 60%] • External doors other than glass doors to R_w+C_{tr} 30dB (Table 6.4) • Mechanical ventilation as per Section 6.3.1
	Side-on	• As above, except the glazing R_w+C_{tr} values for each package may be 3dB less, or max % area increased by 20%		
	Opposite	• No requirements	• As per Package A 'Side On'	• As per Package A 'Facing'
Other indoor areas	Any	• No requirements	• No requirements	• No requirements
Outdoor living areas	Any (Section 6.2.3)	• As per Package C, and/or • At least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2 metres height above ground level	• As per Package C, and/or • At least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2.4 metres height above ground level	• At least one outdoor living area located on the opposite side of the building from the transport corridor

Any penetrations in a part of the building envelope must be acoustically treated so as not to degrade the performance of the building elements affected. Most penetrations in external walls such as pipes, cables or ducts can be sealed through caulking gaps with non-hardening mastic or suitable mortar.

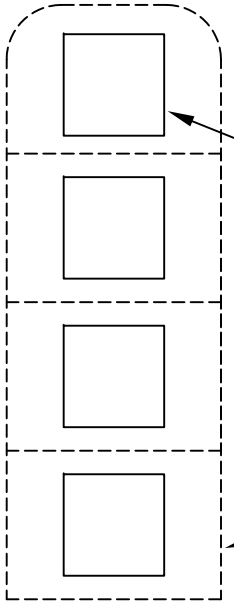
Appendix H – Conceptual Illustrations

(For alternative noise control options)



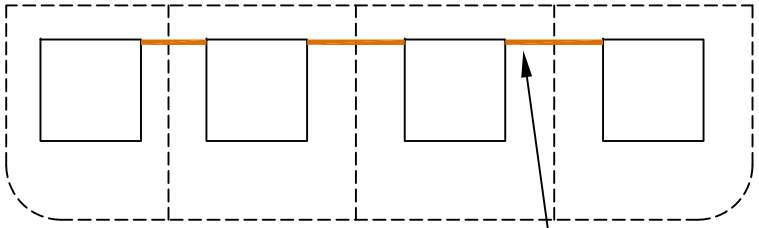
Allotments parrallel to Kwinana Freeway

High-set houses at first row of allotments with back wall facing Kwinana Freeway



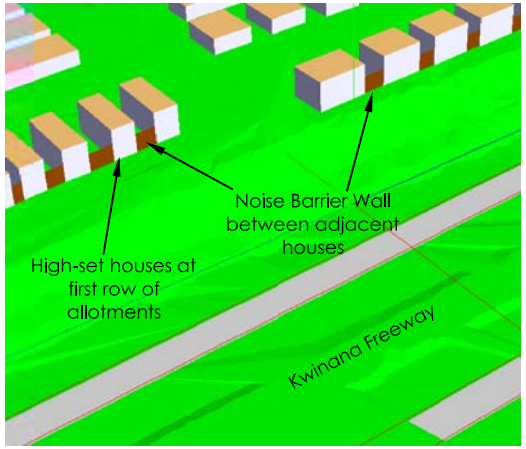
Houses at first row of allotments to be high-set

Lot boundaries



4.0m high Noise Barrier Wall between adjacent houses

3D Perspective - SoundPLAN Noise Model



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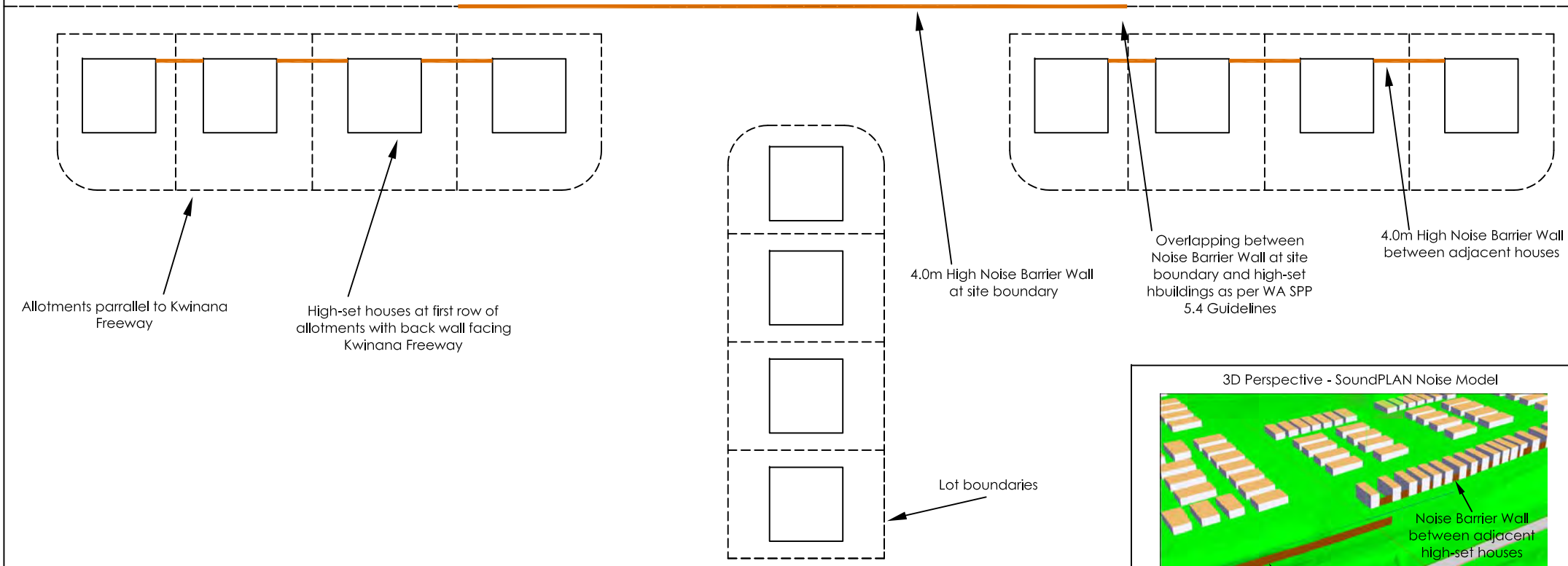
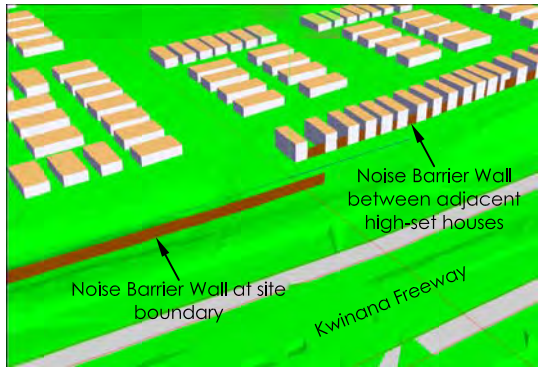
Project: Mandogalup Subdivision	Drawing Ref: Appendix L_Figure 1	Concept Illustration Option 1: Row of High-set Houses	DRAWN: J.S; CHECKED: S.T
Client: Satterly Property Group	Drawing Ref: Not to Scale		DATE: Sept 2016; Rev: 0
			JOB No: 140414



3D Perspective - SoundPLAN Noise Model



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Project: Mandogalup Subdivision	Drawing Ref: Appendix L_Figure 2
Client: Satterly Property Group	Drawing Ref: Not to Scale

Concept Illustration
Option 2: Row of High-set Houses Boundary Noise Walls

DRAWN: J.S	CHECKED: S.T
DATE: Sept 2016	Rev: 0
JOB No: 140414	

2.5m High Noise Barrier Wall at site boundary

Laneway running parallel to full length of Noise Barrier Wall at site boundary

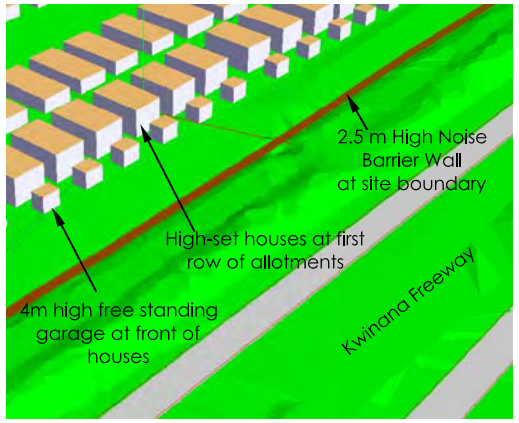
Lot boundaries

High-set houses at first row of allotments parallel to the Kwinana Freeway

Protected outdoor living area to be located behind garage

4.0 m high free-standing double garage in front of each high-set houses at first row of allotments

3D Perspective - SoundPLAN Noise Model



Notes:

1. Protection provided by garages will allow locating the living/dining areas at ground floor at front of the building
2. The noise-sensitive bedrooms and study rooms etc to be located along protected back facade at first floor of the buildings.
3. The store rooms, bathrooms and laundry etc shall be located along the traffic noise impacted front facade at first floor of buildings.

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Project: Mandogalup Subdivision	Drawing Ref: Appendix L_Figure 3	Concept Illustration Option 3: Continous Row of High-set Houses	DRAWN: J.S / CHECKED: S.T DATE: Sept 2016 / Rev: 0 JOB No: 140414
Client: Satterly Property Group	Drawing Ref: Not to Scale		

APPENDIX 6

LANDSCAPE AND PUBLIC OPEN SPACE STRATEGY

ROWEGROUP

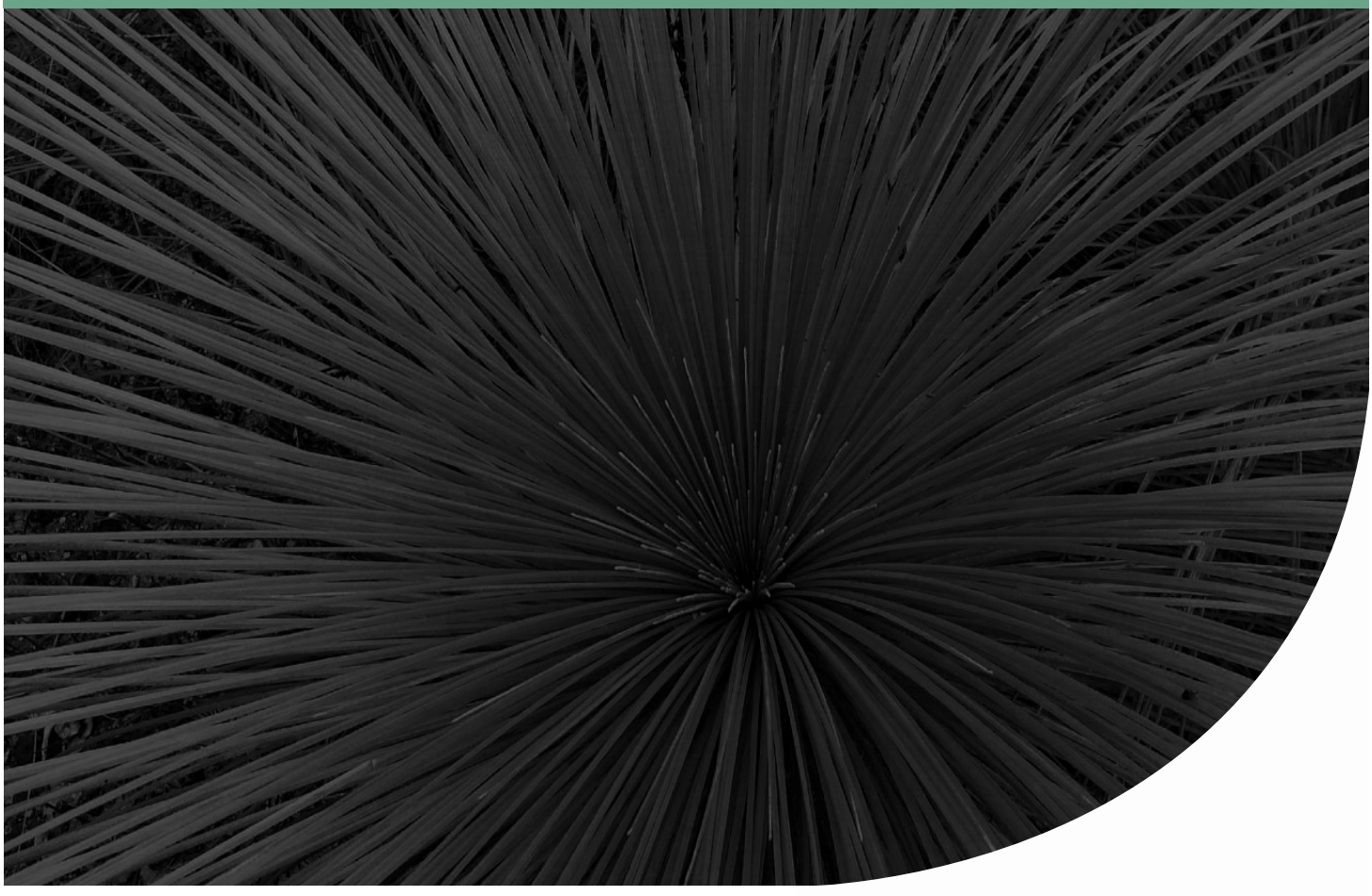
Landscape & Public Open Space Strategy

Mandogalup East Local Structure Plan

Part Lots 9002, 9006 and 11 Hoffman Road, Lot 9019 Rowley Road, Mandogalup

Project No: MA-01-LSP

Prepared for Satterley Property Group Ltd
November 2016



Document Control

Doc name:	Landscape & Public Open Space Strategy Mandogalup East Local Structure Plan Rowley Road, Mandogalup	Part Lots 9002, 9006 and 11 Hoffman Road, Lot 9019			
Doc no.:	MA-01-LSP				
Version	Date	Author		Reviewer	
1					
A	28 July 2014	Jeremy Wilks	JW	Shane Caddy	SC
B	28 November 2016	Carla Ramsland	CR	Shane Caddy	SC
C					
D					

Executive Summary

This report has been prepared by Emerge Associates to accompany the Part Lots 9002, 9006 and 11 Hoffman Road and Lot 9019 Rowley Road, Mandogalup East Local Structure Plan (MELSP) submission to be developed by Satterley Property Group Limited. The report outlines the proposed Public Open Space (POS) and streetscapes landscape strategy for the Development Area.

The Development Area has the Kwinana Freeway running the length of the site's eastern boundary. Hoffman Road allows access to its southern boundary and Rowley Road bounds the northern limit while open farmland currently exists to the west. The western boundary comprises land reserved for further residential development by Qube Property Group and is currently referred to as the Mandogalup West Local Structure Plan (MWLSP).

All landscape concepts outlined in this report and shown on the included Landscape Concept Master plan have been prepared based on the Development Plan prepared by Rowe Group with considerable inputs from the project's Environmental and Hydrological scientists, Civil Engineer and Landscape Architect. The landscape strategy shows due consideration to POS and streetscape interfaces with the MWLSP.

The report details existing site conditions and environment, typical POS typologies and generic landscape treatments of POS areas, including but not limited to:

- Typical POS Recreation Facilities Provided,
- Treatment of Proposed Storm Water Drainage in Landscaped Areas,
- Retention of Existing Significant Vegetation,
- Irrigation Strategy, and
- Landscape Maintenance.

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Appendices

1 Existing Site Conditions and Environment

1.1 Site Character and Adjacent Land Uses

1.1.1 Generally

The existing site, Mandogalup East is approximately 42.67 hectares in area, is generally flat to gently undulating and exhibits minimal change in ground elevation but rises in elevation from west to east and south to north over the site. The low point is approximately 13m AHD in the south western corner, rising evenly to approximately 15m AHD in the south eastern corner. The topography rises steadily south to north from approximately 15m AHD in the south eastern corner to approximately 29m AHD in the north eastern corner adjacent the freeway. Several small knolls in the thin northern portion of the site rise between 2-5m above the gently sloping base level.

The existing site's former land uses include horse agistment and market gardening. This has meant that much of the property has been cleared of the existing vegetation, although sporadic remnant vegetation exists in conjunction with occasional introduced tree plantings which could have been acting as windbreaks and boundaries to paddocks or for spatial definition around sheds and other farming infrastructure.

1.2 Focal Points and Views

1.2.1 Generally

Given the site's generally level topography as outlined above, there are no strong views or vistas from vantage points located within the site.

All of the subject site is located on the low lying, gently undulating Swan Coastal Plain. The nature of the landscape of the Swan Coastal Plain in the immediate vicinity is largely of modified vegetation with a predominant rural character. Vistas created by view shafts through these rural properties exist within the greater area.

The important focal points and views to be considered, retained and reinforced through the urban and landscape design process relate to the pre-existing linear views available through rural allotments. Similar linearity of views will typically occur through the creation and reinforcement of long vistas along trending north-south aligned roads and public open space links within the proposed development. These views and vistas should be reinforced and /or framed through the consideration of tree placement or retained vegetation.

1.3 Recreation Connections

1.3.1 Generally

There are no existing recreation connections around the existing site. Future Sporting Ovals are proposed to be shared between this site and the MWLSP adjacent landholding. The existing cycle

way that runs parallel to the Kwinana Freeway sits just outside the eastern site boundary. Provisions have been made for cyclist access within MELSP to connect to the greater cycleway network.

1.4 Significant Trees

1.4.1 Generally

The extensive pasture / grazing activity during the site's previous land uses, especially to the site's southern portion has resulted in little remnant vegetation remaining over much of this area and as such significant trees that could be retained are limited. In 2016, Strategen Environmental undertook a Significant Tree Assessment to align with the City of Kwinana's recently adopted Local Planning Policy No 1, Landscape Feature and Tree Retention (LFTR) (28 September 2016). Arbor Logic (Arboricultural Consultancy) were also engaged to undertake a Significant Tree Assessment of the MELSP site.

It was found that there were a number of Significant Trees of High, Medium, Low and Very Low retention value across the site as well as stands of trees that encapsulated the LFTR Policy's appropriation of landscape feature. There were no trees deemed to be of Cultural Significance within the site area.

This Landscape and Public Open Space Strategy is specifically tailored to maximise tree retention in accordance with the City of Kwinana's *Local Planning Policy No.1 Landscape Feature and Tree Retention (LPP No1)*.

The LLP No.1 provides for the identification, assessment and retention of significant trees and landscape features to facilitate the viable of native landscape assets within developments occurring with the City of Kwinana. In consultation with the City of Kwinana Environmental Services during 2014 to 2016 the following two landscape features are identified within the Proposal Area:

1. Stand of *Eucalyptus rudis* Open Forest comprising of *Eucalypts rudis* Open Forest in soak/spring with *Melaleuca preissiana* and *M. rhaphiophylla* tall trees.

2. Stand of Melaleuca comprising of *Melaleuca preissiana* and *Melaleuca raphiophylla.*

To ensure the long term viability of retained trees, existing trees with a diameter at breast height (DBH of 0.5m or greater (significant trees) within the landscape features and across the site have been subject to a physical assessment. The physical assessment identified significant tree locations, species, size and structural health. The physical assessment enabled each significant tree to be allocated a retention value of 'very low', 'low', 'medium' or 'high' based on the assessment of health and/or structural integrity. The identification and assessment of significant trees and landscape features is identified within the Mandogalup East Local Structure Plan Environmental Assessment Report (EAR, Strategen 2016). The EAR:

1. Details an appropriate level of information concerning significant trees and landscape features for a structure plan.

2. Describes how the retention of significant trees and landscape features have been optimised through the design process to maximise the retention of character in the development.

In consultation with the City of Kwinana Environment Services all trees identified with a 'very low' or 'low' retention value located outside Public Open Space are not considered as a viable tree for retention due to the potential risk to community. Therefore trees of 'very low' or 'low' retention value located outside Public Open Space are not retained.

In order to maximise the retention of viable trees and avoid impacts to significant trees and landscape features on site the following measures were undertaken by the Proponent:

1. An assessment of the landscape features and significant trees was undertaken within the context of the proposed development.
2. Public Open Space areas where located to maximise retention of the Landscape Features *Eucalyptus rudis* Open Forest and Melaleuca.
3. An engineering and planning assessment was undertaken. A key consideration in this assessment was the level of cut and fill required at the location of the significant tree. A significant tree is retained where the tree meets all of the following criteria. A retained significant tree is:

a) of 'high' or 'medium' retention value located within outside areas of Public Open Space

b) located in fill less than 0.5m

c) a species retained by the City of Kwinana

d) able to be designed into a location of public open space, road reserve, rebated lot for drainage, group housing or education.

Where trees have an ability to be designed into a location of road reserve, rebated lot for drainage, group housing or education the retention of the tree is subject to detailed design at subdivision stage. The retention outcomes of trees subject to further design will be detailed in the Landscape Feature and Tree Retention Plan at Subdivision and Development Approval stage.

This strategy confirms the landscape and Public Open Space responses to the existing landscape and secures the retention of the following environmental assets:

- the retention of a two landscape features within Public Open Space comprising:
- a stand of *Eucalyptus rudis* Open Forest
- a stand of Melaleuca
- the retention of 62 significant trees retained in Public Open Space
- the potential retention of an additional 13 significant trees subject to the following detailed design:
- four (4) trees subject to the design of services and road space within the road reserve
- one (1) tree subject to the design of the drainage within rebated lots
- two (2) trees subject to the design of the proposed group housing site

- four (4) trees subject to the outcome of the proposed education site.

Plate 1: Indicative character image incorporating existing mature trees within new landscape open space.

1.5 Dampier to Bunbury Natural Gas Pipeline Easement

1.5.1 Generally

Within the central southern portion of the site is the Dampier to Bunbury Natural Gas Pipeline (DBNGP) easement. As stipulated by the City of Kwinana and the Department of Planning, the DBNGP easement is not to be credited toward the POS provision for the MELSP, and therefore landscape treatments will be reflective as such.

A group of approximately (13) *Eucalyptus rudis* (Flooded Gum) currently exist to the south eastern boundary of the DBNGP which, upon arborist / environmental consultation and assessment, these trees have been deemed unsuitable for retention due to being located within cut and fill requirements of the development.

Any future landscaping that is required to this easement shall be done so in consultation with the City of Kwinana, MELSP project team and associated service agencies. If required, all shrubs installed over the alignment of the actual gas pipeline will be shallow rooting groundcovers for a distance of 1metre either side of the pipe.

2 Precinct Amenity Character

2.1 Precincts of Mandogalup

2.1.1 Generally

MELSP has five (5) distinct precincts that have been developed to celebrate the existing topographical opportunities, significant trees and landscape features found within the site. It is intended that each precinct will build upon their localized natural asset milieu and develop a maturing sense of place within the development. Each precinct will consist of strong landscape amenity within the streetscape and public open space (POS) areas, which will inform the material colour palette of the built form. The five (5) precincts are below and within the Appendices of this document:

- Northern Pocket Precinct
- Education Precinct
- Urban Precinct
- Parkland Precinct
- Display Precinct

2.2 Northern Pocket Precinct

2.2.1 Generally

The Northern Pocket Precinct is characterized by higher topographical layout to the north eastern corner of the current MELSP at 29.0m AHD. Its location to the most north eastern point of the MELSP has created opportunities for a central pocket park (POS 7, approximately 2,744m2) which encompasses both open space and drainage function. It is anticipated that the character and amenity of this precinct will seek to amplify its higher topographical location with a light and breezy colour palette extending to the surrounding built form.

Plate 2: Indicative character image of Northern Pocket Precinct Open Space

2.3 Education Precinct

2.3.1 Generally

The proposed future primary school and associated local playing fields (POS 6 approximately 11,541 m2) are located within the northern portion of both the MELSP and MWLSP site areas.

2.4 Urban Precinct

2.4.1 Generally

Located at the core of the residential development, the Urban Precinct boasts walking distance proximity to the proposed future primary school and local playing fields, existing landscape features such as large stands of retained *Eucalyptus rudis* trees within POS 5 and significant trees dotted throughout its streetscapes.

POS 5 is approximately 12,185m2 in area and holds both significant tree vegetation and drainage functions within its boundary extent. To ensure the retention values of the POS 5 are upheld, a portion of this area is defined as 'restricted' open space. Whilst indicatively shown on the MELSP, the extent to which the land is defined as 'restricted' versus 'unrestricted' open space will be resolved with the City of Kwinana through the detailed landscape and subdivision design phases of the development. It is anticipated that the character and amenity of this precinct will seek to engage with the natural landscape features found within the precinct and provide an earthy hue palette to the surrounding built form.

Plate 3: Indicative character image of Urban Precinct Open Space boardwalks + connections with 'Landscape Feature' as per City of Kwinana's LFTR policy

2.5 Parkland Precinct

2.5.1 Generally

Surrounded by vast areas of open space, the Parkland Precinct offers multiple experiences within its boundary extents. To the north of the precinct lies the Peel Main Drain Parkland, with open space areas notated as POS 3 and POS 4 sized at 1,508m2 and 4,551m2 respectively. To the south lies POS 2 (approximately 8,392m2) which encompasses the landscape feature described as *Melaleuca*

Dampland Community. The boundary extent of POS 2 meets the Dampier to Bunbury Natural Gas Pipeline Easement (DBNGP) which extends through the MELSP on a north east to south west alignment beyond the MELSP boundary.

The journey along MELSP north south spine road is a sensory experience as it meanders through various proposed POS and amenity areas. It also contains cycle connections that cross through the site and connect to the Kwinana Freeway to the east. It is anticipated that the character and amenity of this precinct will further endorse the natural landscape features and provide a forest floor colour palette to the surrounding built form.

Plate 4: Indicative character image of Parkland Precinct Open Space raised boardwalks + connections with 'Landscape Feature' as per City of Kwinana's LFTR policy

2.6 Display Precinct

2.6.1 Generally

Characterised by a transitioning rural to urban experience along Hoffman Road, the entry to the 'front door' of the development is one of meandering boulevards and village green living. The proposed display village is a short walk to POS 1 (approximately 2,007m2) with the extent of the precinct being within 200m walkability to the POS. It is anticipated that the character and amenity of the Display Precinct will seek to engage with the rural to urban transition experience, providing a distinct point of difference to the surrounding built form.

Plate 5: Indicative character image of Display Precinct streetscape

3 Landscape Response to the Proposed Local Water Management Strategy

3.1.1 Generally

The landscape strategy is tightly woven into the Local Water Management Strategy (LWMS) whereby streetscapes shall contain at source infiltration of the minor storm events (1:1 ARI, up to 1:5 ARI - Average Recurrence Interval). Five (5) typologies listed below have been created to convey stormwater runoff in minor events. On the occurrence of a major storm event, all minor drainage typologies will be saturated / full. Major events (above 1:5 ARI up to 1:100 ARI) shall be collected in selected POS areas as turfed detention basins. By developing the landscape strategy holistically with the LWMS there is greater potential for higher functioning streetscape amenity due to at-source infiltration and larger active open space areas within POS as the need for basins to contain the 1:1 ARI up to 1:5 ARI is not required.

The landscape strategy will correspond with the outcomes of the MELSP LWMS and future UWMP. For specific details on locations of the below five (5) drainage typologies, refer to Figures 11-16 of JDA's LWMS report (November 2016).

3.1.2 Porous Tree Pits

Porous Tree Pits are anticipated to assist in infiltrating the 1:5 ARI event. Running parallel to the road alignment and located at a ratio of one (1) tree per standard lot and two (2) trees per corner lot, areas of street tree plantings are situated at road pavement level. Planting within this zone accommodate tree and grass/ groundcover profiles.

Plate 6: Indicative character image of a Porous Tree Pit at road level

3.1.3 Pocket Gardens

Pocket gardens are larger verge gardens at road pavement level with widened verges and truncations. Pending location, size and surrounding conditions pocket gardens may have an amended soil profile. It is proposed that this typology will also accommodate round-a-bout planting at road level, or sunken round-a-bout planting to accommodate additional storm water runoff.

3.1.4 Linear Rain Gardens

This porous infiltration typology is classified as a verge rain garden at road pavement level in locations of non-active frontages and POS. No crossovers are apparent within this typology. Linear Rain Gardens are typical along priority verge areas along MELSP's north south spine road and will have an amended soil profile.

3.1.5 Rebated Lot Rain Gardens

Rebated Lot Rain Gardens are positioned at specified locations within the local road structure network to capture minor storm events up to 1:5 ARI. This typology denotes a traditional rain garden adjacent to a rebated lot, comprising part of the road reserve. These areas are proposed to be self-sustaining at maturity, include an amended soil profile and specialized planting palette to address stripping of nutrients contained within the runoff.

3.1.6 Central Median Swale

The Central Medial Swale is located on the Neighborhood Connector Road, and is categorized by a central median swale as well as verge planting. An example of this type of landscape / hydrology overlay can be viewed on Honeywood Avenue, Wandi, WA.

4 Landscape Design / Public Open Space Strategy

This section of the report describes the basic principles of the overall Public Open Space (POS) strategy for the MELSP. The proposed residential subdivision is to be developed around a range of open space opportunities and the developments Local Water Management Strategy. There are 4 different categories of open space described which include:

- Multiple Use Corridors
- Streetscapes
- Large Parks
- Pocket Parks

It is envisaged that no resident will be more than approximately 200m away from an open space area. A preliminary Landscape Master plan Concept for the Development Area is included, which outlines the landscape design for all POS areas.

4.1 Public Open Space Principles

4.1.1 Generally

The landscape strategy behind public open space development is to provide a rich landscape amenity that is readily useable, sympathetic to seasonal change aesthetics whilst maintaining an inviting and liveable environment to potential residents from day one. Landscaped open space areas shall incorporate features and facilities to both encourage the residential community to grow and engage with the surrounding milieu and to provide responsive, yet architecturally interesting amenities and built form opportunities to residents. Landscape works shall be holistic in providing an aesthetic and multi-functional use wherever possible.

Aiding in the establishment of the overall landscape aesthetic and function of POS areas throughout the development site will be the retention of existing significant trees and landscape features where long term health and vigour allow, in accordance with proposed Civil Engineering design levels. The retention of existing significant trees will assist in establishing the site's sense of place and rich amenity framework, which will be reinforced through the landscape materials palette.

4.1.2 Material Palette

It is proposed that close attention to detail will be provided in the landscape detailing and materials selection to ensure the development comprises a palette that is relevant to its locality while creating a quality open space environment. As discussed in *Section 2 Precinct Amenity Character* of this report, each precinct will have a defined material palette which will inform the built form product, with the intent that both the landscape and the architectural vernacular will address and respond to each other.

The inclusion and use of some the following detailing is proposed to achieve this outcome within the project area:

- Paving styles and colours will be chosen to create visual interest, assist in differentiation between area uses and provide hard-wearing surfaces of varying textures.

- Wall detailing through the use of local limestone will be complementary with masonry products where retaining / feature elements are required.
- Durable shelter and street furniture shall be of a style and colour palette that will co-ordinate with the overall precinct and POS design.
- Precincts of Mandogalup will each have a specific landscape aesthetic and character, which will be delivered through a strong planting hierarchy and streetscape planting palette. Street tree selection will be both evergreen and deciduous species, so as to further encourage landscape amenity and seasonal appreciation whilst making best use of solar opportunities in the landscape (ie, deciduous trees to western aspects, winter warmth and summer shade).
- Selected tree and shrub species will respond to the surrounding natural environment and shall incorporate water sensitive design (WSUD) principles while creating view shafts and vistas to focal areas within the development to enrich a sense of community value.
- Rain Gardens shall be designed so as they are climatically suited to the conditions, with plant species being selected for various zones of water inundation for extended periods of time during the winter months.
- Biodiverse planting arrangements will be designed for 'at source infiltration' areas such as Porous Verge and Linear Rain Gardens as detailed in the MELSP Local Water Management Strategy report prepared by JDA November 2016.

4.1.3 Planting Palette

It is proposed that the following indicative planting palette will be used in the amenity areas of the public open space and streetscape hierarchies.

Table 1: Indicative Public Open Space & Streetscapes Planting Palette

Indicative Public Open Space and Streetscapes Planting Palette	
LATIN NAME	**COMMON NAME**
TREES	
Acer x freemannii 'Autumn Blaze'	Lipstick Maple
Agonis flexuosa	WA Peppermint
Corymbia calophylla	Marri
Corymbia ficifolia	Red Flowering Gum
Eucalyptus caesia	Silver Princess
Eucalyptus leucoxylon rosea	White Ironbark
Eucalyptus lane-poolei	Salmon White Gum
Eucalyptus marginata	Jarrah
Eucalyptus rudis	Flooded Gum
Eucalyptus sideroxylon	Red Iron
Eucalyptus wandoo	Wandoo
Fraxinus raywoodii	Claret Ash

Indicative Public Open Space and Streetscapes Planting Palette	
Koelreuteria paniculata	Golden Rain Tree
Jacaranda mimosaefolia	Jacaranda
Liquidamber styraciflua	Liquidamber
Melaleuca leucadendra	Weeping Paperbark
Melaleuca preissiana	Modong
Melaleuca rhaphiophylla	Swamp Paperbark
Platanus acerifolia	London Plane Tree
Pyrus calleryana 'Bradford'	Bradford Pear
Pyrus nivalis	Snow Pear
Pyrus usseriensis	Manchurian Pear
Tilia cordata 'Greenspire'	Linden Tree
Tilia cordata 'Winter Orange'	Linden Tree
SHRUBS	
Adenathos sericea	Albany Woolly Bush
Acacia saligna	Golden Wreath Wattle
Agonis flexuosa 'nana'	Dwarf Willow Peppermint
Agonis linearifolia	Swamp Peppermint
Allocasuarina fraseriana	Common She-oak
Anigozanthos sp	Kangaroo Paws
Banksia attenuata	Candle Banksia
Banksia grandis	Bull Banksia
Banksia menziesii	Firewood Banksia
Callistemon 'Little John'	Dwarf Bottlebrush
Callistemon phoenicius	Lesser Bottlebrush
Calothamnus quadrifidus	One-sided Bottlebrush
Conostylis aculeata	Prickly Conostylus
Dianella 'Little Jess'	Dwarf Flax Lily
Dianella revoluta	Flax Lily
Dianella revoluta variegata	Variegated Flax Lily
Grevillea 'Bonfire'	
Grevillea 'Honey Gem'	
Leucophyta brownii	Silver Cushion Bush
Melaleuca lateritia	Robin Red-breast

Indicative Public Open Space and Streetscapes Planting Palette	
Melaleuca 'Little Nessie'	Dwarf Nesophila
Melaleuca thymoides	
Olearia 'Little Smokie'	Coastal Daisy Bush
Patersonia occidentalis	Purple Flag
Verticordia plumosa	Plumed Feather Flower
Westringia fruticosa variegata	Variegated Native Rosemary
GROUNDCOVERS	
Acacia drummondii	Drummond's Wattle
Acacia cognata 'Limelight'	Acacia
Casuarina glauca 'Cousin It'	Casuarina
Dampiera diversofolia	Dampiera
Dryandra nivea	Honeypot Dryandra
Eremophila glabra	Emu Bush
Eremophila glabra 'Prostrata'	Emu Bush
Grevillea bipinnatifida	Fuchsia Grevillea
Grevillea crithmifolia	Coastal Grevillea
Grevillea 'Gin Gin Gem'	Grevillea
Grevillea thelmanniana	Spider Net Grevillea
Scaevola sp.	Fan Flower
Westringia 'White Rambler'	Prostrate Native Rosemary
RUSHES / SEDGES	
Baumea articulata	Jointed Twig Rush
Baumea juncea	Bare Twig Rush
Carex appressa	Tall Sedge
Ficinia nodosa	Knotted Club Rush
Juncus pallidus	Pale Rush
Juncus krausii	Sea Rush
Lomandra longifolia	Mat Rush
Lomandra 'Tanika'	Mat Rush

4.2 Multiple Use Corridors

When combined together, POS 3 and POS 4 contribute as a major Public Open Space within the MELSP. POS 4 has been designated to store a portion of the site's overland drainage from Catchment C (refer to Figure 13: Catchment C – Stormwater Management of JDA's LWMS November 2016 report) whilst also conveying water from outside of the site via the Peel Main Drain.

A north-south portion of the drain comprising Lot 1404, will be retained in a similar design to the existing narrow, trapezoidal shape, however the location of this portion of the PMD is situated outside of the MELSP boundary and will be screened by a noise attenuation wall. A further section of the PMD running east-west will be graded to a more open living stream concept in an attractive landscape setting. (Refer to the attached Landscape Master plan). Public Open POS 4 has an approximate area of 4,551m2 and will detain 385m3 of the site's drainage in a 1:100 year major storm event. POS 3 is approximately 1,508m2 in size and has been designed to detain 155m3 of overland flow from Catchment D (refer to Figure 14: Catchment D – Stormwater Management of JDA's LWMS November 2016 report).

Major Drainage areas provide stormwater conveyance and storage areas with capacity for rainfall events above the 5yr ARI, up to the 100yr ARI. Such areas are designed to be contoured and stabilised where necessary to provide a multiple use - drainage / landscaped response. This will be critical to establishing an immediate active and passive recreation opportunity.

In major stormwater events, the proposed minor drainage structures will be full with excess stormwater bypassing the minor drainage structures and discharging to the major detention storage basin. All outlet structures into POS areas will incorporate stabilised water entry points, smooth and even grading of contours and mass planting of suitable water tolerant tree and shrub species for maintenance minimisation. Major drainage areas will typically be grassed areas with maximum side slopes of 1:6 grade to allow for ongoing maintenance activities and safe egress in the event of a large storm water event. If batters are required, they shall be planted with side slopes no greater than 1:3.

All associated landscape infrastructure such as picnic shelters, playgrounds, footpaths and the like will be constructed above the 1:5 year storm water flood levels. The 1:100 year storm water flood levels will not exceed 500mm deep when full. An informal kick-about area and small playground with shade amenity will be located within the MUC and be visible from the north-south aligned spine road through the Parkland Precinct of the development. Strong views and vistas across the open space and from the proposed road network generally will be designed to draw users into the space.

A Pedestrian crossing over the Peel Main Drain channel will be incorporated into the overall shared use path network which will be constructed of all metal sub frame with timber or composite decking products as agreed with the City. Balustrading will be provided where the fall heights exceed the requirements of the Australian Standards.

Several large Significant Trees within the MUC have been surveyed as high and medium classification for retention within both the northern and southern portions of POS 4 and as such the POS has been shaped to best accommodate their preservation. (Refer to MELSP Environmental Management Report, Strategen November 2016).

Plate 7: Typical Multiple Use Corridor – contoured landscape response

Existing vegetation over the site has been highly modified through previous farming and land use practices. Several large existing Significant Trees are proposed to be retained adjacent to the south-eastern corner of the Peel Main Drain and will remain elevated above any drainage infrastructure to ensure their long term health and viability. One standalone tree is located within the north western corner of POS 4 and has been surveyed as being of high classification for retention subject to design opportunities. These trees (and any other retained vegetation through the site) will have remedial pruning undertaken to ensure accordance with the requirements of fire management techniques and both AS 4970 and 4373.

Edge treatment to the swales will include planted garden beds with mowing kerbs and / or hard edge treatments as a maintenance edge between adjoining turf areas within the open space. Hard edge interfaces will include either one of the following:

- Limestone retaining /seating walls
- Concrete / steel edge mowing kerb
- Informal granite/ bush rock / stone pitching

Plate 8: Typical Treatment of 1:100 ARI storm water basins and Landscape amenity

4.3 Large Parks containing Landscape Features

Two large parks will be developed as part of the development plan (POS 2 and POS 5 on the proposed MELSP Landscape Master Plan).

Public Open Space 2, a large park contains the *Melaleuca Dampland* landscape feature and is located within the Parkland Precinct of the development. POS 2 is bounded by residential frontage to three sides and the DBNGP Easement to its south eastern boundary. POS 2 is approximately 8,392m2 and has been created to celebrate the retained *Melaleuca Dampland* landscape feature and provide an alternative passive recreation opportunity by means of boardwalks beneath the community's upper tree canopy. The POS shall also incorporate informal kick-about areas, shade structures, traditional play and nature play opportunities, respite locations and dual use access paths that provide connectivity to the residential pedestrian footpath and the wider cycle network. Disability access will be given a high priority in all large parks and will be designed in accordance with relevant Australian Standards where practicable.

Public Open Space 5 contains the *Eucalyptus rudis* landscape feature and is of approximately 12,185m2 in size. POS 5 shares a common boundary with the MWLSP, is bound on two sides by residential frontage and the future proposed primary school to its northern boundary. POS 5 also contains a major stormwater storage basin which is located within a natural low lying area within the retained vegetation and will hold the 1:100 ARI. It is anticipated that the depth of this

stormwater detention area shall not exceed more than 400mm of water and has a stored volume of 670m3.

This large park will be the heart of the Urban Precinct and include an extensive playground with traditional and nature play opportunities, shade structures, seating, BBQ's. Additional lawn plantings of evergreen and deciduous trees shall create enhanced seasonal experiences and position this as the predominant community activation space within the Parkland Precinct.

Plate 9: Typical Nature Play Recreational Facilities within Large Parks containing Landscape Features

In order to provide amenity for all aspects of the future community, POS 5 will be a space that offers a range of recreation facilities and provide both informal active and passive opportunities. The parkland will encourage community interaction with the retained *Eucalyptus rudis* landscape feature by means of a passive boardwalk experience through the vegetation community, with potential to revegetate the outer edge, incorporating a limestone firebreak whilst creating connections to the parks designed nature play area. Whilst indicatively shown on the MELSP, the extent to which the open space is defined as 'restricted' versus 'unrestricted', as defined by Liveable neighbourhoods, will be resolved with the City of Kwinana through the detailed landscape and subdivision design phases of the development.

Plate 10: Typical Large Park Amenity Facilities

At least ten (10) trees within the retained landscape feature, have been identified as potential Carnaby's Black Cockatoo breeding trees.

Shrub plantings are planned to strategic areas to provide spatial definition, colour, community interest and wider engagement with the landscape. Shrub planting within the POS will primarily consist of lower growing species with native / ornamental canopy lifted specimen trees to enable clear vision and security through passive surveillance. It is proposed that shrub species will have consideration and adherence to Water wise principles, with the majority of the plant palette comprising of native species. The combination of self-sustaining and manicured landscaped areas shall provide ample locations for the provision of picnic settings and informal gathering spaces.

4.4 Pocket Parks

Two smaller pocket parks have been located within Northern Pocket and Display Precincts within the development. (POS areas 1 and 7 on the proposed MELSP Landscape Master plan). These parks shall incorporate elements of all the items outlined previously including informal recreation / kick about areas and communal features such as BBQ's. POS 7 (Northern Pocket Precinct) has been designed to detain 1:100 ARI major stormwater events and it is anticipated to have no more than 500mm depth of water at its peak. POS 1 (Display Precinct) has not been designed to accept any storm water drainage.

4.5 Streetscapes

Streetscapes throughout the development shall incorporate a variety of treatments in response to the Local Water Management Strategy. As noted within the Engineering Services Report prepared by

Peritas Group (November 2016), all road reserves will be drained. It is proposed that where soakage is possible, at-source infiltration of minor storm events up to the 1:5 ARI shall be contained within Porous Tree Pits, Linear Rain Gardens, Pocket Gardens and Rebated Lot Rain Gardens. In addressing the LWMS, the landscape strategy has implemented a streetscape profile of a split verge. The lower porous area will be located at road level, with the higher level verge creating the pedestrian connectivity pathways at traditional verge separations from road (refer S*ection 3 Landscape Response to Local Water Management Strategy* for infiltration typology descriptions and landscape concept sections within the appendix of this report).

In keeping with WSUD principles, porous areas within the streetscapes of Mandogalup will contain best practice methods and proposed planting palette's that are adaptable to conditions of saturation, inundation and periods of drought. Specialised planting typologies will be further developed for specific infiltration areas such as Rebated Lot Rain Gardens to aid in nutrient stripping of incoming water runoff.

In all cases landscape works shall incorporate tree planting in accordance with accepted traffic standards on the standard street tree alignment in relation to the service utility corridor. Treatments may include soft works such as street trees, hedge planting and groundcovers.

Final tree species are yet to be agreed however an indicative street tree palette has been included within *Section 3.2.3 Planting Palette* of this report, and contains species that are both native and ornamental, evergreen and deciduous. To increase the landscape amenity within the development, deciduous trees will be located in areas where maximum winter sun solar orientation is paramount. Deciduous trees will also be located within close proximity to proposed locations of rebated lot rain gardens, so as to amplify the experience of widened street verges, whilst also acting as a source of seasonal leaf mulch to garden areas. Specific tree, shrub, groundcover species selections and proposed locations shall be addressed in future detail design documentation phases of the project.

Areas of 'priority streetscape' verges are identified as those that are co-located with POS areas along the developments north south spine road, uninterrupted linear rain gardens and pocket gardens. It is anticipated that these areas may be irrigated for the long term, post completion of the development to maintain high quality landscape experiences. These areas will display a planting matrix that contains both native and ornamental species, convey WSUD principles and aim to provide maximum landscape amenity. Further detail of the proposed landscape amenity and hydrology function will be developed in future detail design documentation.

The timing of streetscape landscape amenity installation will occur at the completion of civil engineering works, prior to the construction of homes. Street trees shall be allocated at one per lot for standard lots and three per lot for corner blocks. Rebated Lot Rain Gardens will have numerous trees to enable the microclimatic requirements for the designed long term sustainability of the vegetated community. Trees will be placed typically centre of lot and / or where service alignments permit, located at 2.7m from lot boundary. Tree locations will allow for driveway crossovers and service corridors provided by utility service providers. To achieve appropriate street canopy cover and shade opportunities, pedestrian footpaths will be located on the property boundary.

Passive connectivity within the immediate MELSP development and wider MELSP and MWLSP community shall extend from the pedestrian / shared path network located on local streets and

extend into areas of POS, ensuring that residents are within 400m walkability from an open space area.

4.6 Irrigation Strategy

In general terms the project is committed to undertaking water sensitive design with minimal impact on good quality groundwater sources and preserving water quality.

It is anticipated that irrigation water will be provided through a series of deep aquifer groundwater bores constructed across the open space areas. The flow rate of the production bores will determine the number of bores required, however, it is envisaged that up to three deep aquifer bores will be required for this development. The use of large droplet format sprinklers within turf areas and subsurface drip line irrigation within garden beds will assist in reducing evaporation and aid water conservation.

All irrigation shall be installed to the local authorities' standard specifications and industry best practice. Maintenance minimisation processes will apply in all circumstances. Controllers shall be keyed and accessed in accordance with the local authorities standards. Irrigation shall be designed to incorporate stations that can be terminated as agreed upon planting establishment and maintenance handover to the Council in accordance with relevant policies.

For specific irrigation maintenance requirements relating to the LWMS at-source infiltration typologies, refer to Appendix K of JDA's LWMS report (November 2016).

4.7 Landscape Maintenance

The industry accepted standard Developer funded and managed landscape and irrigation maintenance period is typically two (2) summers as outlined in Liveable Neighbourhoods. Following this period, the landscape and irrigation maintenance will be handed over to the City of Kwinana to manage, unless otherwise negotiated.

Typically the first year is an establishment period, followed by a second year of consolidation. Irrigation requirements are to be scheduled to be wound back during this period to a point of almost self-sufficiency at the time of handover to the Council.

As part of the ongoing approval process, every public open space landscape and irrigation design will be submitted to and approved by the City of Kwinana for Development Application prior to construction commencing.

The Landscape Design will incorporate recreation and environmental requirements, whilst focusing on maintenance minimisation principles and techniques. The developer is committed to working with the local authority to deliver outcomes in this process to reflect best practice throughout the development.

Specific landscape maintenance requirements differ for at-source infiltration typologies that convey water in the major and minor storm events. Refer to Appendix K of JDA's LWMS report (November 2016) for the proposed maintenance schedule

Appendix A

MELSP Landscape Structure Plans

PRECINCT ZONING

LEGEND

- MANDOGALUP EAST LSP BOUNDARY
- NORTHERN POCKET PRECINCT
- EDUCATION PRECINCT
- URBAN PRECINCT
- PARKLAND PRECINCT
- DISPLAY PRECINCT
- PEEL MAIN DRAIN
- DBNGP EASEMENT

HONEYWOOD ESTATE

KWINANA FREEWAY

MANDOGALUP EAST
LOCAL STRUCTURE PLAN

DWG MA-LSP-01- 1
REV B
DATE 07.12.2016
SCALE 1 : 5000 @ A3

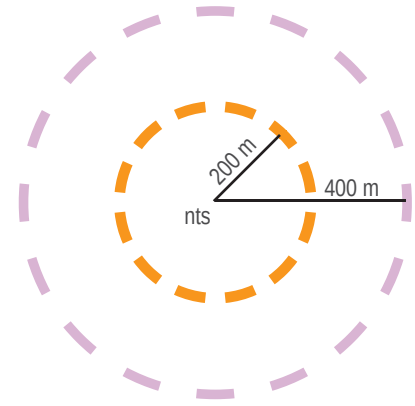
0 25 50 75 100 125 m

emerge ASSOCIATES

400 METRE POS WALKABILITY

LEGEND

- MANDOGALUP EAST LSP BOUNDARY
- NORTHERN POCKET PRECINCT
- EDUCATION PRECINCT
- URBAN PRECINCT
- PARKLAND PRECINCT
- DISPLAY PRECINCT
- PEEL MAIN DRAIN
- DBNGP EASEMENT
- 200m WALKABILITY
- 400m WALKABILITY
- CYCLE ACCESS TO CYCLE WAY



HONEYWOOD ESTATE

KWINANA FREEWAY

MANDOGALUP EAST
LOCAL STRUCTURE PLAN

DWG MA-LSP-01- 2
REV B
DATE 07.12.2016

0 25 50 75 100 125 m

SCALE 1 : 5000 @ A3

emerge ASSOCIATES

MAJOR MOVEMENT CONNECTORS

LEGEND

- MANDOGALUP EAST LSP BOUNDARY
- NORTHERN POCKET PRECINCT
- EDUCATION PRECINCT
- URBAN PRECINCT
- PARKLAND PRECINCT
- DISPLAY PRECINCT
- PEEL MAIN DRAIN
- DBNGP EASEMENT
- NEIGHBOURHOOD CONNECTOR
- NORTH SOUTH SPINE ROAD
- CYCLE NETWORK
- CYCLE ACCESS TO CYCLE WAY

HONEYWOOD ESTATE

KWINANA FREEWAY

MANDOGALUP EAST
LOCAL STRUCTURE PLAN

DWG MA-LSP-01- 3
REV B
DATE 07.12.2016

0 25 50 75 100 125 m

SCALE 1 : 5000 @ A3

emerge ASSOCIATES

POS SPATIAL ACTIVITY PLAY

SYMBOL KEY

- PLAYGROUND (LARGE)
- PLAYGROUND (SMALL)
- DRINK FOUNTAIN
- BBQ
- SEATING NODE
- RETAINED VEGETATION
- SHELTER
- LOOKOUT
- ENTRY SIGN
- WALKING TRAIL
- PASSIVE RECREATION
- SWALE / BASIN

MANDOGALUP EAST

LOCAL STRUCTURE PLAN

DWG MA-LSP-01- 4
REV B
DATE 07.12.2016

0 25 50 75 100 125 m

SCALE 1 : 5000 @ A3

emerge ASSOCIATES

LANDSCAPE MASTERPLAN

DECIDUOUS TREE VIEW SHAFT TO REBATED LOT RAIN GARDENS

REBATED LOT RAIN GARDENS

COMMUNITY POS NODE INCLUDING SHADED PLAY SPACE, SHELTER AND PICNIC FACILITIES

OPEN TURF & STORM DRAINAGE 1:100ARI

FUTURE PLAYING FIELDS

REBATED LOT RAIN GARDENS

FUTURE PRIMARY SCHOOL

PRIORITY VERGE

POCKET GARDEN ROUNDABOUT

RAISED BOARDWALK THROUGH EXISTING RETAINED TREES

NATURE PLAY SPACE SHADED FROM EXISTING RETAINED EUCALYPTUS RUDIS

SHADED SHELTER PICNIC NODE

COMMUNITY PARK / PASSIVE PLAY INFORMAL KICKABOUT

REBATED LOT RAIN GARDENS

POS WITH JUNIOR PLAY SPACE AND PASSIVE TURF AREAS

PEEL MAIN DRAIN

POS WITH PASSIVE OPEN SPACE OPPORTUNITIES

REBATED LOT RAIN GARDENS

RAISED BOARDWALK THROUGH EXISTING MELALEUCA DAMPLAND

SHADED CRUSHED LIMESTONE PICNIC AREA

EXISTING TREES AND VEGETATION TO BE PROTECTED AND RETAINED

DBNGP EASEMENT

PASSIVE TURF

FEATURE ALL AGES PLAY NODE

NEIGHBOURHOOD CONNECTOR ROAD THROUGH MANDOGALUP EAST AND WEST LSP LAND PARCELS

POS 7

POS 6

POS 5

POS 4

POS 3

POS 2

POS 1

HONEYWOOD ESTATE

KWINANA FREEWAY

SYMBOL KEY

- PROPOSED PLAYING FIELDS
- PROPOSED SCHOOL
- PRIVATE LOT
- TRAIN GARDEN
- PLAY SPACE WITHIN POS
- TURF WITHIN POS
- EXISTING TREES TO BE RETAINED

MANDOGALUP EAST

LOCAL STRUCTURE PLAN

DWG MA-LSP-01- 5
REV B
DATE 07.12.2016

0 25 50 75 100 125 m

SCALE 1 : 5000 @ A3

emerge ASSOCIATES

POS ONE [1]
DISPLAY PRECINCT

POS TYPOLOGY

- Neighbourhood Recreation.

SIZE

- POS 1:2009m2 + 651m2 verge.

CONCEPT

- Provide an passive recreation POS with flat grassed areas for informal recreation.
- Path network to disability codes which links into the greater development.

FUNCTIONS / MATERIALS

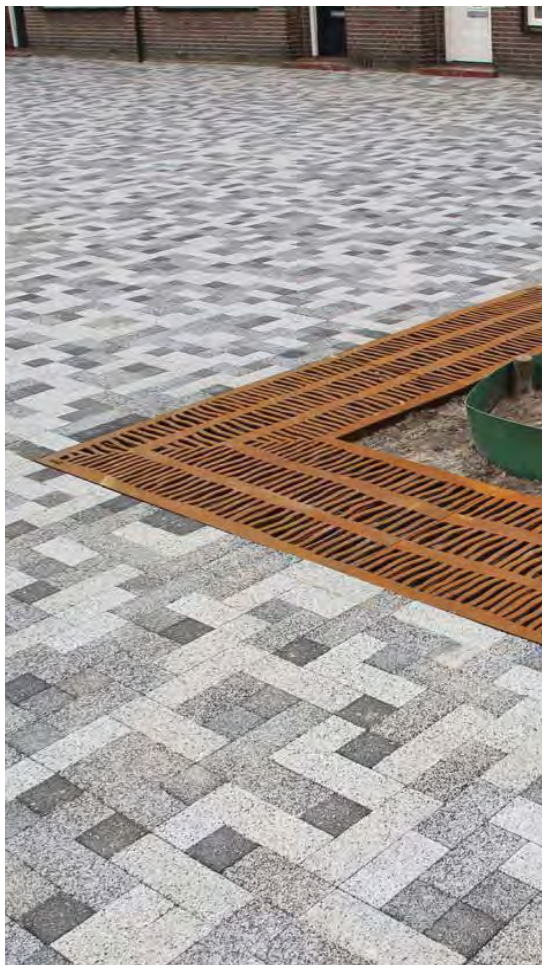
- Provide for informal passive recreation uses within a central turf area with surrounding planted edges.

ENVIRONMENTAL CONSIDERATIONS

- Waterwise Plant Strategy.
- Hydrozoning of plant species.
- Controlled fertiliser application to landscape areas.
- Retain existing trees (where possible).

DRAINAGE CONSIDERATIONS

- 1:100ARI 1535M2
- Linear rain gardens
- Rebated lot rain gardens



MANDOGALUP EAST
LOCAL STRUCTURE PLAN

DWG MA-LSP-01- 6
REV B
DATE 07.12.2016

0 2.5 5.0 7.5 10.0 12.5 m

SCALE 1 : 500 @ A3

emerge ASSOCIATES

POS TYPOLOGY

- Local Nature Park

SIZE

- POS 2: 8393m2 + 750m2 verge.

CONCEPT

- Provide an active recreation POS with flat grassed areas for informal recreation.
- Provide two gathering nodes with picnic and shade structure.
- Retention of melaleuca dampland.
- Path network to disability codes which links into the greater development and future adjoining development within 'KIB'.
- Provide visual interest with feature artwork on street axis.

FUNCTIONS / MATERIALS

- Provide for informal passive recreation uses within a central turf area with surrounding planted edges

ENVIRONMENTAL CONSIDERATIONS

- Waterwise Plant Strategy.
- Hydrozoning of plant species.
- Controlled fertiliser application to landscape areas

DRAINAGE CONSIDERATIONS

- Linear rain gardens
- Rebated lot rain gardens

PARKLAND PRECINCT
POS TWO [2]

MANDOGALUP EAST
LOCAL STRUCTURE PLAN

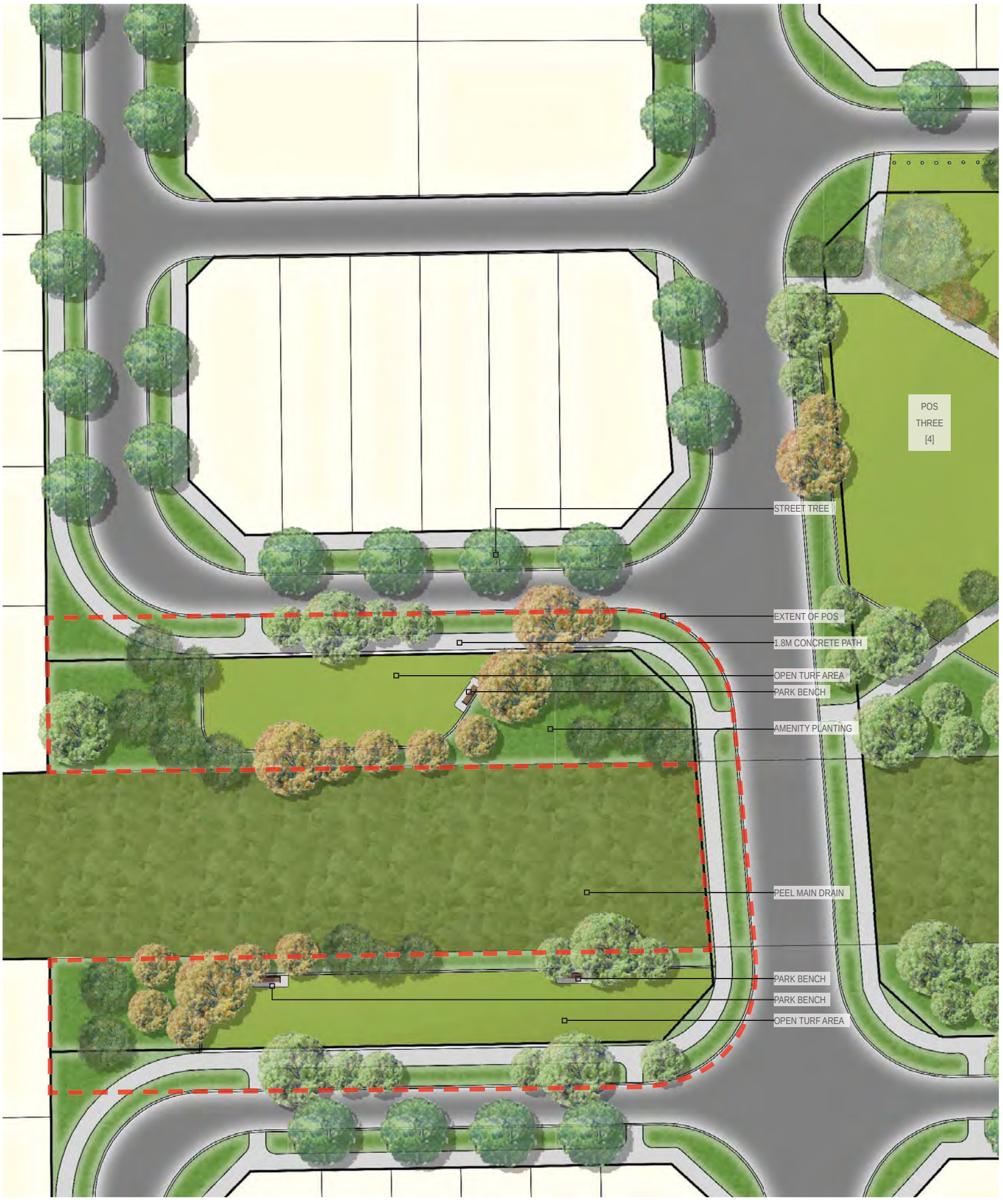
DWG MA-LSP-01- 7
REV B
DATE 07.12.2016

0 2.5 5.0 7.5 10.0 12.5 m

SCALE 1 : 500 @ A3

emerge ASSOCIATES

PARKLAND PRECINCT
POS THREE [3]



POS TYPOLOGY
- Neighbourhood Recreation.

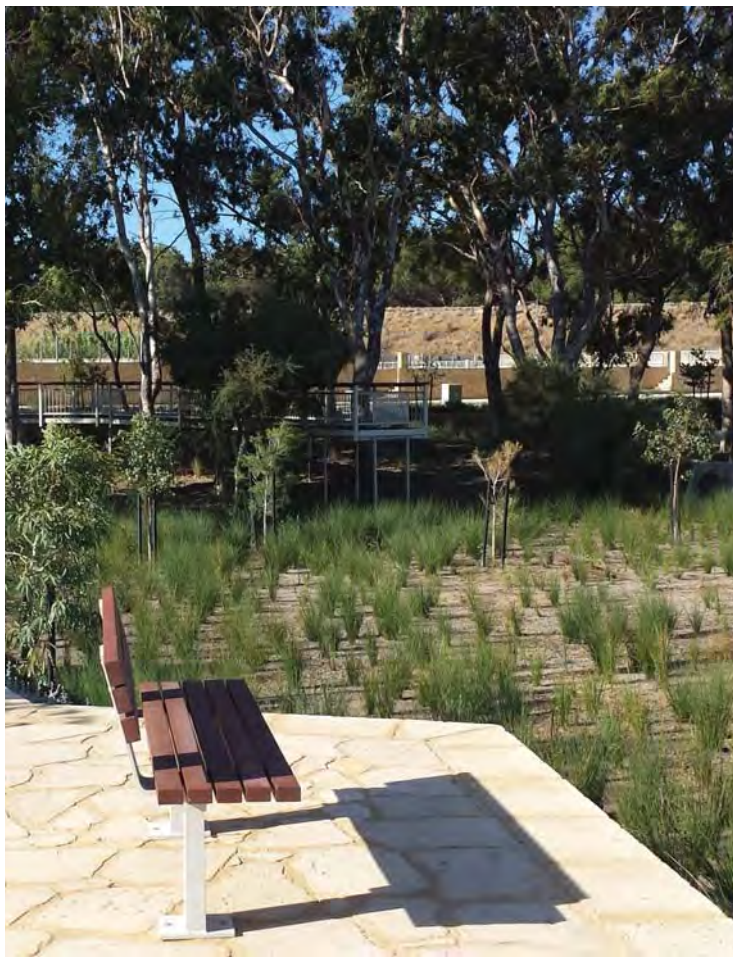
SIZE
- POS 3: 1462m2 + 872m2 verge.

CONCEPT
- Provide an passive recreation POS with flat grassed areas for informal recreation.
- Path network to disability codes which links into the greater development.

FUNCTIONS / MATERIALS
- Provide for informal passive recreation uses within a central turf area with surrounding planted edges.

ENVIRONMENTAL CONSIDERATIONS
- Waterwise Plant Strategy.
- Hydrozoning of plant species.
- Controlled fertiliser application to landscape areas.
- Retain existing trees (where possible).

DRAINAGE CONSIDERATIONS
- 1:100ARI 450M2
- Linear rain gardens
- Rebated lot rain gardens



MANDOGALUP EAST
LOCAL STRUCTURE PLAN

DWG MA-LSP-01- 8
REV B
DATE 07.12.2016
0 2.5 5.0 7.5 10.0 12.5 m
SCALE 1 : 500 @ A3

emerge ASSOCIATES

PARKLAND PRECINCT
POS FOUR [4]

POS TYPOLOGY

- Local Recreation

SIZE

- POS 4: 4626m2 + 1474m2 verge.

CONCEPT

- Provide an active recreation POS with large flat grassed areas for formal recreation.
- Gathering node with picnic and shade structures, over looking children's playground.
- Path network to disability codes which links into the greater development.
- Peel Main Drain to be buffered with native planting

FUNCTIONS / MATERIALS

- Provide for informal passive recreation uses within a central turf area with surrounding planted edges.

ENVIRONMENTAL CONSIDERATIONS

- Waterwise Plant Strategy.
- Hydrozoning of plant species.
- Controlled fertiliser application to landscape areas.
- Retain existing trees (where possible).

DRAINAGE CONSIDERATIONS

- 1:100ARI 1115M2
- Linear rain gardens

MANDOGALUP EAST
LOCAL STRUCTURE PLAN

DWG MA-LSP-01- 9
REV B
DATE 07.12.2016

0 2.5 5.0 7.5 10.0 12.5 m

SCALE 1 : 500 @ A3

emerge ASSOCIATES

URBAN PRECINCT
POS FIVE [5]

POS TYPOLOGY
Local Nature Park.

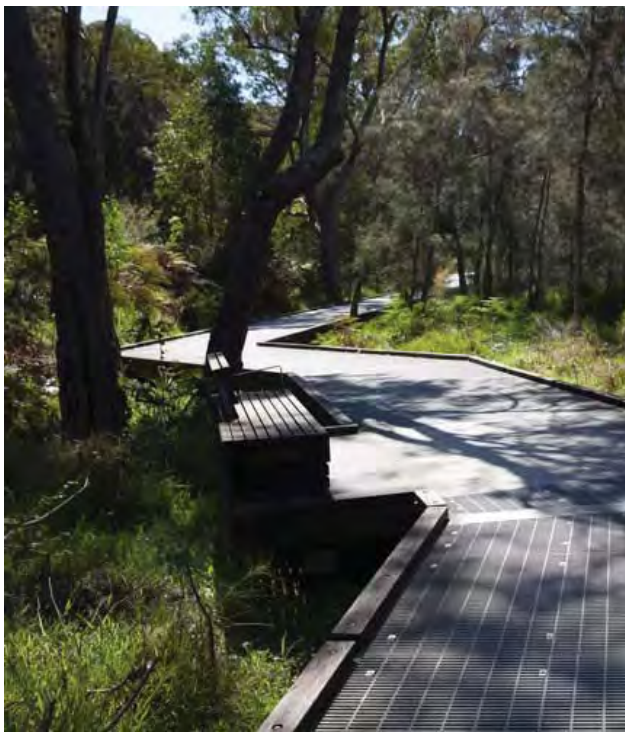
SIZE
- POS 5: 12198m2 + 1360m2 verge.
-

CONCEPT
- Provide an active recreation POS with a flat grassed area for informal recreation.
- Provide a gathering node with picnic and shade structure.
- Retention of existing Eucalyptus rudis vegetation.
- Path network to disability codes which links into the greater development and future adjoining development.
- Provide visual interest with feature artwork on

FUNCTIONS / MATERIALS
- Provide for formal nature play & passive recreation uses within a central turf area with surrounding planted edges.

ENVIRONMENTAL CONSIDERATIONS
- Waterwise Plant Strategy.
- Hydrozoning of plant species.
- Controlled fertiliser application to landscape areas.
- Retain existing trees (where possible).

DRAINAGE CONSIDERATIONS
- 1:100ARI 1970M2
- Linear rain gardens



MANDOGALUP EAST
LOCAL STRUCTURE PLAN

DWG MA-LSP-01- 10
REV B
DATE 07.12.2016
0 2.5 5.0 7.5 10.0 12.5 m
SCALE 1 : 500 @ A3

emerge ASSOCIATES

NORTHERN POCKET PRECINCT
POS SEVEN [7]

POS TYPOLOGY

- Neighbourhood Recreation.

SIZE

- POS 7: 2744m2 + 750m2 verge.

CONCEPT

- Provide an passive recreation POS with flat grassed areas for informal recreation.
- Path network to disability codes which links into the greater development.

FUNCTIONS / MATERIALS

- Provide for informal passive recreation uses within a central turf area with surrounding planted edges.

ENVIRONMENTAL CONSIDERATIONS

- Waterwise Plant Strategy.
- Hydrozoning of plant species.
- Controlled fertiliser application to landscape areas.
- Retain existing trees (where possible).

DRAINAGE CONSIDERATIONS

- 1:100ARI 1535M2
- Linear rain gardens
- Rebated lot rain gardens

MANDOGALUP EAST
LOCAL STRUCTURE PLAN

DWG MA-LSP-01- 11
REV B
DATE 07.12.2016

0 2.5 5.0 7.5 10.0 12.5 m

SCALE 1 : 500 @ A3

emerge ASSOCIATES

TYPICAL STREETSCPAE PLAN

POS TYPOLOGY

- Rebated lot rain garden

SIZE

- Rebated lot rain garden: 200 - 300 m2 (size varies)

CONCEPT

- Porous verge, linear rain gardens & rebated lot rain gardens at source infiltration for minor storm events
- Species selection based on solar orientation & maximising street amenity
- Drought tolerant planting

FUNCTIONS / MATERIALS

- The Rebated lot rain garden accommodate flood storage levels up to the 1:5ARI.

ENVIRONMENTAL CONSIDERATIONS

- Waterwise Plant Strategy.
- Hydrozoning of plant species.
- Controlled fertiliser application to landscape areas.
- Retain existing trees (where possible).

DRAINAGE CONSIDERATIONS

RAIN GARDEN
- Holds up to the 5YR ARI

POROUS TREE PIT
- Holds up to the 5YR ARI

ARI(Average Recurrence Interval)

MANDOGALUP EAST
LOCAL STRUCTURE PLAN

DWG MA-LSP-01- 12
REV B
DATE 07.12.2016

0 2.5 5.0 7.5 10.0 12.5 m

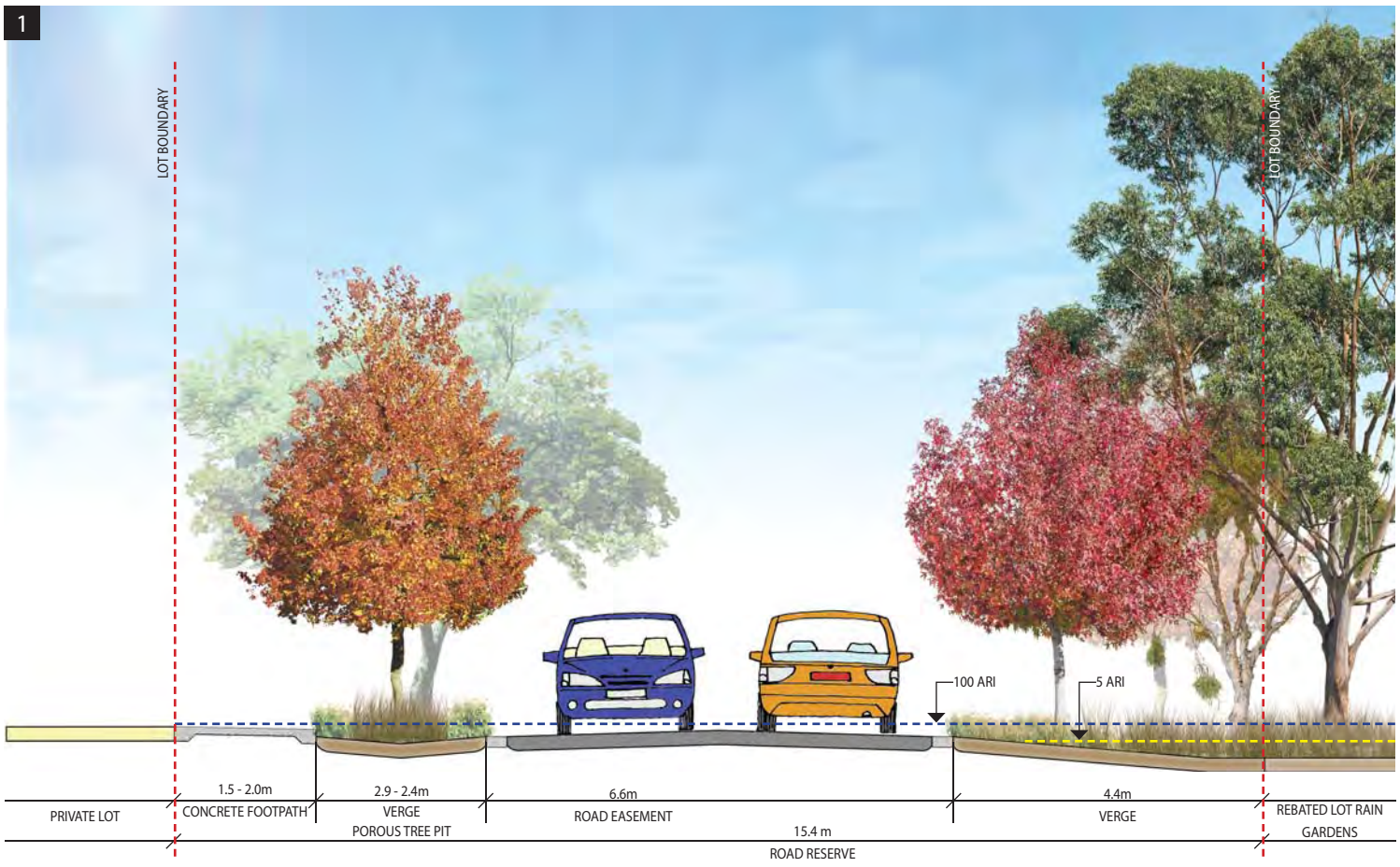
SCALE 1 : 500 @ A3

emerge ASSOCIATES

TYPICAL STREET SECTIONS

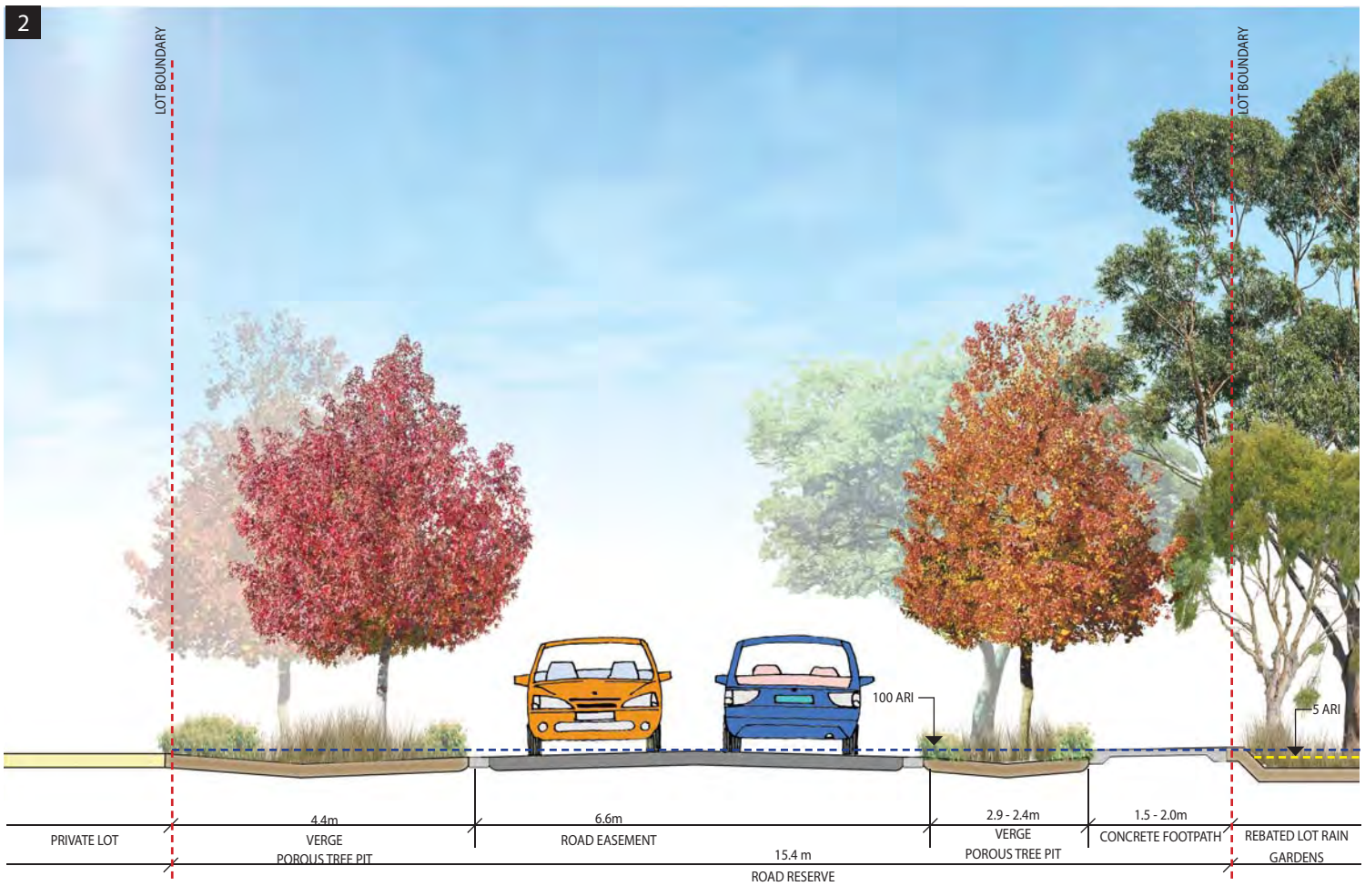
TYPICAL 15.4 m ROAD CROSS SECTION WITH NO FOOTPATH AT REBATED LOTS / RAIN GARDENS

SCALE 1:50



TYPICAL 15.4 m ROAD CROSS SECTION WITH FOOTPATH AT REBATED LOTS / RAIN GARDENS

SCALE 1:50



DWG MA-LSP-01- 13
REV B
DATE 07.12.2016
SCALE 1 : 50 @ A3

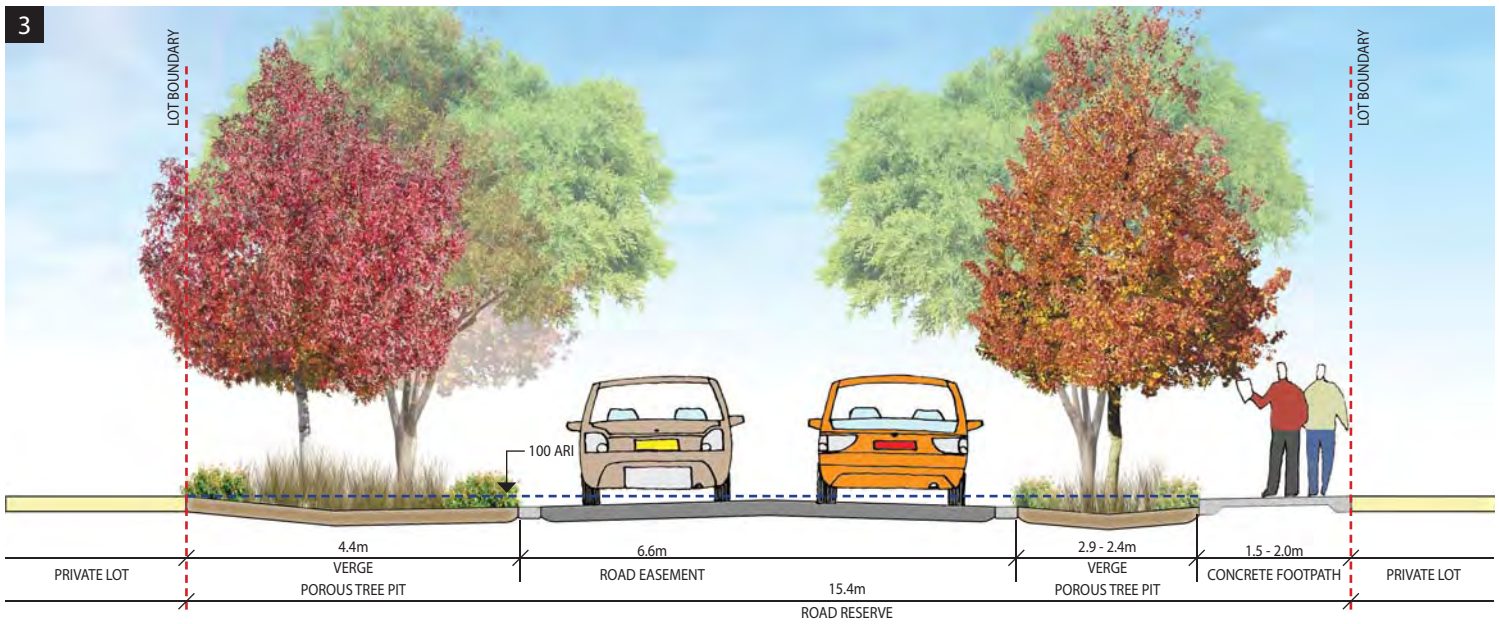
0 0.25 0.5 0.75 1.0 1.25 m

emerge ASSOCIATES

TYPICAL STREET SECTIONS

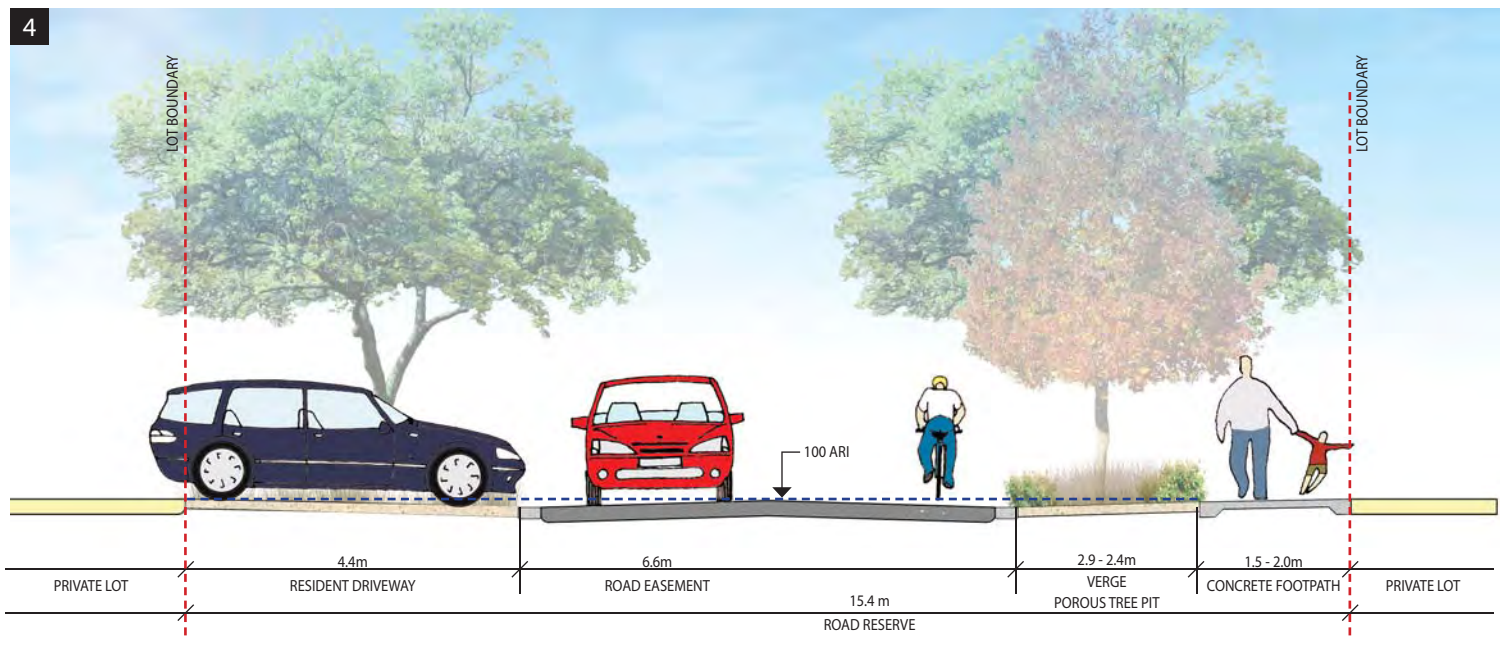
TYPICAL 15.4 m ROAD CROSS SECTION WITH FOOTPATH AT POROUS VERGE

SCALE 1:50



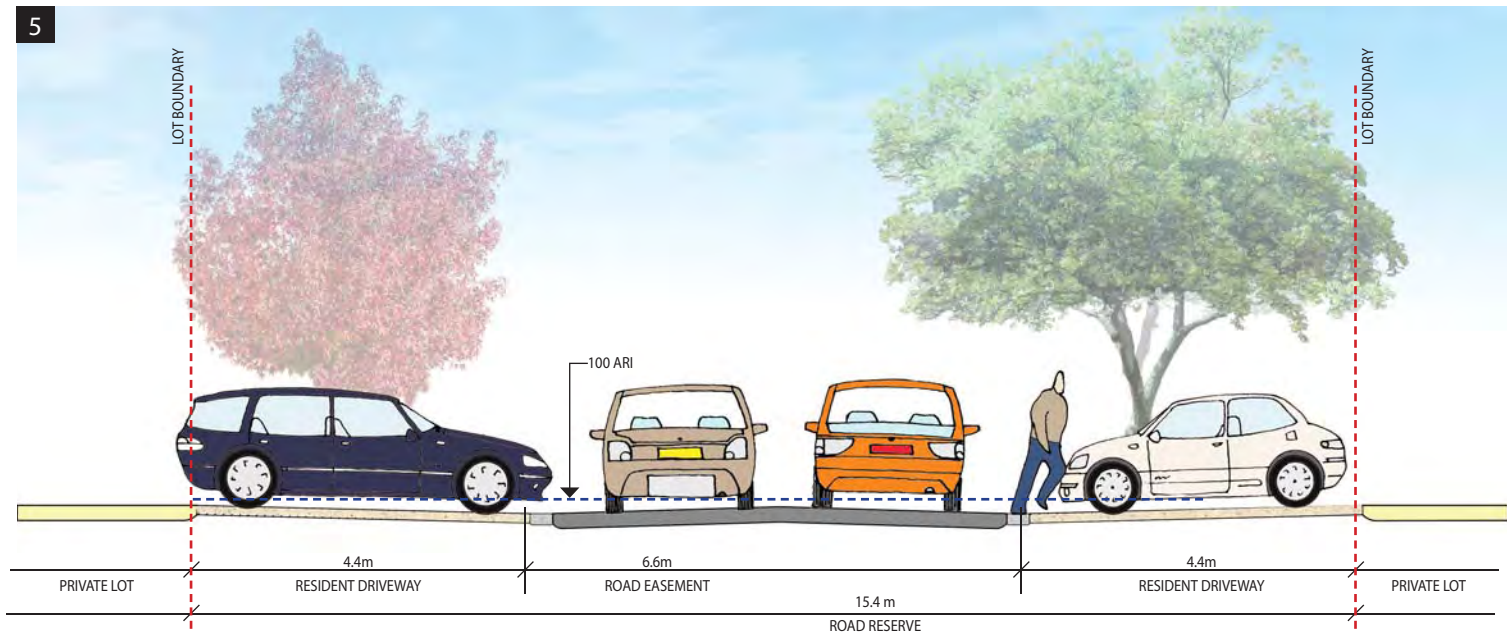
TYPICAL 15.4 m ROAD CROSS SECTION WITH FOOTPATH AT VEHICLE CROSSOVER

SCALE 1:50



TYPICAL 15.4 m ROAD CROSS SECTION WITH NO FOOTPATH AT VEHICLE CROSSOVER

SCALE 1:50



DWG MA-LSP-01- 14
REV B
DATE 07.12.2016

0 0.25 0.5 0.75 1.0 1.25 m

SCALE 1 : 50 @ A3

emerge ASSOCIATES

Appendix B

MELSP Addendum – P

Prior to developing technical reports for the Mandogalup East Local Structure Plan, the consulting team presented the proposed principles and concepts of the hydrology and landscape amenity for the MELSP to the City of Kwinana officers and councillors.

Based upon the general acceptance of the presented concept and principles, the consultancy team undertook works to develop technical reports for LSP submission, which includes reference to Porous Verges. Subsequent to the completion of the LWMS documentation (Thursday 1st December) the City of Kwinana advised that they have reviewed their position and are supportive of the all the hydrology design elements except the porous verges.

JDA has assessed a revised hydrological strategy to allow removal of porous verges and can confirm this has no significant impact to the MELSP. As discussed with the City, the installation of street trees at pavement level (porous tree pits) and extending the detention depth of the other drainage elements will offset the porous verges so they may be removed. It is anticipated that the revised streetscape, including porous tree pits, will be able to contain up to the 1:5 ARI without porous verges. We will continue to look for other design opportunities to optimise the streetscape.

Emerge Associates have liaised with the City of Kwinana in making amendments to the proposed street tree pit size, of which a schematic plan is shown within Appendix B.

In reviewing the Landscape + Public open Space Strategy and LWMS prepared by JDA, it should be noted that this addendum note and schematic plans shown within Appendix B take precedent over landscape masterplans and there are now no porous verges proposed within the development.

The LWMS will be modified once comments are received.

The following plates show schematic concepts of the porous tree pit both with and without a 1.5-2.0m wide footpath located on lot boundary.

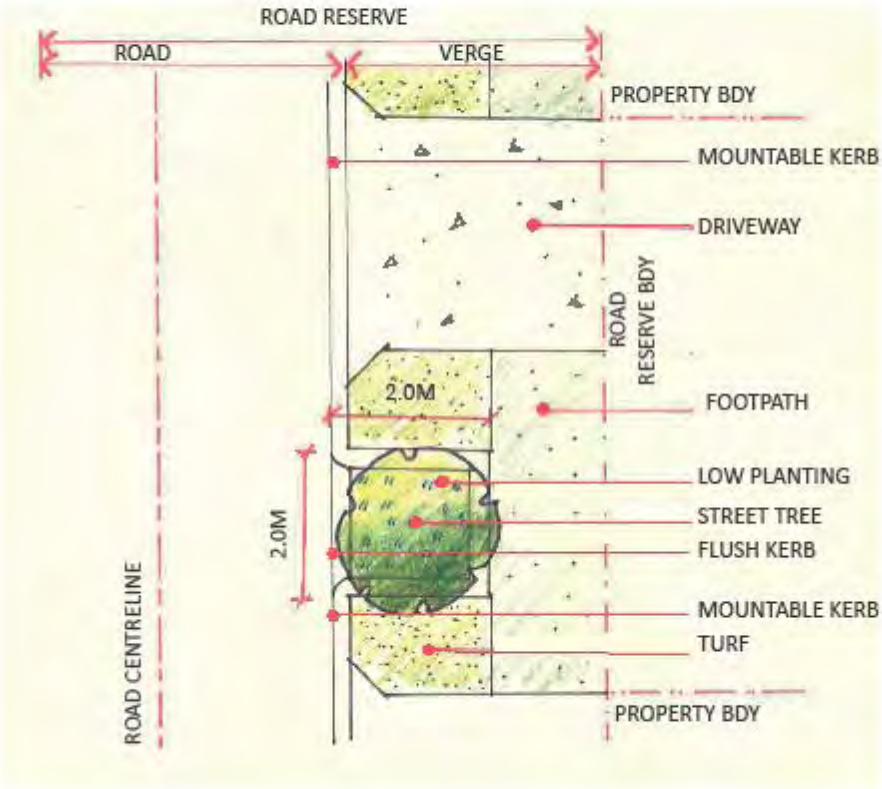


Plate B1: Typical layout plan – with footpath (Scale 1:50@A3)

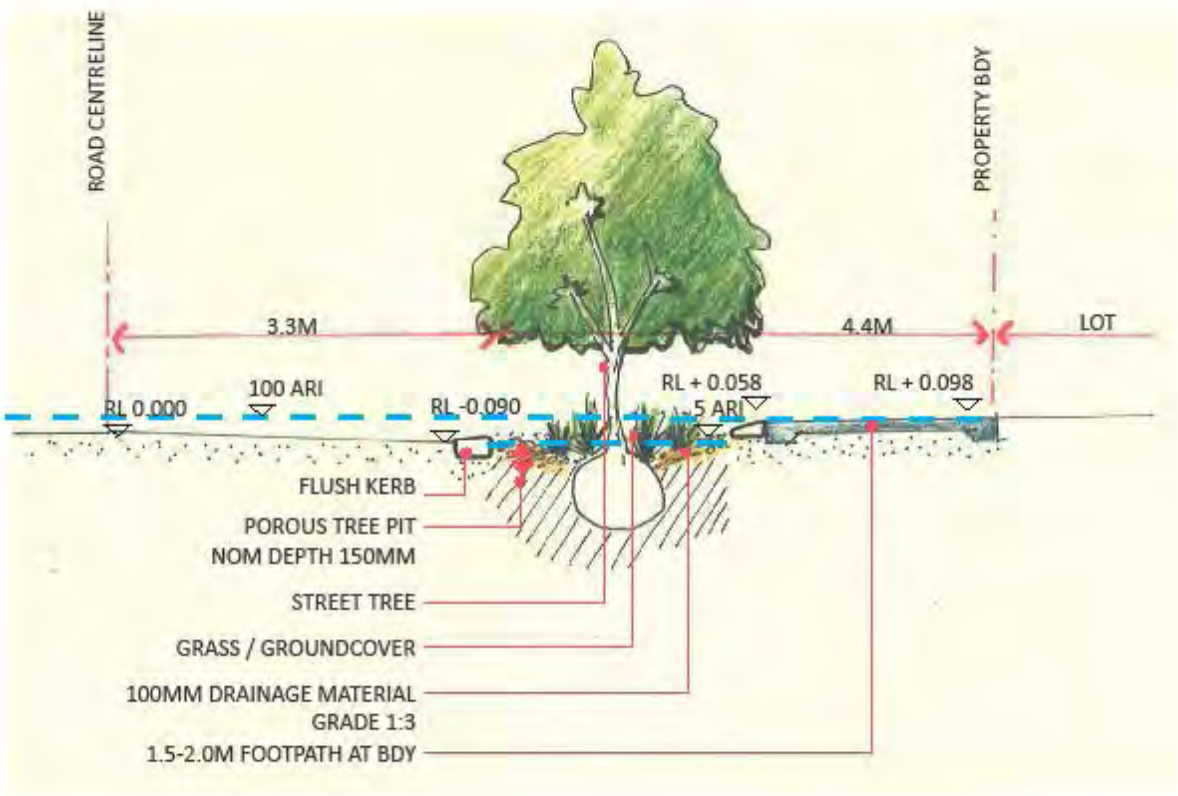


Plate B2: Typical half road section– with footpath (Scale 1:25@A3)

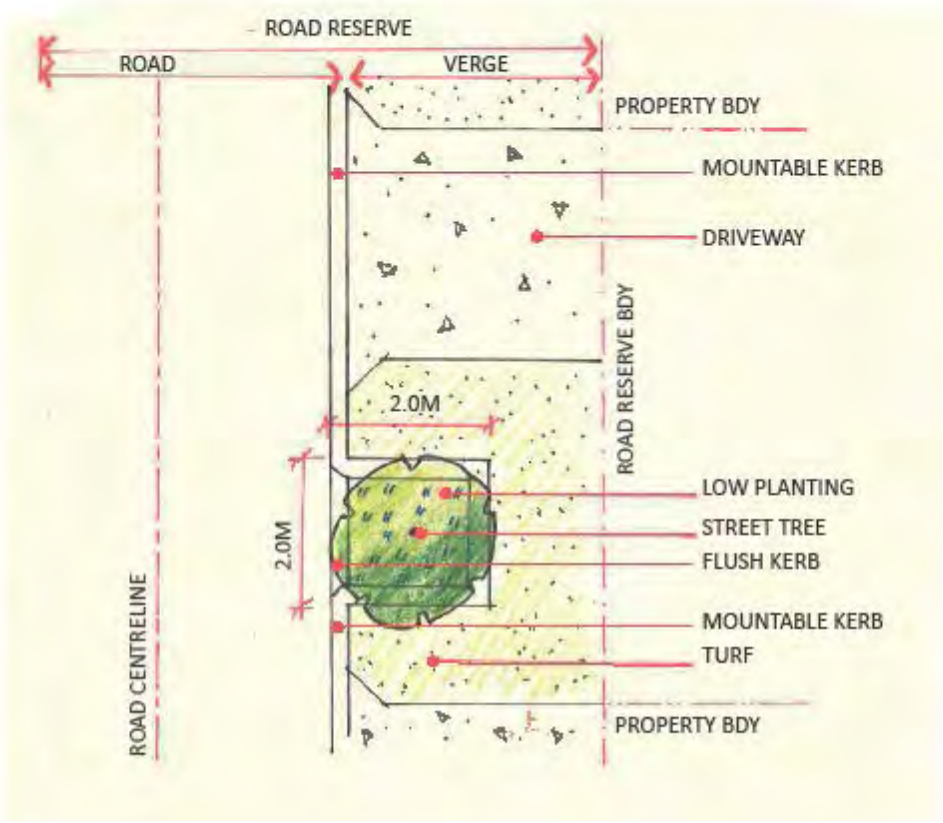


Plate B3: Typical layout plan – no footpath (Scale 1:50@A3)

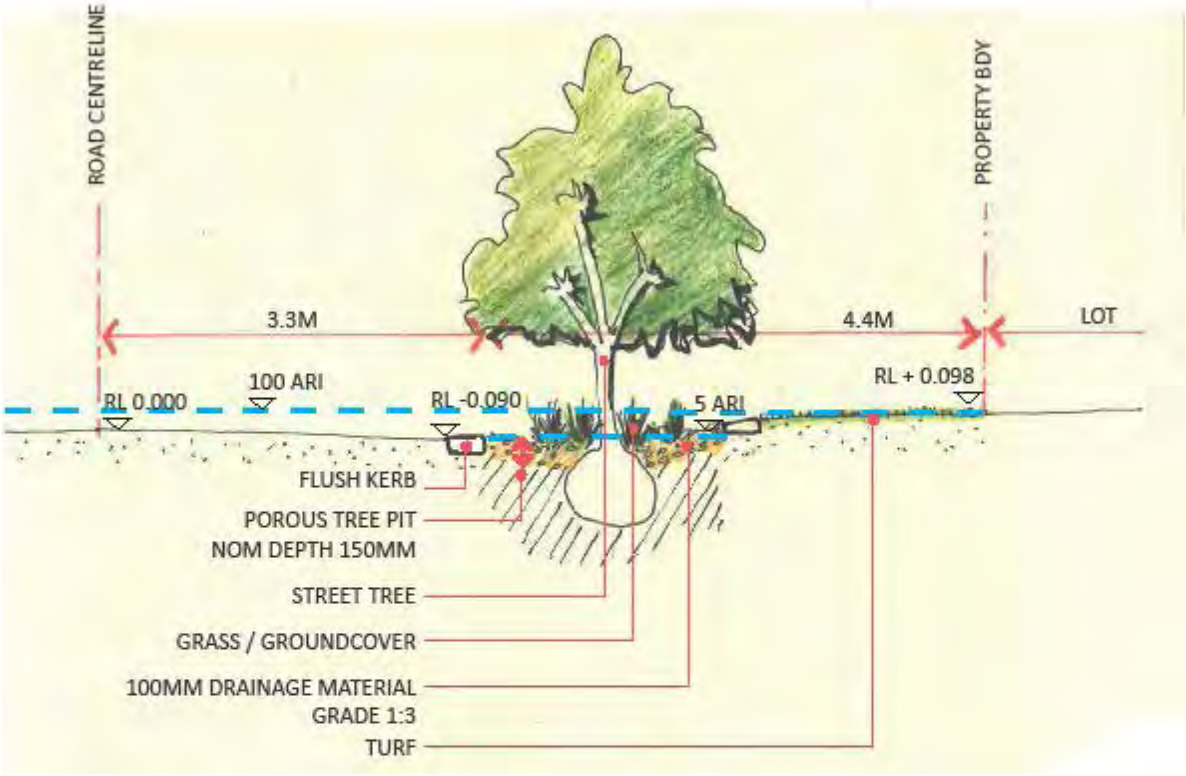


Plate B4: Typical half road section– no footpath (Scale 1:25@A3)

APPENDIX 7

TRANSPORT ASSESSMENT

ROWEGROUP

Mandogalup East Local Structure Plan
Revised Transport Impact Assessment

PREPARED FOR:
Satterley Property Group

December 2016

Document history and status

Author	Revision	Approved by	Date approved	Revision type
M Rasouli	r01	B Bordbar	07/11/2016	Draft
M Rasouli	r01a	B Bordbar	24/11/2016	Draft Final
M Rasouli	r01b	B Bordbar	07/12/2016	Final

File name: t16.216 mr01b.docx

Author: Mohammad Rasouli

Project manager: Mohammad Rasouli

Client: Satterley Property Group

Project: Mandogalup East Local Structure Plan Transport Impact Assessment

Document revision: r01b

Project number: t16.216

TABLE OF CONTENTS

REPORT FIGURES

REPORT TABLES

1.0 Executive Summary

This revised Traffic Impact Assessment (TIA) report has been prepared in accordance with the Transport Impact Assessment Guidelines (WAPC, Vol 2 – Planning Schemes, Structure Plans and Activity Centre Plans, August 2016).

During the course of preparation of this TIA report, liaison was undertaken with Main Roads WA, the City of Kwinana and adjoining landowner (Qube).

The transport modelling and analysis documented in this TIA report is undertaken for Mandogalup West Local Structure Plan (MWLSP) and Mandogalup East Local Structure Plan (MELSP) and the report findings/ recommendations are compatible.

The outcome of this study indicates that the upgraded intersection of Anketell Road/ Hoffman Road can solely accommodate the full development of the MELSP area.

The existing intersection of Anketell Road/ Hoffman Road would be removed or downgraded to left in/ left out intersection after duplication of Anketell Road.

It is anticipated that initially Rowley Road extension would be constructed as a two lane standard road with the existing roundabout intersection between Barfield Road and Frankland Avenue. This roundabout intersection provides access and connectivity to future developments on both sides of Rowley Road.

The existing roundabout is expected to be removed or downgraded to left in/ left out intersection in the ultimate scenario when Rowley Road is duplicated and Hammond Road is extended. At this point MWLSP would connect to Hammond Road from west and Hoffman Road (to the south of MELSP) would also realigned towards west and connect to Hammond Road.

Modelling and analysis undertaken for the potential vehicular/ pedestrian underpass on Rowley Road at Barfield Road location indicate that this proposal has little benefit on the vehicular and pedestrian/ cyclist movements of the MELSP area.

Current discussion with MRWA indicated that it is no longer intended to pursue concepts for a vehicle underpass linking Barfield Road with Mandogalup (Qube) land.

2.0 Introduction and Background

Transcore prepared a Transport Impact Assessment (TIA) report (t13.089 mr01a) in July 2014 on behalf of Satterley Property Group for the proposed original Mandogalup East Local Structure Plan (MELSP). The 2014 TIA report was referred to Main Road WA for review and comments. Accordingly, in October 2015, Transcore prepared an updated report (t13.089 mr01c) which addressed the Main Roads WA comments.

This revised TIA report is prepared for the recently updated MELSP prepared by Rowe Group. The updates include the relocation of the primary school and local playing fields towards the north of the MELSP area. This revised TIA report aims to provide an update on the traffic modelling and analysis to reflect the proposed modifications to the MELSP area and update the report figures to reflect the current Mandogalup East Local Structure Plan.

Transcore is the traffic engineer for the Mandogalup West Local Structure Plan (MWLSP) and has reviewed both LSPs for consistency in terms of access points, connectivity, road hierarchy and road reserves. A Consolidated Plan including both LSPs is also prepared which is used for preparation of the report figures for both LSPs.

During the course of preparation of this report, Transcore has liaised with Main Road WA with respect to the proposed Rowley Road access intersection to serve both LSPs during the interim and ultimate stages. The timeframe associated with the interim and ultimate stages is determined by the status and timing of Hammond Road extension and duplication of Rowley Road.

The report also provides an update on Anketell Road/ Hoffman Road access intersection and the outcome of the modelling and analysis which has been undertaken for this intersection. The proposed intersection layout and upgrades which is proposed to accommodate the MELSP traffic during the interim stage is also provided.

This revised TIA report will address the Department of Planning (DoP) comments on the 2015 TIA report and specifically will address the DoP schedule of modifications including the following comments:

- Reference to be made only to the area outside the Revised Kwinana Industrial (including air quality) Buffer (as of 21 September 2010). Hereafter referred to as KIB;
- Reference to be made only to the lot yield potential with the area outside the KIB;
- Reference to be made to the modified LSP and indicative land use/road/lot layout plan for the area outside the KIB without reference to layout within the KIB;
- Review the proposed main north-south spine road cross section; and

- Review the different indicative road reserve widths for the various road classifications within the LSP.

The proposed MELSP area is located on the western side of the Kwinana Freeway and south of Rowley Road, as shown in **Figure 1.** Rowley Road is located to the north of the subject site, but the proposed LSP area does not have any frontage on Rowley Road. The northern part of Hoffman Road extends to the LSP area from the south. The areas to the west and south of the subject site are vacant land at present.

Figure 1: Location of the Subject Site

3.0 Proposed Local Structure Plan

The proposed Mandogalup East Local Structure Plan is shown in **Figure 2**. A total of approximately 607 residential lots are planned for the MELSP area.

There is a proposed Primary School site within the northern part of the MELSP area, with about half of the school site within the MELSP area. The other half of the primary school is located within the MWLSP.

Figure 2: Proposed Mandogalup East Local Structure Plan

4.0 Existing Situation

4.1 Existing Land Use

The site currently is rural vacant land. Adjacent land uses to the north, west and south are also vacant lands. The Kwinana Freeway forms the eastern boundary of the LSP area.

4.2 Existing Road Network

Rowley Road is classified as a District Distributor A Road in the Main Roads WA Functional Road Hierarchy document and is currently constructed as a rural standard single carriageway road. Traffic data provided by the City of Kwinana indicates 4,870vpd on Rowley Road east of Barfield Road (June 2013) and about 3,280vpd between Frankland Avenue and Barfield Road (May 2012).

Rowley Road provides an east-west connection between South Western Highway (via Eleventh Avenue in Armadale), Tonkin Highway, Kwinana Freeway and Rockingham Road in Wattleup (via Wattleup Road). Rowley Road has been identified as a primary freight route to the Naval Base / Kwinana Beach industrial areas.

Currently, there is no connection into Rowley Road (to the west of the Freeway) from the south. Barfield Road connects to Rowley Road from the north at a priority-controlled T-intersection.

The existing shared path along Kwinana Freeway extends to the west about 100m along the south side of Rowley Road and terminates immediately west of Barfield Road. There is a pedestrian and cyclist underpass (under the Rowley Road) immediately west of the Kwinana Freeway.

Anketell Road is classified as a District Distributor A Road in the Main Roads WA Functional Road Hierarchy document and is constructed as a single carriageway road. The existing traffic counts on Anketell Road sourced from the City of Kwinana indicate that Anketell Road east of Mandogalup Road carried an average weekly traffic volume of about 9,400vpd in February 2016. The AM and PM peak volumes are reported to be about 470vph (11:00-12:00) and 900vph (16:00-17:00) respectively. The existing posted speed limit on Anketell Road (about 150m west of the Hoffman Road) is 80km/hr for westbound and 70km/hr for eastbound directions.

Anketell Road has been identified as an alternative freight route to the Naval Base / Kwinana Beach industrial areas. Liaison with Department of Planning and Main Roads WA indicates that ultimately a dual divided carriageway standard is planned for Anketell Road.

Hoffman Road is a local access road constructed as a 6.2m wide sealed rural road which runs parallel to the Kwinana Freeway. Hoffman Road connects to Anketell Road from the south and extends north to the southern portion of the MELSP area and terminates there. The intersection of Hoffman Road and Anketell Road is in the form of a basic T-intersection without any widening on Anketell Road. There are no traffic counts available on Hoffman Road, but the traffic volumes are expected to be very low.

Kwinana Freeway is classified as a Primary Distributor and is reserved as a Primary Regional Road in the MRS. It is currently constructed as four- lanes divided carriageway in this area and has a posted speed limit of 100km/h. The closest freeway interchanges are at Rowley Road, just to the north of the MELSP area and at Anketell Road, 2km south of the MELSP area. The most recent available Main Roads WA traffic count for the Freeway in this area was approximately 97,200vpd (average weekday traffic, south of Rowley Road) in 2013/2014.

4.3 Public Transport

Currently, there are no bus routes servicing the subject site. The closest existing bus route to the MELSP area is Bus Route No. 527 which traverses through the new developments to the east of the Kwinana Freeway. Bus routes 525 and 526 are located about 2km to the north of the MELSP area and are terminating north of Gaebler Road, as shown in **Figure 3**. Both of these bus routes are located outside the 400m walking distance to the subject site.

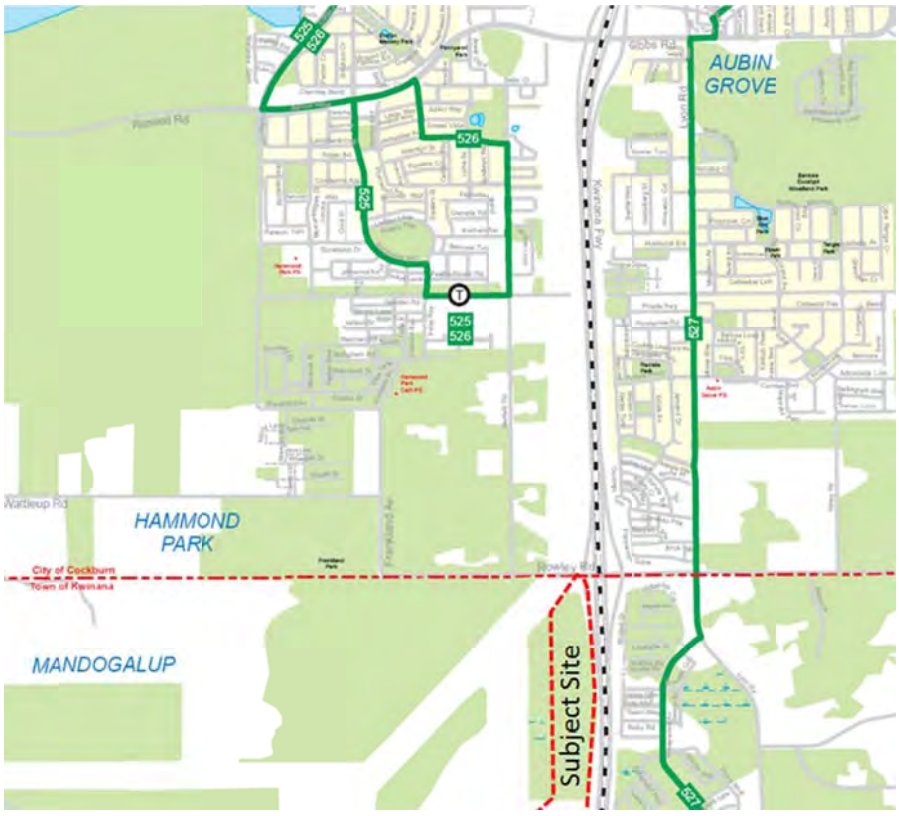


Figure 3: Existing Bus Routes

4.4 Pedestrian and Cyclist Facilities

Currently, there is a 2.5m Principal Shared Path (PSP) on the eastern side of MELSP area along Kwinana Freeway. The PSP continues towards north along Kwinana Freeway through an existing underpass (under the Rowley Road) immediately west of the Freeway. There is an existing shared path along the south side of Rowley Road which connects to the existing PSP. This shared path terminates immediately east of Barfield Road.

The Department of Transport's Perth Bike Map series (see **Figure 4**) also shows the existing PSP along Kwinana Freeway in the vicinity of the MELSP area. According to this plan Rowley Road and Barfield Road are considered to be part of the Perth Bicycle Network (PBN) and are nominated as continuous signed routes.

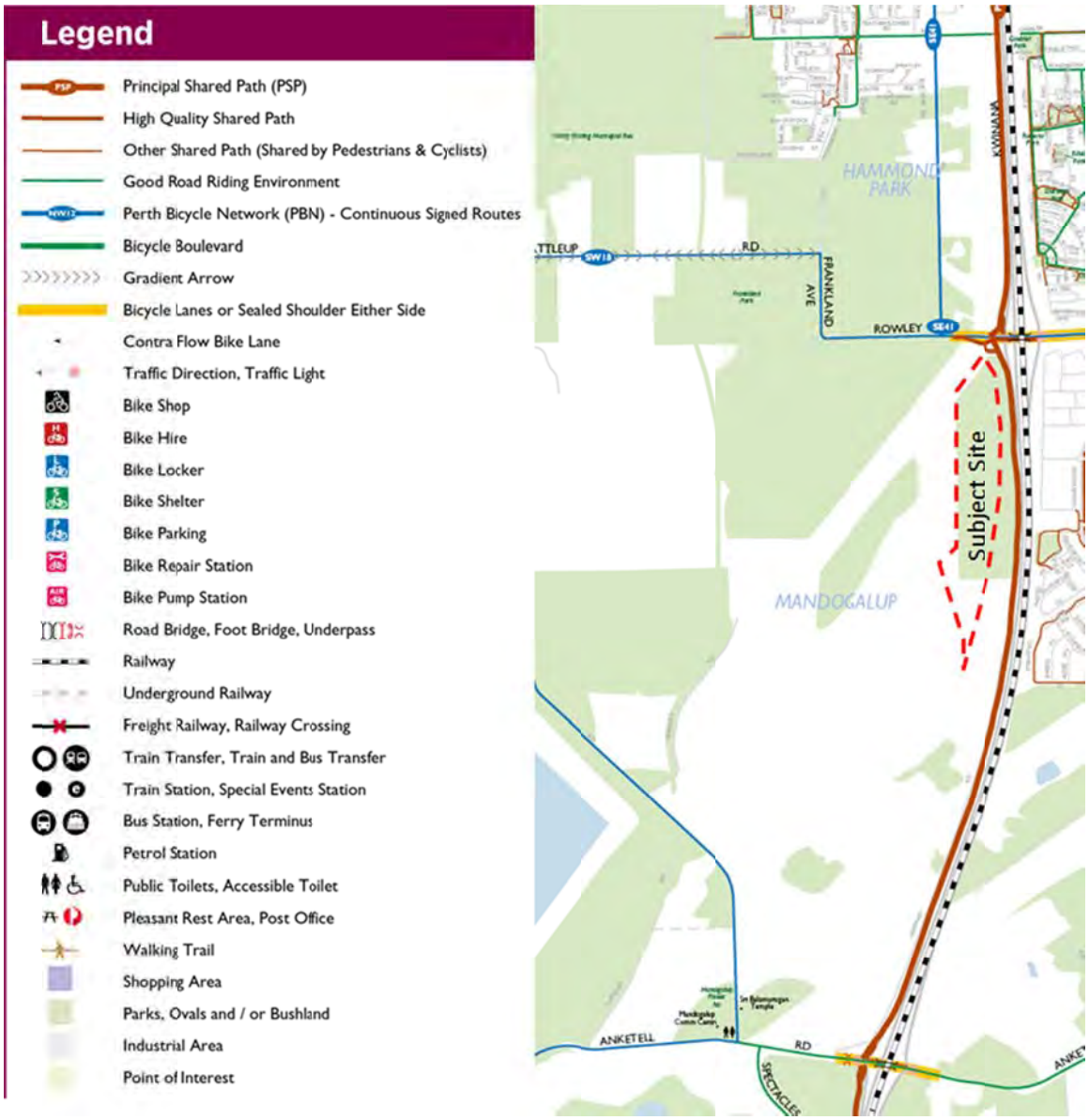


Figure 4: Bike Map

4.5 Changes to the Surrounding Road Network

There are proposed interim and ultimate road network changes in the locality as shown in **Figure 5.** Future road network planning for this part of the Metropolitan area includes the extension of Rowley Road to Rockingham Road. Rowley Road has been identified as a primary freight route to the Naval Base / Kwinana Beach industrial areas. According to the information obtained from Main Roads WA, ultimately Rowley Road is planned to be constructed to four lanes divided standard. The planned intersection arrangements along Rowley Road to the west of the Kwinana Freeway for the ultimate situation are discussed and agreed with Main Roads WA and are as follows (relevant Main Roads WA drawings are also provided in **Appendix A**):

- Barfield Road to be terminated to the north of Rowley Road with no connection on Rowley Road;
- The existing roundabout intersection between Barfield Road and Frankland Avenue in the interim stage would be removed, and the connection from the north would be closed off. The connection from the south would operate as left in/left out or cul-de-sac.
- The Frankland Avenue intersection would be downgraded to left in/ left out intersection;
- Hammond Road would be extended towards south forming a four-way, grade-separated intersection with Rowley Road and a T-intersection with Anketell Road;
- Mandogalup LSPs would connect to Hammond Road from west;
- Existing Hoffman Road intersection with Anketell Road will be converted to left in/left out or cul-de-sac;
- Hoffman Road south of the LSPs would be realigned towards west to connect to Hammond Road extension; and,
- Wattleup Road would be realigned further north with a signalised intersection on Hammond Road.

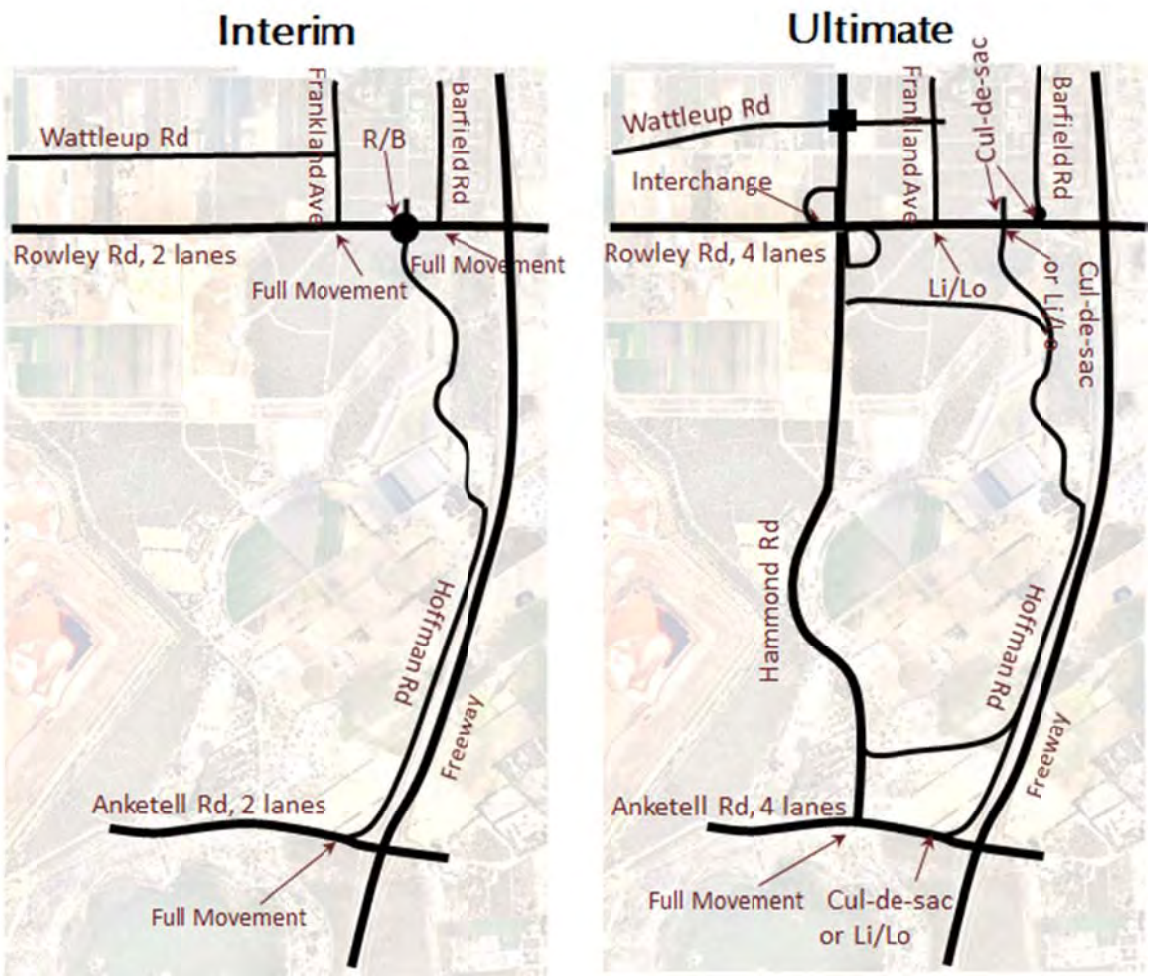


Figure 5: Interim and Ultimate Changes to the Road network

In the interim, it is anticipated that Rowley Road extension would be constructed as two lanes standard. The existing roundabout intersection between Barfield Road and Frankland Avenue provides connectivity for the proposed developments to the north and south of Rowley Road. This roundabout is expected to be removed or downgraded to left in/ left out intersection in the ultimate scenario and when Rowley Road is duplicated and Hammond Road is extended.

In the interim scenario, it is not expected that Hammond Road would be extend south and therefore the proposed MELSP would need to get access via the existing Hoffman Road from the south and the proposed roundabout intersection on Rowley Road. It must be noted that the proposed MELSP do not have any frontage on Rowley Road and therefore, connectivity to Rowley Road would need to be via the proposed MWLSP area (QUBE landholding).

Hoffman Road intersection on Anketell Road is expected to operate satisfactorily in short to medium term before Anketell Road is duplicated (upgrades would be required to the existing standard of the intersection to be able to accommodate the proposed MELSP traffic). When Anketell Road is upgraded to 4 lanes, this intersection would need to be downgraded to left in/left out or cul-de-sac.

4.6 Public Transport Network Planning

According to the information obtained from Public Transport Authority (PTA), it is anticipated that the area to the west of the Kwinana Freeway would be served by future Bus Routes 535 and 536. These new routes are likely to commence around 2016 (subject to the progress of developments and availability of funding) and operate out of Aubin Grove Station. These routes would eventually connect Hammond Park to Mandogalup. **Figure 6** illustrates the proposed bus routes 535 and 536 in this area.

Figure 6: Future Bus Routes in the Vicinity of the LSP Area

5.0 Proposed Transport Network

5.1 Road Hierarchy

The proposed hierarchy of roads within the MELSP and MWLSP area was establish through transport modelling undertaken for both LSPs and is illustrated in **Figure 7.** The proposed road hierarchy was based on traffic projections and the classification of Liveable Neighbourhoods document (2007).

Figure 7: Proposed Road Hierarchy

The proposed road classification reflects future planning for the surrounding district including the proposed future neighbourhood centre adjacent to the extension of Hammond Road.

Some key characteristics of the relevant road classifications have been summarised in Table 1. These are generally based on Liveable Neighbourhoods guidelines.

Table 1: Key Characteristics for the Proposed LSP Road Classifications

Road Classification	Indicative upper volume (vpd)	Indicative road reserve width (m)
Neighbourhood Connector A	7,000	25.2m
Neighbourhood Connector B	3,000	19.4m
Access Street B	3,000	17.9m
Access Street D	1,000	15.4m

It should be noted that the outlined reservation widths are indicative only and are subject to further adjustment in consultation with the Department of Planning and City of Kwinana during detailed subdivision design process.

Neighbourhood Connectors

The current Mandogalup LSP indicates a north-south spine road through both LSP areas. This north-south spine road connects to Anketell Road at its southern end and continues north along the proposed Primary School and connects to Rowley Road. Ultimately, when Hammond Road is extended towards the south, this road would connect to Hammond Road.

Transport Modelling and analysis undertaken indicate that the projected traffic volumes for the southern part of the north-south spine road are less than the estimated volumes from the original modelling and analysis. This is due to:

- Removal of the potential residential dwellings within the Revised Kwinana Industrial (including air quality) Buffer (as of 21 September 2010) as requested by DoP; and,
- Relocation of the proposed Primary School towards the northern part of the LSP area.

Accordingly, the projected traffic volumes for the interim and ultimate scenarios are estimated to be less than 3,000vpd for the southern part of the north-south spine road and therefore this section of spine road can be classified as Neighbourhood Connector B road. The projected traffic volumes for north-south spine road fronting the proposed Primary School and to the north/ north-west of the Primary School is estimated to be between 3,000vpd to 7,000vpd and therefore this section of spine road is classified as Neighbourhood Connector A road.

It must be noted that the proposed road hierarchy and road reserve for the north-south spine road are only determined by the projected traffic volumes (in accordance with LN Guidelines). The proposed road hierarchy and road reserve do

not consider the servicing and drainage requirements or provision of a consistent road cross section for the entire length of the main north-south spine road within both LSP areas.

Access Streets

The majority of both LSP internal roads are classified as Access Street D roads. The Access Street D typical cross section entails 4.7m verges on both sides, with embayed parking provided in the verges as appropriate, such as for visitor parking for rear loading lots. Access Street D classification is proposed for the local roads with less than 1,000vpd.

The access streets to the east and south of the primary school are recommended to be constructed to the 17.9-metre Access Street B cross-section standard, which allows for on-street parking on both sides of the street. The continuation of the proposed Access Street B road towards the south of the Primary School within the MELSP is also estimated to carry more than 1,000vpd and therefore is classified as Access Street B road.

5.2 Public Transport

According to the information obtained from Public Transport Authority (PTA), it is anticipated that the area to the west of Kwinana Freeway would be served by future bus routes 535 and 536 as outlined in Section 3.6 of this report.

It is most likely that route 536 would serve the LSP areas in future as it operates closest to the Kwinana Freeway on the western side. PTA intention is to run bus route 536 along the north-south spine road within the LSP areas to the south of the Rowley Road while maintaining a distance of approximately 500-600m away from the Kwinana Freeway alignment.

The proposed bus route is most likely to traverse southbound on Barfield Road from Hammond Park and then across Rowley Road traversing along the north-south spine road. When Barfield Road intersection is terminated, then this bus route is likely to be rerouted to other north-south links such as Hammond Road.

5.3 Pedestrian and Cyclist Facilities

Figure 8 outlines the proposed pedestrian and cyclist network for both LSP areas. In accordance with the Liveable Neighbourhoods document, shared paths are proposed on one side of the main north-south spine road with a footpath on the other side. Figure 8 also shows the location of the proposed shared path connections to the existing Principal Shared Path along Kwinana Freeway. These connections would improve the utilisation of the existing PSP along the Freeway.

Figure 8: Proposed Pedestrian and Cyclist Road Network

5.4 Integration with Surrounding Area

The proposed land uses for the MELSP area are predominantly residential which are in line with the proposed land uses within the surrounding area. The road network of the MELSP area is proposed to connect to the neighbouring landholding to the west at a number of locations to improve permeability and facilitate connection to Rowley Road. Section 5.3 of the report provides the projected traffic volumes on the MELSP road network and the road connection to the MWLSP.

6.0 Analysis of the Transport Network

6.1 Assessment Period

The assessment year that has been adopted for this analysis is 2031, with the assumption of full development of MELSP, MWLSP, Hammond Park and the other potential developments to the north of Rowley Road as per the Southern Suburbs District Structure Plan (SSDSP) prepared by City of Cockburn. A copy of the SSDSP is provided in **Appendix B** of this report.

The assessment of the operation of the proposed roundabout on Rowley Road for the interim scenario has been undertaken for single carriageway Rowley Road standard but with the full development of the SSDSP area.

6.2 Traffic generation and distribution

Transcore has developed a subregional strategic transport model for year 2031based on weekday traffic flows for this area using the EMME transport modelling software package. Overall, the land uses modelled in this area reflects the land use aspirations of *Directions 2031* document.

The daily traffic generation rate used for this transport assessment is 8 vehicle trips per day (vpd) per dwelling, which corresponds to peak hour trip generation rates recommended in the Western Australian Planning Commission (WAPC) *Transport Assessment Guidelines for Development* (2016).

The anticipated 607 and 911 Lots of the proposed MELSP and MWLSP areas will, therefore, generate approximately 12,144vpd.

For the proposed primary school the trip rate used is 1.0 vph per student during the school peak periods (typically 8-9am and 3-4pm) and 2vpd per student overall. For this assessment, the Education Department's standard 430 student primary school design has been assumed, so this primary school is assumed to attract traffic flows of 860vpd.

The proposed 500m^2 NLA Local Centre within the MWLSP area would also attract approximately 600vpd. The future 7,000m^2 Neighbourhood Centre adjacent to the extension of Hammond Road would attract about 8,480vpd.

The distribution of the LSPs traffic is determined by the transport model in proportion to the location of trip productions and attractors for work trips, education trips and other trips (shopping, social, recreational, etc.) among all the land uses in the traffic model.

6.3 Traffic Flow Forecasts

Transport modelling and analysis were undertaken for both interim and ultimate scenarios. The road network modelled for the interim and ultimate scenarios are as reflected in **Figure 5** in section 4.5 of this report. For the ultimate scenario, additional modelling and analysis were undertaken to reflect the potential termination of the proposed access intersections on Rowley Road and Anketell Road.

Figure 9 illustrates the projected traffic volumes for interim scenario with full movement intersections on Rowley Road and Anketell Road;

Figure 10 shows the projected traffic volumes for the ultimate scenario for two options:

- With no connection on Rowley Road and Anketell Road; and,
- With Li/ Lo connection on Rowley Road and Anketell Road.

Figure 9: Projected Daily Traffic Volumes (Interim Scenario)

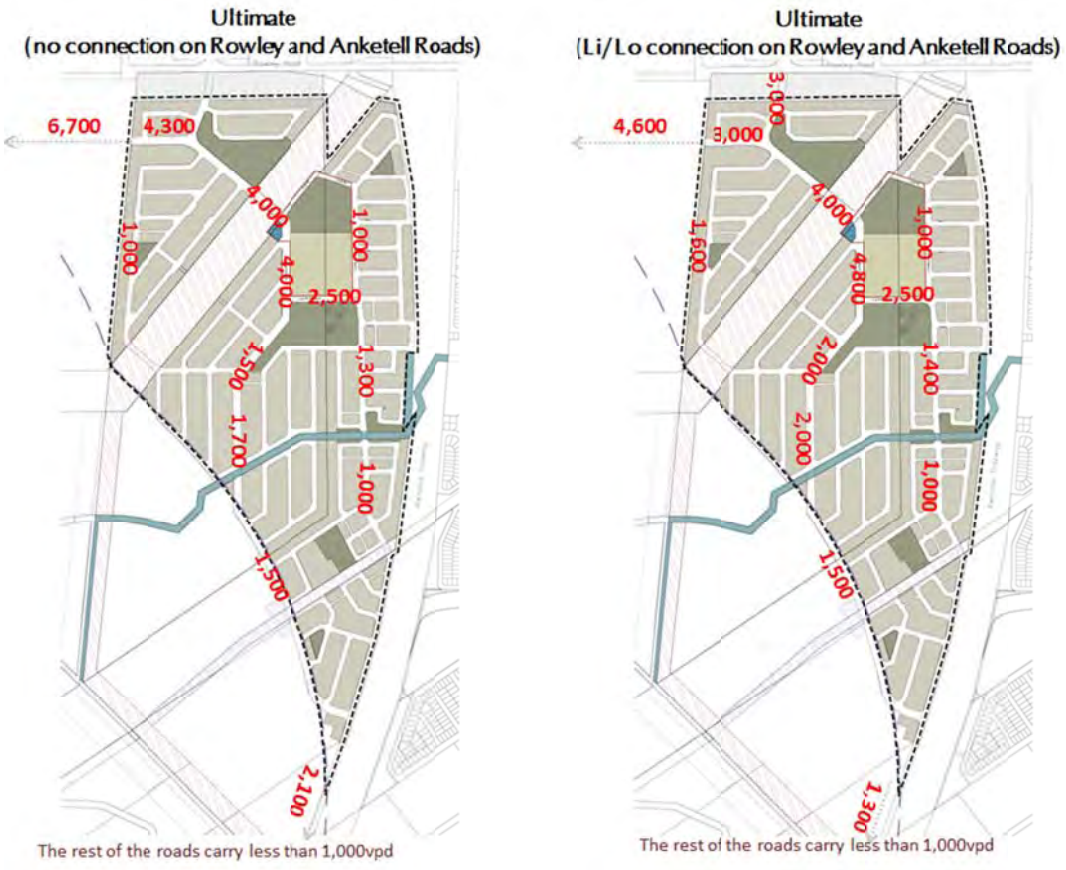


Figure 10: Projected daily traffic volumes for ultimate scenario

6.4 Roads and Intersections

The proposed road network to accommodate both LSP traffic volumes has been detailed in section 4 of this report, including the details of the proposed road hierarchy in section 4.1. Figure 11 details the proposed intersection controls for key intersections within the LSP areas.

Two roundabouts are proposed at south corners of the proposed primary school. These roundabouts will help manage the circulation of traffic flows and assist with speed management on major roads. A priority controlled T-intersection is proposed at the intersection of the two neighbourhood connector roads.

There are number of four-way intersections shown on both LSPs on low-traffic-volume access streets. These intersections are recommended to be constructed as priority-controlled intersections with Give Way control on the minor road approaches as suggested in Liveable Neighbourhoods document. Appropriate entry treatments are recommended on the side roads to help to alert drivers to the presence of the intersections and that traffic on the major road has priority.

Figure 11: Intersection Treatments

6.5 Intersection Analysis

There are two key intersections on the surrounding road network that are expected to be affected by the proposed MELSP and MWLSP traffic. These intersections are:

- Existing roundabout intersection on Rowley Road; and,
- Existing priority controlled T-intersection at Hoffman Road/ Anketell Road intersection.

Ultimately the existing roundabout intersection on Rowley Road will be downgraded to left in/ left out intersection or a cul-de-sac. However, for the interim scenario, this intersection is analysed as a single lane roundabout. In order to assess the operation of the roundabout for the interim stage, the projected daily traffic

volumes through the roundabout were extracted from the transport model for the interim scenario and converted to typical peak hour traffic.

The existing intersection of Hoffman Road/ Anketell Road is located in close proximity of the Kwinana Freeway/Anketell Road interchange. Ultimately when Anketell Road is duplicated, this intersection is expected to be terminated or downgraded to left in/ left out standard. Therefore SIDRA analysis was undertaken for this intersection before duplication of Anketell Road to investigate the potential level of upgrades required to accommodate the MELSP traffic. The intersection analysis was undertaken for both AM and PM peak hours to investigate the operation and appropriate layout of the intersection to accommodate the peak hour traffic.

Accordingly, capacity analysis is undertaken using the SIDRA computer software package. SIDRA is an intersection modelling tool commonly used by traffic engineers for all types of intersections. SIDRA outputs are presented in the form of Degree of Saturation, Level of Service, Average Delay and 95% Queue. These characteristics are defined as follows:

- Degree of Saturation is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The Degree of Saturation ranges from close to zero for infrequent traffic flow up to one for saturated flow or capacity.
- Level of Service is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. In general, there are 6 levels of service, designated from A to F, with Level of Service A representing the best operating condition (i.e. free flow) and Level of Service F the worst (i.e. forced or breakdown flow).
- Average Delay is the average of all travel time delays for vehicles through the intersection.
- 95% Queue is the queue length below which 95% of all observed queue lengths fall.

The results of the SIDRA analysis are summarised in Appendix C. The proposed Rowley Road roundabout layout is also shown in Figure C1.

The SIDRA analysis indicates that the existing roundabout will operate satisfactorily with an overall Level of Service B. All movements will be at level of service A or B or C (good operation). The longest traffic queues will occur on Rowley Road with 95% back of queue of about 100m to the east and west of the existing roundabout. Queue lengths on the side roads are anticipated to be much shorter. (generally about 6 vehicles at a time).

The proposed MELSP is expected to be developed in several stages. During the development stages of MELSP the access/egress would be from Hoffman Road/ Anketell Road intersection. Therefore, this intersection would need to be upgraded to be able to accommodate the MELSP traffic at the outset of the subdivision development.

Appendix D shows the proposed concept design and upgrades required for the intersection of Anketell Road/ Hoffman Road. The concept design shows right and left turn slip lanes on Anketell Road. The proposed slip lanes standard satisfies Austroads requirements for the posted speed limit of 70km/hr on Anketell Road.

This concept design was used as the intersection layout for the purpose of the SIDRA intersection analysis. Intersection analysis was undertaken for full MELSP development (607 lots). The total trip generation of the full development of MELSP area is estimated to be about 4,856vpd or 485vph. The 485vph were distributed to the intersection of Hoffman Road/ Anketell Road assuming that 80% of the development traffic would travel east towards the Kwinana Freeway. In/out traffic split from the MELSP is also assumed to be about 20% / 80% for the AM and reverse for the PM peak hours.

The existing through traffic (February 2016) on Anketell Road have been sourced from City of Kwinana with the location of traffic count being 175m east of Mandogalup Road. Total MELSP Subdivision was assumed to be developed within the next 5 years (assuming construction of about 120 lots per year). Through traffic on Anketell Road has been assumed to grow 2% each year.

Figure 12 illustrates the total MELSP traffic distributed to the intersection of Hoffman Road/ Anketell Road during the AM and PM peak hours.

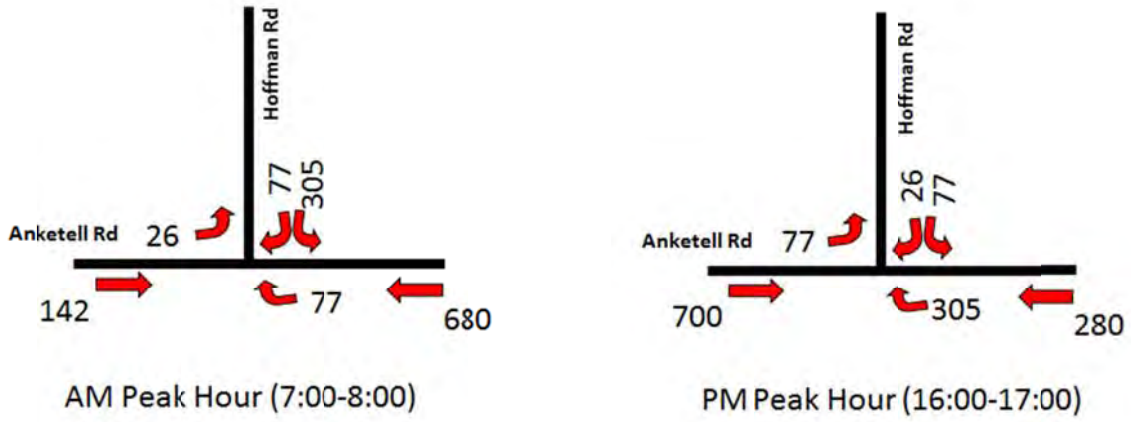


Figure 12: AM and PM peak hour trip distribution of MELSP traffic

Intersection analysis undertaken for full development of the MELSP area indicates that the upgraded intersection of Anketell Road/ Hoffman Road can solely accommodate the full development of the MELSP area and would operate satisfactorily with level of service B and C on Hoffman Road approach during the AM and PM peak hours respectively. The longest queue is expected during the AM peak hour on Hoffman Road and is reported about 18m (about only three cars).

The analysis results indicate sufficient spare capacity at the intersection of Hoffman Road/ Anketell Road to accommodate the future traffic growth on Anketell Road and traffic from other local developments.

6.6 Access to Frontage Properties

The WAPC *Liveable Neighbourhoods* policy requires that "Development along integrator B and neighbourhood connector streets with ultimate vehicle volumes over 5000 vehicles per day should be designed either so vehicles entering the street can do so travelling forward, or are provided with alternative forms of vehicle access. Wider lots with paired driveways and protected reversing areas in the parking lane may be used on streets with up to 7000 vehicles per day."

MELSP area does not have frontage on Rowley Road and all of the roads within the MELSP area are expected to carry less than 7,000vpd, so no restriction on vehicular access is required.

6.7 Pedestrian / Cycle Networks

The proposed network of shared paths for pedestrians and cyclists is described in section 4.3 of this transport assessment. This network of paths will provide an excellent level of accessibility and permeability for pedestrians and cyclists within the MELSP area, and connections to existing PSP along the Freeway and neighbouring precincts.

6.8 Access to Public Transport

At this stage of the planning process the details of the bus route planning and the location of bus stops are not known. However, in these circumstances the WAPC *Transport Assessment Guidelines for Developments* (2006) suggest that it is desirable for at least 90 per cent of dwellings to be within 400m straight line distance of a bus route. The potential future bus route proposed along the main north-south road would service the majority of the lots within both LSP areas.

7.0 Conclusions

The transport modelling and analysis documented in this revised TIA report is undertaken for both MWLSP and MELSP, and the report findings / recommendations are compatible.

The MELSP area is anticipated to accommodate approximately 607 Lots and a part of the proposed primary school, with a total estimated traffic generation of approximately 4,856vpd.

The MELSP is expected to be developed in several stages. During the development of MELSP the access/egress would be from Hoffman Road/ Anketell Road intersection. Therefore, this access intersection would need to be upgraded at the outset to be able to accommodate the MELSP traffic.

Appendix D of this report shows the proposed concept design for the upgrade to the intersection of Anketell Road/ Hoffman Road. The concept design includes right and left turn slip lanes on Anketell Road.

Intersection analysis undertaken for full development of the MELSP area indicates that the upgraded intersection of Anketell Road/ Hoffman Road can solely accommodate the full development of the MELSP area.

The MELSP does not have frontage on Rowley Road, therefore connection to Rowley Road during the interim would be through the adjoining MWLSP area (Qube land).

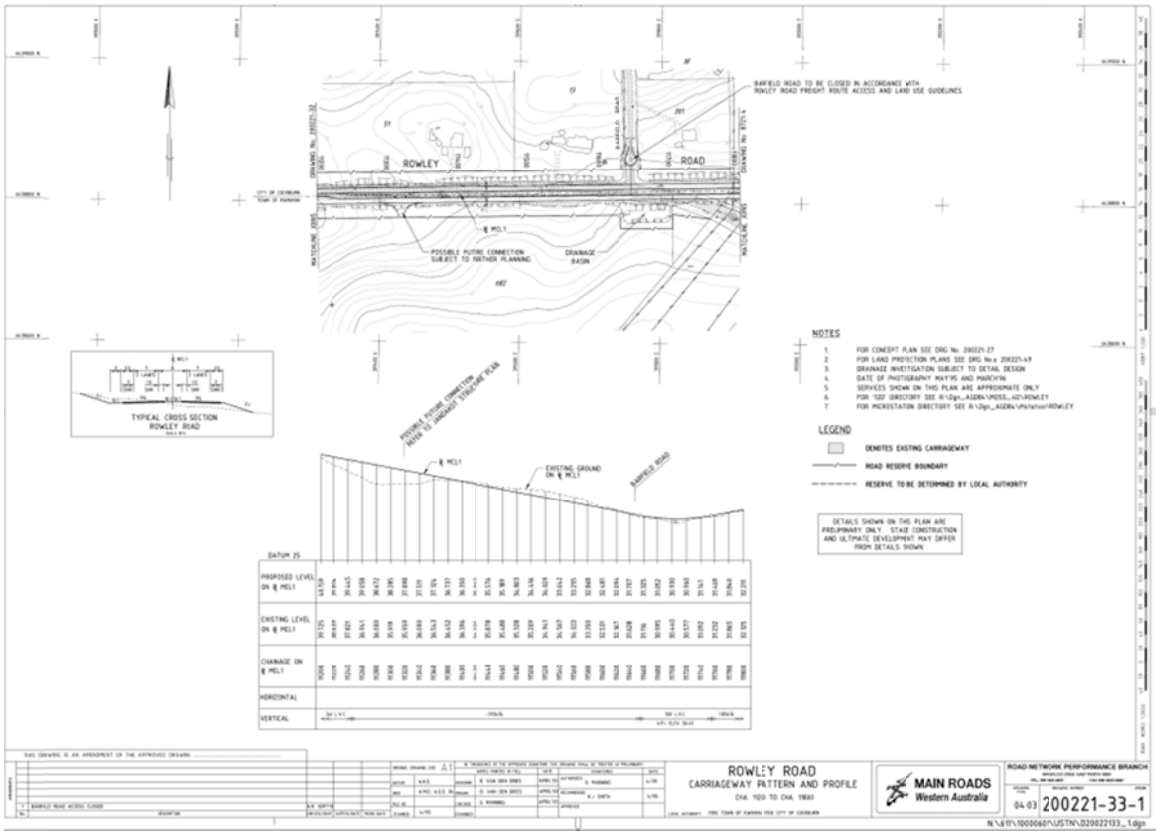
SIDRA analysis undertaken for the existing single lane roundabout on Rowley Road during the interim stage indicates that this roundabout will work satisfactorily with full development of the MELSP and MWLSP areas.

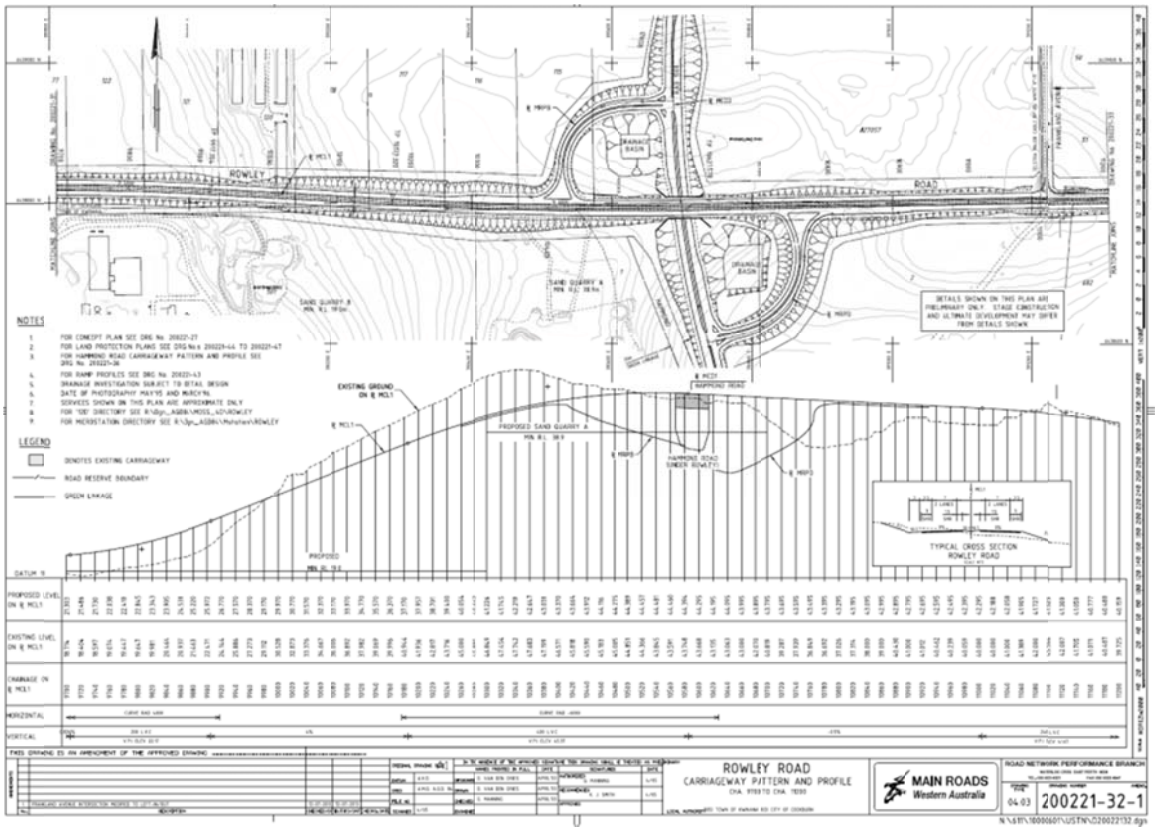
Ultimately when Rowley Road is upgraded to four lanes and Hammond Road extension to Anketell Road is constructed the roundabout on Rowley Road would be downgraded to left in/ left out intersection or a cul-de-sac.

The road network of the MELSP area has been planned based on WAPC Liveable Neighbourhoods guidelines to accommodate the future traffic flows that will be generated within this area.

Appendix A

ROWLEY ROAD ACCESS ARRANGEMENTS
(MAIN ROADS WA DESIGNS)


ROWLEY ROAD
CARRIAGEWAY PATTERN AND PROFILE
CHA 100 TO CHA 1880
MAIN ROADS Western Australia
200221-33-1
NOTES
LEGEND
DENOTES EXISTING CARRIAGEWAY
ROAD RESERVE BOUNDARY
RESERVE TO BE DETERMINED BY LOCAL AUTHORITY
TYPICAL CROSS SECTION ROWLEY ROAD
DRAINAGE BASIN
EXISTING GROUND ON ℄ MC1
HAMPOND ROAD
DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN


ROWLEY ROAD
CARRIAGEWAY PATTERN AND PROFILE
CHA 1700 TO CHA 1930
MAIN ROADS Western Australia
200221-32-1
NOTES
LEGEND
DENOTES EXISTING CARRIAGEWAY
ROAD RESERVE BOUNDARY
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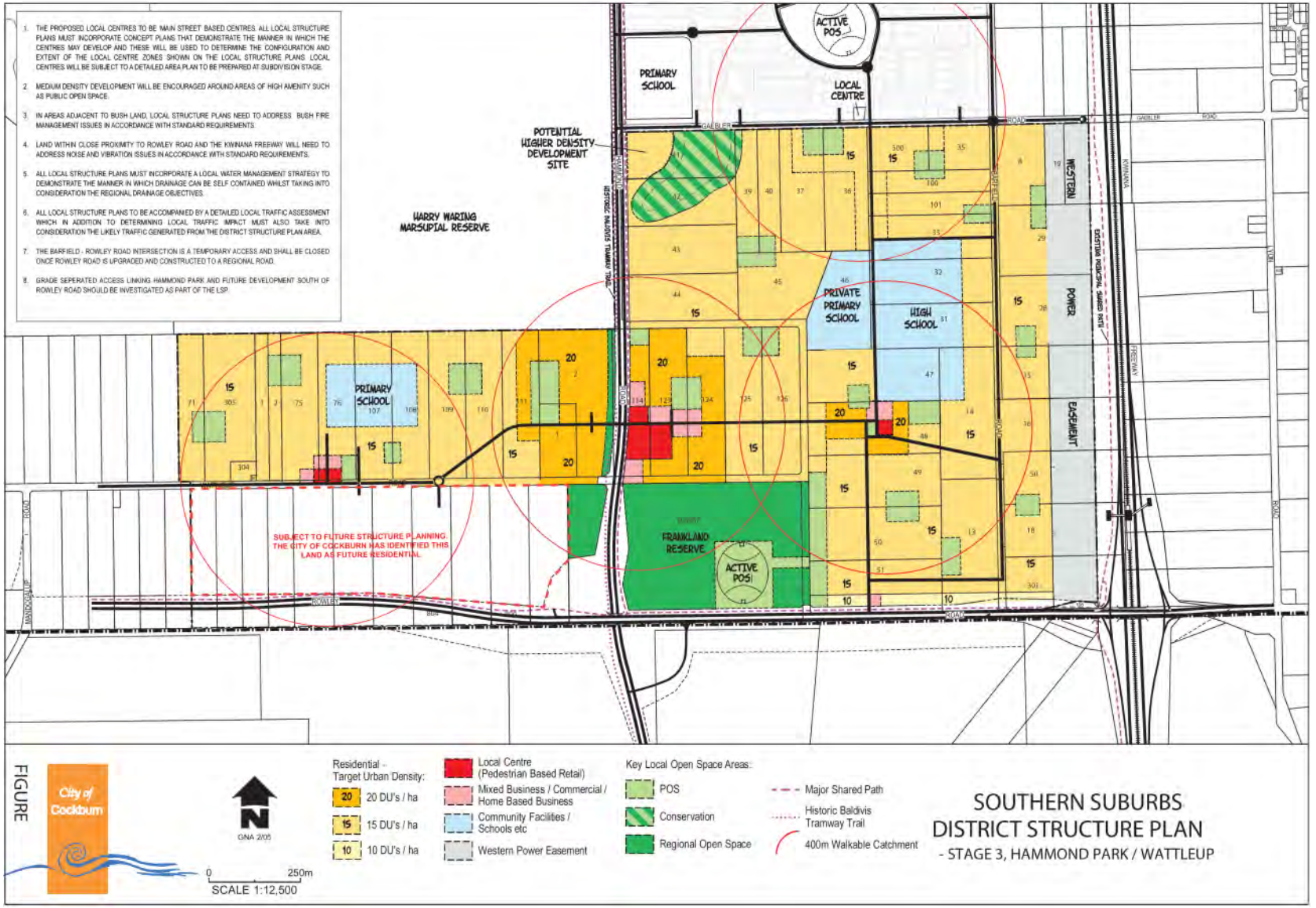
TYPICAL CROSS SECTION ROWLEY ROAD
DRAINAGE BASIN
EXISTING GROUND ON ℄ MC1
HAMPOND ROAD
PROPOSED SAND QUARRY A
DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN

Appendix B

SOUTHERN SUBURBS DISTRUICT STRUCTURE PLAN


1. THE PROPOSED LOCAL CENTRES TO BE MAIN STREET BASED CENTRES. ALL LOCAL STRUCTURE PLANS MUST INCORPORATE CONCEPT PLANS THAT DEMONSTRATE THE MANNER IN WHICH THE CENTRES MAY DEVELOP AND THESE WILL BE USED TO DETERMINE THE CONFIGURATION AND EXTENT OF THE LOCAL CENTRE ZONES SHOWN ON THE LOCAL STRUCTURE PLANS. LOCAL CENTRES WILL BE SUBJECT TO A DETAILED AREA PLAN TO BE PREPARED AT SUBDIVISION STAGE.
2. MEDIUM DENSITY DEVELOPMENT WILL BE ENCOURAGED AROUND AREAS OF HIGH AMENITY SUCH AS PUBLIC OPEN SPACE.
3. IN AREAS ADJACENT TO BUSH LAND, LOCAL STRUCTURE PLANS NEED TO ADDRESS BUSH FIRE MANAGEMENT ISSUES IN ACCORDANCE WITH STANDARD REQUIREMENTS.
4. LAND WITHIN CLOSE PROXIMITY TO ROWLEY ROAD AND THE KWINANA FREEWAY WILL NEED TO ADDRESS NOISE AND VIBRATION ISSUES IN ACCORDANCE WITH STANDARD REQUIREMENTS.
5. ALL LOCAL STRUCTURE PLANS MUST INCORPORATE A LOCAL WATER MANAGEMENT STRATEGY TO DEMONSTRATE THE MANNER IN WHICH DRAINAGE CAN BE SELF CONTAINED WHILST TAKING INTO CONSIDERATION THE REGIONAL DRAINAGE OBJECTIVES.
6. ALL LOCAL STRUCTURE PLANS TO BE ACCOMPANIED BY A DETAILED LOCAL TRAFFIC ASSESSMENT WHICH IN ADDITION TO DETERMINING LOCAL TRAFFIC IMPACT MUST ALSO TAKE INTO CONSIDERATION THE LIKELY TRAFFIC GENERATED FROM THE DISTRICT STRUCTURE PLAN AREA.
7. THE BARFIELD - ROWLEY ROAD INTERSECTION IS A TEMPORARY ACCESS AND SHALL BE CLOSED ONCE ROWLEY ROAD IS UPGRADED AND CONSTRUCTED TO A REGIONAL ROAD.
8. GRADE SEPERATED ACCESS LINKING HAMMOND PARK AND FUTURE DEVELOPMENT SOUTH OF ROWLEY ROAD SHOULD BE INVESTIGATED AS PART OF THE LSP.
PRIMARY SCHOOL
ACTIVE POS
LOCAL CENTRE
POTENTIAL HIGHER DENSITY DEVELOPMENT SITE
HARRY WARING MARSUPIAL RESERVE
PRIVATE PRIMARY SCHOOL
HIGH SCHOOL
WESTERN POWER EASEMENT
SUBJECT TO FUTURE STRUCTURE PLANNING, THE CITY OF COCKBURN HAS IDENTIFIED THIS LAND AS FUTURE RESIDENTIAL
FRANKLAND RESERVE
ACTIVE POS
ROWLEY ROAD
BARFIELD ROAD
GABLER ROAD
KWINANA FREEWAY
FIGURE
City of Cockburn
GNA 2/05
0
250m
SCALE 1:12,500
Residential - Target Urban Density:
20 DU's / ha
15 DU's / ha
10 DU's / ha
Local Centre (Pedestrian Based Retail)
Mixed Business / Commercial / Home Based Business
Community Facilities / Schools etc
Western Power Easement
Key Local Open Space Areas:
POS
Conservation
Regional Open Space
Major Shared Path
Historic Baldivis Tramway Trail
400m Walkable Catchment
SOUTHERN SUBURBS DISTRICT STRUCTURE PLAN
- STAGE 3, HAMMOND PARK / WATTLEUP

Appendix C

INTERSECTION ANALYSIS

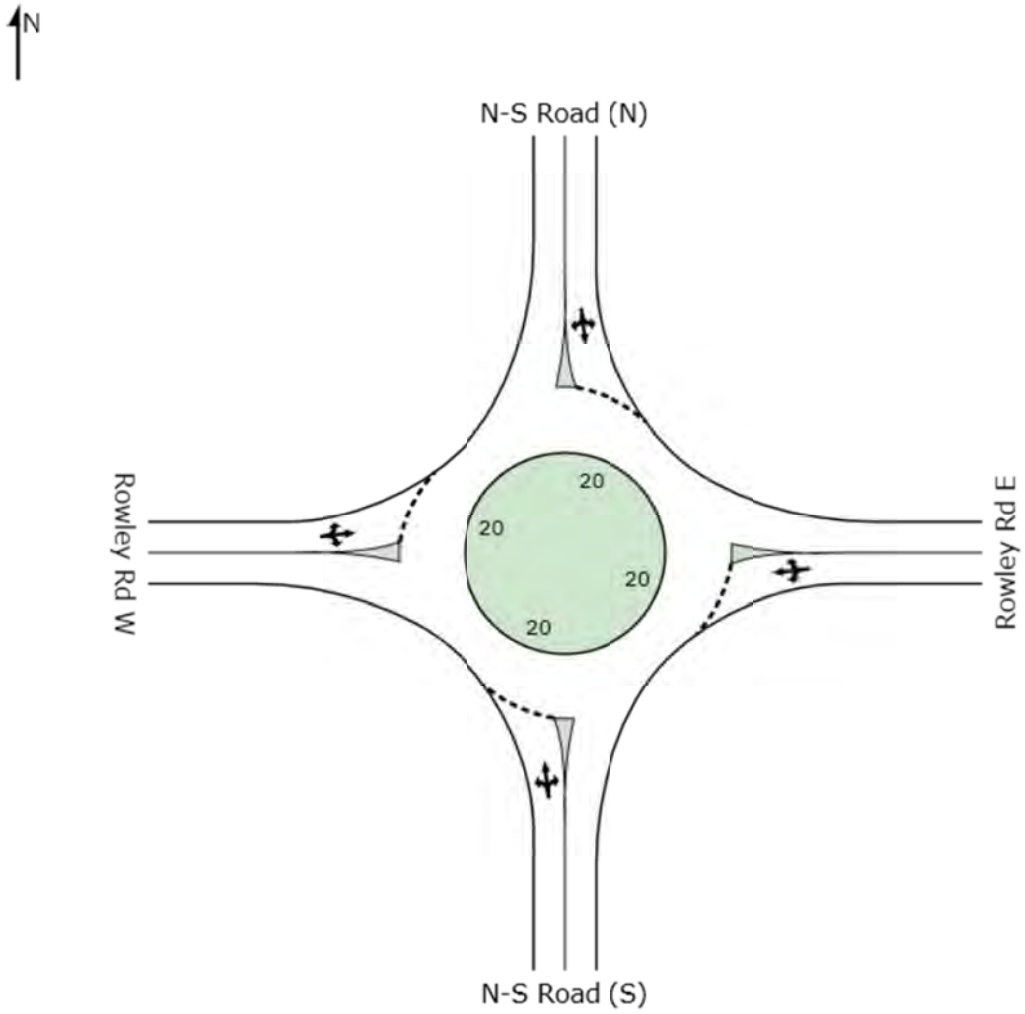


Figure C1: Existing Roundabout layout at Rowley Road

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: N-S Road (S)											
1	L	110	0.0	0.591	21.7	LOS C	5.9	41.0	1.00	1.13	37.2
2	T	10	0.0	0.591	20.8	LOS C	5.9	41.0	1.00	1.13	37.3
3	R	143	0.0	0.591	26.6	LOS C	5.9	41.0	1.00	1.13	35.7
Approach		263	0.0	0.591	24.3	LOS C	5.9	41.0	1.00	1.13	36.4
East: Rowley Rd E											
4	L	140	0.0	0.829	8.1	LOS A	13.2	98.6	0.84	0.58	46.5
5	T	684	12.0	0.829	7.5	LOS A	13.2	98.6	0.84	0.58	46.2
6	R	258	0.0	0.829	13.0	LOS B	13.2	98.6	0.84	0.63	45.3
Approach		1082	7.6	0.829	8.9	LOS A	13.2	98.6	0.84	0.59	46.0
North: N-S Road (N)											
7	L	256	0.0	0.599	20.4	LOS C	6.0	42.0	1.00	1.13	38.4
8	T	20	0.0	0.599	19.5	LOS B	6.0	42.0	1.00	1.13	38.5
9	R	10	0.0	0.599	25.2	LOS C	6.0	42.0	1.00	1.13	36.8
Approach		286	0.0	0.599	20.5	LOS C	6.0	42.0	1.00	1.13	38.4
West: Rowley Rd W											
10	L	10	0.0	0.832	17.3	LOS B	14.3	109.2	1.00	1.11	41.1
11	T	664	12.0	0.832	16.8	LOS B	14.3	109.2	1.00	1.12	41.2
12	R	96	0.0	0.832	22.2	LOS C	14.3	109.2	1.00	1.11	39.1
Approach		770	10.3	0.832	17.5	LOS B	14.3	109.2	1.00	1.12	40.9
All Vehicles		2401	6.7	0.832	14.7	LOS B	14.3	109.2	0.93	0.88	42.1

Table C1: SIDRA results – Proposed Roundabout on Rowley Road, Interim Stage

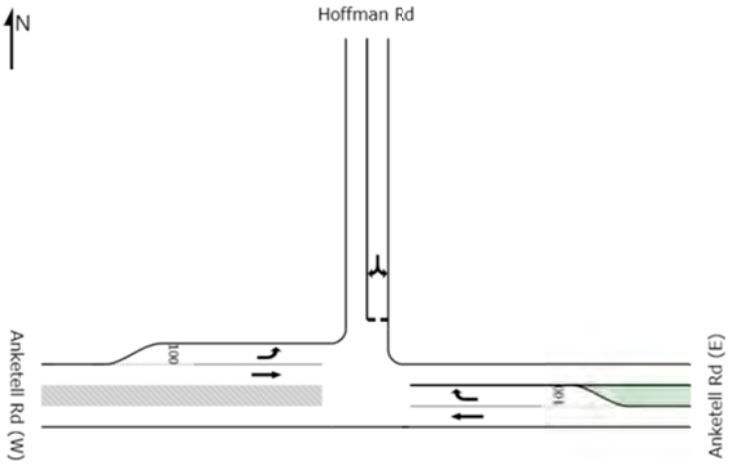


Figure C2: Upgraded Anketell Road/ Hoffman Road intersection layout in SIDRA

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Anketell Rd (E)											
5	T	716	18.0	0.410	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
6	R	77	0.0	0.050	9.0	LOS A	0.2	1.6	0.29	0.64	47.5
Approach		793	16.3	0.410	0.9	NA	0.2	1.6	0.03	0.06	58.5
North: Hoffman Rd											
7	L	305	0.0	0.425	12.1	LOS B	2.7	18.7	0.39	0.68	45.0
9	R	77	0.0	0.425	12.2	LOS B	2.7	18.7	0.39	0.84	44.9
Approach		382	0.0	0.425	12.1	LOS B	2.7	18.7	0.39	0.71	45.0
West: Anketell Rd (W)											
10	L	19	0.0	0.010	8.2	LOS A	0.0	0.0	0.00	0.67	49.0
11	T	149	18.0	0.086	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		168	16.0	0.086	0.9	NA	0.0	0.0	0.00	0.08	58.5
All Vehicles		1343	11.6	0.425	4.1	NA	2.7	18.7	0.13	0.25	53.9

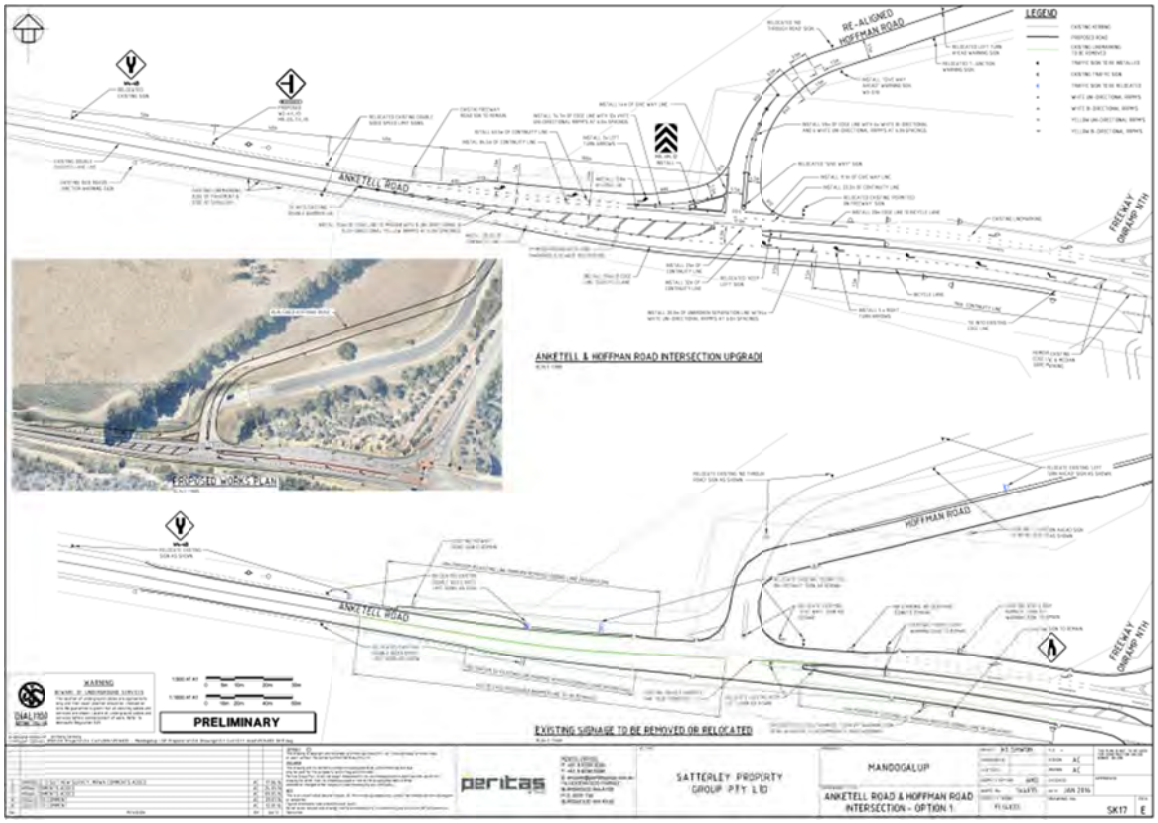
Table C1: AM SIDRA results – Upgraded Anketell Road/ Hoffman Road intersection (Interim, full MELSP development)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop Queued	Effective Stop Rate per veh	Average Speed km/h
East: Anketell Rd (E)											
5	T	295	18.0	0.169	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
6	R	305	0.0	0.435	15.3	LOS C	2.5	17.6	0.73	1.02	42.2
Approach		600	8.8	0.435	7.8	NA	2.5	17.6	0.37	0.52	49.4
North: Hoffman Rd											
7	L	77	0.0	0.214	16.0	LOS C	0.8	5.5	0.73	0.92	41.6
9	R	19	0.0	0.214	16.1	LOS C	0.8	5.5	0.73	0.92	41.6
Approach		96	0.0	0.214	16.0	LOS C	0.8	5.5	0.73	0.92	41.6
West: Anketell Rd (W)											
10	L	77	0.0	0.041	8.2	LOS A	0.0	0.0	0.00	0.67	49.0
11	T	737	18.0	0.422	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		814	16.3	0.422	0.8	NA	0.0	0.0	0.00	0.06	58.8
All Vehicles		1509	12.3	0.435	4.5	NA	2.5	17.6	0.19	0.30	53.4

Table C2: PM SIDRA results – Upgraded Anketell Road/ Hoffman Road intersection (Interim, full MELSP development)

Appendix D

ANKETELL ROAD/ HOFFMAN ROAD DESIGN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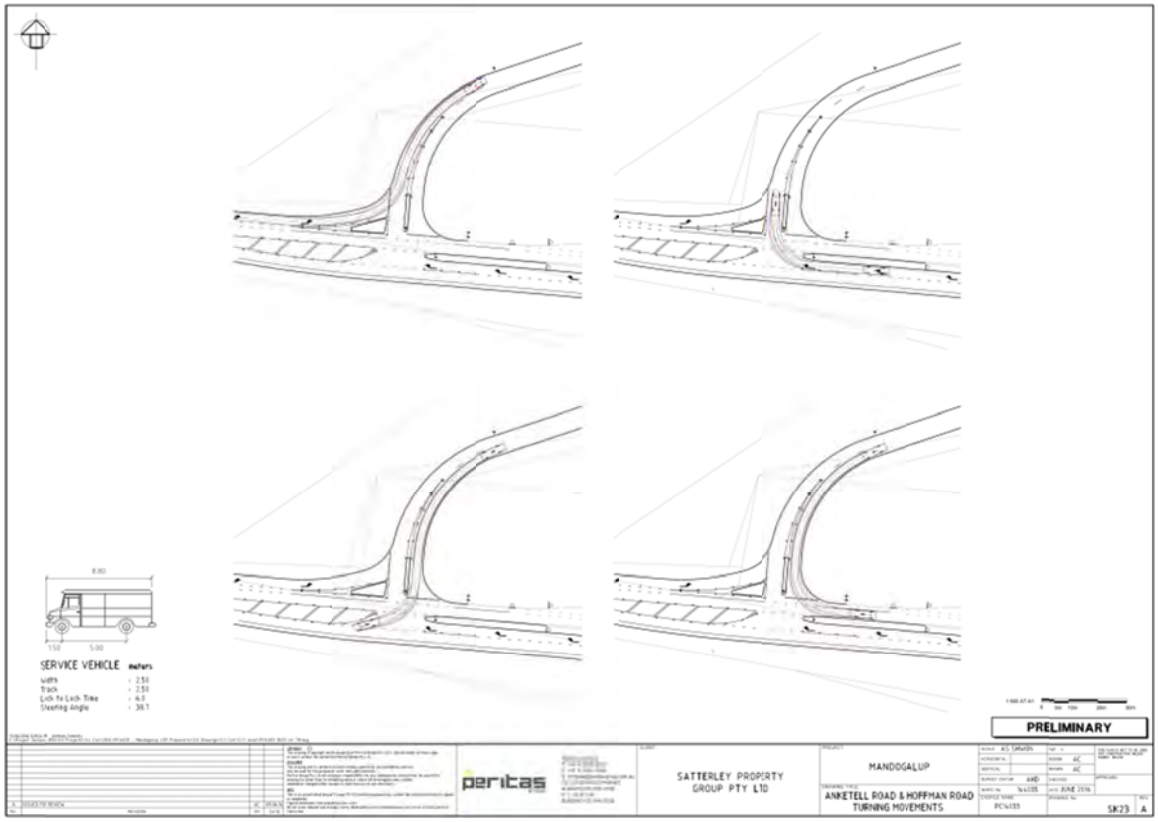
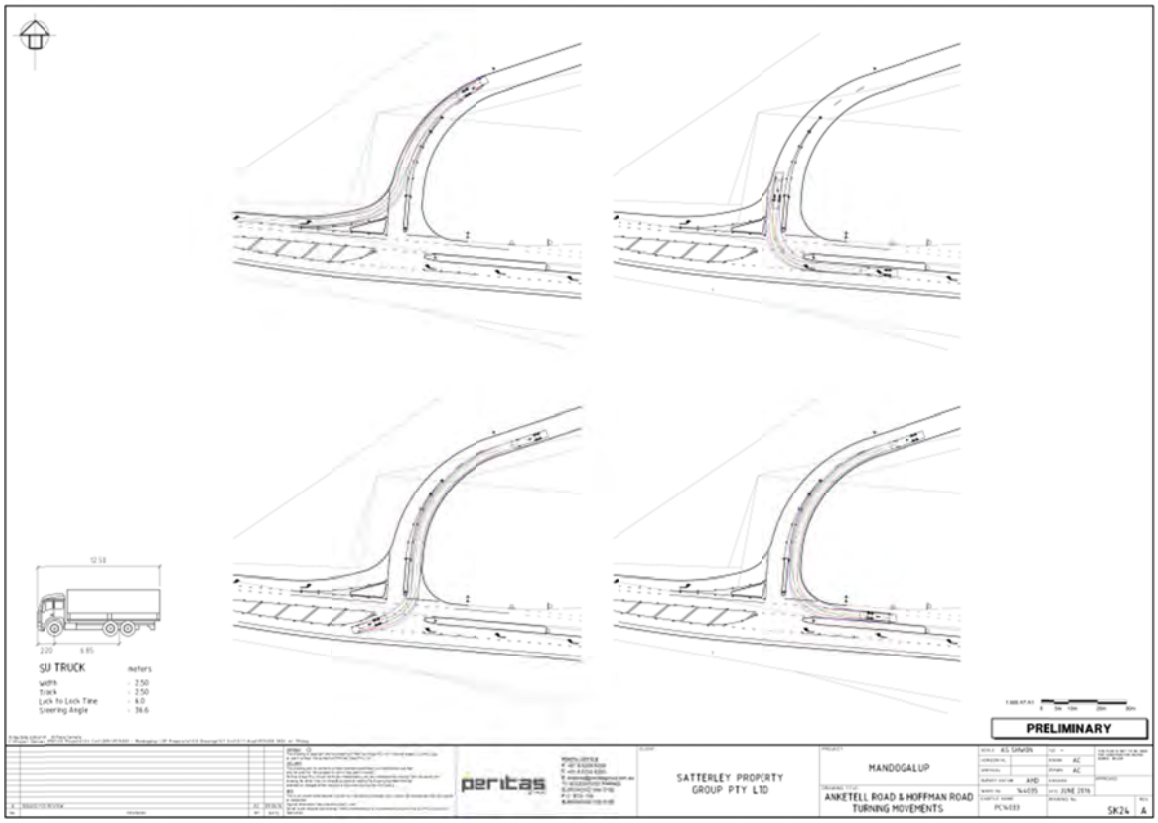
LEGEND
ANKETELL ROAD
FREEWAY OVERPASS WITH
ANKETELL & HOFFMAN ROAD INTERSECTION UPGRADE
PROPOSED LOCK PLAN
HOFFMAN ROAD
ANKETELL ROAD
FREEWAY OVERPASS WITH
WARNING
PRELIMINARY
EXISTING SIGNAGE TO BE REMOVED OR RELOCATED
peritas
SATTERLEY PROPERTY GROUP PTY LTD
MANDOGALUP
ANKETELL ROAD & HOFFMAN ROAD INTERSECTION - OPTION 1
SK17
E


SERVICE VEHICLE
PRELIMINARY
peritas
SATTERLEY PROPERTY GROUP PTY LTD
MANDOGALUP
ANKETELL ROAD & HOFFMAN ROAD TURNING MOVEMENTS
SK23
A


SU TRUCK
meters
width - 2.50
Track - 2.50
Lock to Lock Time - 6.0
Steering Angle - 36.6
PRELIMINARY
peritas
SATTERLEY PROPERTY GROUP PTY LTD
MANDOGALUP
ANKETELL ROAD & HOFFMAN ROAD TURNING MOVEMENTS
JUNE 2016
SK24
A

APPENDIX 8

LOCAL WATER MANAGEMENT STRATEGY

ROWEGROUP

Satterley Property Group

Mandogalup East
Local Water Management Strategy

December, 2016

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The JDA quality control system has been in place since 1997 and meets the requirements of AS/NZS ISO 9001:2008. JDA is committed to maintaining and improving the quality management system

Document Version No.	Issue Date
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	Name	Signature	Date
Author	Sarah Carr		6/12/16.
Checked by	Scott Wills		6/12/16
Approved by	Jim Davies		6/12/16

LWMS Addendum Porous Tree Pits

Prior to developing technical reports for the Mandogalup East Local Structure Plan, the consulting team presented the proposed principles and concepts of the hydrology and landscape amenity for the MELSP to the City of Kwinana officers and councillors.

Based upon the general acceptance of the presented concept and principles, the consultancy team undertook works to develop technical reports for LSP submission, which includes reference to porous verges. Subsequent to the completion of the LWMS documentation (Thursday 1st December) the City of Kwinana advised that they have reviewed their position and are supportive of all the hydrology design elements except the porous verges.

JDA has assessed a revised hydrological strategy to allow removal of porous verges and can confirm this has no significant impact to the MELSP. As discussed with the City, the installation of street trees at pavement level (porous tree pits) and extending the detention depth of the other drainage elements will offset the porous verges so they may be removed. It is anticipated that the revised streetscape, including porous tree pits, will be able to contain up to the 5yr ARI without porous verges. We will continue to look for other design opportunities to optimise the streetscape.

Emerge Associates have liaised with the City of Kwinana in making amendments to the proposed street tree pit size, of which a schematic plan is attached.

In reviewing the Landscape and Public Open Space Strategy and LWMS prepared by JDA, it should be noted that this addendum and the schematic plans attached take precedent over landscape masterplans and there are now no porous verges proposed within the development.

The LWMS will be modified once comments are received.

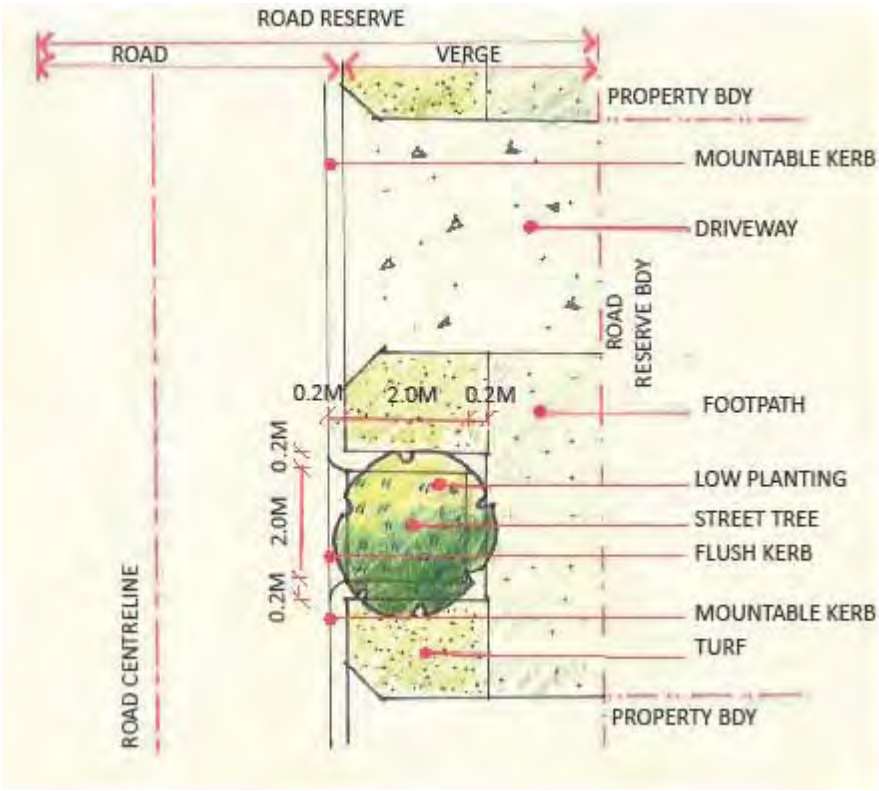

Plate B1: Typical layout plan – with footpath (Scale 1:50@A3)

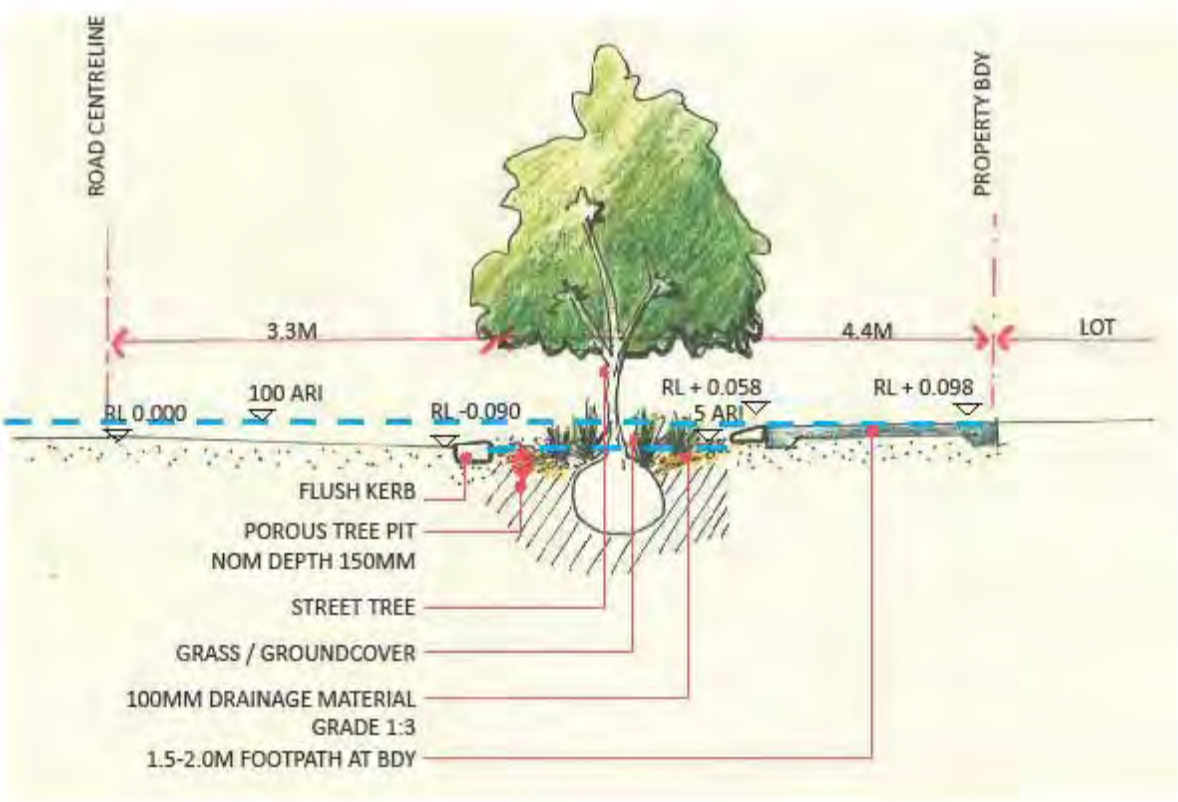

Plate B2: Typical half road section– with footpath (Scale 1:25@A3)

Plate B3: Typical layout plan – no footpath (Scale 1:50@A3)

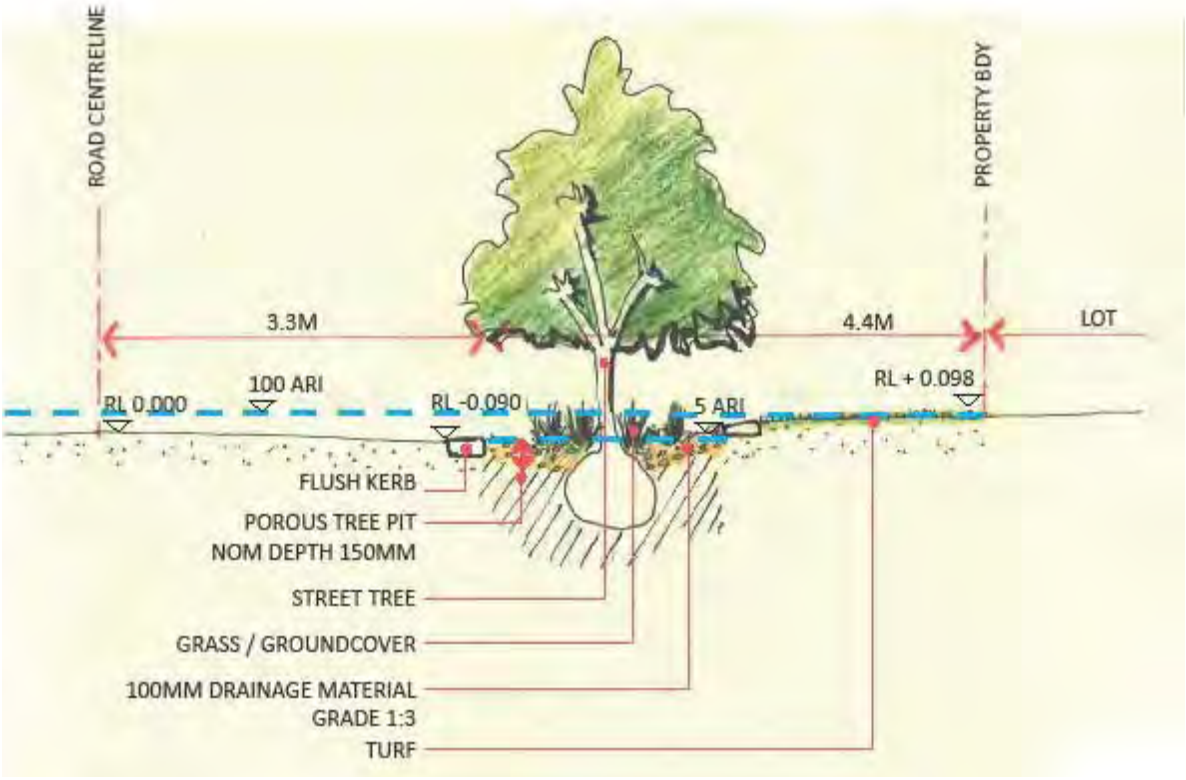

Plate B4: Typical half road section– no footpath (Scale 1:25@A3)

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APPENDICES

1. EXECUTIVE SUMMARY

This Local Water Management Strategy (LWMS) has been prepared in support of the Mandogalup East Local Structure Plan (MELSP). The LWMS provides the framework for the application of total water cycle management to the proposed urban structure within the MELSP, consistent with the District Water Management Strategy (DWMS) and Department of Water (DoW) principles of Water Sensitive Urban Design (WSUD) described in the Stormwater Management Manual (DoW, 2007).

The MELSP forms the eastern portion of the Mandogalup development cell with the balance falling within the Mandogalup West Local Structure Plan (MWLSP). The LWMS documents the integration of water management between the two LSP's, with the primary constraints being:

- Ensuring the profile of the Peel Main Drain (PMD) is consistent between the two developments (Figure 1).
- Ensuring the profile of the North-South connector road central median swale is consistent between the two developments (Figure 1).
- Drainage within the Primary School site consistent between the two developments (Figure 1).
- Drainage within the Playing Field is consistent between the two developments (Figure 1).
- Interface between the Retained Vegetation and the MWLSP.

Integration of the above constraints can be demonstrated, as follows:

- A 20m wide PMD easement with a 4.3m wide base channel with 1:3 side slopes and a meandering overflow channel with 1:6 side slopes. This channel profile will be maintained in the MWLSP.
- The central median swale of the North-South connector road has a total width of 6m, base width of 1m with 1:4 side slopes. The swale will continue into the MWLSP with a transitional section created to maintain consistency between the two developments.
- Primary School building configuration is east-west with a catchment divide located along the boundary of MELSP and MWLSP. Drainage within the Primary School site will be separate in the two developments.
- The Primary School playing field catchment divide is located at the boundary of the MELSP and MWLSP with stormwater drainage separate in the two developments.
- The MWLSP will have Public Open Space (POS) fronting the retained vegetation in the MELSP.
- Drainage within the MWLSP POS will be independent of the retained vegetation, with a catchment divide located at the boundary of the two developments.

A summary of the Mandogalup East LWMS design principles and objectives is presented in Table 1.

TABLE 1: SUMMARY OF LWMS DESIGN PRINCIPLES AND CRITERIA

Key Guiding Principles		
• Facilitate implementation of sustainable best practice in urban water management • Provide integration with planning processes and clarity for agencies involved with implementation • To minimise public risk, including risk of injury or loss of life. • Protection of infrastructure and assets from flooding and inundation • Encourage environmentally responsible development. • Facilitate adaptive management responses to the monitored outcomes of development		
Category	**DWMS Objectives**	**LWMS Criteria**
Surface Water Management	• Minimise changes in hydrology to prevent impacts on receiving environments. • Manage water flows from major events to protect infrastructure and assets. • Apply the Principles of WSUD. • Adopt nutrient load reduction design objectives for stormwater runoff. • Floodplain management and urban drainage.	• Post-development critical 1yr ARI and 100yr ARI peak flow shall be consistent with pre-development peak flow at the discharge point of each catchment and discharge points of all subdivisions into waterways • All 1yr 1hr ARI event runoff to be infiltrated at source where possible. • Maintain the alignment and hydraulic capacity of the Peel Main Drain, as specified in the Jandakot DWMP, but within the Study Area redefine the profile of the drain to an urban standard. • Manage surface water flows from major events to protect infrastructure and assets from flooding and inundation.
Groundwater Management	• Manage groundwater levels to protect infrastructure and assets • Maintain groundwater regimes for the protection of groundwater-dependent ecosystems • Protect the value of groundwater resources. • Adopt nutrient load reduction design objectives for discharges to groundwater.	• Manage and minimise changes in groundwater levels and groundwater quality following development. • Subsurface drainage (sub-soils) and drainage infrastructure set at or above the AAMGL, although existing inverts below this level may remain. • Subsoil drainage outlets to be free draining.
Monitoring and Implementation	• Adopt an adaptive management approach. • Maintain drainage and treatment structures.	• Design based on methodology in Stormwater Management Manual of adopting a treatment train including: • Retention of 1yr ARI 1hr events, • Structural treatment measures (infiltration storages, plus bio-retention/ treatment structures sized to min 2% of connected impervious area) • Non-structural measures to reduce applied nutrient loads. • Maintain groundwater quality at pre-development levels (median winter concentrations) and, if possible, improve the quality of water leaving the development area to maintain and restore ecological systems.
Water Conservation	• Water efficiency initiatives include waterwise landscaping packages, public POS area to be at least 50% native vegetation. • Buildings are to comply with water efficiency standards introduced into the building code.	• Aim to achieve the State Water Plan target for water use of 100 kL/person/yr. • Consider alternative fit for purpose water sources where appropriate and cost-effective. • POS areas to be at least 50% native plants.

2. INTRODUCTION

2.1 Background

This Local Water Management Strategy (LWMS) has been prepared by JDA Consultant Hydrologists on behalf of Satterley Property Group in support of the Mandogalup East Local Structure Plan (MELSP). The Structure Plan covers the urban zoned land within part Lot 9002 Hoffman Road, part Lot 9006 Hoffman Road, part Lot 11 Hoffman Rd and Lot 9019 Rowley Rd, Mandogalup, City of Kwinana (herein referred to as the Study Area, Figure 1).

The 1.5 km Revised Kwinana Industrial (including air quality) buffer (as of 21 September 2010) forms the southern boundary of the Study Area. Land within the buffer is zoned 'Urban Deferred' under the Metropolitan Regional Scheme (WAPC, 2014) (Figure 1).

The LWMS provides the framework for the application of total water cycle management to the proposed urban structure, consistent with the Mandogalup DWMS (JDA, 2011) and Department of Water (DoW) principles of Water Sensitive Urban Design (WSUD) described in the Stormwater Management Manual (DoW, 2007).

2.2 Statutory Framework

2.2.1 District Planning

A Mandogalup District Water Management Strategy (DWMS) was prepared by JDA (2011) and provides guidance on water reuse options, stormwater detention basins, monitoring requirements and structural and non-structural controls for stormwater treatment. The DWMS was approved by City of Kwinana and Department of Water (DoW).

2.2.2 Local Structure Plan

This LWMS is presented in support of the Mandogalup East Local Structure Plan (MELSP) as part of the Better Urban Water Management Framework.

The LWMS addresses the MELSP area and provides a refinement of the flood modelling, surface water management strategy and groundwater management strategy to a local scale.

2.3 Key Design Principles and Objectives

The LWMS employs the following key documents to define its content, key principles and objectives:

- Peel Harvey WSUD Local Planning Policy (EPA, 2006)
- Stormwater Management Manual for Western Australia (DoW, 2007)
- Better Urban Water Management (WAPC, 2008)
- Guidelines for Subdivision Development (City of Kwinana, 2008)
- Jandakot Drainage and Water Management Plan – Peel Main Drain Catchment (DoW, 2009)
- Mandogalup District Water Management Strategy (JDA, 2011)

A summary of the key design principles and objectives from these documents is provided in Table 1 and summarised below.

2.3.1 Peel Harvey WSUD Local Planning Policy (2006)

The Peel Harvey WSUD Local Planning Policy (Peel Development Commission, 2006) was developed through the Federal Governments Coastal Catchments Initiative and endorsed by the Environmental Protection Authority (EPA). It aims to assist local government to help integrate catchment management objectives with land and resource planning in urban landscapes.

The policy identifies broad policy objectives against which strategic and statutory proposals can be assessed

Water quantity management principles and objectives are provided based on post-development discharges being maintained relative to predevelopment levels. Criteria are provided for both ecological protection (1 in 1 year events), and flood protection (1 in 100 year events). Water quality management principles and objectives are based on maintaining or improving water quality relative to existing conditions.

Specific water quality guidelines are provided in the document including limitations on developments where average input rates of nutrients exceed 15 kg/phosphorus/ha per annum or 150 kg/nitrogen/ha per annum.

The policy is consistent with the *Decision Process for Stormwater Management in WA* (DoE and Swan River Trust, 2005) which is appended to the policy and is consistent with the objectives of the Environmental Protection Policy (Peel Inlet – Harvey Estuary) 1992.

This policy is stated as holding no legal standing and envisages each local government in the Peel Harvey catchment will customise the model policy to suite its own specific requirements.

2.3.2 Stormwater Management Manual for Western Australia (DoW, 2007)

The Water and Rivers Commission (now Department of Water, DoW) released *A Manual for Managing Urban Stormwater Quality in Western Australia* in 1998 to define and practically describe Best Management Practices (BMP's) to reduce pollutant and nutrient inputs to stormwater drainage systems. The Manual also aims to provide guidelines for the incorporation of water sensitive design principles into urban planning and design, which would enable the achievement of improved water quality from urban development.

The document was released to provide a guideline for best planning and management practices and was intended for use by Water and Rivers Commission, but also by other State and Local Government Authorities and sectors of the urban development industry.

DoW completed a major review of the Manual in consultation with a working team comprising industry and government representatives, published in August 2007.

Principle objectives for managing urban water in WA are stated as:

- Water Quality: To maintain or improve the surface and groundwater quality within development areas relative to pre-development conditions
- Water Quantity: To maintain the total water cycle balance within development areas relative to the pre-development conditions
- Water Conservation: To maximise the reuse of stormwater
- Ecosystem Health: To retain natural drainage systems and protect ecosystem health
- Economic Viability: To implement stormwater systems that are economically viable in the long term
- Public Health: To minimise the public risk, including risk of injury or loss of life to the community
- Protection of Property: To protect the built environment from flooding and waterlogging

- Social Values: To ensure that social aesthetic and cultural values are recognised and maintained when managing stormwater
- Development: To ensure the delivery of best practice stormwater management through planning and development of high quality developed areas in accordance with sustainability and precautionary principles

2.3.3 Better Urban Water Management (WAPC, 2008)

The guideline document Better Urban Water Management (WAPC, 2008), focuses on the process of integration between land use and water planning and specifying the level of investigations and documentations required at various decision points in the planning process, rather than the provision of any specific design objectives and criteria for urban water management.

This LWMS complies with the BUWM process.

2.3.4 Guidelines for Subdivision Development (City of Kwinana, 2010)

The City of Kwinana (CoK) Guidelines for Subdivision Development (ToK, 2010) provides details of the City's requirements regarding stormwater drainage management. The document provides both general guidelines at the strategic conceptual design level and also more specific detailed criteria for design of drainage systems (grades, subsoil drainage).

At the strategic level key design guidelines are citied as follows:

- Australian Rainfall and Runoff (Institution of Engineers Australia, 1987).
- Stormwater Drainage Design in Small Urban Catchments (J Argue, ARRB Special Report No 34).
- Subsurface Drainage of Road Structures (RJ Gerke, ARRB Special Report No 35).
- Water Sensitive Urban (Residential) Design Guidelines for the Perth Metropolitan Region (Whelans et al, 1993).
- Stormwater Quality Management Manual (Water and Rivers Commission, 1998).

Specific criteria in relation to stormwater/groundwater are detailed as:

- Examine the total drainage catchment area and ensure that any upstream drainage is able to pass through the subdivision.
- Drainage network is designed to 10yr ARI except for arterial drainage and compensating storages to be designed to a 20yr ARI.
- Floor levels minimum 500 mm above 100yr ARI flood level in storages, main drains and watercourses.
- The pre-development AAMGL generally be maintained following development. Where AAMGL is within 1.2m of the design surface level, subsoils will be installed at AAMGL and fill imported. Subsoils are generally provided as a separate system.
- Water Sensitive Urban Design principles incorporated into the design.
- Open Drainage facilities have 1:6 side slopes.
- Nutrient filtration to occur prior to drainage water being released to a Water Corporation Main Drain.

2.3.5 Jandakot Drainage and Water Management Plan (DoW, 2009)

The Jandakot Drainage and Water Management Plan (DWMP) provides guidance on the management of stormwater in the Peel Main Drain Catchment and was prepared by DoW to support the Jandakot Structure Plan (WAPC, 2007)

The scope of the DWMP is to cover aspects of total water cycle management, including;

- Protection of significant environmental assets within the structure plan, including meeting their water requirements, managing potential impacts from development and protecting their cultural value.
- Alternative water supply options, opportunities for conservation and demand management measures, and wastewater management.
- Surface runoff, including both peak event (flood) management and the application of water sensitive urban design principles to frequent events.
- Groundwater, including the impact of urbanisation, variation in climate, installation of drainage to manage groundwater levels, potential impacts on the environment and the potential to use groundwater as a resource.
- Water quality management, which includes source control of pollution inputs by catchment management, acid sulphate soil management, control of contaminated discharges from industrial areas and management of nutrient exports from surface runoff and groundwater through structural measures.

2.3.6 Mandogalup District Water Management Strategy (JDA, 2011)

The DWMS was prepared to support rezoning of the Satterley and QUBE landholdings in Mandogalup and demonstrate that the area was capable of supporting the proposed urban zoning.

The aims of the DWMS are to:

1. Define land area requirements for conveyance of flood flows and protection of future development from peak flood events;

2. Propose a drainage design strategy appropriate for local conditions in the strategy area that incorporates best practice water sensitive urban design measures. This strategy should identify Water Sensitive Urban Design (WSUD) practices to be implemented within both private allotments and the public domain, and the legal mechanisms by which all identified practices will be implemented;

3. Prescribe the design criteria for water quantity and water quality for each catchment;

4. Outline the hydrologic and hydraulic framework parameters and subsequently develop the overall drainage network concept;

5. Define an implementation framework for the drainage design objectives; and

6. Recommend monitoring programs for water quantity and water quality pre, during and post development as well as for ensuring hydraulic performance over the lifetime of the drainage structures.

3. PROPOSED DEVELOPMENT

The Study Area is 42.67 ha (excluding investigation area (1), shown on Figure 1) and is situated within the southern corridor of the Perth Metropolitan Region, approximately 23 km south of the Perth CBD.

The Study Area is bounded by Anketell Rd to the south, Kwinana Fwy to the east and Rowley Rd to the north (Figure 1) (Rowe Group, 2016).

The proposed land use is for residential development consistent with regional planning. The Structure Plan for the Study Area is shown on Figure 1.

Key elements of the Structure Plan related to urban water management include:

- Use of porous verges and rain gardens through each catchment for detention and treatment of stormwater;
- Retention of the existing Peel Main Drain alignment and hydraulic capacity through the Study Area, and redefine the Drain to an urban standard;
- Use of higher density urban residential zonings to reduce landscape nutrient input at a domestic scale; and
- The extensive use of local native species in open spaces, streetscapes and wetland buffers to reduce nutrient input and conserve water resources.

4. PRE-DEVELOPMENT ENVIRONMENT

4.1 Existing Land Use

The Study Area is currently undeveloped with the southern portion extensively cleared of native vegetation. The southern portion, previously used for market gardens and grazing, primarily consists of degraded bushland and pasture. The northern portion of the Study Area consists primarily of degraded bushland (Figure 2).

4.2 Topography

The topography of the Study Area is shown on Figure 2, slopes from north to south, with a high of 28 mAHD at the north eastern edge and a low point of 18 mAHD at the south eastern corner.

4.3 Climate

The Mandogalup area is characterised by a Mediterranean climate with warm dry summers and cool wet winters.

Rainfall data provided is from the nearby Bureau of Meteorology Medina Research Station (Site No. 9194)

The long term average annual rainfall is 760 mm (1986 to 2013). This average has decreased between 2000 to present, to an average annual rainfall of 639 mm, reflecting an 18% reduction compared to the long term average.

The seasonal rainfall distribution has also altered since 2000, with a reduction of average monthly totals in the winter months, but no reduction in summer months.

The average annual pan evaporation is approximately 1900 mm (Luke et al, 1988).

4.4 Geology and Soils

Surface geology mapping by Gozzard (1983) is shown on Figure 3.

The Study Area is situated within the Bassendean Dune system (S7, S8 and S10) and is overlaid in places by swamp deposits (Cps and Ms5). The thickness of the Bassendean Sands varies and overlies clays of the Guildford Formation. The Bassendean Sands are characterised as “very light at surface, yellow at depth, fine to medium grained, sub-rounded quartz moderately well sorted of Aeolian origin” (Gozzard, 1983).

A preliminary geotechnical investigation was carried out by Golder Associates (2008) with results generally in accordance with Gozzard (1983) mapping:

- Topsoil – sand/silty sand, fine to medium grained, grey, containing roots and organic matter, extending from the surface to between about 0.25 and 0.5 m; overlying
- Sand, fine to medium grained, loose to medium dense generally loose at the surface, silty in parts, grey/grey brown/pale grey, generally dry to moist, becoming saturated, extending to depths of between about 4 m and the maximum depth investigated of 10 m; overlying
- Sand, dense to very dense, extending to the maximum depth investigated of 10.1 m below natural surface.

Cemented sand (coffee rock) was encountered at some locations. It can be described as dark brown and yellow brown and weakly to moderately iron cemented. Where present, the cemented sand was typically up to about 0.5 m thick.

Variation to the generalised profile exists in the south-west part of the site where conditions can be generalised as:

- Clayey sand/sandy clay, low to high plasticity clay, fine to medium grained sand, typically grey mottled yellow, generally firm to stiff, organic in parts, extending from the surface to depths of between 0.5 and greater than 2.2 m; overlying
- Sand/silty sand, loose to very dense, extending to the maximum depth investigated of 5.2 m below natural surface.

A copy of the geotechnical report is provided in Appendix B.

4.5 Acid Sulphate Soils

According to mapping published by the DEC (2010), the Study Area consists of:

- High to moderate risk of Acid Sulphate Soils (ASS) occurring less than 3m from surface in the southern portion of the Study Area.
- Moderate to low risk of ASS occurring less than 3m from surface in the central to northern portion of the Study Area.

Regional Acid Sulphate Soil mapping is shown on Figure 3.

Detailed ASS investigations will be undertaken at the time of subdivision. In the event that any ASS is encountered an Acid Sulphate Soil Management Plan will be prepared and implemented as part of the subdivision process in accordance with WAPC (2003).

4.6 Significant Trees

In accordance with the City of Kwinana's Local Planning Policy No.1 (LLP No.1) Landscape Feature and Tree Retention, an Environmental Assessment Report (EAR) was completed for the Mandogalup East LSP (Strategen, 2016). As part of the EAR, all significant trees identified within the Study Area were subjected to a physical assessment. The physical assessment identified the retention value of each tree.

In consultation with the City of Kwinana all trees identified with a 'very low' or 'low' retention value located outside of a Public Open Space are not considered viable for retention due to the potential risk to community.

Significant trees with a retention value of ‘medium’ or ‘high’ that have an ability to be designed into a location of road reserve, POS, minor drainage structure, group housing or school site, are considered viable fore retention.

4.7 Surface Water Hydrology

4.7.1 Existing Surface Drainage

The existing local drainage network is shown on Figure 4.

The Peel Main Drain (PMD) runs east to west through the central part of the Study Area. The PMD flows into Mandogalup Swamp at the southern boundary of the Study Area and the Spectacles Wetland south of Anketell Rd. The PMD outlets at the Serpentine River, which flows to the Peel Harvey Estuary (Figure 4).

The Peel Main Drain was modelled by DoW in the Jandakot DWMP (DoW, 2009) as described in Section 1.3.5. A maximum flood level in the 100 yr ARI upstream of the Mandogalup Swamp for the existing system is 16.1 mAHD causing inundation of the Mandogalup Swamp area along the southern boundary of the Study Area. The balance of the Study Area is not expected to be affected by flooding.

4.7.2 Surface Water Quality

Surface water quality in the PMD was measured by JDA as part of pre-development monitoring from October 2004 to September 2006 (JDA, 2007). Results indicate the PMD is characterised by high nutrient concentrations and pH levels generally less than 6.8, consistent with other drains in the area and historic land use. Water quality data at locations Surface Drains 1, 2, 3 shown on Figure 4 is provided in Appendix C.

4.8 Wetlands

The Department of Environment and Conservation Geomorphic Wetlands of the Swan Coastal Plain Wetland mapping shows the boundaries and locations of wetlands in the Study Area (Figure 5). The majority of the Study Area is classified as Multiple Use Dampland, which does not preclude urban development. There is a small Resource Enhancement Wetland in the northern corner of the Study Area.

To the south of the Study Area is the Spectacles Wetland, a Conservation Category Wetland (CCW) is an Environmental Protection Policy (EPP) listed lake which contains significant flora, a number of significant mammal and reptile species and provides an important waterfowl breeding site. The Peel Main Drain contributes approximately 48% of the water entering the Spectacles, with the remainder from groundwater through-flow (DoW, 2009).

4.9 Groundwater Hydrology

There are two aquifers of significance underlying the Study Area; each assigned the name of the major geological unit in which the aquifer occurs. In descending order of depth from natural surface they are:

- Superficial Aquifer (unconfined, +20 to -25 mAHD)
- Leederville Aquifer (confined, -25 to -250 mAHD)

4.9.1 Superficial Aquifer

The Superficial Formation is of quaternary age and consists of a thin veneer of sand (Bassendean Sand) overlying sandy clay and clay (Guildford Formation). The Superficial Formation forms an unconfined aquifer containing generally fresh to slightly brackish groundwater (500 to 1500 mg/L Total Dissolved Solids), with slightly acid to neutral pH (5 to 7) (Davidson, 1995). The water table is shallow in places, rising to the surface during winter, depending on surface elevation.

Pre-development groundwater monitoring was completed in 2007 by JDA (2007a, b). Seven bores were installed west of Kwinana Freeway (11, 12, 13, 14, 15, 16 and 17), although Bores 13 and 15 were destroyed before water levels were measured. Bores 11, 12, 16 are within the Study Area.

Water quality bores WAM1, WAM2, WAM3 and WAM4 (shallow and deep) were installed 19 October 2004 and monitored to September 2006 (JDA, 2007a,b).

Bore details and locations are presented in Table 2 and shown in Figure 6.

TABLE 2: DETAILS OF GROUNDWATER MONITORING BORES

Bore ID	GDA Coordinates		Natural Surface (mAHD)	Total Depth (mBNS)	Top of Casing (mAHD)	Water Level 22 March 2007 (mAHD)	Estimated AAMGL (mAHD)	Depth to AAMGL (mBNS)
	Easting	Northing						
11	392155	6438840	23.66	6.0	24.67	19.59	20.74	2.92
12	392064	6438431	22.84	6.0	24.02	19.03	20.18	2.66
14	391687	6437406	15.98	3.0	16.98	14.54	15.69	0.29
16	392025	6437114	17.60	3.0	18.47	14.92	16.07	1.53
17	391527	6436880	13.58	3.0	14.66	11.34	12.49	1.09
WAM1S	392672	6438501	23.77	6.0	24.48	-	-	-
WAM1D	392673	6438501	23.77	10.0	24.52	-	-	-
WAM2S	392478	6437397	21.92	6.0	22.57	-	-	-
WAM2D	392478	6437396	21.92	10.0	22.51	-	-	-
WAM3S	391271	6437128	13.44	5.0	14.02	-	-	-
WAM3D	391272	6437127	13.44	10.0	14.09	-	-	-
WAM4S	392150	6436561	15.83	3.5	16.54	-	-	-
WAM4D	392149	6436560	15.83	10.0	16.43	-	-	-

Notes: m BNS = metres below natural surface
m AHD = metres Australian Height Datum

To correlate the measured groundwater levels to long-term groundwater monitoring measurements, groundwater levels were recorded in Department of Water (DoW) monitoring bores JE12C, JM41, JM42, JM49 and SP1-2B).

TABLE 3: DETAILS OF DOW MONITORING BORES

Bore ID	Record Period	Top of Casing (mAHD)	Water Level 22 March 2007 (mAHD)	AAMGL (mAHD)	Difference (m)	MGL (mAHD)	Difference (m)
JM42	1975 - 2007	25.80	20.94	22.75	+1.81	23.64	+2.70
JM49	1980 - 2007	26.67	22.96	23.82	+0.86	24.36	+1.40
JE12C	1984 - 2007	37.10	18.82	19.86	+1.04	20.70	+1.88
JM41	1975 - 2007	19.68	11.38	12.63	+1.25	13.72	+2.34
SP1-2B	1995 - 2007	14.90	11.00	11.79	+0.78	12.07	+1.07
Average					+1.15		+1.88

For each of the DoW monitoring bores an Average Annual Maximum Groundwater Level (AAMGL) was calculated as the average of the winter peak levels over the period of record. Based on the water levels recorded in the DoW bores (Table 3) a correction of 1.15 m was applied to the water levels measured in the JDA bores on the same date to estimate the AAMGL for the JDA bores. AAMGL contours and depth to AAMGL from the existing natural surface are shown on Figure 6. Note the AAMGL contours have been corrected to PMD invert level where necessary.

Maximum Groundwater Levels (MGL) for each DoW monitoring bore is presented in Table 3, which is the highest peak water level over the period of record. On average the MGL is 0.73 m above the estimated pre-development AAMGL.

Groundwater quality monitoring of nested (shallow and deep) bores WAM1, WAM2, WAM3 and WAM4 was completed monthly by JDA from October 2004 to September 2006 (JDA, 2007). Samples were analysed for physical parameters and nutrients. Groundwater quality results including time series plots are attached as Appendix D.

ANZECC 95% guideline values for wetlands of south west Australia (ANZECC, 2000) have been used for water quality parameter comparison where no local reference data is available. The Peel Harvey Water Quality Improvement Plan (Peel Harvey WQIP) (EPA, 2008) total phosphorus targets for the rivers and estuary of the Peel-Harvey System have been used in preference to ANZECC 2000 guideline values.

A summary of the monitoring results are as follows:

- Average Total Nitrogen (TN) concentrations for all bores were above the ANZECC 2000 TN guideline of 1.2 mg/L with the exception of WAM3(d).
- Average Total Phosphorus (TP) concentrations varied between bores. WAM3(d), WAM4(s) and WAM4(d) were above the Peel-Harvey WQIP TP target value of 0.1 mg/L.
- The pH is slightly acidic to neutral (4.5 to 7.1) and below ANZECC guideline values.

The Study Area is characterised by high nutrient concentrations and pH levels generally less than 6.0. Groundwater quality at the water table, within the Bassendean Sand, is generally acidic due to organic acids generated by decomposition of vegetation in swampy environments. High nitrate and phosphorous levels are present in the superficial aquifer in areas of intensive horticulture as a direct result of fertiliser leaching (Davidson, 1995).

4.9.2 Leederville Aquifer

The Leederville Aquifer is of Cretaceous age and consists of interbedded sandstone, siltstone and shales made up by the Mariginiup, Wanneroo and Pinjar members and the Henley Sandstone Formation. The Leederville Aquifer is a major regional aquifer from which large yields of fresh groundwater can be obtained. The groundwater in the Leederville Formation is confined with the potentiometric surface in this area at approximately ground level (Davidson, 1995).

The South Perth Shale is present from -260 to -310m AHD and forms the confining layer between the Leederville Aquifer and Yarragadee Aquifer.

4.9.3 Groundwater Resources for Irrigation

The Superficial Aquifer is the most cost effective groundwater source for irrigation of POS for the development of the Study Area.

The Study Area is located within the Jandakot Groundwater Area, Mandogalup Groundwater Sub-area. As of 3 June 2014 DoW reported 1,626,265 kL/yr available for allocation.

Through discussions with Department of Water, a Form 3G will be submitted to amend Honeywood GWL169930(3) (see Appendix E) requesting a further 76,650 kL/yr for construction, POS irrigation and school grounds.

5. LOCAL WATER MANAGEMENT STRATEGY

5.1 Water Balance

The water balance of the Study Area will be influenced by the frequency and intensity of rainfall and evapotranspiration. As the most reliable estimates of rainfall, evaporation, transpiration and recharge are at a regional scale, for the purpose of this water balance assessment, average annual values have been assumed and the site has been considered as a whole.

Pre-development Water Balance

For the pre-development water balance assumptions are as follows;

- Rainfall based on the long term annual average for Medina Research Station of 760 mm.
- Recharge is 20% of rainfall as estimated by Davidson and Yu (2008).
- The balance of inputs is discharged as surface runoff to the Peel Main Drain.

Post-development Water Balance

Assumptions for the post-development water balance are as follows;

- Water supply for all POS irrigation will be met by local groundwater supplies. Irrigation rate of 7,500 kL/ha/yr is assumed consistent with DoW allocation.
- 10% of landowners assumed to have a private bore for irrigation supply.
- Recharge is maintained at the pre-development volume.
- Surface runoff assumed to infiltrate into the minor drainage network to be discharged via subsoil drainage.
- The balance of inputs will be discharged via subsoil drainage.

Results of the water balance are presented in Table 4.

TABLE 4: STUDY AREA WATER BALANCE

Pre Development		Use	Area (ha)	Quantity mm/yr		Total kl/yr	% (Approx)
Inputs	**Rainfall**		42.67	760		324,292	100
					Input total	324,292	
Outputs							
	Evapotranspiration	*Bush*	22.50	400		90,000	27
		Cleared Pasture	20.17	600		121,020	38
	Superficial aquifer recharge					64,858	20
	Surface Runoff					48,414	15
					Output total	324,292	100
					Balance	0	
Post Development		**Use**	**Area (ha)**	**Quantity mm/yr**		**Total kl/yr**	
Inputs	**Rainfall**		42.67	760		324,292	87
	Water supply						
	Groundwater abstraction	*POS*	4.25			31,875	8
		Domestic	0.90			6,750	2
		School ground	1.30			9,750	3
					Input total	372,667	100
Outputs							
	Evapotranspiration	*Urban (Domestic gardens)*	9.06	1,200		108,720	28
		Parks and Streetscapes	4.25	1,200		51,000	13
		School Oval	1.10	1,200		13,200	3
	Superficial aquifer recharge					64,858	17
	Surface Runoff					0	0
	Subsoil Discharge					146,517	38
					Output total	384,295	100
					Balance	0	

5.2 Water Sustainability Initiatives

5.2.1 Water Supply

Public Open Spaces

Considering the fit for purpose strategy, the water supply for the public open spaces is proposed to be from local groundwater resources.

Residential Lots

Water supply to households is to be via extension of the scheme water system. The project civil engineer will negotiate the extension of the system with Water Corporation.

5.2.2 Water Efficiency Measures

Public Open Spaces

Groundwater licence GWL169930(3) has been reissued and increased to 236,650 kL to provide construction water (28,729 kl/yr) irrigation of POS areas (80,345kL/yr) and streetscapes (10,926 kL/yr) for the development. This will be sourced from the unconfined groundwater reserves consistent with a fit for purpose strategy. The groundwater licence has been included as Appendix E.

Landscaped Public Open Space areas are to be at least 50% native plants, with water wise irrigation system design.

Residential Lots

To achieve water efficiency targets, households are to be built consistent with current Building Code of Australia (BCA) water efficiency standards.

5.3 Wetland Management

The following key measures will be implemented to ensure the wetlands and watercourses to the south and east of the site, including Mandogalup Swamp, will not be negatively impacted by urban runoff;

- All stormwater and groundwater discharge from the estate will be treated prior to discharging to the Peel Main Drain (Refer Section 4.6).
- Peak outflows will be consistent with pre-development flow rates.

5.4 District Stormwater Management

5.4.1 District Drainage

The alignment of the Peel Main Drain will be preserved through the Study Area. It is proposed to redefine the Drain to an urban standard, which will require re-grading of the batters to more gentle grades so the Drain can be incorporated into POS areas without boundary fencing. The final drain profile will achieve sufficient hydraulic capacity to convey the post-development 100 yr ARI flow, as specified in the Jandakot DWMP, within the drain and maintain the current Drain easement width of 20 m.

The Drain's final urban form will be similar to the recently modified drain in Honeywood Estate, east of the Kwinana freeway, which utilises 1:3 (v:h) and 1:6 batter slopes while maintaining existing inverts (Figure 7). The maintenance requirements and responsibilities will be similar to Honeywood Estate. Satterley is consulting with Water Corporation for approval of the Drain's design including re-profilling and landscape treatment.

The proposed Drain long-section, and cross section of the deepest part, is provided in Figures 7 and 8. Levels presented for both pre and post-development scenarios differ from those shown in the DWMP (DoW, 2009) because the Peel Main Drain invert information provided in the DWMP is incorrect, and a drain survey completed by McMullen Nolan (2009) has been used in JDA's modelling.

Mandogalup Swamp

The Mandogalup Swamp is located outside of the MELSP, but within the Mandogalup cell. The Swamp is within the DWMS Study Area (Figure 4) and is classed as a highly modified wetland currently used for market gardens. The DWMP identifies Mandogalup Swamp as a regional flood storage area, reducing peak flows to Spectacles Wetland.

The DWMP assessed four scenarios for post-development land use and associated changes with the Swamp. Based on the magnitude of impact of the removal of the Swamp, the Department of Water and

City of Kwinana agreed that the Mandogalup Swamp can be developed in line with Scenario 3, i.e. Mandogalup Swamp North is partially retained – only the power line and pipeline corridors remain undeveloped. Adoption of Scenario 3 allows for an increase in discharge from pre-development flows and a reduction in storage volume in Mandogalup Swamp (Figure 4).

The water level and volume in Mandogalup Swamp North for 100 year ARI storm event with pre- and post- development land use for Scenario 3 is summarised in Table 5.

TABLE 5: WATER LEVEL AND VOLUME IN MANDOGALUP SWAMP NORTH

	Water Level, mAHD		Storage volume in Mandogalup Swamp (m^3)	Discharge at Mandogalup Road (m^3/s)
	Mandogalup Swamp North	Spectacles Wetland North		
Pre- Development Scenario	13.5	9.4	85,900	1.5
Post-development scenario 3, (swamp partially retained – power line and pipeline	13.7	9.6	68,700	2.0

5.5 Local Stormwater Management

The local stormwater drainage system will be designed using a major/minor approach. The major drainage system is defined as the arrangement of roads, drainage reserves, detention basins and open space planned to provide safe passage of stormwater runoff from major events which exceed the capacity of the minor system, typically greater than 5 yr ARI. The major drainage system is described below with the key elements of the drainage system shown in Figures 10 and 11.

The minor drainage system is defined as a series of porous verges, rain gardens and gutters etc. designed to carry runoff generated by frequent storms, typically less than 5 yr ARI. The minor drainage incorporates a treatment train of best management practice (BMP) controls such as pocket gardens, linear rain gardens and rebated lot rain gardens that provide water quality treatment from the proposed development.

5.5.1 Minor Drainage

To meet the design criteria for the minor drainage system, the following strategies are proposed;

- All lots to have soakwells to infiltrate the 1yr 1hr rainfall event.
- Soakwells to be interconnected, with overflow directed towards the road drainage system.
- Approximately 10% of lot area (driveways, hardstand areas etc) is expected to contribute to the road drainage system in events up to the 5yr ARI.
- The road drainage system consists of porous verges with runoff entering the verge via a flush beam and slotted kerb. Porous verges will consist of porous gardens, pocket gardens or porous pavement. Runoff not infiltrated in the porous verges will discharge overland, towards rebated lot rain gardens. A preliminary landscaping cross-section representing porous verges is attached as Appendix F with engineering road cross-sections attached as Appendix G.
- Retention storages (pocket gardens, linear rain gardens and rebated lot rain gardens) are located throughout the development to increase infiltration higher in the catchment, sized to contain the critical 5yr ARI. Preliminary landscaping cross-sections representing linear rain gardens and rebated lot rain gardens are attached as Appendix F, with engineering road cross-sections attached

as Appendix G. The typical dimensions of a pocket garden detail will be similar to a linear rain garden.

- No pit and pipe system is proposed. Water conveyance as per Figure 10.
- In events above the 5yr ARI, the retention storages are assumed to be full, with excess stormwater runoff bypassing the structures and discharging to the major detention storages via overland flow. The detention storages will be located in the catchment low point within the POS.

The key design criteria for the porous verges and retention storages are as follows:

- Porous gardens and pavement to be located between driveways (Appendices F and G).
- Priority verges are porous gardens that are irrigated.
- Pocket gardens to be located within widened verges and road truncations.
- Linear rain gardens are uninterrupted verge gardens located along non-active lot frontages and POS, underlain with at least 250mm of amended soil media (Appendices F and G).
- Rebated lot rain gardens located between residential lots, underlain with at least 250mm of amended soil media (Appendices F and G).

TABLE 6: MINOR DRAINAGE TREATMENT TRAIN

	Type		
	Pocket Gardens	**Linear Garden**	**Rebated Lot**
Typical Width (m)	4.1	4.1	250
Typical Area (m^2)	Variable	Variable	
Typical Depth (m)	0.20	0.20	0.30
Amended Soil	No	Yes	Yes
Minimum Hydraulic Conductivity (m/day)	5	5	5
Minimum depth to estimated post-development groundwater level (m)	1.0	1.0	1.0

Indicative landscape concepts of the various treatment structures are attached as Appendix F, with engineering drawings attached as Appendix G. XP-STORM modelling results are shown in Figures 11 to 16 for the critical 5yr ARI and 100yr ARI.

The design strategy is consistent with the objectives provided in the DWMS (JDA, 2011).

5.5.2 Major Drainage

The major drainage system is designed to manage rainfall events greater than the 5 yr ARI, up to the 100 yr ARI.

Key points of the major drainage system strategy are as follows:

- In major storm events the minor drainage structures will be full with excess stormwater bypassing the minor drainage structures and discharging to the major detention storage basin. The basin is located in the lowest point of the catchment.
- Discharge rates from POS detention basins B to F controlled to pre-development flow rates.
- All lot finished levels will have a minimum 0.5 m clearance above the estimated 100yr ARI flood level of the detention storages.

- Storage areas to have a minimum separation of 0.5 m between maximum or controlled groundwater levels and a maximum side slope of 1:6 (v:h).
- Catchment A utilises infiltration to dispose of stormwater. Modelling parameters are provided in Appendix H. An infiltration rate of 5 m/day has been used based on JDA interpretation of geotechnical results. No coffee rock was reported in this area in the geotechnical investigation (Golders, 2008).

The design strategy is consistent with the objectives provided in the DWMS (JDA, 2011).

Indicative landscape concepts of the POS stormwater basins are attached as Appendix G. XP-STORM modelling results are shown in Figures 11 to 16 for the critical 5yr ARI and 100yr ARI.

Porous Verge Flow Velocity and Scour Management

In minor stormwater events rainfall will sheet off the road pavement into the porous verges and retention storages where it will be infiltrated. In rainfall events above the 5yr ARI the verges will be filled to design depth and excess runoff will preferentially flow along the edge of the road pavement. A connection under the driveway will allow some flow along the verge at a controlled rate.

The minimum flow velocity to mobilise and erode sand is 0.5 m/s (hjulstrom diagram). To prevent scour within the minor drainage structures the verge connections under the driveways will be designed to convey a flow velocity of ≤0.5 m/s.

High velocities will occur along the edge of the road pavement where stormwater is bypassing verges, consistent with a traditional drainage system.

5.5.3 Surface Water Modelling

The XP-STORM model was used to estimate POS basins and minor drainage structures for the Study Area. MODRET was used to calibrate the Catchment A POS retention basin and the Minor drainage linear and rebated lot infiltration parameters, which were entered into the XP-STORM model. MODRET results for Catchment A POS detention storage, linear rain gardens and rebated lot rain gardens are attached in Appendix H.

POS detention storage locations were modelled based on existing topographic contours, survey levels, depth to groundwater and local structure plan constraints (Figure 11). Storage elevations have been assumed at least 0.5 m above the controlled groundwater levels. Existing drain inverts were maintained as per Section 4.4.1.

The design storms modelled were according to the methodology in Australian Rainfall & Runoff (AR&R) (Institution of Engineers Australia, 1987). The rainfall temporal pattern was assumed to be spatially uniform across the catchment with storm durations from 10 minutes to 72 hours.

Allowable Flow Rates

The Study Area is located within sub-catchments CAT19, CAT17A and CAT17B of the DWMP (DoW, 2009), as shown on Figure 9. The peak 100yr ARI allowable flow rates from the Study Area were calculated pro-rata from the peak flows listed in the DWMS (JDA, 2011) and presented in Table 7. The pro rata rate of 0.117 m^3/s will be used to calculate the peak discharge rates for the post-development catchments.

TABLE 7: PEAK 100YR ARI ALLOWABLE OUTFLOW RATES

Catchment	DWMS Catchment Area (ha)	DWMS Peak Allowable Outflow (m^3/s)	Area within LWMS (ha)	LWMS Prorata Allowable Outflow (m^3/s)
CAT19	97.4	0.10	26.20	0.027
CAT17A	85.2	0.16	18.10	0.034
Total	**182.6**	**0.26**	**44.20**	**0.061**

Flow rates presented in Table 8 are based on the total allowable outflow of 0.061m^3/s as described in Section 3.6.3 and shown on Figure 9.

TABLE 8: LWMS CATCHMENTS AND ALLOWABLE OUTFLOW RATES

LWMS Catchments	Area (ha)	Allowable 100yr ARI flow (m^3/s)
A[1]	6.00	0.008
B	9.95	0.014
C	7.30	0.010
D	1.60	0.002
E	9.30	0.013
F	10.05	0.014
Total	**44.20**	**0.061**

Note: 1 – Catchment A utilises infiltration to dispose of stormwater

Catchment Runoff Parameters

Runoff coefficients applied for various land uses are presented in Table 9 with land use areas presented in Table 10.

Residential lot continuing losses are based on field measurements of soakwell infiltration (JDA, 2015) with calculations provided in Appendix I. Road continuing loss was calibrated using MODRET and is based on a 100m length of road with porous verges (Appendix I).

TABLE 9: RUNOFF PARAMETERS FOR XP-STORM MODEL

Land Use	Runoff Coefficient	Initial Loss (mm)	Continuing Loss (mm/hr)
Standard Lots (> 350m2)	-	13	7.0
Compact Lots (< 350m2)	-	13	7.0
Road	-	-	15.0
DBNGP Easement	0.1	-	-
Public Open Space	0.1	-	-
School	0.5	-	-

TABLE 10: POST-DEVELOPMENT LWMS CATCHMENT LAND USE BREAKDOWN

Land Use (ha)	A	B	C	D	E	F	Total
Standard Lots (> 350m^2)	2.15	2.65	1.75	0.55	3.70	3.20	**14.00**
Compact Lots (≤ 350m^2)	1.40	1.00	1.85	0.35	1.85	1.65	**8.10**
Rain Garden	0.15	0.12	0.13	0.00	0.15	0.20	**0.75**
Road	2.05	2.33	2.17	0.55	2.75	3.75	**13.60**
DBNGP Easement	0.00	0.00	0.00	0.00	0.00	1.05	**1.05**
POS	0.25	2.35	0.45	0.15	0.85	0.20	**4.25**
Peel Main Drain	0.00	0.00	0.95	0.00	0.00	0.00	**0.95**
School	0.00	1.50	0.00	0.00	0.00	0.00	**1.50**
Total Area (ha)	**6.00**	**9.95**	**7.30**	**1.60**	**9.30**	**10.05**	**44.20**

XP-STORM modelling results are shown in Figures 11 to 16 for the critical 5yr ARI and 100yr ARI.

Catchments E and F storage basins will be located within the 1.5 km buffer in urban deferred land. Final landscaping treatment of the basins is subject to further discussions with the City.

5.6 Groundwater Management

Groundwater Management for the Study Area has been prepared in line with design criteria presented in the Mandogalup DWMS (JDA, 2011) and the Stormwater Management Manual for Western Australia (DoW, 2007).

The objectives are to:

- Subsoils will discharge treated stormwater directly into the Peel Main Drain. No treatment of subsoils are proposed.
- Manage groundwater levels to protect infrastructure and assets.
- Maintain groundwater regimes for the protection of groundwater-dependent ecosystems.
- Protect the value of groundwater resources.
- Adopt nutrient load reduction design objectives for discharges to groundwater.

5.6.1 Managing Changes to Groundwater Levels

To protect infrastructure from high seasonal groundwater levels, the groundwater design level has been set at AAMGL, as described in Section 4.8.1 (Figure 6).

The UWMP will assess a post-development groundwater level and subsoils will be installed where required to ensure sufficient clearance to lot finished levels and operation of minor drainage system.

Based on the depth to groundwater levels (Figure 6), the majority of the Study Area south of the Peel Main Drain is expected to require subsoils to control groundwater levels.

Water table mounding will occur between subsoil drain inverts and will be allowed for in detailed design.

5.7 Water Quality Management

5.7.1 Nutrient Source Controls

The effective implementation of the structural and non-structural controls as part of the urban development will enhance water quality from the Study Area as a result of the land use change.

Non-structural source controls to reduce nutrient export from the Study Area will focus on reducing the need for nutrient inputs into the landscape. The following strategies are proposed;

- Local native plants make up a minimum 50% of the planted areas and streetscape treatments. Any non-local species will be selected for drought tolerance and low fertiliser requirements.
- Street sweeping. The UWMP will outline the schedule and cleaning requirements for street sweeping, which will be co-ordinated with the City of Kwinana.

Structural source controls are proposed to compliment the non-structural source controls and provide a complete treatment train for stormwater movement through the development. The following structural controls are considered appropriate for the development area;

- Porous verges: Consisting of porous gardens, pocket gardens or porous pavement located within the road reserve between driveways. Porous verges are not irrigated and will not be underlain with amended soil media.
- Priority verges: Consisting of porous gardens and pocket gardens located within the road reserve between driveways. Priority verges will be irrigated but won't be underlain with amended soil media.
- Linear rain gardens and rebated lot rain gardens: consisting of irrigated rain gardens underlain with a minimum of 250mm of amended soil media.

The minimum specifications for linear and rebated lot rain gardens are presented in Table 11.

TABLE 11: MINIMUM SPECIFICATIONS FOR RAIN GARDENS

Item	Specification
Amended soil media	• Minimum 500 mm thick. • Hydraulic Conductivity (sat) 3 m/day. • PRI >10 • Light compaction only. • Infiltration testing of material prior to installation and again once construction is complete. On-going testing as per the monitoring program.
Plant selection	• Tolerant of periodic inundation and extended dry periods. • Preferential selection of endemic and local native species.

The rain garden systems should be sized to function correctly with a K (saturated) of 3 m/day. Research conducted by the Facility for Advancing Water Biofiltration (FAWB, 2008) indicates that the desired K_{sat} is in the range of 2.5 to 7 m/day, to fulfil the drainage requirements as well as retain sufficient moisture to support the vegetation. The FAWB (2008) research also specifies that for vegetated systems some clogging will occur in the first few years until the vegetation is established. Once the plants are established, the roots and associated biological activity maintain the conductivity of the soil media over time.

Data currently guiding the design of bio-retention systems is largely based on laboratory testing. Details of plant selection, maintenance and likely nutrient uptake in the Mandogalup environment are not known at this stage. The specifications provided in this document are the best available information at the time. Some flexibility in the specifications will be required as the knowledge base increases.

5.7.2 Land Use Change Nutrient Impacts

JDA NiDSS model (Nutrient Input Decision Support System) has been used to help quantify the nutrient inputs for the pre-development and post-development scenarios. The NiDSS model analysis's inputs for Total Phosphorus and Total Nitrogen only.

The NiDSS analysis shows that the changes in land use from rural (pasture) to a built urban environment, without Water Sensitive Design (WSUD) measures, will result in an increase in th nutrient load on the catchment. This increase needs to be reduced using WSUD principles. With the implementation of the proposed structural and non-structural controls, a reduction of 44.9% for Phosphorus and 35.3% for Nitrogen is achieved compared to urban development without WSUD. The modelled post-development input rates of 13.8 kg/ha/yr for Phosphorus and 130.3 kg/ha/yr for Nitrogen are within the targets of the Peel Harvey WSUD Planning Policy which specifies input rates of 15 kg/ha/yr for Phosphorus and 150 kg/ha/yr for Nitrogen (EPA, 2006).

Modelling results are provided in Appendix J.

6. IMPLEMENTATION

6.1 Urban Water Management Plan (Subdivision)

Processes defined in Better Urban Water Management (WAPC, 2008) require an Urban Water Management Plan (UWMP) at subdivision stage. With an approved LWMS, a UWMP is required as a condition of subdivision and prior to any subdivision activities.

Further work that is identified for inclusion in the UWMP:

- Design of treatment structures, vegetated rain gardens and dry/ephemeral storages as outlined in the Stormwater Management Manual (DoW, 2007);
- Refine the final configuration (storage side slopes etc) and exact location of the flood detention storage areas dependent on final earthworks, drainage and road design levels for the development;
- Confirmation of subsoil location and levels; and
- Peel Main Drain works and maintenance responsibilities.
- Investigate the possibility of utilising road side rain gardens to allow groundwater recharge higher in the catchment.

6.2 Construction Management

6.2.1 Dewatering

Dewatering will be required for some elements of subdivision construction. Given the depth of construction, dewatering will only be in the Superficial Aquifer.

Prior to the commencement of any dewatering, the construction contractor will apply for and obtain from DoW a “Licence to Take Water”. All dewatering will be carried out in accordance with the conditions of this licence. Where possible, construction will be timed to minimise impacts on groundwater and any dewatering requirement.

6.2.2 Acid Sulphate Soils

Management of Acid Sulphate Soils (ASS) will be addressed as a separate process to the urban water management document approvals process (LWMS/UWMP).

ASS will be investigated and managed in accordance with the applicable DEC Acid Sulphate Soil Guideline Series and requirements of dewatering licences as they arise.

6.3 Stormwater System Operation and Maintenance

The operation and maintenance of the drainage system will initially be the responsibility of the developer, ultimately reverting to the local authority, City of Kwinana.

The surface and subsoil drainage system will require regular maintenance to ensure its efficient operation. The operating and maintenance practices required are attached as Appendix K. The minor drainage treatment train has removed the need for a road stormwater pipe network, increasing infiltration and treatment throughout the Study Area.

6.4 Monitoring Programme and Contingency Planning

A post-development monitoring program has been designed to allow a quantitative assessment of hydrological impacts of the proposed development.

This program is designed to operate over a 3 year period. The program will be periodically reviewed to ensure suitability and practicality. The program may need to be modified as data is collected to increase or decrease the monitoring effort in a particular area or alter the scope of the programme itself.

The post-development monitoring locations proposed are:

- Monitor groundwater levels for 3 (11, 13 and 15) pre-development groundwater sites for comparison to pre-development data (Figure 6).
- Measure groundwater quality at site WAM3.
- Measure peak outflow from Catchment C and PMD at the western boundary of the Study Area.

A summary of the proposed monitoring program and reporting schedule is shown in Table 12, with the frequency of water quality target review and the contingency action plan detailed in Table 13.

All sampling is to be conducted according to Australian Standards and all water quality sample testing will be conducted by a NATA approved laboratory.

TABLE 12: MONITORING SCHEDULE AND REPORTING

Monitoring Type	Location	Method	Frequency, Timing & Responsibility	Parameter	Reporting
Groundwater Level	3 monitoring sites (11, 13 and 15)	Electrical depth probe or similar	Quarterly for 3 years by Developer (Jan, April, July, Oct)	Water Level (m AHD)	Annual reports to be provided by the developer for a period of 3 years. Reports will be submitted to DoW/CoK within 3 months of completion of the reporting period.
Surface Water Quantity	Catchment C outlet to the PMD and the PMD on the western boundary of the Study Area	continuous logger	Downloaded 3 times per year	Stage (Flow inferred)	
Groundwater Quality	1 monitoring site (WAM3)	Pumped bore samples	Quarterly for 3 years by Developer (typically Jan, April, July, Oct)	In-situ: pH, EC, temp Lab: TN, TKN, NO_X, Ammonia, TP, FRP, selected metals	
Surface Water Quality	Catchment C outlet to the PMD and the PMD on the western boundary of the Study Area	Collected grab samples or rising stage sampler	3 times per year while flowing	In-situ: pH, EC, temp Lab: TN, TKN, NO_X, Ammonia, TP, FRP, selected metals, TSS	

TABLE 13: CONTINGENCY PLANNING

Monitoring Type	Criteria for Assessment	Criteria Assessment Frequency	Contingency Action
Groundwater Level	Groundwater levels not to exceed the estimated phreatic line by more than 300mm	After monitoring occasion	1. Review design and operation of subsoil and stormwater drainage system. 2. Perform maintenance as required.
Surface Water Quantity	Flow discharging from Study Area to be within peak flows established in the LWMS	Annual review of water quantity targets	1. Review design and operation of detention storage areas 2. Perform maintenance as required
Groundwater Quality	Nutrient concentrations in shallow bores should not exceed 20% of the maximum recorded pre-development level.	Annual review of water quality targets	1. Identify and remove any point sources. 2. Consider reinforcement of Community Education/Awareness program. 3. Review operational and maintenance (e.g. fertilising, cleaning) practices. 4. Consider alterations to POS areas including landscape regimes and soil amendment. 5. Consider modifications to the stormwater system. 6. Consider initiation of community based projects.
Surface Water Quality	Assess performance of vegetated detention storages in nutrient reduction. (Water quality discharging from the Study Area aims should not exceed 20% of the maximum recorded pre-development level.).		

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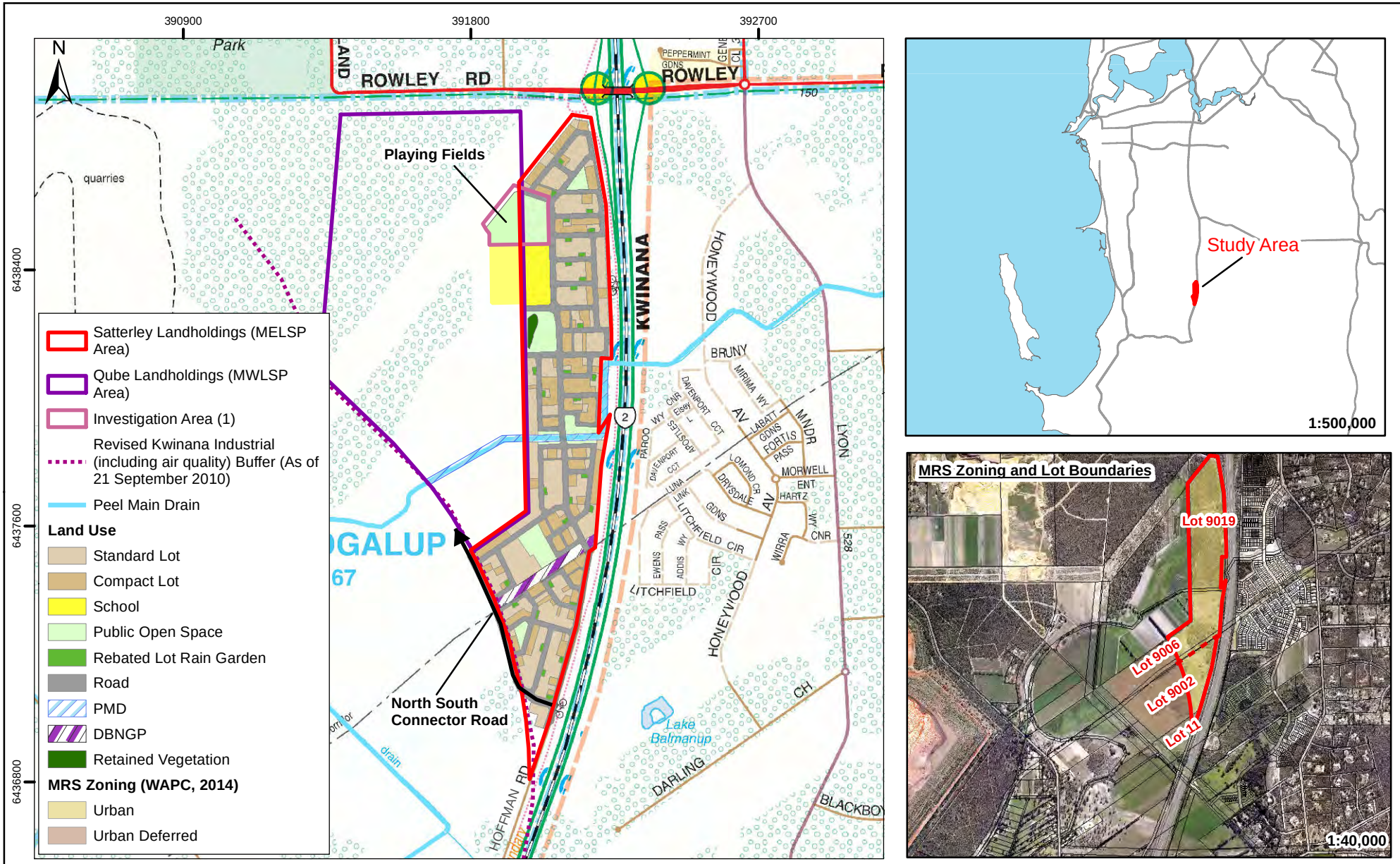
FIGURES



Data Source: Perth Main Roads (2010), Landgate (2012), Rowe Group (2016)

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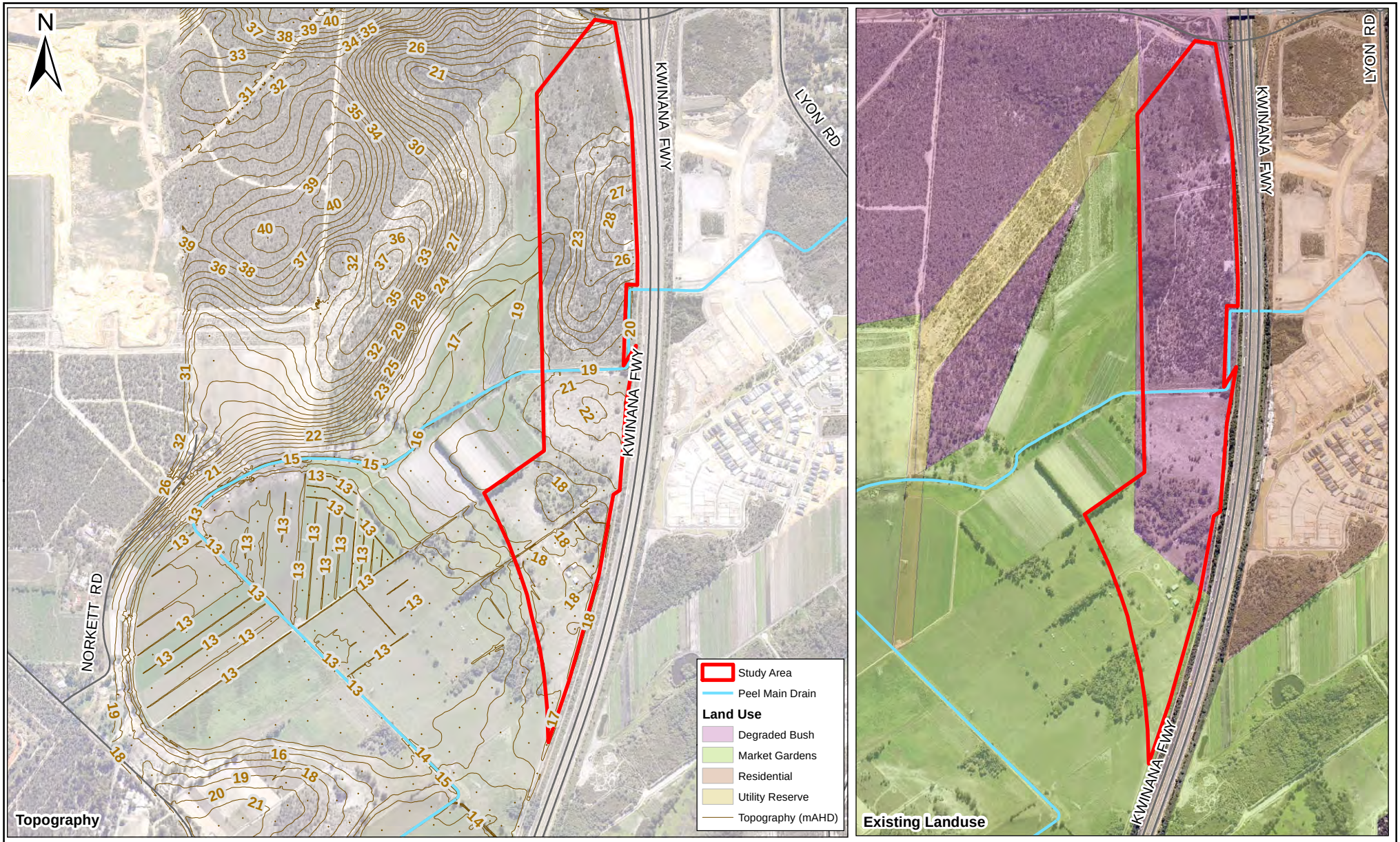
0 300 600 900 1,200 Metres

Satterley Property Group
Mandogalup East LWMS

Figure 1: Location and Structure Plan



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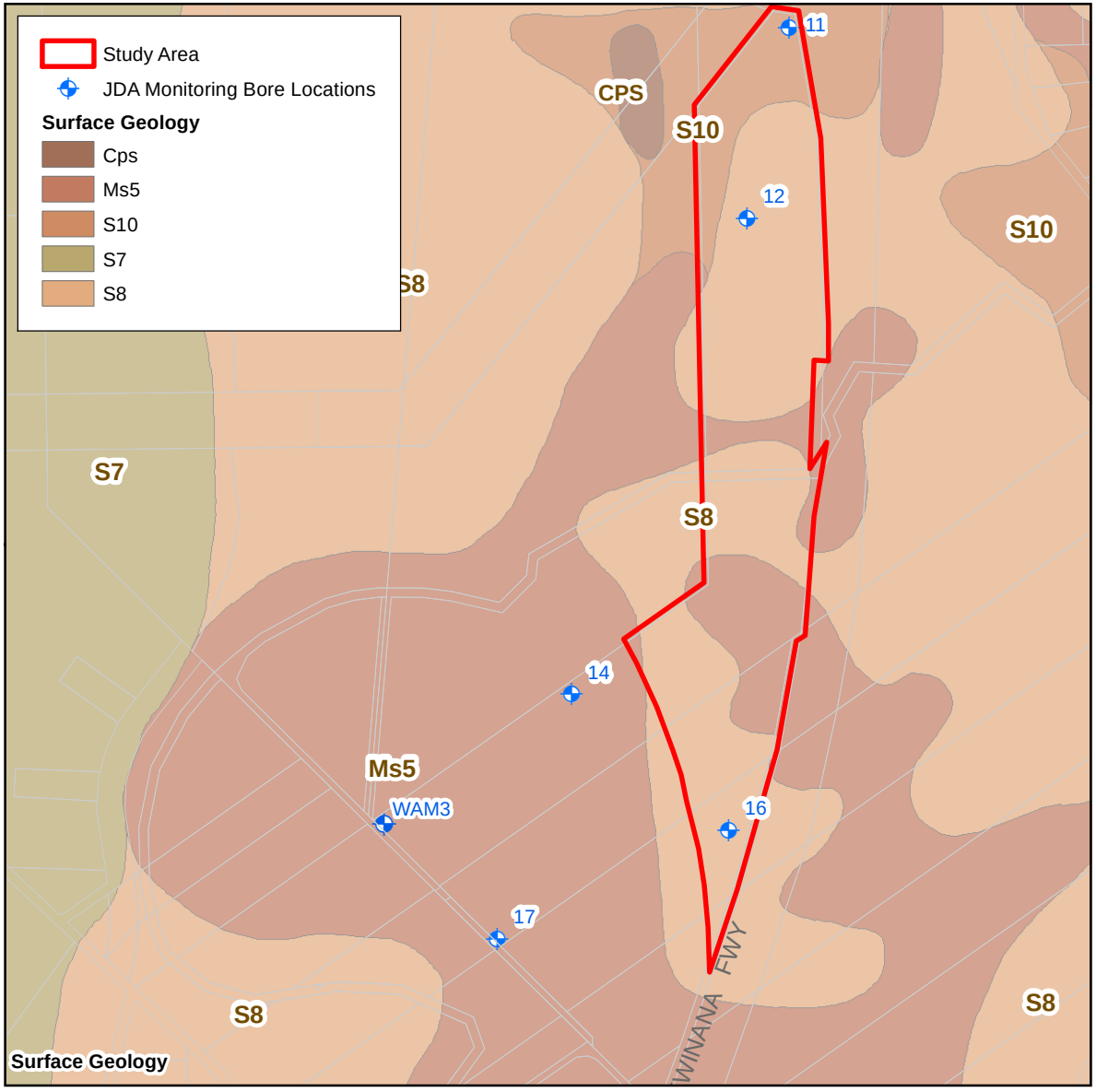
Satterley Property Group
Mandogalup East LWMS

Figure 2: Existing Land Use and Topography



Surface Geology

Cps:PEATY CLAY - dark grey and black, soft, variable organic content, some quartz and sand in places, of lacustrine origin.

Ms5: SANDY SILT - dark brownish grey silt, with disseminated fine grained quartz sand, firm, variable clay content, of lacustrine origin.

S7: SAND - pale yellowish brown, medium to coarse grained, sub angular quartz, trace of feldspar, moderately sorted, of residual origin.

S8: SAND - very light grey at surface, yellow at depth, fine to medium grained, sub-rounded quartz, moderately well sorted, of eolian origin as relatively thin veneer over C2, M4 and Mc2.

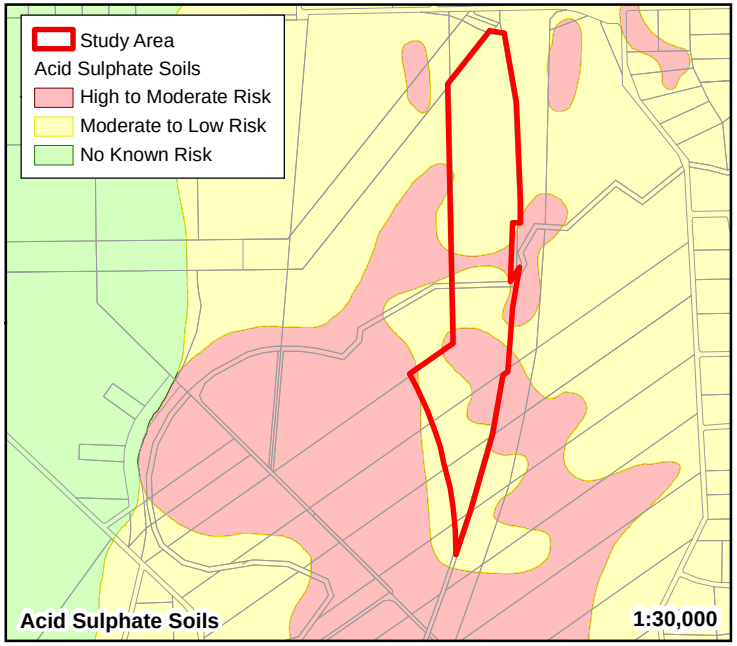
S10: SAND - as S8 relatively thin veneer over strong, blocky, brown silts and clays

ACID SULPHATE SOILS - RISK DEFINITIONS:

High to moderate risk of ASS occurring within 3m of natural soil surface:
ASS in these environments can be widespread or sporadic. They may be very close to the surface or buried by many metres of alluvium or windblown sand. Base sediments of estuaries, rivers, creeks and lakes are also considered areas of high risk of ASS occurrence.

Moderate to low risk of ASS occurring within 3m of natural soil surface:
Where environments have not generally been suitable for ASS formation or ASS are highly localised or sporadic, they have been classed as having a moderate to low risk of occurrence. Where ASS is present, it may be close to the surface or buried by many metres of alluvium or windblown sand. Most of these landforms are not expected to contain ASS.

No known risk of ASS occurring within 3m of natural soil surface (or deeper):
ASS are not known or expected to occur in these environments



Data Source: Gozzard (1983), DEC (2010)

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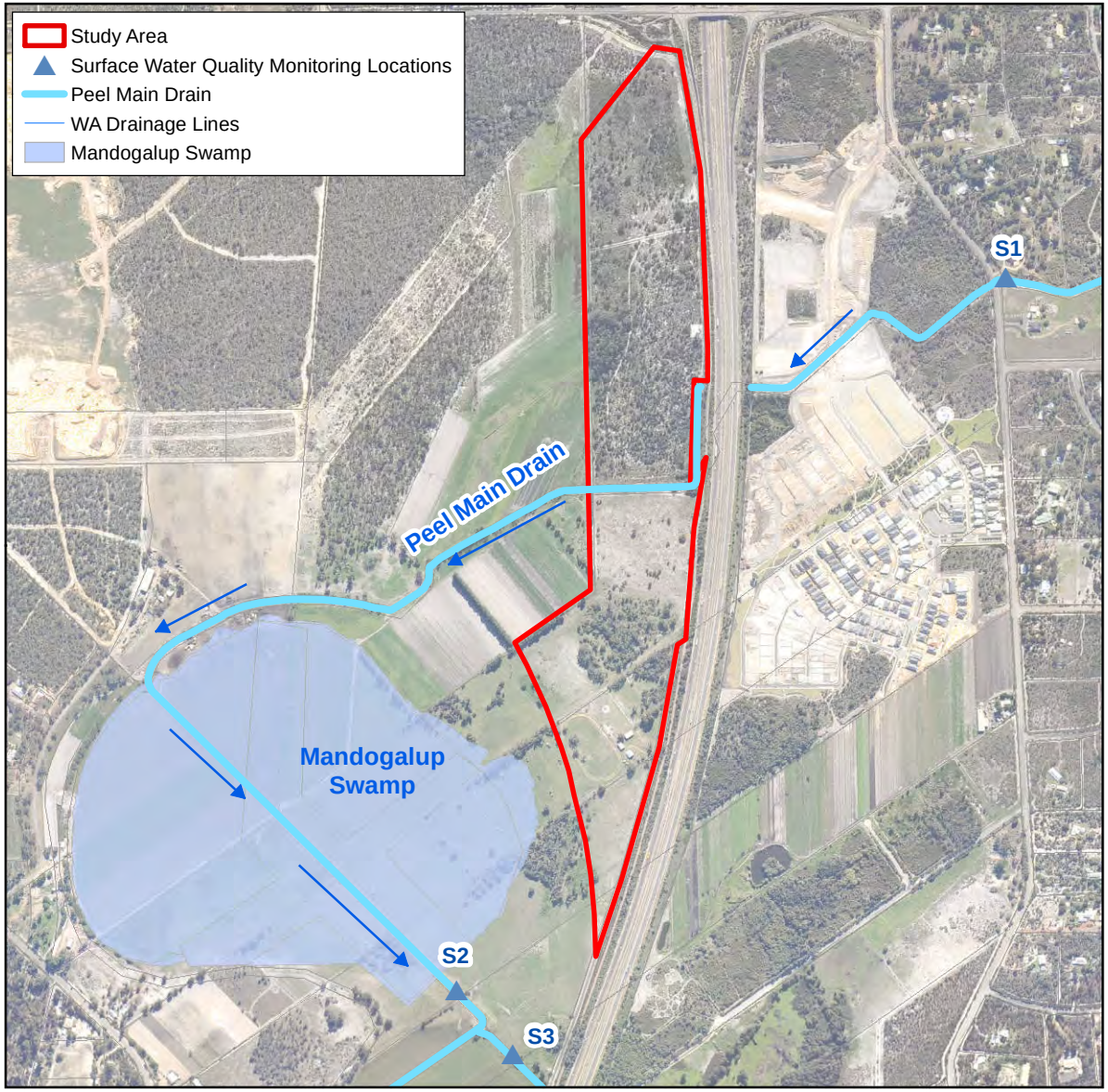
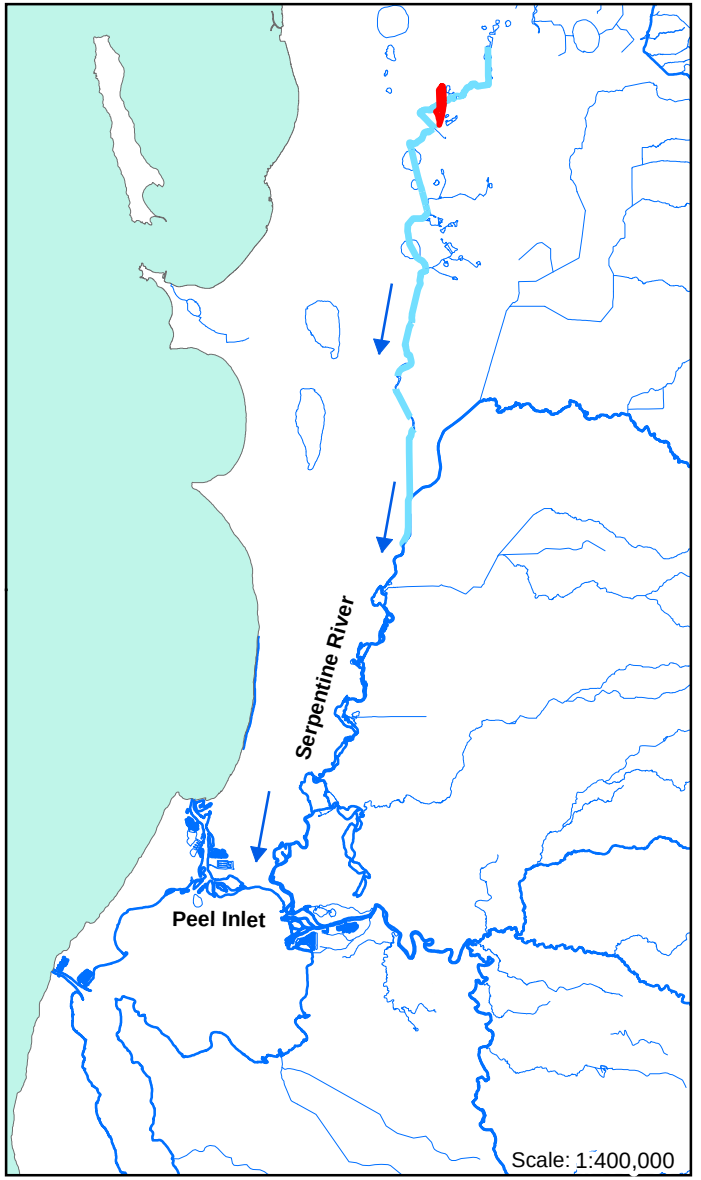
Satterley Property Group
Mandogalup East LWMS

Figure 3: Surface Geology and ASS





Data Source: Department of Water (2009)

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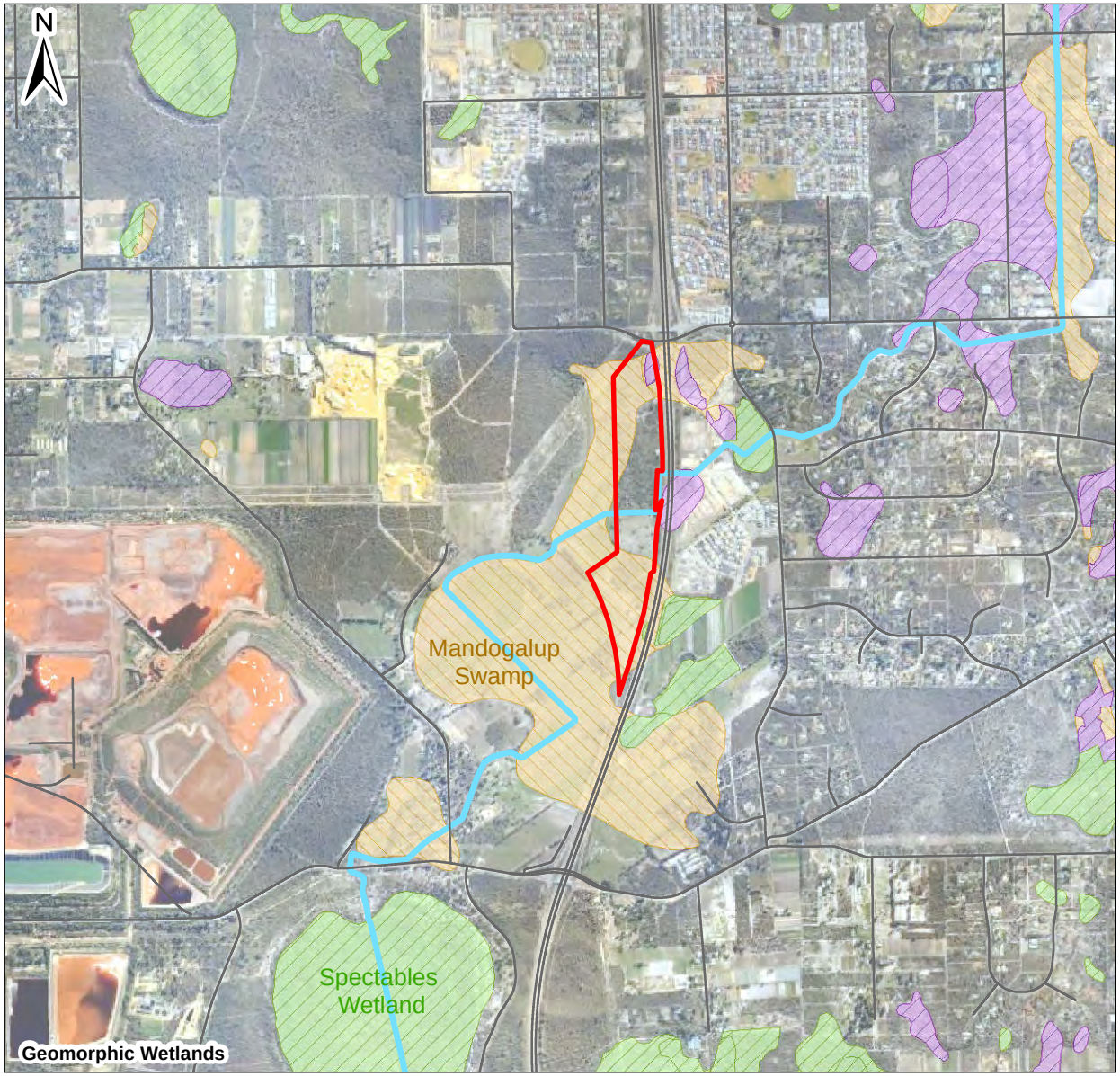
Satterley Property Group
Mandogalup East LWMS

Figure 4: Existing Surface Drainage



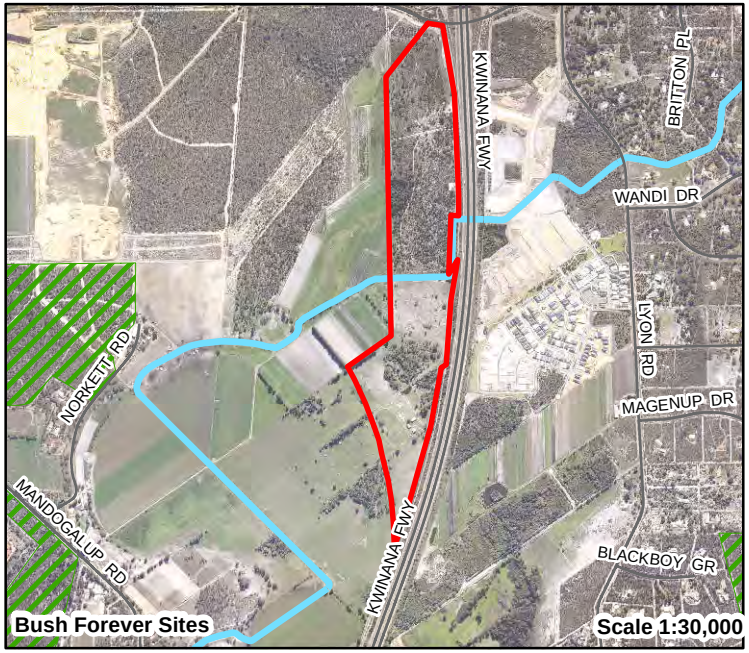
Study Area
Peel Main Drain

Geomorphic Wetlands (DEC, 2012)

Conservation Category Wetland (CCW)
Resource Enhancement Wetland (REW)
Multiple Use Dampland
Peel Main Drain
Bush Forever Sites

WETLAND DEFINITIONS:

Conservation Wetland:
Wetlands that support a high level of ecological attributes and functions.
Resource Enhancement Wetland:
Wetlands which may have been partially modified but still support substantial ecological attributes and functions.
Multiple Use Dampland:
Wetlands with few ecological attributes and functions remaining.



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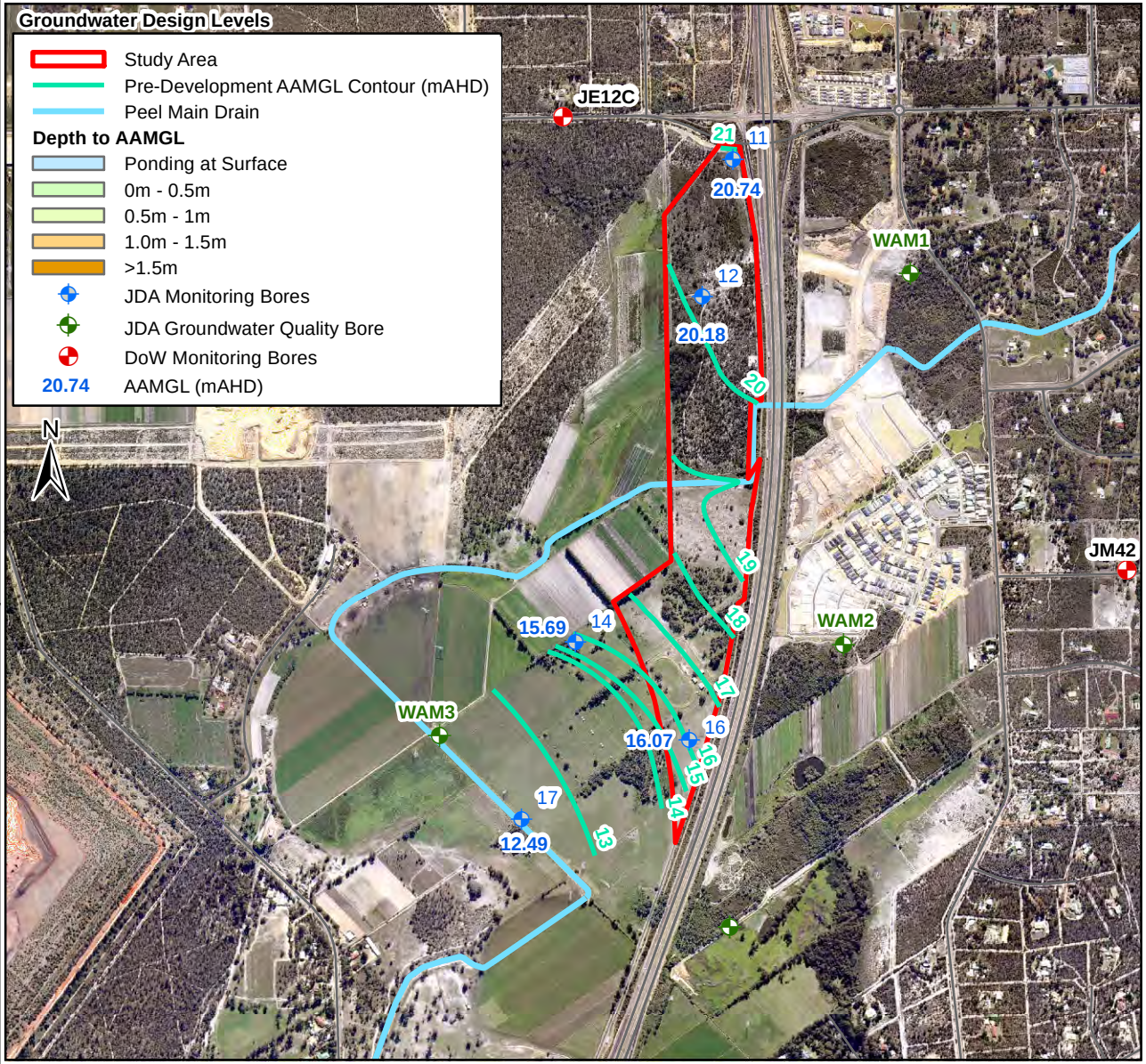
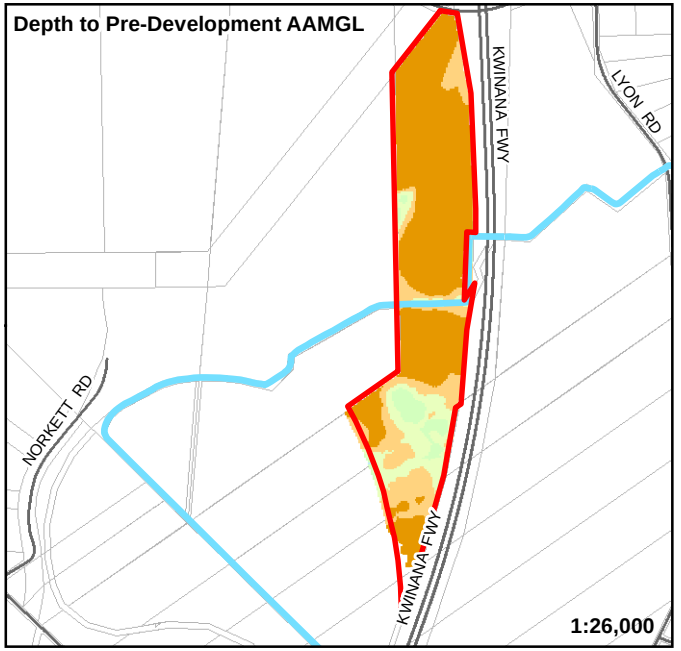
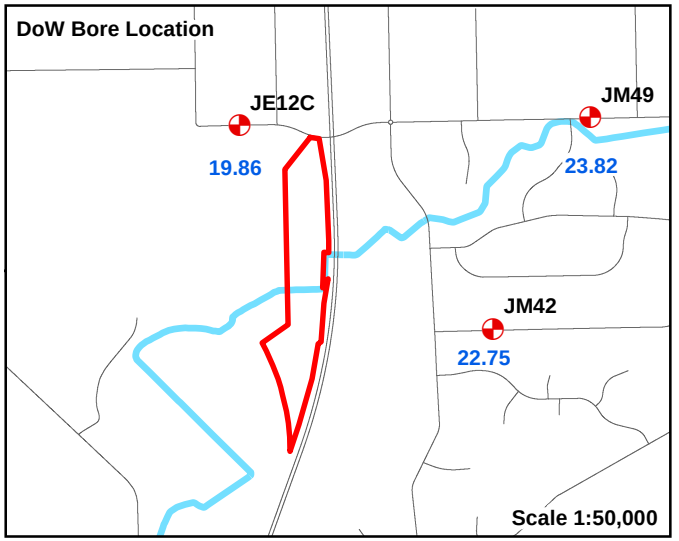
Satterley Property Group
Mandogalup East LWMS

Figure 5: Wetland Mapping







Note: JDA monitoring bore locations consist of both a shallow and deep bore

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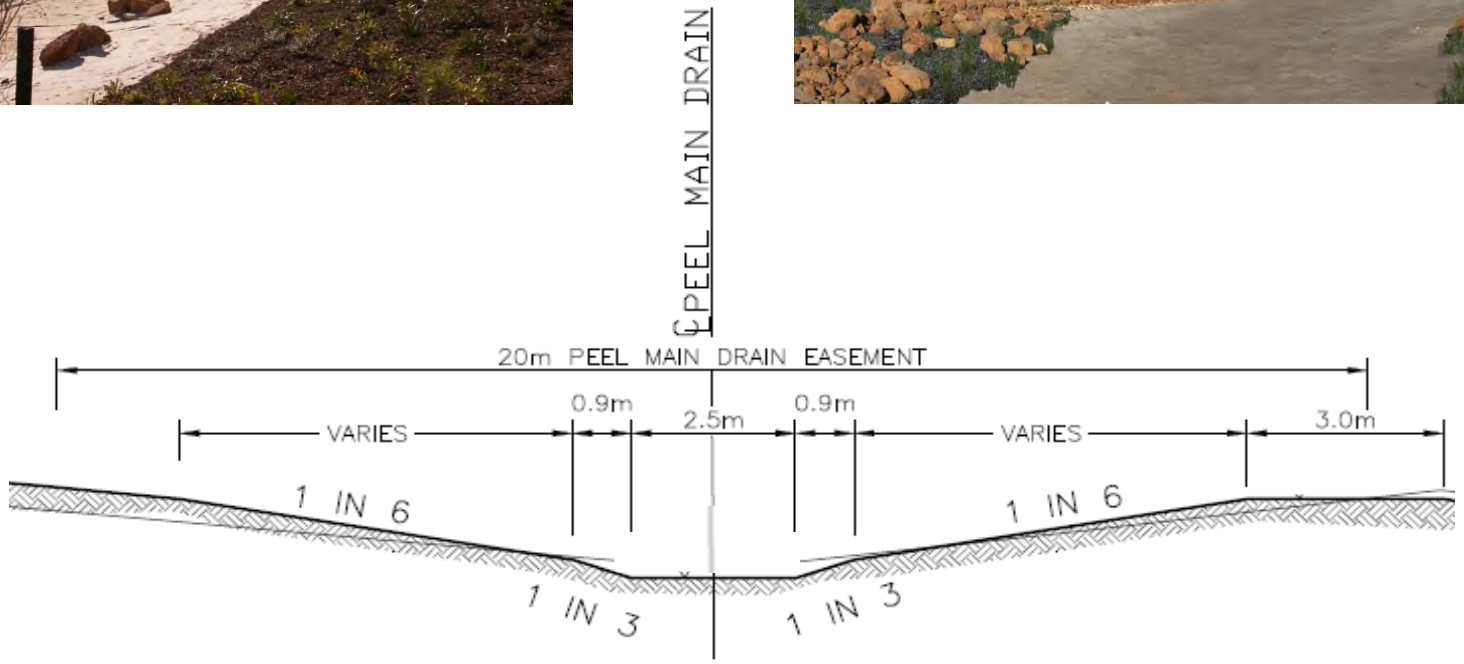
Satterley Property Group
Mandogalup East LWMS

Figure 6: Groundwater Levels



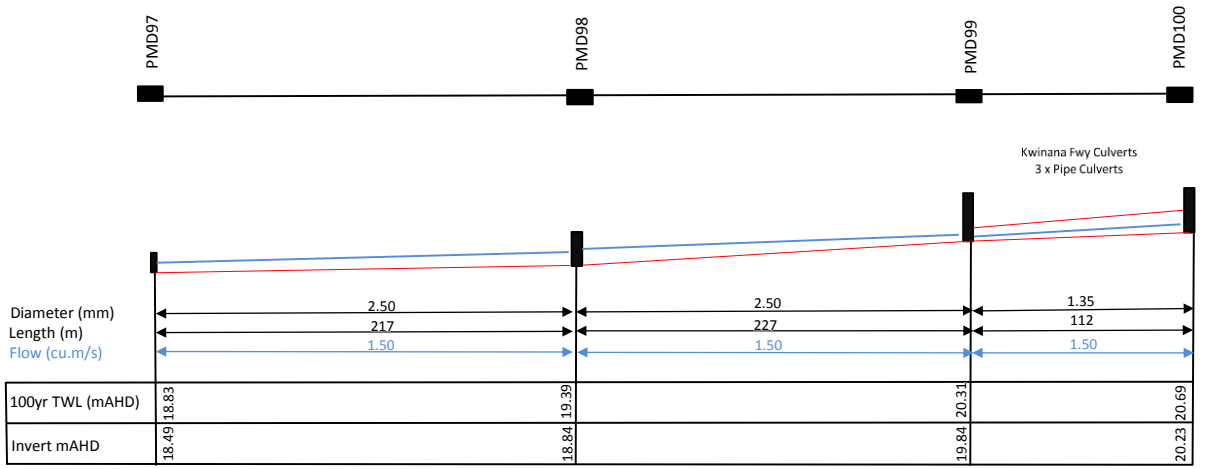
Data Source: BCA (2013), Emerge (2014)

Job No. J5483

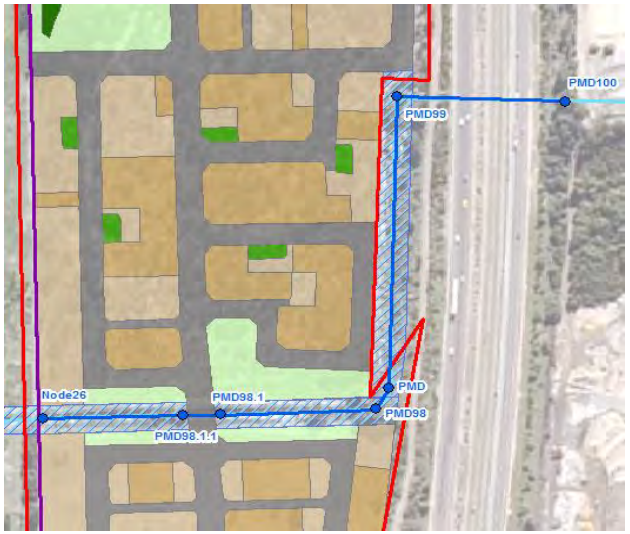
Satterley Property Group
Mandogalup East, LWMS

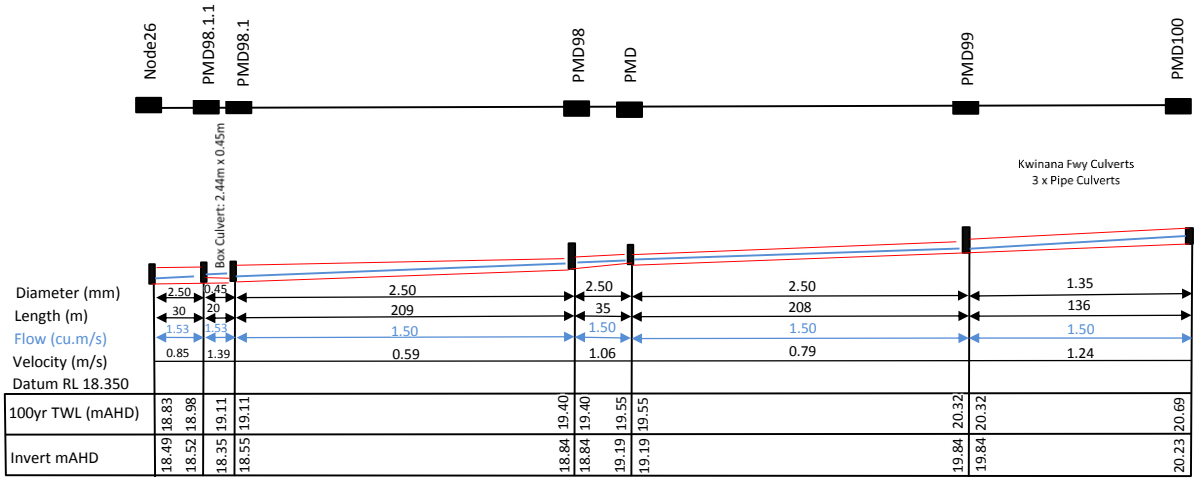
Figure 7: Peel Main Drain Concept

Pre-Development (DoW, 2009)



Post-Development

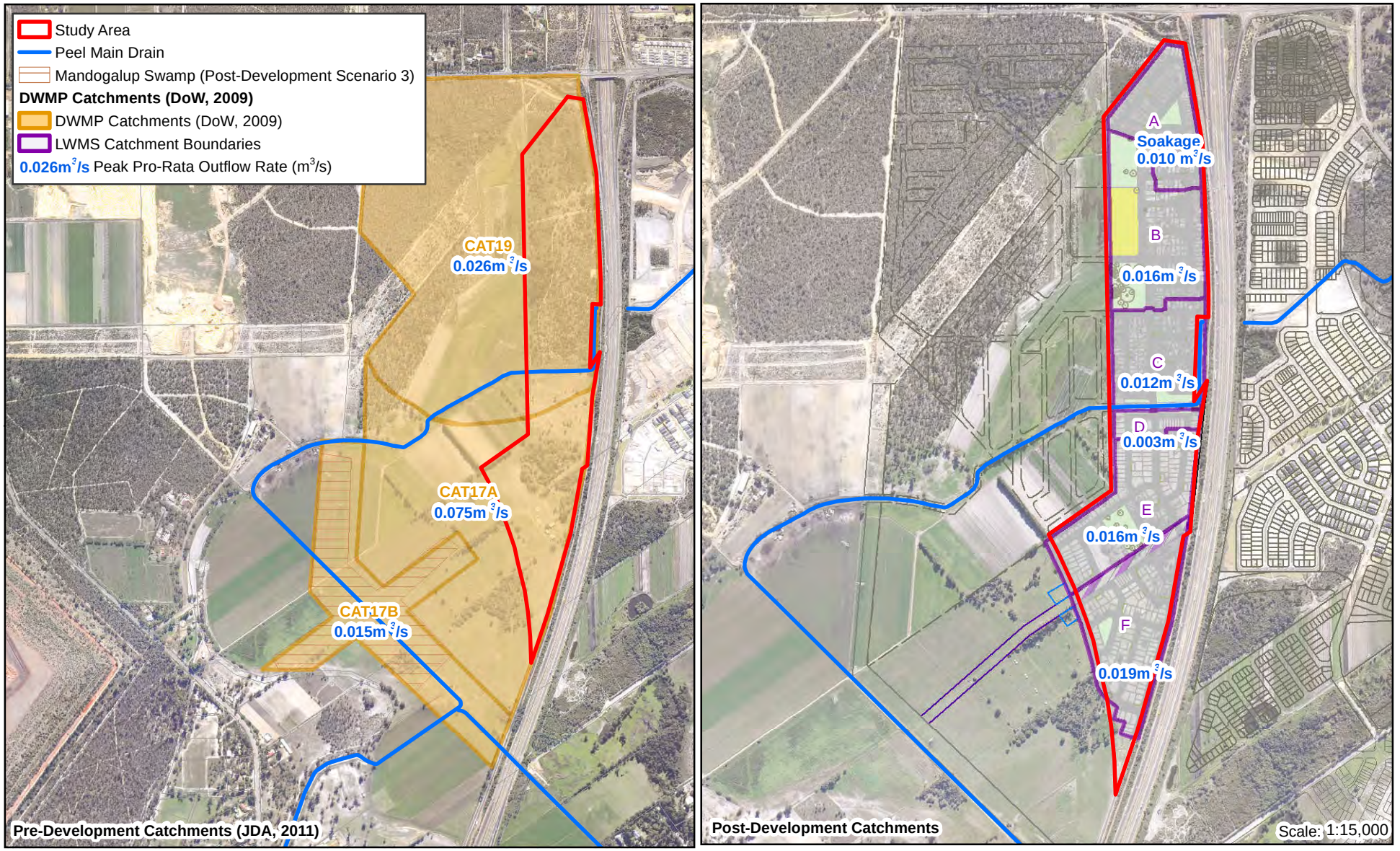




Job No. J5483

Satterley Property Group
Mandogalup East, LWMS

Figure 8: Proposed Peel Main Drain Long-Section Pre and Post Development: 100yr ARI Flow



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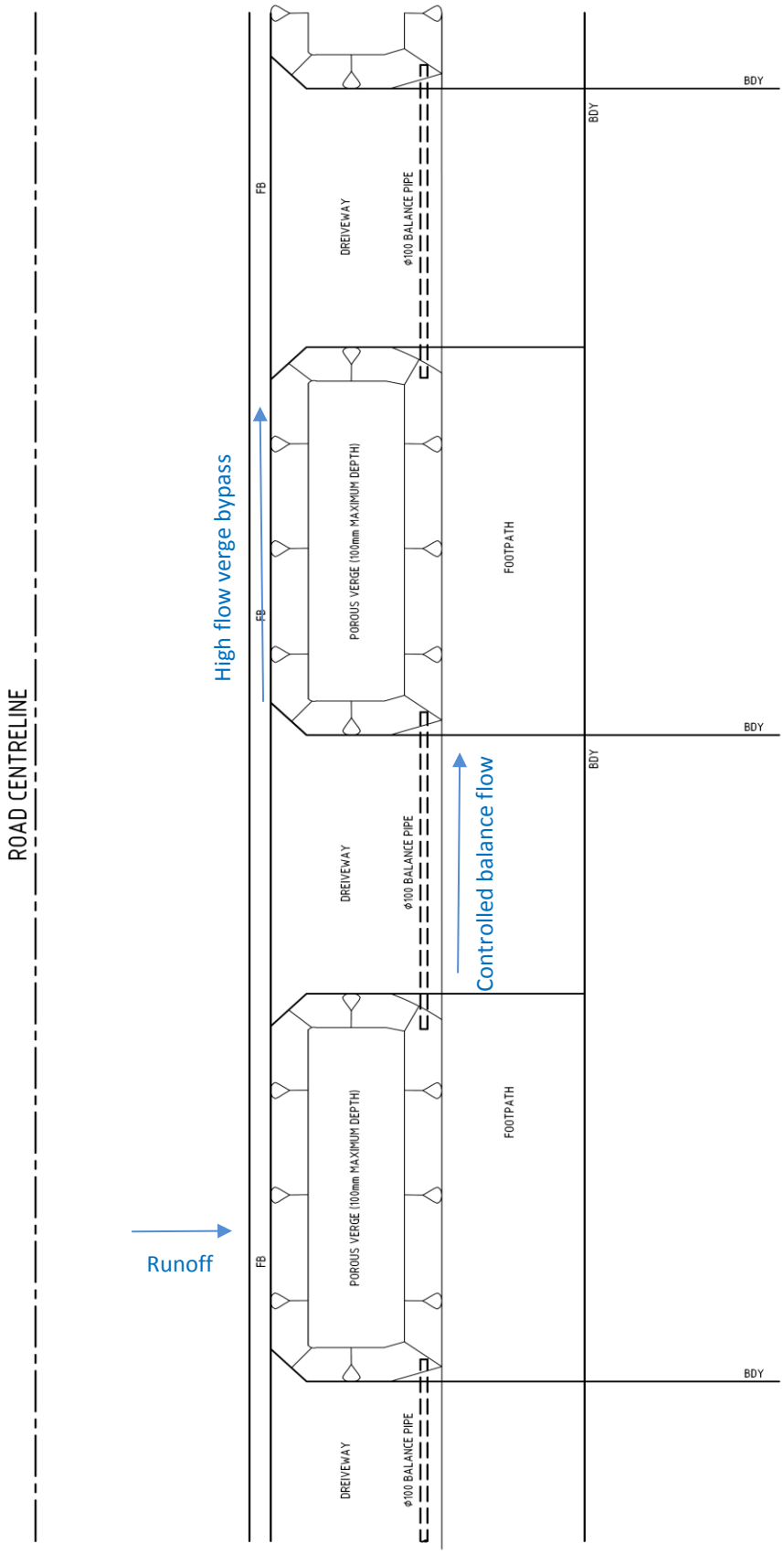
Satterley Property Group
Hoffman Road Mandogalup, LWMS

Figure 9: Pre-Development and Post-Development Outflow and Catchment Mapping

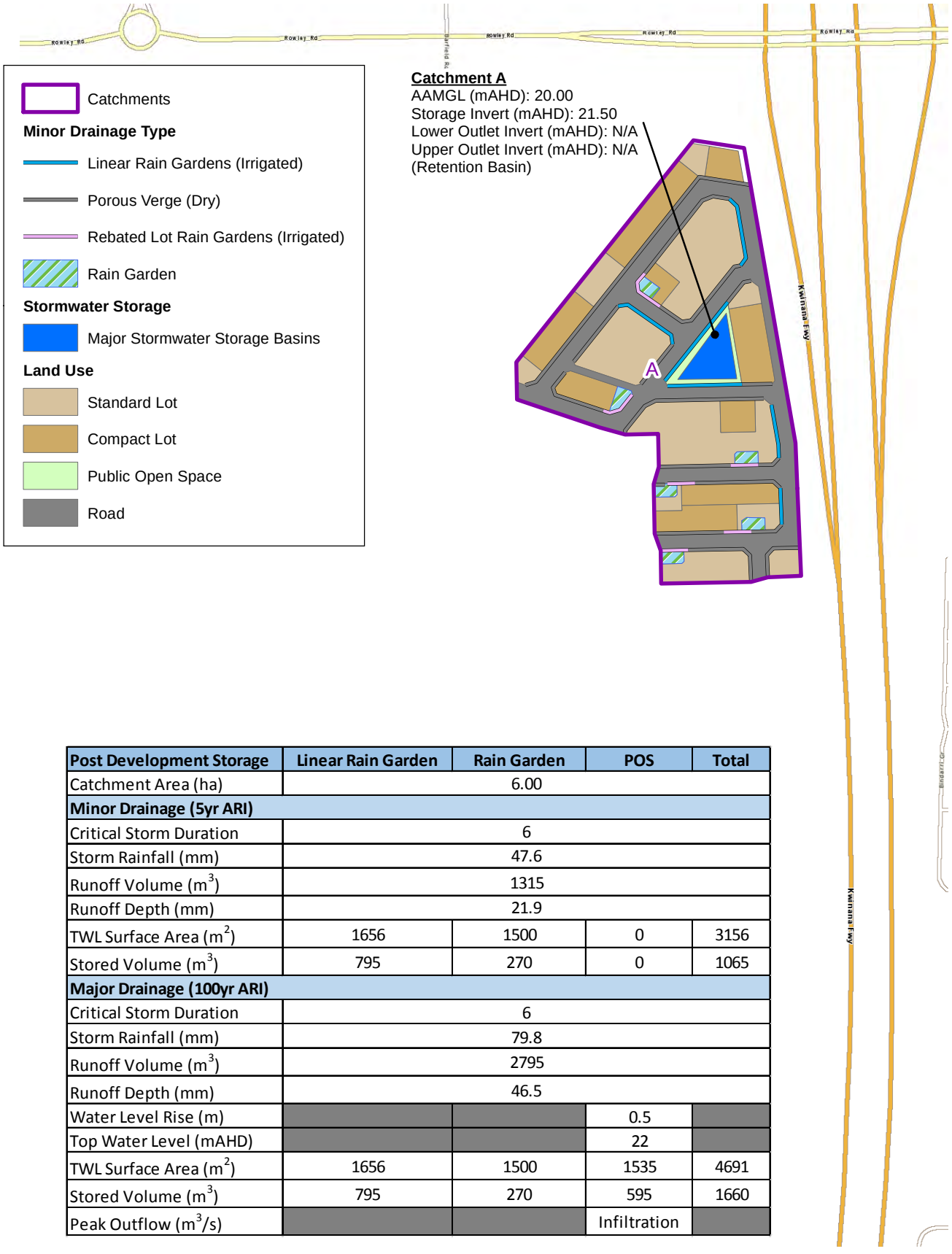


Data Source: Peritas Group (2016)

Job No. J5483

Satterley Property Group
Mandogalup East, LWMS

Figure 10: Road Water Conveyance



Post Development Storage	Linear Rain Garden	Rain Garden	POS	Total
Catchment Area (ha)	6.00			
Minor Drainage (5yr ARI)				
Critical Storm Duration	6			
Storm Rainfall (mm)	47.6			
Runoff Volume (m^3)	1315			
Runoff Depth (mm)	21.9			
TWL Surface Area (m^2)	1656	1500	0	3156
Stored Volume (m^3)	795	270	0	1065
Major Drainage (100yr ARI)				
Critical Storm Duration	6			
Storm Rainfall (mm)	79.8			
Runoff Volume (m^3)	2795			
Runoff Depth (mm)	46.5			
Water Level Rise (m)			0.5	
Top Water Level (mAHD)			22	
TWL Surface Area (m^2)	1656	1500	1535	4691
Stored Volume (m^3)	795	270	595	1660
Peak Outflow (m^3/s)			Infiltration	

Job No. J5483
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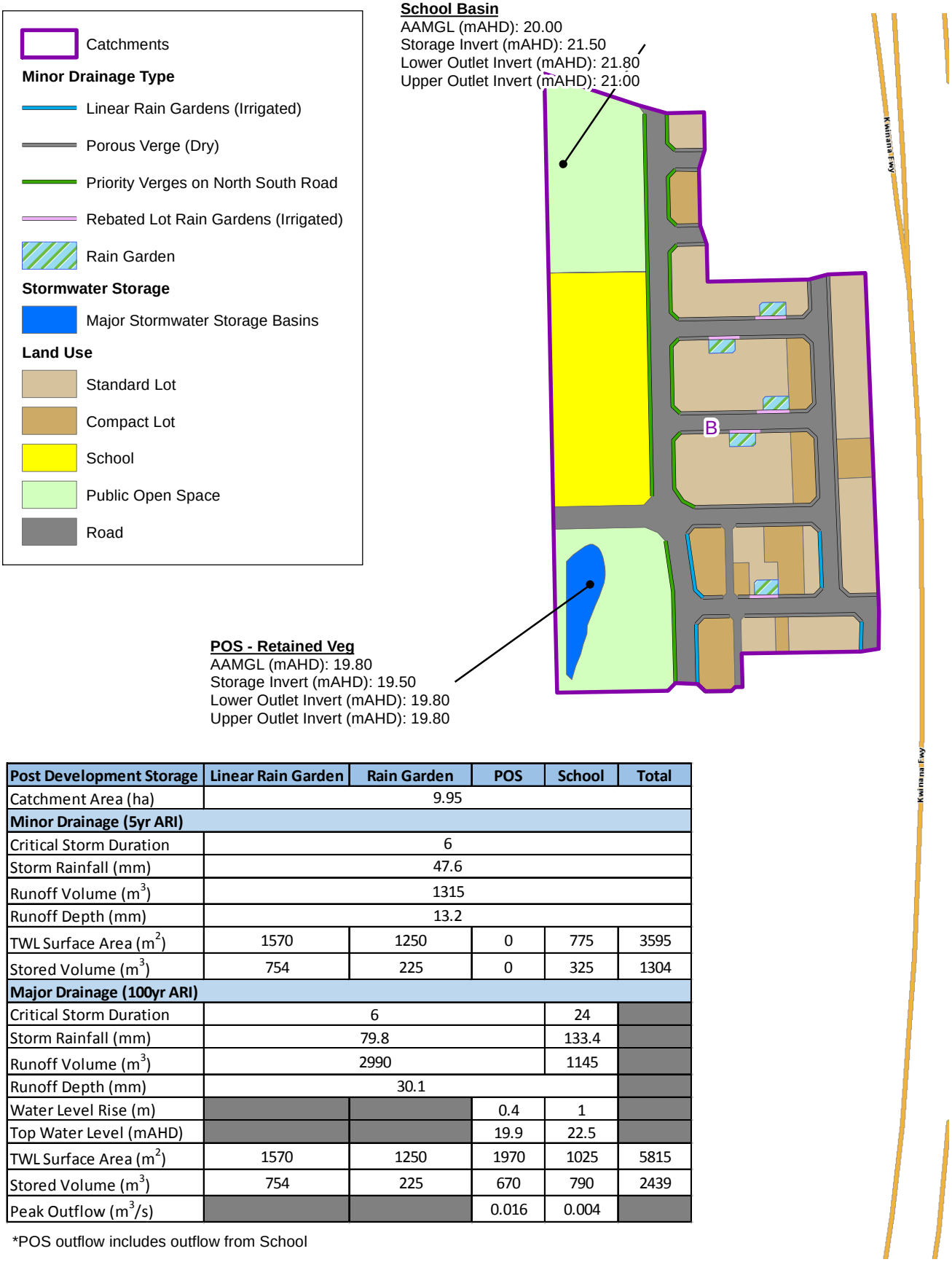
Coordinate System: GDA 94, Zone 50

Satterley Property Group
Hoffman Road Mandogalup LWMS

Figure 11: Catchment A - Stormwater Management



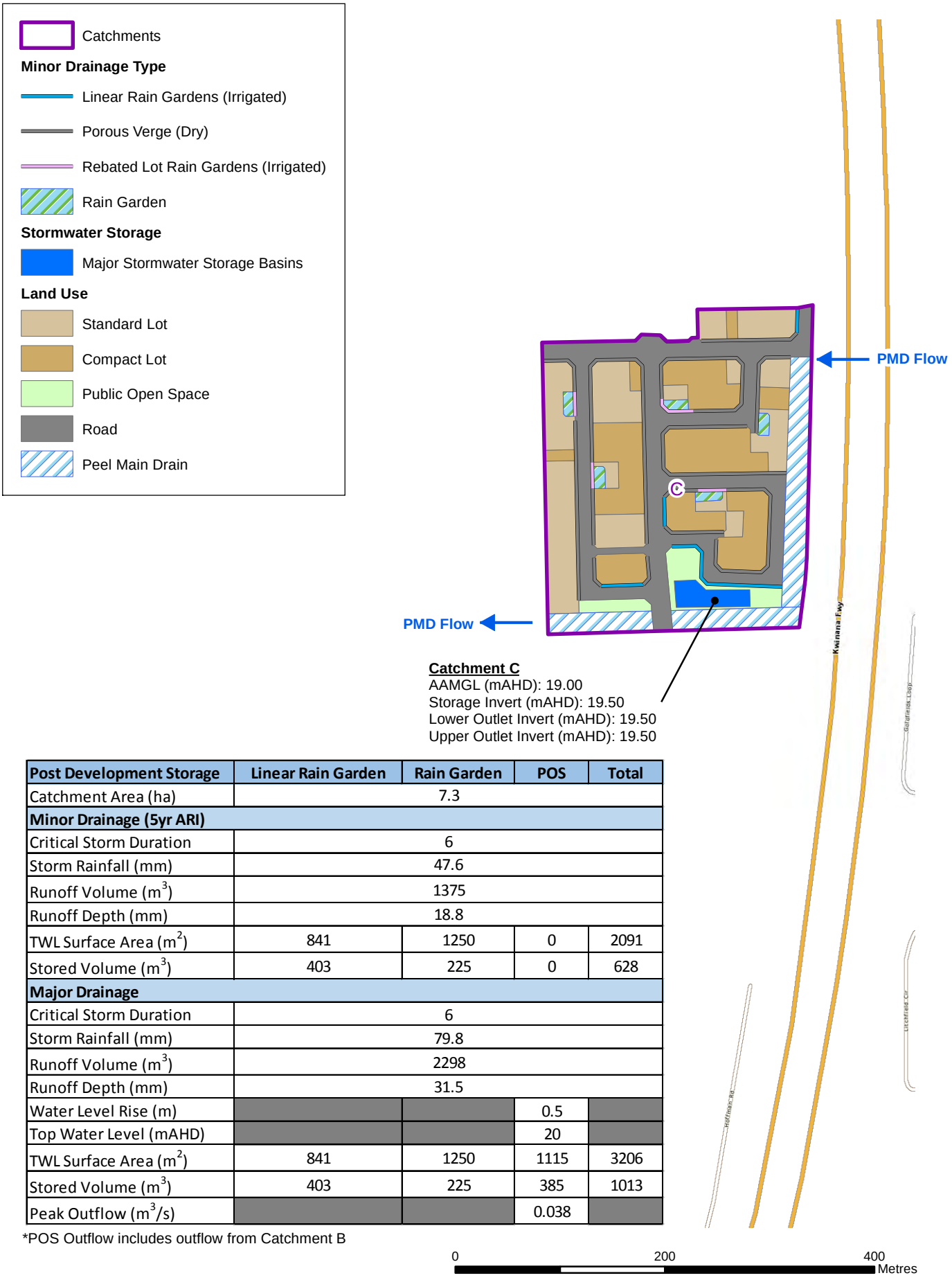
Post Development Storage	Linear Rain Garden	Rain Garden	POS	School	Total
Catchment Area (ha)		9.95			
Minor Drainage (5yr ARI)					
Critical Storm Duration		6			
Storm Rainfall (mm)		47.6			
Runoff Volume (m^3)		1315			
Runoff Depth (mm)		13.2			
TWL Surface Area (m^2)	1570	1250	0	775	3595
Stored Volume (m^3)	754	225	0	325	1304
Major Drainage (100yr ARI)					
Critical Storm Duration		6		24	
Storm Rainfall (mm)		79.8		133.4	
Runoff Volume (m^3)		2990		1145	
Runoff Depth (mm)		30.1			
Water Level Rise (m)			0.4	1	
Top Water Level (mAHD)			19.9	22.5	
TWL Surface Area (m^2)	1570	1250	1970	1025	5815
Stored Volume (m^3)	754	225	670	790	2439
Peak Outflow (m^3/s)			0.016	0.004	

*POS outflow includes outflow from School

Job No. J5483
Scale 1:4,423 @A4
Coordinate System: GDA 94, Zone 50

Satterley Property Group
Hoffman Road Mandogalup LWMS

Figure 12: Catchment B - Stormwater Management



Post Development Storage	Linear Rain Garden	Rain Garden	POS	Total
Catchment Area (ha)	7.3			
Minor Drainage (5yr ARI)				
Critical Storm Duration	6			
Storm Rainfall (mm)	47.6			
Runoff Volume (m^3)	1375			
Runoff Depth (mm)	18.8			
TWL Surface Area (m^2)	841	1250	0	2091
Stored Volume (m^3)	403	225	0	628
Major Drainage				
Critical Storm Duration	6			
Storm Rainfall (mm)	79.8			
Runoff Volume (m^3)	2298			
Runoff Depth (mm)	31.5			
Water Level Rise (m)			0.5	
Top Water Level (mAHD)			20	
TWL Surface Area (m^2)	841	1250	1115	3206
Stored Volume (m^3)	403	225	385	1013
Peak Outflow (m^3/s)			0.038	

*POS Outflow includes outflow from Catchment B

Job No. J5483
Scale 1:5,000 @A4
Coordinate System: GDA 94, Zone 50

Satterley Property Group
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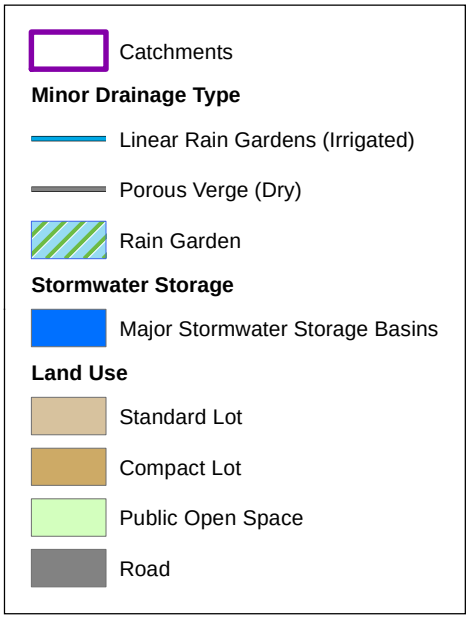
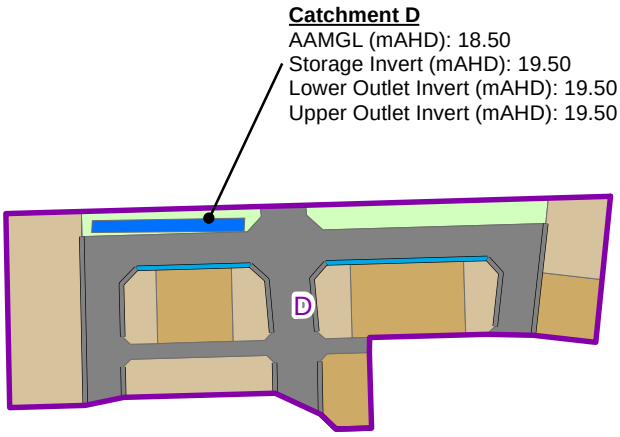
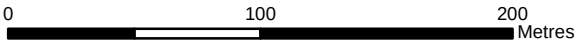
Figure 13: Catchment C - Stormwater Management





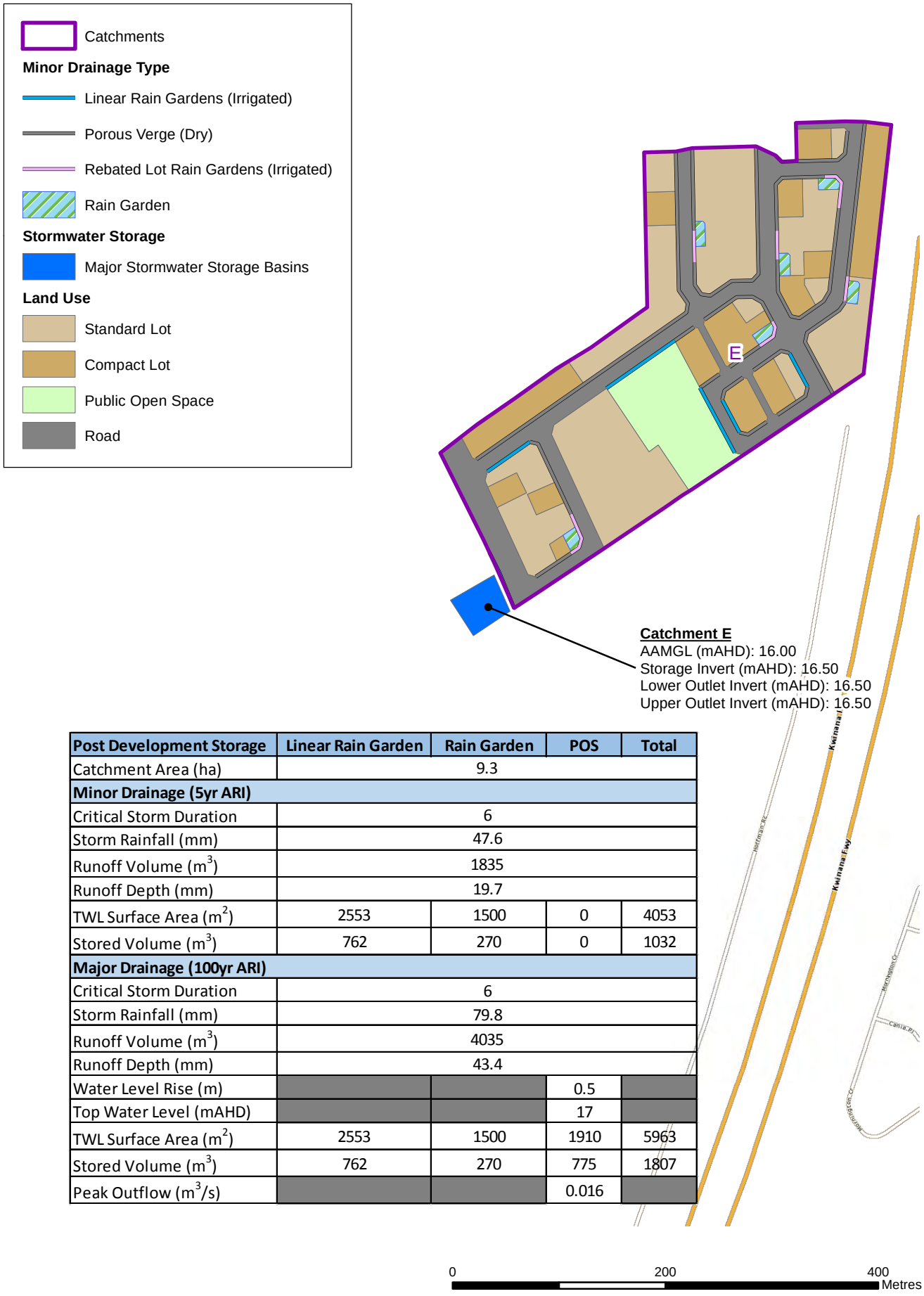
Post Development Storage	Linear Rain Garden	Rain Garden	POS	Total
Catchment Area (ha)	1.6			
Minor Drainage (5yr ARI)				
Critical Storm Duration	6			
Storm Rainfall (mm)	47.6			
Runoff Volume (m^3)	345			
Runoff Depth (mm)	21.6			
TWL Surface Area (m^2)	447	0	0	447
Stored Volume (m^3)	215	0	0	215
Major Drainage (100yr ARI)				
Critical Storm Duration	6			
Storm Rainfall (mm)	79.8			
Runoff Volume (m^3)	735			
Runoff Depth (mm)	45.9			
Water Level Rise (m)			0.5	
Top Water Level (mAHD)			20	
TWL Surface Area (m^2)	447		450	897
Stored Volume (m^3)	215		155	370
Peak Outflow (m^3/s)			0.003	



Job No. J5483
Scale 1:3,000 @A4
Coordinate System: GDA 94, Zone 50

Satterley Property Group
Hoffman Road Mandogalup LWMS

Figure 14: Catchment D - Stormwater Management

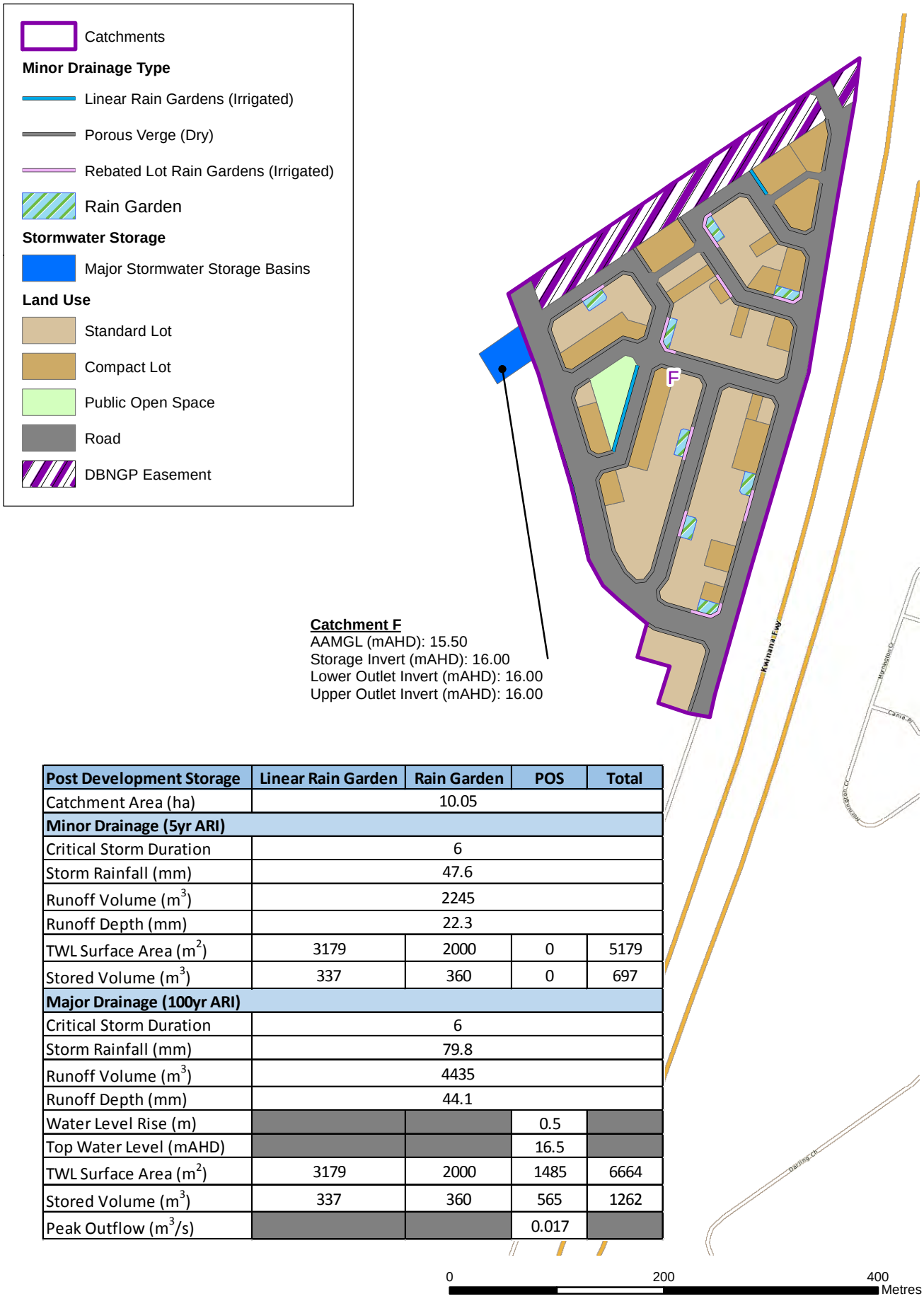


Post Development Storage	Linear Rain Garden	Rain Garden	POS	Total
Catchment Area (ha)	9.3			
Minor Drainage (5yr ARI)				
Critical Storm Duration	6			
Storm Rainfall (mm)	47.6			
Runoff Volume (m^3)	1835			
Runoff Depth (mm)	19.7			
TWL Surface Area (m^2)	2553	1500	0	4053
Stored Volume (m^3)	762	270	0	1032
Major Drainage (100yr ARI)				
Critical Storm Duration	6			
Storm Rainfall (mm)	79.8			
Runoff Volume (m^3)	4035			
Runoff Depth (mm)	43.4			
Water Level Rise (m)			0.5	
Top Water Level (mAHD)			17	
TWL Surface Area (m^2)	2553	1500	1910	5963
Stored Volume (m^3)	762	270	775	1807
Peak Outflow (m^3/s)			0.016	

Job No. J5483
Scale 1:5,000 @A4
Coordinate System: GDA 94, Zone 50

Satterley Property Group
Hoffman Road Mandogalup LWMS

Figure 15: Catchment E - Stormwater Management



Post Development Storage	Linear Rain Garden	Rain Garden	POS	Total
Catchment Area (ha)		10.05		
Minor Drainage (5yr ARI)				
Critical Storm Duration		6		
Storm Rainfall (mm)		47.6		
Runoff Volume (m^3)		2245		
Runoff Depth (mm)		22.3		
TWL Surface Area (m^2)	3179	2000	0	5179
Stored Volume (m^3)	337	360	0	697
Major Drainage (100yr ARI)				
Critical Storm Duration		6		
Storm Rainfall (mm)		79.8		
Runoff Volume (m^3)		4435		
Runoff Depth (mm)		44.1		
Water Level Rise (m)			0.5	
Top Water Level (mAHD)			16.5	
TWL Surface Area (m^2)	3179	2000	1485	6664
Stored Volume (m^3)	337	360	565	1262
Peak Outflow (m^3/s)			0.017	

Job No. J5483
Scale 1:5,000 @A4
Coordinate System: GDA 94, Zone 50

Satterley Property Group
Hoffman Road Mandogalup LWMS

Figure 16: Catchment F - Stormwater Management

Appendix A

Local Water Management Strategy Checklist for Developers

Checklist for integrated water cycle management assessment of local structure plan or local planning scheme amendment

1. Tick the status column for items for which information is provided.
2. Enter N/A in the status column if the item is not appropriate and enter the reason in the comments column.
3. Provide brief comments on any relevant issues.
4. Provide brief description of any proposed best management practices, eg. multi-use corridors, community based-social marketing, water re-use proposals.

Local water management strategy item	Deliverable	☑	Comments
Executive summary			
Summary of the development design strategy, outlining how the design objectives are proposed to be met	Table 1: Design elements & requirements for BMPs and critical control points	X	
Introduction			
Total water cycle management – principles & objectives Planning background Previous studies		X	
Proposed development			
Structure plan, zoning and land use. Key landscape features Previous land use	Site context plan Structure plan	X X	
Landscape - proposed POS areas, POS credits, water source, bore(s), lake details (if applicable), irrigation areas	Landscape Plan	X	
Design criteria			
Agreed design objectives and source of objective		X	
Pre-development environment			
Existing information and more detailed assessments (monitoring). How do the site characteristics affect the design?		X	
Site Conditions - existing topography/ contours, aerial photo underlay, major physical features	Site condition plan	X	
Geotechnical - topography, soils including acid sulfate soils and infiltration capacity, test pit locations	Geotechnical plan	X	
Environmental - areas of significant flora and fauna, wetlands and buffers, waterways and buffers, contaminated sites	Environmental Plan plus supporting data where appropriate	X	
Surface Water – topography, 100 year floodways and flood fringe areas, water quality of flows entering and leaving (if applicable)	Surface Water Plan	X	
Groundwater – topography, pre development groundwater levels and water quality, test bore locations	Groundwater Plan plus details of groundwater monitoring and testing	X	
Water use sustainability initiatives			
Water efficiency measures – private and public open spaces including method of enforcement		X	
Water supply (fit-for-purpose strategy), agreed actions and implementation. If non-potable supply, support with water balance		X	
Wastewater management		X	
Stormwater management strategy			
Flood protection - peak flow rates, volumes and top water levels at control points,100 year flow paths and 100 year detentions storage areas	100yr event Plan Long section of critical points	X X	
Manage serviceability - storage and retention required for the critical 5 year ARI storm events Minor roads should be passable in the 5 year ARI event	5yr event Plan	X	

Local water management strategy item	Deliverable	☑	Comments
Protect ecology – detention areas for the 1 yr 1 hr ARI event, areas for water quality treatment and types of (including indicative locations for) agreed structural and non-structural best management practices and treatment trains. Protection of waterways, wetlands (and their buffers), remnant vegetation and ecological linkages	1yr event plan Typical cross sections	X X	
Groundwater management strategy			
Post development groundwater levels, fill requirements (including existing and likely final surface levels), outlet controls, and subsoils areas/exclusion zones	Groundwater/subsoil Plan	X	
Actions to address acid sulfate soils or contamination		X	
The next stage – subdivision and urban water management plans			
Content and coverage of future urban water management plans to be completed at subdivision. Include areas where further investigations are required prior to detailed design.		X	
Monitoring			
Recommended future monitoring plan including timing, frequency, locations and parameters, together with arrangements for ongoing actions		X	
Implementation			
Developer commitments		X	
Roles, responsibilities, funding for implementation		X	
Review		X	

Appendix B (CD Attached)

Geotechnical Report (Golders, 2008)

Appendix C

Pre-Development Surface Water Monitoring Data
(JDA, 2007)

No flow

Flow [L/s]

	25/10/2004	30/11/2004	21/12/2004	27/01/2005	18/02/2005	16/03/2005	27/04/2005	31/05/2005	5/07/2005	27/07/2005	9/09/2005	23/09/2005	21/10/2005	23/11/05	10/01/06	31/01/06	3/03/06	4/04/06	4/05/06	29/05/06	28/06/05	2/08/06	30/08/2006	6/10/2006
Surface Drain 1									20	5	10	50	3	2										
Surface Drain 2									100	40	50	80	10											
Surface Drain 3	8	2	2	2	4	3	2	8	40	20	35	80	15	5	2	2	1	2	3	6	6	5	8	NM

EC

	25/10/2004	30/11/2004	21/12/2004	27/01/2005	18/02/2005	16/03/2005	27/04/2005	31/05/2005	5/07/2005	27/07/2005	9/09/2005	23/09/2005	21/10/2005	23/11/2005	10/01/2006	31/01/2006	3/03/2006	4/04/2006	4/05/2006	29/05/2006	28/06/2005	2/08/2006	30/08/2006	6/10/2006
Surface Drain 1									1.00	0.92	0.89	0.81	0.63	0.62										
Surface Drain 2									1.56	1.57	1.27	1.22	0.81											
Surface Drain 3	0.38	0.3	0.3	0.33	0.30	0.30	0.27	0.31	0.70	0.66	0.56	0.63	0.43	0.41	0.34	0.38	0.44	0.42	0.27	0.27	0.32	1.45	0.47	

pH

	25/10/2004	30/11/2004	21/12/2004	27/01/2005	18/02/2005	16/03/2005	27/04/2005	31/05/2005	5/07/2005	27/07/2005	9/09/2005	23/09/2005	21/10/2005	23/11/2005	10/01/2006	31/01/2006	3/03/2006	4/04/2006	4/05/2006	29/05/2006	28/06/2005	2/08/2006	30/08/2006	6/10/2006
Surface Drain 1									5.99	5.80	5.28	5.49	5.55	5.45										
Surface Drain 2									6.95	7.15	6.91	6.51	6.60											
Surface Drain 3	6.72	6.77	6.75	6.75	6.78	6.59	7.74	6.65	7.18	7.15	6.98	6.50	6.85	6.65	0.00	6.76	6.46	6.85	6.68	6.16	6.72	6.60	6.20	

probe failure

TKN

	25/10/2004	30/11/2004	21/12/2004	27/01/2005	18/02/2005	16/03/2005	27/04/2005	31/05/2005	5/07/2005	27/07/2005	9/09/2005	23/09/2005	21/10/2005	23/11/2005	10/01/2006	31/01/2006	3/03/2006	4/04/2006	4/05/2006	29/05/2006	28/06/2005	2/08/2006	30/08/2006	6/10/2006
Surface Drain 1									1.70	2.60	2.10	2.40	2.10	2.40										
Surface Drain 2									0.90	3.60	2.70	2.90	2.20											
Surface Drain 3	0.81	0.32	0.62	1.10	1.60	1.80	0.57	0.43	0.82	1.30	1.10	1.30	0.83	0.80	0.52	0.73	0.76	0.53	0.46	0.26	0.71	1.10	0.70	

TN

	25/10/2004	30/11/2004	21/12/2004	27/01/2005	18/02/2005	16/03/2005	27/04/2005	31/05/2005	5/07/2005	27/07/2005	9/09/2005	23/09/2005	21/10/2005	23/11/2005	10/01/2006	31/01/2006	3/03/2006	4/04/2006	4/05/2006	29/05/2006	28/06/2005	2/08/2006	30/08/2006	6/10/2006
Surface Drain 1									1.90	2.70	2.20	2.50	2.10	2.4										
Surface Drain 2									7.80	8.90	5.00	5.10	2.30											
Surface Drain 3	1.30	0.30	1.10	1.10	1.60	2.10	0.60	0.88	1.40	1.70	1.30	1.50	0.94	0.8	0.54	0.74	0.780	0.530	0.62	0.53	1.20	1.10	1.00	

NH4_N

	25/10/2004	30/11/2004	21/12/2004	27/01/2005	18/02/2005	16/03/2005	27/04/2005	31/05/2005	5/07/2005	27/07/2005	9/09/2005	23/09/2005	21/10/2005	23/11/2005	10/01/2006	31/01/2006	3/03/2006	4/04/2006	4/05/2006	29/05/2006	28/06/2005	2/08/2006	30/08/2006	6/10/2006
Surface Drain 1									0.057	0.079	0.009	0.018	<0.005	<0.005										
Surface Drain 2									0.25	0.38	0.16	0.17	0.15											
Surface Drain 3	0.05	<0.05	<0.05	<0.05	0.08	0.07	<0.05	0.06	0.049	0.041	0.01	0.011	0.022	0.009	0.15	0.11	0.039	0.017	0.013	0.02	0.04	0.10	0.10	

NOx_N

	25/10/2004	30/11/2004	21/12/2004	27/01/2005	18/02/2005	16/03/2005	27/04/2005	31/05/2005	5/07/2005	27/07/2005	9/09/2005	23/09/2005	21/10/2005	23/11/2005	10/01/2006	31/01/2006	3/03/2006	4/04/2006	4/05/2006	29/05/2006	28/06/2005	2/08/2006	30/08/2006	6/10/2006
Surface Drain 1									0.11	0.10	0.04	0.054	0.02	0.005										
Surface Drain 2									6.90	5.30	2.30	2.20	0.12											
Surface Drain 3	0.47	<0.05	0.47	<0.05	<0.05	0.18	0.07	0.36	0.62	0.48	0.20	0.17	0.01	0.046	0.02	0.01	0.025	0.005	0.16	0.27	0.48	0.53	0.30	

FRP (PO4_P)

	25/10/2004	30/11/2004	21/12/2004	27/01/2005	18/02/2005	16/03/2005	27/04/2005	31/05/2005	5/07/2005	27/07/2005	9/09/2005	23/09/2005	21/10/2005	23/11/2005	10/01/2006	31/01/2006	3/03/2006	4/04/2006	4/05/2006	29/05/2006	28/06/2005	2/08/2006	30/08/2006	6/10/2006
Surface Drain 1									0.25	0.32	0.20	0.20	0.25	0.34										
Surface Drain 2									0.05	0.68	0.59	0.68	0.76											
Surface Drain 3	0.11	0.10	0.11	0.49	0.22	0.13	0.12	0.10	0.30	0.34	0.28	0.27	0.20	0.22	0.02	0.18	0.08	0.12	0.08	0.12	0.13	0.08	0.13	

TP

	25/10/2004	30/11/2004	21/12/2004	27/01/2005	18/02/2005	16/03/2005	27/04/2005	31/05/2005	5/07/2005	27/07/2005	9/09/2005	23/09/2005	21/10/2005	23/11/2005	10/01/2006	31/01/2006	3/03/2006	4/04/2006	4/05/2006	29/05/2006	28/06/2005	2/08/2006	30/08/2006	6/10/2006
Surface Drain 1									0.28	0.45	0.27	0.22	0.40	0.40										
Surface Drain 2									0.56	1.20	0.73	0.90	1.30											
Surface Drain 3	0.15	0.14	0.15	0.65	0.26	0.42	0.16	0.13	0.34	0.48	0.31	0.27	0.88	0.67	0.31	0.23	0.11	0.14	0.09	0.19	0.20	0.26	0.16	

Data Source: JDA(2007)

Appendix D

Pre-Development Groundwater Quality Monitoring Data (JDA, 2007)

EC

Bore	25/10/2004	30/11/2004	21/12/2004	27/01/2005	18/02/2005	16/03/2005	27/04/2005	31/05/2005	5/07/2005	27/07/2005	9/09/2005	23/09/2005	21/10/2005	23/11/2005	10/01/2006	31/01/2006	3/03/2006	4/04/2006	4/05/2006	29/05/2006	28/06/2006	2/08/2006	30/08/2006	6/10/2006
WAM1 (s)	0.44	0.30	0.31	1.52	0.30	0.31	0.33	0.27	0.33	0.33	0.43	0.40	1.33	0.39	0.32	0.29	0.3	0.27	0.29	0.27	0.28	1.2	0.51	1.71
WAM1 (d)	1.68	1.56	1.69	0.29	1.59	1.46	1.50	1.55	1.67	1.64	1.47	1.61	0.52	1.43	1.64	1.81	1.74	1.3	1.28	1.7	1.66	2.58	1.89	0.26
WAM2 (s)	1.03	1.05	1.15	0.93	1.07	1.00	1.07	1.15	1.31	1.27	1.13	1.09	0.97	1.10	1.13	1.15	1.08	1	0.95	1.2	1.17	2.09	1.48	1.23
WAM2 (d)	0.94	0.93	0.93	0.70	0.75	0.67	0.51	0.62	0.76	0.77	0.74	0.81	0.74	0.98	0.75	0.95	0.88	0.72	0.79	0.77	0.86	1.57	0.93	0.83
WAM3 (s)	1.80	1.73	1.89	1.33	1.22	1.11	1.22	1.19	1.41	1.37	1.15	1.22	1.08	1.18	1.41	1.77	1.75	1.37	1.25	1.4	1.33	1.5	1.44	
WAM3 (d)	0.63	0.64	0.73	0.56	0.59	0.57	0.59	0.58	0.71	0.69	0.61	0.63	0.62	0.69	0.70	0.71	0.71	0.66	0.62	0.61	0.64	0.14	0.74	
WAM4 (s)	0.28	0.27	0.30	0.23	0.28	0.24	0.24	0.21	0.35	0.47	0.21	0.84	0.19	0.35	0.34	0.33	0.33	0.33	0.31	0.32	0.28	0.89	0.72	0.36
WAM4 (d)	0.74	0.81	0.93	0.77	0.82	0.78	0.81	0.55	0.58	0.87	0.81	0.20	0.78	0.86	0.85	0.40	0.85	0.79	0.75	0.78	0.77	1.36	0.93	0.77

pH

Bore	25/10/2004	30/11/2004	21/12/2004	27/01/2005	18/02/2005	16/03/2005	27/04/2005	31/05/2005	5/07/2005	27/07/2005	9/09/2005	23/09/2005	21/10/2005	23/11/2005	10/01/2006	31/01/2006	3/03/2006	4/04/2006	4/05/2006	29/05/2006	28/06/2006	2/08/2006	30/08/2006	6/10/2006
WAM1 (s)	4.68	4.57	4.40	5.61	4.45	4.47	4.91	3.97	4.25	4.30	4.05	4.03	5.00	4.31	4.27	4.73	4.11	4.51	4.37	4.4	4.68	4.75	4.72	5.94
WAM1 (d)	5.70	5.55	5.48	4.66	5.65	5.60	6.15	5.20	5.60	5.25	5.50	5.57	5.02	5.53	5.32	5.53	5.14	5.43	5.24	5.31	5.54	5.39	5.84	4.67
WAM2 (s)	5.27	5.32	5.95	4.85	5.08	4.73	5.85	4.85	5.15	4.90	4.85	5.00	4.92	4.70		4.92	4.58	4.84	5.01	4.5	4.92	4.90	5.23	4.87
WAM2 (d)	5.19	5.21	5.38	5.14	5.17	4.97	6.02	5.11	5.30	4.92	4.62	4.55	4.76	4.97		5.18	4.92	5.1	5.03	4.81	5.24	5.26	5.38	5.01
WAM3 (s)	6.74	6.64	6.20	6.15	6.53	6.82	7.33	6.40	6.93	7.06	6.74	6.13	7.16	6.91		6.67	6.25	6.7	6.53	6.59	6.75	7.27	6.83	
WAM3 (d)	7.21	6.96	6.75	6.82	7.14	6.50	7.91	6.66	6.98	7.23	7.04	6.65	7.42	7.27		7.33	7.07	7.28	7.22	6.95	7.19	6.96	7.37	
WAM4 (s)	3.91	3.77	4.21	3.92	4.18	4.15	4.65	3.70	3.70	3.73	3.70	3.83	4.24	4.05		4.21	3.89	4.22	4.12	3.86	4.39	4.49	3.75	4.01
WAM4 (d)	5.47	5.14	5.59	5.10	5.30	5.42	6.00	4.87	5.10	5.25	5.36	5.34	5.55	5.45		5.47	5.28	5.49	5.22	5.05	5.46	5.14	5.18	5.36

* probe failure

TDS	25/10/2004	30/11/2004	21/12/2004	27/01/2005	18/02/2005	16/03/2005	27/04/2005	31/05/2005	5/07/2005	27/07/2005	9/09/2005	23/09/2005	21/10/2005	23/11/2005	10/01/2006	31/01/2006	3/03/2006	4/04/2006	4/05/2006	29/05/2006	28/06/2006	2/08/2006	30/08/2006	6/10/2006
WAM1 (s)	242.00	165.00	170.50	836.00	165.00	170.50	181.50	148.50	181.50	181.50	236.50	220.00	731.50	214.50	176.00	159.50	165	148.5	159.5	148.5	154	660	280.5	940.5
WAM1 (d)	924.00	858.00	929.50	159.50	874.50	803.00	825.00	852.50	918.50	902.00	808.50	885.50	286.00	786.50	902.00	995.50	957	715	704	935	913	1419	1039.5	143
WAM2 (s)	566.50	577.50	632.50	511.50	588.50	550.00	588.50	632.50	720.50	698.50	621.50	599.50	533.50	605.00		632.50	594	550	522.5	660	643.50	1149.50	814.00	676.5
WAM2 (d)	517.00	511.50	511.50	385.00	412.50	368.50	280.50	341.00	418.00	423.50	407.00	445.50	407.00	539.00		522.50	484	396	434.5	423.5	473	863.5	511.5	456.5
WAM3 (s)	990.00	951.50	1039.50	731.50	671.00	610.50	671.00	654.50	775.50	753.50	632.50	671.00	594.00	649.00		973.50	962.5	753.5	687.5	770	731.5	825	792	0
WAM3 (d)	346.50	352.00	401.50	308.00	324.50	313.50	324.50	319.00	390.50	379.50	335.50	346.50	341.00	379.50		390.50	390.5	363	341	335.5	352	77	407	0
WAM4 (s)	154.00	148.50	165.00	126.50	154.00	132.00	132.00	115.50	192.50	258.50	115.50	462.00	104.50	192.50		181.50	181.5	181.5	170.5	176	154	489.5	396	198
WAM4 (d)	407.00	445.50	511.50	423.50	451.00	429.00	445.50	302.50	319.00	478.50	445.50	110.00	429.00	473.00		220.00	467.5	434.5	412.5	429	423.5	748	511.5	423.5

Data Source: JDA(2007)

Total Kjeldahl Nitrogen_N

LOD [mg/L]																								
	25/10/2004	30/11/2004	21/12/2004	27/01/2005	18/02/2005	16/03/2005	27/04/2005	31/05/2005	5/07/2005	27/07/2005	9/09/2005	23/09/2005	21/10/2005	23/11/2005	10/01/2006	31/01/2006	3/03/2006	4/04/2006	4/05/2006	29/05/2006	28/06/2006	2/08/2006	30/08/2006	6/10/2006
WAM1 (s)	5.40	4.40	3.50	3.50	3.50	3.40	3.60	2.70	2.30	2.80	2.40	2.50	2.10	2.4	1.5	3.00	3.40	3.40	3.30	2.30	2.50	2.6	3	2
WAM1 (d)	1.00	1.20	2.10	0.85	1.60	1.80	1.80	1.60	1.30	1.00	1.20	1.30	1.60	1.5	2.7	1.80	1.60	1.60	1.70	1.20	1.70	0.95	1.5	3.7
WAM2 (s)	4.70	0.08	0.09	<0.05	0.25	0.15	30.00	63.00	7.00	8.00	7.00	7.50	22.00	7	1	21.00	7.00	7.00	8.00	5.00	1.00	11	3	0.05
WAM2 (d)	11.00	0.14	0.16	0.06	0.21	0.22	0.61	0.27	0.27	0.23	0.26	0.28	0.45	0.3	0.36	1.90	0.5	0.05	0.28	0.25	0.31	1.4	0.11	1.2
WAM3 (s)	1.30	0.62	1.00	0.96	1.50	1.20	0.78	0.56	0.58	1.04	0.92	1.30	1.20	0.7	1.2	1.50	1.30	0.98	1.20	0.39	1.80	1.8	1.3	
WAM3 (d)	0.44	0.18	0.46	0.08	0.45	0.42	0.62	0.42	0.15	0.28	0.25	0.45	0.42	0.6	0.28	0.65	0.64	0.57	0.61	0.27	0.48	0.47	0.4	
WAM4 (s)	1.60	6.30	6.30	1.40	4.00	4.80	41.00	1.30	4.00	8.00	0.74	1.30	5.50	3.4	3.7	3.80	4.20	3.90	3.90	3.00	4.00	3.3	4.3	5.8
WAM4 (d)	1.90	0.45	1.60	0.47	1.60	1.30	1.40	0.97	0.39	1.40	1.20	6.90	1.40	1.6	1.1	1.80	1.50	1.20	1.00	0.75	1.40	1	1.4	1.6

Total Nitrogen_N

LOD [mg/L]																								
	25/10/2004	30/11/2004	21/12/2004	27/01/2005	18/02/2005	16/03/2005	27/04/2005	31/05/2005	5/07/2005	27/07/2005	9/09/2005	23/09/2005	21/10/2005	23/11/2005	10/01/2006	31/01/2006	3/03/2006	4/04/2006	4/05/2006	29/05/2006	28/06/2006	2/08/2006	30/08/2006	6/10/2006
WAM1 (s)	6.90	5.40	4.10	3.60	3.50	3.60	3.70	3.10	2.60	2.90	2.40	2.60	2.10	2.4	1.5	3.10	3.5	3.4	3.3	2.3	2.5	2.6	3.4	2
WAM1 (d)	1.20	1.20	2.20	0.90	1.60	1.90	1.80	1.70	1.40	1.60	1.70	1.60	1.70	1.6	2.8	1.80	1.8	1.6	1.8	1.2	1.9	1.4	1.5	3.7
WAM2 (s)	38.00	32.00	32.00	34.00	34.00	32.00	68.00	100.00	51.00	55.00	49.00	47.00	71.00	49	35	44.00	43	36	33	54	49	65	68	86
WAM2 (d)	33.00	8.00	4.50	2.80	2.90	1.70	0.80	0.40	9.00	1.90	1.00	2.30	0.98	22	1	8.00	11	0.91	4.5	3.8	2.8	14	7.9	7.6
WAM3 (s)	1.80	0.80	1.40	1.20	1.80	1.40	1.10	0.98	1.00	1.30	1.10	1.40	1.20	1.4	1.2	1.50	1.7	1.1	1.4	0.93	1.9	1.8	1.5	
WAM3 (d)	0.60	0.20	0.50	0.20	0.60	0.50	0.60	0.42	0.50	0.43	0.30	0.48	0.45	0.8	0.36	0.66	0.7	0.6	0.75	0.34	0.49	0.47	0.47	
WAM4 (s)	2.20	6.30	6.50	1.40	4.00	4.90	41.00	1.30	4.10	8.00	0.74	1.30	5.50	3.4	3.7	3.80	4.2	3.9	3.9	3	4	3.3	4.3	5.8
WAM4 (d)	2.70	0.50	1.70	0.50	1.70	1.40	1.50	1.00	0.65	1.40	1.00	6.90	1.40	1.6	1.1	1.80	1.5	1.2	1.5	0.92	1.4	1	1.4	1.6

Ammonia_N

LOD [mg/L]																								
Bore	25/10/2004	30/11/2004	21/12/2004	27/01/2005	18/02/2005	16/03/2005	27/04/2005	31/05/2005	5/07/2005	27/07/2005	9/09/2005	23/09/2005	21/10/2005	23/11/2005	10/01/2006	31/01/2006	3/03/2006	4/04/2006	4/05/2006	29/05/2006	28/06/2006	2/08/2006	30/08/2006	6/10/2006
WAM1 (s)	0.18	<0.05	0.12	0.07	0.23	0.08	0.61	0.36	0.32	0.34	0.53	0.50	0.49	0.28	0.71	0.27	0.32	0.34	0.41	0.39	0.43	0.41	0.38	0.9
WAM1 (d)	0.93	0.26	0.78	0.22	0.73	0.26	0.80	0.86	0.78	0.32	0.26	0.56	0.80	0.71	0.012	0.78	0.84	0.97	0.85	0.9	0.61	0.57	0.68	0.46
WAM2 (s)	0.08	<0.05	0.09	<0.05	<0.05	<0.05	<0.05	0.02	0.02	0.02	<0.005	<0.005	0.036	<0.005	0.007	0.025	0.005	0.012	0.013	0.08	0.005	0.023	0.016	0.21
WAM2 (d)	0.18	<0.05	<0.05	<0.05	0.06	<0.05	0.08	0.09	0.02	0.01	<0.005	0.007	0.016	<0.005	0.024	0.03	0.024	0.044	0.005	0.005	0.016	0.043	0.017	0.11
WAM3 (s)	<0.05	0.15	0.21	0.26	0.70	0.38	0.26	0.21	0.51	0.54	0.71	0.069	0.73	0.61	0.005	0.38	0.36	0.45	0.23	0.005	0.12	0.072	0.35	
WAM3 (d)	0.40	0.09	0.18	<0.05	0.20	0.08	0.32	0.33	0.14	0.06	0.24	0.23	0.23	0.25	0.005	0.35	0.36	0.41	0.28	0.19	0.22	0.2	0.22	
WAM4 (s)	0.06	0.15	0.10	0.11	<0.05	0.20	0.14	0.09	<.005	<0.005	<0.005	0.47	<0.005	<0.005	0.3	0.05	0.1	0.11	0.062	0.056	0.06	0.11	0.078	0.17
WAM4 (d)	0.38	0.12	0.25	0.14	0.31	0.06	0.45	0.38	0.02	0.46	0.48	<0.005	0.49	0.48	0.14	0.49	0.52	0.47	0.007	0.057	0.45	0.45	0.55	0.58

Nitrate/Nitrite (NOx)_N

LOD [mg/L]																								
Bore	25/10/2004	30/11/2004	21/12/2004	27/01/2005	18/02/2005	16/03/2005	27/04/2005	31/05/2005	5/07/2005	27/07/2005	9/09/2005	23/09/2005	21/10/2005	23/11/2005	10/01/2006	31/01/2006	3/03/2006	4/04/2006	4/05/2006	29/05/2006	28/06/2006	2/08/2006	30/08/2006	6/10/2006
WAM1 (s)	1.56	0.97	0.59	0.09	<0.05	0.18	0.07	0.36	0.29	0.01	<0.005	0.012	<0.005	0.061	0.053	0.530	0.041	0.005	0.005	0.005	0.005	0.021	0.38	0.005
WAM1 (d)	0.20	<0.05	0.07	<0.05	<0.05	0.09	<0.05	0.09	0.07	0.55	0.46	0.23	0.016	0.057	0.16	0.013	0.017	0.005	0.11	0.045	0.22	0.44	0.045	0.005
WAM2 (s)	34.00	32.00	32.00	34.00	34.00	32.00	38.00	41.00	44.00	47.00	42.00	40.00	49.00	42	34	23.000	36	29	25	49	48	54	65	86
WAM2 (d)	22.00	7.90	4.30	2.70	2.70	1.50	0.23	0.13	8.70	1.70	0.70	2.00	0.53	22	0.65	6.100	11	1.2	4.2	3.5	2.5	13	7.7	6.4
WAM3 (s)	0.45	0.14	0.35	0.25	0.29	0.16	0.32	0.42	0.42	0.21	0.14	0.085	0.066	0.74	0.027	0.005	0.34	0.11	0.23	0.54	0.06	0.17	0.28	
WAM3 (d)	0.11	<0.05	0.07	0.09	0.11	0.09	<0.05	<0.005	0.35	0.15	0.05	0.027	0.032	0.17	0.081	0.009	0.06	0.029	0.14	0.066	0.009	0.057	0.07	
WAM4 (s)	0.61	<0.05	0.18	<0.05	<0.05	0.07	0.07	<0.005	0.01	<0.005	<0.005	0.008	<0.005	0.005	0.005	0.005	0.005	<0.005	0.005	0.006	0.005	<0.005	0.005	0.008
WAM4 (d)	0.81	<0.05	0.07	<0.05	0.07	0.07	0.09	0.03	0.26	0.02	<0.005	<0.005	<0.005	0.037	0.025	0.005	0.007	<0.005	0.46	0.17	0.014	0.044	0.005	0.032

Data Source: JDA(2007)

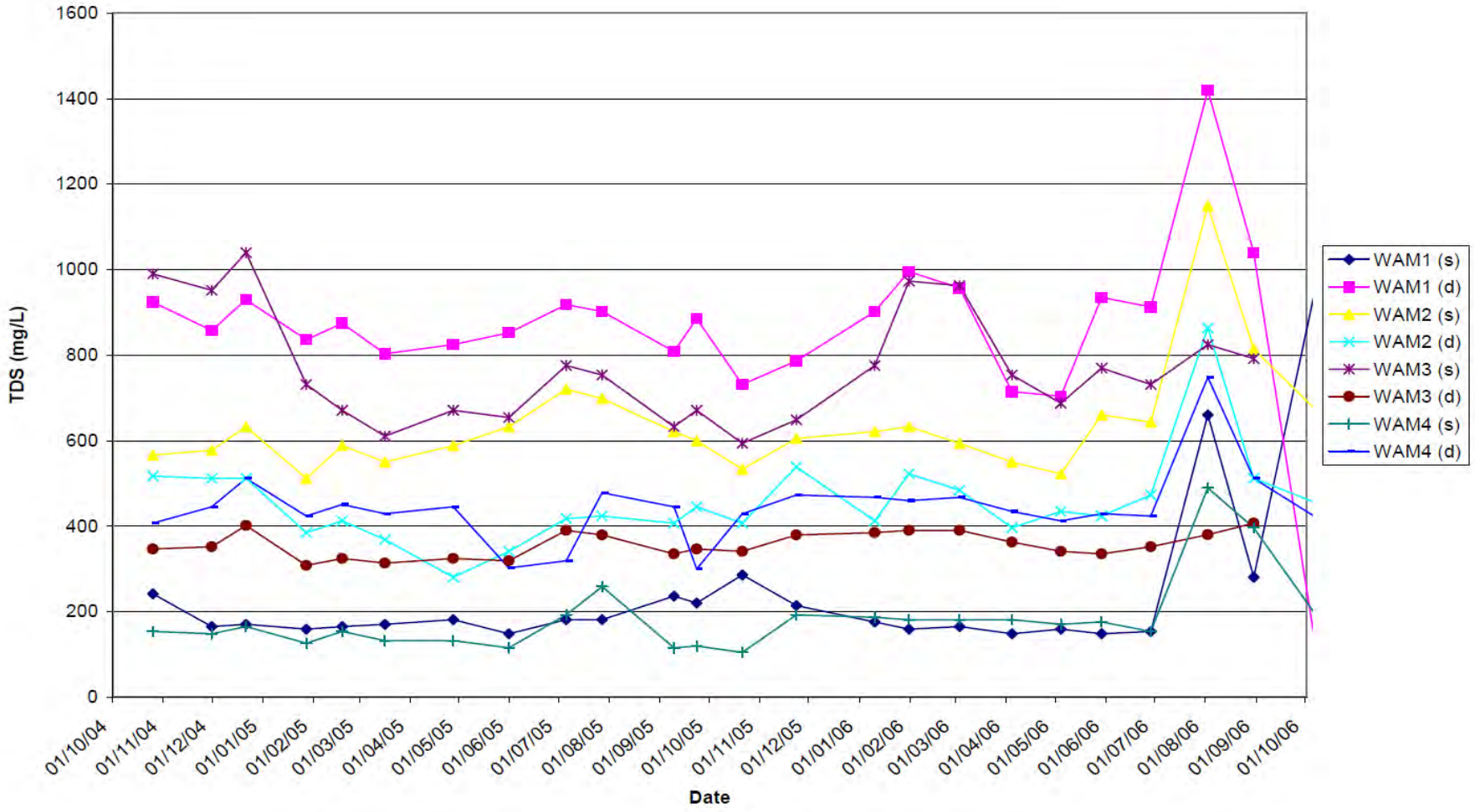
Filterable Reactive Phosphorus_P (PO4_P

LOD [mg/L]																								
Bore	25/10/2004	30/11/2004	21/12/2004	27/01/2005	18/02/2005	16/03/2005	27/04/2005	31/05/2005	5/07/2005	27/07/2005	9/09/2005	23/09/2005	21/10/2005	23/11/2005	10/01/2006	31/01/2006	3/03/2006	4/04/2006	4/05/2006	29/05/2006	28/06/2006	2/08/2006	30/08/2006	6/10/2006
WAM1 (s)	0.05	0.03	0.05	0.04	0.03	0.04	0.04	0.04	0.02	0.03	0.02	0.021	0.020	0.02	0.005	0.039	0.047	0.044	0.047	0.062	0.035	0.059	0.031	0.006
WAM1 (d)	<0.01	0.02	0.02	0.02	0.03	0.02	0.03	0.03	0.02	0.05	<0.002	0.014	0.021	0.02	0.005	0.02	0.019	0.021	0.021	0.018	0.005	0.005	0.02	0.033
WAM2 (s)	0.01	<0.01	0.02	0.02	<0.01	<0.01	0.01	0.01	0.00	0.01	<0.002	<0.002	0.006	<0.01	0.006	0.005	<0.005	<0.005	0.005	0.005	0.005	0.005	0.006	0.005
WAM2 (d)	0.20	<0.01	<0.01	<0.01	0.01	<0.01	0.01	0.01	0.01	0.00	<0.002	<0.002	0.005	<0.01	0.005	0.005	<0.005	<0.005	0.006	0.005	0.005	0.005	0.006	0.005
WAM3 (s)	<0.01	<0.01	<0.01	0.06	<0.01	<0.01	<0.01	0.01	0.00	0.00	<0.002	<0.002	0.006	<0.01	0.005	0.005	<0.005	<0.005	0.005	0.005	0.005	0.005	0.006	
WAM3 (d)	0.04	0.09	0.09	0.08	0.09	0.03	0.08	0.04	0.05	0.04	0.04	0.052	0.054	0.06	0.075	0.06	0.074	0.053	0.028	0.068	0.06	0.042	0.056	
WAM4 (s)	1.50	0.91	1.00	1.40	3.30	0.38	3.60	4.40	1.20	3.20	2.60	0.009	3.700	3.4	0.005	3.2	3.2	3.3	3.4	3.3	3.7	3.5	4.6	3.3
WAM4 (d)	0.04	0.04	0.01	0.02	0.03	0.02	0.02	0.30	0.60	0.04	0.02	2.00	0.031	0.04	0.005	0.038	0.054	0.035	0.061	0.074	0.015	0.035	0.04	0.022

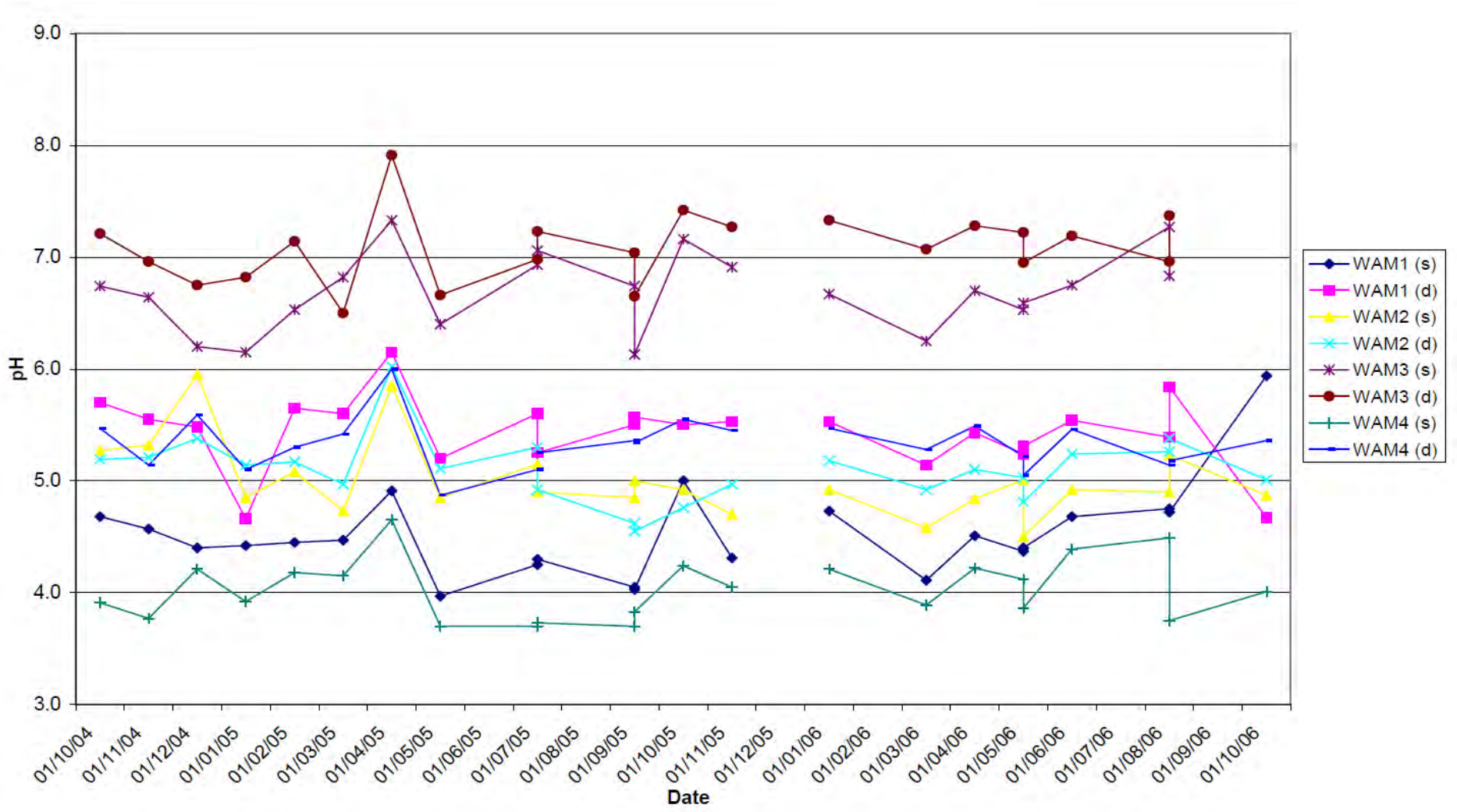
Total Phosphorus_P

LOD [mg/L]																								
Bore	25/10/04	30/11/04	21/12/04	27/01/05	18/02/05	16/03/05	27/04/05	31/05/05	05/07/05	27/07/05	09/09/05	23/09/05	21/10/05	23/11/05	10/01/06	31/01/06	03/03/06	04/04/06	04/05/06	29/05/06	28/06/06	02/08/06	30/08/06	06/10/06
WAM1 (s)	0.08	0.04	0.05	0.05	0.05	0.05	0.04	0.05	0.15	0.12	0.03	0.02	0.05	0.02	0.05	0.05	0.06	0.05	0.05	0.07	0.03	0.06	0.04	0.09
WAM1 (d)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.11	0.16	<0.01	0.02	0.05	0.02	0.07	0.02	0.04	0.03	0.03	0.02	0.02	0.03	0.03	0.1
WAM2 (s)	0.02	<0.01	0.02	0.01	<0.01	<0.01	0.02	0.01	0.10	0.10	<0.01	<0.01	0.05	0.02	0.16	0.02	0.02	0.01	0.03	0.01	0.01	0.01	0.02	0.08
WAM2 (d)	0.05	<0.01	<0.01	0.02	0.01	0.01	0.03	0.03	0.11	0.81	0.01	<0.01	0.07	0.01	0.04	0.04	0.03	0.01	0.03	0.01	0.02	0.03	0.02	0.08
WAM3 (s)	<0.01	0.05	0.01	0.06	0.05	0.03	0.01	0.01	0.10	0.19	<0.01	<0.01	0.06	<0.01	0.04	0.02	0.02	0.02	0.03	0.01	0.01	0.04	0.02	
WAM3 (d)	0.10	0.10	0.11	0.08	0.09	0.12	0.09	0.10	0.16	0.18	0.07	0.06	0.07	0.27	0.11	0.12	0.09	0.1	0.07	0.12	0.21	0.14	0.08	
WAM4 (s)	3.80	4.40	1.20	3.90	3.50	0.40	3.70	4.90	1.40	4.70	3.00	0.01	4.00	3.8	2.7	3.3	3.4	5.6	3.4	3.7	4	4.3	5.1	0.09
WAM4 (d)	0.09	0.05	0.05	0.03	0.05	0.03	0.03	0.22	0.62	0.22	0.02	2.20	0.16	0.24	0.05	0.05	0.06	0.03	0.06	0.1	0.03	0.06	0.05	0.09

Data Source: JDA(2007)



Data Source: JDA(2007)



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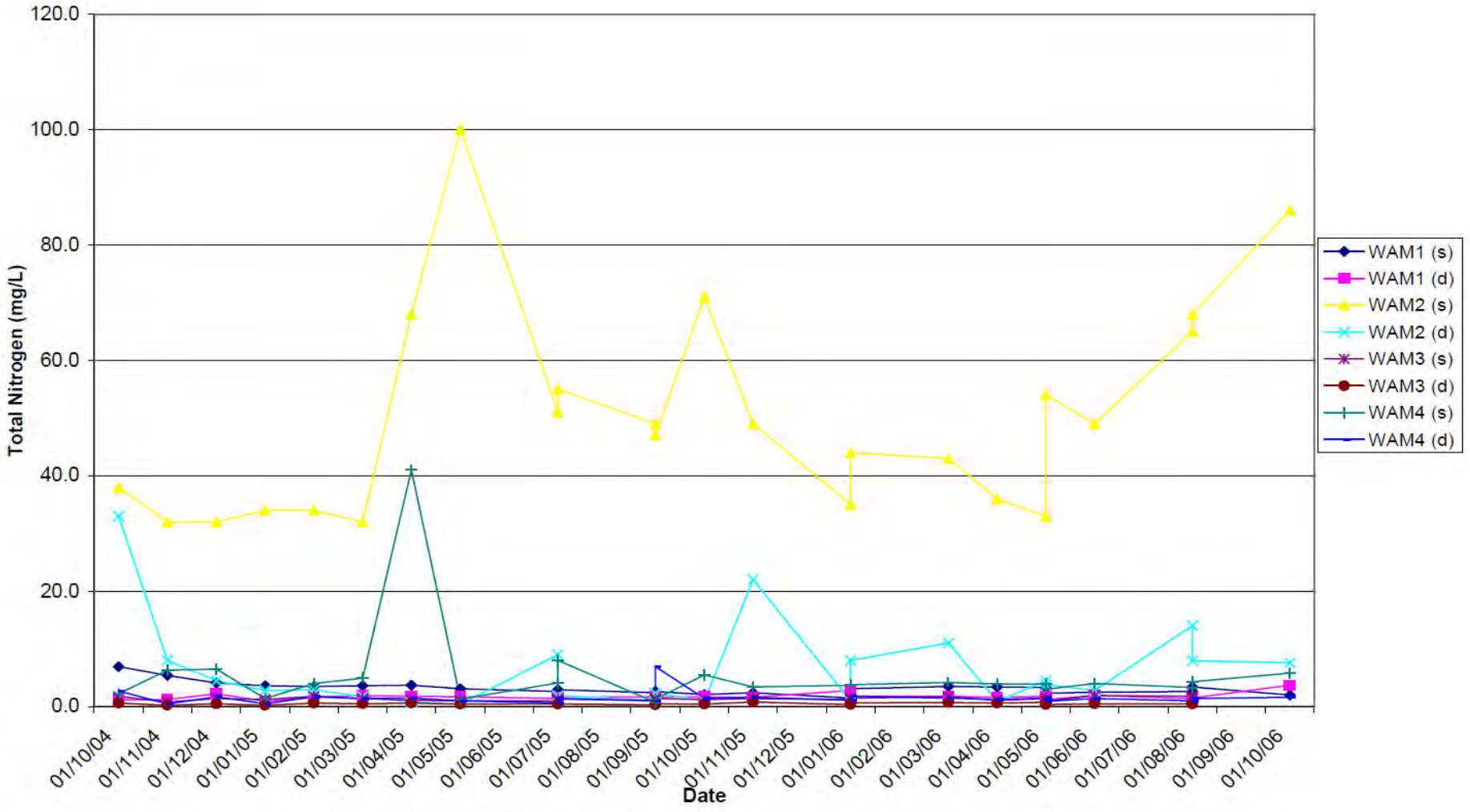

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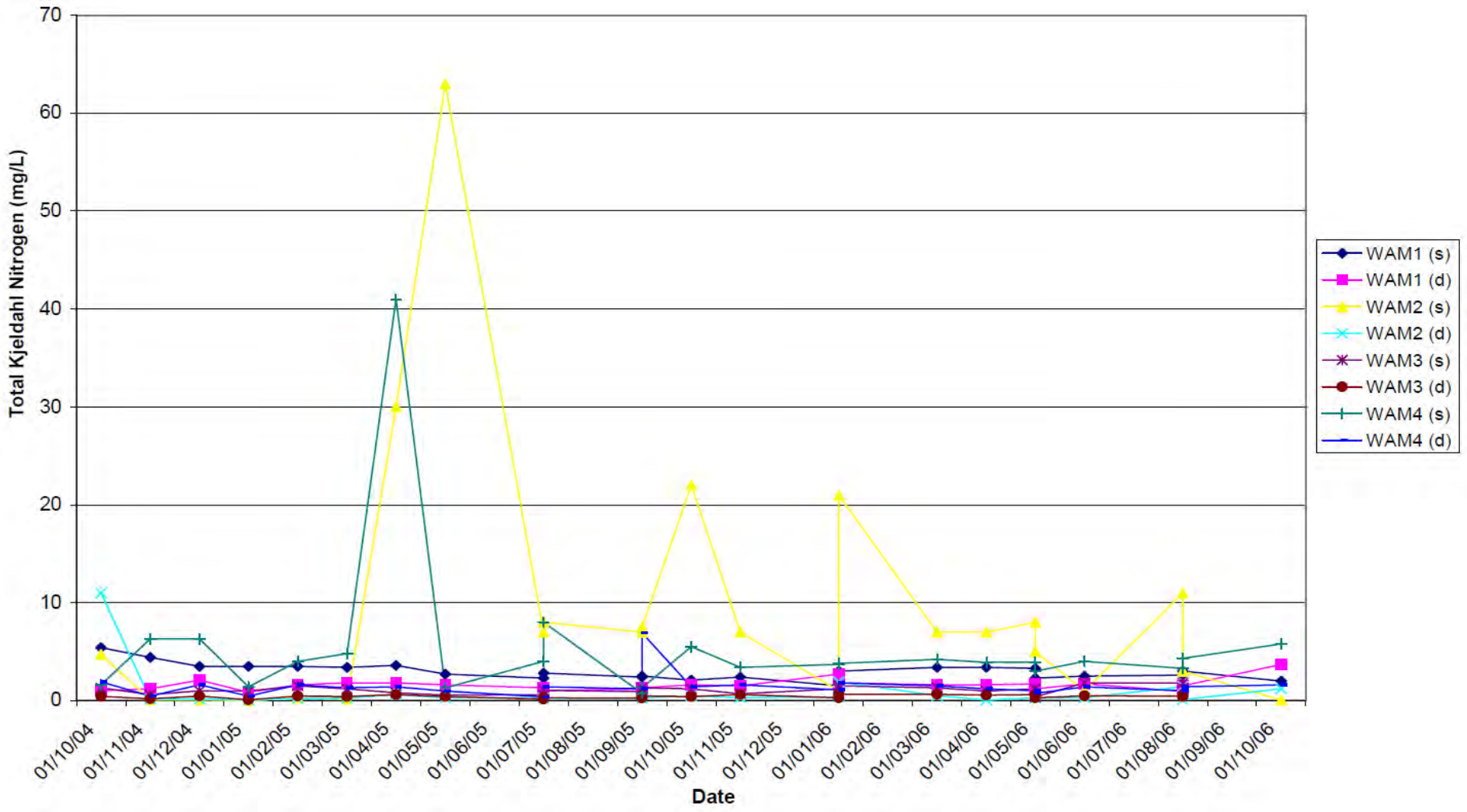
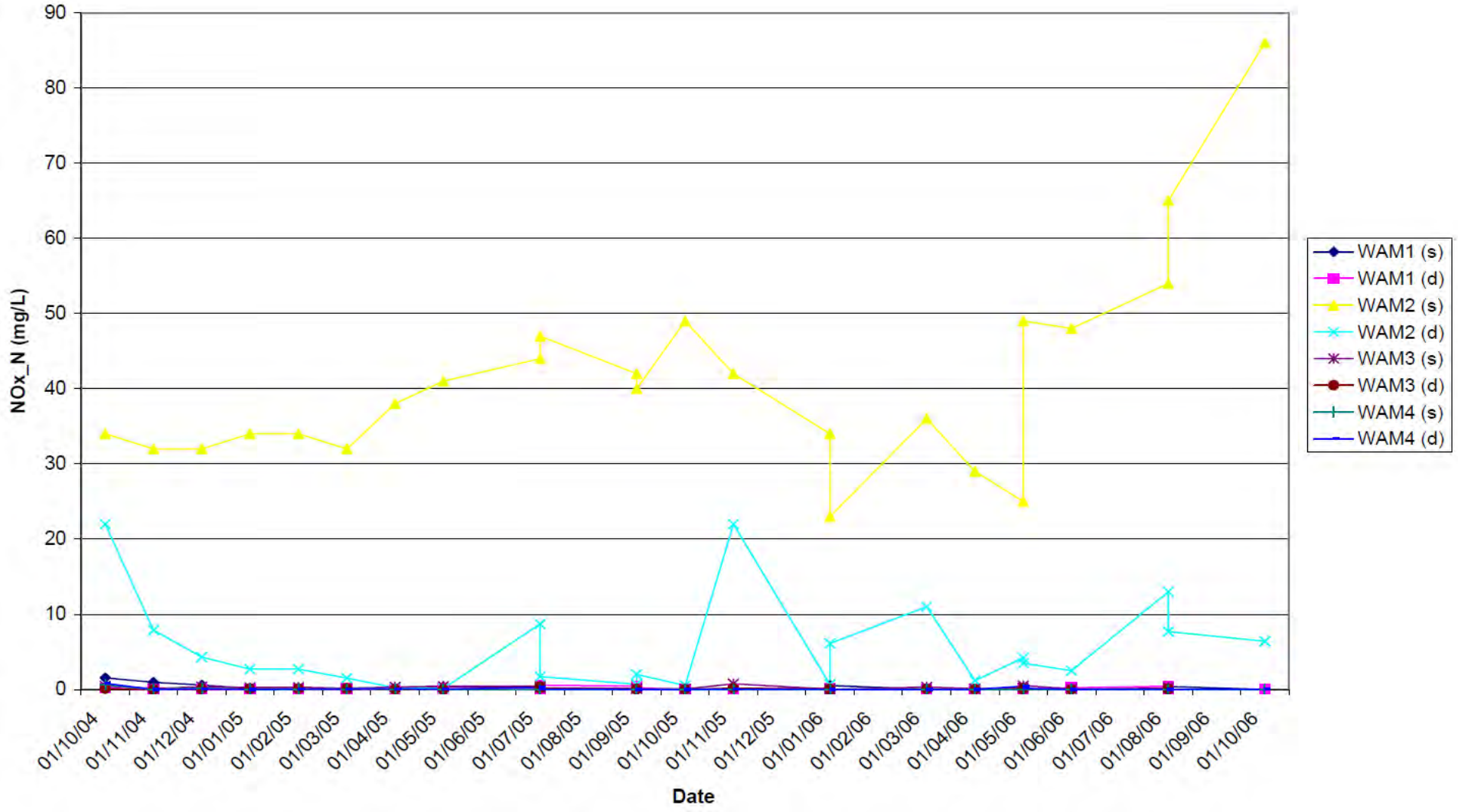


Data Source: JDA(2007)

Job No. J5483

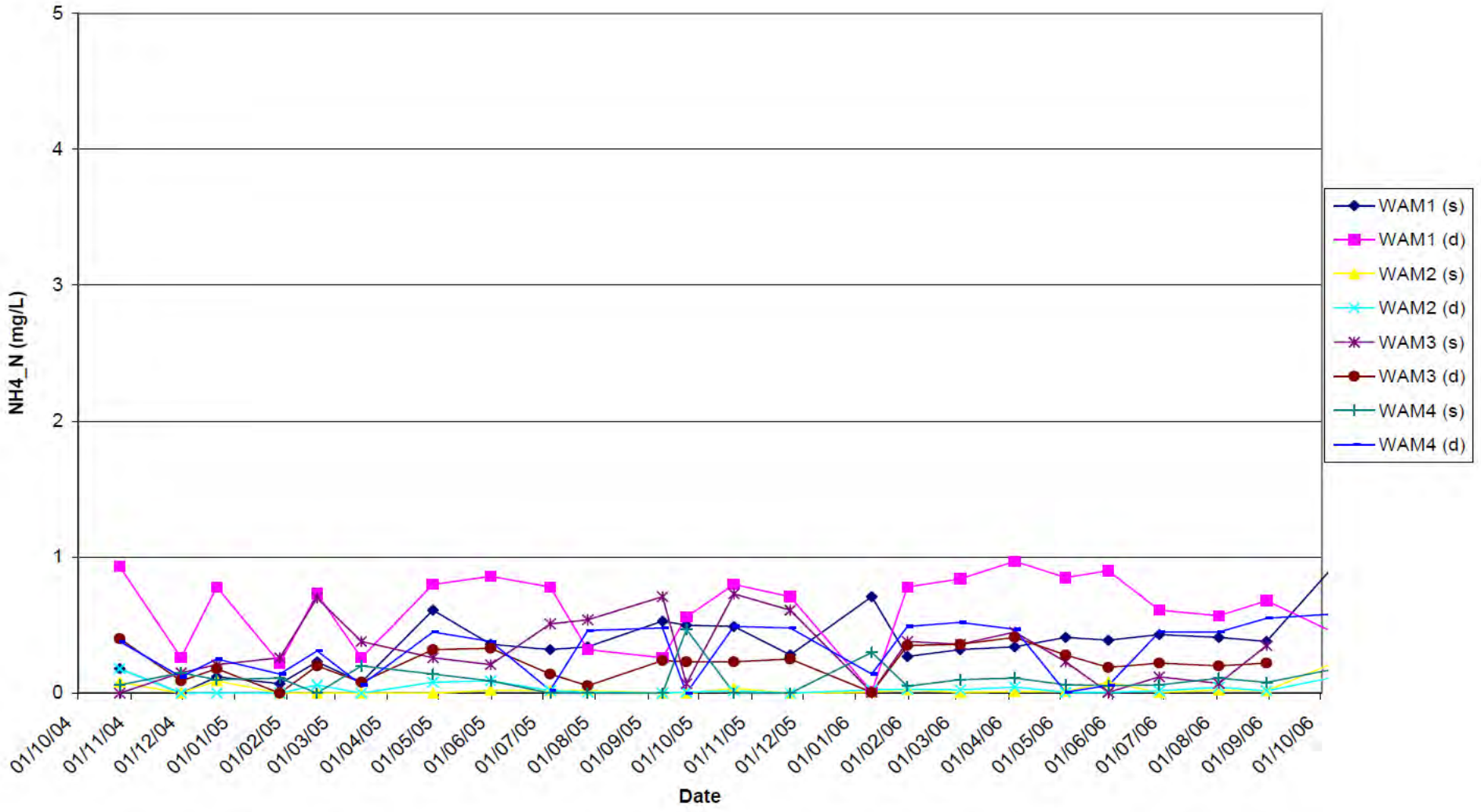
Satterley Property Group
Mandogalup East LWMS
AppendixD7: Groundwater Monitoring Data



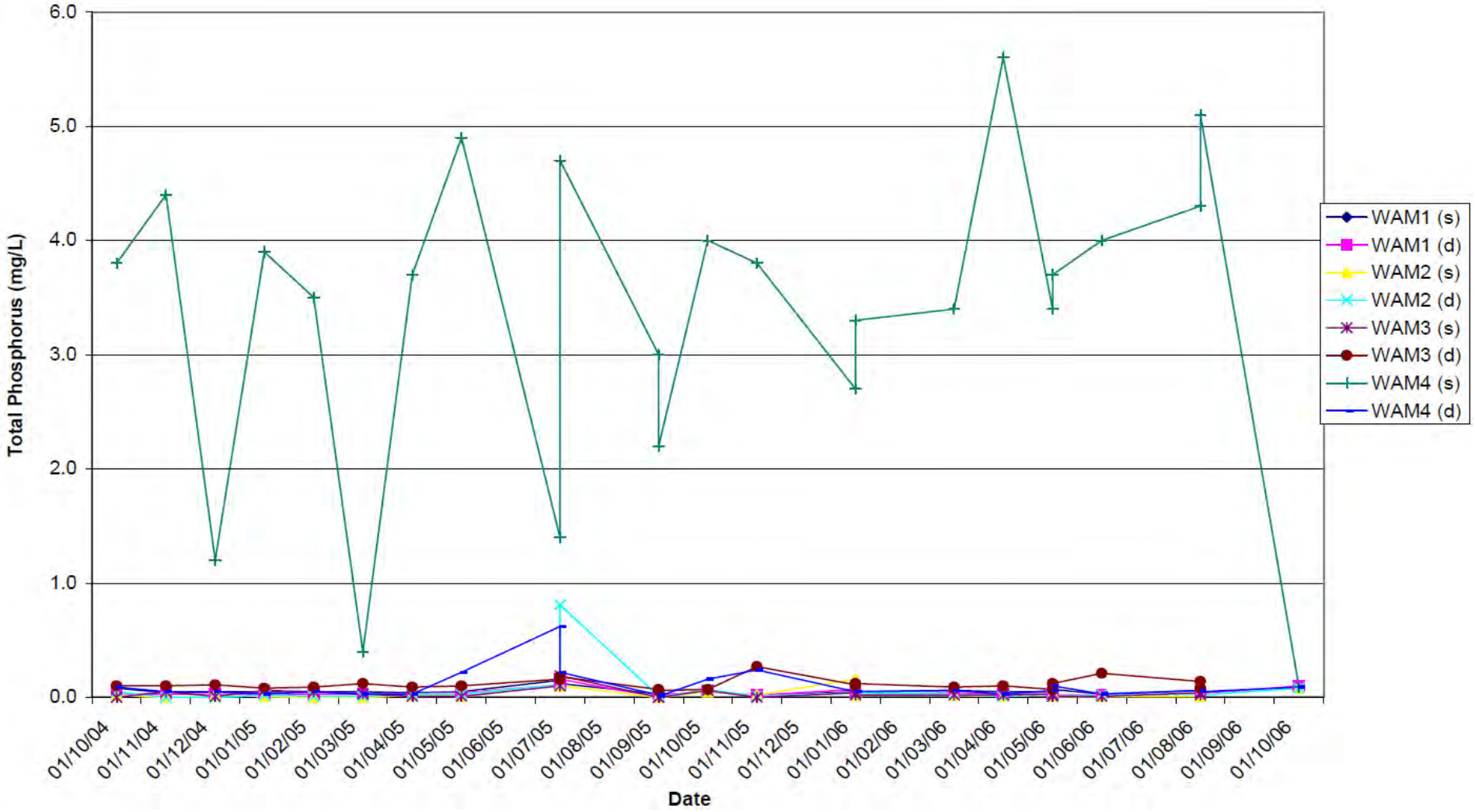
Data Source: JDA(2007)

Job No. J5483

Satterley Property Group
Mandogalup East LWMS
Appendix D8: Groundwater Monitoring Data



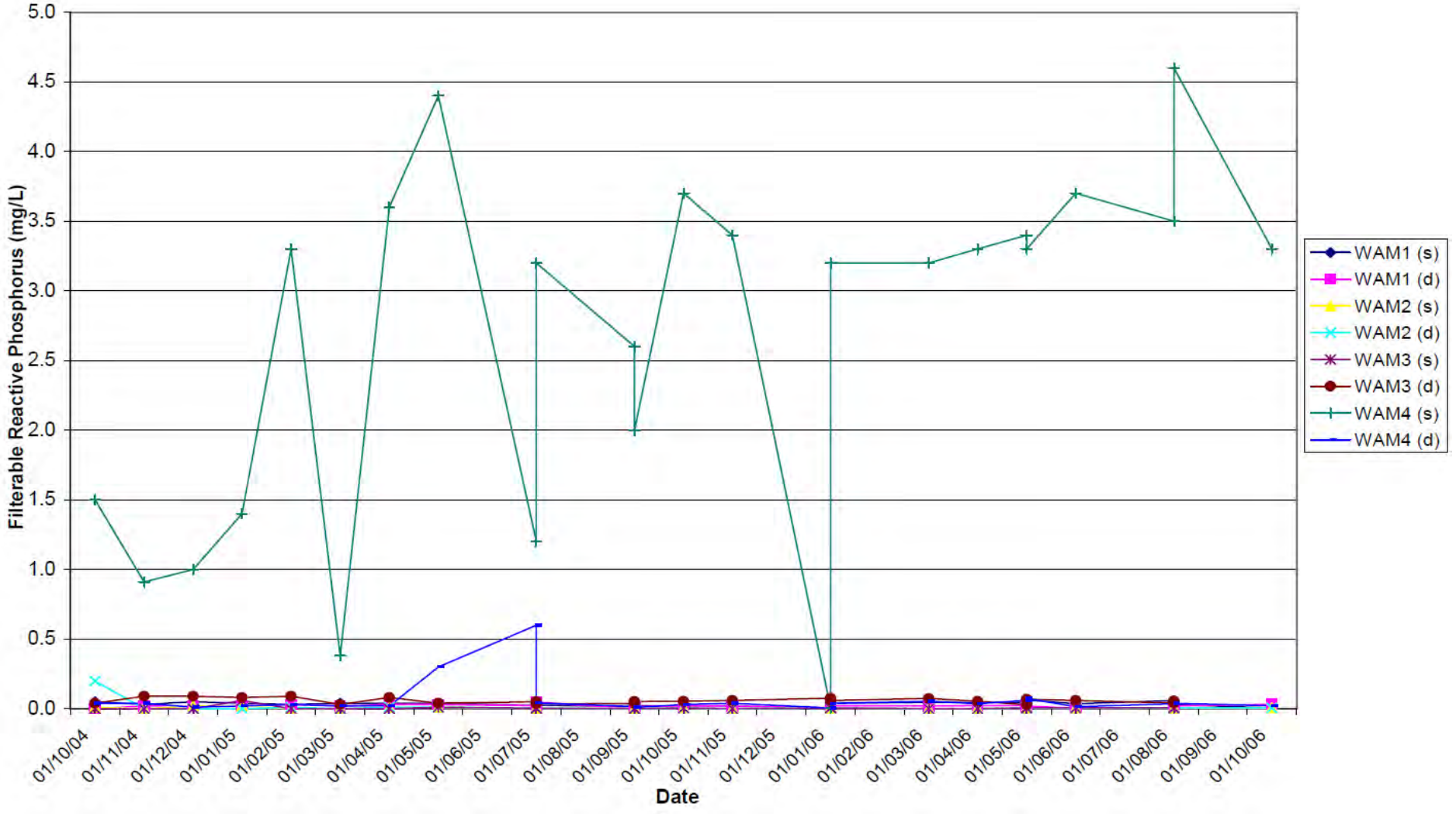
Data Source: JDA(2007)



Data Source: JDA(2007)

Job No. J5483

Satterley Property Group
Mandogalup East LWMS
Appendix D10: Groundwater Monitoring Data



Data Source: JDA(2007)

Job No. J5483

Satterley Property Group
Mandogalup East LWMS
Appendix D11: Groundwater Monitoring Data

Appendix E

Groundwater Licence GWL166930(3)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Wandi Anketell Holdings Pty Ltd		
Description of Water Resource	Jandakot Perth - Superficial Swan	**Annual Water Entitlement**	239650 kL
Location of Water Source	Lot 8010 On Plan 74310 - Volume/Folio Lr3163/133 - Lot 8010 Wandi - Production Bore 9 Lot 8001 On Plan 69132 - Volume/Folio Lr3160/188 - Lot 8001 Lyon Rd Wandi - Production Bore 7 Lot 8005 On Plan 400200 - Volume/Folio Lr3164/92 - Lot 8005 - Production Bore 5 Lot 8028 On Plan 400989 - Volume/Folio Lr3164/69 - Lot 8028 - Production Bore 8		

Authorised Activities	**Taking of water for**	**Location of Activity**
	Dust suppression for earthworks and construction purposes	Lot 9002 On Plan 69132 - Volume/Folio 2758/177 - Lot 9002 Hoffman Rd Mandogalup - Mandogalup Lot 9006 On Plan 70124 - Volume/Folio 2769/846 - Lot 9006 Hoffman Rd Mandogalup - Mandogalup Lot 9021 On Plan 402386 - Volume/Folio 2846/260 - Lot 9021 Mandogalup Lot 8007 On Plan 76957 - Volume/Folio Lr3163/605 - Lot 8007 Lot 8005 On Plan 400200 - Volume/Folio Lr3164/92 - Lot 8005 - Production Bore 5 Lot 9021 On Plan 402386 - Volume/Folio 2846/260 - Lot 9021 Honeywood
	Irrigation of up to 22.43 ha of public open space	Lot 8010 On Plan 74310 - Volume/Folio Lr3163/133 - Lot 8010 Wandi - Production Bore 9 Lot 8001 On Plan 69132 - Volume/Folio Lr3160/188 - Lot 8001 Lyon Rd Wandi - Production Bore 7 Lot 8006 On Plan 70124 - Volume/Folio Lr3160/932 - Lot 8006 Honeywood Av Wandi Lot 8011 On Plan 76939 - Volume/Folio Lr3163/445 - Lot 8011 Wandi Lot 8000 On Plan 69132 - Volume/Folio Lr3160/187 - Lot 8000 Lyon Rd Wandi Lot 9006 On Plan 70124 - Volume/Folio 2769/846 - Lot 9006 Hoffman Rd Mandogalup - Mandogalup

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

		Lot 8007 On Plan 76957 - Volume/Folio Lr3163/605 - Lot 8007 Lot 8005 On Plan 400200 - Volume/Folio Lr3164/92 - Lot 8005 - Production Bore 5 Lot 8009 on Plan 400200, and Lots 8020, 8022, 8023 & 8024 on Plan 400193 - Public Open Space - North East Lot 9021 On Plan 402386 - Volume/Folio 2846/260 - Lot 9021 Honeywood
	Irrigation of up to 2 ha of road verge	Lot 8015 On Plan 70124 - Volume/Folio Lr3160/824 - Lot 8015 Bruny Mndr Wandi Lot 8016 On Plan 70124 - Volume/Folio Lr3160/825 - Lot 8016 Honeywood Av Wandi
Duration of Licence	From 30 December 2014 to 2 December 2023	

This Licence is subject to the following terms, conditions and restrictions:

1 The licensee shall comply with the commitments of the operating strategy Honeywood Estate: Irrigation Water Supply, as prepared by the licensee and approved by the Department of Water on 15 July 2011 including any modifications to the commitments as approved during the term of the licence.

2 The licensee shall not use water for public open space between 9 am and 6 pm except for the establishment of newly planted areas. For newly planted areas water may be used within these hours for a period of up to 28 consecutive days, commencing from the date of planting.

3 Between 1 June and 31 August in any year, the licence-holder must not water a lawn, garden, or grass-covered area ("turf") by reticulation, provided always that this restriction shall not apply to watering with a hand held hose; or watering, by way of reticulation: newly planted areas for a period of up to 28 days from the date of planting; for renovating turf; or for maintenance of reticulation systems.

4 The volume of all water taken under this licence must be metered using an approved meter fitted to each drawpoint.

5 The annual water year for water taken under this licence is defined as 1 July to 30 June.

6 The licensee must not, in any water year, take more water than the annual water entitlement specified in this licence.

7 The licensee must take and record the reading from each meter required under this licence at the beginning and another at the end of the water year defined on this licence.

8 The licensee must take and record the reading from each meter required under this licence, at the end of each month.

9 The licensee must submit to the Department of Water the recorded meter readings and the volume of water taken within the water year, every 12 month(s) commencing 14/07/2014.

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

This Licence is subject to the following terms, conditions and restrictions:

10 The licensee must ensure the installed meter(s) accuracy is maintained to within plus or minus 5% of the volume metered, in field conditions.

11 The licensee must notify the Department of Water in writing of any water meter malfunction within seven days of the malfunction being noticed.

12 The licensee must obtain authorisation from the Department of Water before removing, replacing or interfering with any meter required under this licence.

13 The licensee shall provide to the Department of Water a Groundwater Monitoring Review, every 12 month(s), commencing 30/09/2014.

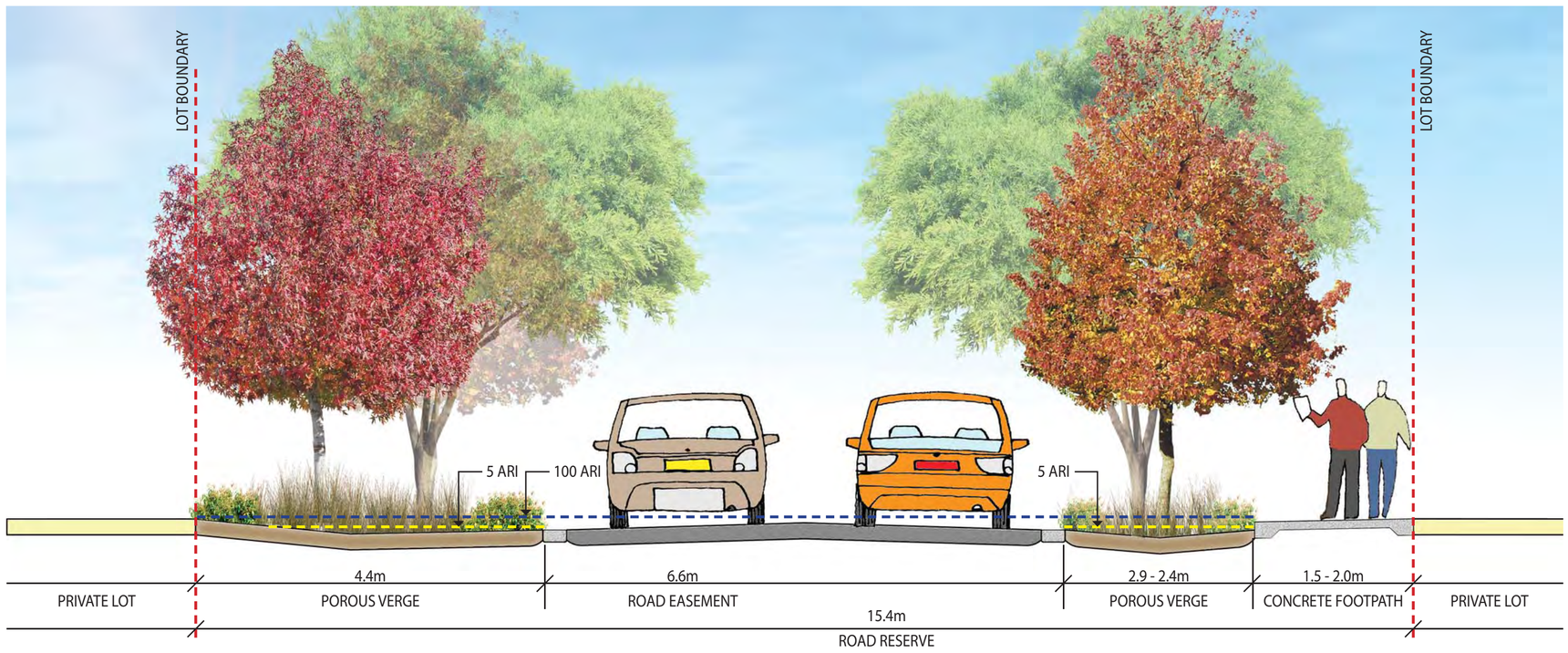
End of terms, conditions and restrictions

Appendix F

Preliminary Landscape Concepts (Emerge, 2016)

TYPICAL 15.4 m ROAD CROSS SECTION WITH FOOTPATH AT POROUS VERGE

SCALE 1:50



TYPICAL 15.4 m ROAD CROSS SECTION WITH FOOTPATH AT VEHICLE CROSSOVER

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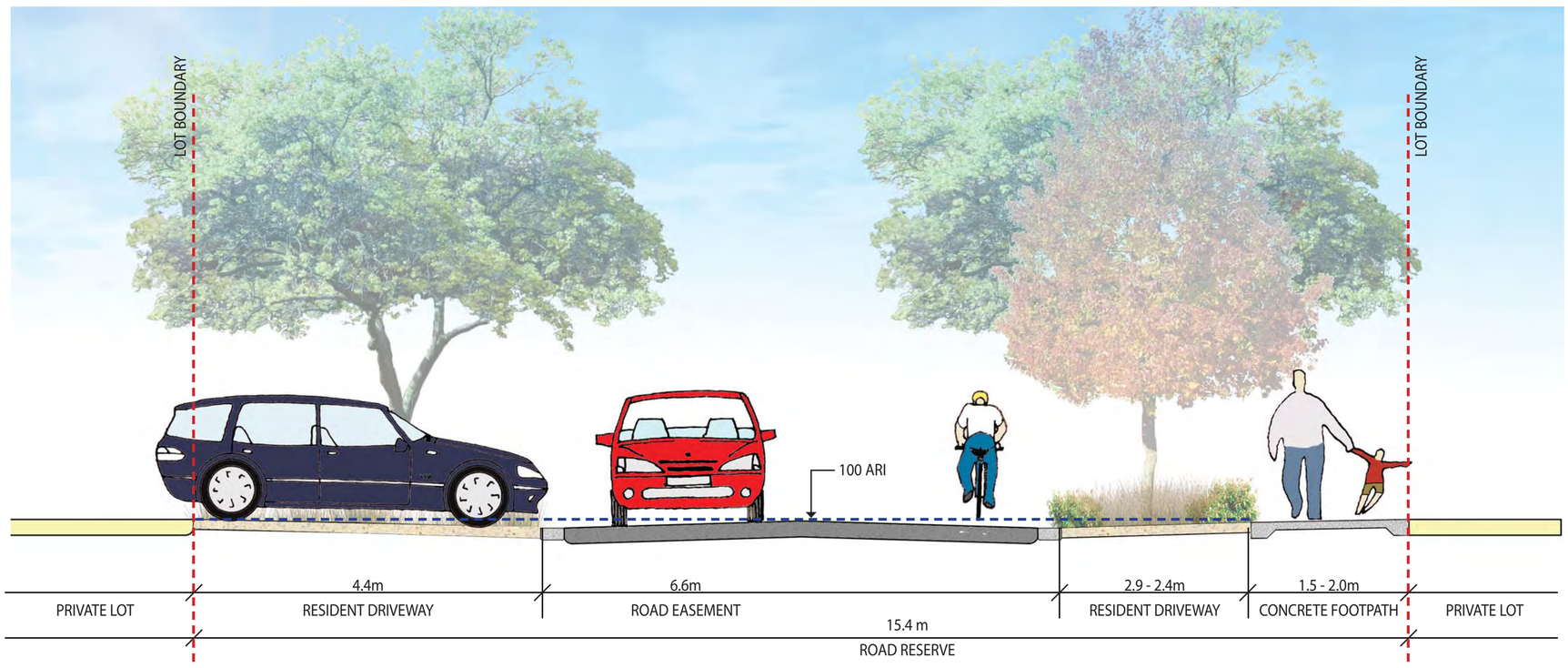

TYPICAL 15.4 m ROAD CROSS SECTION WITH NO FOOTPATH AT VEHICLE CROSSOVER

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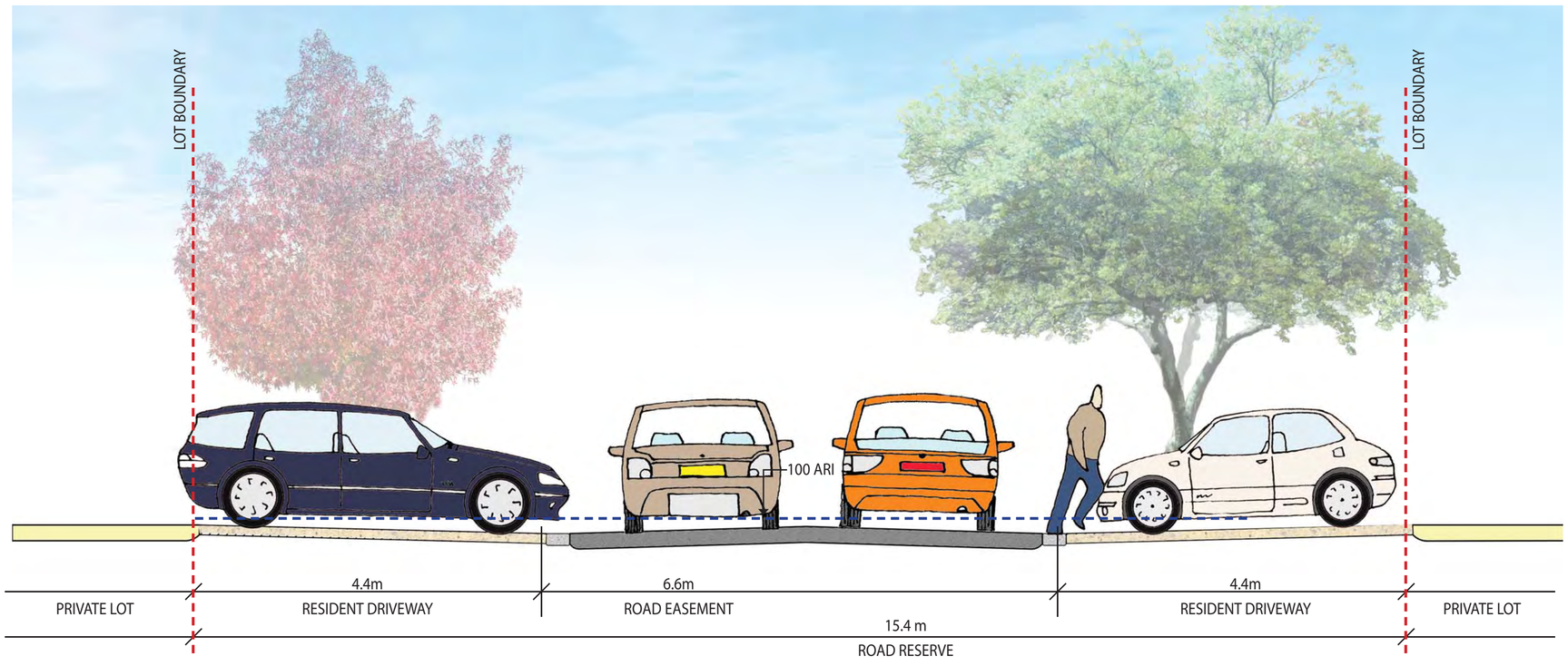


MANDOGALUP

TYPICAL STREET CROSS SECTIONS

DWG MA-01-01
REV A
DATE 21.11.16

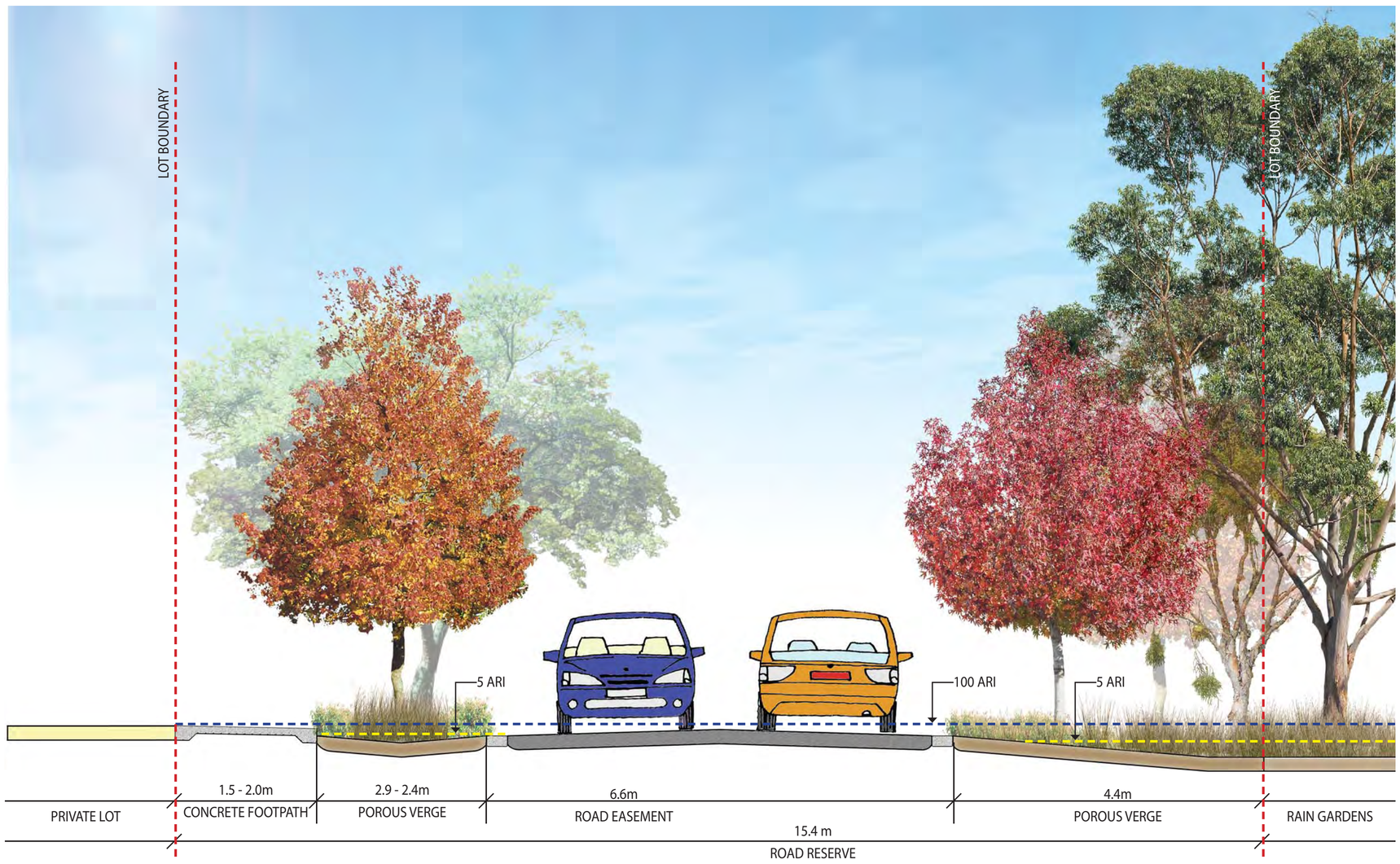
0 0.5 1 1.5 2 m

SCALE 1 : 50 @ A1

emerge ASSOCIATES

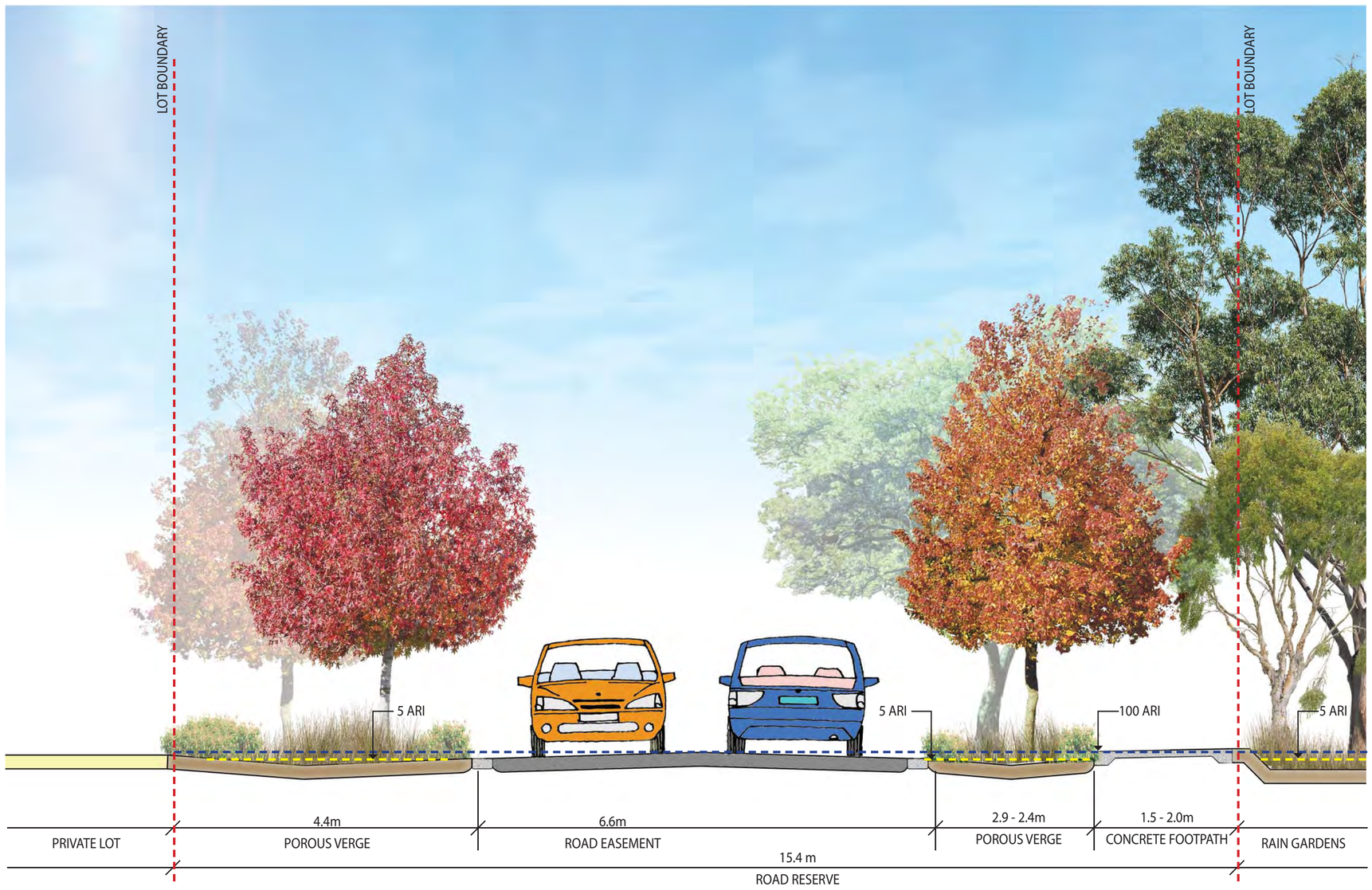
TYPICAL 15.4 m ROAD CROSS SECTION WITH NO FOOTPATH AT REBATED LOTS / RAIN GARDENS

SCALE 1:50



TYPICAL 15.4 m ROAD CROSS SECTION WITH FOOTPATH AT REBATED LOTS / RAIN GARDENS

SCALE 1:50



MANDOGALUP

TYPICAL STREET CROSS SECTIONS

DWG MA-01-01
REV A
DATE 21.11.16

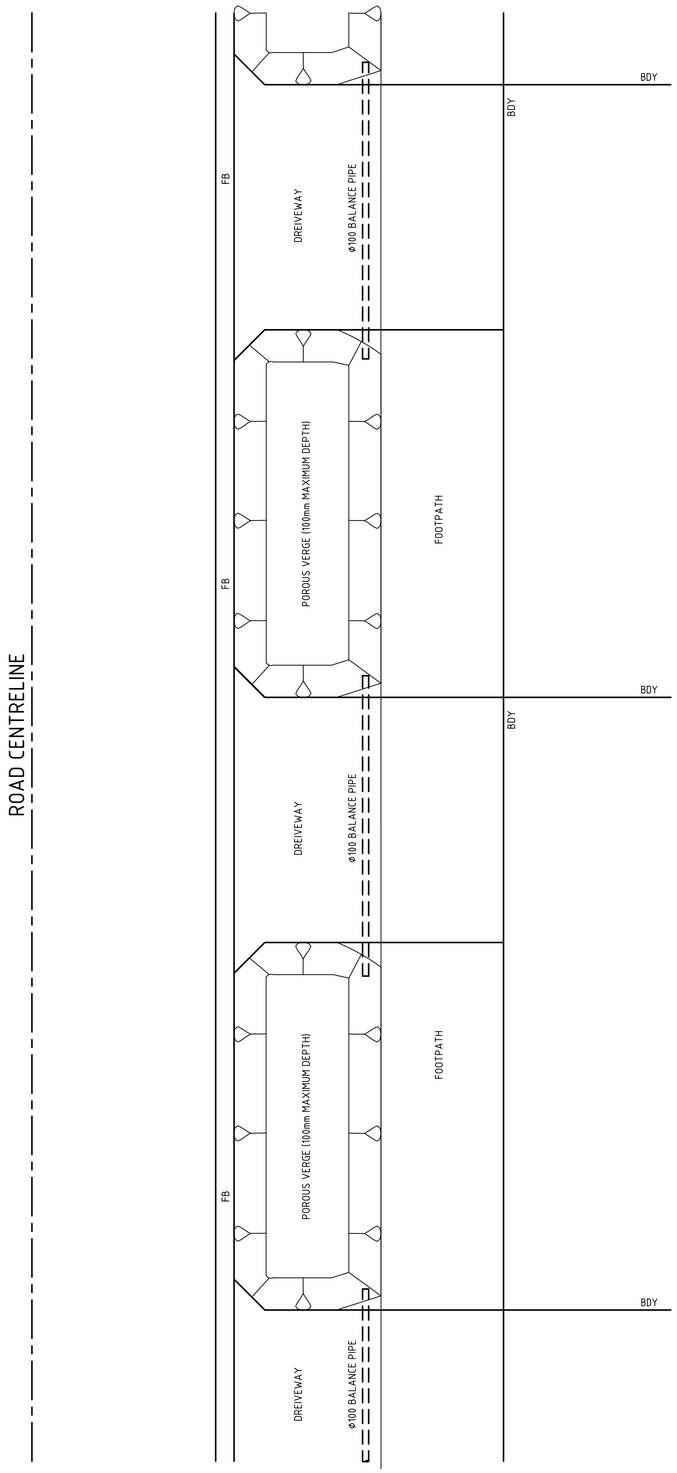
0 0.5 1 1.5 2 m

SCALE 1 : 50 @ A1

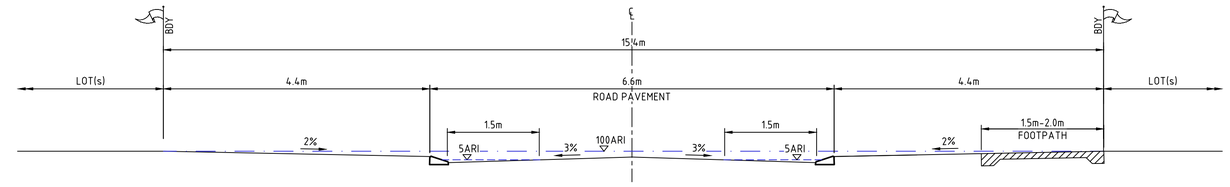
emerge ASSOCIATES

Appendix G

Preliminary Engineering Drawings (Peritas, 2016)



TYPICAL LAYOUT PLAN
SCALE 1:50



TYPICAL 15.4m ROAD CROSS SECTION (MK)
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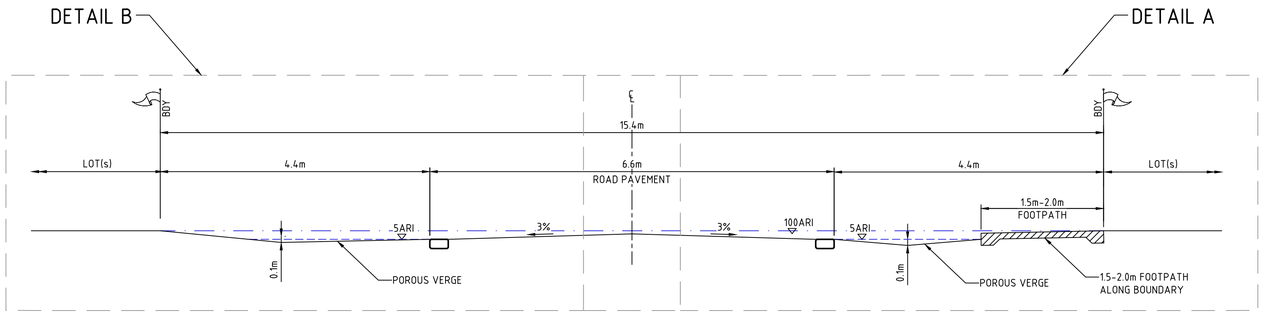
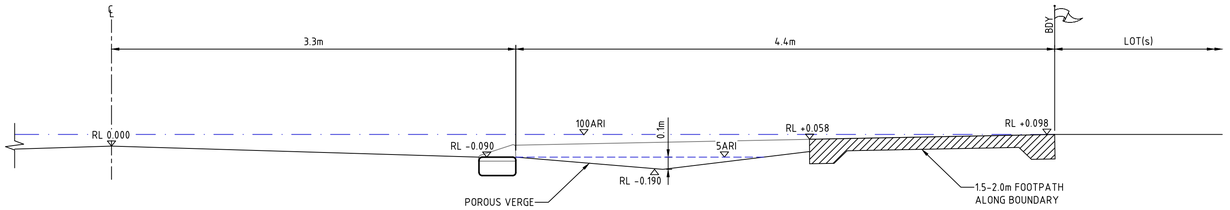


TYPICAL 15.4m ROAD CROSS SECTION (FB) AT POROUS VERGE
SCALE 1:50



DETAIL A
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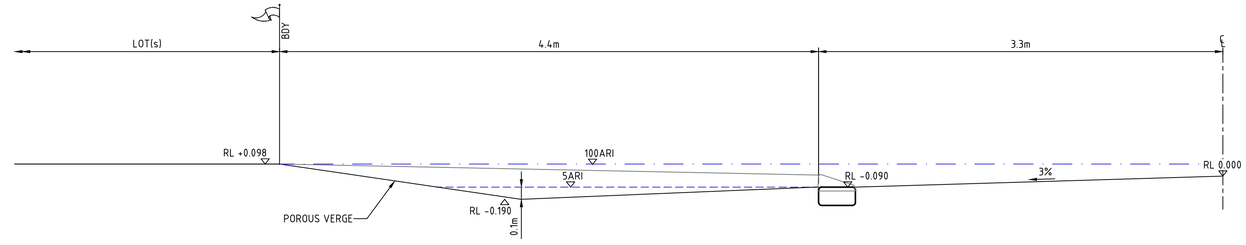

DETAIL B
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16-11-16 1:52:14 PM Nguyen Thu Trang
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PROJECT: MANDOGALUP WESTERN AUSTRALIA

DRAWING TITLE: TYPICAL ROAD CROSS SECTIONS SHEET 1 OF 4

SCALE	AS SHOWN	FILE	-
HORIZONTAL	-	DESIGN	-
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WAPC No	-	DATE	NOV 16
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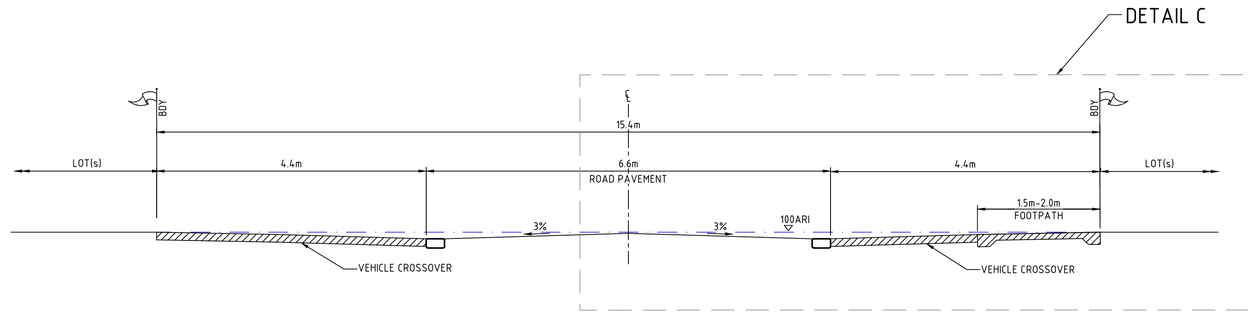
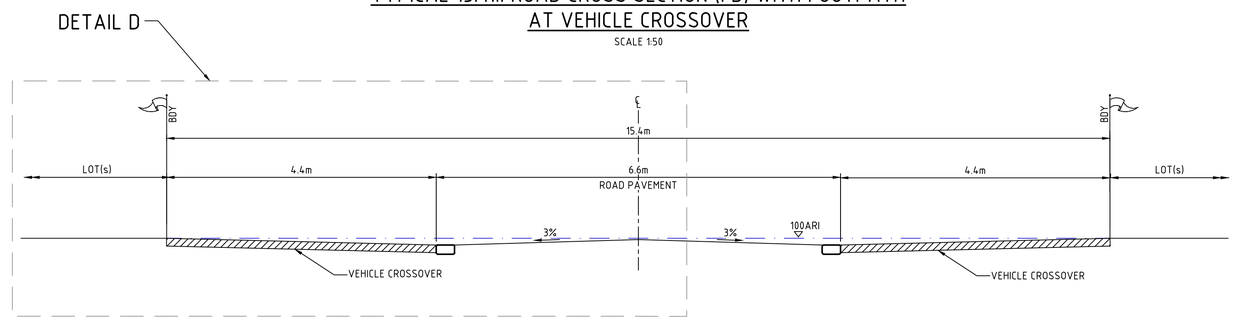


TYPICAL 15.4m ROAD CROSS SECTION (FB) WITH FOOTPATH AT VEHICLE CROSSOVER

SCALE 1:50

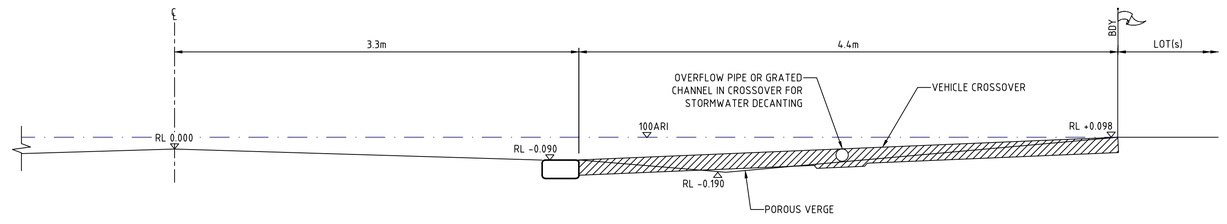


TYPICAL 15.4m ROAD CROSS SECTION (FB) WITH NO FOOTPATH AT VEHICLE CROSSOVER

SCALE 1:50

DETAIL C

SCALE 1:25



DETAIL D

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SCALE 1:25

METRES 1 0 1 2 3m

SCALE 1:50

16-11-16 1:52:18 PM Nguyen Thu Trang
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DRAWING TITLE: TYPICAL ROAD CROSS SECTIONS
SHEET 2 OF 4

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VERTICAL	-	DRAWN	DCD
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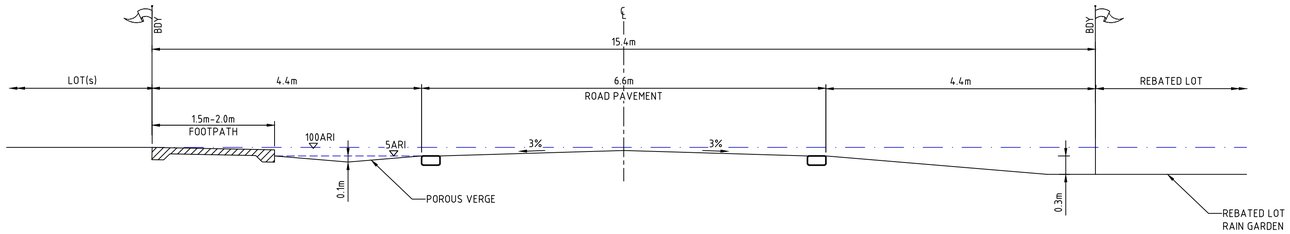
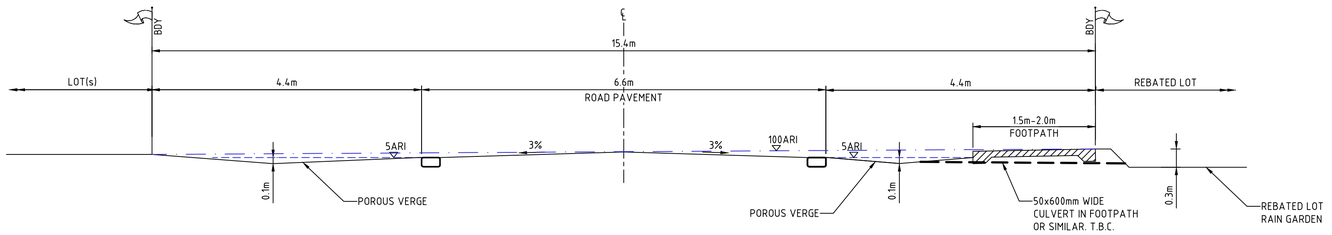


TYPICAL 15.4m ROAD CROSS SECTION (FB) WITH REBATED LOT RAIN GARDENS
NON-FOOTPATH OPTION

SCALE 1:50



TYPICAL 15.4m ROAD CROSS SECTION (FB) WITH REBATED LOT RAIN GARDENS
FOOTPATH OPTION

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SCALE 1:25

METRES 1 0 1 2 3m

SCALE 1:50

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DRAWING TITLE: TYPICAL ROAD CROSS SECTIONS
SHEET 3 OF 4

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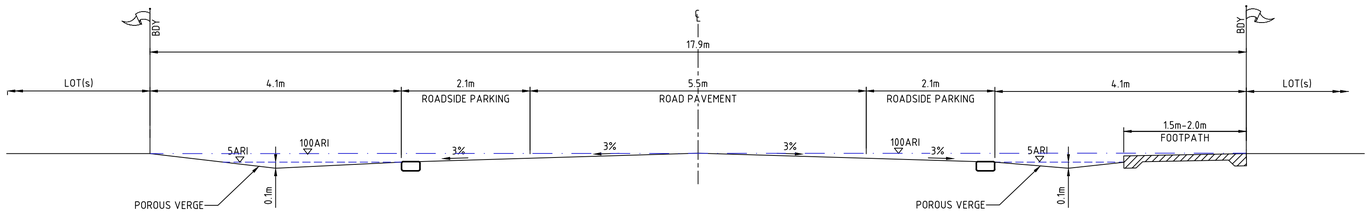
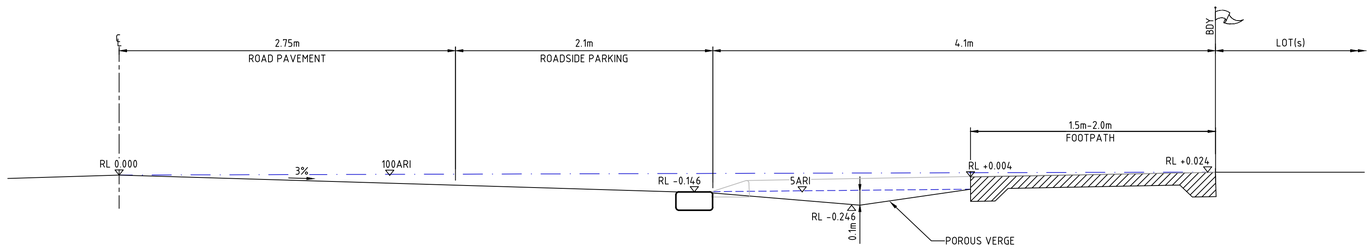


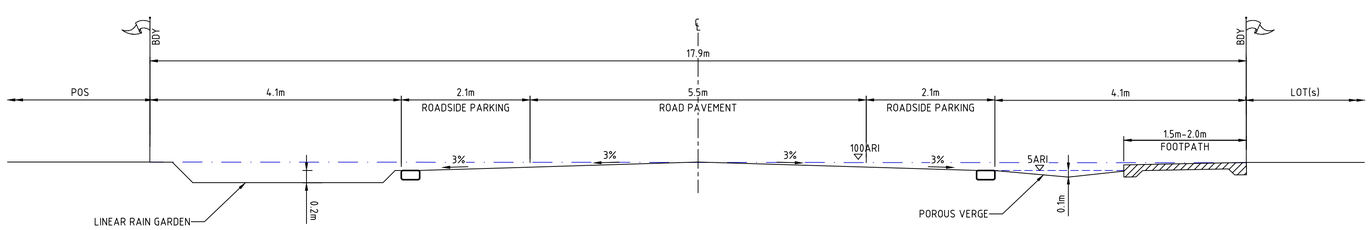
TYPICAL 17.9m ROAD CROSS SECTION (FB) WITH POROUS VERGE

SCALE 1:50



TYPICAL 17.9m HALF ROAD CROSS SECTION (FB) WITH FOOTPATH AT POROUS VERGE

SCALE 1:25



TYPICAL 17.9m ROAD CROSS SECTION (FB) WITH NO FOOTPATH AT LINEAR RAIN GARDEN

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SCALE 1:25

METRES 1 0 1 2 3m

SCALE 1:50

16-11-16 1:52:28 PM Nguyen Thu Trang
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WESTERN AUSTRALIA

DRAWING TITLE: TYPICAL ROAD CROSS SECTIONS
SHEET 4 OF 4

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HORIZONTAL	-	DESIGN	-
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Appendix H

Modelling Parameters

TABLE H1: XP-SWMM Modelling Assumptions

Key Elements	Parameter			Value
IFD Data	BOM IFD Calculator			Jandakot Area
Runoff Assumptions	Land Use	Lots (Traditional)	Initial Loss (mm)	13
			Continuing Loss (mm/hr) all ARI	7.0
			Manning's n for impervious area	0.03
			Manning's n for pervious area	0.03
		Lots (Compact)	Initial Loss (mm)	13
			Continuing Loss (mm/hr) all ARI	7
			Manning's n for impervious area	0.03
			Manning's n for pervious area	0.03
		Road Reserve	Initial Loss (mm)	0.00
			Runoff Coefficient (%) all ARI	80
			Manning's n for impervious area	0.014
			Manning's n for pervious area	0.03
		POS	Initial Loss (mm)	0.00
			Runoff Coefficient (%) all ARI	10
			Manning's n for impervious area	0.014
			Manning's n for pervious area	0.03
			Initial Loss (mm)	0.00
			Runoff Coefficient (%) all ARI	10
			Manning's n for impervious area	0.014
			Manning's n for pervious area	0.03
			Initial Loss (mm)	0.00
			Runoff Coefficient (%) all ARI	10
			Manning's n for impervious area	0.014
			Manning's n for pervious area	0.03
	Catchment Grade			0.003
	Runoff routing method used			Laurenson's method ($S=BQ^{n+1}$)
	Evaporation			None Assumed
Simulation Parameters	Dry time step			86400 Seconds (1 day)
	Transition time Step			30 Seconds
	Wet time step			30 Seconds
	Simulation period			7 Days
Hydraulics	Culverts		Manning's n	0.014
			Headwall type	Circular
			Entrance/Exit loss Coefficients	0.5, 1
	Subsoil[1]		Manning's n	0.014
			Headwall type	-

		Entrance/Exit loss Coefficients	-
	Swale	Centre channel Manning's n	0.025
		Over bank Manning's n	0.025
		Assumed Swale Infiltration	0.00
	Storages	Assumed Swale Infiltration	0.00
		Minimum side slopes	1:6 (v:h)

Notes: [1] Subsoil drains beneath basins are modelled at basin invert.

MODRET - Summary Results

Job: J5483

Date :24/08/16

Performed by : SC

Mandogalup East LWMS

Catchment Lots	1.12	ha
Catchment Area Road	1.56	ha
Top Elevation	21.8	mAHD
Base Elevation	21.5	mAHD
Base Length		m
Base Width		m
Depth		m
Batter		
K_H	5	m/day
K_V	5	m/day
n	0.2	
Groundwater Level	20.5	mAHD
Base of Aquifer	15.5	mAHD

Road		
Stage Volume relationship		
Stage (mAHD)	Volume (m^3)	Area (m^2)
0.00	0.0	4700.0000
0.10	465.0	4700.0000
0.15	700.0	4700.0000

Road Reserve			
Storm Event	Depth	Infiltrated Volume	mm/hr
0.5	0	-	-
1	0	-	-
3	0.01	890	63
6	0.05	1050	37
12	0.10	1250	22
24	0.15	1550	14
48	0.16	1950	9
72	0.21	2250	7
96	0.18		
120	0.21		

Note: Road Reserve Based on 2.68ha of connected impervious area. 1km stretch of road at 15.6m wide, with 20% of connected lot area, assuming 28m deep lots

MODRET - Summary Results

Job: J5483 Date :24/08/16 Performed by : SC

Mandogalup East LWMS

Catchment Area Lots	0.06	ha
Catchment Area Road	0.15	ha
Top Elevation	21.8	mAHD
Base Elevation	21.5	mAHD
Base Length		m
Base Width		m
Depth		m
Batter		
K_H	5	m/day
K_V	5	m/day
n	0.2	
Groundwater Level	20.5	mAHD
Base of Aquifer	15.5	mAHD

Rebated Lot			Linear Rain Garden		
Stage Volume relationship			Stage Volume relationship		
Stage (mAHD)	Volume (m^3)	Area (m^2)	Stage (mAHD)	Volume (m^3)	Area (m^2)
0.0	0.0	66.0	0.0	0.0	0.007
0.1	9.0	115.4	0.1	7.0	0.007
0.2	23.5	176.4	0.2	14.0	0.007
0.3	44.6	248.9			

5yr 24hr - Rebated Lot Rain Garden			5yr 24hr - Linear Rain Garden	
Depth	Infiltrated Volume	mm/hr	Infiltrated Volume	mm/hr
0.2	68 (20hrs)	48		
0.3			299 (30hrs)	43

MODRET - Summary Results

Job: J5483

Date :11/07/14

Performed by : RD

Basin A: Mandogalup LWMS

Catchment Area <5yr ARI	2.05	ha
Catchment Area >5yr ARI	6	ha
Top Elevation	22.5	mAHD
Base Elevation	21.5	mAHD
Base Length	48.5	m
Base Width	45	m
Depth	1	m
Batter	1:6	
K_H	5	m/day
K_V	5	m/day
n	0.2	
Groundwater Level	20.5	mAHD
Base of Aquifer	0	mAHD

Stage Volume relationship		
Stage (mAHD)	Volume (m^3)	Area (m^2)
21.5	0.0	600.0
21.6	60.0	600.0
21.7	120.0	600.0
21.8	180.0	600.0
21.8	180.0	2180.0
21.9	405.0	2295.0
22.0	640.0	2415.0
22.1	890.0	2530.0
22.2	1145.0	2655.0
22.3	1415.0	2780.0
22.4	1700.0	2910.0
22.5	2000.0	3040.0

Duration	1 Yr ARI			5 Yr ARI			100 Yr ARI		
	Peak Level (mAHD)	Volume (m^3)	Total Runoff (m^3)	Peak Level (mAHD)	Volume (m^3)	Total Runoff (m^3)	Peak Level (mAHD)	Volume (m^3)	Total Runoff (m^3)
0.5hr				21.89	380	582	21.82	225	1103
1hr	21.80	180	250	21.90	405	748	21.96	545	1368
3hr				21.91	430	1083	22.09	860	1894
6hr				21.94	495	1369	22.18	1095	2357
12hr				21.99	615	1753	22.28	1360	2986
24hr				22.10	890	2263	22.42	1760	3932
48hr				22.09	860	2891	22.48	1940	5210
72hr				22.07	810	3227	22.50	2000	5908
96hr									
120hr									

Appendix I

Runoff Coefficients – Continuing Loss Calculations

TYPICAL COMPACT LOT

User input

Lot design								
Lot area	m^2	300						
Roof area of house	m^2	150	Assumed maximum 50% lot area based on R-Codes					
Outdoor living area	m^2	30	Assumed maximum 10% lot area based on R-Codes, greater than minimum of 30m^2.					
Driveway area	m^2	30	Assumed maximum 10% lot area based on R-Codes					
Total impervious	m^2	210						
Total impervious contributing	m^2	210	Entire lot contributes to road drainage system					
Rainfall contributing to soakwells from impervious area								
Rainfall depth	mm	13						
	m	0.013						
Rainfall volume	m^3	2.73	Rainfall depth (m) times total impervious contributing area (m^2) to soakwells. Min Soakwell Volume.					
Soakwell Volume Requirements		**soakwell 1**	**soakwell 2**	**soakwell 3**	**soakwell 4**	**Total**		
Soakwell Height	m	0.60	0.60	0.60	0.60			
Soakwell Diameter	m	1.20	1.20	1.20	1.20			
Soakwell Volume	m^3	0.68	0.68	0.68	0.68	**2.71**	Total soakwell volume to equal rainfall volume	
Soakwell Surface Area	m^2	1.13	1.13	1.13	1.13			
Soakage Calculation								
Soil conductivity (K)	m/day	5	5	5	5			
Aquifer Depth	m	3	3	3	3			
Connected area per soakwell	m^2	52	52	52	52	**209**	Total connected area per sokwell to equal total impervious contributing	
Soakage Rate	m^3/hr	0.76	0.76	0.76	0.76			
Soakage Continuing Loss	mm/hr	14	14	14	14			
Soakwell clogging factor	%	50%	50%	50%	50%			
	mm/hr	7	7	7	7			

Modelling assumptions		
Initial loss	mm	13
Continuing loss	mm/hr	7

TYPICAL STANDARD LOT

User input

Lot design			
Lot area	m^2	400	
Roof area of house	m^2	240	Assumed maximum 60% lot area based on R-Codes
Outdoor living area	m^2	40	Assumed maximum 10% lot area based on R-Codes, greater than minimum of $30m^2$.
Driveway area	m^2	40	Assumed maximum 10% lot area based on R-Codes
Total impervious	m^2	320	
Total impervious contributing	m^2	160	Front

Rainfall contributing to soakwells from impervious area			
Rainfall depth	mm	13	
	m	0.013	
Rainfall volume	m^3	2.08	Rainfall depth (m) times total impervious contributing area (m^2) to soakwells. Min Soakwell Volume.

Soakwell Volume Requirements		soakwell 1	soakwell 2	soakwell 3	soakwell 4	Total	
Soakwell Height	m	0.60	0.60	0.60	0.60		
Soakwell Diameter	m	1.20	1.20	1.20	1.20		
Soakwell Volume	m^3	0.68	0.68	0.68	0.68	**2.71**	Total soakwell volume to equal rainfall volume
Soakwell Surface Area	m^2	1.13	1.13	1.13	1.13		
Soakage Calculation							
Soil conductivity (K)	m/day	5	5	5	5		
Aquifer Depth	m	3	3	3	3		
Connected area per soakwell	m^2	52	52	52	52	**209**	Total connected area per sokwell to equal total impervious contributing
Soakage Rate	m^3/hr	0.76	0.76	0.76	0.76		
Soakage Continuing Loss	mm/hr	14	14	14	14		
Soakwell clogging factor	%	50%	50%	50%	50%		
	mm/hr	7	7	7	7		

Modelling assumptions		
Initial loss	mm	13
Continuing loss	mm/hr	7

MODRET - Summary Results

Job: J5483 Date :24/08/16 Performed by : SC

Mandogalup East LWMS

Catchment Area Lots/Swale	6.14	ha
Catchment Area Road	2.68	ha
Top Elevation	21.8	mAHD
Base Elevation	21.5	mAHD
Base Length		m
Base Width		m
Depth		m
Batter		
K_H	5	m/day
K_V	5	m/day
n	0.2	
Groundwater Level	20.5	mAHD
Base of Aquifer	15.5	mAHD

Rebated Lot			Linear Rain Garden			Road		
Stage Volume relationship			Stage Volume relationship			Stage Volume relationship		
Stage (mAHD)	Volume (m^3)	Area (m^2)	Stage (mAHD)	Volume (m^3)	Area (m^2)	Stage (mAHD)	Volume (m^3)	Area (m^2)
0.0	0.0	66.0	0.0	0.0	0.007	0.00	0.0	4700.0000
0.1	9.0	115.4	0.1	7.0	0.007	0.10	465.0	4700.0000
0.2	23.5	176.4	0.2	14.0	0.007	0.15	700.0	4700.0000
0.3	44.6	248.9						

5yr 24hr - Rebated Lot Rain Garden			5yr 24hr - Linear Rain Garden	
Depth	Infiltrated Volume	mm/hr	Infiltrated Volume	mm/hr
0.2	68 (20hrs)	48		
0.3			299 (30hrs)	43

Road Reserve			
Storm Event	Depth	Infiltrated Volume	mm/hr
0.5	0	-	-
1	0	-	-
3	0.01	890	63
6	0.05	1050	37
12	0.10	1250	22
24	0.15	1550	14
48	0.16	1950	9
72	0.21	2250	7
96	0.18		
120	0.21		

Note: Road Reserve Based on 2.68ha of connected impervious area. 1km stretch of road at 15.6m wide, with 20% of connected lot area, assuming 28m deep lots

Appendix J

NiDSS Nutrient Modelling Output Results

NiDSS

Nutrient Input Decision Support System
Version 2.0 March 2005

JDA Consultant Hydrologists
Report Date : 12-Mar-14

Hoffman Rd LWMS	
Total Nutrient Input - No WSUD (kg/yr)	**14,343**
Reduction due to WSUD (kg/yr)	**5,092**
Percentage Overall Reduction	**35.5%**
Pecentage Development Reduction	**35.5%**
Cost of Selected Program ($/kg/yr)	**$4**

○ Total Phosphorus
◉ Total Nitrogen

Catchment Name	Hoffman Road Mandogalup LWMS	
Option Description	Post-Development Scenario	
Catchment Area	71	ha

Land Use Breakdown

Residential : School	5.0%	lower density residential areas (excludes road reserve area)
Residential : ~R35	48.0%	higher density residential areas (excludes road reserve area)
Road Reserves : Minor	28.0%	maintainance of verge by landowners
Road Reserves : Major	0.0%	maintainance of verge by local authority
POS : Active	16.0%	grassed areas
POS : Passive / Basins	3.0%	native vegetation
Rural : Pasture	0.0%	general pasture
Rural : Residential ~R2.5/R5	0.0%	low density
Rural : Poultry	0.0%	specific high nutient input land use
Commercial/Industrial	0.0%	town centre etc

Total Residential	**53.0%**
Total Area	**100.0%**

Nutrient Input Without WSUD

Residential	Garden	80.93	kg/net ha/yr	42.89	kg/gross ha/yr	3,045	kg/yr	21.2%
	Lawn	113.32		60.06		4,264		29.7%
	Pet Waste	64.08		33.96		2,411		16.8%
	Car Wash	0.04		0.02		1		0.0%
	Sub Total			136.94		9,723		67.8%
POS	Garden/Lawn	73.40	kg/ha POS/yr	11.74	kg/gross ha/yr	834	kg/yr	5.8%
	Pet Waste	102.31		16.37		1,162		8.1%
	Sub Total			28.11		1,996		13.9%
Road	Major Roads	29.36	kg/ha RR/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
Reserve	Minor Roads	132.00		36.96		2,624		18.3%
	Sub Total			36.96		2,624		18.3%
Rural	Pasture	60.00	kg/ha Rural/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
	Poultry Farms	175.00		0.00		0		0.0%
	Residential (R2.5/R5)	15.20		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
		Total		**202.01**	kg/gross ha/yr	**14,343**	kg/yr	**100.0%**

Residential Areas (R15-R35) : Nutrient Removal via Source Control

☑ Native Gardens (Lots - Garden)
☑ Native Gardens (Lots - Lawn)
☑ Native Gardens (POS)
☑ Street Sweeping
☑ Community Education : Fertiliser
☐ Community Education : Pet Waste
☐ Community Education : Car Wash

Education Effectiveness: 20%

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Native Gardens (Lots - Garden)	50%	21.45	1,523	10.6%	$0	$0	$0.0
Native Gardens (Lots - Lawn)	50%	30.03	2,132	14.9%	$0	$0	$0.0
Native Gardens (POS)	50%	5.87	417	2.9%	$0	$0	$0.0
Community Education : Fertiliser	100%	13.31	945	6.6%	$0	$879	$0.9
Community Education : Pet Waste	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Car Wash	0%	0.00	0	0.0%	$0	$0	$0.0
Street Sweeping	100%	0.49	35	0.2%	$0	$8,201	$236.8
Totals		**71.14**	**5,051**	**35.2%**	**$0**	**$9,079**	**$1.8**

Residential Areas (R15-R35) : Nutrient Removal via In-Transit Control

☑ Gross Pollutant Trap
☐ Water Pollution Control Pond

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Gross Pollutant Traps	100%	0.57	41	0.3%	$133,480	$5,112	$322.1
Water Pollution Control Ponds	0%	0.00	0	0.0%	$0	$0	$0.0
Total		**0.57**	**41**	**0.3%**	**$133,480**	**$5,112**	**$322.1**

Net Nutrient Input

	kg/gross ha/yr	kg/yr	%
Nutrient Input : Residential Area without WSUD	202.01	14,343	100.0%
Nutrient Input : Rural Area	0.00	0	0.0%

				Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Removal via Source Control	71.14	5,051	35.2%	$0	$9,079	$1.8
Removal via In-Transit Control	0.57	41	0.3%	$133,480	$5,112	$322.1
Total Removal	71.72	5,092	35.5%	$133,480	$14,191	$4.4
Net Nutrient Input	**130.29**	**9,251**	**64.5%**			

NiDSS

Nutrient Input Decision Support System
Version 2.0 March 2005

JDA Consultant Hydrologists
Report Date : 12-Mar-14

Hoffman Road LWMS	
Total Nutrient Input - No WSUD (kg/yr)	**1,783**
Reduction due to WSUD (kg/yr)	**800**
Percentage Overall Reduction	**44.9%**
Pecentage Development Reduction	**44.9%**
Cost of Selected Program ($/kg/yr)	**$28**

(●) Total Phosphorus
( ) Total Nitrogen

Catchment Name Hoffman Road Mandogalup LWMS
Option Description Post-Development Scenario
Catchment Area 71 ha

Land Use Breakdown

Residential : School	5.0%	lower density residential areas (excludes road reserve area)
Residential : ~R35	48.0%	higher density residential areas (excludes road reserve area)
Road Reserves : Minor	28.0%	maintainance of verge by landowners
Road Reserves : Major	0.0%	maintainance of verge by local authority
POS : Active	16.0%	grassed areas
POS : Passive / Basins	3.0%	native vegetation
Rural : Pasture	0.0%	general pasture
Rural : Residential ~R2.5/R5	0.0%	low density
Rural : Poultry	0.0%	specific high nutient input land use
Commercial/Industrial	0.0%	town centre etc

Total Residential **53.0%**
Total Area **100.0%**

Nutrient Input Without WSUD

Residential	Garden	21.65	kg/net ha/yr	11.47	kg/gross ha/yr	815	kg/yr	45.7%
	Lawn	10.09		5.35		380		21.3%
	Pet Waste	2.81		1.49		106		5.9%
	Car Wash	0.13		0.07		5		0.3%
	Sub Total			18.38		1,305		73.2%
POS	Garden/Lawn	2.60	kg/ha POS/yr	0.42	kg/gross ha/yr	30	kg/yr	1.7%
	Pet Waste	4.47		0.72		51		2.8%
	Sub Total			1.13		80		4.5%
Road	Major Roads	1.04	kg/ha RR/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
Reserve	Minor Roads	20.00		5.60		398		22.3%
	Sub Total			5.60		398		22.3%
Rural	Pasture	20.00	kg/ha Rural/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
	Poultry Farms	75.00		0.00		0		0.0%
	Residential (R2.5/R5)	4.00		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
		Total		**25.11**	kg/gross ha/yr	**1,783**	kg/yr	**100.0%**

Residential Areas (R15-R35) : Nutrient Removal via Source Control

- [x] Native Gardens (Lots - Garden)
- [x] Native Gardens (Lots - Lawn)
- [x] Native Gardens (POS)
- [x] Street Sweeping
- [x] Community Education : Fertiliser
- [ ] Community Education : Pet Waste
- [ ] Community Education : Car Wash

Education Effectiveness 20%

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Native Gardens (Lots - Garden)	50%	5.74	407	22.8%	$0	$0	$0.0
Native Gardens (Lots - Lawn)	50%	2.67	190	10.6%	$0	$0	$0.0
Native Gardens (POS)	50%	0.21	15	0.8%	$0	$0	$0.0
Community Education : Fertiliser	100%	2.34	166	9.3%	$0	$879	$5.3
Community Education : Pet Waste	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Car Wash	0%	0.00	0	0.0%	$0	$0	$0.0
Street Sweeping	100%	0.20	14	0.8%	$0	$8,201	$585.7
Totals		**11.16**	**792**	**44.4%**	**$0**	**$9,079**	**$11.5**

Residential Areas (R15-R35) : Nutrient Removal via In-Transit Control

- [x] Gross Pollutant Trap
- [ ] Water Pollution Control Pond

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Gross Pollutant Traps	100%	0.11	8	0.4%	$133,480	$5,112	$1,663.1
Water Pollution Control Ponds	0%	0.00	0	0.0%	$0	$0	$0.0
Total		**0.11**	**8**	**0.4%**	**$133,480**	**$5,112**	**$1,663.1**

Net Nutrient Input

	kg/gross ha/yr	kg/yr	%
Nutrient Input : Residential Area without WSUD	25.11	1,783	100.0%
Nutrient Input : Rural Area	0.00	0	0.0%

				Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Removal via Source Control	11.16	792	44.4%	$0	$9,079	$11.5
Removal via In-Transit Control	0.11	8	0.4%	$133,480	$5,112	$1,663.1
Total Removal	11.27	800	44.9%	$133,480	$14,191	$27.7
Net Nutrient Input	**13.84**	**983**	**55.1%**			

NiDSS

Nutrient Input Decision Support System
Version 2.0 March 2005

JDA Consultant Hydrologists
Report Date : 12-Mar-14

Hoffman Rd LWMS	
Total Nutrient Input - No WSUD (kg/yr)	2,130
Reduction due to WSUD (kg/yr)	0
Percentage Overall Reduction	0.0%
Pecentage Development Reduction	0.0%
Cost of Selected Program ($/kg/yr)	$0

○ Total Phosphorus
◉ Total Nitrogen

Catchment Name Hoffman Road Mandogalup LWMS
Option Description Pre-Development Scenario
Catchment Area 71 ha

Land Use Breakdown

Residential : ~R15	0.0%	lower density residential areas (excludes road reserve area)
Residential : ~R35	0.0%	higher density residential areas (excludes road reserve area)
Road Reserves : Minor	0.0%	maintainance of verge by landowners
Road Reserves : Major	0.0%	maintainance of verge by local authority
POS : Active	0.0%	grassed areas
POS : Passive / Basins	50.0%	native vegetation
Rural : Pasture	50.0%	general pasture
Rural : Residential ~R2.5/R5	0.0%	low density
Rural : Poultry	0.0%	specific high nutient input land use
Commercial/Industrial	0.0%	town centre etc

Total Residential 0.0%
Total Area 100.0%

Nutrient Input Without WSUD

Residential	Garden	64.90	kg/net ha/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
	Lawn	92.40		0.00		0		0.0%
	Pet Waste	15.72		0.00		0		0.0%
	Car Wash	0.04		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
POS	Garden/Lawn	73.40	kg/ha POS/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
	Pet Waste	0.00		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
Road	Major Roads	29.36	kg/ha RR/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
Reserve	Minor Roads	132.00		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
Rural	Pasture	60.00	kg/ha Rural/yr	30.00	kg/gross ha/yr	2,130	kg/yr	100.0%
	Poultry Farms	175.00		0.00		0		0.0%
	Residential (R2.5/R5)	15.20		0.00		0		0.0%
	Sub Total			30.00		2,130		100.0%
			Total	**30.00**	kg/gross ha/yr	**2,130**	kg/yr	**100.0%**

Residential Areas (R15-R35) : Nutrient Removal via Source Control

☐ Native Gardens (Lots - Garden) ☐ Native Gardens (Lots - Lawn) ☐ Native Gardens (POS) ☐ Street Sweeping
☐ Community Education : Fertiliser ☐ Community Education : Pet Waste ☐ Community Education : Car Wash

Education Effectiveness 0%

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Native Gardens (Lots - Garden)	0%	0.00	0	0.0%	$0	$0	$0.0
Native Gardens (Lots - Lawn)	0%	0.00	0	0.0%	$0	$0	$0.0
Native Gardens (POS)	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Fertiliser	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Pet Waste	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Car Wash	0%	0.00	0	0.0%	$0	$0	$0.0
Street Sweeping	0%	0.00	0	0.0%	$0	$0	$0.0
Totals		**0.00**	**0**	**0.0%**	**$0**	**$0**	**$0.0**

Residential Areas (R15-R35) : Nutrient Removal via In-Transit Control

☐ Gross Pollutant Trap ☐ Water Pollution Control Pond

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Gross Pollutant Traps	0%	0.00	0	0.0%	$0	$0	$0.0
Water Pollution Control Ponds	0%	0.00	0	0.0%	$0	$0	$0.0
Total		**0.00**	**0**	**0.0%**	**$0**	**$0**	**$0.0**

Net Nutrient Input

	kg/gross ha/yr	kg/yr	%
Nutrient Input : Residential Area without WSUD	0.00	0	0.0%
Nutrient Input : Rural Area	30.00	2,130	100.0%

				Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Removal via Source Control	0.00	0	0.0%	$0	$0	$0.0
Removal via In-Transit Control	0.00	0	0.0%	$0	$0	$0.0
Total Removal	0.00	0	0.0%	$0	$0	$0.0
Net Nutrient Input	**30.00**	**2,130**	**100.0%**			

NiDSS

Nutrient Input Decision Support System
Version 2.0 March 2005

JDA Consultant Hydrologists
Report Date : 19-Jun-14

Hoffman Road Mandogalup LWMS	
Total Nutrient Input - No WSUD (kg/yr)	**710**
Reduction due to WSUD (kg/yr)	**0**
Percentage Overall Reduction	**0.0%**
Pecentage Development Reduction	**0.0%**
Cost of Selected Program ($/kg/yr)	**$0**

(•) Total Phosphorus
( ) Total Nitrogen

Catchment Name Hoffman Road Mandogalup LWMS
Option Description Pre-Development Scenario
Catchment Area 71 ha

Land Use Breakdown

Residential : ~R15	0.0%	lower density residential areas (excludes road reserve area)
Residential : ~R35	0.0%	higher density residential areas (excludes road reserve area)
Road Reserves : Minor	0.0%	maintainance of verge by landowners
Road Reserves : Major	0.0%	maintainance of verge by local authority
POS : Active	0.0%	grassed areas
POS : Passive / Basins	50.0%	native vegetation
Rural : Pasture	50.0%	general pasture
Rural : Residential ~R2.5/R5	0.0%	low density
Rural : Poultry	0.0%	specific high nutient input land use
Commercial/Industrial	0.0%	town centre etc

Total Residential **0.0%**
Total Area **100.0%**

Nutrient Input Without WSUD

Residential	Garden	21.65	kg/net ha/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
	Lawn	10.09		0.00		0		0.0%
	Pet Waste	2.81		0.00		0		0.0%
	Car Wash	0.13		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
POS	Garden/Lawn	2.60	kg/ha POS/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
	Pet Waste	4.47		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
Road	Major Roads	1.04	kg/ha RR/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
Reserve	Minor Roads	20.00		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
Rural	Pasture	20.00	kg/ha Rural/yr	10.00	kg/gross ha/yr	710	kg/yr	100.0%
	Poultry Farms	75.00		0.00		0		0.0%
	Residential (R2.5/R5)	4.00		0.00		0		0.0%
	Sub Total			10.00		710		100.0%
		Total		**10.00**	kg/gross ha/yr	**710**	kg/yr	**100.0%**

Residential Areas (R15-R35) : Nutrient Removal via Source Control

☐ Native Gardens (Lots - Garden) ☐ Native Gardens (Lots - Lawn) ☐ Native Gardens (POS) ☐ Street Sweeping
☐ Community Education : Fertiliser ☐ Community Education : Pet Waste ☐ Community Education : Car Wash

Education Effectiveness 0%

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Native Gardens (Lots - Garden)	0%	0.00	0	0.0%	$0	$0	$0.0
Native Gardens (Lots - Lawn)	0%	0.00	0	0.0%	$0	$0	$0.0
Native Gardens (POS)	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Fertiliser	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Pet Waste	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Car Wash	0%	0.00	0	0.0%	$0	$0	$0.0
Street Sweeping	0%	0.00	0	0.0%	$0	$0	$0.0
Totals		**0.00**	**0**	**0.0%**	**$0**	**$0**	**$0.0**

Residential Areas (R15-R35) : Nutrient Removal via In-Transit Control

☐ Gross Pollutant Trap ☐ Water Pollution Control Pond

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Gross Pollutant Traps	0%	0.00	0	0.0%	$0	$0	$0.0
Water Pollution Control Ponds	0%	0.00	0	0.0%	$0	$0	$0.0
Total		**0.00**	**0**	**0.0%**	**$0**	**$0**	**$0.0**

Net Nutrient Input

	kg/gross ha/yr	kg/yr	%
Nutrient Input : Residential Area without WSUD	0.00	0	0.0%
Nutrient Input : Rural Area	10.00	710	100.0%

				Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Removal via Source Control	0.00	0	0.0%	$0	$0	$0.0
Removal via In-Transit Control	0.00	0	0.0%	$0	$0	$0.0
Total Removal	0.00	0	0.0%	$0	$0	$0.0
Net Nutrient Input	**10.00**	**710**	**100.0%**			

Appendix K

Drainage Infrastructure – Maintenance Schedule

	Maintenance Schedule - Mandogalup East LWMS				
	Monthly	Quarterly	Bi-Annually	Annually	As Required
Road Pavement					
Street Sweeping					✓
Porous Verges					
Removal of Sediment Buildup (Silts/clogging layers)					✓
removal of Litter		✓			
Removal of dead, dying or diseased plants		✓			
Removal of weed growth		✓			
Mulching (within defined mulch areas)				✓	
Plant Pruning				✓	
Fertilising			✓		
Irrigation for Establishment					✓
Maintain all plants free from insects or disease (Fungal)		✓			
Pocket Gardens					
Removal of Sediment Buildup (Silts/clogging layers)					✓
removal of Litter		✓			
Removal of dead, dying or diseased plants		✓			
Removal of weed growth		✓			
Mulching (within defined mulch areas)				✓	
Plant Pruning				✓	
Fertilising			✓		
Irrigation					✓
Maintain all plants free from insects or disease (Fungal)		✓			
Linear Rain Gardens					
Removal of Sediment Buildup (Silts/clogging layers)					✓
removal of Litter		✓			
Removal of dead, dying or diseased plants		✓			
Removal of weed growth		✓			
Mulching (within defined mulch areas)				✓	
Replacement of Amended Soil					✓ (Every 10 to 15 years)
Plant Pruning				✓	
Fertilising			✓		
Irrigation					✓
Maintain all plants free from insects or disease (Fungal)		✓			
Rebated Lot Rain Gardens					
Removal of Sediment Buildup (Silts/clogging layers)					✓
removal of Litter		✓			
Removal of dead, dying or diseased plants		✓			
Removal of weed growth		✓			
Mulching (within defined mulch areas)				✓	
Replacement of Amended Soil					✓ (Every 10 to 15 years)
Plant Pruning				✓	
Fertilising			✓		
Irrigation					✓
Maintain all plants free from insects or disease (Fungal)		✓			
Turfed Drainage Areas (POS)					
Pipe Inspections			✓		
Mowing	✓				
Weed control		✓			
Aeration				✓	
Top Dressing				✓	
Dethatching				✓	
Fertilising		✓			

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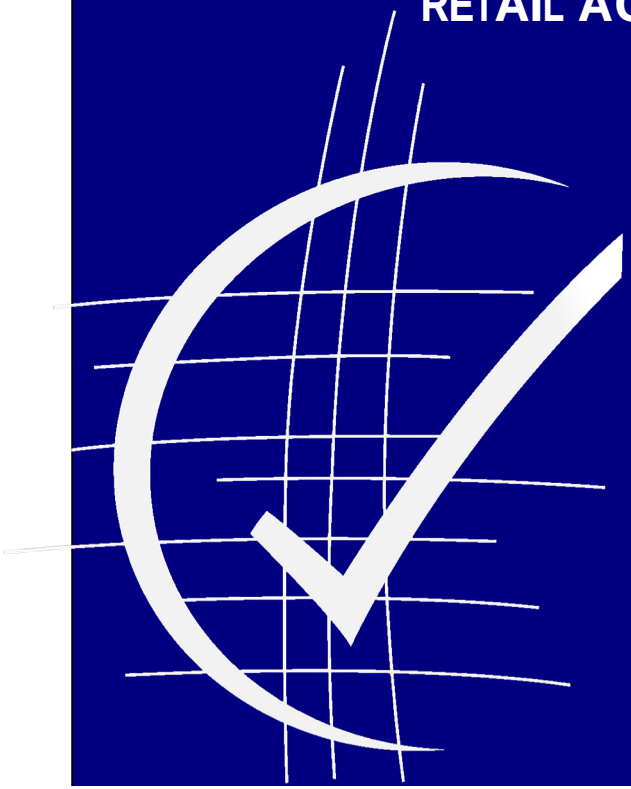
APPENDIX 9

RETAIL NEEDS ASSESSMENT

ROWEGROUP

Taktics4
Mandogalup Local Structure Plan (East and West)

RETAIL ACTIVITY STRATEGY



Satterley & Qube
November 2016
1630

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CONTENTS

1 INTRODUCTION

This Retail Activity Strategy for Mandogalup (incorporating East Mandogalup and West Mandogalup) is designed to guide the location and nature of commercial activity in the planned Mandogalup community. It responds specifically to policy implications and market drivers to ascertain the most commercially efficient and equitable distribution of commercial activity for future residents.

1.1 Purpose

The findings in this paper are subsequently based on the assessment of the current and future retail needs of the resident population and other consumer markets in the vicinity of the planning area. The findings will guide the future planning, development and staging of retail and associated commercial and community development.

It provides advice designed to inform the layout and design of the structure plan in Mandogalup by identifying the size and nature, components and configuration, location and land area, timing and staging and commercial risks associated with the delivery of any retail activity.

1.2 Approach

The findings are based on analysis of:

- the extent of major retailer demand in the area by highlighting the existing and planned distribution of their store networks;
- the extent of the intended resident catchment planned retail activity will likely service;
- the number and nature of the resident community planned for the catchment;
- the spending capacity of the resident catchment;
- the extent and nature of spending profiles of other consumer markets;
- the correlation between spending capacity, potential market share, sales productivity to retail floor space and retail development models;
- other commercial or community opportunities associated with the development;
- any economic impacts associated with delivering retail activity in the area

2 STRATEGY AND POLICY

The delivery of activity centres in Mandogalup will be influenced by broader planning policies and strategies prepared at the State and Local Government level.

2.1 SPP 4.2 – Activity Centres Perth and Peel

State Planning Policy 4.2 applies throughout the Perth and Peel regions to guide the preparation and review of local planning strategies, schemes and structure plans; and development control. It promotes a hierarchy of activity centres to guide and prioritise the development of activity and employment throughout the Metropolitan Region.

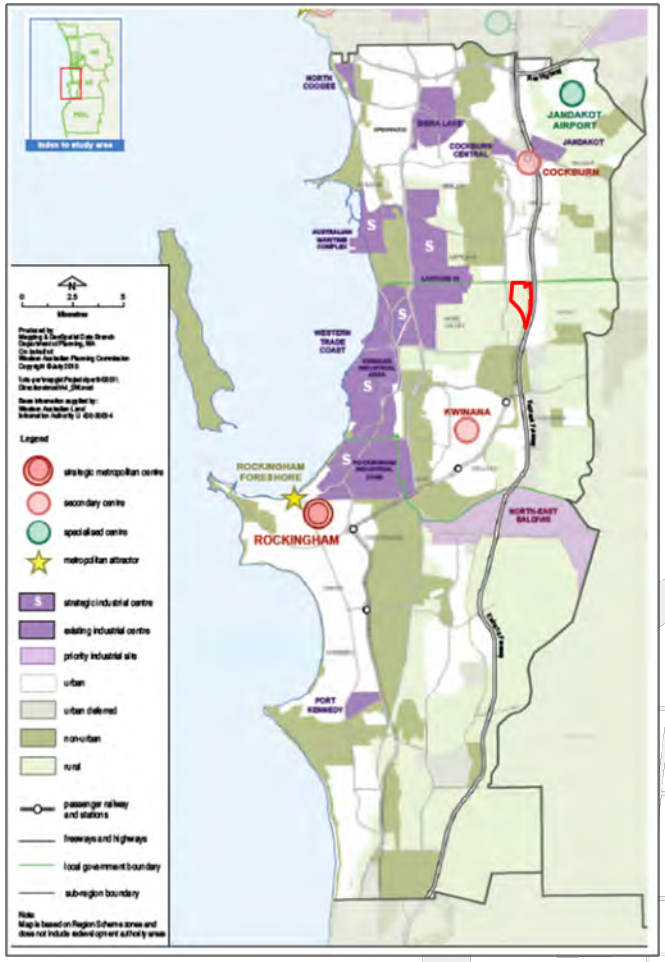
Strategic Metropolitan Centres

Mandogalup is located midway between three existing designated Strategic Metropolitan Centres at Fremantle, Rockingham and Armadale. The relatively long distance to these facilities from the planned Mandogalup community is offset to a degree by the increased choice of having access to these three centres. Each centre provides a different activity and employment focus. The relatively large distances from Mandogalup to each of these centres places a greater emphasis on the lower order centres to deliver the regional and district needs of the resident community.

Secondary Centres

Mandogalup is also located mid way between two existing designated Secondary Centres at Cockburn and Kwinana.

FIGURE 1 - COMMERCIAL ACTIVITY NETWORK AND HIERARCHY



SPP4.2 (WAPC 2010)

Cockburn Gateway

Cockburn Secondary Centre is located 6km north of Mandogalup and offers direct access for Mandogalup residents via the Kwinana Freeway. Cockburn began primarily as a shopping based centre. But it has more recently developed as a comprehensive Secondary Centre, with an increased range of non retail commercial and residential activity predominantly around the Cockburn Railway Station.

Kwinana Town Centre

Kwinana Secondary Centre is located 7.5km south of Mandogalup. Although it is closer than Cockburn, Kwinana is more difficult to access for Mandogalup residents. This is compounded by the fact that Kwinana represents travel in the opposite direction to the Perth CBD. This subsequently increases the perception of distance to centres in the opposite direction to normal travel patterns.

The future residents of Mandogalup and its immediate surrounds will have access to a full range of Secondary Centre activity at two centres within acceptable urban travel distances for these facilities. This reduces demand for Secondary Centres to be included within the Mandogalup community.

District Centres

A future District Centre is currently designated for Wandi on Anketell Road immediately east of the Kwinana Freeway interchange. This centre is located 3.5km south east from the centre of Mandogalup. Wandi will subsequently have the greatest influence over the planning of retail activity in the immediate Mandogalup area. Wandi District Centre has been allocated 16,000sqm of retail floor space and 10,000sqm of bulky goods/showroom floor space. The floor space allocation is capable of supporting two full line supermarkets and a Discount Department Store (Kmart, Target or BigW) and a wide range of complementary specialty shops.

Mandogalup residents will have direct access to Wandi District Centre via Anketell Road. The location of the Wandi District Centre would appear to remove the demand for any additional District Centre (or DDS based centres) in Mandogalup.

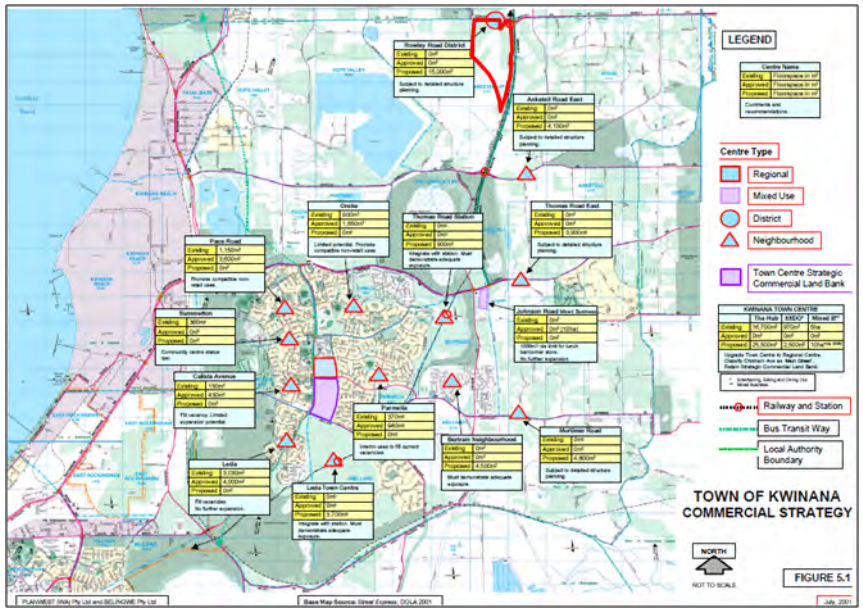
Neighbourhood and Local Centres

SPP 4.2 does not cover the distribution of neighbourhood and local centres. These centres are subsequently designated and allocated by Local Government Commercial Strategies and further refined during District Structure Planning of urban areas.

2.2 City of Kwinana

Kwinana Commercial Activity Centres Strategy (September 2003)

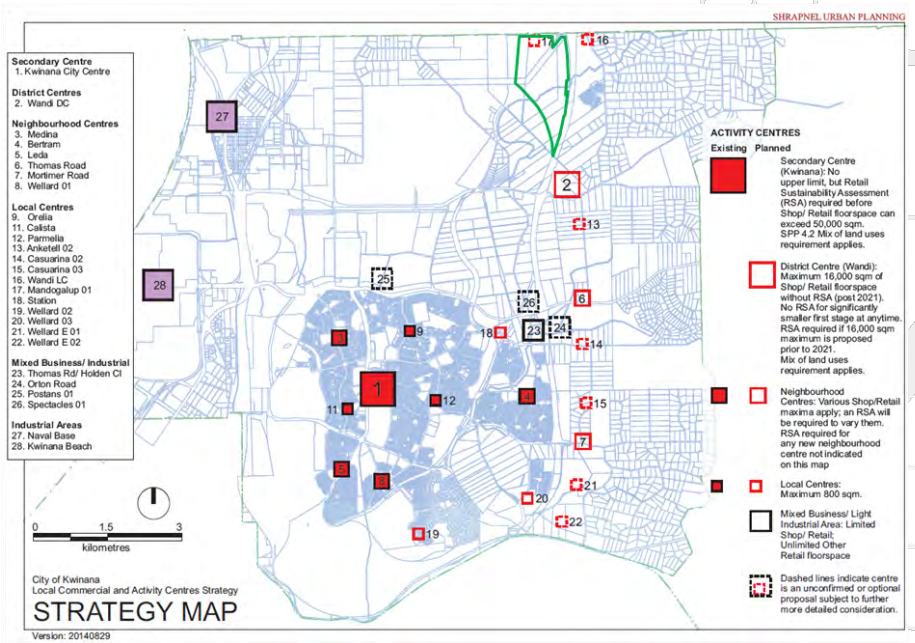
The distribution and roles of commercial activity in the City of Kwinana is currently guided by the adopted Kwinana Centre Strategy (2003). This plan allocated a District Centre of 15,000sqm on Rowley Road (west of Freeway) in Mandogalup. This was partly designed to also allow the centre to cater to the residents north of Rowley Road in the City of Cockburn. It was also intended to reflect Transit Oriented Design principles based on its proximity to the planned railway station immediately south of Rowley Road. The planned railway station has since been relocated, removing any potential synergies with a District Centre on Rowley Road. The strategy also allocates a neighbourhood centre of 4,100sqm on Anketell Road (east of the Freeway). These are the only two centres currently allocated to serve the Mandogalup community in the commercial strategy.



Local Commercial & Activity Centres Strategy Final (Sept 2014)

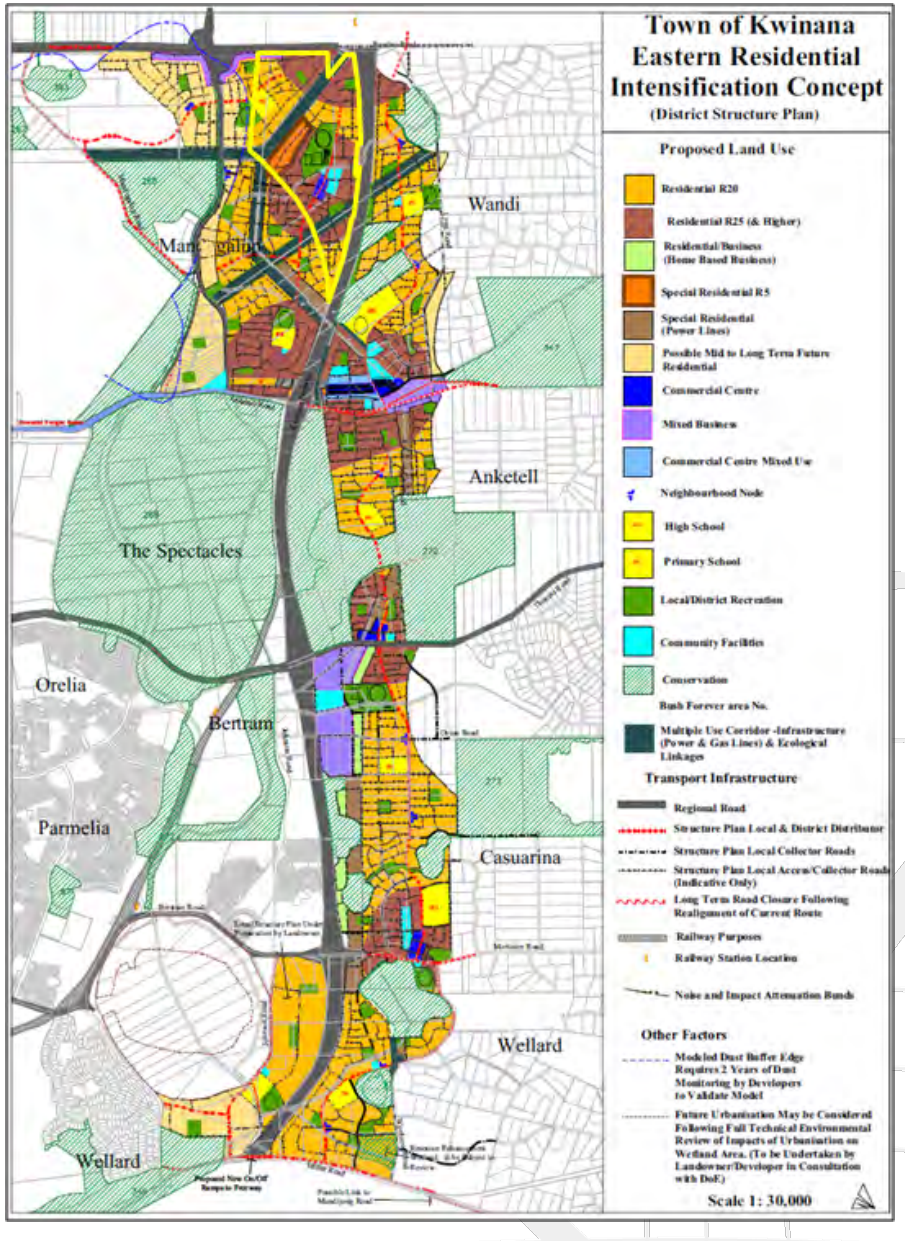
A review of the 2003 Local Commercial Strategy has resulted in the preparation of a Local Commercial Strategy (completed and adopted in September 2014). The latest draft has changed the distribution of retail activity in the Mandogalup vicinity. The new strategy proposes a District Centre (2) in Anketell Road immediately east of the Freeway replacing the initial allocation of a District Centre on Rowley Road west of the Freeway. This centre is allocated 20,000sqm of retail floor space and 10,000sqm of bulky goods showroom floor space.

It also reallocates a Neighbourhood Centre (17) for Mandogalup on Rowley Road. This Centre is allocated up to 1,500sqm of retail floor space.



Eastern Residential Intensification Concept District Structure Plan – (ERIC)

The Eastern Residential Intensification Concept sets out the broad location for future urban areas within the City of Kwinana. It reinforces that a significant future residential population is planned for Mandogalup. Residential dwelling and population yields for Mandogalup are primarily defined from ERIC. ERIC indicates a range of commercial nodes for the area although these are all subject to future planning and are not necessarily considered to be the preferred location or distribution of activity for the area. The District Centre initially planned on Rowley Road in the Local Commercial Strategy is reallocated to the Anketell Road District Centre site due primarily to the relocation of the railway away from Rowley Road and the designation and role of Rowley Road as a freight route which was considered to reduce the accessibility of district facilities for local residents.



2.3 City of Cockburn

Mandogalup is located solely within the City of Kwinana administrative boundary. However the site abuts Rowley Road which forms the southern boundary of the City of Cockburn. The catchment for any commercial activity may therefore include communities within the City of Cockburn.

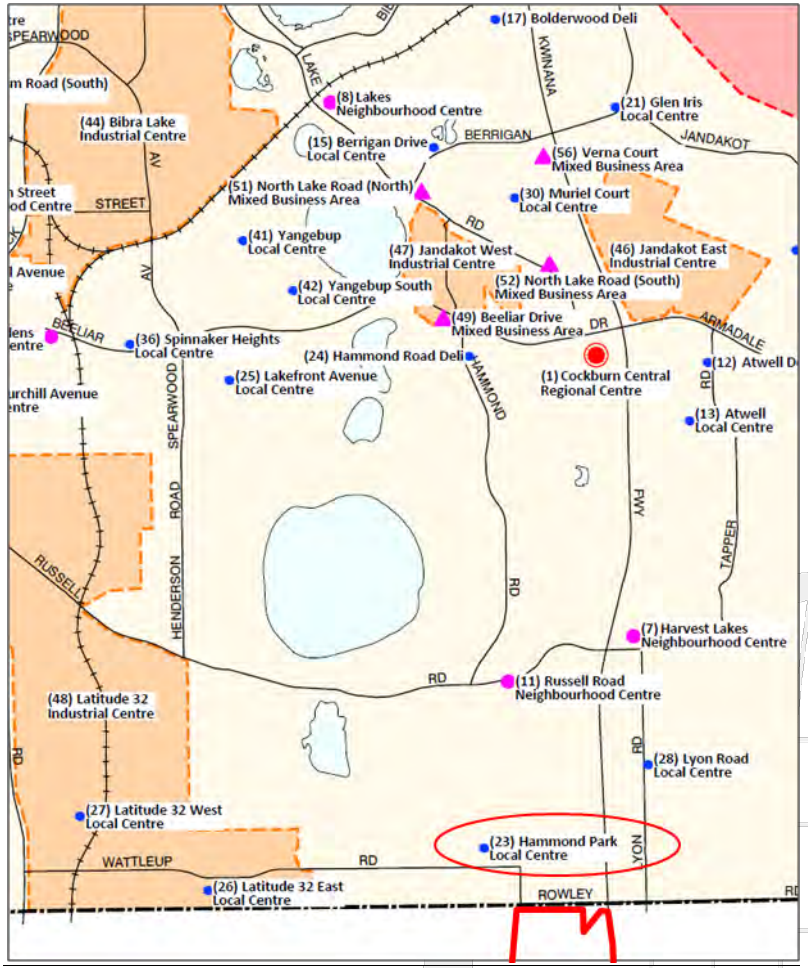
The future Mandogalup community may potentially be served by centres either designated or planned to the north of Rowley Road in the City of Cockburn. Similarly the advent of a commercial centre south of Rowley Road may also be expected to serve the residents in the suburbs of Hammond Park in the City Cockburn north of Rowley Road.

Local Commercial Strategy (December 2006)

The Commercial Activity Centres Policy for the City of Cockburn was finalised and Adopted in December 2006. The strategy allocates centres or floor space to specific communities. A local centre is allocated to Hammond Park immediately north of Rowley Road and Mandogalup. No other commercial activity is planned in the vicinity of Hammond Park. The Hammond Park Local Centre (Centre 23) is allocated only 800sqm of retail floor space. The centre of this size is incapable of containing a major supermarket.

Local Commercial and Activity Centres Strategy (December 2012)

A new Local Commercial Strategy was completed in December 2012. Whilst it represents a comprehensive review of all employment based activity in the City of Cockburn it did not make any recommended changes to the distribution and role of centres in Hammond Park and its surrounds.



City of Cockburn - Local Structure Plans

Structure plans are continuing to be prepared for properties immediately north of Rowley Road in the City of Cockburn. Only a limited amount of centre activity is currently allocated in the Hammond Park areas that have adopted structure plans in the City of Cockburn north of Rowley Road.

Local Structure Plans - 26(i) and 27(a) have been adopted by the City of Cockburn. They both provide for a local centre within close proximity to Rowley Road, immediately north of the Mandogalup Structure Plan Area.

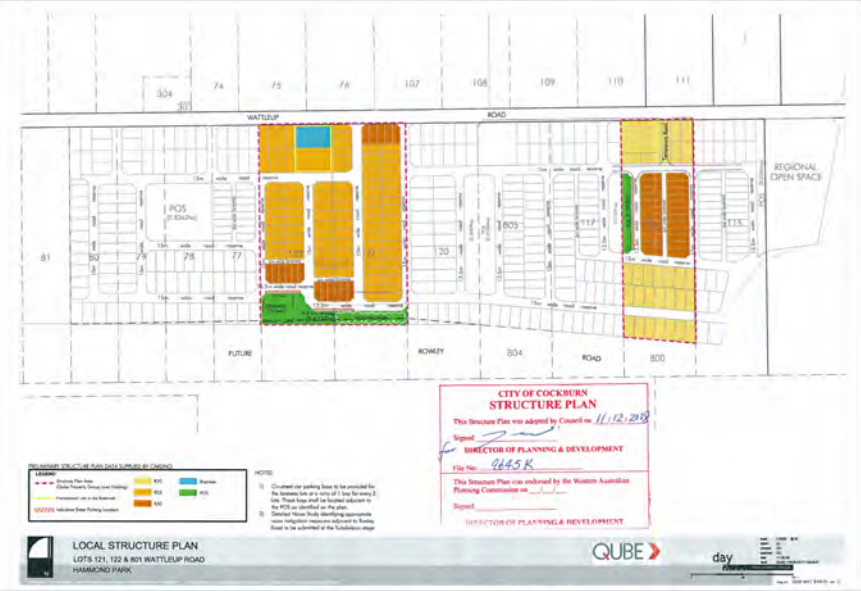
Both of these local centre areas are relatively small in nature, and may be expected to generate up to 500sqm of retail floor space on each site.

Whilst this is less than the prescribed allocation for Hammond Park within the City of Cockburn Local Commercial Strategy, the adoption of these local centres locations and sizes will subsequently result in the expectation that they are to serve their immediate local communities in Hammond Park north of Rowley Road.

It therefore appears that recent structure planning for Hammond Park in the City of Cockburn, north of Rowley Road has provision for local centres to serve the Hammond Park community.

Hammond Park LSP 26(i)

Hammond Park LSP 27(a)



3 CATCHMENT ANALYSIS

This section considers the potential influences on the market demand for retail activity in the planning area, and subsequently delineates the likely extent of the resident catchment available to major tenants as the basis for determining the retail market demand in the area.

3.1 Philosophy

Retailers such as major supermarket chains and Discount Department Stores capture a significant share of overall retail sales. They therefore underpin visitor traffic for our shopping centres and generate the exposure necessary for smaller specialty shops to survive. A shopping centres commercial viability is severely reduced without having an anchor tenant to drive the foot traffic for these smaller specialty shops. If the major tenant or tenants are able to generate sufficient sales from a particular catchment then the remaining specialty shops are generally in a position to capitalise on their success. To this end analysis in this report focuses on understanding the market demand for these major tenants in order to ascertain the overall demand and sustainability for a centre.

3.2 Networks and Distribution Pattern

The distribution network for major supermarkets throughout urban Australia generally highlights that a supermarket requires a dedicated residential catchment of at least 1.5km. Smaller supermarkets require a smaller catchment. The distribution pattern for Discount Department Stores throughout urban Australia suggests these larger stores require a dedicated catchment of 3.5km.

3.3 Major Tenants

Discount Department Stores

Discount Department Stores will ultimately be expected to be developed at Cockburn Gateway and Kwinana Town Centre (Secondary Centres) and Anketell District Centre. Kwinana and Cockburn will be expected to play a role in the shopping needs of the Mandogalup community. However, Wandi District Centre will ultimately provide the main DDS and associated tenant needs for the Mandogalup residents.

Supermarkets

No major supermarket based centres have been allocated in and around Mandogalup. The nearest supermarket based centres planned around Mandogalup include:

- Harvest Lakes Neighbourhood Centre (Atwell)
- Wandi District Centre (Anketell Road)

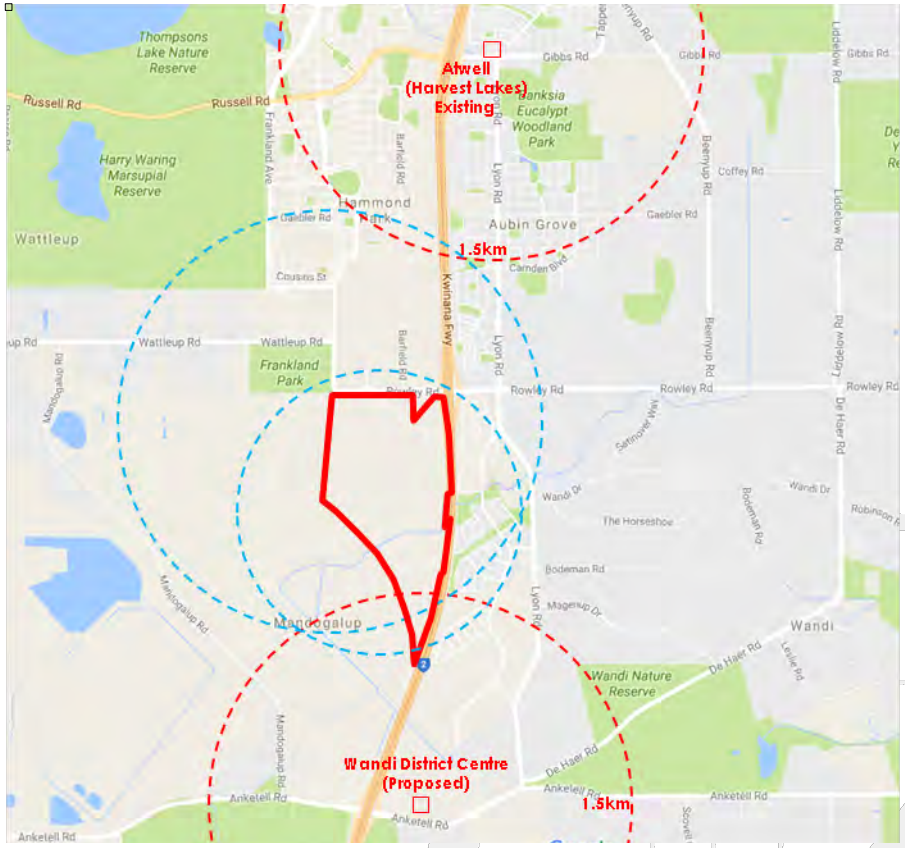
Atwell NC (Harvest Lakes) is 3km north of Rowley Road. While Anketell Road (Wandi DC) will also provide supermarket needs to the south although this centre is also over 3km south of Rowley Road.

3.4 Summary

The current future network of centres affirms the view that the Mandogalup or surrounding region may be capable of spatially sustaining a supermarket based centre if the market demand is capable of sustaining it. Provision for commercial activity within the East and West Mandogalup communities will only be required to serve the Mandogalup community and not the Hammond Park community immediately to the north of Rowley Road. Planning for commercial activity in Mandogalup therefore centres on the future residents solely within the planned Mandogalup community.

The following sections will determine the extent of the planned residential market within the Mandogalup community, and its subsequent ability to sustain a centre in Mandogalup.

SPATIAL RETAIL NETWORK AND DISTRIBUTION PATTERNS



Taktics4

4 CONSUMER MARKETS

Having delineated the intended resident catchment(s) available to major tenants, this section considers the extent and nature of the current and future resident population within the delineated catchment as a starting point for determining the capacity for retail floor space in the planning area.

4.1 Mandogalup Population

Development of the overall Mandogalup LSP confirms the opportunity for 1,500 dwellings to be developed comprising 900 dwellings in Mandogalup West and 600 dwellings in Mandogalup east

POPULATION AND DWELLINGS

Structure Plan Area	Lot / dwellings yield	Average household size	Estimated population
Mandogalup West	900	2.9	2,610
Mandogalup East	600	2.9	1,740
Mandogalup Total	1,500	2.9	4,350

Structure Plan Analysis

It would be reasonable to expect that the development could be developed over a 10 year period. A five year and ten year population base has subsequently been used as a basis for determining the timing of future commercial activity in Mandogalup.

4.2 Resident Retail Spending Capacity

Retail spending profiles are derived from two main data sets.

1. Household Expenditure Surveys are captured by ABS every six years. The most recent survey was completed in 2009/10 with data becoming available during 2011. This data records the weekly spending behaviour of households against a range of demographic profiles.
2. Retail sales are also captured by the ABS on a monthly basis. This data is recorded against a range of retail categories and store types.

The correlation of these two data sets to a common per capita variable allows the reporting of the average annual retail spending per person for each designated store type against a range of demographic profiles. The most influential characteristic in determining the amount and store of an individual is household income and household size. The Hammond Park community has recorded an average household income of $111,000 p.a. which is 27% above Australian averages. Household sizes of 2.9 people are 12% above Australian averages. These profiles are consistent with a retail spending profile reflecting households in the fourth quintile of income generation.

Household Income	
Average Annual Household Income	$111,124
difference from Australian Average	27%
Household Size	
average persons per household	2.9
difference to Australian average	12%
Quintile spending profile to use	Fourth

Census (ABS 2011)

Average Spending Capacity

Household with an average income reflecting the fourth quintile of income earners are estimated to generate nearly $9,000 in convenience based retail spending per person per annum.

AVERAGE SPENDING CAPACITY ($/ p.a.)

Store category	Average Retail Spending (per capita/p.a.)1
Total Food	$5,545
Non Food Convenience	$1,627
Cafes, restaurants and takeaway food	$1,807
All Convenience based Store Categories	**$8,979**

Household Expenditure Surveys (ABS 2009/10)
Retail CPI Index (2016)

Aggregate Retail Spending Capacity

Base on the average spending profiles the combined Mandogalup catchment is expected to produce $20M p.a. in aggregate retail spending capacity, including $12M p.a. in food/grocery spending by 2021 (after 5 years of development). By 2026, the fully developed Mandogalup resident catchment is expected to generate nearly $40M p.a. in retail spending including $24 M p.a. in food and grocery spending.

AGGREGATE SPENDING CAPACITY ($M P.A.) IN 2016 DOLLARS

Store category	2021 (year 5)	2026 (Year 10)
Food	$12	$24
Convenience based – non food	$4	$7
Cafes, restaurants and takeaway food	$4	$8
All Convenience based Store Categories	**$20**	**$39**

Household Expenditure Surveys (ABS 2009/10)
Retail CPI Index (2016)

There are limited opportunities or additional sales to be derived from other consumer markets.

5 MARKET POTENTIAL

Having determined the spending capacity of the catchment and other markets available to the centre and its tenants, this section assesses the potential market share of the available retail spending capacity that a tenant and its centre may be capable of achieving.

5.1 Market Capture

The market capture rates for a retail centre and major tenants may be assessed a number of ways, including retail gravity modelling. However major tenants simply identify the overall spending capacity and the expected market share based on proximity and accessibility of other major competing retailers. Taktics4 adopts this more transparent method to highlight the market share a centre may attract and is better able to assess the sensitivity of the market share to its overall performance and sustainability.

The potential for Wandi District Centre to be developed to at least a single supermarket based centre in the medium term, and ultimately a second supermarket suggests that a centre at Mandogalup may ultimately only be able to capture 33% of the retail spending capacity from within the Mandogalup catchment.

Contribution from Outside Catchment

The centre would also expect to capture a relatively small proportion of its sales from outside its main catchment. A small supermarket based centre may expect to generate up to a modest 2.5% of its sales from outside its primary catchment from visitors and reps and employees to the centre.

5.2 Sales Potential

Based on these market capture rates, and catchment contributions, retail activity in the planning area could expect to generate the following retail sales. By 2021, a centre in Mandogalup could expect to generate $6.5M p.a., including $4 M p.a. in supermarket sales. By 2026, the same centre could expect to generate $13M p.a. including $8m p.a. in supermarket sales.

SALES FROM CATCHMENT SPENDING ($M P.A.)

Store category	2021	2026
Food	$4.0	$8.0
Non food Convenience	$1.0	$2.5
Cafes, restaurants and takeaway	$1.5	$2.5
All Store Categories	**$6.5**	**$13.0**

Household Expenditure Surveys (ABS 2009/10)

5.3 Sustainable Floor space

The potential retail sales from the resident population for the LSP Area of Mandogalup will ultimately be capable of supporting a centre of 750 sqm of retail floor space comprising a 500sqm deli and up to 4 specialty shops which may contain a hair dresser, newsagency, fast food and or cafe. These activities will not be sustained until the full development of the catchment occurs.

SUSTAINABLE FLOOR SPACE (SQM)

Store category	shops	Floor space (sqm)
Food	1	500
Non food Convenience	2	125
Cafes, restaurants and takeaway	2	125
All Store Categories	**0**	**750**

Household Expenditure Surveys (ABS 2009/10)

6 DISTRIBUTION AND CONFIGURATION

The layout and configuration of the centre will have a significant role in its economic performance and its subsequent ability to achieve the objectives from the redevelopment. This section assesses the implications of the location, layout for the centre under the range of development scenarios.

6.1 Number of Centres

There is an opportunity for a single supermarket local centre to be located in Mandogalup. It allows for a small supermarket to be developed in a manner which complements the planned District Centre offering at Anketell Road without having an undue impact on sales or performance of this centre and its components.

6.2 Nature

The centre needs listed in this strategy are inconsistent with the City of Kwinana Local Commercial Strategy. Although the strategy does state that the centre allocation for Mandogalup should be subject to further detailed consideration.

6.3 Location

The centre should ideally be located further north to satisfy the immediate needs of the catchment toward Rowley Road. The southern residents closer to Anketell Road will ultimately be serviced more readily by the planned activity in the Wandi DC.

6.4 Site

A 750 sqm small supermarket local centre would require a land area of at least 1,500sqm (0.15Ha). The land should be relatively uniform with similar dimensions to all sides to create flexibility for design and layout of the centre. The centre may be designed to accommodate on street parking where possible.

6.5 Staging and Timing

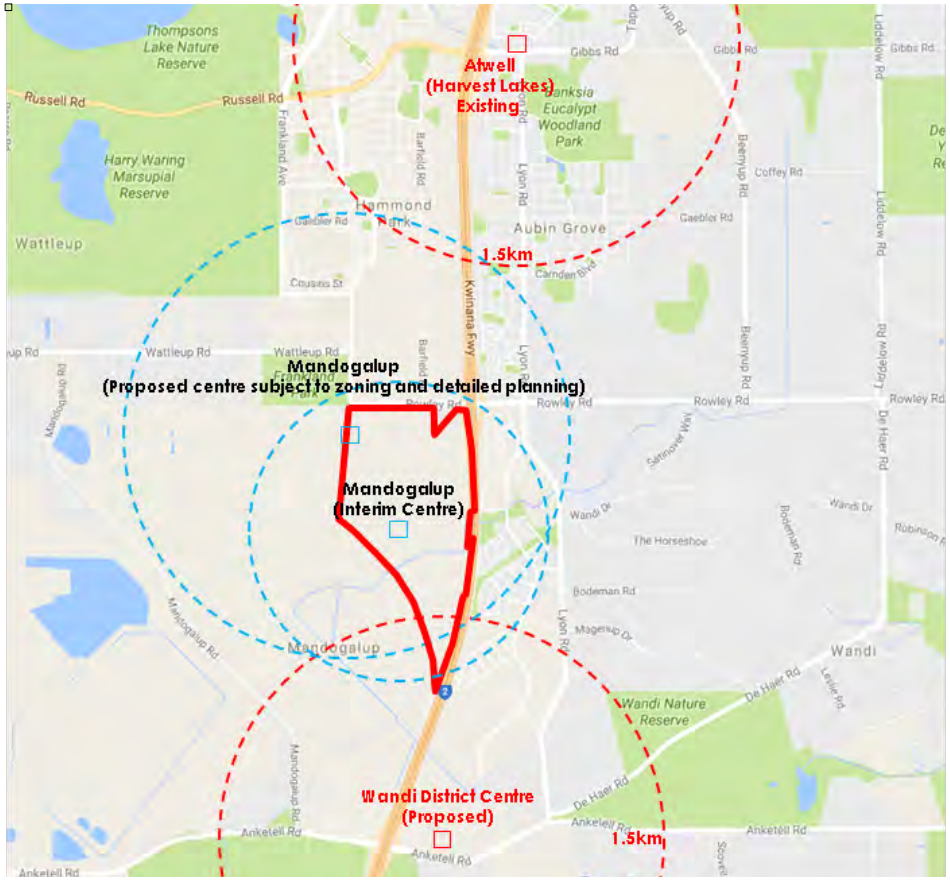
The centre will function at its best upon full development of its residential catchment. However, it may be delivered earlier to satisfy the needs of the establishing catchment and create loyalty and strong trading habits amongst local residents. The timing of the centre should have no impact on the performance or timing of other centres.

6.6 Future Planning

Any expansion of the current residential catchment within Mandogalup would increase the spending capacity and sales potential within the community. Therefore, any future planning for the expansion of the Mandogalup residential catchment should be cognisant of providing and planning for additional retail activity.

Earlier analysis (refer Taktics4 report dated April 2014) and modelling concludes that an increased catchment would support the need for an increased (size) retail centre and relocation of same from its current temporary/interim location (QUBE's land) to a location more accessible for Mandogalup and surrounding catchments, with that location being the Hammond Road South site within Lot 2. In doing this, the need for the interim centre (as depicted in this report) would no longer be required.

PLANNED MANDOGALUP RETAIL STRATEGY



Taktics4

APPENDIX 10

ENGINEERING SERVICES REPORT

ROWEGROUP

Report Name:	MANDOGALUP RESIDENTIAL AREA Proposal for Mandogalup (East) Local Structure Plan.
Project Title:	Engineering Services Report

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Revision	Description	Author	Checked	Approved	Date
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4	Additional Changes	MM	OO	EB	28/11/2016

Recipients are responsible for eliminating all superseded documents in their possession.

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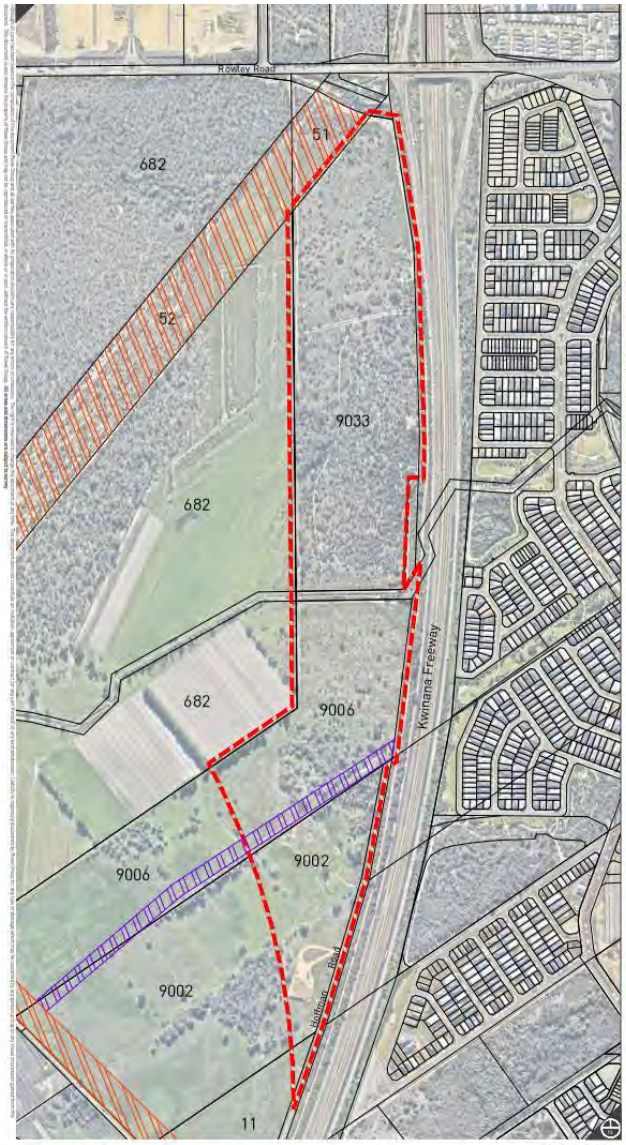
1. INTRODUCTION

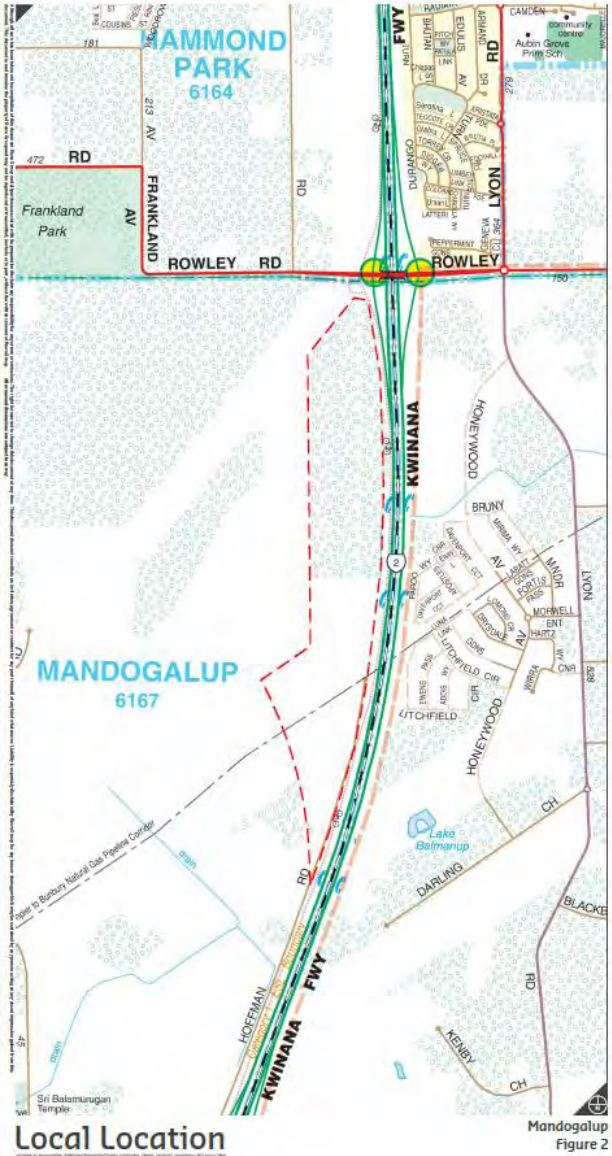
Peritas Group was commissioned by Satterley Property Group **'SPG'** on behalf of Wandi Anketell Land Finance Co P/L as t/f Wandi Anketell Finance Unit Trust to review the engineering constraints and servicing requirements associated with the development of the subject land.

The Study area is a total of 81.3ha approximately (42.67ha within Mandogalup East Local Structure Plan (MELSP) and is located within the Jandakot Structure Plan Area. The area is bounded by Kwinana Freeway to the east, Anketell Rd to the south, Rowley Rd to the north and Mandogalup Rd to the west.



Site Plan

Mandogalup
Figure 3



Local Location

Mandogalup
Figure 2

The majority of the site is currently vacant and has been cleared from all structures. In the past the site was used for rural purposes including grazing hobby farming and the like.

In summary, this report highlights:

- The subject land is capable of sustaining intensive development in keeping with the proposed residential rezoning proposals.
- The land is capable of being connected to and provided with all essential services to sustain residential development (based on current and future service authority planning).
- The proponent's strategy for the subject land will complement the natural landform by careful design of the bulk excavation and site grading and maintaining maximum vegetation.

This report also presents the proponent's commitments regarding further engineering assessment of the site.

This report has been compiled based on the following terms of reference:

- Briefing discussions and regular meetings with the client and the Consultant team.
- Site inspections with the Consultant team after formulation of the preliminary Local Structure Plan to further refine concepts and development strategies.
- Numerous meetings and discussions with Local Government Agencies.
- Site data and documents included on this report.
- Servicing concepts and Regional Strategic Infrastructure planning by the regulatory authorities.

Peritas Group has consulted with the consultants for and duly considered the engineering and servicing requirements of the adjoining Mandogalup West Local Structure Plan. We confirm that to our knowledge all conclusions and recommendations are compatible with those for the Mandogalup West Local Structure Plan at the time of the preparation of the report.

2. SITE EVALUATION

Over 50% of the subject land has undulating Terrain and generally slopes from the East to the West. The balance of the land (the North-Eastern portion) is gently inclined to the east.

Ground levels in the Northern side of the subject land range between 22m AHD to 24m AHD, with a local high point rising to RL 28.5m AHD, while the Sothern side is topographically lower, with levels ranging from 13m AHD in the south-western and RL 14-15 in the south-eastern corners of the site.

Site gradients range from medium slopes ranging from 1 in 10 to 1 in 15, to gentle slopes of 1 in 500. Greater than 50% of the subject land has gradients < 1 in 100.

Land with medium gradients dictate that bulk earthworks will be required to regrade the site with retaining walls incorporated in the steeper portions of the site to create level building pads and hence, most of the work will involve reshaping to form level pads where appropriate and to provide infrastructure servicing to the site.

The majority of the filling requirements of the site is due to achieving clearances to AAMGL levels established for the site.

Refer to section 2.2 and Appendix D for details.

2.1. SITE GEOLOGY

A formal geotechnical investigation was undertaken including a review of the existing Geological Maps by Golder Associates Pty Ltd and presented in their report entitled “Preliminary Geotechnical Investigation and Preliminary Acid Sulphate Soil Assessment Proposed Urban and Residential Development Lots 676, 678, 679, 680 and 683 Lyon Road, Wandi, February 2008”.

Based on the results of the above investigation undertaken by Golder Associates in 2008, surface conditions across the site can be summarised as:

- TOPSOIL – SAND/SILTY SAND (SP/SM), fine to medium grained, grey, containing, roots and organic matter, extending from the surface to between about 0.25m and 0.5m; overlying.
- SAND (SP), fine to medium grained, loose to medium dense, generally loose at the surface, silty in parts grey/grey brown/pale grey, generally dry to moist, becoming saturated, extending to depths of between about 4m and the maximum depth investigated of 10m; overlying.
- SAND (SP), dense to very dense, extending to the maximum depth investigated of 10.1m.

Cemented SAND (including coffee rocks) was encountered at some locations. It can be described as dark brown and yellow brown and weakly to moderated iron cemented. Where present, the cemented sand was typically up to 0.5m thick.

Variation to the generalised profile exists in the south-west part of the site (refer Figure 2 of Report by Golder Associates) where conditions can be generalised as:

- CLAYEY SAND/SANDY CLAY (SC/CL/CI/CH), low to high plasticity clay, fine to medium grained sand, typically grey mottled yellow, generally firm to stiff, organic in parts, extending from the surface to depths of between 0.5 and greater than 2.2m; overlying
- SAND/SILTY SAND (SP/SM), loose to very dense, extending to the maximum depth investigated of 5.2m.

Based on the data available it is not expected that any major difficulties will be experienced during the construction of the development, however, the presence of silty materials will require further investigation during specific development phases with due regard to the nature of the intended land use, facilities proposed and drainage requirements.

For further details refer to the Golder Associates Pty Ltd report as noted above.

General definition of Site Classes within the development zone

Australian Standard AS 2870 -1996 provides a system of site Classification for residential slabs and footings design as follows:

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground moment from moisture changes
M	Moderately reactive clay or silt sites, which can expect moderate ground movements from moisture changes
H	Highly reactive clay or silt sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement form moisture changes.
A to P	Filled Sites
P	Sites which include: Soft soils, such as soft clays or silts or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive soils subject to abnormal moisture conditions or sites which cannot be classified otherwise.

Table 2.1-1– General definition of Site Classes

The Mandogalup development area soils comprise a range of fine to medium grain sands to areas of fine to medium grained clayey sands with medium plasticity fines. A site classification of Class A is considered appropriate for the majority of the site in its current form with clay 'S' potentially in the areas overlaying deep clays. Modification of the areas of potentially class 'S' sites is possible to improve foundation conditions and ensure class A site conditions for building development across the development area.

It is anticipated that filling of the site within the lots will comprise material excavated from the development area with some importation required. It is therefore anticipated that a site classification of A will remain valid following site stripping, filling and compaction of locally won sandy soils.

It should be noted that site classifications advised with reference to AS 2870-1996 apply to buildings that are covered by that code being, buildings less than 30m in length and up to 2 stories high. Commercial buildings outside the standard that may be developed within the estate may require specific investigation and footing designs.

Based on the data available it is not expected that any major difficulties will be experienced during the construction of the development from an earthwork and building pad point of view.

2.2. GROUND WATER

The Study Area is within the City of Kwinana and the Peel Main Drain Catchment. It is approximately 22 km south of Perth (refer to Figure 1, JDA`s DWMS 2011). The boundary of the groundwater study area is defined based on the catchment hydrology; Mandogalup and Norkett Road to the west, Anketell Road to the south, the Kwinana Freeway to the east and Rowley Rd on the northern boundary.

The results of the preliminary studies culminating in the JDA Consultants Hydrologist Report Mandogalup District Water Management Report dated September 2011, indicate that the ground water levels across the site vary from RL 20.5m AHD to RL 13m AHD (Based on AAMGL estimated levels).

Refer to Appendix J for details of the Average Annual Maximum Groundwater Level (AAMGL) and depth to GWL and Drawing SK 5 for depth contours between NSL and AAMGL.

For the purposes of development, potential AAMGL can be taken as at the ground surface for the majority of the lower portions of the site in the south-western sector. Refer to the District Water Management Strategy (JDA report September 2011) for further details.

2.3. SITE GRADING & BULK EARTHWORK

General Principles & Approach

The subject land is a gently sloping site with flatter terrain in the in the southern western portion, substantially cleared, incorporating a network of old farm drains, formal branch drains ultimately discharging into the peel main drain that traverses the site and discharges to the West.

Site grading and remodelling will be kept to minimum limits wherever possible and will generally be limited to roadworks, building pads for future development and associated works within the following parameters:

- Creation of Residential building sites.
- Shaping of siteworks to create interesting features and focal points at each development node keeping within an urban and residential estate theming.
- Contouring of land to suit servicing requirements of the development, sewerage and drainage requirements.
- Creation of sufficient variation in the grading to allow the contouring of public areas with swales and landscaped open spaces along existing natural drainage outfalls.

Site grading will generally be determined by the servicing requirements and environmental constraints of the site to ensure a sustainable as well as economic development of the infrastructure.

Various areas within the subject land contain remnant vegetation cover and every effort should be made to maintain existing significant trees and vegetation by controlling the clearing operations during the earthworks and site grading works, particularly within public areas and at the boundaries of preservation zones.

Therefore clearing, prior to bulk earthworks, will be completed with due regard to selective vegetation preservation and will be restricted to approved areas development and in accordance with planning guidelines to be established.

Peritas Group anticipate that the bulk earthwork operations will be partly completed using material available from the area and importation of fill material that will be locally sourced from existing sand mining operations within the locality.

Once the earthworks have been completed, the site will be stabilised either by the respreading of stock piled top soil from the bulk earthwork operations, or by hydromulch stabilisation as appropriate or in accordance with the requirements of the local authority.

Whilst land gradients are not excessive, steeper cross-gradients within road and residential precincts will require re-grading and stabilisation to ensure building sites are created to take advantage of aspect and location as well as facilitate ease of construction and access.

The natural land form will be reshaped within accepted guidelines and in accordance with the requirements for site servicing and building pad creation, however, natural drainage flow paths will be maintained wherever possible.

Preparatory works prior to earth working should be limited to the following:

- Removal of fencing and other improvements as necessary, however, retaining as many existing and significant trees and vegetation as possible.
- Stripping and grubbing of areas to be earth worked with due regards to vegetation preservation in selected areas.
- Strip and stockpiling topsoil.
- Cut to fill operations and imported fill to selected areas to improve geotechnical parameters for development.
- Stabilisation of any areas to be landscaped or where topsoil has not been respread on verges and embankments.

Site levels shall be set in accordance with the following parameters:

- Geotechnical and soil parameters to ensure that the site achieves appropriate site classification for its purpose generally Class 'A" for residential purposes.
- Fill levels to provide clearance to groundwater (AAMGL and as prescribe by authority approvals)
- Building pad levels to be designed to ensure that floor levels maintain a clearance of a minimum of 0.5m to the regional 1:100-year flood levels.
- Finished pad levels are to conform to the regional drainage requirements as identified in the published urban stormwater drainage strategies consistent with recent government initiatives for the area.

Upon completion of bulk earthworks, any disturbed areas shall be stabilised either by respreading the stockpiled topsoil from the bulk earthwork operations or via hydro mulching stabilisation as appropriate or in accordance with the requirements of the local authority.

Clearing and Disposal

Wherever possible, cleared vegetative material will be collected and used in soil and land stabilisation, either as 'brush matting' or chipped and used as a mulch. Where approved, rushes will be harvested and used in wetland re-vegetation. Debris from clearing which cannot be re-used will be disposed off in approved land fill sites in accordance with Local Authority policy.

Following clearing, the topsoil will be stripped and stockpiled on site for later use in stabilising verges or topsoiling of embankments and swales.

Land Stabilisation & Dust Suppression

Prior to construction taking place, a construction water supply will be established to provide water for dust suppression, temporary sand stabilisation and irrigation during the construction phases. Water trucks and spray equipment will be on site throughout the construction programme to damp down exposed sand surfaces until the surface is physically stabilised. In the event that adjacent occupied homes or trafficked roads are affected by sand drift, a sand trapping fence will be constructed fronting the affected section of the development.

In the event of strong winds blowing towards adjacent properties that cause blown sand to reach those properties, earthworks, including the stripping or respreading of topsoil, will be temporarily suspended and dust suppression measures immediately implemented.

Stabilisation of the soil surface will be carried out, as required, immediately following topsoil re-spreading and minor regrading.

Soil stabilisation will generally comprise stockpiled topsoil respreading; however, Hydromulch without seed will also be used with Council Approval. Hydromulch with seed, or dry seeding, may also be employed in select locations with due care to utilise wherever possible local and native species.

Soil stabilisation will be maintained until such time as the vegetation cover is sufficient to prevent erosion.

3. ROAD NETWORK & TRAFFIC CONSIDERATIONS

Overview

In the early phases of development, access to the site will be from the South of Anketell Road and along the existing road network via Hoffman Road.

Internal proposed roads generally consist of asphalted pavements with porous verges. Minimum recommended carriageway widths will be selected with due reference to local authority (City of Kwinana) and the provisions of Liveable Neighbourhoods.

The design of the road hierarchy and network associated with the proposed Structure Plan has considered the policy document "Liveable Neighborhoods - Community Design Code, Element 2, and Movement Network."

In planning the internal road network for the subject land the following considerations were taken into account:

- Topographic conditions and existing road networks.
- Retention of the existing trees to comply with City of Kwinana Tree Retention Policy.
- Nature of existing vehicle movements and their major on/off site destinations especially in relation to major regional destinations.
- Compatibility with the proposed land use.
- Relationship to the existing road network and consideration of future potential development and expansion into adjacent areas.
- Separation of through traffic from local traffic.
- Balance accessibility for all the tenants and occupiers to the major proposed public facilities.

Residential streets/minor roads will be designed to be remain passable in the 5-year ARI event and defined major arterial roads will be designed to be remain passable in the 100-year ARI event.

In residential areas, generally road truncations maybe reduced from 6mx6m to 3mx3m in the following situations (although they will be subject to more detailed design at subdivision stage):

- On roads that intersect with a 20m road reserve and wider (i.e. 15m road onto a 20m road reserve or wider). 15m roads onto a 15m road will not work and for anything below this other than at laneways (see below).
- On road bends (and for reserve widths greater than 12m) where the angle is greater than 120 degrees in deviation. 90-degree bends will not work other than as noted above and as noted for laneways below.
- On laneways (6m reserve width) that intersect at right angles to roads that have a reserve width 12m and greater (i.e. 6m laneway onto a 12m, 15m etc. road reserve).
- In some odd intersection situations where the roads come in at differing angles (see examples below).

Figure 1. Examples of truncations 3mx3m in particular intersection situations.

Road Hierarchy

The road network design achieves its objectives to separate non-local traffic from the minor road network. The design focuses on a structured road hierarchy which is self-regulating, creating road environments compatible with the traffic needs of land use.

The proposed hierarchy of roads within MELSP and MWLSP area was established through transport modeling undertaken by Transcore Pty Ltd for both LSPs and is presented in Transcore`s traffic assessment report (reference t16.216mr01, November 2016).

The proposed road hierarchy was based on traffic projections and the classification of Liveable Neighborhoods document 2007 and illustrated on Figure 7 of Transcore report.

The network is flexible, allowing a staged implementation of the major road network as development of the subject land progresses. In particular, the needs of commercial vehicles, public transport, pedestrians and cyclists have been considered in the design of appropriate road cross sections. In this way, design features are integrated to provide streetscapes which serve all road users efficiently.

There are inbuilt opportunities for further expansion, which will not compromise the operation or aesthetics of the network for any road user group.

Any development plan for the area will incorporate a structured road network which includes a range of traffic control and regulating devices including roundabouts, road medians and convenient turning areas, both for council refuse truck use and local industrial vehicular traffic. The road network would be complemented by pedestrian links and landscaping treatments to enhance the verges and streetscapes in keeping with a green park theme.

The focus of traffic management and road network design within the development is to create a legible, functional road hierarchy which will be safe for all road users with a self-enforcing speed environment achieved through the use of:

- A hierarchy compatible with land use.
- Appropriate road construction widths and standards.
- Appropriate intersection control treatments and midblock traffic management.
- Property access control (where appropriate).
- Optimized intersection location, spacing and interaction.

Some key characteristics of relevant road classifications have been summarised below:

i) Neighborhood Connectors

Neighborhood connectors link neighborhoods and towns, are carefully designed to calm traffic and facilitate pedestrian use and have frequent local street connections. The neighborhood connector should not attract substantial long distance through traffic, but provide for safe and convenient local travel to and from arterial routes. The number of median breaks will need to be controlled to ensure reasonable levels of traffic speed and flow, limiting delays and potential traffic conflict points.

Neighborhood connectors spread local traffic loads and reduce intersection loadings, act as bus routes and support the location and viability of neighborhood centres.

ii) Access Streets

The access street is the most common street in residential subdivisions designed under Liveable Neighborhoods. The environment of the abutting land use dominates, traffic speed and volumes are low, and pedestrian and bike movements are facilitated by the streetscape and traffic behavior. Vehicle speeds will be constrained by street length, on-street parking intensity, variation in width and alignment of the road, the presence of street trees, and type of road construction.

The majority of both LSP internal roads are classified as Access Street Type D roads with indicative upper volume of traffic being 1,000 vpd.

The access streets to the east and south of the proposed primary school site are recommended to be constructed as Access Street Type B with 17.9m road reserve width that will allow for on-street parking on both sides of the road.

All roads would be provided to residential street standards, providing local access between properties and the distribution network in a low speed, low volume environment pavement widths to accommodate on-street parking help control vehicle speeds without the need for restrictive traffic control devices. In this way, street environments can be created where shared vehicle-pedestrian areas can exist and in corporate/enterprise areas to optimize the use of available road space for parking and service vehicle access.

Traffic Management

Appropriate intersection control is a key to regulating traffic speeds and creating a self-enforcing road environment.

One roundabout is proposed at south corner of the proposed primary school site. This roundabout will help manage the circulation of the traffic flows and assist with speed management on major road. In addition, it will provide landscaping opportunities and improve traffic safety at major intersection.

Significant levels of internal and external traffic are expected to be generated by the improved connectivity to the major regional road network. The standard of road treatments and hierarchy has been specifically addressed to cater not only for internally generated traffic, but to recognize the importance of the subject land road system within the context of a wider regional network.

A number of four-way intersections is proposed in both LSPs on low traffic volume access streets. These intersections will be constructed as priority-controlled intersections with Give Way control on the minor road approaches as suggested in Liveable Neighborhood document. Appropriate entry treatments will be implemented on side roads to help to alert road users about presence of the intersection and that traffic on the major road has priority.

4. STORMWATER DRAINAGE

Preliminary discussions with City of Kwinana indicate that the design philosophy for drainage in the area is to ensure that downstream discharges are limited to existing discharge flows. Additional water is to be compensated on site using alternative measures to an end of pipe solution.

To achieve this, a combination of Rebated Lot rain gardens, median swales, linear and pocket rain gardens and porous verges will be required prior to surface water being allowed to overflow into the adjacent drainage network and into compensation basins downstream.

Stormwater collection disposal strategies will incorporate storage and flood attenuation prior to discharge to existing outfalls including the proposed regional drainage system.

All road reserves will be drained. It is proposed however, that where soakage is possible porous verges, rebated lot rain garden and linear gardens in road sides would be installed to allow for appropriate infiltration in lieu to a conventional piped drainage system (consisting of collector pits, manholes, and controlled outfalls). These nutrient stripping zones and infiltration would incorporate water sensitive design and quality principles.

The stormwater concepts are proposed to meet the key criteria defined by JDA Mandogalup District Water Management Strategy report September 2011;

- The 1-year 1-hour ARI event shall be retained on site through the use of retention (soakwell) or storage devises. Chapter 9 of the Stormwater Management Manual for Western Australia (DoW, 2007) details suitable devices and appropriate design of retention system for the soil type of the site.
- A range of flows from 1 in 1 year to the areas required for flood management to be determined based on stormwater modelling for the 100yr ARI. These areas will be allocated in the local structure plan.
- Public open space (POS) and retention basins should operate as dry basins with a clearance of 0.5m (or alternative level agreed with the city) between the controlled groundwater level and the invert of the basin.
- Defined major arterial roads should remain passable in the 100-year ARI event.
- Water quality treatment systems and water sensitive urban design structure must be designed in accordance with the Stormwater Management Manual for Western Australia (Department of Water & Swan River Trust, 2007) Chapter 9 (Structural Controls) and Australian Runoff Quality (Engineers Australia, 2006).
- All minor rainfall events will be infiltrated at source (porous verges, pocket and linear rain gardens) wherever possible, consistent with DWMP design criteria.
- The surface water management strategy to be guided by the DWMP, Stormwater Management Manual and follows Water Sensitive Urban Design principles.

Refer to the JDA Mandogalup District Water Management Strategy report September 2011 for further details of Stormwater Drainage and LWMS reference number J5483.

5. WASTEWATER DISPOSAL

Preliminary information from Water Corporation of WA indicates that there is no service network in the area, however, planning has been underway for a number of developments in the area and have now resolved supply issues adjacent to development that will enhance the regional network. The preliminary discussion with Water Corporation also addressed the concept for ultimate discharge from the proposed Mandogalup development area inclusive of Mandogalup East Local Structure Plan and Mandogalup West Local Structure Plan areas.

The Water Corporation have indicated that the planning and disposal strategies that we have outlined below are in accordance with their wastewater planning proposals. Peritas Group has also been engaged to design and document the proposed sewer network and sewer pumping station that will service Mandogalup development area.

It should be noted that wastewater from this catchment would not commence until subdivision has been instigated over the land. This is not anticipated before 2016 and that residential building construction would only commence in late 2016-2017 approximately.

Please refer to Appendix H for a plan showing the proposed sewer configuration and staging plan and the location of the proposed sewer pumping station.

The MELSP and development Precinct will be served in accordance with preliminary Water Corporation Sewage Planning as shown in Appendix K.

This sewer planning identifies the need for a prefunded WWPS (Thompsons Lake Pump Station J) with a long term pumping rate of approximately 190 litres / sec.

In order to serve the proposed MELSP development area (and ultimately MWLSP area, the QUBE landholdings, as part of the same catchment) the WWPS will need to be located in the south-eastern corner of the SPG landholding as shown on preliminary catchment plan in Appendix K.

This WWPS plus the rising main to be located on the preferred route through SPG landholdings will be required to be included on the Water Corporation Capital works program.

A preliminary staging plan has been developed by Peritas for discussion with Water Corporation that outlines a staged approach that proposes to use the existing Honeywood (Thompsons Lake Pump Station J) by diverting flow under the freeway from the southern corner of the Mandogalup precinct and upgrading the existing pump station for the increased flow conditions.

This may be a temporary or an interim measure until such time as the Mandogalup catchment develops to its full extent and as the QUBE land comes on stream in later stages. The Water Corporation may consider allowing the early stages of the SPG land to gravitate to that catchment to save construction of the major infrastructure necessary for the Mandogalup catchment to stall the major expenses within the Capital works for the Mandogalup area.

6. POTABLE WATER SUPPLY

Overview

Preliminary information from Water Corporation of WA indicates that there is no service network in the area, however, planning has been underway for a number of developments to the north of the MELSP area that have now resolved supply issues that will enhance the regional network that will also ultimately feed the urban zone that is subject of this application.

The MELSP and development Precinct will be served in accordance with current Water Corporation Water Supply Planning and generally as identified on attached sketch plan in Appendix I.

The Water Corporation has indicated that the water distribution mains along Brushwood Boulevard and Russell Road were completed and that the 500DN extension southwards along Hammond Road/Frankland Avenue would be completed in the near future.

This would leave a section of distribution main to be completed in order to connect the northern end of the Mandogalup development precinct to water supply. This infrastructure would require the construction of a combination of 375DN and possibly 900DN or 700DN water mains southwards along Frankland Avenue to the intersection of Rowley Road.

The 375DN and larger main would need to be constructed along yet constructed future road reserve alignments that will become the extension of Hammond Road along the current Frankland Avenue alignment (refer to sketch plan SK-01A in Appendix G and Water Reticulation Planning layout in Appendix I)

It is unclear at this stage what size mains the Water Corporation would select for the prefunded works sections of the water supply extension. The Corporation has advised that they are currently reviewing water supply generally in the Mandogalup and adjacent precincts due to the increased demand for development land in the area.

Current indications are that the mains constructed under a prefund arrangement would terminate at the intersection of future Hammond Road/Rowley Road and from there the developer (whoever developed first) would need to extend a minimum 300DN distribution main along Rowley Road to service the northern end of the Mandogalup precinct.

On this basis, if SPG developed ahead of QUBE this would require the extension of a 300DN main along Rowley Road and into the SPG landholdings adjacent to the eastern extremity of the QUBE landholdings on Rowley Road and then enter the northern development precinct of the SPG Mandogalup LSP area.
As in the case of Honeywood, the 300DN distribution main would then continue southwards through the SPG landholdings along proposed road alignments (generally along the major spine road similar to that undertaken along Honeywood Avenue) to service progressive stages starting from the southern portion of the site.

The selected water main route would also most likely be the same as the route for the sewer rising main required from the sewage pump station which will serve all estates within the Water Corporation catchment area which includes both QUBE and SPG estates.

Depending on the outcomes of the QUBE discussions and the timing of their application, the water supply capital works highlighted may well already be planned to be included in the Water Corporation Capital works planning as the greater component of the infrastructure required by SPG will also be required to serve stage 1 of any development undertaken by QUBE commencing form the northern end (Rowley Road) of the QUBE landholding.

Water Supply Reticulation System

All internal water reticulation pipework will be designed and constructed to the standards and requirements of the Water Corporation of Western Australia.

A ring main feeder system will distribute water along the major arterial roads. Internal reticulation will then proceed from this ring main into the various collector roads and cul-de-sacs.

Standard Water Corporation water headwork charges will apply.

Please refer to Appendix I for a plan showing the location of the planning Water Supply network within the development precinct. .

7. POWER, TELECOMMUNICATION & GAS

7.1. WESTERN POWER

The proposed development is currently surrounded by overhead HV infrastructure ranging from local distribution network capacity lines of 22kV right up to major kV distribution lines with a capacity of 330kV. The lower order distribution network can be utilised to supply power to the development. Satterley Property Group has engaged Western Power to undertake a preliminary feasibility study to establish the capacity of the current network. The study undertaken by Western Power has indicated that the existing power network in the vicinity of MELSP area has insufficient capacity to accommodate the whole development and provided recommendations on possible network extensions that would be required to deliver power services to the estate. The copy of the feasibility study is attached in Appendix L.

Following the receipt of the feasibility study from Western Power, Peritas Group Engineers have made further contacts with Western Power to discuss options of power supply. Based on these discussions it is anticipated that first stages f MELSP development could be serviced from the existing network by way of upgrading existing feeders. However, the exact capacity can be established at the detailed stage only.

All lots within the proposed development will have to be served with underground power. The cost of upgrades and extensions to the existing network will need to be met in full by the developer.

Standard Western Power requirements will apply including cost for headworks upgrades and exclusions to serve the site.

Several pad mount sites will be required throughout the development, however, due to the range of sizes of lots proposed within the development, it is not envisaged that there will be a problem in providing the sites strategically located to meet both Western Power design requirements and the requirements of the developer.

The street lighting throughout the development shall provide effective illumination for both pedestrian and vehicles.

The following criteria was used as a basis for the street lighting design.

1. Street lighting shall be provided to the entire development.
2. Lighting levels will vary from major to minor roads.
3. Street lighting cable shall be installed underground.

Roadway lighting will generally be at low elevations however high mast lighting will still be necessary to accomplish high illumination levels required for fast moving or heavy traffic areas.

Low height luminaires up to 6 metres high are generally used on all minor roadways and these also provide general amenity lighting to pedestrian pathways. Lighting should be suitably designed to co-ordinate with other streetscape elements such as roads, pathways, landscape, street furniture etc.

7.2. TELECOMMUNICATION SERVICES

It is anticipated that all lots within the proposed development will be served with Telecommunication services or an external private supply provider as is the case of LBN Co in Honeywood and Wandi South Estates.

The selected provider will install telecommunication facilities to the proposed subdivision, subject to the developer providing at his cost, trenching for cable laying.

Alternatively, where cable routes match Western Power underground power supply routes, the communications provider will wherever possible use the Western Power trenches in lieu of the developer providing additional trenching.

Headwork charges for Telecommunication services extensions are anticipated.

7.3. GAS SUPPLY

ATCo Gas has advised that reticulated gas services are available in the surrounding area.

ATCo Gas may provide road crossing conduits for future use; however, this is subject to cost allocations and budgets being approved by the gas authorities.

No developer contributions to provide for future reticulated gas supplies are anticipated.

The Dampier – Bunbury Natural Gas Pipeline (DBNGP) traverses the Southern portion of the site, and as was the case in Honeywood Estate, Wandi, earthworks in this corridor are not permitted with adjacent land being graded to maintain access and to maintain existing gas corridor levels.

Services that need cross the pipeline reserve or at road crossing locations across the reserve will need to be negotiated with DBP (Dampier Bunbury Pipeline Authority) regulation and designed to accommodate their requirements in full.

This will not provide any major technical challenges and the contracts established with the DBP regulatory authority during adjacent development will ensure streamlined approvals for any local development or infrastructure proposals associated with the subject land.

8. CONCLUSIONS & RECOMMENDATIONS

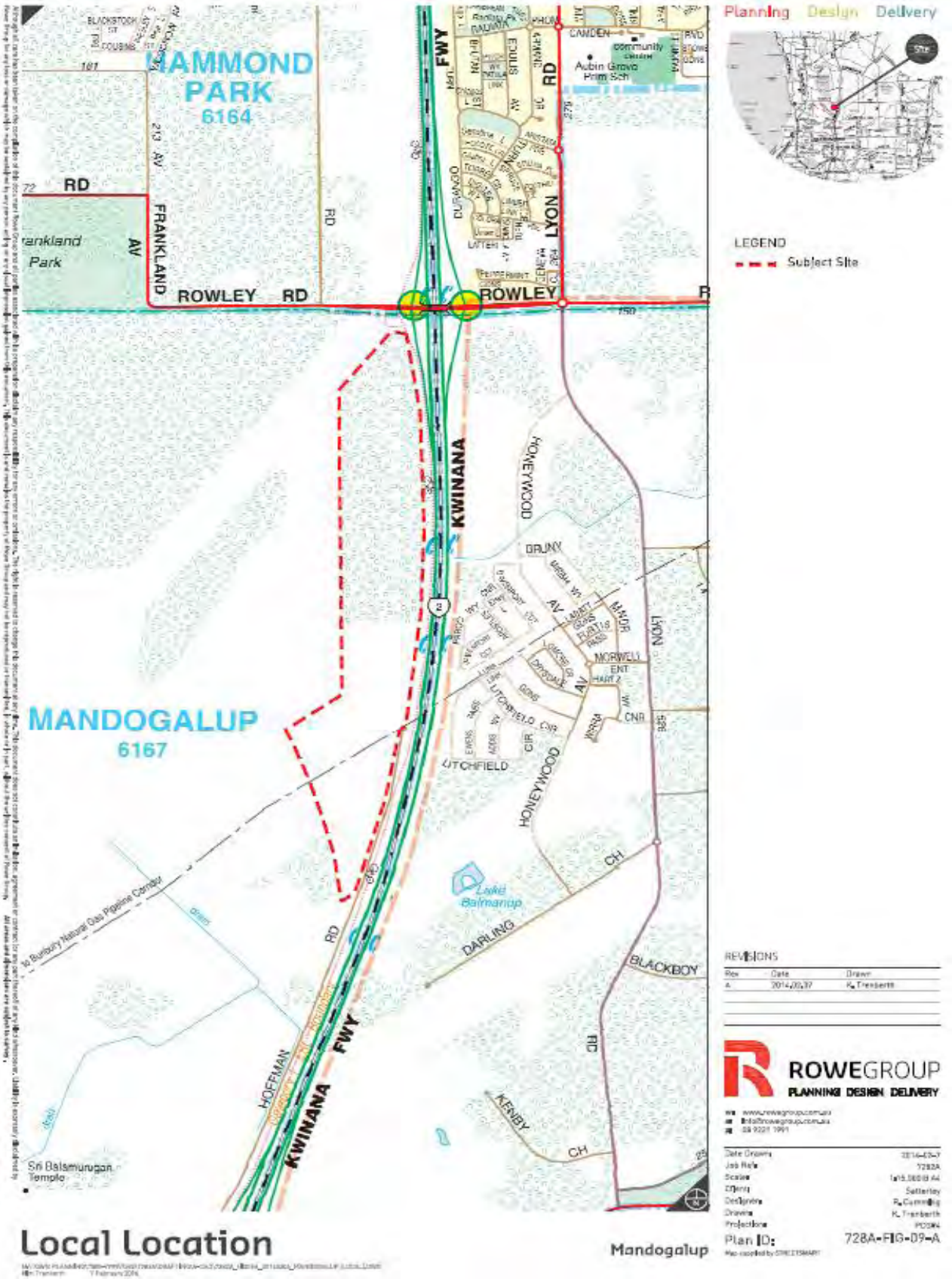
Peritas Group does not envisage any major servicing constraints for the proposed development and has allowed appropriate costs for major servicing infrastructure based on a stand-alone site development of the subject land. Should joint development or cost sharing with neighbours be achieved then development costs, depending on development timing, would be reduced.

The site is capable of being serviced with all essential services, has no identifiable problematic soil conditions based on preliminary inspection of the site and with careful considered design would result in a high quality development.

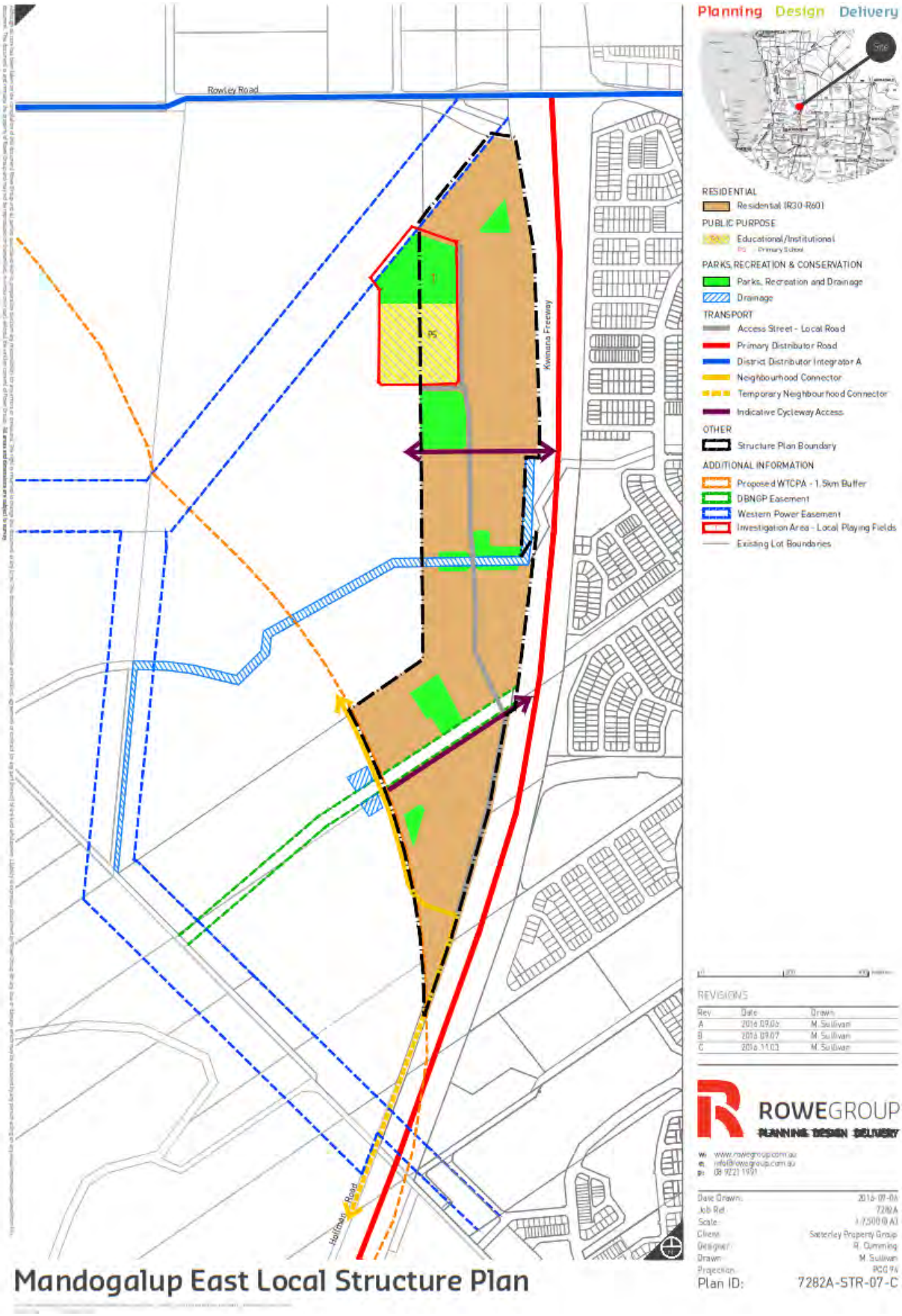
It is recommended that additional detailed work be undertaken in conjunction with the regulatory authorities and service provider to determine the land requirements associated with the necessary infrastructure as envisaged by the Water Corporation and other service authorities, and to ensure the major works are incorporated on Water Corporation capital works program that will assist in the timely delivery of the major infrastructure items detailed in this report.

Additionally, the major service authorities should again be approached to formally confirm further details of any upgrade requirements based on the staged development of the site so that the early planning major infrastructure can be undertaken and forward work construction programmed.

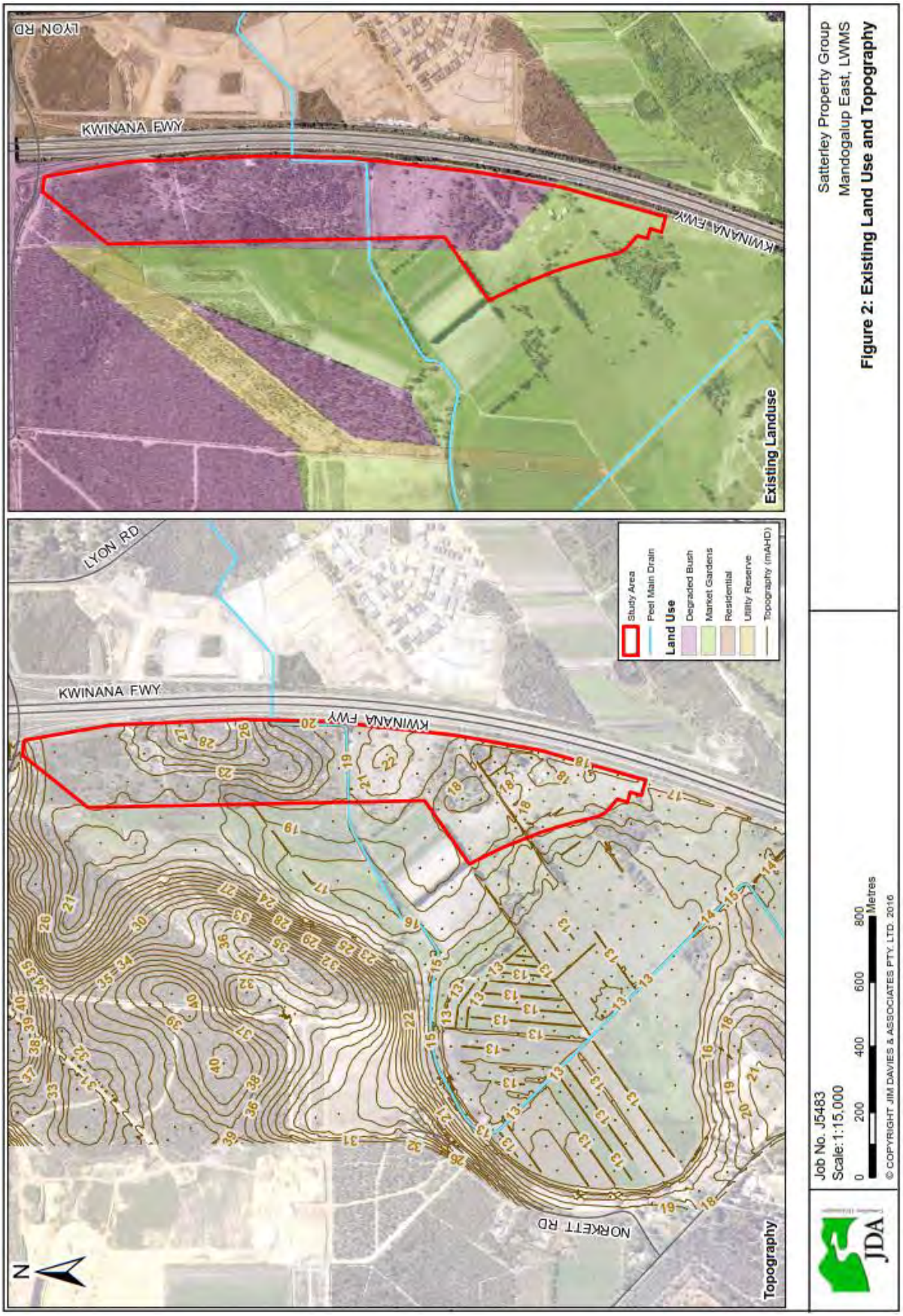
APPENDIX A - LOCATION PLAN



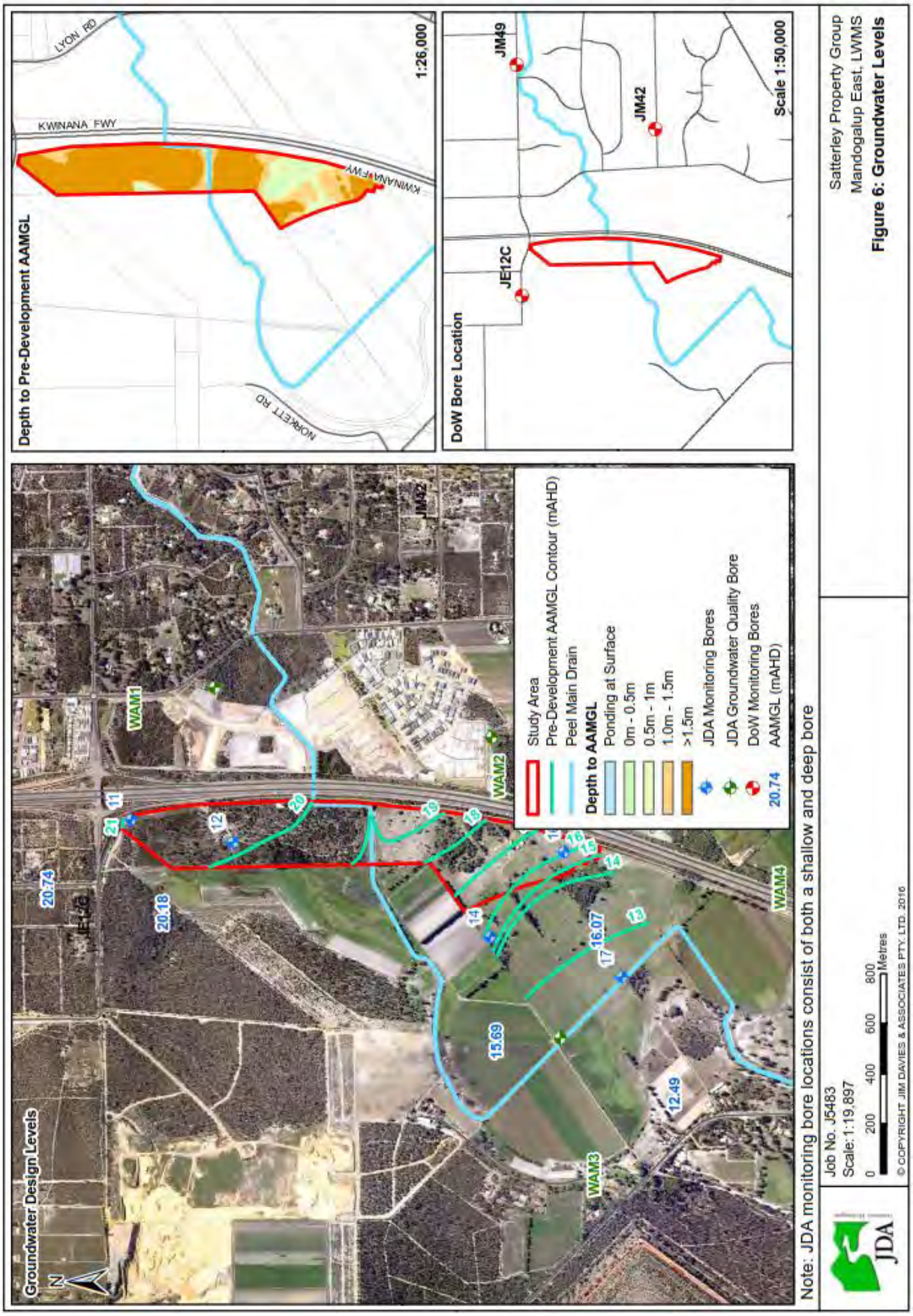
APPENDIX B - PROPOSED LOCAL STRUCTURE PLAN



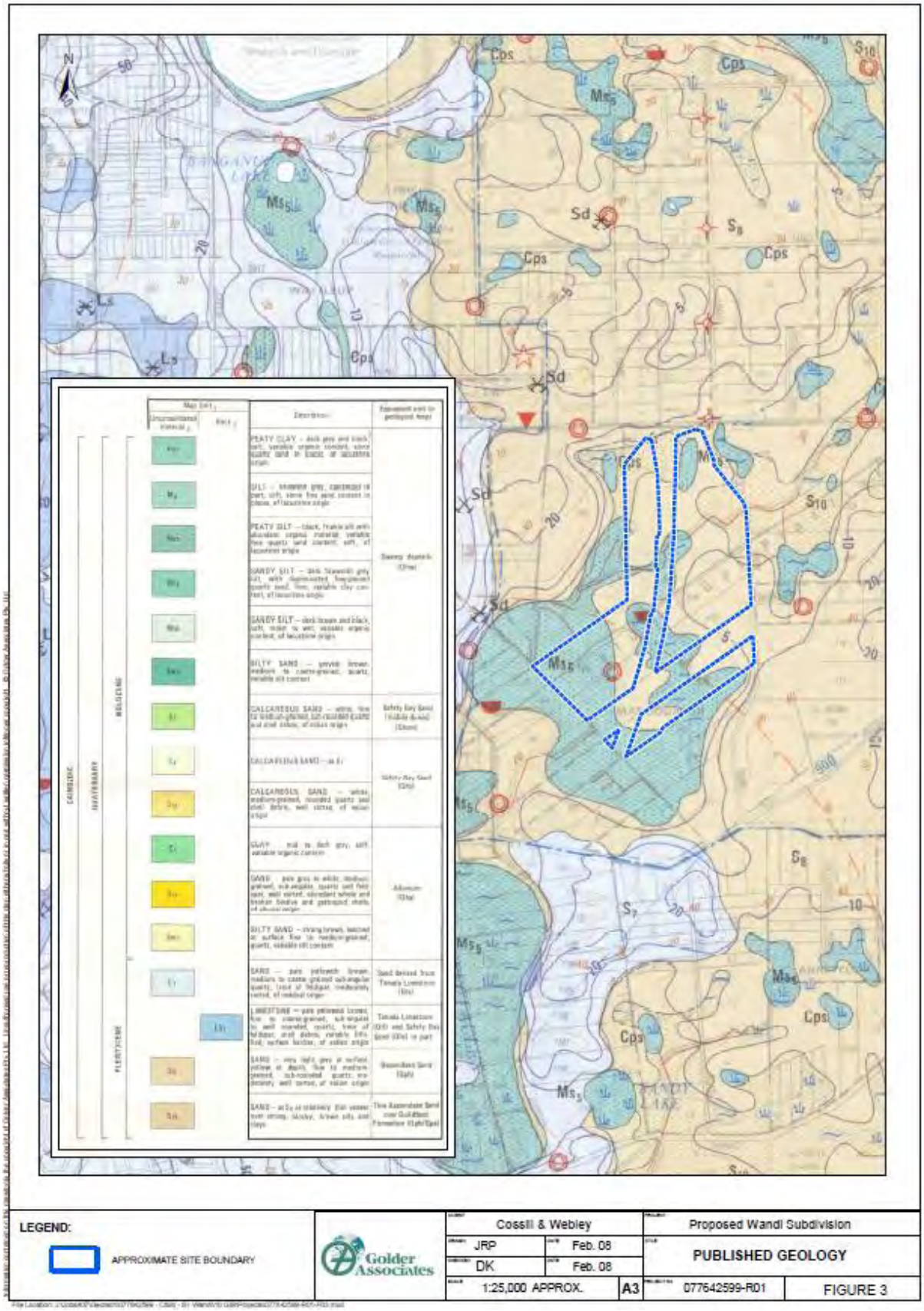
APPENDIX C - TOPOGRAPHICAL FEATURES PLAN



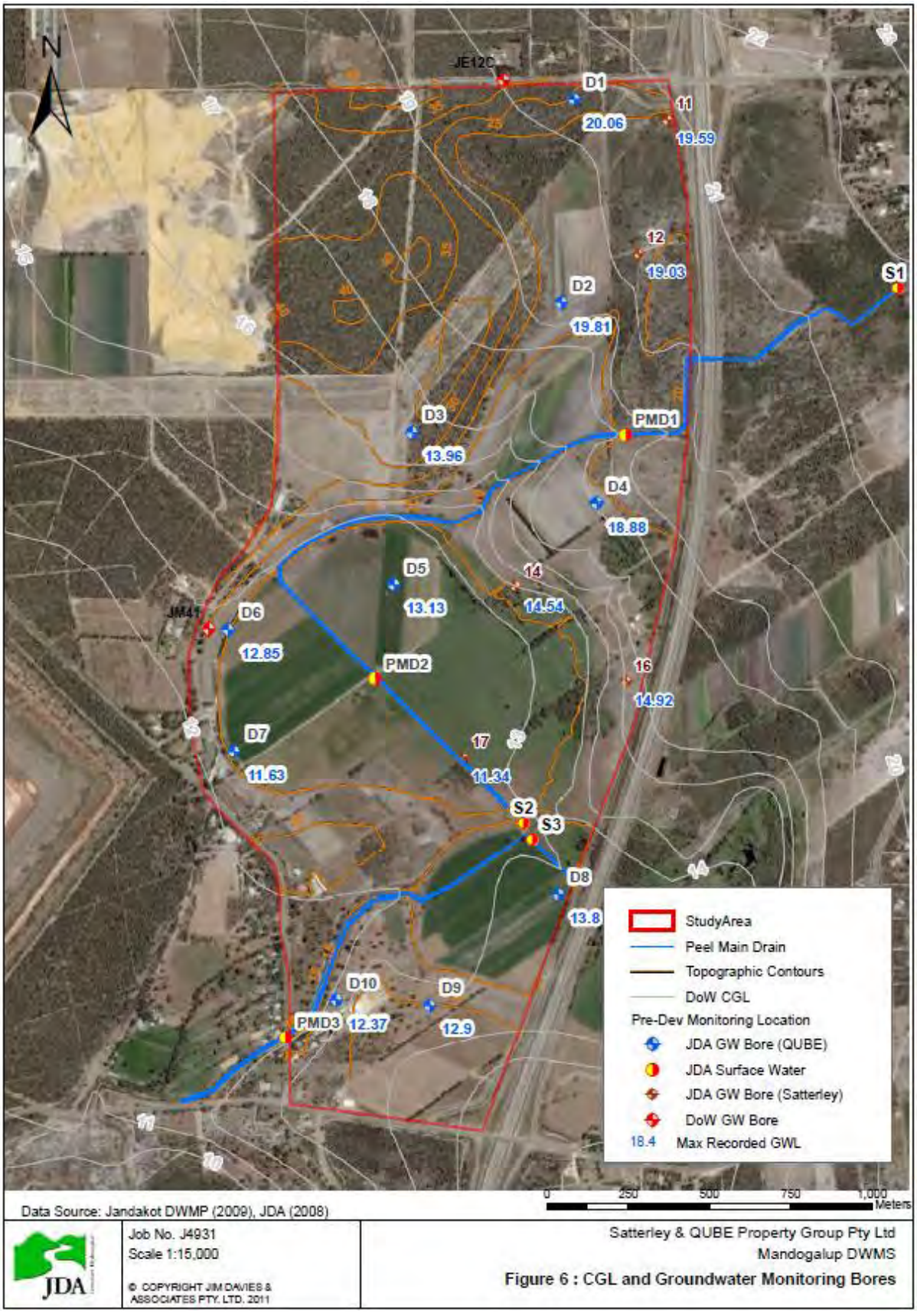
APPENDIX D - AAMGL CONTOURS & GROUNDWATER LEVELS



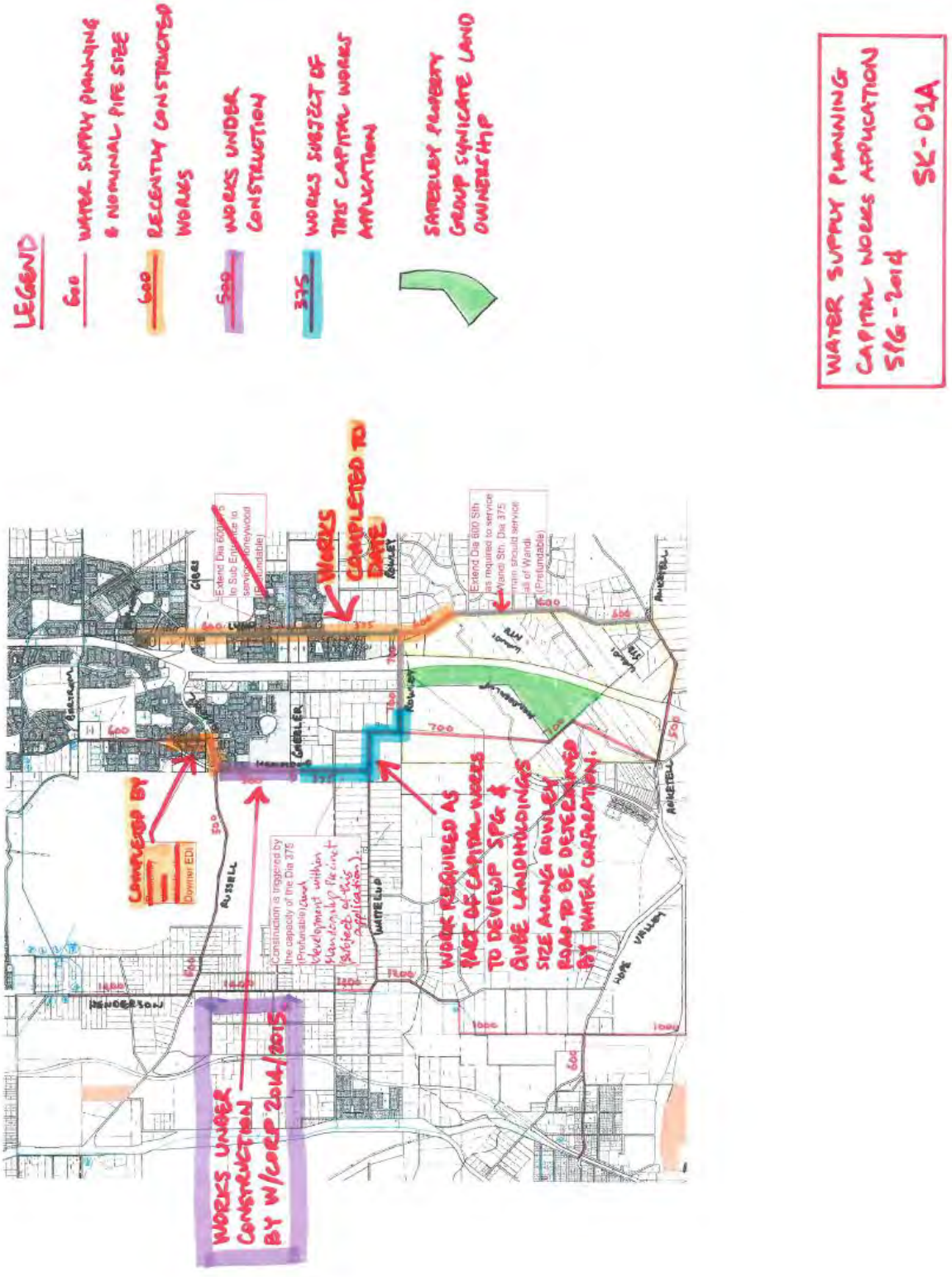
APPENDIX E - GEOLOGICAL MAPPING PLAN



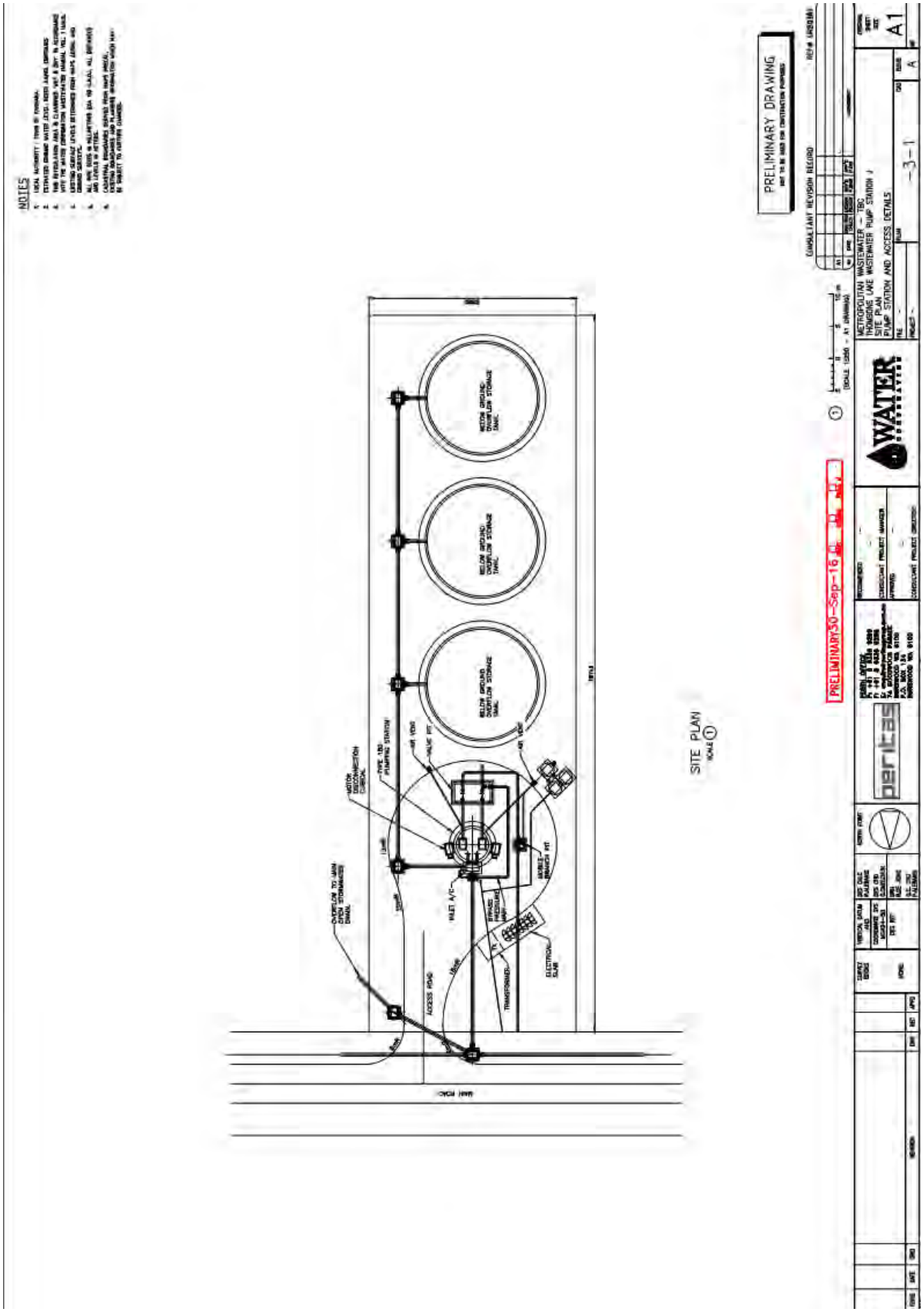
APPENDIX F - GROUNDWATER CONTOUR



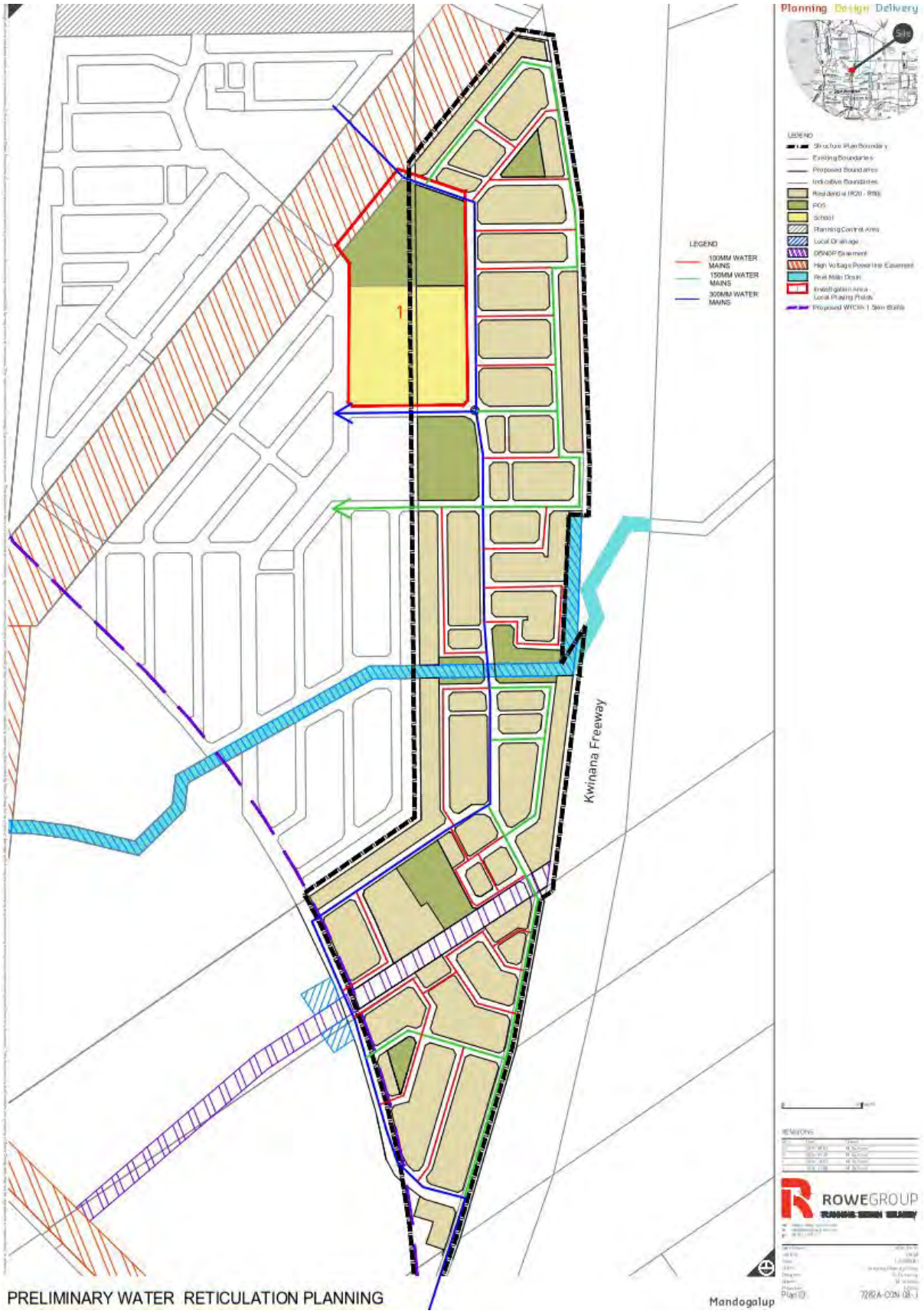
APPENDIX G - WATER SUPPLY PLANNING CAPITAL WORKS



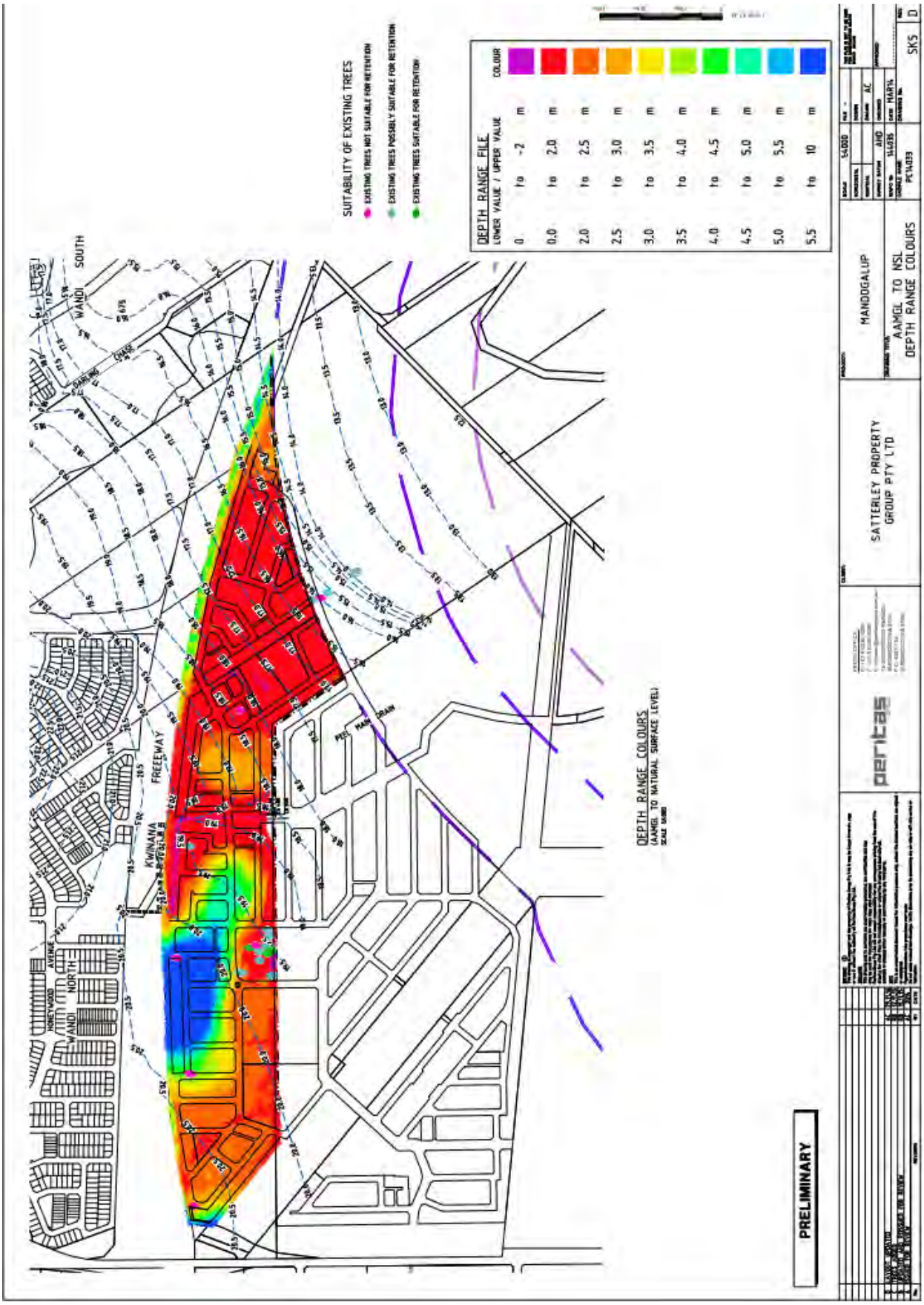
APPENDIX H - SEWAGE DISPOSAL CONCEPT PLAN


NOTES
PRELIMINARY DRAWING
SITE PLAN
PRELIMINARY30-Sep-16
METROPOLITAN WASTEWATER – TBC
THOMSONS LAKE WASTEWATER PUMP STATION J
SITE PLAN
PUMP STATION AND ACCESS DETAILS
A1
-3-1

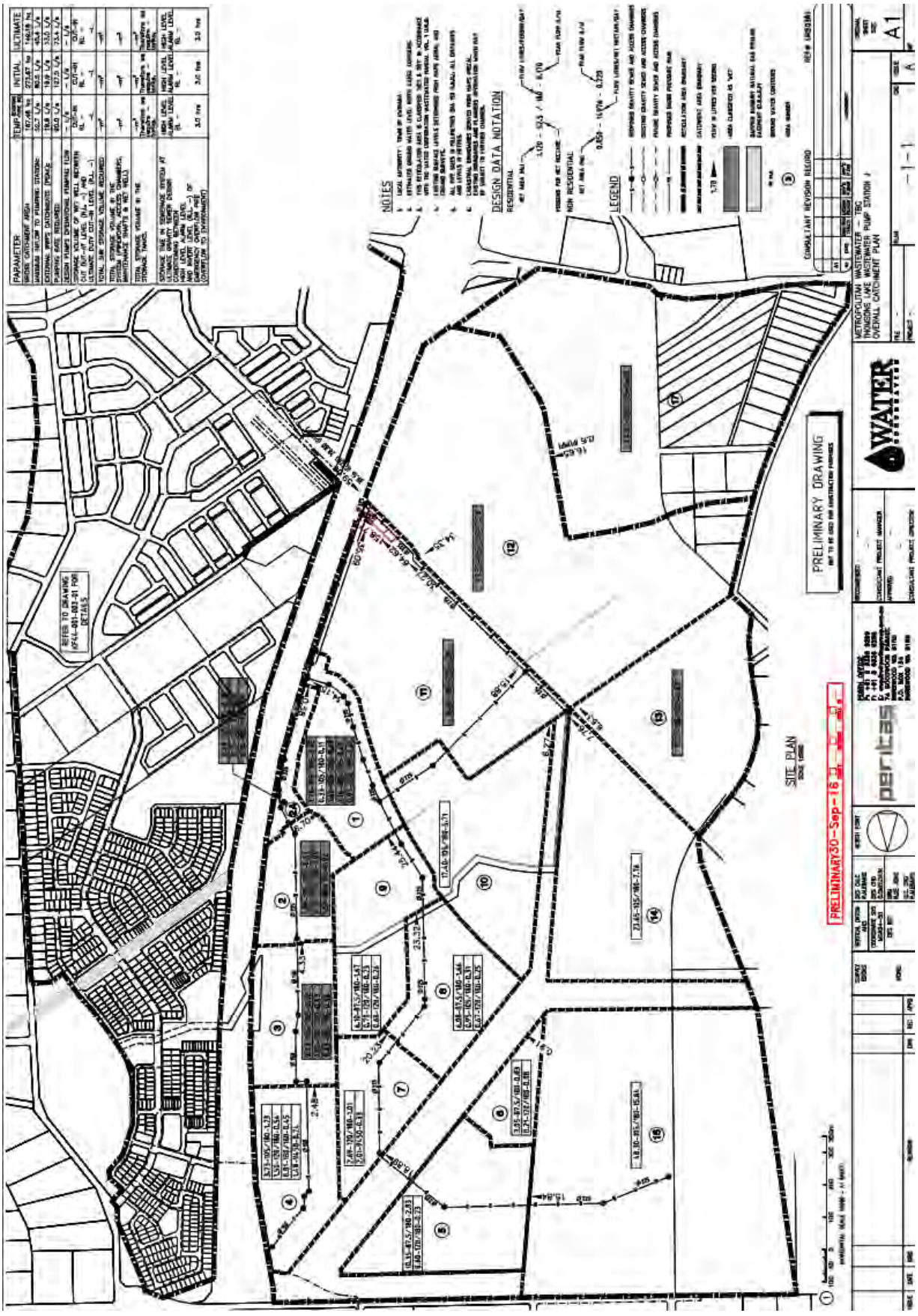
APPENDIX I - WATER SUPPLY CONCEPT PLAN



APPENDIX J – AVERAGE ANNUAL MAXIMUM GROUNDWATER LEVEL



APPENDIX K - OVERALL SEWER CATCHMENT PLAN



APPENDIX L – WESTERN POWER FEASIBILITY STUDY

Feasibility Report

MF010540 – 4.61MVA, Mandogalup

Large Residential Development - DIP

29/06/2016

Document release information

Client	UPD
Project name	MF010540
Document number	DM#40256853
Document title	4.61MVA Mandogalup
Revision status	A

Document prepared by:

Western Power
ABN 18540492861

71 Ewing Street, Bentley 6102

Prepared by:	Reviewed by:
Aden Hoddy	Ryan Shaw
Distribution Design Network Officer	Distribution Design Coordinator

Table of contents

1 Introduction

1.1 Background

Satterley Property Group Pty Ltd is planning a large freehold residential subdivision bordered by the Kwinana Fwy in Mandogalup. The development consists of 11 stages requiring an estimated 4.61MVA of network capacity. The subdivision will be released in stages with most expected to be completed by the end of 2018. The customer is seeking Western Power's advice on available network capacity to accommodate the new residential development and if there are any constraints from a Western Power perspective that would impact on the proposed development.

1.2 Purpose

The purpose of this study is to determine whether there is sufficient capacity available on the Medina (MED) HV network to accommodate the proposed residential development in Mandogalup.

The proposed outcomes from the feasibility study are:

- Determine if there is sufficient capacity available on the HV distribution network to accommodate the 4.61MVA residential development; network capacity to be assessed for all 11 stages.
- Determine the Western Power head works (if required) to reinforce the HV distribution network.
- Advise on any potential issues in relation to the proposed development.

1.3 Scope of Study

The activities that will be undertaken to achieve the specified outcomes are:

1. Network Configuration Assessment
2. Network Impact Assessment
3. Network Capacity Assessment

2 Study Activities

2.1 Activity 1 – Network Configuration Assessment

The proposed development site is adjacent to the Kwinana Fwy as shown in Figure 1 below. There are two 22kV feeders (MED504 and MED526) in the vicinity which may be used to connect the proposed subdivision.

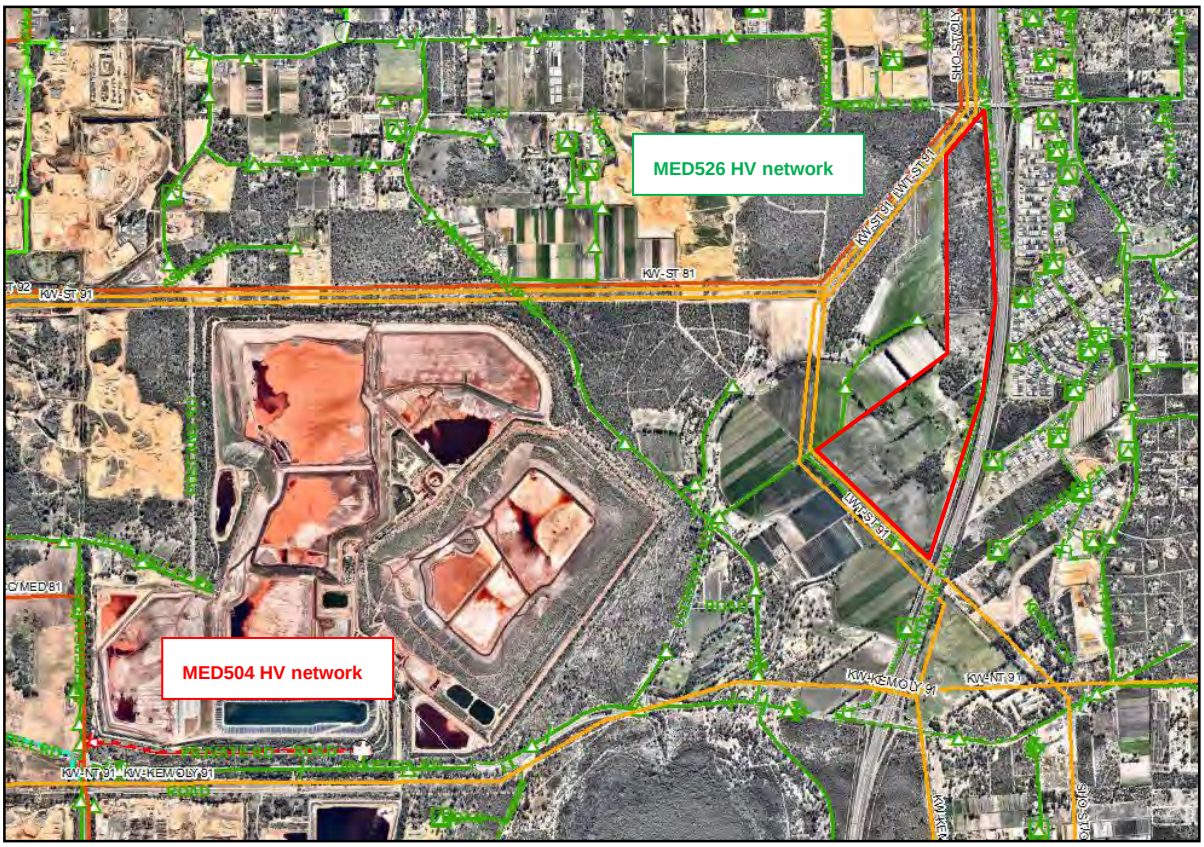


Figure 1 - Surrounding Western Power Network

2.2 Activity 2 – Network Impact Assessment

There are currently only two 22kV HV feeders (MED504 and MED524) near the proposed development site. The model is based on the existing network plus upcoming customer loads and with the addition of a 4.61MVA load increase at the customer location.

The planning study demonstrates that the MED526 feeder has insufficient capacity to service the entire development. There does however appear to be sufficient capacity on the MED504 feeder network based on the existing feeder utilisation levels.

3 Technical Evaluation

3.1 Network Capacity Assessment

3.1.1 Overview

Based on the existing feeder utilisation on the MED526 feeder, there is insufficient capacity available to connect the proposed development. This subdivision is to be connected to the MED504 feeder backbone by extending this feeder using 400mm2 XLPE 22kV cable. It is estimated that approximately 6.0kM of 400mm2 XLPE 22kV cable will be required to make a power supply available on the south-east boundary (near stage 11A) of the proposed development site.

3.1.2 Site Map

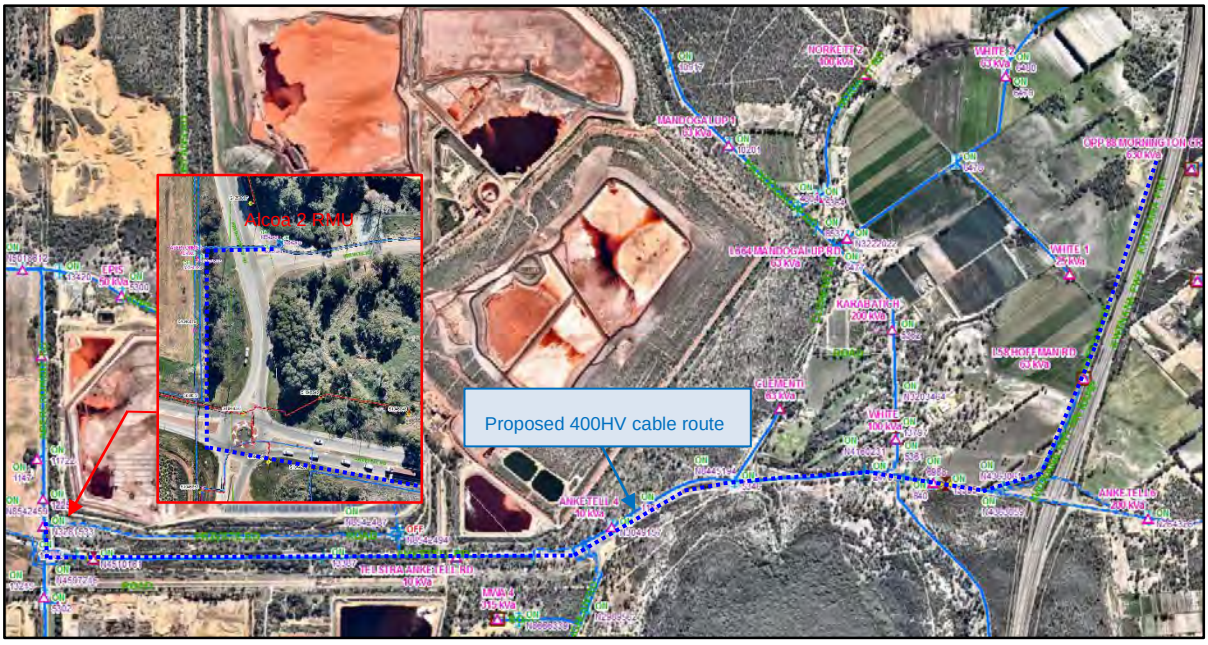


Figure 2 - Proposed Western Power Scope of Works

3.1.3 Western Power Works

The proposed network interface works is to install approximately 6.0km of 400mm2 HV XLPE cable from the 'Alcoa 2' RMU to the development site boundary.

3.1.4 Customer Contribution for Western Power Works

With reference to the interface works identified in section 3.1.3 the estimated customer contribution towards the Western Power works approximately is **$1,600,000** +/-30%.

Please note this estimate based on a desktop review of the required Western Power works associated with implementing this option. This estimate is non-binding and could be subject to change at completion of the Access Offer.

3.1.5 Assumptions

The customer contribution and scope of works are dependent on the following assumptions;

- No other connection requests and changes to network conditions prior to the formal application for this connection.
- Potential environmental permits and approvals can be obtained.
- Third party approvals that may apply are granted.
- No allowance for rock excavation or rock drilling.
- Specific cable route has not been considered.
- Transmission line and transformer capacity has not been considered.
- Existing overhead network that may be impacted by the development site has not been considered.

3.1.6 Application Requirements

Developers are responsible to engage Electrical Consultants to produce the UDS subdivisions electrical reticulation designs in accordance with the Underground Distribution Scheme manual.

Western Power will:

- Provide the Designer Organisations with a Design Information Package (DIP) appropriate to the developments and their locations.
- Audit the UDS designs certified by Engineers on random basis to ensure they conform to Western Power's design requirements, planning criteria and construction practices.

For more information on the DIP process, please refer to section 4.3 of the UDS manual. The Western Power scope of works detailed in section 3.1.3 of this document will be resolved during the DIP process and will need to be completed prior to WAPC approval.

Reference of this feasibility study should be included within the formal DIP submission to Western Power.

4 Conclusions and Recommendations

Network Planning network analysis has identified there is insufficient capacity available on the nearby HV feeder and the recommendation is to extend the MED504 feeder to the development site to provide the supply.

A transmission capacity clearance has not been conducted as part of this planning study.

There is an existing overhead transmission line to the south of the development site which is within close proximity to several residential stages. Consideration should be noted in relation to the transmission easement restriction zones.

If you would like further information about easements or to check whether you have an easement registered on your Certificate of Title please contact us on the details below.

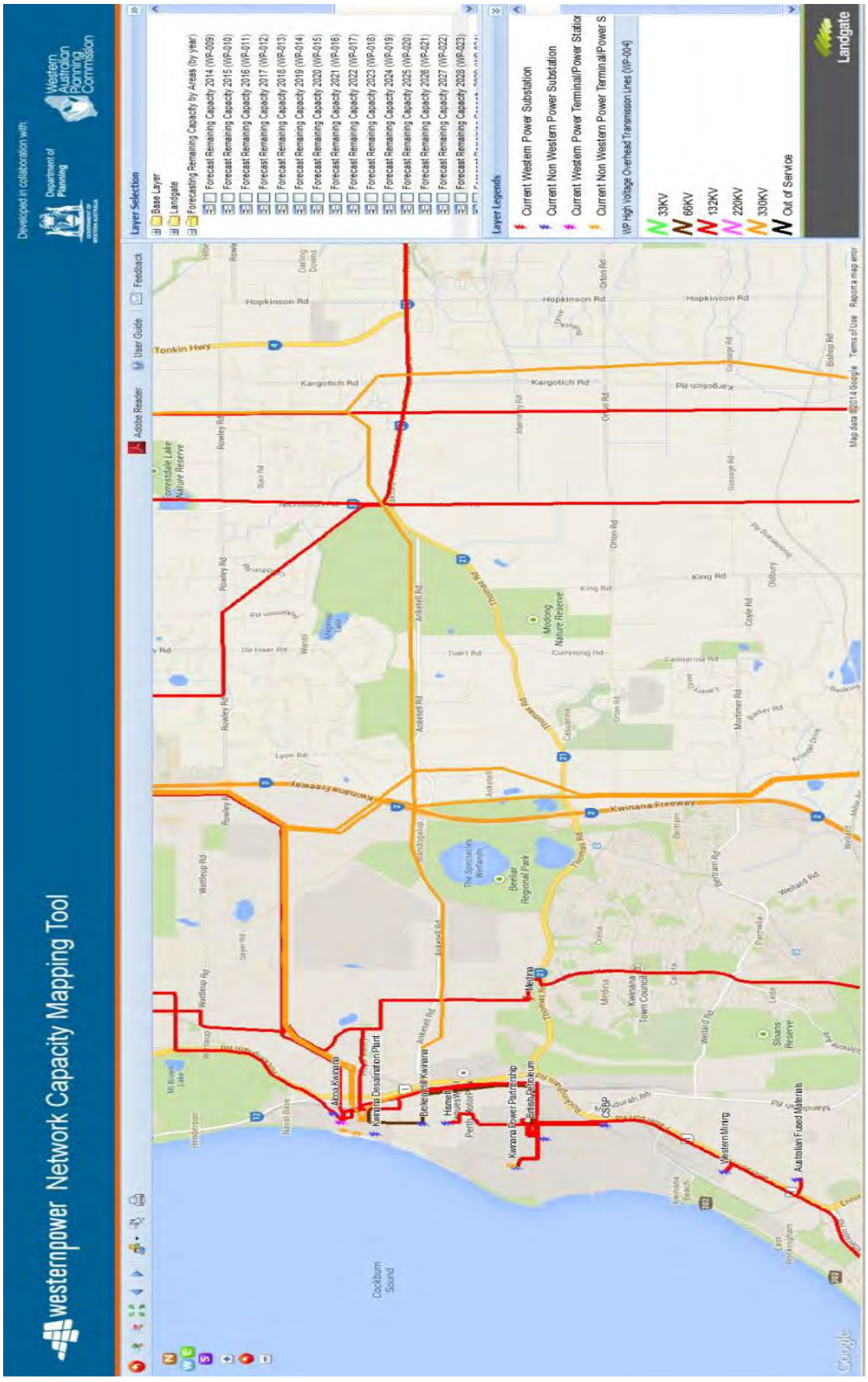
Email: enquiry@westernpower.com.au, Phone: 13 10 87

Please take note that the information herein is provided in good faith and is accurate at the time of issue. Power systems are dynamic in nature, due to the connection of new users and changes in consumer behaviour. As such, Western Power's distribution electricity networks will change over time - this may have a bearing on the amount of reinforcement required to accommodate new developments.

As capacity cannot be reserved, it is possible that requirements will also be altered, resulting in a significant variation in power infrastructure requirements. There may be other competing application for new loads or upgrades which may use the available spare capacity.

Applicants need to be aware that Western Power's response may become out-of-date, resulting in a significant variation in power infrastructure requirements. To provide a firm connection proposal and cost, a formal application to Western Power will need to be made, in accordance with current connection policies.

APPENDIX M – WP TRANSMISSION LINES



APPENDIX 11

DEPARTMENT OF EDUCATION CORRESPONDENCE

ROWEGROUP

From:	COOPER Michael [Strategic Asset Planning]
To:	"John Hirdman" (johnh@satterley.com.au)
Cc:	Gary Williams; Ray Stokes; Mark Hector (Mark@qubeproperty.com.au); Tim and Kerry Trefry (tim.trefry@robertsday.com.au); "Page-Croft, Frances"; Rebecca Cumming; Brett Cammell
Subject:	MANDOGALUP PS-LSP SITE LOCATION
Date:	Monday, 15 August 2016 1:37:11 PM
Attachments:	Final paving field design.pdf 7282A_FIG71A_20160808 Mandogalup (WAPC - Proposed ZOOM)-A3P.PDF 7282A_FIG69B_20160808 Mandogalup (WAPC - Proposed ZOOM)-A3P.PDF

Good Afternoon John (and all other interested stakeholders),

The Department is in receipt of correspondence regarding the location of the primary school site, co-located with the City of Kwinana's shared use playing fields, within the Mandogalup Structure Plan Area.

In regard to the drawings provided (see attached – Drawing 7282A-CON-09-C (Dated 25 July 2016), 7282a-FIG-71-A (Dated 8 August 2016) and 7282A-FIG-69-B (Dated 8 August 2016)) and Satterley's and the City of Kwinana's response to the proposed SP, on behalf of the Department, I provide the following response:

- In-principle support is given to the location and configuration of the primary school site as shown on Drawing 7282A-CON-09-C, in co-location with the shared playing fields.
- In regard to the proposed investigation areas confirmed on Drawing 7282A-FIG-71-A and 7282A-FIG-69-B, in-principle support is also given to the proposed area boundaries shown on each drawing and prepared to confirm two options for the primary school site, one co-located with shared playing fields as a 3.5ha site and one as a stand-alone 4.0ha site if the playing fields are to be relocated to land within the buffer zone and currently zoned Rural, if permitted at some time in the future.
- Whilst the investigation area confirmed for the stand-alone option is not the Department's preferred location (originally further south wrapping around the parcel of preserved bushland), it is noted that this location has now been designated as 'Parks, Recreation and Drainage'. Therefore, it is assumed that a primary school can no longer be located in this area. For this reason, in-principle support is again given for the proposed investigation area for the stand-alone 4.0ha school site.
- With the co-located shared playing fields it is noted that:
    - The City will provide and consolidate two hard courts with the Department's standard provision of two hard courts.
    - The City will provide six car bays on the City's land, with an expectation that additional parking expected will be made available by the Department on the school site. Whilst the Department is happy to explore opportunities for consolidating, extending and sharing parking, it should not be the Department's responsibility to provide all the parking for the shared playing fields. School parking areas will be used exclusively during school hours and in the final design may not necessarily be in close proximity to the fields. More detailed concept design work needs to be done in this area.
    - The Department agrees with the City that embayment car parking located within the road reserve needs to be maximised around both sites to provide more parking options for the community users and school parents.

- As a reviewing agency, the Department will be in a position to make no objection to the Structure Plan Application.

I trust this will satisfy the Department of Planning and allow the Structure Plan approval process to progress with certainty.

Regards,

Michael Cooper

| **Principal Consultant** |

| **Infrastructure** | **Planning** | **Policy** |

| Strategic Asset Planning |

| **Department of Education** |

A | L2, 1 Puccini Court, Stirling, 6021 |

P | 151 Royal Street, East Perth, 6004 |

E | Michael.Cooper3@education.wa.edu.au |

P | 08 9264 4308| **F** | 08 264 4882 | **M** | 0427 775 158 |

S | http://ifex.det.wa.edu.au/ifex/pages/unsecure/uploadentry.jsf Files >2 MB |

W | http://www.det.wa.edu.au/ |

| Please consider the environment before printing this email |

15.2 Joint Development Assessment Panel Application – Proposed Additions to Hazardous Industry – Ammonium Nitrate Emulsion Plant – Lot 20 Port Road, Kwinana Beach

SUMMARY:

Council has received a proposal for Additions to Hazardous Industry – Ammonium Nitrate Emulsion Plant for consideration under the City of Kwinana Town Planning Scheme No. 2 (Scheme). The proponent – CSBP Limited, seeks to construct and operate an Ammonium Nitrate Emulsion (ANE) plant located to the north of the existing Ammonium Nitrate Prilling Plant (PP2) located within the CSBP Kwinana Industrial Complex [refer to Attachment 2-7 of the Responsible Authority Report (RAR)].

The proposed additions encompass an area approximately 600m² within the Ammonium Nitrate Production high security process area. The ANE plant will utilise the existing Ammonium Nitrate Solution (ANSol) manufactured from the three existing Ammonium Nitrate Production Facilities. The ANE plant will require the addition of fuel and additives to ANSol for the production of up to 100,000 tonnes per annum of ANE.

The proposed ANE plant will be constructed on an existing limestone laydown area which was used during the construction of the third ammonium nitrate plant. The ANE plant consists of three processing areas, product storage and truck loading facilities. The three areas are as detailed below;

Area 1

The first process area will involve the dilution of 90% Ammonium Nitrate (AN) solution from the existing 300 tonne AN solution tank located in PP2 by the addition of water to produce an 82% AN solution. This AN solution is then cooled to approximately 85ºC in a heat exchanger using cooling water before additives required for pH adjustment and customer formulation are added.

Area 2

The second process area consists of fuel oil (diesel) and concentrated emulsifier storage. The concentrated emulsifier will be delivered to site in isotainers while the diesel will be supplied by road tankers. These two ingredients are mixed together in a predetermined ratio in the fuel phase storage area using mechanical agitation.

Area 3

This production area is referred to as the Blend Module, where 82% AN solution with additives from Area 1 is combined with the fuel oil/emulsifier blend from Area 2. Separate flows from each process area are brought together in a controlled ratio to the pre-blend tank where the ingredients are mixed using a mechanical agitator. The final stage of the production process involves this pre-mixture passing through the emulsion pump where sufficient shear forces and mixing are combined to produce the final product.

The proposal also includes the construction of a laboratory and a Motor Control Room (MCC) building.

The proposal was approved for implementation by the Minister for Environment under section 45C of the Environmental Protection Act 1986 on the 24 January 2017.

As the estimated development cost of this application is in excess of $10 million, the City does not have delegation to determine the application. The application is therefore

required to be referred to the South West Metropolitan Joint Development Assessment Panel (JDAP) for determination. The application is to be considered by the JDAP at a meeting that is to yet to be scheduled, however it is expected to be mid February 2017. City officers have prepared the attached RAR in accordance with the Development Assessment Panel Regulations and it is attached for Council's consideration and determination.

The City is required to submit the RAR to the DAP Secretariat on 10 February 2017. Should the City not submit this report to the DAP Secretariat within the required timeframe, the Minister for Planning may direct the City to submit any information it has and provide it to the DAP directly.

The application has been referred to Council as the City received legal advice informing the City that officers do not have delegation to prepare the RAR under the DAP Regulations. Council should note that if it wishes to modify or make an alternative recommendation to that contained with the RAR this should be in the form of a separate recommendation which will be forwarded to the JDAP for consideration at its meeting.

OFFICER RECOMMENDATION:

That Council consider and adopt the recommendation of the Responsible Authority Report (Attached to this report) to the South West Metropolitan Joint Development Assessment Panel for the proposed Additions to Hazardous Industry – Ammonium Nitrate Emulsion Plant on Lot 20 Port Road, Kwinana Beach.

FINANCIAL/BUDGET IMPLICATIONS:

There are no financial of budget implications as a result of this application.

ENVIRONMENTAL IMPLICATIONS:

The proposal was approved for implementation by the EPA under section 45C of the Environmental Protection Act 1986 on the 24 January 2017. The EPA noted that it was satisfied that the proposal would not result in a significant detrimental effect on the environment. The proposal is required to comply with the EPA conditions.

STRATEGIC/SOCIAL IMPLICATIONS

It could be argued that the proposal stimulates economic development in the City, in particular within the Industrial area.

15.2 JOINT DEVELOPMENT ASSESSMENT PANEL APPLICATION – PROPOSED ADDITIONS TO HAZARDOUS INDUSTRY – AMMONIUM NITRATE EMULSION PLANT – LOT 20 PORT ROAD KWINANA BEACH

COMMUNITY ENGAGEMENT:

The proposal was referred to adjoining landowners and external authorities for a period of 21 days during November – December 2016 in accordance with the City's Advertising 'SA' and Town Planning Scheme Amendment Policy and the Community Engagement Policy. No submissions objecting to the proposal were received during the advertising period. In total, three submissions were received from adjoining landowners in support of the development with no modifications.

RISK IMPLICATIONS:

Risk Event	**Joint Development Assessment Panel making a decision on the development without Council's Responsible Authority Report**
Risk Theme	Failure to fulfil statutory regulations or compliance requirements Providing inaccurate advice/ information.
Risk Effect/Impact	Reputation Compliance
Risk Assessment Context	Strategic
Consequence	Major
Likelihood	Possible
Rating (before treatment)	High
Risk Treatment in place	Reduce - mitigate risk
Response to risk treatment required/in place	• Ensure the Responsible Authority Report is prepared and considered by Council within statutory timeframes set by the JDAP. • Work instructions in place and checklists used when assessing the application. • Ensure the application is in compliance with the Town Planning Scheme, and the advice received from EPA, DER, DMP and other relevant agencies, and included within the Responsible Authority Report. • Liaising with the applicant throughout the application process.
Rating (after treatment)	Low

COUNCIL DECISION

426

MOVED CR S LEE **SECONDED CR B THOMPSON**

That Council consider and adopt the recommendation of the Responsible Authority Report (Attached to this report) to the South West Metropolitan Joint Development Assessment Panel for the proposed Additions to Hazardous Industry – Ammonium Nitrate Emulsion Plant on Lot 20 Port Road, Kwinana Beach.

CARRIED
6/0

Government of Western Australia
Development Assessment Panels

Form 1 - Responsible Authority Report

(Regulation 12)

Property Location:	Lot 20 Port Road, Kwinana Beach
Application Details:	Proposed Additions to Hazardous Industry – Ammonium Nitrate Emulsion Plant
DAP Name:	METRO SOUTH – WEST
Applicant:	CSBP Limited
Owner:	CSBP Limited
LG Reference:	DA8813
Responsible Authority:	City of Kwinana
Authorising Officer:	Felicitas Dhliwayo – Senior Planning Officer
Department of Planning File No:	DAP/16/01147
Report Date:	January 2017
Application Receipt Date:	16 November 2016
Application Process Days:	90 Days
Attachment(s):	1: Location Plan 2: Overall Site Plan – 1100 – 0 – 0001/082 – REV E 3: Site Plan – 1154 – 0-0001/000 – REV 1 4: Site & Elevation Plan – 1154-0-0002/000 5: MCC Building Floor Plan – 9741 – SUB - 002 6: MCC Building Elevation Plan – 9741-SUB-003 7: Laboratory Floor & Elevation Plan – MP9630 – REV A 8: Environmental Protection Authority Ministerial Approval 9. Ministerial Statement 875

Officer Recommendation:

That the Metro South – West DAP resolves to:

Approve DAP Application reference DAP/16/01147 and accompanying plans 1100 – 0 – 0001/082 – REV E, dated March 2010, 1154 – 0-0001/000, REV 1, dated 30 September 2016, 1154-0-0002/000, dated 8 November 2016, 9741 – SUB - 002, 9741 – SUB - 003, dated 20 January 2015, MP9630 – REV A dated April 2008 in accordance with Clause 6.1 of the City of Kwinana Town Planning Scheme No.2, subject to the following conditions:

Conditions

1. This decision constitutes planning approval only and is valid for a period of two years from the date of approval. If the subject development is not substantially commenced within the two year period, the approval shall lapse and be of no further effect.
2. Stormwater drainage from roofed and paved areas being contained and disposed of on site or as otherwise approved via Environmental Protection

Authority (EPA) Licence conditions or an approved Stormwater Management Plan.

3. The applicant shall implement dust control measures for the duration of the Site and Construction Works and for the ongoing operation of the site to the satisfaction of the City of Kwinana.

4. Landscaping areas, vehicle parking spaces and accessways, and all other items and details as shown on the approved development plans shall be installed prior to occupying the proposed development and maintained thereafter to the satisfaction of the City of Kwinana.

5. All vehicle parking to be accommodated within the boundaries of the subject lot.

6. The existing landscaping shall be maintained to a high standard to the satisfaction of the City of Kwinana.

7. On-site effluent disposal systems shall be nutrient retentive to comply with the Health Act 1911 and Cockburn Sound Management Council requirements. Use of conventional septic systems is not permitted.

8. The development shall be connected to an adequate potable water supply in accordance with the standards required by the National Health and Medical Research Council Australian Drinking Water Guidelines, 2004.

9. Storage of chemicals and liquids shall be within bunded impervious areas capable of containing any spillages and be connected to an appropriate treatment and disposal system.

10. All trafficable areas are to be asphalt sealed and drained as per the City of Kwinana 'Trafficable Areas' Specifications to the satisfaction of the City of Kwinana.

2. Advice to Applicant

2.1 The applicant is advised that all future development must be submitted to the City of Kwinana prior to the commencement of works or alteration of land use.

2.2 Should the applicant be aggrieved by the decision or any condition imposed, then a right of review should be lodged with the State Administrative Tribunal within 28 days of the date of this decision.

2.3 The applicant is advised that this is not a building permit the City of Kwinana issues to enable construction to commence. A building permit is a separate Council requirement and construction cannot be commenced until a building permit is obtained.

2.4 The applicant should ensure the proposed development complies with all other relevant legislation, including but not limited to, the *Environmental Protection Act 1986* and Regulations*, Health Act 1911* and Regulations*, Environmental Protection (Noise) Regulations 1997, Air and Water Handling Systems Regulations, Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974, WA Government Sewerage Policy and Cockburn Catchment Sound Policy, Dangerous Goods Safety Act 2004, Dangerous Goods Safety Act 2004* and Regulations*, Major Hazard Facilities WA, Code of*

Practice for Handling Dangerous Goods, Contaminated Sites Act 2003 and the *National Construction Code.*

2.5 The applicant is advised to liaise with the Kwinana Industries Council (KIC) to include the noise emissions from the development into the KIC cumulative noise model.

2.6 The proponent is advised to register the cooling towers with the City of Kwinana.

2.7 The proponent is advised to undertake a risk assessment on the proposed ANE project and update the Major Hazard Facility Safety Report to the satisfaction of the Department of Mines and Petroleum.

2.8 The development shall comply with the Department of Environment Regulation Works Approval and Licence conditions.

Background:

Property Address:		Lot 20 Port Road, Kwinana Beach
Zoning	MRS:	Industry
	TPS:	General Industry
Use Class:		Hazardous Industry
Strategy Policy:		City of Kwinana Local Planning Policy (LPP) - Development within Industrial Zones
Development Scheme:		City of Kwinana Town Planning Scheme No.2
Lot Size:		138 hectares
Existing Land Use:		Hazardous Industry – Ammonium Nitrate Emulsion Plant
Value of Development:		$11.3 million

CSBP Limited operates the existing Ammonium Nitrate Production Facilities which are managed under environmental conditions in the current Ministerial Statements 689 and 875 and Part V Environmental Licence at the CSBP Kwinana Industrial Complex. CSBP is a licenced Major Hazard Facility (MHF) regulated under the *Dangerous Goods Safety (MHF) Regulations 2007*. The Ammonium Nitrate Production Facility (ANPF) has an existing Safety Report that is approved by the Department of Mines and Petroleum (DMP) to manage risks from the current activities.

CSBP's operations on Lot 20 Port Road, Kwinana Beach, make them one of the largest manufacturers and suppliers of chemicals, fertilisers, and related services to the mining, minerals processing, industrial and agricultural sectors within Western Australia. Many of the products produced on the site are essential inputs into a large range of industries such as iron ore, coal mining, nickel and gold extraction, broad-acre agriculture, and construction.

The current chemical and fertiliser manufacturing operations on the site include the following process plants:

1. Ammonia Plant;
2. Nitric Acid Plants 1, 2 and 3;
3. Ammonium Nitrate Solution Plants 1, 2 and 3;
4. Ammonium Nitrate Prilling Plant 2;

5. Liquid Sodium Cyanide Plants 1 and 2;
6. Solid Sodium Cyanide Plant;
7. Superphosphate Manufacturing Plant;
8. Compound Fertiliser Granulating Plant; and
9. Liquid Fertiliser Manufacturing Plant, which includes the production of Flexi-N.

There have been over 100 development applications determined on the site dating back as early as the mid 1960s, with the majority of which being approved subject to conditions. The most recent major upgrades to the site occurred between 2012 – 2014 where the capacity of the existing ANPF was expanded from approximately 520,000 tonnes per annum (tpa) to approximately 936,000 tpa.

Proposal

CSBP Limited is proposing to construct and operate an Ammonium Nitrate Emulsion (ANE) plant located to the north of the existing Ammonium Nitrate Prilling Plant (PP2) located within the CSBP Kwinana Industrial Complex. The proposed additions encompass an area approximately 600m² within the Ammonium Nitrate Production high security process area. The ANE plant will utilise the existing Ammonium Nitrate Solution (ANSol) manufactured from the three existing ANPFs. The ANE plant will require the addition of fuel and additives to ANSol for the production of up to 100,000 tonnes per annum of ANE.

The proposed ANE plant will be constructed on an existing limestone laydown area which was used during the construction of the third ammonium nitrate plant. The ANE plant consists of three processing areas, product storage and truck loading facilities. The three areas are as detailed below;

Area 1

The first process area will involve the dilution of 90% Ammonium Nitrate (AN) solution from the existing 300 tonne AN solution tank located in PP2 by the addition of water to produce an 82% AN solution. This AN solution is then cooled to approximately 85ºC in a heat exchanger using cooling water before additives required for pH adjustment and customer formulation are added.

Area 2

The second process area consists of fuel oil (diesel) and concentrated emulsifier storage. The concentrated emulsifier will be delivered to site in isotainers while the diesel will be supplied by road tankers. These two ingredients are mixed together in a predetermined ratio in the fuel phase storage area using mechanical agitation.

Area 3

This production area is referred to as the Blend Module, where 82% AN solution with additives from Area 1 is combined with the fuel oil/emulsifier blend from Area 2. Separate flows from each process area are brought together in a controlled ratio to the pre-blend tank where the ingredients are mixed using a mechanical agitator. The final stage of the production process involves this pre-mixture passing through the emulsion pump where sufficient shear forces and mixing are combined to produce the final product.

The proposal also includes the construction of a laboratory and a Motor Control Room (MCC) building.

Inputs

The production of ANE consists of the following components;

- Fuel (diesel);
- Emulsifier;
- AN solution (90%);
- Water (for dilution and condensate losses) sourced from existing groundwater licensed allocation;
- Steam;
- Instrument and plant hire; and
- Despatch facilities

The proponent states that the AN solution required for the emulsion will be supplied from the existing AN manufacturing plants and storage tanks. There is no requirement to manufacture additional AN above existing approved volumes.

Prior Approvals

Environmental Approval

The CSBP application was lodged with the Environmental Protection Authority (EPA) requesting approval of changes to the existing Ammonium Nitrate Production Expansion Project: Phase 2 (Ministerial Statement 875) to add the proposed ANE plant and associated infrastructure. The EPA considered that the changes to Ministerial Statement 875 would "not result in a significant detrimental effect on the environment in addition to, or different from, the effect of the original proposal." Approval of the changes was granted under section 45C of the Environmental Protection Act 1986 on 24 January 2017.

The implementation of the existing Ammonium Nitrate Production Expansion Project: Phase 2, including the approved ANE plant is subject to the conditions of Ministerial Statement 875 (shown at Attachment 9).

Legislation and Policy:

Legislation

The existing ANPF is subject to a range of licences and regulations applying to industry in Western Australia. In addition to gaining environmental approval from the Minister for the Environment under the Environmental Protection Act, the proponent is required to comply with other legislation. A summary of the key relevant legislation, regulations and policies are listed below:

- *Contaminated Sites Act 2003*
- *Dangerous Goods Safety Act 2004* and Regulations
- *Environmental Protection Act 1986* and relevant Regulations
- *Health Act 1911*
- Kwinana Environmental Protection (Atmospheric Waste) Policy 1992 as amended
- State Environmental (Cockburn Sound) Policy 2005

- *Planning and Development Act 2005*
- City of Kwinana, Local Planning Scheme No. 2 and Local Planning Policies

State Government Policies
State Planning Policy 4.1 – State Industrial Buffer Policy
State Planning Policy 2.6 – State Coastal Planning Policy and associated Position Statement

Local Policies
Local Planning Policy 3.3.25 – Development within the Cockburn Sound Catchment
Local Planning Policy 3.3.29 – Development within Industrial Zones.

Consultation:

Public Consultation
The proposal was referred to adjoining landowners and external authorities for a period of 21 days during November – December 2016 in accordance with the City's Advertising 'SA' and Town Planning Scheme Amendment Policy, and the Community Engagement Policy. No submissions objecting to the proposal were received during the advertising period. In total, three submissions were received from adjoining landowners in support of the development with no modifications.

Consultation with other Agencies or Consultants
During the advertising period the proposal was referred to the Public Transport Authority (PTA) of Western Australia, Dampier-Bunbury Natural Gas Pipeline (DBNGP) Pty Ltd, Environmental Protection Authority (EPA), Main Roads Western Australia, WA Gas Networks, APA Group, Department of Environment Regulation (DER) and the Department of Mines and Petroleum DMP. Responses were received from PTA, DBNGP, Main Roads, APA Group, DER, EPA and DMP in support for the proposal. No responses were received from any other referred agency.

Planning assessment:

Town Planning Scheme No. 2 Implications

The proposal represents a Hazardous Industry in the context of Town Planning Scheme No. 2 (TPS 2) which is described under Appendix 4 (Interpretations) as: *"an industry which by reason of the processes involved or the method of manufacture, or the nature of the materials used or produced requires isolation from other buildings".*

In the context of the General Industrial Zone, a Hazardous Industry represents an "SA" use, where Council, after consideration of public submissions, is able to exercise its discretion to approve or refuse to approve the proposal.

The City's Draft Industrial Strategy has been prepared as a supporting document to the City's draft Local Planning Strategy. The draft Local Planning Strategy is currently under review. In December 2014, Council adopted the draft Local Planning Strategy for consultative advertising prior to formally forwarding it to the Western Australian Planning Commission (WAPC) for certification for formal advertising under the Town Planning Regulations. The draft strategy proposed a series of industrial classes according to the intensity and nature of the industrial use. It is useful as a guiding

document for proposals of this type. Under this draft strategy, the proposal represents a Class II Industry. Class II industry under the draft strategy requires a 1000 metre separation distance from the nearest residential areas. The land holding is 2.1 km from the nearest residential zone in Kwinana and 3 km from the nearest residential zone in the City of Rockingham and therefore meets this objective.

It is worth noting that the proposal is located within an area suitable for Class I (highest impact industries) under the draft strategy and represents a lower industry class for the area.

Development Requirements under Town Planning Scheme No.2

The following Table lists the relevant provisions under TPS 2 which apply to this application. Other elements of the application relevant to the determination of applications under Part 2.4 of the Scheme are also detailed following.

Table 1 – Town Planning Scheme Summary

City Planning Scheme No.2 Clause	Requirements	Planning Comment
6.8.1 – Outline Development Plans	Not Applicable	The Development is not subject to an Outline Development Plan.
6.8.2, 6.8.3 – Minor Works not requiring planning approval	Not Applicable	The works proposed are substantial and do not fall within the works not requiring approval clauses of the Scheme.
6.8.4 – Plot Ratio and Site Coverage	0.8 Plot Ratio 65% Site Cover	The plot ratio and site coverage of the lot is well within the scheme requirements with approximately 35% site cover in total.
6.8.5 – Minimum Setbacks from Boundaries	Side – 6 metres Rear – 9 metres Front - 15 metres	Setbacks to the proposed development comply with the scheme requirements with a minimum of 115 metres from the side boundaries.
6.8.6 – Appearance of Buildings	Buildings located, constructed and finished so as to not cause detriment to the locality.	All proposed extensions to the plant process equipment and buildings will be constructed to match and complement existing developments on site.
6.8.7 – Landscaping Areas	5% of site area to be landscaped and maintained	The current level of landscaping on the site is maintained to a high standard and is in excess of the 5% required by the Scheme.
6.8.8 – Car Parking and Crossovers	Car Parking Spaces to be provided in accordance with Table III of the	The proposal entails two additional staff and this requires two additional parking bays in accordance with Table III of the Scheme. There is adequate parking

	Scheme	located to the north of the location of the additions. No additional parking is required to be installed on site.
6.8.9 – Loading and Unloading	Loading / Unloading areas to be maintained in good order	The existing loading/unloading areas of the development are maintained in the appropriate manner. The proposed loading areas of the expanded development are proposed to be managed in the same manner.
6.8.10 – Waste Water and Effluent Disposal	Waste Water to be managed appropriately to preserve the environment and groundwater	Whilst there is an increase in the volume of stormwater generated on site as a result of the development, the volume is still within the approved EPA licence limits for the site. The proposed method of waste water management is acceptable.
6.8.11 – Recycled Water	Council shall have regard to the ability to recycle water in industrial processes.	The proponent noted an additional 400 ML/year of recycled process water will be utilised from the Kwinana Reclamation Plant. The EPA approval allows for the use of up to 5.25 Gigalitres/annum of water sourced from the Kwinana Water Reclamation Plant.
6.8.12 – Fencing	Not Applicable	There is no boundary fencing proposed as part of this development. In the event that boundary fencing is erected, it will need to comply with the requirements of TPS.2 and the City of Kwinana Fencing Local Law.
6.8.13 – Private Utility	Not Applicable	Not applicable.

The proposed ANE plant complies with the requirements of Town Planning Scheme No.2 and its Policies.

CSBP have submitted full elevations of the proposed development (Refer Attachments 1 – 7) and it is considered that the structures proposed as part of the expansion should not adversely impact on the visual amenity of the Kwinana Industrial Area (KIA). This is attributed to the proposed structures being similar to the existing ANPF, the large boundary setbacks and their location behind existing mature vegetation along Patterson Road and Kwinana Beach Road.

City of Kwinana Local Planning Policies (LPP)

The proposed development complies with the requirements of both the *Development within the Cockburn Sound Catchment,* and *Development within Industrial Zones* local planning policies.

With respect to LPP 3.3.25 – *Development within the Cockburn Sound Catchment*, the proposal has indicated that it will not generate volumes of waste water from the proposed and existing development on site over and above the existing approved EPA Licence conditions. CSBP have a long standing commitment to implement best practice standards and where possible seek to reduce the nutrient content of their wastewater emissions. The objectives of LPP 3.3.25 are to minimise the run off of nutrients from developments into the Cockburn Sound. The ANE plant is expected to generate an additional 2 Mega Litres (ML) per year of waste water, however will still be within CSBP's current licence limits (up to 2.5ML/day) for wastewater discharge issued under the Environmental Protection Act. In this regard the increase in wastewater production is deemed satisfactory.

With regard to the provisions of LPP 3.3.29 – *Development within the Industrial Zones*, the proposed development complies with all relevant requirements of this policy. The development is required to be connected to a nutrient retentive effluent disposal system which limits the amount of nutrient run-off from effluent disposal.

The proposed development complies with the requirements of TPS2 and its Policies. The development is considered appropriate for the intent and policy objectives for the General Industry Zone.

Traffic and Transport Considerations

The applicant argued that the proposed ANE plant is likely to have an insignificant impact on truck and vehicle movements within the CSBP site and on public roads. It is estimated that two additional trucks per day will be required for the transport of ANE. The applicant also noted that diesel deliveries would occur two times per week and isotainers would be delivered every seven to ten days. The City's Engineering Department reviewed the application and concurred with the applicant, therefore no additional traffic and transport considerations have been required.

Environmental and Risk Considerations

There are a number of other matters which the development raises for consideration as part of this application for development approval. In particular, there are a number of environmental and risk factors which should also be considered.

The applicant referred the proposal to the EPA, requesting approval of changes to the existing Ammonium Nitrate Production Expansion Project: Phase 2 (Ministerial Statement 875) to add the proposed ANE plant and associated infrastructure.

On the 24 January 2017, the EPA approved the proposal and noted that it would "not result in a significant detrimental effect on the environment in addition to, or different from, the effect of the original proposal". The EPA also noted that the implementation of the ANE plant is subject to the conditions of Ministerial Statement 875.

The key environmental issues considered as part of this application are air emissions including dust and particulates, risk, noise, liquid waste disposal, water supply and greenhouse gas emissions. These issues have largely been addressed through the EPA process and are adequately managed via Ministerial conditions. These are detailed further below:

Waste Disposal

Any waste generated from the construction and operation is required to be managed in accordance with the relevant waste legislation and in particular the Environmental Protection (Controlled Waste) Regulations 2004.

The effluent generated on the site is required to be treated via a nutrient retentive effluent disposal system. It is recommended that a condition of approval be that the development be connected to such a system.

It is intended that all stormwater from building and paved areas on site will be collected, treated and piped to a number of drainage sumps across the site.

Noise

An acoustic assessment report prepared by Herring Storer Acoustics and dated 27 October 2016 was submitted with the application. The report indicated that the additional equipment associated with the ANE plant is not expected to result in a significant increase in noise emissions from the CSBP site. The additional noise sources consist of a proposed helper tower for cooling and relatively small pumps and mixers which have low noise emissions.

The City's Environmental Health Department reviewed the report and agreed with its findings. CSBP is required to remain compliant with the *Environmental Protection (Noise) Regulations 1997 as amended.* An advice note has been recommended advising the proponent to liaise with the Kwinana Industries Council (KIC) to include the noise emissions from the development into the KIC cumulative noise model.

The proponent sought an amendment to the existing works approval and licence with the DER to ensure compliance with noise regulations. The development is required to comply with the DER works approval and licence conditions.

Wastewater Management

The ANE plant is expected to generate an additional 2ML per year of wastewater on the CSBP Kwinana Industrial Complex. All wastewater discharged from CSBP is required to comply with the conditions contained in the proponent's existing EP Act Licence 6107/1967.

The proponent noted that for discharges to the Sepia Depression Ocean Outlet landline (SDOOL) obligations in the existing Water Services Agreement between the Water Corporation and CSBP Limited will continue to apply. The discharge of wastewater to the SDOOL is also governed by the Ministerial conditions in Ministerial Statement No. 665 – Use of the Cape Peron Outlet Pipeline to dispose of Industrial Wastewater to the Sepia Depression, Kwinana.

The proponent noted that the water discharged via the cooling tower is for cooling purposes only and does not come into contact with any part of the emulsion mixing/production process.

The EPA approval allows the proponent to discharge up to 2.5ML/day of waste water via the SDOOL. The proposed 2ML/day is therefore within the EPA licence conditions.

Storage of chemicals and liquids

The proponent states that all dangerous goods storage will be bunded to Australian Standard (AS) 1940 - Storage and handling of flammable and combustible liquids. The diesel tanks will be double skinned and the unloading area will be constructed with spill grates that will capture any spills/leaks and directed back to the fuel phase/emulsifier bund.

The City's Environmental Health Department reviewed the application and recommended conditions require that all chemical storage areas be in a bunded, roofed and on impervious hard stand area. Storage of all liquids and chemicals is also required to comply with AS 1940.

Offsite Risk

A full Quantitative Risk Assessment (QRA) was undertaken by GHD consultants, on behalf of the proponent, for the site in 2007 in conjunction with the construction of the Ammonium Nitrate Plant 2. In the planning approval for the Ammonium Nitrate Plant 3 expansion in 2011, the overall cumulative risk contours for the site were updated to include that development. The revised contours indicated that the proposed 2011 expansion met the EPA risk criteria for off-site societal risk.

As part of this proposal, modelling of the storage tanks was undertaken for three storage options, being 100 tonnes, 200 tonnes and 400 tonnes by risk assessment firm Risk Consult. The consultant's findings indicate that the fatality risk contours associated with the total site (inclusive of the proposed ANE facility) in the vicinity of the BP Refinery are negligible. In additional, the fatality risk contours for the total site inclusive of the proposed ANE facility does not increase the level of societal risk to Wells Park. The results of the cumulative model for the site incorporating a 400 tonne ANE storage tank are as shown in the figures below;

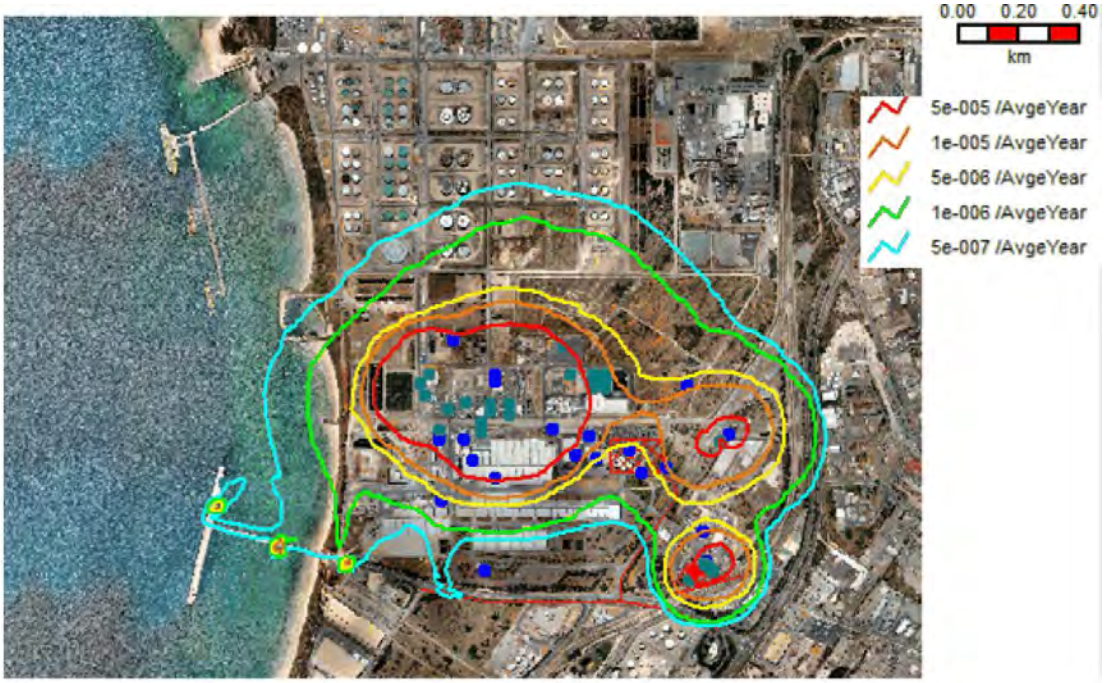


Figure A1: Total Site contour (existing)

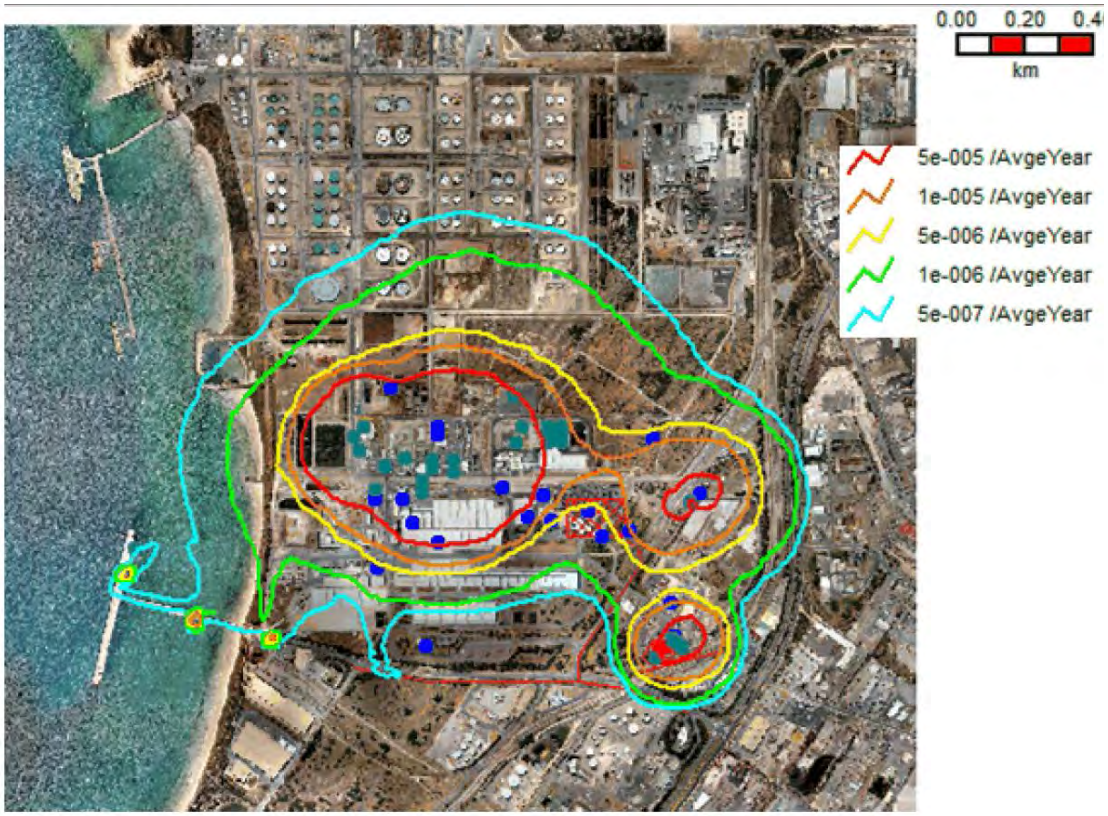


Figure A2: Total Site contour (including ANE proposed development)

The Risk Consult report noted that the 1E-6 (1 in a million) risk contour does not extend over the BP Refinery boundary to the north and west for any of the three storage options modelled (100 tonnes, 200 tonnes and 400 tonnes). It was further noted that a review of these results against the existing total site risk contours indicates that the inclusion of the ANE plant does not increase the offsite risk contours in the vicinity of the BP Refinery boundary or Wells Park. Whilst the total storage requirements have not been finalised, the modelled risk results indicate that any storage configuration up to 400 tonnes of ANE product can be located in the proposed location without increasing the level of off-site risk to the BP Refinery or Wells Park.

It should be noted that the acceptable individual fatality risk level associated with industrial sites should, as a target, contain a risk level of 50 in a million (5E-5) within the boundaries of the site. The modelled risk levels indicate that the site contains the 50 in a million risk contour within the boundaries of the site. Additionally, the acceptable fatality risk level associated with sporting complexes and active open spaces (ie Wells Park) should not exceed levels in excess of ten in a million (1E-5). In this regard, the modelled risk levels associated with the development indicate that the ten in a million risk level is within the boundaries of the subject site and does not encroach on Wells Park.

Given the potential risk implications associated with the proposed development, the proposal was referred to DMP for comment. DMP advised that the proponent is required to undertake a full quantitative risk assessment on the proposed ANE project and update the MHF Safety Report. The proponent has been advised of this requirement.

Climate Change and Sea Level Rise

The objectives of the WAPC State Planning Policy 2.6 State Coastal Planning and associated Position Statement requires that the location of coastal facilities and development takes into account coastal processes including erosion and sea level change and biophysical criteria.

The Department of Transport's Sea Level Change in Western Australia – Application to Coastal Planning Report (February 2010) recommends for planning timeframes beyond 100 years that a vertical sea level rise of 0.01 m/year be added to 0.9m for every year beyond 2110. Under the WAPC Position Statement, for new development on a sandy coast the impact of this increase in vertical sea level rise value from 0.38 to 0.9m will result in an increased horizontal setback of 52m, thus requiring a setback of 100m to 150m as a general guide.

The proposed development has a horizontal separation from the water mark of approximately 750m.

Conclusion:

Upon assessment of the development against the objectives and requirements of Town Planning Scheme No.2 it is considered that the application can be approved subject to conditions. It has been considered that the environmental emissions from the development are adequately addressed via the Ministerial Conditions set on the proposal under the provisions of the Environmental Protection Act.

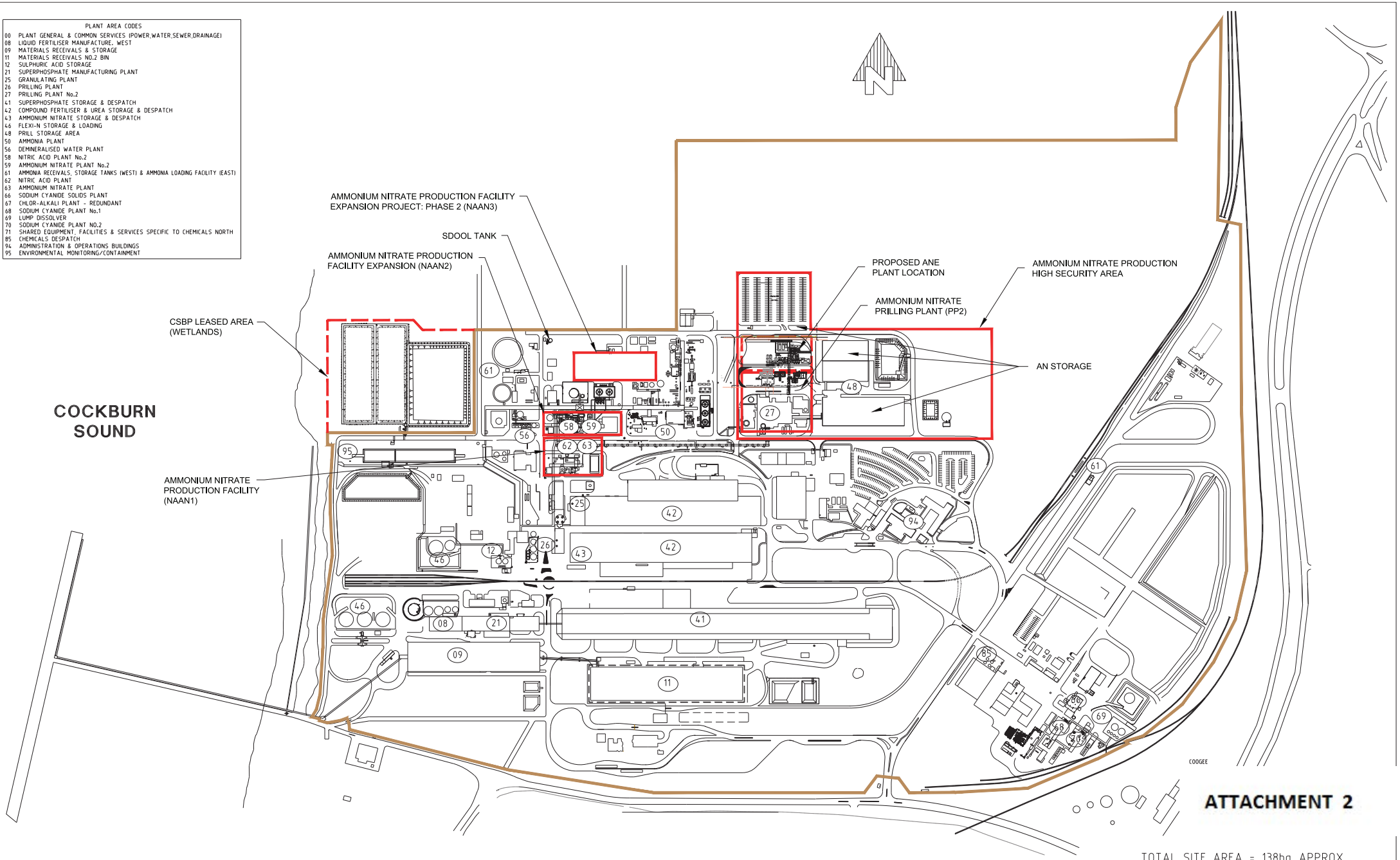
The applicant is required to undertake a risk assessment on the proposed ANE project and update the MHF Safety Report. It is important that the risk modelling be assessed to ensure the cumulative risk for the development complies with the Environmental Protection Authority – Risk Criteria.

The proposed expansion represents an addition to an existing use within the core of the Kwinana Industrial Area and is deemed appropriate for this location.


LOCATION PLAN
Proposed Additions
Patterson Rd
ATTACHMENT 1
nearmap

PLANT AREA CODES

00	PLANT GENERAL & COMMON SERVICES (POWER,WATER,SEWER,DRAINAGE)
08	LIQUID FERTILISER MANUFACTURE, WEST
09	MATERIALS RECEIVALS & STORAGE
11	MATERIALS RECEIVALS NO.2 BIN
12	SULPHURIC ACID STORAGE
21	SUPERPHOSPHATE MANUFACTURING PLANT
25	GRANULATING PLANT
26	PRILLING PLANT
27	PRILLING PLANT No.2
41	SUPERPHOSPHATE STORAGE & DESPATCH
42	COMPOUND FERTILISER & UREA STORAGE & DESPATCH
43	AMMONIUM NITRATE STORAGE & DESPATCH
46	FLEXI-N STORAGE & LOADING
48	PRILL STORAGE AREA
50	AMMONIA PLANT
56	DEMINERALISED WATER PLANT
58	NITRIC ACID PLANT No.2
59	AMMONIUM NITRATE PLANT No.2
61	AMMONIA RECEIVALS, STORAGE TANKS (WEST) & AMMONIA LOADING FACILITY (EAST)
62	NITRIC ACID PLANT
63	AMMONIUM NITRATE PLANT
66	SODIUM CYANIDE SOLIDS PLANT
67	CHLOR-ALKALI PLANT - REDUNDANT
68	SODIUM CYANIDE PLANT No.1
69	LUMP DISSOLVER
70	SODIUM CYANIDE PLANT NO.2
71	SHARED EQUIPMENT, FACILITIES & SERVICES SPECIFIC TO CHEMICALS NORTH
85	CHEMICALS DESPATCH
94	ADMINISTRATION & OPERATIONS BUILDINGS
95	ENVIRONMENTAL MONITORING/CONTAINMENT



ATTACHMENT 2

TOTAL SITE AREA = 138ha APPROX.

	No.	DATE	REVISIONS	BY	CHKD.	CSBP E.
	E	24.10.16	ISSUED FOR OEPA	DV	RP	RP
	D	23.9.16	ISSUED FOR ENVIRONMENTAL APPROVALS	DV	RP	RP
	C	10.11.10	SITE AREA UPDATED	FTL		
	B	20.4.10	BOUNDARY FENCE AND DRAWING TITLE UPDATED	FTL		
	A	18.3.10	ISSUED FOR INFORMATION	FTL		

REF. DRG. No.

CHKD. NAME: SIGN: DATE:

CSBP ENGR. NAME: SIGN: DATE:

CSBP APPD. NAME: SIGN: DATE:

ORIGINAL APPROVAL

CSBP Limited
A.B.N. 81 008 668 371

KWINANA WORKS
AMMONIUM NITRATE EMULSION PLANT
LOCATION - ENV. APPROVALS

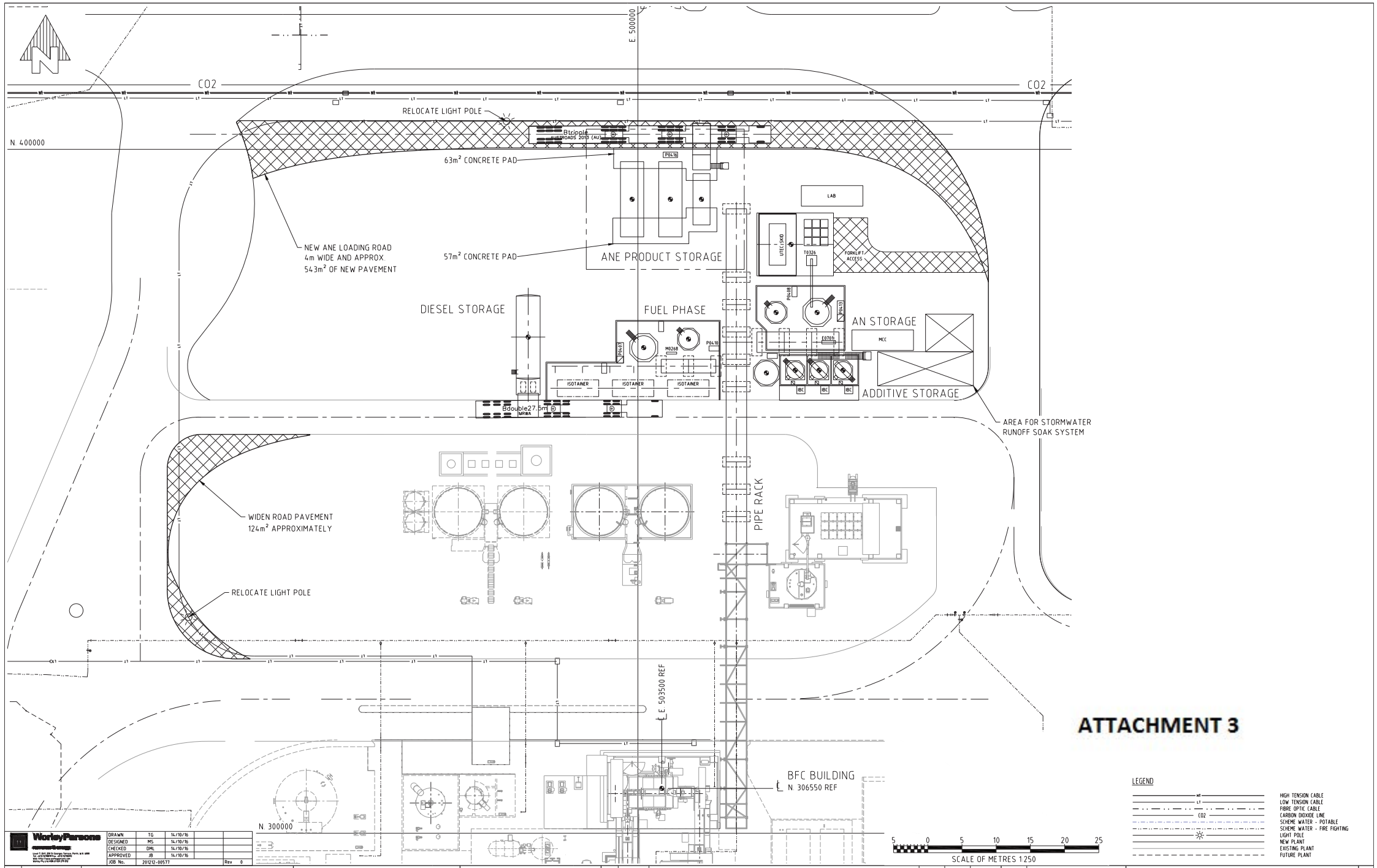
CAD DRAWING
DO NOT ALTER MANUALLY

SCALE: 1:6000 | DRN: FTL | DATE MARCH.10 | A3

DRAWING NUMBER
1100-0-0001/082

PROJ. DEVT.

REV. E



ATTACHMENT 3

LEGEND

- HT — HIGH TENSION CABLE
- LT — LOW TENSION CABLE
- FIBRE OPTIC CABLE
- CO2 — CARBON DIOXIDE LINE
- SCHEME WATER - POTABLE
- SCHEME WATER - FIRE FIGHTING
- LIGHT POLE
- NEW PLANT
- EXISTING PLANT
- FUTURE PLANT

DRAWN	TG	14/10/16			
DESIGNED	MS	14/10/16			
CHECKED	DML	14/10/16			
APPROVED	JB	14/10/16			
JOB No.	201212-00577		Rev	0	

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resources & energy
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Perth Western Australia 6000
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Web: http://www.worleyparsons.com
Worley Pty Ltd ABN 61 001 279 812

No.	DRAWING NUMBER	TITLE
1	1127-0-0002/000	No. 2 PRILL PLANT GENERAL ARRANGEMENT

REFERENCE DRAWINGS

CONS/CONT. | NAME | SIGN | DATE

No.	DATE	DESCRIPTION	BY	CHKD.	CSBP ENGR.
1	05/12/16	UPDATED	DV	AC	AC
0	14/10/16	ISSUED FOR USE	WORLEY	WORLEY	P. BROWN

REVISIONS

CHKD.	NAME: SIGN:	DATE:
CSBP ENGR.	NAME: SIGN:	DATE:
CSBP SAFETY	NAME: SIGN:	DATE:
CSBP APPD.	NAME: SIGN:	DATE:
AREA MGR.	NAME: SIGN:	DATE:

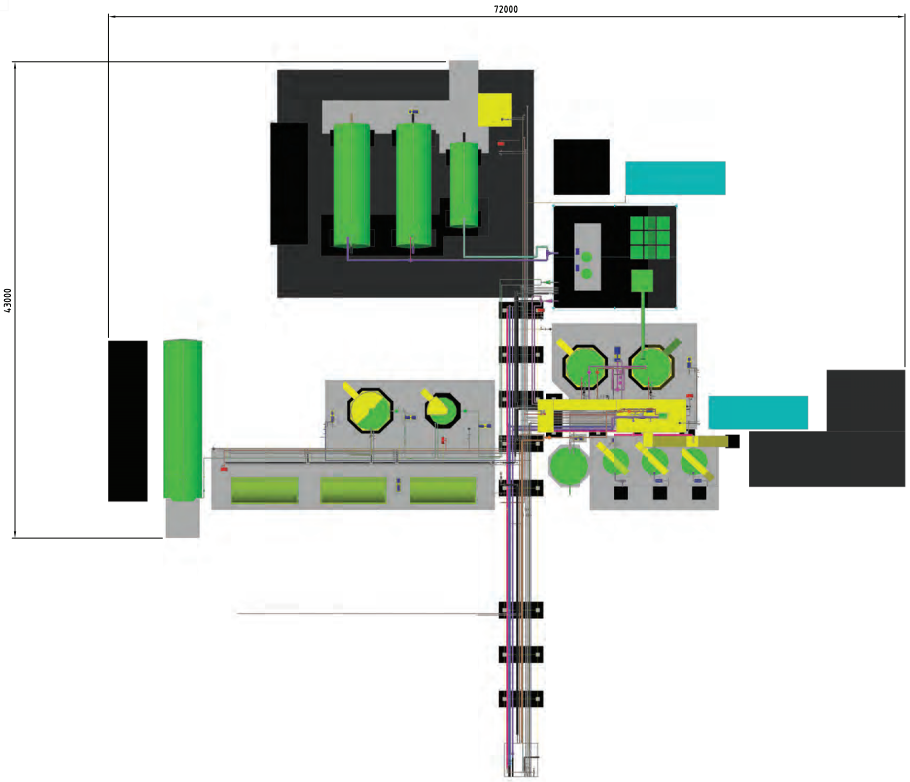
ORIGINAL DRAWING APPROVAL

CAD DRAWING - DO NOT ALTER MANUALLY | A1

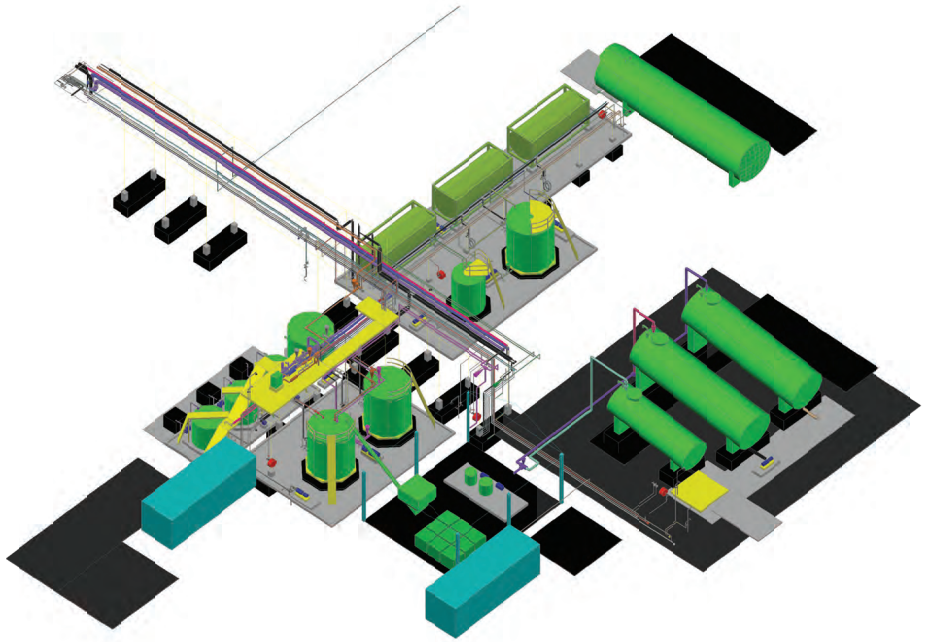
CSBP Limited
A.B.N. 81 008 668 371

KWINANA WORKS
AN EMULSION PLANT
GENERAL ARRANGEMENT

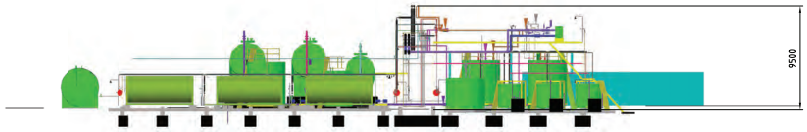
SCALE	1:250	DRAWING NUMBER	1154-0-0001/000
DRN	WORLEY	REVISION	1
DATE	30/09/2016	PROJ. DEVT.	



SITE PLAN



ISOMETRIC VIEW FROM NORTH EAST



VIEW LOOKING NORTH

VIEW LOOKING WEST

ATTACHMENT 4

No.	DRAWING NUMBER	TITLE
		REFERENCE DRAWINGS

WorleyParsons
resources & energy
Level 7, QV1, 250 St Georges Terrace
Perth Western Australia 6000
Tel: +61 8 92708111 Fax: +61 8 92708110
Web: http://www.worleyparsons.com
Worley Pty Ltd ABN 61 001 279 812

CONS/ CONT. NAME: SIGN: DATE:

No.	DATE	DESCRIPTION	BY	CHKD.	CSBP ENGR.
0	14/10/16	ISSUED FOR USE	WORLEY	WORLEY	P. BROWN

REVISIONS

CHKD.	NAME: SIGN:	DATE:
CSBP ENGR.	NAME: SIGN:	DATE:
CSBP SAFETY	NAME: SIGN:	DATE:
CSBP APPD.	NAME: SIGN:	DATE:
AREA MGR.	NAME: SIGN:	DATE:

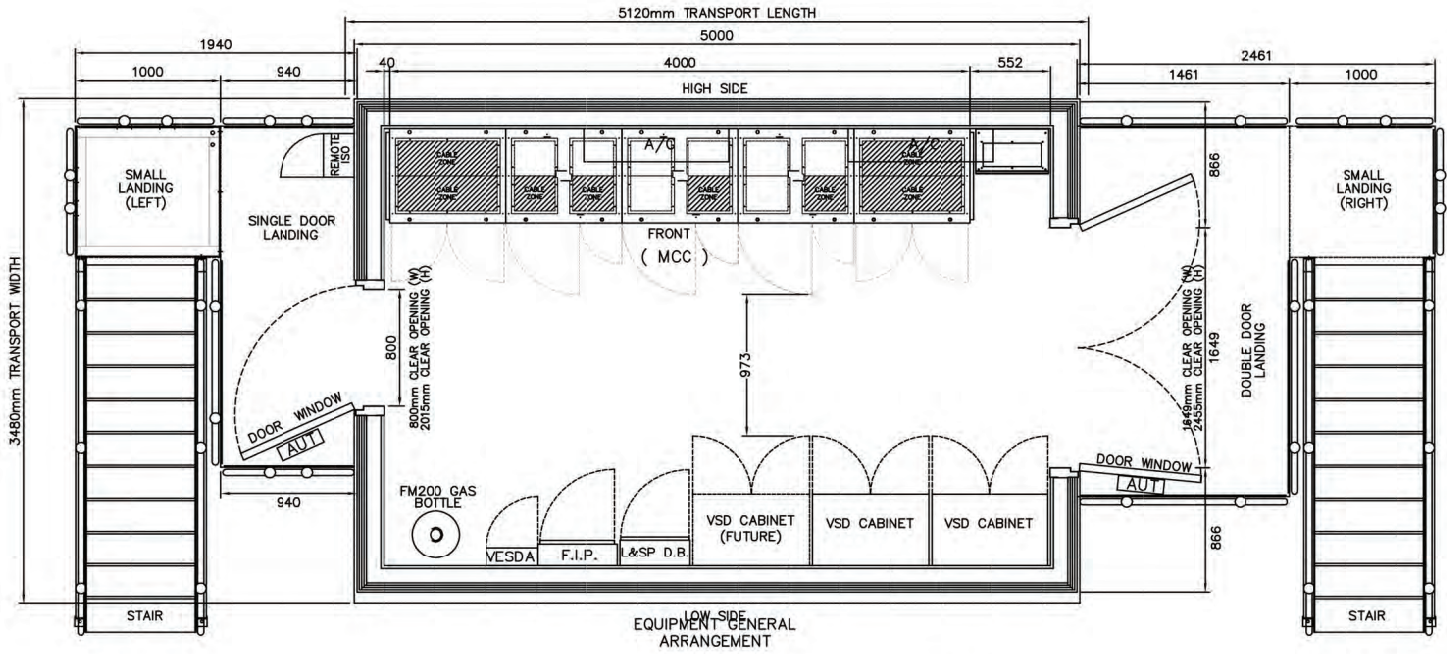
ORIGINAL DRAWING APPROVAL

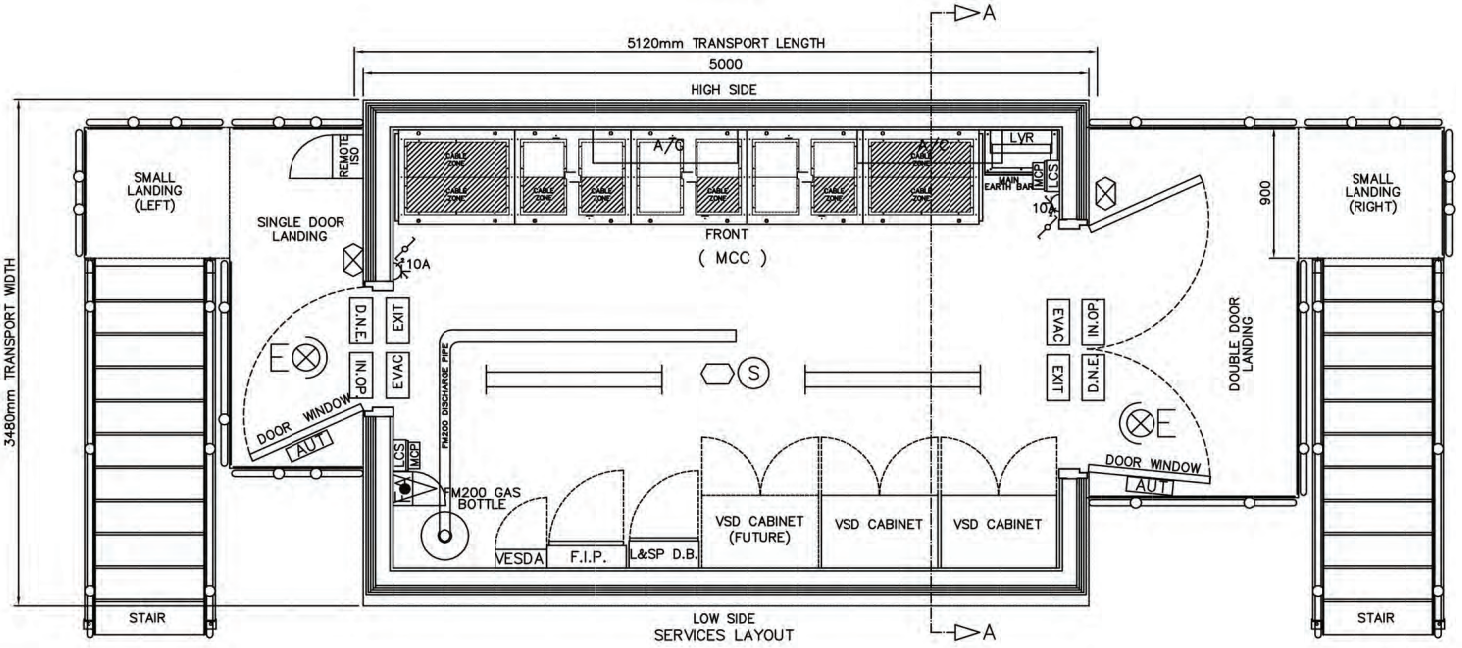
CAD DRAWING - DO NOT ALTER MANUALLY | A1

CSBP Limited
A.B.N. 81 008 668 371

KWINANA WORKS
AN EMULSION PLANT
PLAN AND ELEVATIONS

SCALE:	NTS	DRAWING NUMBER	REVISION
DRN:	WORLEY	1154-0-0002/000	0
DATE:	08.11.16		PROJ. DEVT.





SWITCHROOM LABELS

MATERIAL: SIGN WHITE C/BOND STEEL

END WALL LABEL
40mm BLACK LETTERING

BOOSTER STATION SWITCHROOM
3 / 200
600

SIDE WALL LABEL
80mm BLACK LETTERING

BOOSTER STATION SWITCHROOM
3 / 400
1200

SYMBOLS KEY

- FLUORESCENT LIGHT– HERO TWIN 36 WATT
- EXIT – EMERGENCY EXIT LIGHT– PHILLIPS L4 51/10SE (with 2hr battery backup)
- E – IP65 BULKHEAD LIGHT FITTING– VERSALUX TWIN 18W FLUORESCENT (with 2hr battery backup)
- 2 WAY LIGHT SWITCH– CLIPSAL 56 SERIES (with IPA studs)
- 10A – 2 GANG 10A SWITCH SOCKET (ELCB protected c/with IPA studs)
- FIP – FIRE INDICATOR PANEL
- VESDA – VESDA FIRE DETECTION UNIT
- LCS – FM200 LOCAL CONTROL STATION
- MCP – MANUAL CALL POINT
- ⊗ – FIRE ALARM SOUNDER/STROBE (EXT)
- ⬭ – FIRE ALARM SOUNDER/STROBE (INT)
- (S) – SMOKE DETECTOR
- 5KG CO2 FIRE EXTINGUISHER (INT)
- D.N.E. – DO NOT ENTER WARNING SIGN
- EVAC – EVACUATE WARNING SIGN
- IN.OP – SYSTEM INOPERATIVE WARNING SIGN
- AC – AC INDOOR UNIT– FUJITSU 8.0kW (C/WITH DRIP TRAYS)
  (INT.) ASTA30JCC OUTDOOR UNITS
  (EXT.) ASTA30JCA (SUPPLY ONLY – INSTALLATION BY OTHERS)
- AC ISOLATOR SWITCH (SUPPLIED LOOSE)
- FA – FIRST AID KIT
- AUT – DANGER/WARNING SIGNAGE (AUTHORISED PERSONNEL ONLY)
- LVR – LV RESUSCITATION KIT (INCLUDING HOOK)

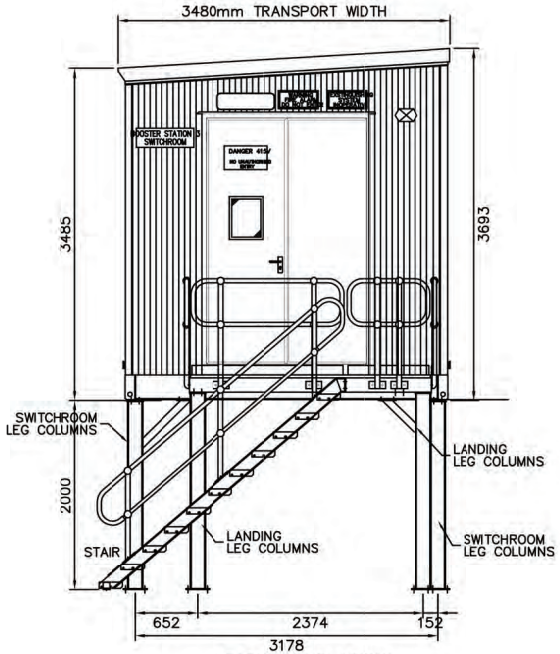
ATTACHMENT 5

REFERENCE DRAWINGS		REVISIONS				
					DRAWN.	R. B.
					CHECKED.	E. M.
		0	13–02–15	ISSUED FOR OCNSTRUCTION	D.L.	DATE. 20–01–15
		B	05/02/15	ISSUED FOR APPROVAL	R.B.	SCALE NTS
–	–	A	03/02/15	PRELIMINARY	R.B.	
DWG No	TITLE	REV	DATE	DESCRIPTION	BY	PLOTTED

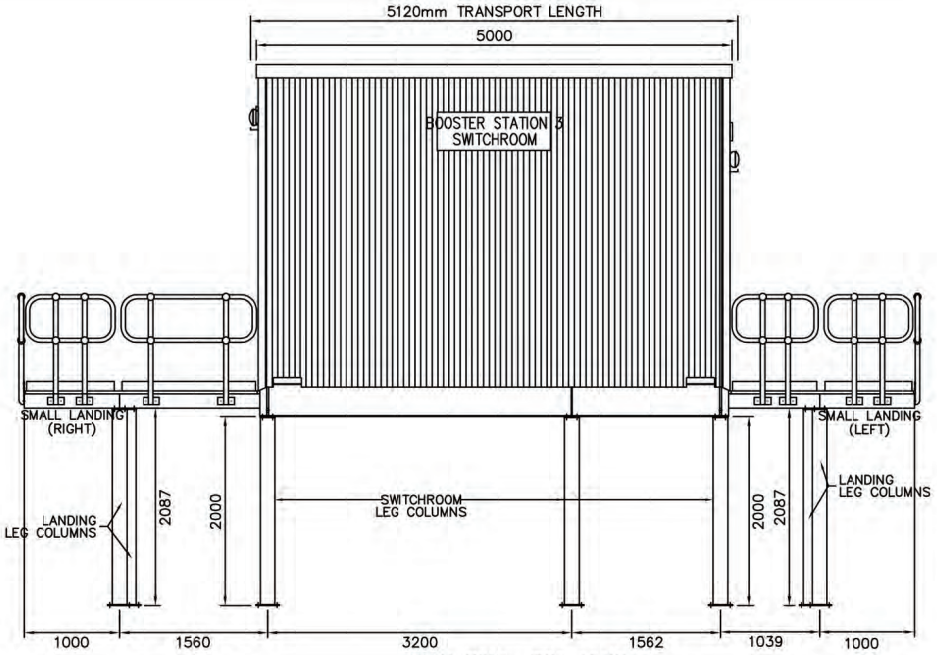
PLUMMERS INDUSTRIES PTY LTD
10 Wheeler St. Belmont 6104
PO BOX 35, Cloverdale 6105
Western Australia
Ph: 61 8 9277 7255
Fx: 61 8 9479 3008
Email: admin@plummers.com.au

CSBP
ANE MCC BUILDING
FLOOR PLAN

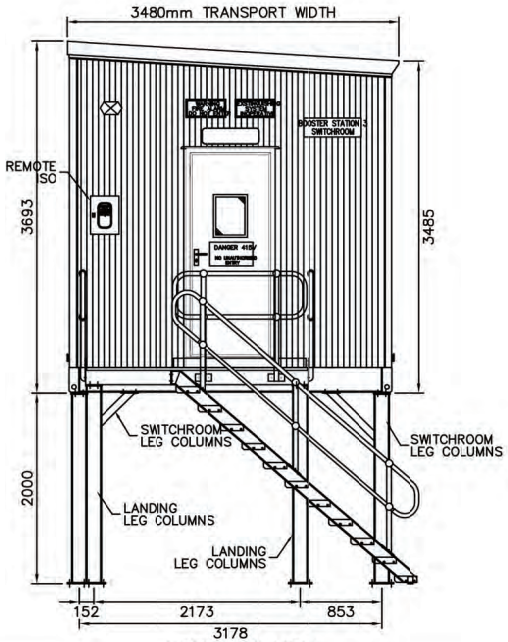
DWG NO 9741–SUB–002 A1 REV. 0



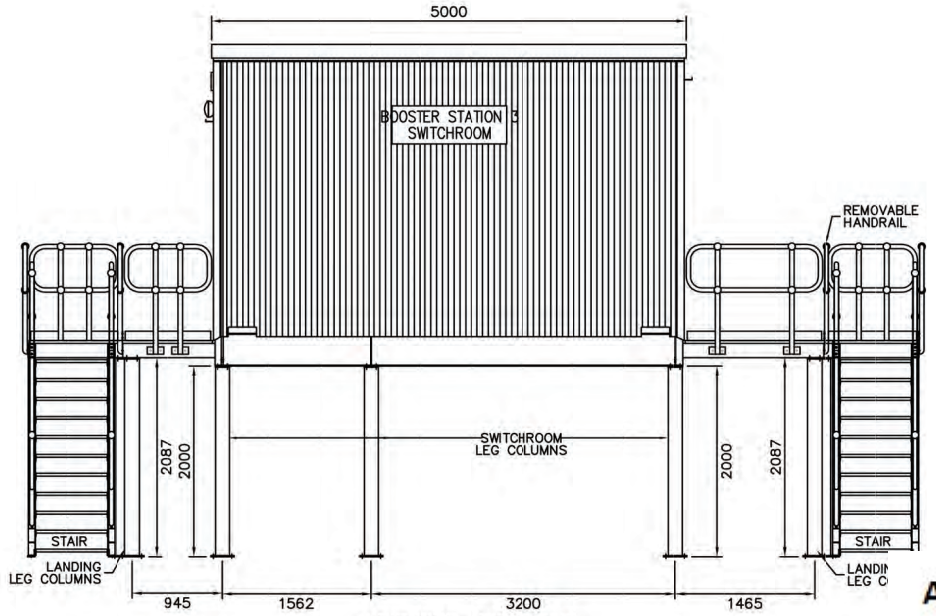
RIGHT END VIEW



HIGH SIDE: SIDE VIEW



LEFT END VIEW



LOW SIDE: SIDE VIEW

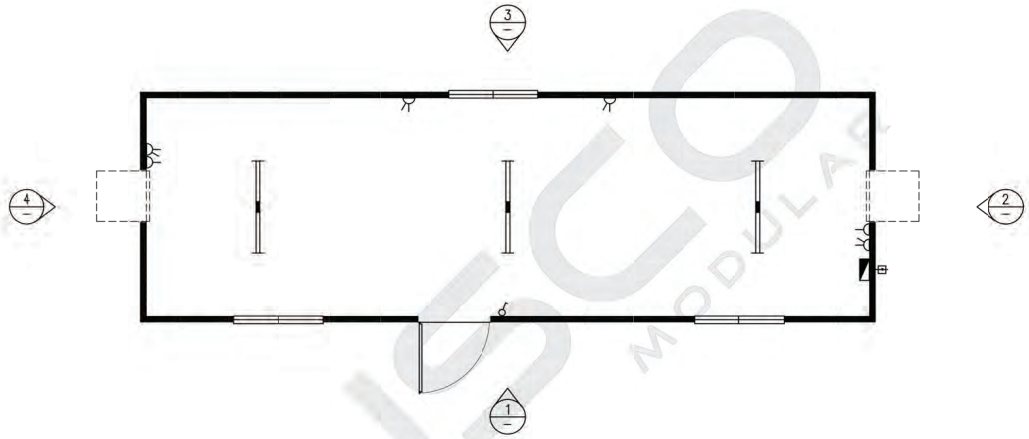
ATTACHMENT 6

REFERENCE DRAWINGS		REVISIONS					
						DRAWN.	R. B.
						CHECKED.	E. M.
						DATE.	20-01-15
		0	13-02-15	ISSUED FOR OCNSTRUCTION	D.L.	SCALE	NTS
		B	06/02/15	ISSUED FOR APPROVAL	R.B.		
–	–	A	04/02/15	ISSUED FOR INTERNAL REVIEW	R.B.		
DWG No	TITLE	REV	DATE	DESCRIPTION	BY	PLOTTED	

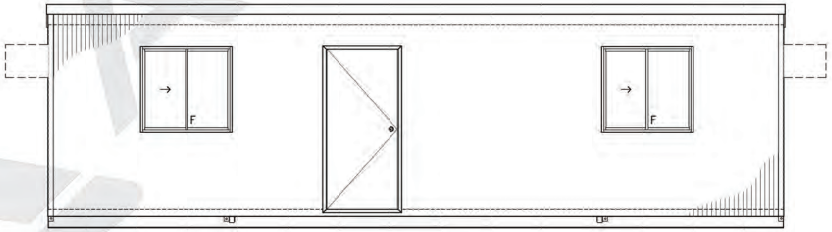
PLUMMERS INDUSTRIES LTD
10 Wheeler St, Belmont 6104
PO BOX 35, Cloverdale 6105
Western Australia
Ph: 61 8 9277 7255
Fx: 61 8 9478 3008
Email: admin@plummers.com.au

CSBP
ANE MCC BUILDING
ELEVATION

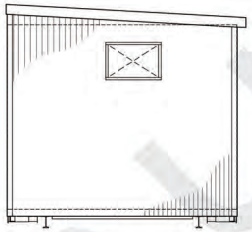
DWG NO 9741-SUB-003 A1 REV. 0



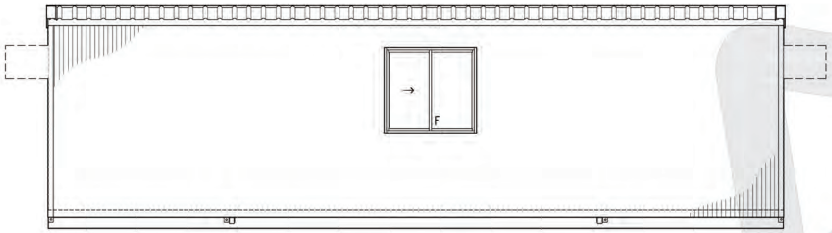
PLAN
SCALE 1:50



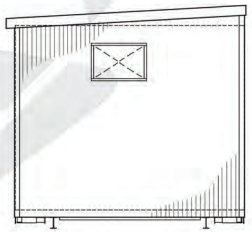
ELEVATION 1
SCALE 1:50



ELEVATION 2
SCALE 1:50



ELEVATION 3
SCALE 1:50



ELEVATION 4
SCALE 1:50

ATTACHMENT 7

GENERAL NOTES:
1. FOR FURTHER DETAILS REFER FLOOR PLAN DRAWING

SYMBOL LEGEND

18W FLUORO	LIGHT SWITCH	TV TELEVISION OUTLET
36W FLUORO	LIGHT SWITCH WP	
2x36W FLUORO	LIGHT SW' 2 WAY	TP TELEPHONE OUTLET
DIFFUSED FLUORO	LIGHT SW' DBL	
18W FLUORO WP	S/OUTLET 10amp	DC DATA COM. OUTLET
EXT 18W VANDALITE	S/OUTLET 10A DBL	
EXT 18W VANDALITE	S/OUTLET 15amp	DRAW WIRE
8W BED LAMP	S/OUTLET 20amp	FIRE EXTINGUISHER
BULKHEAD LIGHT	ISOLATOR SWITCH	WATER INLET
INCAND' LIGHT	SWITCHBOARD	WASTE OUTLET
WP DOME FLUORO	POWER ENTRY	HOSE COCK
OYSTER LIGHT	JUNCTION BOX	FLOOR WASTE
EXIT LIGHT	SMOKE ALARM	COAT HOOK
EMERG' LIGHT	EXTRACTOR FAN	DUAL COAT HOOKS

Issue	Date	Description	By	Check
A	AS NOTED	ORIGINAL		

FORM No GDWGPFCO

AUSCO MODULAR

Title
CSBP
ANE LAB BUILDING

Project
SALE: 9.6 x 3.0 x 2.4m
MULTIPURPOSE

Client

Drawn By	Drawn Date	Scale	
GKO	APR 08	1:50	A2

Checked By | Check Date | DIMENSIONS ARE IN MM DO NOT SCALE

Project No. | Order No.

Dwg No. MP9630 | Sheet 2 | Issue A

GOVERNMENT OF WESTERN AUSTRALIA

Environmental Protection Authority

Ms Stephanie Felstead
Environmental Superintendent
CSBP Limited
PO Box 345
KWINANA WA 6966

Our Ref: 17-000972
Enquiries: Ceidwen Pengelly, 6145 0809
Email: Ceidwen.pengelly@epa.wa.gov.au

Dear Ms Felstead

AMMONIUM NITRATE PRODUCTION EXPANSION PROJECT: PHASE 2, KWINANA – MINISTERIAL STATEMENT 875 – CHANGE TO PROPOSAL APPROVED UNDER SECTION 45C OF THE *ENVIRONMENTAL PROTECTION ACT 1986*

I refer to the application for a change to proposal from CSBP Limited, dated 28 October 2016, requesting approval of changes to the Ammonium Nitrate Production Expansion Project: Phase 2 (Ministerial Statement 875).

I consider the changes, as described in Attachment 2 to Ministerial Statement 875, will not result in a significant detrimental effect on the environment in addition to, or different from, the effect of the original proposal. Approval of the changes is therefore granted under section 45C of the *Environmental Protection Act 1986*. This approval does not replace any responsibilities you may have for seeking approvals from other government agencies to implement the changes.

Please note, implementation of the Ammonium Nitrate Production Expansion Project: Phase 2, including the approved changes described in Attachment 2, is subject to the conditions of Ministerial Statement 875. The Chief Executive Officer of the Office of the Environmental Protection Authority may monitor the implementation of the proposal for the purpose of determining whether the implementation conditions are being complied with.

Yours sincerely

Dr Tom Hatton
CHAIRMAN
for the Minister for Environment
under Notice of Delegation dated 24 November 2004.

24 January 2016

Encl: Attachment 2 to Ministerial Statement 875

ATTACHMENT 8

The Atrium Level 8, 168 St Georges Terrace, Perth, Western Australia 6000.
Postal Address: Locked Bag 10, East Perth, Western Australia 6892.

Telephone: (08) 6145 0800 | Facsimile: (08) 6145 0896 | Email: info@epa.wa.gov.au
Website: www.epa.wa.gov.au

Attachment 2 to Ministerial Statement 875

Change to proposal approved under section 45C of the
Environmental Protection Act 1986

This Attachment replaces Schedule 1 and all previous Attachments of Ministerial Statement 875

Proposal: **Ammonium Nitrate Expansion Project: Phase 2**

Proponent: **CSBP Limited**

Changes:

- Increase the boundary of Project Area;
- Addition of an ammonium nitrate emulsion plant and associated infrastructure;
- Remove elements that are not a significant key characteristic relevant to the environment or are regulated under Part V of *the Environmental Protection Act 1986*; and
- Update Figures and reference coordinates.

Table 1: Summary of the Proposal

Proposal Title	Ammonium Nitrate Expansion Project: Phase 2
Short Description	The proposal is for the expansion of the Kwinana Ammonium Nitrate Production Facility (ANPF) to include a third nitric acid ammonium nitrate plant by incorporating additional components into the existing facility and re-engineering (debottlenecking) some existing components (including the 2008 prilling plant) in order to increase ammonium nitrate production capacity from 520,000 tonnes per annum (tpa) to 936,000 tpa. The proposal is located within the 138 ha CSBP Kwinana Industrial Complex (KIC), approximately 40 kilometres south of Perth (Figure 1). The project area for the proposal is shown on Figure 2. The proposal includes the construction and operation of the Kwinana Ammonium Nitrate Production Facility including: • Three nitric acid plants. The new third nitric acid plant will be designed and constructed to incorporate tertiary nitrous oxide (N2O) abatement technology; • Nitric acid storage tanks; • Three ammonium nitrate solution plants; • Ammonium nitrate solution storage; • An ammonium nitrate bag packaging facility; • A solid ammonium nitrate storage facility (within the Dangerous Goods Licence approved limit); • A new auxiliary boiler; • A debottlenecked prilling plant; • An ammonium nitrate emulsion plant and associated infrastructure to manufacture up to 100,000 tonnes per annum of ammonium nitrate emulsion (ANE); and • Upgraded utilities and supporting infrastructure to support the expansion.

ATTACHMENT 8

Table 2: Location and authorised extent of physical and operational elements

Element	Previously Authorised Extent	Authorised Extent
General		
CSBP KIC site area	Approximately 138 ha.	**See "Proposal area".**
Proposal area	Approximately 1 ha within CSBP KIC site boundary.	**Up to 2.3 ha** within **the** CSBP KIC site boundary.
Project life	20 - 30 years.	**Removed as not a significant key characteristic relevant to the environment.**
Plant operating hours	24 hours/day continuous operation, except for maintenance shutdowns.	**Removed as not a significant key characteristic relevant to the environment.**
Plant components		
Nitric acid plants	Increase from two plants to three plants. The new third nitric acid plant will be designed and constructed to incorporate tertiary nitrous oxide (N2O) abatement technology.	**Removed as included in the description of the proposal.**
Nitric acid storage tanks	Increase in storage capacity from approximately 2,000 tonnes to 5,500 tonnes via construction of an additional 3,500 tonne 100% nitric acid solution tank (to store 63% nitric acid solution).	**Up to** 5,500 tonnes **storage capacity.**
Ammonium nitrate solution plants	Increase from two plants to three plants.	**Removed as included in the description of the proposal.**
Ammonium nitrate (90% solution) storage tanks	Increase from approximately 305 m^3 to 610 m^3 total capacity.	**Up to** 610 m^3 **storage** capacity.
Ammonium nitrate (70 - 90% solution) storage tank	Approximately 730 m^3 capacity (No change).	**Up to** 730 m^3 **storage** capacity.
2008 prilling plant	Debottlenecked.	**Removed as included in the description of the proposal.**
Ammonium nitrate bag packaging facility	No change to existing facility.	**Removed as included in the description of the proposal.**
Ammonium nitrate solids storage facility	Construction of an additional solid ammonium nitrate storage facility (within Dangerous Goods Licence approved limit).	**Removed as included in the description of the proposal.**
New auxiliary boiler		**Removed as managed under Part V of the *Environmental Protection Act 1986*.**
Production		
Total nitric acid production	Increase from approximately 400,000 tpa to 720,000 tpa.	**Up to** 720,000 tpa.

Element	Previously Authorised Extent	Authorised Extent
Total ammonium nitrate solution production	Increase from approximately 520,000 tpa to 936,000 tpa.	**Up to** 936,000 tpa.
Total prilled ammonium nitrate production	Increase from approximately 420,000 tpa to 780,000 tpa.	**Up to** 780,000 tpa.
Net power generation	Increase from approximately 4 MW to 6 MW.	**Up to** 6 MW.
Ammonium Nitrate Solution storage for Emulsion	**Not previously defined.**	**Up to 80 tonnes storage capacity.**
Final Ammonium Nitrate Emulsion storage	**Not previously defined.**	**Up to 370 tonnes storage capacity.**
Total ammonium nitrate emulsion production	**Not previously defined.**	**Up to 100,000 tpa.**
Inputs		
Water	Additional quantity of approximately 520 ML/yr above current usage of about 3,325 ML/yr consisting of about 400 ML/yr sourced from the Kwinana Water Reclamation Plant (KWRP) and the remainder sourced from the superficial aquifer, the Western Power Corporation (WPC) Industrial Water Source, and scheme water. Additional quantity of approximately 1,500 to 1,900 ML/yr above current usage of about 3,325 ML/yr if sufficient water cannot be obtained from the KWRP and it has to be sourced from the superficial and sub-artesian aquifers, the WPC Industrial Water Source, and scheme water.	**Up to 5.25 GL/annum of water** sourced from the Kwinana Water Reclamation Plant (KWRP) and the remainder sourced from the superficial aquifer, the Western Power Corporation (WPC) Industrial Water Source, and scheme water.
Outputs		
Oxides of nitrogen (NOx)	Increase from approximately 269 tpa to 569 tpa.	**Up to** 569 tpa.
Ammonium nitrate particulates as $PM_{2.5}$	Increase from approximately 12 tpa to 20 tpa.	**Up to** 20 tpa.
Ammonia (NH_3)	Increase from approximately 12 tpa to 18 tpa.	**Up to** 18 tpa.

ATTACHMENT 8

Element	Previously Authorised Extent	Authorised Extent
Liquid waste	Increase from approximately 2 ML/day to 2.4 ML/day discharged via the Sepia Depression Ocean Outlet Landline (SDOOL).	**Up to 2.5** ML/day discharged via the Sepia Depression Ocean Outlet Landline (SDOOL).

Note: Text in **bold** in Table 2 indicates a change to the proposal.

Abbreviations

ha	hectares	GL/annum	gigalitres per annum
m^3	cubic metres	tpa	tonnes per annum
ML/day	megalitres per day	$PM_{2.5}$	particulate matter with an aerodynamic diameter of less than 2.5 micrometres
MW	megawatts (10^6 Watts)		

Figures – All previous Figures are replaced by the following:

Figure 1 Site Location
Figure 2 Statement 875 Project Area

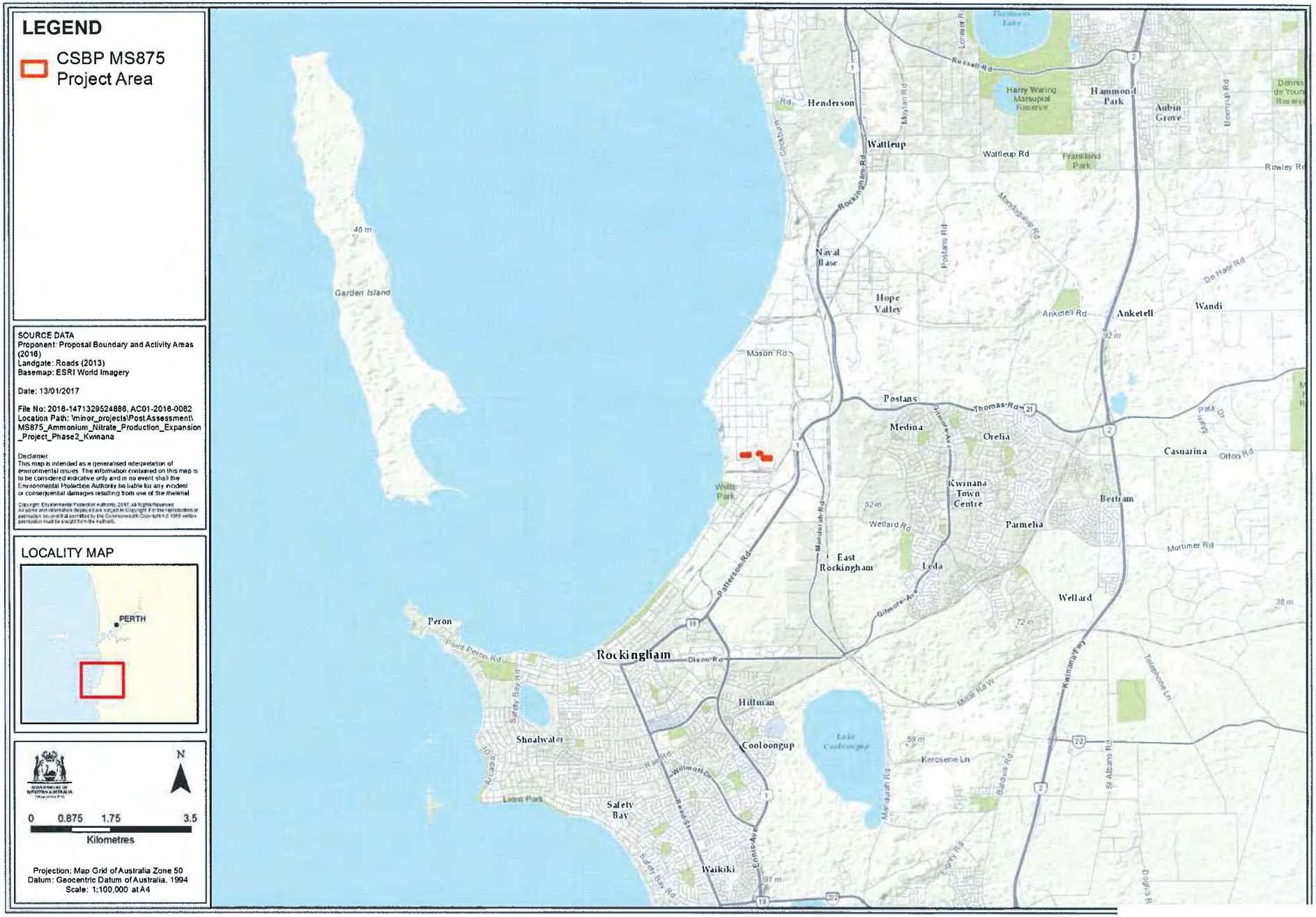
Coordinates defining the Project Area are held by the Office of the Environmental Protection Authority (Reference Number 2017 – 1484728360712).

Dr Tom Hatton
CHAIRMAN
Environmental Protection Authority
under delegated authority

Approval date: 24/1/17

ATTACHMENT 8

Figure 1 Site Location



ATTACHMENT 8

Figure 2 Statement 875 Project Area

ATTACHMENT 8

MINISTER FOR ENVIRONMENT; WATER

Statement No: 875

STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED
(PURSUANT TO THE PROVISIONS OF THE
ENVIRONMENTAL PROTECTION ACT 1986)

AMMONIUM NITRATE PRODUCTION EXPANSION
PROJECT: PHASE 2, KWINANA
TOWN OF KWINANA

Proposal: CSBP Limited proposes to expand its Kwinana Ammonium Nitrate Production Facility located within the CSBP Kwinana Industrial Complex approximately 40 kilometres south of Perth by incorporating additional components into the existing facility and re-engineering (debottlenecking) some existing components in order to increase ammonium nitrate production capacity from 520,000 tonnes per annum to 936,000 tonnes per annum. The proposal is further documented in Schedule 1 of this statement.

Proponent: CSBP Limited

Proponent Address: PO Box 345, KWINANA WA 6966.

Assessment Number: 1834

Previous Assessment Number: 1537

Report of the Environmental Protection Authority: 1407

Previous Report of the Environmental Protection Authority: 1182

Previous Statement Number: 689 (Published on 21 September 2005)

The proposal referred to in the above report of the Environmental Protection Authority may be implemented. The implementation of that proposal is subject to the following conditions and procedures:

Published on:

Level 29, 77 St Georges Terrace, Perth, Western Aus[illegible]
Telephone: +61 8 9220 5000 Facsimile:+61 8 9220 5001 Email: Mink
www.ministers.wa.gov.au/marmion

ATTACHMENT 9

1 Proposal Implementation

1-1 The proponent shall implement the proposal as documented and described in schedule 1 of this statement subject to the conditions and procedures of this statement.

2 Proponent Nomination and Contact Details

2-1 The proponent for the time being nominated by the Minister for Environment under sections 38(6) or 38(7) of the *Environmental Protection Act 1986* is responsible for the implementation of the proposal.

2-2 The proponent shall notify the Chief Executive Officer of the Office of the Environmental Protection Authority (CEO) of any change of the name and address of the proponent for the serving of notices or other correspondence within 30 days of such change.

3 Time Limit of Authorisation

3-1 The authorisation to implement the proposal provided for in this statement shall lapse and be void five years after the date of this statement if the proposal to which this statement relates is not substantially commenced.

3-2 The proponent shall provide the CEO with written evidence which demonstrates that the proposal has substantially commenced on or before the expiration of five years from the date of this statement.

4 Compliance Reporting

4-1 The proponent shall prepare and maintain a compliance assessment plan to the satisfaction of the CEO.

4-2 The proponent shall submit to the CEO the compliance assessment plan required by condition 4-1 at least six months prior to the first compliance report required by condition 4-6, or prior to implementation, whichever is sooner.

The compliance assessment plan shall indicate:

1. the frequency of compliance reporting;
2. the approach and timing of compliance assessments;
3. the retention of compliance assessments;
4. the method of reporting of potential non-compliances and corrective actions taken;
5. the table of contents of compliance assessment reports; and

ATTACHMENT 9

6. public availability of compliance assessment reports.

4-3 The proponent shall assess compliance with conditions in accordance with the compliance assessment plan required by condition 4-1.

4-4 The proponent shall retain reports of all compliance assessments described in the compliance assessment plan required by condition 4-1 and shall make those reports available when requested by the CEO.

4-5 The proponent shall advise the CEO of any potential non-compliance within seven days of that non-compliance being known.

4-6 The proponent shall submit to the CEO the first compliance assessment report fifteen months from the date of issue of this Statement addressing the twelve month period from the date of issue of this Statement and then annually from the date of submission of the first compliance report.

The compliance assessment report shall:

1. be endorsed by the proponent's Managing Director or a person delegated to sign on the Managing Director's behalf;

2. include a statement as to whether the proponent has complied with the conditions;

3. identify all potential non-compliances and describe corrective and preventative actions taken;

4. be made publicly available in accordance with the approved compliance assessment plan; and

5. indicate any proposed changes to the compliance assessment plan required by condition 4-1.

5 Greenhouse gas abatement

5-1 The proponent shall install, commission, and operate secondary nitrous oxide (N_2O) abatement technology in the existing Nitric Acid Plants 1 and 2 prior to the commencement of debottlenecking procedures in these two plants.

5-2 The proponent shall provide the CEO with documentation which confirms the practical completion of the installation and commissioning of secondary N_2O abatement technology in the existing Nitric Acid Plants 1 and 2 within six months following the completion of the installation and commissioning of secondary N_2O abatement technology in the existing Nitric Acid Plants 1 and 2.

ATTACHMENT 9

5-3 The proponent shall implement a Greenhouse Gas Abatement Program prior to the commencement of operation of the expanded project. The Program shall:

1. demonstrate that the expansion project is designed and operated in a manner which minimises greenhouse gas emissions as far as practicable;

2. demonstrate that maximising energy efficiency and opportunities for future energy recovery have been given due consideration in the design of the proposed expansion project;

3. ensure that the "greenhouse gas" intensity (measured in tonnes of CO_2-e produced per tonne of product produced) is equivalent to, or better than, benchmarked best practice for equivalent plants; and

4. achieve continuous improvement in "greenhouse gas" intensity through the periodic review, and if practicable, adoption of advances in technology and process management.

5-4 Following the implementation of the Greenhouse Gas Abatement Program, the proponent shall review each calendar year and submit an assessment to the CEO on the performance of the proposal against the requirements of condition 5-3 by 31 March of each year.

5-5 The proponent shall make the Greenhouse Gas Abatement Program required by condition 5-3 publicly available in a manner approved by the CEO.

5-6 Conditions 5-3, 5-4 and 5-5 continue to have effect and condition the implementation of the proposal until such time as it is determined by the Minister for Environment that they are non-complementary to the Commonwealth's greenhouse gas reduction legislation applicable to the proposal.

6 Decommissioning

6-1 At least six months prior to the anticipated date of closure, the proponent shall submit a Final Decommissioning Plan designed to ensure that the site is suitable for future land uses, for approval of the CEO. The Final Decommissioning Plan shall set out procedures and measures for:

1. removal or, if agreed in writing by the appropriate regulatory authority, retention of plant and infrastructure agreed in consultation with relevant stakeholders;

2. rehabilitation of all disturbed areas to a standard suitable for the new land use(s) as agreed pursuant to the consultation referred to in condition 6-1(1); and

ATTACHMENT 9

3. identification of contaminated areas, including provision of evidence of notification and proposed management measures to relevant statutory authorities.

6-2 The proponent shall implement the Final Decommissioning Plan required by condition 6-1 from the date of closure until such time as the Minister for Environment determines, on advice of the CEO, that the proponent's decommissioning responsibilities have been fulfilled.

6-3 The proponent shall make the Final Decommissioning Plan required by condition 6-1 publicly available in a manner approved by the CEO.

Notes

1. Where a condition states "on advice of the Office of the Environmental Protection Authority", the Office of the Environmental Protection Authority will provide that advice to the proponent.

2. The Minister for Environment will determine any dispute between the proponent and the Office of the Environmental Protection Authority over the fulfilment of the requirements of the conditions.

3. The proponent is required to apply for a Works Approval and Licence for this project under the provisions of Part V of the *Environmental Protection Act 1986*.

Bill Marmion

HON BILL MARMION MLA
MINISTER FOR ENVIRONMENT; WATER

- 6 OCT 2011

ATTACHMENT 9

Schedule 1

The Proposal (Assessment No. 1834)

CSBP Limited proposes to expand its Kwinana Ammonium Nitrate Production Facility (ANPF) by incorporating additional components into the existing facility and re-engineering (debottlenecking) some existing components in order to increase ammonium nitrate production capacity from 520,000 tonnes per annum (tpa) to 936,000 tpa.

The ANPF is located within the CSBP Kwinana Industrial Complex (KIC), approximately 40 kilometres (km) south of Perth (Figure 1). The CSBP KIC covers an area of approximately 138 hectares (ha) within the Kwinana Industrial Area (KIA). The proposal encompasses an area of approximately 1 ha within the CSBP KIC (Figure 2). A site plan of the CSBP KIC is shown in Figure 3.

The proposal requires the following changes to be made to the existing ANPF:

1. Debottlenecking of the existing nitric acid ammonium nitrate plants by 20% and construction of an additional nitric acid ammonium nitrate plant, which will then be debottlenecked by 20%, which would result in a total nitric acid production capacity of 720,000 tpa and a total ammonium nitrate solution production capacity of 936,000 tpa.

2. Debottlenecking of the 2008 prilling plant by 100% to double output.

3. Construction of an additional 3,500 tonne 100% nitric acid solution tank (to store 63% nitric acid solution).

4. Construction of an additional 305 cubic metre ammonium nitrate solution tank.

5. Construction of a new auxiliary boiler.

6. Construction of additional solid ammonium nitrate storage facility (within Dangerous Goods Licence approved limit).

7. Upgrade of the existing ammonium nitrate solid and solution despatch facilities.

8. Upgrade of existing utilities and supporting infrastructure and construction of new utilities and supporting infrastructure to support the expansion.

The construction of the third nitric acid ammonium nitrate plant is planned to be completed before debottlenecking activities are undertaken on the existing nitric acid ammonium nitrate plants. Debottlenecking of the nitric acid ammonium nitrate plants would be undertaken as required to meet increased demand for product. There would be no increase in ammonia production or storage capacity on site.

The main characteristics of the proposal are summarised in Table 1 below. A detailed description of the proposal is provided in Chapter 1 - Section 5 of the Public Environmental Review document (Strategen & Parsons Brinckerhoff, 2010).

Table 1: Summary of key proposal characteristics

Element	Description
General	
CSBP KIC site area	Approximately 138 ha.
Proposal area	Approximately 1 ha within CSBP KIC site boundary.
Project life	20 - 30 years.
Plant operating hours	24 hours/day operation, 365 days per year, except for maintenance shutdowns.
Plant components	
Nitric acid plants	Increase from two plants to three plants. The new third nitric acid plant will be designed and constructed to incorporate tertiary nitrous oxide (N_2O) abatement technology.
Nitric acid storage tanks	Increase in storage capacity from approximately 2,000 tonnes to 5,500 tonnes via construction of an additional 3,500 tonne 100% nitric acid solution tank (to store 63% nitric acid solution).
Ammonium nitrate solution plants	Increase from two plants to three plants.
Ammonium nitrate (90% solution) storage tanks	Increase from approximately 305 m^3 to 610 m^3 total capacity.
Ammonium nitrate (70 - 90% solution) storage tank	Approximately 730 m^3 capacity (No change).
2008 prilling plant	Debottlenecked.
Ammonium nitrate bag packaging facility	No change to existing facility.
Ammonium nitrate solids storage facility	Construction of an additional solid ammonium nitrate storage facility (within Dangerous Goods Licence approved limit).
New auxiliary boiler	
Production	
Total nitric acid production	Increase from approximately 400,000 tpa to 720,000 tpa.
Total ammonium nitrate solution production	Increase from approximately 520,000 tpa to 936,000 tpa.
Total prilled ammonium nitrate production	Increase from approximately 420,000 tpa to 780,000 tpa.
Net power generation	Increase from approximately 4 MW to 6 MW.
Inputs	
Water	Additional quantity of approximately 520 ML/yr above current usage of about 3,325 ML/yr consisting of about 400 ML/yr sourced from the Kwinana Water Reclamation Plant (KWRP) and the remainder sourced from the superficial aquifer, the Western Power Corporation (WPC) Industrial Water Source, and scheme water. Additional quantity of approximately 1,500 to 1,900 ML/yr above current usage of about 3,325 ML/yr if sufficient water cannot be obtained from the KWRP and it has to be sourced from the superficial and sub-artesian aquifers, the WPC Industrial Water Source, and scheme water.
Outputs	
Oxides of nitrogen (NO_x)	Increase from approximately 269 tpa to 569 tpa.
Ammonium nitrate particulates as $PM_{2.5}$	Increase from approximately 12 tpa to 20 tpa.
Ammonia (NH_3)	Increase from approximately 12 tpa to 18 tpa.
Greenhouse gas emissions	Decrease from approximately 925,088 tonnes of CO_2-e per year to approximately 264,000 tonnes of CO_2-e per year for Scenario 3 in the Public Environmental Review document.
Liquid waste	Increase from approximately 2 ML/day to 2.4 ML/day discharged via the Septa Depression Ocean Outlet Landline (SDOOL).

Abbreviations

CO_2-e	carbon dioxide equivalent
ha	hectares
m^3	cubic metres
ML/day	megalitres per day
ML/yr	megalitres per year
MW	megawatts (10^6 watts)
PER	Public Environmental Review
$PM_{2.5}$	particulate matter with an aerodynamic diameter of less than 2.5 micrometres
tpa	tonnes per annum

References

1. Strategen & Parsons Brinckerhoff (2010). *CSBP Kwinana: Ammonium Nitrate Production Expansion Project: Phase 2 Public Environmental Review*. Prepared by Strategen & Parsons Brinckerhoff for CSBP Limited. November 2010.

ATTACHMENT 9

Figures (attached):

Figure 1: Regional location (Source: Figure 1.1 from Strategen & Parsons Brinckerhoff, 2010).

Figure 2: Site location (Source: Figure 1.2 from Strategen & Parsons Brinckerhoff, 2010).

Figure 3: CSBP Limited Kwinana Industrial Complex plant layout (Source: Figure 1.4 from Strategen & Parsons Brinckerhoff, 2010).

ATTACHMENT 9

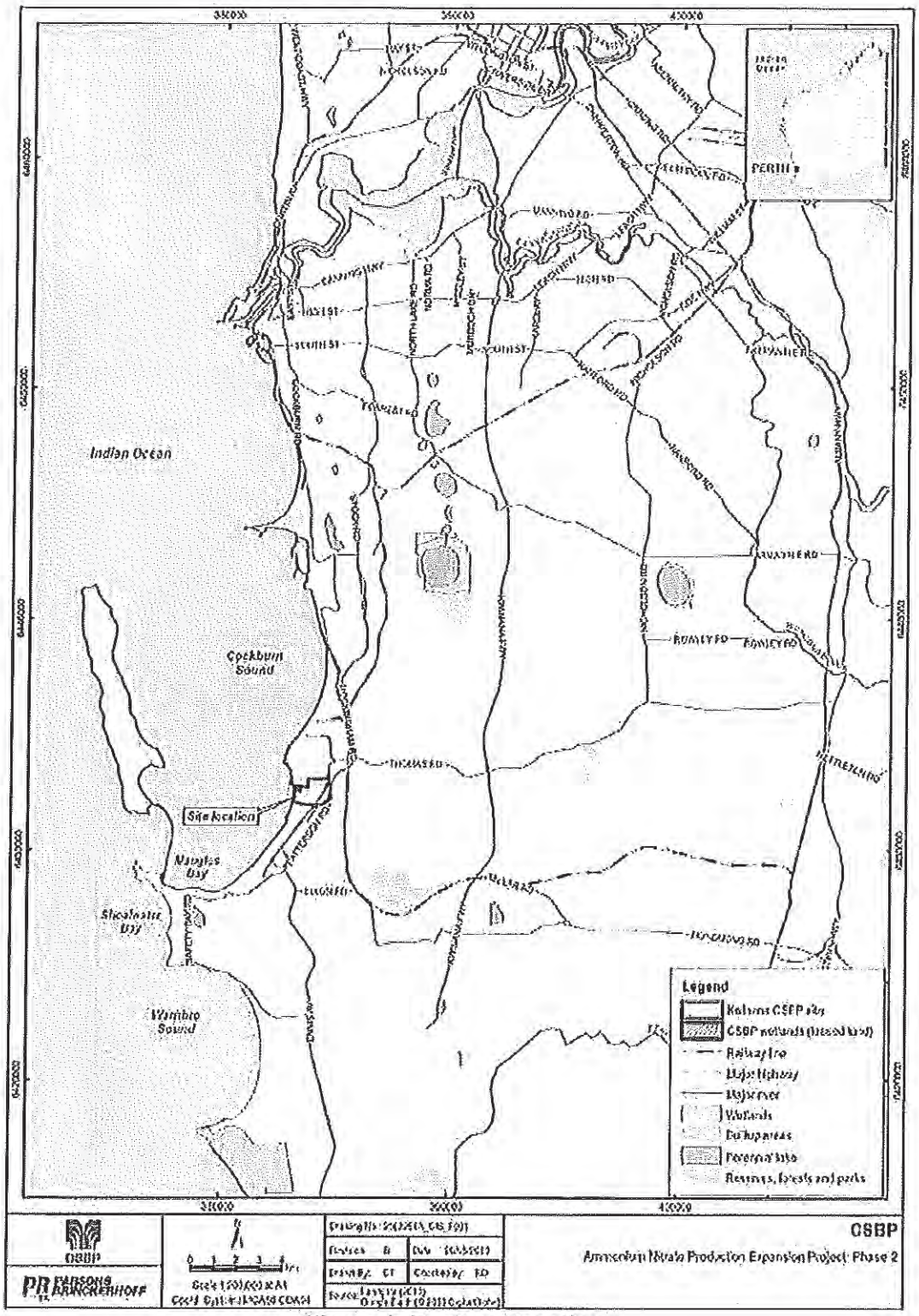


Figure 1: Regional location

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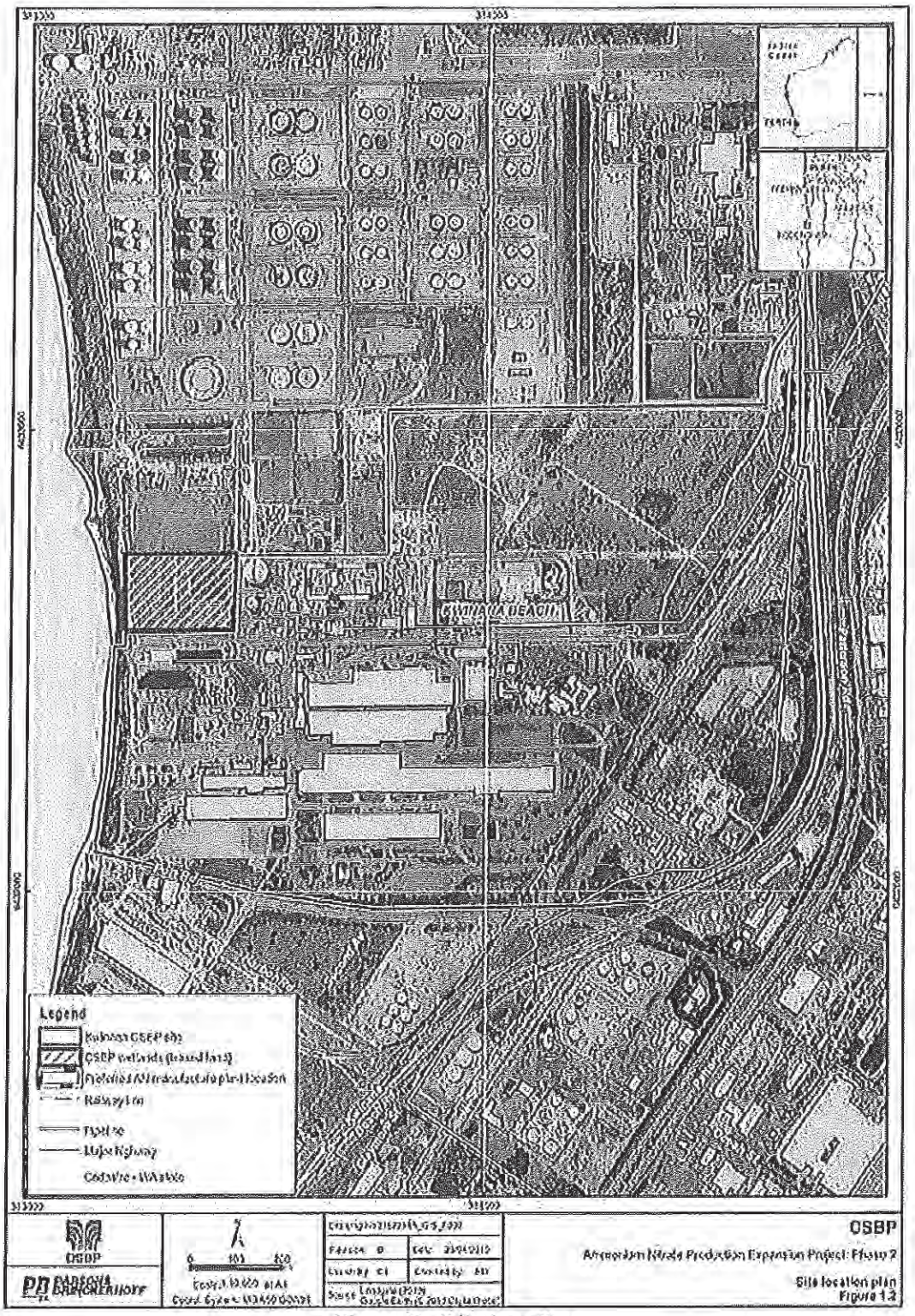

Figure 2: Site location

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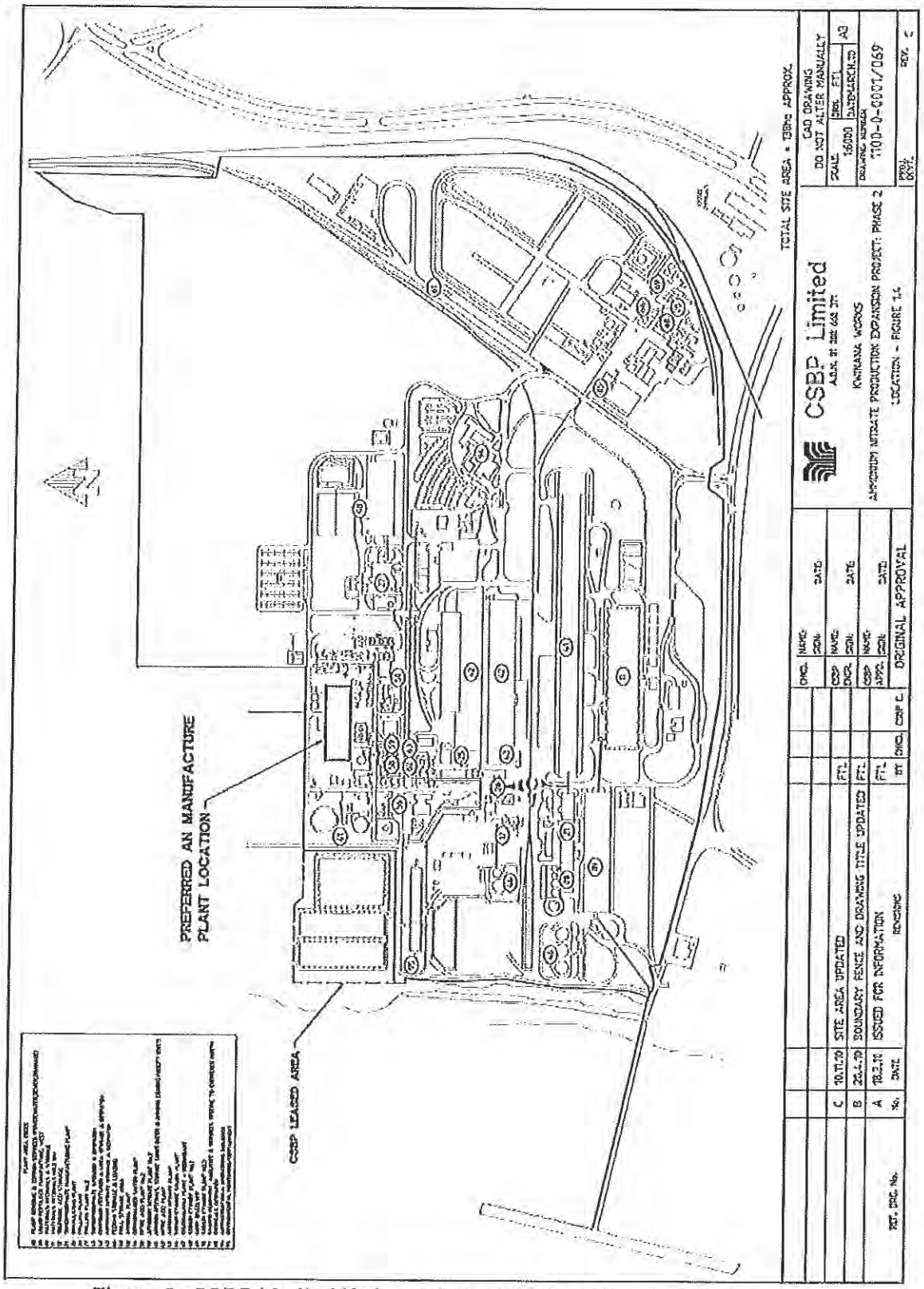

Figure 3: CSBP Limited Kwinana Industrial Complex plant layout

ATTACHMENT 9

MINISTER FOR ENVIRONMENT; WATER

Our Ref: 42-18467

Mr Trevor Naughton
Environment and Laboratory Services Manager
CSBP Limited
Kwinana Beach Road
KWINANA WA 6966

Dear Mr Naughton

AMMONIUM NITRATE PRODUCTION EXPANSION PROJECT (MINISTERIAL STATEMENT 875) – SECTION 45C APPLICATION

Thank you for your letter of 2 November 2012 requesting approval of a change to the above proposal under section 45C of the *Environmental Protection Act 1986*.

Under section 45C of the *Environmental Protection Act 1986* I am able to approve a change or changes to a proposal without a revised proposal being submitted to the Environmental Protection Authority.

I consider that the changes described in Attachment 1 to Ministerial Statement 875 will not result in a significant, detrimental, environmental effect in addition to, or different from, the effect of the original proposal.

Approval of the changes to the proposal is therefore granted under section 45C of the *Environmental Protection Act 1986*. You are reminded that this approval shall be implemented in accordance with the implementation conditions in Ministerial Statement 875, and also that this approval does not replace any responsibilities you may have for seeking approvals from other government agencies to implement the change.

Yours sincerely

Bill Marmion

HON BILL MARMION MLA
MINISTER FOR ENVIRONMENT; WATER

Encl: Attachment 1 to Ministerial Statement 875

ATTACHMENT 9

3 JAN 2013

Level 29, 77 St Georges Terrace, Perth, Western Australia 6000
Telephone: +61 8 9220 5000 Facsimile:+61 8 9220 5001 Email: Minister.Marmion@dpc.wa.gov.au
www.ministers.wa.gov.au/marmion

Attachment 1 to Ministerial Statement 875

Change to proposal under s45C of the *Environmental Protection Act 1986*

Proposal: Ammonium Nitrate Expansion Project: Phase 2

Proponent: CSBP Limited

Change: Removal of "Greenhouse gas emissions".

The Proposal (Assessment No. 1834)

CSBP Limited proposes to expand its Kwinana Ammonium Nitrate Production Facility (ANPF) by incorporating additional components into the existing facility and re-engineering (debottlenecking) some existing components in order to increase ammonium nitrate production capacity from 520,000 tonnes per annum (tpa) to 936,000 tpa.

The ANPF is located within the CSBP Kwinana Industrial Complex (KIC), approximately 40 kilometres (km) south of Perth (Figure 1). The CSBP KIC covers an area of approximately 138 hectares (ha) within the Kwinana Industrial Area (KIA). The proposal encompasses an area of approximately 1 ha within the CSBP KIC (Figure 2). A site plan of the CSBP KIC is shown in Figure 3.

The proposal requires the following changes to be made to the existing ANPF:

1. Debottlenecking of the existing nitric acid ammonium nitrate plants by 20% and construction of an additional nitric acid ammonium nitrate plant, which will then be debottlenecked by 20%, which would result in a total nitric acid production capacity of 720,000 tpa and a total ammonium nitrate solution production capacity of 936,000 tpa.
2. Debottlenecking of the 2008 prilling plant by 100% to double output.
3. Construction of an additional 3,500 tonne 100% nitric acid solution tank (to store 63% nitric acid solution).
4. Construction of an additional 305 cubic metre ammonium nitrate solution tank.
5. Construction of a new auxiliary boiler.
6. Construction of additional solid ammonium nitrate storage facility (within Dangerous Goods Licence approved limit).
7. Upgrade of the existing ammonium nitrate solid and solution despatch facilities.

ATTACHMENT 9

8. Upgrade of existing utilities and supporting infrastructure and construction of new utilities and supporting infrastructure to support the expansion.

The construction of the third nitric acid ammonium nitrate plant is planned to be completed before debottlenecking activities are undertaken on the existing nitric acid ammonium nitrate plants. Debottlenecking of the nitric acid ammonium nitrate plants would be undertaken as required to meet increased demand for product. There would be no increase in ammonia production or storage capacity on site.

The main characteristics of the proposal are summarised in Table 1, below. A detailed description of the proposal is provided in Chapter 1 - Section 5 of the Public Environmental Review document (Strategen & Parsons Brinckerhoff, 2010).

Key Characteristics Table: This table replaces Table 1 in Schedule 1

Element	Description	Description of approved change to proposal
General		
CSBP KIC site area	Approximately 138 ha.	Approximately 138 ha.
Proposal area	Approximately 1 ha within CSBP KIC site boundary.	Approximately 1 ha within CSBP KIC site boundary.
Project life	20 - 30 years.	20 - 30 years.
Plant operating hours	24 hours/day operation, 365 days per year, except for maintenance shutdowns.	24 hours/day operation, 365 days per year, except for maintenance shutdowns.
Plant components		
Nitric acid plants	Increase from two plants to three plants. The new third nitric acid plant will be designed and constructed to incorporate tertiary nitrous oxide (N_2O) abatement technology.	Increase from two plants to three plants. The new third nitric acid plant will be designed and constructed to incorporate tertiary nitrous oxide (N_2O) abatement technology.
Nitric acid storage tanks	Increase in storage capacity from approximately 2,000 tonnes to 5,500 tonnes via construction of an additional 3,500 tonne 100% nitric acid solution tank (to store 63% nitric acid solution).	Increase in storage capacity from approximately 2,000 tonnes to 5,500 tonnes via construction of an additional 3,500 tonne 100% nitric acid solution tank (to store 63% nitric acid solution).
Ammonium nitrate solution plants	Increase from two plants to three plants.	Increase from two plants to three plants.
Ammonium nitrate (90% solution) storage tanks	Increase from approximately 305 m^3 to 610 m^3 total capacity.	Increase from approximately 305 m^3 to 610 m^3 total capacity.
Ammonium nitrate (70 - 90% solution) storage tank	Approximately 730 m^3 capacity (No change).	Approximately 730 m^3 capacity (No change).
2008 prilling plant	Debottlenecked.	Debottlenecked.
Ammonium nitrate bag packaging facility	No change to existing facility.	No change to existing facility.
Ammonium nitrate solids storage facility	Construction of an additional solid ammonium nitrate storage facility (within Dangerous Goods Licence approved limit).	Construction of an additional solid ammonium nitrate storage facility (within Dangerous Goods Licence approved limit).
New auxiliary boiler		
Production		
Total nitric acid production	Increase from approximately 400,000 tpa to 720,000 tpa.	Increase from approximately 400,000 tpa to 720,000 tpa.
Total ammonium nitrate solution production	Increase from approximately 520,000 tpa to 936,000 tpa.	Increase from approximately 520,000 tpa to 936,000 tpa.
Total prilled ammonium nitrate production	Increase from approximately 420,000 tpa to 780,000 tpa.	Increase from approximately 420,000 tpa to 780,000 tpa.
Net power generation	Increase from approximately 4 MW to 6 MW.	Increase from approximately 4 MW to 6 MW.
Inputs		
Water	Additional quantity of approximately 520 ML/yr above current usage of about 3,325 ML/yr consisting of about 400 ML/yr sourced from the Kwinana Water Reclamation Plant (KWRP) and the remainder sourced from the superficial aquifer, the Western Power Corporation (WPC) Industrial Water Source, and scheme water. Additional quantity of approximately 1,500 to 1,900 ML/yr above current usage of about 3,325 ML/yr if sufficient water cannot be obtained from	Additional quantity of approximately 520 ML/yr above current usage of about 3,325 ML/yr consisting of about 400 ML/yr sourced from the Kwinana Water Reclamation Plant (KWRP) and the remainder sourced from the superficial aquifer, the Western Power Corporation (WPC) Industrial Water Source, and scheme water. Additional quantity of approximately 1,500 to 1,900 ML/yr above current usage of about 3,325 ML/yr if sufficient water cannot be obtained from the

	the KWRP and it has to be sourced from the superficial and sub-artesian aquifers, the WPC Industrial Water Source, and scheme water.	KWRP and it has to be sourced from the superficial and sub-artesian aquifers, the WPC Industrial Water Source, and scheme water.
Outputs		
Oxides of nitrogen (NO_X)	Increase from approximately 269 tpa to 569 tpa.	Increase from approximately 269 tpa to 569 tpa.
Ammonium nitrate particulates as $PM_{2.5}$	Increase from approximately 12 tpa to 20 tpa.	Increase from approximately 12 tpa to 20 tpa.
Ammonia (NH_3)	Increase from approximately 12 tpa to 18 tpa.	Increase from approximately 12 tpa to 18 tpa.
Greenhouse gas emissions	Decrease from approximately 925,688 tonnes of CO2-e per year to approximately 264,000 tonnes of CO2-e per year for Scenario 3 in the Public Environmental Review document.	**Removed as inconsistent with the *Clean Energy Act 2011***
Liquid waste	Increase from approximately 2 ML/day to 2.4 ML/day discharged via the Sepia Depression Ocean Outlet Landline (SDOOL).	Increase from approximately 2 ML/day to 2.4 ML/day discharged via the Sepia Depression Ocean Outlet Landline (SDOOL).

Note: Text in bold in the Proposal and Key Characteristics Table, indicates changes to the proposal.

Abbreviations

CO_2-e	carbon dioxide equivalent	MW	megawatts (10^6 watts)
ha	hectares	PER	Public Environmental Review
m^3	cubic metres	$PM_{2.5}$	particulate matter with an aerodynamic diameter of less than 2.5 micrometres
ML/day	megalitres per day		
ML/yr	megalitres per year	tpa	tonnes per annum

References

1. Strategen & Parsons Brinckerhoff. *CSBP Kwinana: Ammonium Nitrate Production Expansion Project: Phase 2 Public Environmental Review.* November 2010.

Bill Marmion

HON BILL MARMION MLA
MINISTER FOR ENVIRONMENT; WATER

Approval date: 3/1/2013

ATTACHMENT 9

16 Reports – Civic Leadership

16.1 Budget Variations

SUMMARY:

To amend the 2016/2017 budget to reflect various adjustments to the General Ledger with nil effect to the overall budget as detailed below. Due to the nature of these variations, they fall outside the annual budget review.

OFFICER RECOMMENDATION:

That the required budget variations to the Adopted Budget for 2016/2017 as outlined in the report be approved.

NOTE: AN ABSOLUTE MAJORITY OF COUNCIL IS REQUIRED

DISCUSSION:

ITEM #	LEDGER ACCOUNT	DESCRIPTION	OPERATING BUDGET	INCREASE/ DECREASE	REVISED BUDGET
1	600007.1561	Capital Expense	(3,294,089)	Nil	(3,294,089)
	300137.1003	Capital Revenue	1,904,487	Nil	1,904,487
	Reason:	**Transport Development - transfer of $70,000 identified savings in Barter Road Reseal due to change of scope of works after further assessment of pavement, to Chisham Avenue pedestrian crossing to allow for safe pedestrian movement, and transfer of $10,000 identified savings in Lipscombe Court road reseal due to contingency not being fully used, to Mangart Road Bertram speed humps. (The original projects were approved Roads to Recovery and the new projects have been approved for Roads to Recovery)**			
2	600007.1563	Capital Expense	(320,000)	(60,000)	(380,000)
	600023.1565	Capital Expense	(315,000)	60,000	(255,000)
	Reason:	**Transport Development - transfer of $60,000 identified savings in Sloans Cottage carpark construction due to change of scope of works after some existing pavement was deemed suitable for reuse, to Walgreen Crescent Drainage to discharge storm water away from the Adventure Park.**			
3	600007.1562	Capital Expense	(125,000)	(25,000)	(150,000)
	400480.1985	Operating Expense	(344,000)	25,000	(319,000)
	Reason:	***Transport Development - transfer of $25,000 identified savings in Leda Boulevard street lighting due to cheaper quote from Western Power and transfer of $25,000 identified savings in Djilba View footpath construction due to reduction in scope of works, to 'Walgreen Crescent to Adventure Park' footpath construction to link Adventure Park carpark to existing footpath.***			

4	600004.1001	Capital Expense	(34,500)	(3,500)	(38,000)
	400275.1144	Operating Expense	(15,000)	3,500	(11,500)
	Reason:	**Recquatic - transfer of identified savings from operating to capital, from expendable equipment to purchase functional training equipment – super bench and lifting platforms.**			

LEGAL/POLICY IMPLICATIONS:

The Local Government Act 1995 Part 6 Division 4 s 6.8 (1) requires the local government not to incur expenditure from its municipal fund for an additional purpose except where the expenditure-

(b) is authorised in advance by resolution*

“additional purpose” means a purpose for which no expenditure estimate is included in the local government’s annual budget.

*requires an absolute majority of Council.

FINANCIAL/BUDGET IMPLICATIONS:

Budget Item Name:	Various items as listed above
Budgeted Amount:	
Expenditure to Date:	
Proposed Cost:	Nil effect
Balance:	

*NOTE: All figures are exclusive of GST

ASSET MANAGEMENT IMPLICATIONS:

The allocation of funds towards the upgrading and renewal of existing City assets in the capital expenditure items is in line with the Asset Management Strategy and will reduce the current asset management gap.

ENVIRONMENTAL IMPLICATIONS:

No environmental implications have been identified as a result of this report or recommendation.

16.1 BUDGET VARIATIONS

STRATEGIC/SOCIAL IMPLICATIONS:

This proposal will support the achievement of the following objectives and strategies detailed in the Strategic Community Plan and/or Corporate Business Plan (D16/3339).

Plan	Objective	Strategy
Corporate Business Plan	6.1 Ensure the financial sustainability of the City of Kwinana into the future.	6.1.2 Implement sound revenue and expenditure policies, seek additional revenue sources and optimise financial management systems.

COMMUNITY ENGAGEMENT:

There are no community engagement implications as a result of this report or recommendation.

RISK IMPLICATIONS:

There are no risk implications that have been identified as a result of the report or recommendation.

COUNCIL DECISION

427

MOVED CR B THOMPSON **SECONDED CR S LEE**

That the required budget variations to the Adopted Budget for 2016/2017 as outlined in the report be approved.

CARRIED BY ABSOLUTE MAJORITY OF COUNCIL
6/0

16.2 Monthly Statement of Financial Activity for the Period Ending 31 December 2016

SUMMARY:

The Monthly Statement of Financial Activity and explanation of material variances for the period ending 31 December 2016 has been prepared for Council acceptance.

OFFICER RECOMMENDATION:

That Council accepts:

1. The Monthly Statements of Financial Activity for the period ending 31 December 2016; and

2. The explanations for material variances for the period ending 31 December 2016.

DISCUSSION:

Variance percentages between budget estimates to the end of December and actual amounts to the end of December have been presented in the attached Statement of Financial Activity.

The material variances that are required to be reported on are:

Description	Actual	Y-T-D Budget		Variance (%)
Directorate City Development Revenue	2,989,900	3,389,137	▼	(11.78%)
Directorate Corporate and Engineering Services Expenditure	(9,736,699)	(14,517,251)	▼	32.93%
Directorate City Living Expenditure	(12,921,498)	(14,842,414)	▼	12.94%
Directorate City Development Expenditure	(1,569,196)	(2,223,044)	▼	29.41%
Depreciation of Assets	2,199,432	5,658,520	▼	(61.13%)
Contributions for the Development of Assets	2,015,349	1,017,642	▲	98.04%
Proceeds from Disposal of Assets	265,144	470,000	▼	(43.59%)
Purchase Computing Equipment	(130,140)	(266,952)	▼	51.25%
Purchase Plant and Machinery	(604,126)	(806,750)	▼	25.12%

16.2 MONTHLY STATEMENT OF FINANCIAL ACTIVITY FOR THE PERIOD ENDING 31 DECEMBER 2016

Description	Actual	Y-T-D Budget		Variance (%)
Purchase Transportation Vehicles	(273,890)	(590,000)	▼	53.58%
Purchase Land and Buildings	(326,578)	(644,053)	▼	49.29%
Purchase Reserve Development	(49,937)	(687,936)	▼	92.74%
Purchase Playground Equipment	(2,127,237)	(3,293,555)	▼	35.41%
Transfers from Reserves	1,739,684	3,937,668	▼	55.82%

Note: A negative (%) variance indicates additional expenditure or reduced revenue than budgeted. A positive % variance indicates additional revenue or reduced expenditure than budgeted.

Directorate City Development Revenue – (11.78%)
This area shows reduced revenue mainly due to the following area:
a. Planning and Building Services *(Statutory Planning/Approvals)* – There is less revenue than budgeted for Development Approval Fees which reflects a general slow down in development activity and less larger projects. Further there have been less prosecutions under Statutory Planning than anticipated resulting in reduced revenue.

Directorate Corporate and Engineering Services Expenditure – 32.93%
This area shows reduced expenditure mainly due to the following areas:
a. Engineering Services *(Infrastructure Maintenance)* – purchase orders have been raised and works scheduled for maintenance and renewal works.
b. Facilities Management *(Reserves and Parks)* – purchase orders have been raised and works scheduled for maintenance and renewal works.

Directorate City Living Expenditure – 12.94%
This area shows reduced expenditure mainly due to the following areas:
a. Environmental Health Services *(Waste Management)* – consultancy costs associated with waste management planning are yet to be realised. In addition, delayed receipt of invoices for waste and resource recycling has resulted in timing variances.
b. Facilities Management *(Building Services)* – purchase orders are in the system and works are underway.

Directorate City Development Expenditure – 29.41%
This area shows reduced expenditure mainly due to the following areas:
a. Planning and Building Services *(Developer Contributions Administration)* – City contributions required under the Wellard Village Agreement are payable upon request for clearance by Developers however no applications had been lodged at reporting date.
b. Planning and Building Services *(Statutory Planning/Approvals)* – recruitment of the vacant Planning Compliance Technical position was deferred due to Officer secondment and a business case is to be prepared.

c. Planning and Building Services *(Strategic Planning)* – recruitment of vacant positions has been deferred pending the submission of a business case. In addition, consultants have been engaged to undertake works on the Urban Amenity Strategy, purchase orders are in the system and invoices are expected.

Depreciation of Assets – (61.13%)
Nil effect on rates as non-cash. Depreciation less than budgeted due to depreciation only being processed to end of August 2016 causing a timing variance.

Contributions for the Development of Assets – 98.04%
The third milestone payment for the Adventure Park was received from the Department of Infrastructure earlier than had been anticipated resulting in a timing variance.

Proceeds from Disposal of Assets – (43.59%)
Processing of asset disposals has only been processed up to the end of August 2016 causing a timing variance.

Purchase Computing Equipment – 51.25%
Purchase of the new Leisure Centre and Facilities Booking Software scheduled for December 2016 and the purchase of various ICT equipment has been placed on hold awaiting the implementation of the ICT Strategic Plan.

Purchase Plant and Machinery – 25.12%
The purchase of the new GPS Tracking systems for trucks has been delayed due to the completion of a HR Policy. It is anticipated purchase will occur in February 2017. In addition the purchase of a Trolley Hoist Large steps for 25m pool has been delayed as an alternative supplier needs to be sourced. It is unknown when purchase is likely to happen at time of reporting.

Purchase Transportation Vehicles – 53.58%
Vehicle purchases anticipated to have occurred during the month were delayed either due to supplier lead time or delay in discussions with relevant officers in relation to the purchase of motor vehicles. Purchase orders are in the system for most vehicles and delivery are expected January/February 2017.

Purchase Land and Buildings – 49.29%
Much of the budgeted expenditure at Callistemon Court and Banksia Park Retirement Village is contingent upon units becoming vacant or when repairs are required. Purchase orders are in the system for painting works; air conditioning projects are being combined for quote whilst other works are scheduled for early 2017 resulting in a timing variance. Pending the feasibility of the administration building, the administration building projects are on hold.

Purchase Reserve Development – 92.74%
Various projects including those relating to the Parks for People Strategy have been delayed due to the completion and opening of the Adventure Playground. Design is now underway with purchase orders raised and construction expected to commence in early 2017. Thomas Oval Netball Court renewal works are conditional upon securing Department of Sport and Recreation funding. This grant has now been confirmed. Following the Councillor workshop regarding beautification works within the Medina Revitalisation area, a purchase order has been raised and works scheduled. In addition, landscape works to the Recquatic Centre entrance and surrounding gardens will now not occur until after the peak summer season thereby minimising disruption within the City Centre.

Purchase Playground Equipment – 35.41%
The purchase of playground equipment and completion of landscaping at the Bright Futures Family Day Care Centre has been delayed. A forum will be conducted with educators in the following weeks and quotes will then need to be sourced. This is unlikely to be completed by the end of 30 June 2017.

Transfers from Reserves – 55.82%
Transfers from Reserves are processed monthly as costs are incurred.

Investment activity December 2016

- *Tier 1* – Investment rates available to the City were not favourable therefore no funds were invested in this tier.
- *Tier 2* – Funds were allocated in accordance with the guidelines of the Investment Policy.
- *Tier 3* – Funds were allocated in accordance with the guidelines of Investment Policy. A non-compliance resulted at month end 31 December 2016 due to a timing variance resulting from funds being withdrawn from the Investment Portfolio for cash flow purposes. This non-compliance will be rectified in January 2017 when maturities occur.
- *Tier 4* – Funds were allocated in accordance with the guidelines of the Investment Policy.

LEGAL/POLICY IMPLICATIONS:

Local Government (Financial Management) Regulations – Clause 34.

FINANCIAL/BUDGET IMPLICATIONS:

As outlined in the ‘Discussion’ and ‘Risk’ sections.

ASSET MANAGEMENT IMPLICATIONS:

No asset management implications have been identified as a result of this report or recommendation.

16.2 MONTHLY STATEMENT OF FINANCIAL ACTIVITY FOR THE PERIOD ENDING 31 DECEMBER 2016

ENVIRONMENTAL IMPLICATIONS:

No environmental implications have been identified as a result of this report or recommendation.

STRATEGIC/SOCIAL IMPLICATIONS:

Plan	Objective	Strategy
Corporate Business Plan	6.1 Ensure the financial sustainability of the City of Kwinana into the future.	6.1.2 Implement sound revenue and expenditure policies, seek additional revenue sources and optimise financial management systems.

COMMUNITY ENGAGEMENT:

There are no community engagement implications as a result of this report.

RISK IMPLICATIONS:

Risk Event	Inadequate management of the City's provisions, revenues and expenditures.
Risk Theme	Failure to fulfil statutory regulations or compliance Providing inaccurate advice/information
Risk Effect/Impact	Financial Reputation Compliance
Risk Assessment Context	Operational
Consequence	Minor
Likelihood	Unlikely
Rating (before treatment)	Low
Risk Treatment in place	Reduce (mitigate the risk)
Response to risk treatment required/in place	Annual adoption of variance tolerances for reporting purposes.
Rating (after treatment)	Low

16.2 MONTHLY STATEMENT OF FINANCIAL ACTIVITY FOR THE PERIOD ENDING 31 DECEMBER 2016

COUNCIL DECISION

428

MOVED CR D WOOD **SECONDED CR S MILLS**

That Council accepts:

1. **The Monthly Statements of Financial Activity for the period ending 31 December 2016; and**

2. **The explanations for material variances for the period ending 31 December 2016.**

CARRIED
6/0

CITY OF KWINANA

MONTHLY STATEMENT OF FINANCIAL ACTIVITY

FOR THE PERIOD 1 JULY 2016 TO 31 DECEMBER 2016

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CITY OF KWINANA
RATE SETTING STATEMENT by DIRECTORATE
FOR THE PERIOD 1 JULY 2016 TO 31 DECEMBER 2016

	NOTE	December 2016 Actual $	December 2016 Y-T-D Budget $	2016/17 Revised Budget $		Variance Budget to Actual YTD $	Y-T-D %
Estimated Surplus/(Deficit) July 1 B/Fwd	7	2,844,089	2,844,089	2,844,089			
Revenues	1						
Directorate City Strategy		344,473	309,043	507,395			
Directorate Corporate & Engineering Services		2,789,990	2,684,661	5,221,483			
Directorate City Living		11,897,338	11,067,368	16,128,520			
Directorate City Development		2,989,900	3,389,137	8,373,574	▼	399,237	11.78%
		18,021,701	17,450,209	30,230,972			
Expenses	1						
Directorate City Strategy		(2,016,233)	(2,171,651)	(4,712,319)			
Directorate Corporate & Engineering Services		(9,736,699)	(14,517,251)	(30,287,435)	▼	(4,780,552)	32.93%
Directorate City Living		(12,921,498)	(14,842,414)	(29,276,117)	▼	(1,920,916)	12.94%
Directorate City Development		(1,569,196)	(2,223,044)	(4,323,214)	▼	(653,848)	29.41%
		(26,243,626)	(33,754,360)	(68,599,085)			
NET OPERATING RESULT EXCLUDING RATES		(8,221,925)	(16,304,151)	(38,368,113)			
Adjustments for Cash Budget Requirements:							
Non-Cash Expenditure and Revenue							
(Profit) on Asset Disposals	4	(39,899)	(173,213)	(214,497)			
Loss on Asset Disposals		28,527	13,994	20,557			
Movement in Deferred Pensioner Rates		30,663	-	-			
Movement in Employee Leave Provision		-	-	-			
Depreciation on Assets		2,199,432	5,658,520	11,316,975	▼	3,459,088	61.13%
		2,218,723	5,499,301	11,123,035			
Capital Revenue							
Grants/Contributions for Development of Assets		2,015,349	1,017,642	3,814,090	▲	(997,707)	(98.04%)
Proceeds from Disposal of Assets	4	265,144	470,000	476,500	▼	204,856	43.59%
		2,280,493	1,487,642	4,290,590			
Capital Expenditure							
Purchase Furniture and Equipment	3	(27,579)	(86,820)	(97,820)			
Purchase Computing Equipment	3	(130,140)	(266,952)	(631,107)	▼	(136,812)	51.25%
Purchase Plant and Machinery	3	(604,126)	(806,750)	(914,750)	▼	(202,624)	25.12%
Purchase Transportation Vehicles	3	(273,890)	(590,000)	(590,000)	▼	(316,110)	53.58%
Purchase Land and Buildings	3	(326,578)	(644,053)	(2,251,620)	▼	(317,475)	49.29%
Purchase Reserve Development	3	(49,937)	(687,936)	(1,416,963)	▼	(637,999)	92.74%
Purchase Playground Equipment	3	(2,127,237)	(3,293,555)	(3,823,555)	▼	(1,166,318)	35.41%
Purchase Infrastructure - Urban Road Grant	3	(375,094)	(391,902)	(1,109,133)			
Purchase Infrastructure - Black Spot Grant	3	(8,711)	(22,000)	(22,000)			
Purchase Infrastructure - Roads to Recovery	3	(66,173)	-	(966,398)			
Purchase Infrastructure - Road Resurfacing	3	(2,170)	-	(202,000)			
Purchase Infrastructure - Street Lights	3	(2,159)	-	(25,000)			
Purchase Infrastructure - Bus Shelters	3	-	-	(50,000)			
Purchase Infrastructure - Footpaths	3	(24,203)	(50,000)	(125,000)			
Purchase Infrastructure - Drainage	3	-	-	(320,000)			
Purchase Infrastructure - Other Structures	3	-	-	-			
Purchase Infrastructure - Municipal Roadworks	3	(70,813)	(70,000)	(994,558)			
Purchase Infrastructure - Car Parks	3	(36,585)	-	(315,000)			
Purchase of Land held for resale	3	-		-			
		(4,125,395)	(6,909,968)	(13,854,904)			
Financing Expenditure & Revenue							
Repayment of Loans Principal	5	(298,392)	(316,067)	(640,453)			
Repayment of Liquidity Advance	5	(2,500,000)	(2,500,000)	(2,500,000)			
Proceeds from New Loan Borrowings	5	2,500,000	2,500,000	2,605,550			
Self-Supporting Loan Principal Revenue	5	18,606	18,792	37,590			
Transfer from Loan Fund for Capital	5	54,935	-	62,705			
Transfers to Reserves (Restricted Assets)	6	(2,812,706)	(2,951,937)	(8,882,279)			
Transfers from Reserves (Restricted Assets)	6	1,739,684	3,937,668	8,610,659	▼	2,197,984	55.82%
		(1,297,873)	688,456	(706,228)			
Estimated Surplus/(Deficit) Year to Date	7	27,947,920	21,891,686	-			
Amount Required to be Raised from Rates	8	(34,249,808)	(34,586,317)	(34,671,531)			

This statement is to be read in conjunction with the accompanying notes.

CITY OF KWINANA
STATEMENT OF COMPREHENSIVE INCOME BY PROGRAM
FOR THE PERIOD 1 JULY 2016 TO 31 DECEMBER 2016

	NOTE	December 2016 Actual $	December 2016 Y-T-D Budget $	2016/17 Revised Budget $
Revenues	1			
General Purpose Funding		36,436,705	36,570,033	38,583,711
Governance		195,295	112,297	113,895
Law, Order, Public Safety		206,188	207,678	407,851
Health		46,008	80,268	384,632
Education and Welfare		3,666,918	3,091,374	6,061,114
Community Amenities		9,160,495	9,290,923	13,996,608
Recreation and Culture		1,547,580	1,450,693	2,989,458
Transport		169,258	181,978	261,984
Economic Services		676,320	781,004	1,564,439
Other Property and Services		126,843	97,065	324,314
		52,231,610	51,863,313	64,688,006
Expenses Excluding Finance Costs	1			
General Purpose Funding		(565,386)	(760,706)	(1,589,197)
Governance		(2,226,316)	(1,951,939)	(5,159,345)
Law, Order, Public Safety		(1,157,837)	(1,479,732)	(2,914,286)
Health		(623,154)	(708,401)	(1,394,160)
Education and Welfare		(4,365,713)	(4,530,799)	(8,749,690)
Community Amenities		(3,623,931)	(5,220,009)	(10,629,660)
Recreation & Culture		(6,875,062)	(9,410,026)	(17,931,035)
Transport		(3,637,074)	(6,045,105)	(12,877,280)
Economic Services		(886,067)	(1,030,460)	(2,100,999)
Other Property and Services		(1,765,601)	(2,023,828)	(4,009,285)
		(25,726,141)	(33,161,005)	(67,354,937)
Finance Costs	1			
General Purpose Funding		-	-	-
Governance		(28,286)	(32,155)	(63,009)
Law, Order, Public Safety		-	-	-
Health		-	-	-
Education and Welfare		(41,583)	(48,569)	(96,765)
Community Amenities		-	-	-
Recreation & Culture		(368,727)	(446,478)	(886,255)
Transport		(50,362)	(52,159)	(177,562)
Economic Services		-	-	-
Other Property and Services		-	-	-
		(488,958)	(579,361)	(1,223,591)
		26,016,511	18,122,947	(3,890,522)
Grants/Contributions for the Development of Assets		2,015,349	1,017,642	3,814,090
Profit on Disposal of Assets	4	39,899	173,213	214,497
(Loss) on Disposal of Assets	4	(28,527)	(13,994)	(20,557)
NET RESULT		28,043,232	19,299,808	117,508
Other Comprehensive Income		-	-	-
TOTAL COMPREHENSIVE INCOME		28,043,232	19,299,808	117,508

This statement is to be read in conjunction with the accompanying notes.

CITY OF KWINANA
STATEMENT OF COMPREHENSIVE INCOME BY NATURE & TYPE
FOR THE PERIOD 1 JULY 2016 TO 31 DECEMBER 2016

	NOTE	December 2016 Actual $	December 2016 Y-T-D Budget $	2016/17 Revised Budget $
Revenues	**1**			
Rates	**8**	34,249,808	34,586,317	34,671,531
Operating Grants, Subsidies & Contributions		6,361,759	5,970,197	13,705,037
Reimbursements and Donations		368,272	350,323	586,782
Fines & Penalties		24,543	86,248	186,000
Fees and Charges		8,981,222	8,920,314	11,781,944
Interest Earnings		1,307,713	1,051,502	1,967,000
Income from Property		925,356	881,310	1,757,512
Other Revenue		12,937	17,102	32,200
		52,231,610	51,863,313	64,688,006
Expenses Excluding Finance Costs	**1**			
Employee Costs		(11,902,738)	(14,003,056)	(27,324,505)
Materials and Contracts		(9,667,802)	(11,317,798)	(24,394,397)
Utilities Charges (gas, electricity, water, etc)		(1,034,209)	(1,223,618)	(2,564,418)
Leases		(142,255)	(160,476)	(320,935)
Depreciation on Non-current Assets		(2,199,432)	(5,658,520)	(11,316,975)
Insurance Expenses		(538,909)	(512,982)	(593,600)
Other Expenditure		(240,796)	(284,555)	(840,107)
		(25,726,141)	(33,161,005)	(67,354,937)
Finance Costs				
Interest Expenses	**5**	(488,958)	(579,361)	(1,223,591)
		26,016,511	18,122,947	(3,890,522)
Grants/Contributions for the Development of Assets				
Non-operating Grants, Subsidies & Contributions		1,988,375	1,017,642	3,802,090
Non-operating Reimbursements & Donations		26,974	-	12,000
		2,015,349	1,017,642	3,814,090
Profit/(Loss) on Disposal of Assets	**4**			
Profit on Asset Disposals		39,899	173,213	214,497
Loss on Asset Disposals		(28,527)	(13,994)	(20,557)
		11,372	159,219	193,940
NET RESULT		28,043,232	19,299,808	117,508
Other Comprehensive Income		-	-	-
TOTAL COMPREHENSIVE INCOME		28,043,232	19,299,808	117,508

This statement is to be read in conjunction with the accompanying notes.

1. SIGNIFICANT ACCOUNTING POLICIES

The significant accounting policies which have been adopted in the preparation of this statement of financial activity are:

(a) Basis of Accounting

The budget has been prepared in accordance with applicable Australian Accounting Standards, other mandatory professional reporting requirements and the Local Government Act 1995 (as amended) and accompanying regulations (as amended).

(b) The Local Government Reporting Entity

All Funds through which the Council controls resources to carry on its functions have been included in this statement.

In the process of reporting on the local government as a single unit, all transactions and balances between those funds (for example, loans and transfers between Funds) have been eliminated.

All monies held in the Trust Fund are excluded from the financial statement, but a separate statement of those monies appears at Note 9 to this budget.

(c) Rounding Off Figures

All figures shown in this statement, other than a rate in the dollar, are rounded to the nearest dollar.

(d) Rates, Grants, Donations and Other Contributions

Rates, grants, donations and other contributions are recognised as revenues when the local government obtains control over the assets comprising the contributions. Control over assets acquired from rates is obtained at the commencement of the rating period or, where earlier, upon receipt of the rates.

(e) Goods and Services Tax

In accordance with recommended practice, revenues, expenses and assets capitalised are stated net of any GST recoverable. Receivables and payables are stated inclusive of applicable GST.

(f) Fixed Assets

Property, plant and equipment and infrastructure assets are brought to account at cost or fair value less, where applicable, any accumulated depreciation or amortisation and any accumulated impairment balances.

1. SIGNIFICANT ACCOUNTING POLICIES (Continued)

(g) Depreciation of Non-Current Assets

All non-current assets having a limited useful life are systematically depreciated over their useful lives in a manner which reflects the consumption of the future economic benefits embodied in those assets.

Depreciation is recognised on a straight-line basis, using rates which are reviewed each reporting period. Major depreciation periods are:

ASSET CLASS	ASSSET DESCRIPTION	Economic Life	Depreciation Rate
Land	Land	Nil	
	Vested Land	Nil	
	Other Vested Land	Nil	
Buildings	Fencing	20 to 50	5% to 2%
	Building Structure	40 to 60	2.5% to 1.67%
	Air conditioning	10 to 30	10% to 3.33%
	Soft Furnishings	10	0.10%
	Fixtures	10	0.10%
	Other	10 to 30	10% to 3.33%
	Alarms	3 to 10	33.33% to 10%
Plant & Equipment	Vehicles	5 to 10	20% to 10%
	Major Plant	5 to 10	20% to 10%
	Minor Plant & Equipment	3 to 10	33.33% to 10%
Furniture & Equipment	Computing Equipment	2 to 7	50% to 14.29%
	Office Furniture	7 to 13	14.29% to 7.69%
	Office Equipment	3 to 10	33.33% to 10%
	Audio Visual Equipment	3 to 10	33.33% to 10%
	Specialised Equipment	7 to 13	14.29% to 7.69%
	White Goods	7 to 13	14.29% to 7.69%
	Art Works	Nil	
Infrastructure - Roads		50	0.02%
Infrastructure - Footpaths		50	0.02%
Infrastructure - Drainage	Drainage	75	0.0133%
	Sewerage	75	0.0133%
Infrastructure - Crossovers		50	0.02%
Infrastructure - Car Parks		20 to 40	5% to 2.5%
Infrastructure - Bus Shelters		20	0.05%
Infrastructure - Street Lights	Street Lights	30	0.0333%
	Other Lights	30	0.0333%
Infrastructure – Parks & Ovals	Playground Equipment	5 to 15	20% to 6.67%
	Bores/Pumps/Irrigation	8 to 20	12.5% to 5%
	BBQ's	10 to 20	10% to 5%
	Streetscapes	20 to 50	5% to 2%
	Landscape Surrounds	10 to 50	10% to 2%
	Sportsgrounds - Reticulated	15 to 25	6.67% to 4%
	Public Open Space Not Reticul	20 to 50	5% to 2%
Infrastructure - Other Structures	Jetties	20 to 40	5% to 2.5%
	Other Structures	20 to 50	5% to 2%
	Tennis Courts	30 to 50	3.33% to 2%

2. STATEMENT OF OBJECTIVE

In order to discharge its responsibilities to the community, the City has developed a set of operational and financial objectives. These objectives have been established both on an overall basis, reflected by the City's Vision, and for each of its broad activities/programs.

CITY'S VISION

"Kwinana 2030: Rich in spirit, alive with opportunities, surrounded by nature - it's all here!"

Council operations as disclosed in this budget encompass the following service orientated activities/programmes:

GENERAL PURPOSE FUNDING

Rates Income and Expenditure, Grants Commission and Pensioner Deferred Rates interest and interest on Investments. Principal and Interest payments on borrowing's.

GOVERNANCE

Members of Council and Governance (includes Audit and other costs associated with reporting to council). Administration, Financial and Computing Services are included.

LAW, ORDER, PUBLIC SAFETY

Supervision of various local laws, fire prevention and animal control.

HEALTH

Prevention and treatment of human illness, including inspection of premises/food control, immunisation and child health services.

EDUCATION AND WELFARE

Provision, management and support of services for families, children and the aged and disabled within the community; including pre-school playgroups, day and after school care, assistance to schools, senior citizens support groups, meals on wheels provision and Aged Persons Units and Resident Funded Units.

COMMUNITY AMENITIES

City planning and development, rubbish collection services, stormwater drainage, the provision of public conveniences, bus shelters, roadside furniture and litter control.

RECREATION AND CULTURE

Provision of facilities and support for organisations concerned with leisure time activities and sport, support for the performing and creative arts and the preservation of the national estate. This includes maintenance of halls, aquatic centre, recreation and community centres, parks, gardens, sports grounds and the operation of Libraries.

TRANSPORT

Construction, maintenance and cleaning of streets, roads, bridges, drainage works, footpaths, parking facilities, traffic signs and the City depot, including plant purchase and maintenance.

ECONOMIC SERVICES

Rural services and pest control and the implementation of building controls.

OTHER PROPERTY & SERVICES

Private works, public works overheads, council plant operations, materials, salaries and wages. With the exception of private works, the above activities listed are mainly summaries of costs that are allocated to all works and services undertaken by the council.

3. ACQUISITION OF ASSETS

The following assets are budgeted to be acquired during the period under review:

By Directorate	December 2016 Actual $	2016/17 Revised Budget $
City Strategy		
Furniture & Equipment	-	-
Transportation Vehicles	(39,178)	(39,000)
Land & Buildings	-	-
	(39,178)	**(39,000)**
Corporate & Engineering Services		
Furniture & Equipment	-	-
Computing Equipment	(130,140)	(631,107)
Plant & Equipment	(594,241)	(852,500)
Transportation Vehicles	(26,332)	(158,000)
Land & Buildings	-	-
Reserve Development	(49,937)	(1,416,963)
Playground Equipment	(2,115,111)	(3,703,555)
Urban Road Grant	(375,094)	(1,109,133)
Black Spot Grant	(8,711)	(22,000)
Roads to Recovery Grant	(66,173)	(966,398)
Road Resurfacing	(2,170)	(202,000)
Street Lighting	(2,159)	(25,000)
Bus Shelter Construction	-	(50,000)
Footpath Construction	(24,203)	(125,000)
Drainage Construction	-	(320,000)
Municipal Roadworks	(70,813)	(994,558)
Carpark Construction	(36,585)	(315,000)
	(3,501,669)	**(10,891,214)**
City Living		
Furniture & Equipment	(27,579)	(97,820)
Plant & Equipment	(9,885)	(62,250)
Transportation Vehicles	(99,063)	(193,000)
Land & Buildings	(326,578)	(2,251,620)
Playground Equipment	(12,126)	(120,000)
	(475,231)	**(2,724,690)**
City Development		
Transportation Vehicles	(109,317)	(200,000)
	(109,317)	**(200,000)**
	(4,125,395)	(13,854,904)

3. ACQUISITION OF ASSETS (Continued)

By Class	December 2016 Actual $	2016/17 Revised Budget $
Furniture and Equipment	(27,579)	(97,820)
Computing Equipment	(130,140)	(631,107)
Plant and Equipment	(604,126)	(914,750)
Transportation Vehicles	(273,890)	(590,000)
Land and Buildings	(326,578)	(2,251,620)
Reserve Development	(49,937)	(1,416,963)
Playground Equipment	(2,127,237)	(3,823,555)
Infrastructure - Urban Road Grant	(375,094)	(1,109,133)
Infrastructure - Black Spot Grant	(8,711)	(22,000)
Infrastructure - Roads to Recovery	(66,173)	(966,398)
Infrastructure - Road Resurfacing	(2,170)	(202,000)
Infrastructure - Street Lights	(2,159)	(25,000)
Infrastructure - Bus Shelters	-	(50,000)
Infrastructure - Footpaths	(24,203)	(125,000)
Infrastructure - Drainage	-	(320,000)
Infrastructure - Municipal Roadworks	(70,813)	(994,558)
Infrastructure - Carpark	(36,585)	(315,000)
	(4,125,395)	(13,854,904)

4. DISPOSALS OF ASSETS

The following assets have been disposed of during the period under review;

By Class	Net Book Value December Actual $	Sale Proceeds December Actual $	Profit(Loss) December Actual $
Furniture and Equipment	(1,292)	-	(1,292)
Plant and Equipment	(102,021)	114,685	12,664
Transportation Vehicles	(150,459)	150,459	-
Buildings	-	-	-
Reserve Development	-	-	-
Land	-	-	-
Other	-	-	-
	(253,772)	265,144	11,372

Summary

	December Actual $
Profit on Asset Disposals	39,899
(Loss) on Asset Disposals	(28,527)
	11,372

5. INFORMATION ON BORROWINGS

(a) Loan Repayments

Particulars	Principal 1-Jul-16	Interest Rate	Maturity Date	New Loans	Principal Repayments		Principal Outstanding		Interest Repayments	
				Dec-16 Actual $	Dec-16 Actual $	2016/17 Budget $	Dec-16 Actual $	2016/17 Budget $	Dec-16 Actual $	2016/17 Budget $
Governance										
Loan 99 - Administration Office Renovations	925,362	6.25%	25-Jun-25	-	39,077	79,376	886,285	845,986	28,285	63,009
Education & Welfare										
Loan 96 - Youth Specific Space	193,278	7.53%	19-Jun-23	-	10,738	21,880	182,540	171,398	6,837	15,486
Loan 100 -Youth Specific Space	1,521,312	4.67%	25-Jun-28	-	-	-	1,521,312	1,521,312	34,746	81,279
Recreation & Culture										
Loan 94 - Wellard Sports Pavilion	289,483	6.38%	04-May-22	-	20,178	41,000	269,305	248,483	6,324	19,836
Loan 95 - Orelia Oval Pavilion	463,867	7.53%	19-Jun-23	-	25,771	52,512	438,096	411,355	16,409	37,166
Loan 97 - Orelia Oval Pavilion Extension	2,047,558	6.25%	25-Jun-25	-	86,467	175,636	1,961,091	1,871,922	62,588	139,419
Loan 102 - Resource & Knowledge Centre	7,421,567	4.54%	28-Jun-29	-	-	-	7,421,567	7,421,567	164,807	386,856
Loan 103 - Kwinana Golf Club	297,904	4.07%	25-Jun-23	-	18,606	37,590	279,298	260,314	5,930	13,815
Loan 104 - Recquatic Upgrade	3,350,000	4.05%	26-Jun-30	-	-	-	3,350,000	3,350,000	66,363	159,318
Loan 105 - Bertram Community Centre	1,296,840	3.25%	27-Mar-30	-	-	-	1,296,840	1,296,840	20,616	50,851
Loan 106 - Calista Destination Park	1,700,000	3.14%	24-Jun-31	-	44,801	90,000	1,655,199	1,700,000	25,691	70,000
New - Darius Wells Building Solar Panels	-			-	-	35,302	-	191,360	-	8,994
Transport										
Loan 98 - Streetscape Beautification	1,249,239	6.25%	25-Jun-25	-	52,754	107,157	1,196,485	1,142,082	38,185	85,062
Loan 101 - City Centre Road Network**	2,500,000	2.18%	27-Sep-16	-	2,500,000	2,500,000	-	-	12,177	-
Loan 101 - City Centre Road Network	-	2.47%	27-Sep-21	2,500,000	-	-	2,500,000	2,500,000	-	92,500
	23,256,410			2,500,000	2,798,392	3,140,453	22,958,018	22,932,619	488,958	1,223,591

Principal Repayments - Debentures	298,392	640,453
Liquidity Advance Repayments	2,500,000	2,500,000
	2,798,392	3,140,453

(*) Self Supporting loan financed by payments from third parties
(**) Short Term Facility Loans
All loan repayments were financed by general purpose revenue.

5. INFORMATION ON BORROWINGS (Continued)

(b) New Debentures

Particulars/Purpose	Amount Borrowed		Institution	Loan Type	Term (Years)	Total Interest & Charges	Interest Rate	Amount Used		Balance Unspent $
	Actual	Budget						Actual	Budget	
Darius Wells Building Solar Panels	-	105,550	WA Treasury	Debenture	10	4,960	4.0% & 0.7%	-	105,550	-
Loan 101 - City Centre Redevelopment	2,500,000	2,500,000	WA Treasury	Debenture	5	101,750	2.47% & 0.7%	2,500,000	2,500,000	-
	2,500,000	2,605,550				106,710		2,500,000	2,605,550	-

The City has a $12,578,433 Short Term Loan Facility with Western Australian Treasury Corporation (WATC) that expires on 30 June 2017

(c) Unspent Debentures

Particulars	Date Borrowed	Balance 1-Jul-16 $	Borrowed During Year $	Expended During Year	Liquidity Repayment $	Balance 31-Dec-16 $
Loan 99 - Administration Office Renovations	25-Jun-10	62,705	-	54,935	-	7,770
		62,705	-	54,935	-	7,770

(d) Self Supporting Loan Repayments

Particulars	Principal 1-Jul-16	New Loans	Principal Repayments		Principal Outstanding		Interest Repayments	
			Dec-16 Actual $	2016/17 Budget $	Dec-16 Actual $	2016/17 Budget $	Dec-16 Actual $	2016/17 Budget $
Recreation & Culture								
Loan 103 - Kwinana Golf Club	297,904	-	18,606	37,590	279,298	260,314	3,405	13,815
	297,904	-	18,606	37,590	279,298	260,314	3,405	13,815

6. RESERVES

Reserve Accounts Transactions

RESERVE FUND DETAILS	Opening Balance 1 July 2016	Transfers			Movements	Closing Balance 31 December 2016
		To Reserve	Interest	From Reserve		
Aged Persons Units Reserve	528,629	-	8,096	(36,299)	-	500,426
Asset Management Reserve	1,212,394	-	16,806	(109,867)	-	1,119,333
Asset Replacement Reserve	531,373	-	6,753	(265,132)	-	272,994
Banksia Park Reserve	72,480	-	1,081	(25,806)	-	47,755
CLAG Reserve	246,658	-	3,803	-	-	250,461
Community Services & Emergency Relief Reserve	25,299	-	390	-	-	25,689
Employee Leave Reserve	4,100,853	-	-	-	-	4,100,853
Family Day Care Reserve	1,423,011	-	21,936	(12,695)	-	1,432,252
Future Community Infrastructure Reserve	2,571,524	-	38,473	(305,257)	-	2,304,740
Golf Course Cottage Reserve	26,469	-	408	-	-	26,877
Infrastructure Reserve	119,703	-	1,845	-	-	121,548
Refuse Reserve	8,385,016	-	129,277	-	-	8,514,293
Restricted Grants & Contributions Reserve	2,303,075	-	-	(754,488)	-	1,548,587
Settlement Agreement Reserve	157,743	-	-	-	-	157,743
Un-Restricted Reserves Sub Total	21,704,227	-	228,868	(1,509,544)	-	20,423,551

RESERVE FUND DETAILS	Opening Balance 1 July 2016	Transfers			Movements	Closing Balance 31 December 2016
		To Reserve	Interest	From Reserve		
DCA 1 - Hard Infrastructure - Bertram	1,483,289	255,259	22,810	-	-	1,761,358
DCA 2 - Hard Infrastructure - Wellard East	1,530,683	297,912	27,187	-	-	1,855,782
DCA 5 - Hard Infrastructure - Wandi	2,846,531	169,019	44,503	-	-	3,060,053
DCA 7 - Hard Infrastructure - Mandogalup (West)	-	8,413	33	-	-	8,446
DCA 8 - Soft Infrastructure - Mandogalup	-	-	-	-	-	-
DCA 9 - Soft Infrastructure - Wandi/Anketell	9,116,394	548,722	142,502	(62,257)	-	9,745,361
DCA 11 - Soft Infrastructure - Wellard East	3,647,606	487,875	59,639	(32,477)	-	4,162,643
DCA 12 - Soft Infrastructure - Wellard West	5,779,219	346,166	90,711	(8,082)	-	6,208,014
DCA 13 - Soft Infrastructure - Bertram	286,381	-	4,384	(8,100)	-	282,665
DCA 14 - Soft Infrastructure - Wellard/Leda	406,289	2,733	6,034	(62,026)	-	353,030
DCA 15 - Soft Infrastructure - Townsite	137,457	67,822	2,114	(57,198)	-	150,195
Developer Contribution Reserves Sub Total	25,233,849	2,183,921	399,917	(230,140)	-	27,587,547
Reserves Total	46,938,076	2,183,921	628,785	(1,739,684)	-	48,011,098

All of the above reserve accounts are to be supported by money held in financial institutions.

6. RESERVES

		December Actual $	2016/17 Budget $
	Cash Backed Reserves		
(a)	**Aged Persons Units Reserve**		
	Opening Balance	528,629	528,629
	Amount Set Aside / Transfer to Reserve	-	279,314
	Interest Applied to Reserve	8,096	9,488
	Amount Used / Transfer from Reserve	(36,299)	(210,315)
		500,426	607,116
(b)	**Asset Management Reserve**		
	Opening Balance	1,212,394	1,212,394
	Amount Set Aside / Transfer to Reserve	-	-
	Interest Applied to Reserve	16,806	24,193
	Amount Used / Transfer from Reserve	(109,867)	(816,174)
		1,119,333	420,413
(c)	**Asset Replacement Reserve**		
	Opening Balance	531,373	531,374
	Amount Set Aside / Transfer to Reserve	-	250,000
	Interest Applied to Reserve	6,753	11,767
	Amount Used / Transfer from Reserve	(265,132)	(559,000)
		272,994	234,141
(d)	**Banksia Park DMF Reserve**		
	Opening Balance	72,480	72,479
	Amount Set Aside / Transfer to Reserve	-	-
	Interest Applied to Reserve	1,081	1,869
	Amount Used / Transfer from Reserve	(25,806)	(85,400)
		47,755	(11,052)
(e)	**CLAG Reserve**		
	Opening Balance	246,658	246,658
	Amount Set Aside / Transfer to Reserve	-	72,306
	Interest Applied to Reserve	3,803	4,593
	Amount Used / Transfer from Reserve	-	(83,120)
		250,461	240,437
(f)	**Community Services & Emergency Relief Reserve**		
	Opening Balance	25,299	25,299
	Amount Set Aside / Transfer to Reserve	-	-
	Interest Applied to Reserve	390	561
	Amount Used / Transfer from Reserve	-	-
		25,689	25,860
(g)	**Employee Leave Reserve**		
	Opening Balance	4,100,853	4,100,853
	Amount Set Aside / Transfer to Reserve	-	-
	Interest Applied to Reserve	-	-
	Amount Used / Transfer from Reserve	-	-
		4,100,853	4,100,853
(h)	**Family Day Care Reserve**		
	Opening Balance	1,423,011	1,423,011
	Amount Set Aside / Transfer to Reserve	-	-
	Interest Applied to Reserve	21,936	28,997
	Amount Used / Transfer from Reserve	(12,695)	(170,570)
		1,432,252	1,281,438
(i)	**Future Community Infrastructure Reserve**		
	Opening Balance	2,571,524	2,571,524
	Amount Set Aside / Transfer to Reserve	-	518,629
	Interest Applied to Reserve	38,473	33,752
	Amount Used / Transfer from Reserve	(305,257)	(1,985,799)
		2,304,740	1,138,106
(j)	**Golf Course Cottage Reserve**		
	Opening Balance	26,469	26,469
	Amount Set Aside / Transfer to Reserve	-	-
	Interest Applied to Reserve	408	577
	Amount Used / Transfer from Reserve	-	-
		26,877	27,046

6. RESERVES

		December Actual $	2016/17 Budget $
	Cash Backed Reserves		
(k)	**Infrastructure Reserve**		
	Opening Balance	119,703	119,703
	Amount Set Aside / Transfer to Reserve	-	-
	Interest Applied to Reserve	1,845	2,586
	Amount Used / Transfer from Reserve	-	-
		121,548	122,289
(l)	**Refuse Reserve**		
	Opening Balance	8,385,016	8,385,016
	Amount Set Aside / Transfer to Reserve	-	-
	Interest Applied to Reserve	129,277	148,242
	Amount Used / Transfer from Reserve	-	(710,119)
		8,514,293	7,823,139
(m)	**Restricted Grants & Contributions Reserve**		
	Opening Balance	2,303,075	2,303,075
	Amount Set Aside / Transfer to Reserve	-	241,890
	Interest Applied to Reserve	-	-
	Amount Used / Transfer from Reserve	(754,488)	(1,999,670)
		1,548,587	545,295
(n)	**Settlement Agreement Reserve**		
	Opening Balance	157,743	157,743
	Amount Set Aside / Transfer to Reserve	-	-
	Interest Applied to Reserve	-	-
	Amount Used / Transfer from Reserve	-	-
		157,743	157,743
	Un-Restricted Reserves Sub Total	20,423,551	16,712,824
	Developer Contributions Reserve - DCA 1 - Hard		
(o)	**Infrastucture Bertram**		
	Opening Balance	1,483,289	1,483,289
	Amount Set Aside / Transfer to Reserve	255,259	-
	Interest Applied to Reserve	22,810	27,970
	Amount Used / Transfer from Reserve	-	(54,000)
	Movement	-	-
		1,761,358	1,457,259
	Developer Contributions Reserve - DCA 2 - Hard		
(p)	**Infrastucture Wellard**		
	Opening Balance	1,530,683	1,530,683
	Amount Set Aside / Transfer to Reserve	297,912	825,740
	Interest Applied to Reserve	27,187	34,269
	Amount Used / Transfer from Reserve	-	-
		1,855,782	2,390,692
	Developer Contributions Reserve - DCA 4 - Hard		
(q)	**Infrastucture Anketell**		
	Opening Balance	-	-
	Amount Set Aside / Transfer to Reserve	-	305,103
	Interest Applied to Reserve	-	-
	Amount Used / Transfer from Reserve	-	-
		-	305,103
	Developer Contributions Reserve - DCA 5 - Hard		
(r)	**Infrastucture Wandi**		
	Opening Balance	2,846,531	2,846,531
	Amount Set Aside / Transfer to Reserve	169,019	-
	Interest Applied to Reserve	44,503	58,736
	Amount Used / Transfer from Reserve	-	-
		3,060,053	2,905,267
	Developer Contributions Reserve - DCA 7 - Hard		
(s)	**Infrastructure Mandogalup (West)**		
	Opening Balance	-	-
	Amount Set Aside / Transfer to Reserve	8,413	-
	Interest Applied to Reserve	33	-
	Amount Used / Transfer from Reserve	-	-
		8,446	-

6. RESERVES

	Cash Backed Reserves	December Actual $	2016/17 Budget $
	Developer Contributions Reserve - DCA 8 -Soft		
(t)	**Infrastucture Mandogalup**		
	Opening Balance	-	-
	Amount Set Aside / Transfer to Reserve	-	475,303
	Interest Applied to Reserve	-	-
	Amount Used / Transfer from Reserve	-	(16,119)
		-	459,184
	Developer Contributions Reserve - DCA 9 -Soft		
(u)	**Infrastucture Wandi/Anketell**		
	Opening Balance	9,116,394	9,116,394
	Amount Set Aside / Transfer to Reserve	548,722	1,733,961
	Interest Applied to Reserve	142,502	192,062
	Amount Used / Transfer from Reserve	(62,257)	(358,151)
		9,745,361	10,684,266
	Developer Contributions Reserve - DCA 10 -Soft		
(v)	**Infrastucture Casuarina/Anketell**		
	Opening Balance	-	-
	Amount Set Aside / Transfer to Reserve	-	362,462
	Interest Applied to Reserve	-	-
	Amount Used / Transfer from Reserve	-	(24,502)
		-	337,960
	Developer Contributions Reserve - DCA 11 -Soft		
	Infrastucture Wellard East		
(w)	Opening Balance	3,647,606	3,647,605
	Amount Set Aside / Transfer to Reserve	487,875	1,382,313
	Interest Applied to Reserve	59,639	80,796
	Amount Used / Transfer from Reserve	(32,477)	(83,009)
		4,162,643	5,027,705
	Developer Contributions Reserve - DCA 12 -Soft		
	Infrastucture Wellard West		
(x)	Opening Balance	5,779,219	5,779,218
	Amount Set Aside / Transfer to Reserve	346,166	842,081
	Interest Applied to Reserve	90,711	122,810
	Amount Used / Transfer from Reserve	(8,082)	(307,302)
	Movement	-	-
		6,208,014	6,436,807
	Developer Contributions Reserve - DCA 13 -Soft		
(y)	**Infrastucture Bertram**		
	Opening Balance	286,381	286,381
	Amount Set Aside / Transfer to Reserve	-	281,178
	Interest Applied to Reserve	4,384	6,580
	Amount Used / Transfer from Reserve	(8,100)	(96,569)
		282,665	477,570
	Developer Contributions Reserve - DCA 14 -Soft		
(z)	**Infrastucture Wellard/Leda**		
	Opening Balance	406,289	406,290
	Amount Set Aside / Transfer to Reserve	2,733	191,283
	Interest Applied to Reserve	6,034	7,270
	Amount Used / Transfer from Reserve	(62,026)	(226,471)
		353,030	378,372
	Developer Contributions Reserve - DCA 15 -Soft		
(aa)	**Infrastucture Townsite**		
	Opening Balance	137,457	137,458
	Amount Set Aside / Transfer to Reserve	67,822	320,716
	Interest Applied to Reserve	2,114	2,882
	Amount Used / Transfer from Reserve	(57,198)	(279,074)
		150,195	181,982
	Developer Contributions Reserves Sub Total	24,527,494	27,831,797
	Total Cash Backed Reserves	48,011,098	47,754,991

All of the above reserve accounts are to be supported by money held in financial institutions.

6. RESERVES

In accordance with council resolutions in relation to each reserve account, the purpose for which the reserves are set aside are as follows:

Aged Persons Units Reserve
This Reserve has been established to provide funds for the capital acquisition and maintenance of the Aged Persons Units, Callistemon Court

Arts Centre Reserve
This Reserve was established to cover any increases in the cost of operations and maintenance for the Kwinana Arts Centre

Asset Management Reserve
This Reserve is utilised to provide funds for renewal projects for the City's building and infrastructure assets.

Asset Replacement Reserve
This Reserve is utilised to replace existing fleet, plant and other City assets

Banksia Park Reserve
This Reserve has been established to provide funds for the capital acquisition and maintenance of the Banksia Park Retirement Village

CLAG Reserve
This Reserve has been established to provide funds for the prevention and education of Mosquito management.

Community Services & Emergency Relief Reserve
This Reserve is established to provide funding to alleviate the effect of any disaster within the City of Kwinana boundaries and to provide funds to develop

Employee Leave Reserve
This Reserve is established for the purpose of ensuring that adequate funds are available to finance employee leave entitlements

Family Day Care Reserve
This Reserve provides for the capital acquisitions and maintenance of this facility

Future Community Infrastructure Reserve
This Reserve is established to accumulate the City's contributions for the capital funding of future community infrastructure in accordance with Town Planning Scheme #2

Golf Course Cottage Reserve
This Reserve was established to provide funds for the maintenance of this building

Infrastructure Reserve
This Reserve was established to be used to provide funds to create new City assets or for the major upgrade of City assets to increase the service level provided by the asset

Refuse Reserve
This Reserve was established to provide funds for the costs and subsidy of Waste Management in the City

Restricted Grants & Contributions Reserve
The Reserve is utilised to restrict funds required to complete projects from prior financial years

Settlement Agreement Reserve
This Reserve was established to provide funds to account for future negotiated settlement agreement payments.

DCA 1 - Hard Infrastructure - Bertram
This Reserve is established to restrict funds received from Developers for contributions towards future infrastructure costs and administrative costs for DCA 1 - Hard Infrastructure Bertram

DCA 2 - Hard Infrastructure - Wellard
This Reserve is established to restrict funds received from Developers for contributions towards future infrastructure costs and administrative costs for DCA 2 - Hard Infrastructure Wellard

DCA 5 - Hard Infrastructure - Wandi
This Reserve is established to restrict funds received from Developers for contributions towards future infrastructure costs and administrative costs for DCA 5 - Hard Infrastructure Wandi

DCA 8 - Soft Infrastructure - Mandogalup
This Reserve is established to restrict funds received from Developers for contributions towards future infrastructure costs and administrative costs for DCA 8 - Soft Infrastructure Mandogalup

DCA 9 - Soft Infrastructure - Wandi/Anketell
This Reserve is established to restrict funds received from Developers for contributions towards future infrastructure costs and administrative costs for DCA 9 - Soft Infrastructure Wandi/Anketell

6. RESERVES

DCA 10 - Soft Infrastructure - Casuarina/Anketell
This Reserve is established to restrict funds received from Developers for contributions towards future infrastructure costs and administrative costs for DCA 10 - Soft Infrastructure Casuarina/Anketell

DCA 11 - Soft Infrastructure - Wellard East
This Reserve is established to restrict funds received from Developers for contributions towards future infrastructure costs and administrative costs for DCA 11 - Soft Infrastructure Wellard East

DCA 12 - Soft Infrastructure - Wellard West
This Reserve is established to restrict funds received from Developers for contributions towards future infrastructure costs and administrative costs for DCA 12 - Soft Infrastructure Wellard West

DCA 13 - Soft Infrastructure - Bertram
This Reserve is established to restrict funds received from Developers for contributions towards future infrastructure costs and administrative costs for DCA 13 - Soft Infrastructure Bertram

DCA 14 - Soft Infrastructure - Wellard/Leda
This Reserve is established to restrict funds received from Developers for contributions towards future infrastructure costs and administrative costs for DCA 14 - Soft Infrastructure Wellard/Leda

DCA 15 - Soft Infrastructure - Townsite
This Reserve is established to restrict funds received from Developers for contributions towards future infrastructure costs and administrative costs for DCA 15 - Soft Infrastructure Townsite

7. NET CURRENT ASSETS

Composition of Estimated Net Current Asset Position

CURRENT ASSETS	**December 2016 Actual $**	**Brought Forward 1-Jul $**
Cash - Unrestricted	18,973,461	8,356,933
Cash - Restricted (Reserves)	48,011,098	46,938,076
Cash - Restricted (Unspent Loan Funds)	7,770	62,705
Rates - Current	10,876,526	1,590,578
Sundry Debtors	1,159,740	1,139,001
GST Receivable	175,516	554,076
Accrued Receivables	-	410,710
Inventories	53,547	26,163
	79,257,658	59,078,242
LESS: CURRENT LIABILITIES		
Sundry Creditors	(241,441)	(4,674,862)
Bonds and Deposit Creditors	(3,049,429)	(3,408,346)
Accrued payables - Current	-	(1,150,164)
Current Borrowings	(3,105,457)	(3,105,457)
Provisions - Current	(4,545,806)	(4,545,806)
	(10,942,133)	(16,884,635)
Net Current Asset Position (Prior to Adjustment)	68,315,525	42,193,607
Less:		
Cash Restricted - (Unspent Loan Funds)	(7,770)	(62,705)
Cash Restricted - (Reserves)	(48,011,098)	(46,938,076)
	(48,018,868)	(47,000,781)
Add Back:		
Cash Backed Leave Reserve - Current	4,545,806	4,545,806
Current Loan Liability	3,105,457	3,105,457
	7,651,263	7,651,263
	$ 27,947,920	$ 2,844,089

8. RATING INFORMATION

RATE TYPE Differential General Rate	Rate in $	Number of Properties	Rateable Value $	2016/17 Actual Rate Revenue $	2016/17 Actual Interim Rates $	2016/17 Back Rates $	2016/17 Total Revenue $	2016/17 Total Budget $
Gross Rental Value (GRV)								
Improved Residential	0.07303	10,615	184,561,500	13,478,527	810,971	-	14,289,498	13,899,543
Vacant Residential	0.17974	555	8,674,147	1,559,091	(286,605)	-	1,272,486	1,559,091
Improved Special Rural	0.06385	716	16,868,756	1,077,070	152,848	-	1,229,918	1,077,070
Light Industrial and Commercial	0.09082	146	22,148,306	2,011,509	33,240	-	2,044,749	2,011,509
General Industry and Service Commercial	0.07961	318	33,469,413	2,664,500	28,886		2,693,386	2,664,500
Large Scale General Industry and Service Commercial	0.08260	48	52,329,591	4,322,424	(247,800)		4,074,624	4,322,424
Improved Value (UV)								
General Industrial	0.02639	3	121,200,000	3,198,468	-	-	3,198,468	3,198,468
Rural	0.00464	187	184,212,000	854,744	(360,284)		494,460	854,744
Mining	0.00793	13	27,291,000	216,418	13,486	-	229,904	216,418
Urban/Urban Deferred	0.00612	65	171,510,000	1,049,641	(145,449)	-	904,192	1,049,641
		12,666	822,264,713	30,432,392	(707)	-	30,431,685	30,853,408

.. RATING INFORMATION (Continued)

Minimum Payments	Minimum $	Number of Properties	Rateable Value $	2016/17 Actual Rate Revenue $	2016/17 Actual Interim Rates $	2016/17 Back Rates $	2016/17 Total Revenue $	2016/17 Total Budget $
Gross Rental Value (GRV)								
Improved Residential	943	2,679	31,546,688	2,526,297	-	-	2,526,297	2,526,297
Vacant Residential	943	1,220	5,290,264	1,150,460	-	-	1,150,460	1,150,460
Improved Special Rural	943	5	68,260	4,715			4,715	4,715
Light Industrial and Commercial	1226	18	168,008	22,068	-	-	22,068	22,068
General Industry and Service Commercial	1226	37	299,688	45,362	-	-	45,362	45,362
Large Scale General Industry and Service Commercial	1226	0	-	-			-	-
Improved Value (UV)								
General Industrial	1226	0	-	-	-		-	-
Rural	943	11	1,453,000	10,373			10,373	10,373
Mining	1226	1	15,000	1,226	-		1,226	1,226
Urban/Urban Deferred	1226	47	7,786,600	57,622	-	-	57,622	57,622
Sub-Totals		4,018	46,627,508	3,818,123	-	-	3,818,123	3,818,123
							34,249,808	34,671,531
Specified Area Rates							-	-
Totals		16,684	868,892,221	34,250,515	(707)	-	34,249,808	34,671,531

The City of Kwinana raises rates on all land within it's boundaries, except exempt land, using a combination of dual rating and differential rating. Generally land within the urban area is rated at Gross Rental Value (GRV) and land within the rural area being rated with Unimproved Valuations (UV). Certain Town Planning zonings have attracted different rates so as to achieve greater equity within the urban and rural sectors.

The general rates detailed above for the 2016/17 financial year have been determined by Council on the basis of raising the revenue required to meet the deficiency between the total estimated expenditure proposed in the budget and the estimated revenue to be received from all sources other than rates and also bearing considering the extent of any increase in rating over the level adopted in the previous year.

The minimum rates have been determined by Council on the basis that all ratepayers must make a reasonable contribution to the cost of the Local Government services/facilities.

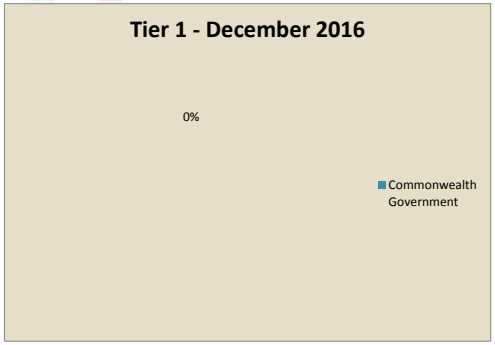
9. TRUST FUNDS

Funds held at balance date over which the Municipality has no control and which are not included in this financial statements are as follows:

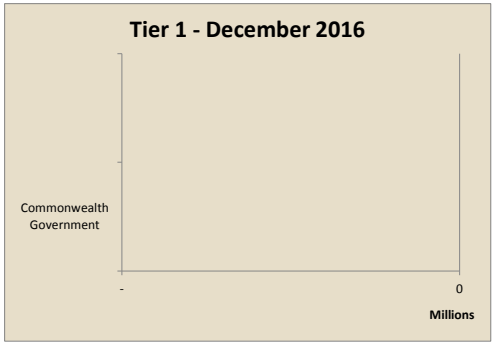
	Balance 1-Jul-16 $	Amounts Received $	Amounts Paid $	Balance 2016/17 $
Contiguous Local Authorities Group CLAG	-	200	-	200
	-	200	-	200

City of Kwinana
Statement of Investments
For the Period Ending 31 December 2016

		Rating	Compliance Indicators
Tier 1 - AAA rated authorised institutions			
Direct Investment Maximum 100%			
Per Institution Maximum Limit 45% of Total Portfolio			
1	Commonwealth Government	AAA	-
2			
			-



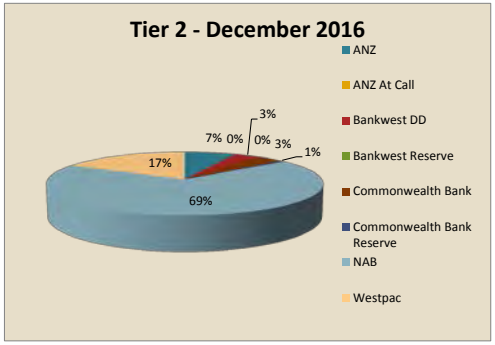
Indicates the distribution of funds across Tier 1 by percentage

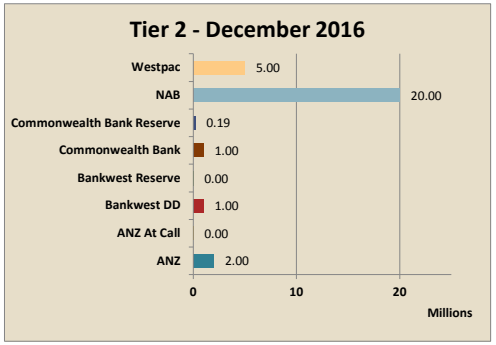


Indicates the distribution of funds across Tier 1 by dollar value

Comment: Tier 1 rates available to the City were not favourable and therefore no funds were invested in this tier.

Tier 2 - AA rated issuers that are incorporated in Australia				
Direct Investment Maximum 100%				
Per Institution Maximum Limit 35% of Total Portfolio				
1	ANZ	AA-	2,000,000.00	
2	ANZ At Call	AA-	1,083.24	
3	Bankwest DD	AA-	1,000,000.00	
4	Bankwest Reserve	AA-	15.16	
5	Commonwealth Bank	AA-	1,000,000.00	
6	Commonwealth Bank Reserve	AA-	190,398.38	
7	NAB	AA-	20,000,000.00	
8	Westpac	AA-	5,000,000.00	
			29,191,496.78	



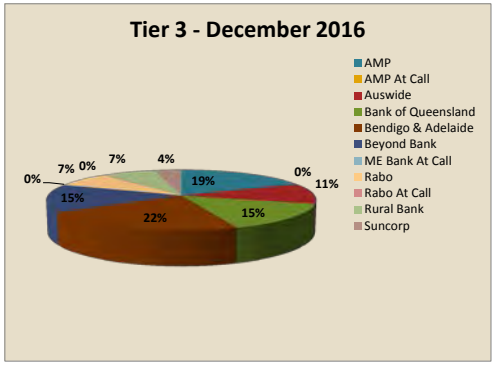


Comment: Funds were allocated in accordance with the guidelines of Investment Policy.

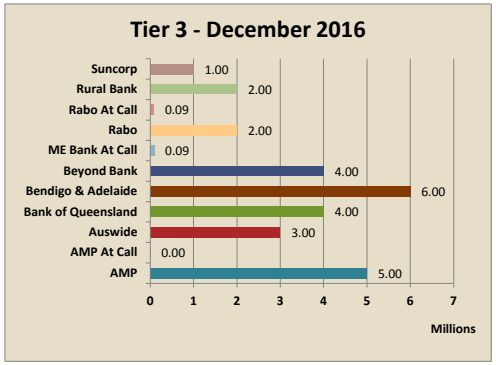
City of Kwinana
Statement of Investments
For the Period Ending 31 December 2016

Tier 3 - other investment grade authorised institutions
Direct Investment Maximum 40%
Per Institution Maximum Limit 20% of Total Portfolio

1	AMP	A+	5,000,000.00
2	AMP At Call	A+	195.34
3	Auswide	BBB	3,000,000.00
4	Bank of Queensland	A-	4,000,000.00
5	Bendigo & Adelaide	A-	6,000,000.00
6	Beyond Bank	BBB	4,000,000.00
7	ME Bank At Call	BBB	91,071.02
8	Rabo	AA-	2,000,000.00
9	Rabo At Call	AA-	85,489.28
10	Rural Bank	A-	2,000,000.00
11	Suncorp	A+	1,000,000.00
			27,176,755.64



Indicates the distribution of funds across Tier 3 by percentage



Indicates the distribution of funds across Tier 3 by dollar value

Comment: Funds were allocated in accordance with the guidelines of Investment Policy. A non-compliance resulted at month end 31 December 2016 due to a timing variance resulting from funds being withdrawn from the Investment Portfolio for cash flow purposes. This non-compliance will be rectified in January 2017 when maturities occur.

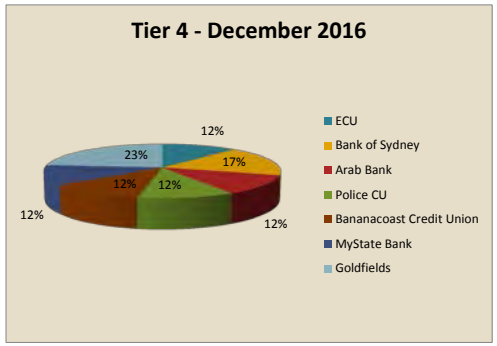
Tier 4 - other compliant authorised institutions
Direct Investment Maximum 30%
Per Institution Maximum Limit 5% of Total Portfolio

Term Deposits

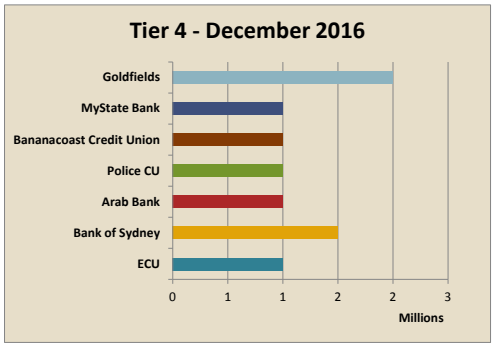
1	ECU	UR	1,000,000.00
2	Bank of Sydney	UR	1,500,000.00
3	Arab Bank	BB+	1,000,000.00
4	Police CU	UR	1,000,000.00
5	Bananacoast Credit Union	UR	1,000,000.00
6	MyState Bank	UR	1,000,000.00
7	Goldfields	UR	2,000,000.00

CDOs -

MA S6-7 (Parkes IA'AAA')	NR	
MA S6-7 (Parkes IIA'AAA')	NR	
		8,500,000.00
		$ 64,868,252.42



Indicates the distribution of funds across Tier 4 by percentage



Indicates the distribution of funds across Tier 4 by dollar value

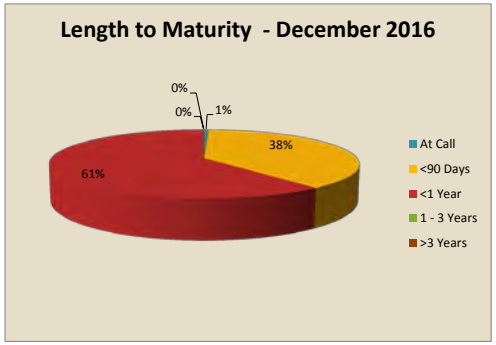
Comment: Funds were allocated in accordance with the guidelines of Investment Policy.

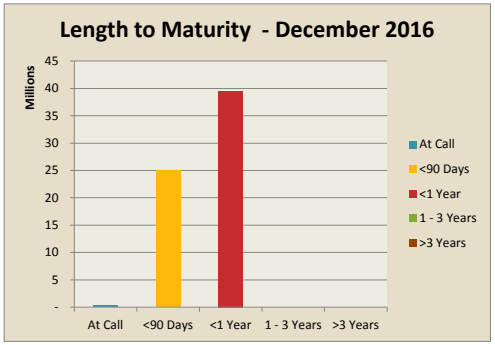
Legend

FRNs	Floating Rate Notes
CDOs	Collateralised Debt Obligations

City of Kwinana
Statement of Investments
For the Period Ending 31 December 2016

At Call	368,252.42
<90 Days	25,000,000.00
<1 Year	39,500,000.00
1 - 3 Years	-
>3 Years	-
	$ 64,868,252.42





Portfolio Term to Maturity Limits

	At Call	<90 Days	<1 Year	1-3 Years	>3 Years
At Call investment	$ 368,252.42				
	0.57%				
Compliance Indicator	☐				
Funds invested for 90 days or less		$ 25,000,000.00			
100% (with 10% minimum) of Total Portfolio		38.54%			
Compliance Indicator		☐			
Funds invested for between 90 days and up to 1 year			$ 39,500,000.00		
100% (with 40% minimum) of Total Portfolio			60.89%		
Compliance Indicator			☐		
Funds invested for between 1 and 3 years				$ -	
60% (Bonds Only) of Total Portfolio				0.00%	
Compliance Indicator				☐	
Funds invested for greater than 3 years					$ -
0% of Total Portfolio					0.00%
Compliance Indicator					☐

Comment: Portfolio compliant with the Policy

City of Kwinana
Statement of Investments
For the Period Ending 31 December 2016

Portfolio Credit Framework

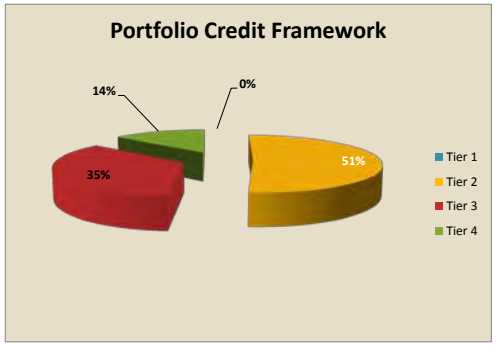
Direct Investment Maximum 100%
Per Institution Maximum Limit 45% of Total Portfolio

Direct Investment Maximum 100%
Per Institution Maximum Limit 35% of Total Portfolio

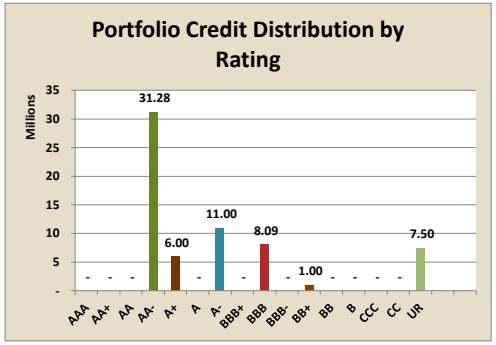
Direct Investment Maximum 40%
Per Institution Maximum Limit 20% of Total Portfolio

Direct Investment Maximum 30%
Per Institution Maximum Limit 5% of Total Portfolio

Tier 1	Tier 2	Tier 3	Tier 4
0.00%	45.00%	41.90%	13.10%

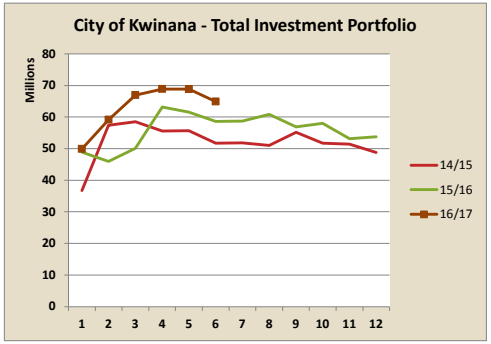


Indicates the distribution of funds across the 4 Tiers

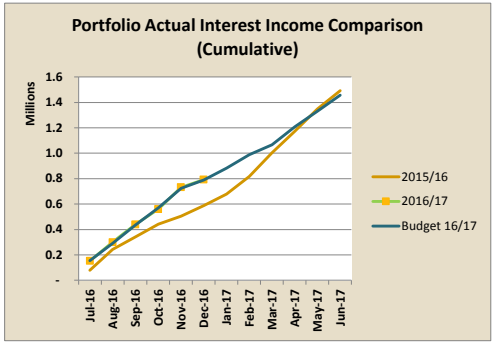


Indicates the distribution of funds by credit rating

Comment: Portfolio is non-compliant against policy guidelines at month end. Funds have been allocated in accordance with the Investment Policy however it is difficult to predict when funds will be required for Accounts Payable purposes. This non-compliance will be rectified in January when maturities occur and funds are withdrawn.



Indicates the total amount invested at the report date compared to prior years



Indicates the amount of interest earnt on investments for the period to report date

16.3 Development Assessment Panel Nominations

SUMMARY:

On 1 July 2011 the State Government introduced fifteen Development Assessment Panels (DAPs). Each DAP consists of five panel members, three being specialist members and two local government members. Local members are members of a local government council who are nominated by that local government to sit on a DAP. Local representation is considered a vital component of the DAP.

The purpose of this report is to nominate two City of Kwinana Elected Member representatives as local members and two Elected Member representatives as alternate local members (in the case where any DAP member cannot attend a meeting due to illness or absence or other cause, an alternate member may attend the meeting in his or her place).

OFFICER RECOMMENDATION:

That Council:

1. Nominate Councillor _____ and Councillor _____ as the City of Kwinana's local member representatives and Councillor _____ and Councillor_____ as the City's alternate local member representatives to the Development Assessment Panel.

2. Advise the Minister for Planning of the nominated local member representatives and alternate local member representatives for consideration to appointment on the relevant Development Assessment Panel.

DISCUSSION:

A Development Assessment Panel (DAP) is an independent decision-making body comprised of technical experts and elected local government representatives. These panels determine development applications made under local and region planning schemes, in the place of the original decision maker. DAPs are mandatory in Western Australia, and a DAP has been created for each local government that has a local planning scheme. The Minister for Planning has established a DAP under section 171C of the Planning and Development Act 2005 for each local government area, by the publication of an order in the Government Gazette.

Two different types of DAPs were established by the Minister:

1. **Local development assessment panels (LDAPs)**
   LDAPs were established to service a single local government, where it is deemed to be a high growth local government with enough development to support its own DAPs.

2. **Joint development assessment panels (JDAPs)**
   JDAPs were established to service two or more local governments where those local governments are not considered to have enough development to support their own DAP.

16.3 DEVELOPMENT ASSESSMENT PLANEL NOMINATIONS

Most DAPs in Western Australia are JDAPs. There are five metropolitan JDAPs and nine regional JDAPs. There is one LDAP, which deals with applications within the City of Perth.

This report seeks Council's support to nominate two local government representative members for the DAP, together with two alternate local government representative members.

The City will provide the Minister with the names of the nominated panel members, and the Minister will consider and appoint the local government representatives. The names of the members appointed to each DAP will be published on the DAP website maintained by the Department of Planning.

The period of appointment for all DAP members will be two years. After the two year term has come to an end, the Minister will ask the City to provide nominations for its two local government members (and two alternate members). The same individuals can be re-nominated by the City however the regulations require the nomination process to occur every two years.

Where any DAP member cannot attend a meeting due to illness, absence or other cause, an alternate member may attend the meeting in his or her place. Alternate members are nominated and appointed in the same way as permanent DAP members.

All DAP members will be required to attend a mandatory training workshop before they can sit on a DAP for the first time. The training will address the planning and development assessment framework in Western Australia, planning law (including what is an appropriate planning consideration), operation and conduct of DAPs, and the DAP Code of Conduct and expected behaviour of DAP members. The Department of Planning will deliver this training to all new DAP members following their appointment to a DAP.

The regulations require DAP members (and alternate members when sitting in place of a DAP member) to comply with the DAP Code of Conduct. If a DAP member fails to comply with the code of conduct, the Minister may remove them from office for committing misconduct.

In addition, the Minister must remove a member if they cease to hold a position or qualification which made them eligible to sit as a DAP member (i.e. where a local government member is not re-elected as a local government councillor).

Local government elections may result in a change to local DAP membership if current Councillors who are DAP members, are not re-elected. In this instance, the alternate local DAP members will take the place of the former DAP members. If both local and alternate local members are not re-elected, the local government will need to re-nominate Councillors and request the Minister consider nominated Councillors for appointment.

Correspondence from the Department of Planning in relation to these nominations advised the following:

When selecting nominees, the Council should consider that local government elections may result in a change to DAP membership if current councillors, who are DAP members, are not re-elected. If members are not re-elected the local government will need to re-nominate for the Minister's consideration.

The full letter is detailed in Attachment A.

16.3 DEVELOPMENT ASSESSMENT PLANEL NOMINATIONS

In considering the decision on who to appoint, Council should also take note of the Premier's Circular regarding State Government Boards and Committees, as detailed in Attachment B. The Circular states "As a general guide, an individual should not sit on more than two (2) State Government Boards and Committees".

If nominations are not provided to the Department of Planning by 28 February 2017, regulation 26 of the Planning and Development (Development Assessment Panels) Regulations 2011 enables the Minister to include on the City's register a person who is an eligible voter of the government district and who has relevant knowledge or experience that will enable that person to represent the interest of the local community of the City of Kwinana.

A copy of the Development Assessment Panel Code of Conduct 2011 is provided in Attachment C for perusal.

LEGAL/POLICY IMPLICATIONS:

Relevant legislation and polices:

Development Assessment Panel Code of Conduct 2011
Planning and Development Act 2005
Planning and Development Regulations 2009
Planning and Development (Development Assessment Panels) Regulations 2011

FINANCIAL/BUDGET IMPLICATIONS:

No financial or budgetary implications have been identified as a result of this report or recommendation.

ASSET MANAGEMENT IMPLICATIONS:

No asset management implications have been identified as a result of this report or recommendation.

ENVIRONMENTAL IMPLICATIONS:

No environmental implications have been identified as a result of this report or recommendation.

16.3 DEVELOPMENT ASSESSMENT PLANEL NOMINATIONS

STRATEGIC/SOCIAL IMPLICATIONS:

Development Assessment Panels (DAPs) are intended to enhance planning expertise in decision making by improving the balance between technical advice and local knowledge.

This proposal will support the achievement of the following objectives and strategies detailed in the Strategic Community Plan and/or Corporate Business Plan (D16/3339).

Plan	Objective	Strategy
Strategic Community Plan	Objective 2.6: Provide a best practice development approval system that attracts and retains business investment in the area	2.6.1 Pursue an approval system that is integrated across the City of Kwinana to ensure planning, building and environmental health applications are processed in a timely manner to reduce costs to the applicant and provide them with certainty of outcome.

COMMUNITY ENGAGEMENT:

1. Community Engagement has taken place in the following forms: N/A

2. The following community engagement is proposed to take place: N/A

There are no community engagement implications as a result of this report'.

16.3 DEVELOPMENT ASSESSMENT PLANEL NOMINATIONS

RISK IMPLICATIONS:

Should the local government fail to nominate representatives, the Minister has the power to appoint alternative community representatives to ensure local representation is always present on a panel. Community representatives are not necessarily elected members of the local government and therefore the City's best interests may not be taken into account as a result.

The risk implications in relation to this proposal are as follows:

Risk Event	**Council fails to nominate elected members to DAP by the required date of 28 February 2017.**
Risk Theme	• Errors omissions delays • Failure to fulfil statutory regulations. • Providing inaccurate advice and information.
Risk Effect/Impact	Environment Compliance Property
Risk Assessment Context	Strategic
Consequence	Major
Likelihood	Almost certain
Rating (before treatment)	Extreme
Risk Treatment in place	Avoid - remove cause of risk
Response to risk treatment required/in place	Council to ensure elected members are appointed as per requirements.
Rating (after treatment)	Low

COUNCIL DECISION

429

MOVED CR W COOPER **SECONDED CR D WOOD**

That Council:

1. **Nominate Councillor S Mills and Councillor D Wood as the City of Kwinana's local member representatives and Councillor B Thompson and Councillor R Alexander as the City's alternate local member representatives to the Development Assessment Panel.**

2. **Advise the Minister for Planning of the nominated local member representatives and alternate local member representatives for consideration to appointment on the relevant Development Assessment Panel.**

CARRIED
6/0

Government of **Western Australia**
Development Assessment Panels

Our Ref: DP/12/00609
Enquiries: DAP Secretariat
Telephone: 6551 9919

Ms Joanne Abbiss
Chief Executive Officer
City of Kwinana
PO Box 21
KWINANA WA 6966

Dear Ms Abbiss,

DEVELOPMENT ASSESSMENT PANELS – LOCAL GOVERNMENT NOMINATIONS

As you would be aware, Development Assessment Panels (DAP) member appointments expire on 26 April 2017.

Members whose term has expired will be eligible for re-consideration at this time. Under regulation 26 of the *Planning and Development (Development Assessment Panels) Regulations 2011* (DAP Regulations), your local council is requested to nominate four elected members of the Council, comprising two local members and two alternate local members to sit on your respective DAP as required. The local government nominations process require online submissions at the following - https://consultation.planning.wa.gov.au/office-of-the-director-general/fec6cd28
Nominations are required to be received by 28 February 2017.

Following receipt of all local government nominations, the Minister for Planning will consider and appoint nominees for up to a three-year term, expiring on 26 April 2020. All appointed local members will be placed on the local government member register and advised of DAP training dates and times. It is a mandatory requirement, pursuant to the DAP regulations, that all DAP members attend training before they can sit on a DAP and determine applications. Local government members who have previously undertaken training are not required to attend further training, but are encouraged to attend refresher training.

When selecting nominees, the Council should consider that local government elections may result in a change to DAP membership if current councillors, who are DAP members, are not re-elected. If members are not re-elected, the local government will need to re-nominate for the Minister's consideration. DAP members are entitled to be paid for their attendance at DAP meetings and training, unless they fall within a class of persons excluded from payment. Further details can be found in the *Premier's circular – State Government Boards and Committees Circular (2010/02)*.

If you have any queries regarding this request for nominations, please contact the DAPs secretariat on (08) 6551 9919 or email daps@planning.wa.gov.au. Further information is available online at https://www.planning.wa.gov.au/Development-Assessment-Panels.asp.

Yours sincerely

Gail McGowan
Director General

4 January 2017

Premier's Circular

Number:	2010/02
Issue Date:	26/07/2010
Review Date:	21/05/2017

TITLE

STATE GOVERNMENT BOARDS AND COMMITTEES

BACKGROUND

This Circular defines what constitutes a Government Board or Committee, and also provides clarity on remuneration for people who sit on these Boards and Committees. A register of State Government Boards and Committees can be found at http://www.dpc.wa.gov.au. This register provides transparency in relation to State Government Boards and Committees and also provides an effective tool for monitoring Boards and Committees. This is consistent with the Government's objectives of promoting efficiency within the public sector and making Government more responsive to the needs of Western Australians.

POLICY

This policy applies to all State Government Boards and Committees.

Ministers and agencies are encouraged to utilise interdepartmental working groups, drawing upon external advice and engaging in other forms of consultation that do not involve the establishment of a State Government Board or Committee and the payment of fees.

The Government has endorsed the recommendations of the Public Sector Commission's (PSC) 2012 "Report on Government Boards and Committees".

A State Government Board or Committee is a body:

(i) established for the purpose or function of having a major impact on government policy; or
(ii) which has a cross-over of Ministerial responsibilities; or
(iii) where members are paid a fee (other than reimbursements for travel expenses).

This includes sub-committees that fall within that definition.

All establishments, abolitions (including those due to expire), changes in name, appointments, and reappointments to State Government Boards and Committees are matters for Cabinet consideration.

The authority to pay fees to State Government Board and Committee members derives from statutory provision or endorsement by Cabinet where applicable. The rate of any fee is to be recommended by the Public Sector Commissioner unless provided by statute.

A member of a State Government Board or Committee is not eligible for fees (other than reimbursements for travel expenses) if they are:

(i) on the public payroll, including all current full time State, Commonwealth and Local Government employees; Members of Parliament; current and retired judicial officers; and current non-academic employees of public academic institutions; or
(ii) a former Member of Parliament and less than 12 months has passed since sitting in Parliament.

Part time public servants; elected Local Government councillors and university academics are eligible for fees when sitting on State Government Boards and Committees.

A university academic is defined as someone who is engaged primarily for the purpose of providing educational services and not administrative or other services.

Part time public servants are eligible for remuneration for membership on Government Boards and Committees if:

(i) it is clearly demonstrated to the satisfaction of the relevant Minister that the part time public servant's Board or Committee work will happen in their own time; and
(ii) potential conflicts of interest will be appropriately managed.

Section 102 of the *Public Sector Management Act 1994* which requires employees to obtain the prior permission of their employing authority to engage in activities unconnected with their functions also applies.

As a general guide, an individual should not sit on more than two (2) State Government Boards and Committees.

The Department of the Premier and Cabinet (DPC) provides advice on the application of this circular, including the eligibility of members to receive remuneration, supports appointment processes and maintains a database of State Government Boards and Committees, from which a Register is accessible at http://www.dpc.wa.gov.au.

The Public Sector Commission (PSC) provides recommendations on remuneration levels for eligible members of Government Boards and Committees.

Members of the public interested in serving on a State Government Board or Committee are able to register their interest on the Government of Western Australia Jobs website (http://jobs.wa.gov.au). To express an interest, members of the public should select the Interested Persons Register tab on the website home page and follow the directions to complete an online nomination form and upload a current curriculum vitae.

Guidelines for the reimbursement of travel expenses are contained in the *Public Sector Commissioner's Circular 2009–20: Reimbursement of Travel Expenses for Members of Government Boards and Committees.* Principles for good governance of Boards and Committees and the Conduct Guide for Boards and Committees are published on PSC's website (http://www.publicsector.wa.gov.au).

Remuneration of Board members should be reported in an agency's Annual Report and consistent with the guidelines issued annually for the preparation of such reports.

Colin Barnett MLA
PREMIER

For enquiries contact:	Richard May 6552 5235 (for policy and database advice) Department of the Premier and Cabinet Andrew Dores 6552 8633 (for remuneration matters) Public Sector Commission
Other relevant Circulars:	Public Sector Commissioner's Circulars 2009-20

ATTACHMENT C

Government of **Western Australia**
Department of **Planning**

Development Assessment Panel Code of Conduct 2011

Under the

Planning and Development (Development Assessment Panels) Regulations 2011

March 2011

Published by the Department of Planning
Albert Facey House, 469 Wellington Street. Perth WA 6000

Published March 2011

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TTY: 08 9264 7535
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Introductory statement

This Code of Conduct sets out principles to guide the behaviour of members of Development Assessment Panels (DAPs) established under Part 11A of the *Planning and Development Act 2005* (the Act).

DAP members are required, under regulation 45 (2) of the *Planning and Development (Development Assessment Panels) Regulations 2011* (the Regulations), to comply with this Code.

Other legal requirements applying to DAP members are contained in the Act and Regulations.

Where requirements of the Act or Regulations are relevant to matters dealt with in this Code of Conduct, the relevant provisions are referred to in the text of the Code for information purposes. However, the references in this Code, act or regulation are not intended to be a comprehensive statement of all legal obligations applying to DAP members.

It remains the responsibility of each DAP member to be aware of the legal obligations that apply to them in the performance of their functions under the Act.

Table of contents

I, Eric Lumsden PSM, Director General of the Department of Planning, make this Code of Conduct under regulation 45 (1) of the *Planning and Development (Development Assessment Panels) Regulations 2011.*

Eric Lumsden PSM

23 / 3 / 2011

Part 1 Preliminary

1.1 Citation

This Code of Conduct may be cited as the *Development Assessment Panel Code of Conduct 2011*.

1.2 Purpose

This Code of Conduct establishes a set of principles to guide the behaviour of members of DAPs.

1.3 Application of Code

1.3.1 This Code of Conduct applies to a person performing functions as a DAP member.

1.3.2 DAP members are required to comply with this Code of Conduct in the performance of their functions, under regulation 45 (2) of the DAP regulations.

1.4 Definitions

1.4.1 In this Code, unless otherwise defined, words and phrases have the same meanings as they have in the Act, the DAP regulations and the DAP Standing Orders.

1.4.2 In particular:

DAP means a development assessment panel established under Part 11A of the *Planning and Development Act 2005*.

DAP member means a specialist member, a local government member, or a deputy member, of a DAP.

DAP regulations means the *Planning and Development (Development Assessment Panels) Regulations 2011*.

DAP Standing Orders means the *Development Assessment Panel Standing Orders 2011*.

DAP secretariat means the departmental officer or officers made available to provide services to a DAP or DAPs under regulation 49 of the DAP regulations.

Department means the Department of Planning.

Director General means the Director General of the Department.

Presiding member means the DAP member presiding at a meeting of a DAP under regulation 27 of the DAP regulations.

Relevant DAP, in relation to a DAP member, means the DAP of which the member is a member.

the Act refers to the *Planning and Development Act 2005*.

Part 2 Personal behaviour and communication

Division 1 - personal behaviour

2.1 DAP member behaviour

2.1.1 Each DAP member, when carrying out the member's functions as a DAP member, must:

a. act with reasonable care and diligence

b. act honestly, ethically and responsibly

c. be open and accountable to the public

d. consider issues consistently, comprehensively, promptly and fairly

e. base decisions on relevant and factually correct information

f. treat others with respect and fairness

g. uphold the highest standards of behaviour

h. treat others with professionalism, courtesy and respect

i. not seek to improperly influence other DAP members; and

j act in accordance with the law and the provisions of this code of conduct.

Note: *Section 266 (2) of the Act requires a DAP member, at all times, to act honestly in the performance of a function under the Act. There is a $5,000 penalty for non-compliance with section 266.*

2.1.2 A local government member of a DAP is not bound by any previous decision or resolution of the local government in relation to the subject-matter of a DAP application. In such a situation, the member is not prevented from voting for a decision that is the same as the local government's. However, the member must exercise independent judgment, and consider the application on its planning merits, in deciding how to vote.

2.1.3 A DAP member must not make improper use of the member's position:

a. to gain, directly or indirectly, an advantage for the member or for any other person; or

b. to cause detriment to the DAP or to any other person.

Note: *Section 266 (6) of the Act provides that a DAP member is not to make improper use of information acquired by virtue of the performance of a function under the Act to gain an advantage or to cause a detriment. There is a $5,000 penalty for non-compliance with section 266.*

2.1.4 A DAP member must not make any statement that is critical, or that could be understood as being critical, of the Minister, the Director General of the Department, a local government, a local government or departmental employee, a DAP or another DAP member.

2.1.5 A DAP member must use any departmental resources provided for use in the performance of the member's duties under the Act effectively and economically.

2.1.6 A DAP member must not use any departmental resources provided for use in the performance of the member's duties under the Act for private purposes, unless such use is authorised in writing by the Director General of the Department.

Division 2 - communication

2.2 Definitions

In this division, **an applicant**, in relation to a development application, includes the person making the application and a representative or associate of that person.

2.3 Communication with local government and departmental staff

2.3.1 A DAP member, other than a local government member performing functions as a member of the local government, is not to have any involvement with a development application that is before the relevant DAP or which the member is aware may come before that DAP in future during the assessment of the application by the local government or the department.

2.3.2 A DAP member must not, in relation to a development application that is before the relevant DAP or which the member is aware may come before that DAP in future, attempt to direct the action or influence the conduct of a person who is a local government or departmental employee, in the person's capacity as employee.

2.3.3 A DAP member who is a ratepayer or an elector in a local government district in relation to which the relevant DAP is constituted:

a. must not request preferential treatment by the local government due to his or her membership of the DAP; and

b. must avoid making any statement, doing or omitting any act that could suggest to a member of the public that such preferential treatment has been received.

2.4 Communication in relation to applications

2.4.1 A DAP member is not to approach an applicant in relation to any application that is before the relevant DAP, or which the member is aware may come before that DAP in future, otherwise than in accordance with the provisions of the DAP Standing Orders.

2.4.2 A DAP member must not make a representation to any person that the member commits, or purports to commit, his or her vote on an application that is before the relevant DAP or which the member is aware may come before that DAP in future.

2.4.3 If a DAP member is approached with a request to commit his or her vote on an application the member must inform the presiding member of the DAP of the details of the approach.

2.4.4 A DAP member is not to accept an invitation from an applicant to attend any meeting in relation to an application that is before the relevant DAP or which the member is aware may come before that DAP in future.

2.4.5 A DAP member must not participate in:

a. a discussion with an applicant, formally or informally, in person or otherwise

b. a site visit, private meeting, briefing, discussion or similar event with any other DAP member

In respect to a development application that is before the relevant DAP or which the member is aware may come before that DAP in future, unless the discussion, visit, meeting or similar event has been consented to by the presiding member of the relevant DAP and arranged by the DAP secretariat.

2.4.6 In the case of DAP members participating in a site visit, private meeting, briefing, discussion or similar event:

a. no DAP member may express a view that may suggest pre-judgement of the relevant development application; and

b. the members must ensure that a written record of the event is prepared and submitted to the DAP secretariat for discussion at the next DAP meeting during which the relevant application is discussed.

2.4.7 If a DAP member participates in a site visit, private meeting, briefing, discussion or similar event and later becomes aware that a DAP application has been made that relates to the meeting, briefing, discussion or event, the member is to ensure that a written record of the event is prepared and submitted to the DAP secretariat for discussion at the DAP meeting during which the relevant application is discussed.

2.4.8 Nothing in this Code of Conduct prevents DAP members from communicating with local government or departmental staff members in accordance with Part 3 of the DAP Standing Orders prior to a DAP meeting, or during the discussion of any matter during a DAP meeting.

2.4.9 Nothing in this clause prevents a local government member from performing functions as a member of a local government.

2.5 Communication with the general public

2.5.1 Only the presiding member of a DAP may publicly comment on the operations or determinations of the DAP.

Note: *This is a requirement under regulation 48 of the DAP regulations.*

2.5.2 If a member of the public attempts to initiate discussion on the operations or determinations of a DAP with a DAP member, the DAP member is not to make any comment.

Part 3 Conflicts of interest and disclosure procedures

3.1 Definitions

In this section:

3.1.1 **close associate** of a DAP member means a person who:

a. operates a business in partnership with the member, employs the member or is a beneficiary under a trust, or an object of a discretionary trust, of which the member is a trustee

b. is a body corporate

c. is a director, secretary or executive officer where the member holds shares with a total value exceeding $10,000 or one per-cent of the total value of the issued share capacity of the body corporate, whichever is the lesser

d. is the spouse, de facto partner or child of the member and is living with the member; or

e. has a relationship of a kind specified in any of paragraphs a to d in relation to the member's spouse or de-facto partner if the spouse or de-facto partner is living with the member

3.1.2 **Conflict of interest**, in relation to a DAP member, means a direct or indirect pecuniary interest of the member, or of a close associate of the member, in connection with a development application that is before the relevant DAP or which the member is aware may come before that DAP in future.

3.1.3 **Direct pecuniary interest** means a person's interest in a development application where it is reasonable to expect that the application, if dealt with by a DAP, will result in a financial gain, loss, benefit or detriment for the person.

3.1.4 **Impartiality interest** means an interest that could, or could reasonably be perceived to, adversely affect the impartiality of a member with such an interest and includes an interest arising from kinship, friendship, partnership, or membership of an association, that is connected to a development application that is before the relevant DAP or which the member is aware may come before that DAP in future.

3.1.5 **Indirect pecuniary interest** means a person's interest in a development application where a financial relationship exists between that person, or a close associate of the person, and the applicant.

3.1.6 **Proximity interest**, in relation to a DAP member, means an interest of the member, or of a close associate of the member, in a development application if the application concerns land:

a. adjoining the person's land; or

b. directly across a thoroughfare from the person's land .

3.2 Members to identify conflicts and interests

3.2.1 A DAP member must identify any:

a. conflict of interest; or

b. impartiality interest

that the member has, or may reasonably be perceived to have, in relation to any development application that is before the relevant DAP or which the member is aware may come before that DAP in future.

3.2.2 A DAP member must identify any proximity interest that the member has in relation to any development application that is before the relevant DAP or which the member is aware may come before that DAP in future.

3.3 Disclosure of conflicts of interest

3.3.1 A DAP member who identifies an actual or potential conflict of interest, or an impartiality interest, in accordance with item 3.2.1 before the application giving rise to the conflict is considered at a meeting of the relevant DAP is to disclose the matter to the DAP secretariat according to the procedure set out in the DAP Standing Orders.

3.3.2 A DAP member who identifies an actual or potential conflict of interest in accordance with item 3.2.1 during a DAP meeting at which the application giving rise to the conflict is being considered:

a. is to disclose the interest to the other members as soon as possible after the relevant facts have come to the member's knowledge; and

b. following the disclosure, is not to be present during any consideration or discussion of the relevant matter or to vote on the matter.

Note 1: *This is a requirement under section 266 (3) of the Act. There is a $5,000 penalty for non-compliance with section 266.*

Note 2: *Part 6 of the DAP Standing Orders sets out specific procedures for the disclosure of interests during DAP meetings.*

3.3.3 A DAP member who identifies an impartiality interest in accordance with item 3.2.1 during a DAP meeting at which the application giving rise to the conflict is being considered is to disclose the existence, and nature, of the interest to the other members as soon as possible after the relevant facts have come to the member's knowledge.

3.3.4 A DAP member who discloses an impartiality interest in relation to a DAP application is entitled to continue to perform the member's functions in relation to that application unless the interest is sufficient to give rise to a reasonable perception that the member's decision may not be made impartially. Part 6 of the DAP Standing Orders deals with the circumstances in which an impartiality interest may be decided to be sufficient to disqualify the member from performing functions in relation to an application.

3.3.5 A DAP member who identifies a proximity conflict in accordance with item 3.2.2:

a. before the application giving rise to the conflict is considered at a meeting of the relevant DAPs to disclose the matter to the DAP secretariat to be dealt with according to the procedure set out in item 6.2 of the DAP Standing Orders; or

b. during a meeting at which the application giving rise to the conflict is being considered is to disclose the matter according to the procedure set out in item 6.3 of the DAP Standing Orders.

3.4 Disclosure of communication

If a DAP member has engaged in verbal communication with a person, or the representative of a person, who has a direct or indirect pecuniary interest in a development application that is to come before a meeting of the relevant DAP, the member, as soon as possible after the relevant facts have come to the member's knowledge is to make a record of the communication and disclose it to the DAP secretariat in accordance with the procedure set out in item 3.9 of the DAP Standing Orders.

Part 4 Gifts

4.1 General principles relating to gifts

4.1.1 A DAP member is not to seek any gift for themselves or any other person in connection with the exercise of the member's functions under Part 11A of the Act.

4.1.2 A DAP member is not to accept any gift from a person in connection with the exercise of the member's functions under Part 11A of the Act, otherwise than in the circumstances set out in regulation 46 of the DAP regulations.

4.2 Notifiable gifts and prohibited gifts

4.2.1 As provided in regulation 46 (1) of the DAP regulations:

a. a notifiable gift is:

(i) a gift worth between $50 and $300

(ii) a gift that is one, two or more gifts given to a DAP member by the same person within a period of six months that are, in total, worth between $50 and $300

Gifts given to a DAP member by the same person within a period of six months that are, in total, worth between $50 and $300; and

b. a prohibited gift is:

(i) a gift worth $300 or more

(ii) a gift that is one, two, or more gifts given to a DAP member by the same person within a period of six months that are, in total, worth $300 or more.

4.2.2 As provided in regulation 46 (2) of the DAP regulations, a DAP member must not accept a prohibited gift from a person who is undertaking, seeking to undertake, or likely to undertake development that will require the determination of a development assessment.

4.2.3 As provided in regulation 46 (3) of the DAP regulations, a DAP member who accepts a notifiable gift from a person who is undertaking, seeking to undertake, or likely to undertake development that will require the determination of a development assessment, is required to notify the Director General of the acceptance of the gift. Notification is to accord with regulation 46 (4) of the DAP regulations

4.2.4 As provided in regulation 46 (5) of the DAP regulations, the Director General is to maintain a register of notified gifts.

Note: *Regulation 46 of the DAP regulations imposes requirements, as summarised above, in respect to notifiable and prohibited gifts. These requirements are based on the provisions regarding gifts that local government councillors are subject to under the Local Government Act 1995 and associated regulations.*

Part 5 Dealing with misconduct and breaches of this Code

5.1 Suspected breaches of the Code

DAP members are to report any suspected breaches of the Code in accordance with the complaint-handling procedures set out in the DAP Member Procedures Manual.

5.2 Application of Corruption and Crime Commission Act 2003

5.2.1 The Corruption and Crime Commission (CCC) has statutory powers to investigate and deal with allegations of misconduct by public officers.

5.2.2 Section 4 of the CCC Act defines "misconduct" to include a range of conduct by a public officer that is corrupt or dishonest or involves the misuse of the officer's position.

5.2.3 DAP members are public officers within the meaning of the *Corruption and Crime Commission Act 2003* (CCC Act).

5.2.4 Accordingly, DAP members may be subject to the scrutiny of the CCC in relation to the exercise of their functions under the Act.

5.3 Consequences of misconduct or contravention of Code

5.3.1 Section 266 of the Act imposes penalties for DAP members in relation to:

a. failure to act honestly in the performance of a function under the Act (s 266 (2));

b. unlawful disclosure of information acquired in connection with the carrying out of functions under the Act (s 266 (5));

c. making improper use of information to gain an advantage or to cause a detriment.

5.3.2 Under regulation 32 (1) of the DAP regulations, a DAP member's office automatically becomes vacant on the following grounds (among others):

a. conviction for an offence punishable by imprisonment for at least 12 months;

b. conviction for an offence against section 266 of the Act.

5.3.3 The Minister may, under regulation 32 (2) of the DAP regulations, remove a DAP member from office on the following grounds (among others):

a. neglect of duty;

b. misconduct or incompetence.

16.4 Local Commercial and Activity Centre Improvement Grant Funding

SUMMARY:

The City of Kwinana recognises that Commercial and Activity Centres play a vital role in both the local economy and residents' quality of life. In order to ensure that this crucial sector continues to provide essential services to the community, City Officers have developed a grant program, which will complement the City's Local Commercial and Activity Centres Strategy. The grant funds will be allocated on a competitive basis via a grant application process.

A Policy has been developed that contains the details of the grant funding program and is at Attachment A which is recommended for Council endorsement.

OFFICER RECOMMENDATION:

That Council:

1. Adopt the new Local Commercial and Activity Centre Improvement Grant Funding Policy, included in Attachment A;

2. Nominate Cr _____ and Cr _____ to sit with the Director of City Strategy and the Manager of City Enterprise as the Local Commercial and Activity Centre Improvement Grant Funding Panel;

3. Authorise the Local Commercial and Activity Centre Improvement Grant Funding Panel to make decisions regarding the disbursement of funds in accordance with the Local Commercial and Activity Centre Improvement Grant Funding Policy;

4. Approve the Transfer $30,000 in funding from Economic Development Consultancy to the Economic Development Contribution account.

NOTE: AN ABSOLUTE MAJORITY OF COUNCIL IS REQUIRED

DISCUSSION:

The City of Kwinana's Strategic Community Plan and Corporate Business Plan identify the need to develop a diverse and thriving economy which benefits the residents by providing employment opportunities and enhanced services. Particular emphasis has been placed on Local Commercial and Activity Centres via strategies and recent capital investment. These areas are a focal point for the communities that they serve and often reflect the unique sense of place of each community. The objectives of the Policy will ensure the grant funds are distributed in an equitable manner to assist the City and local businesses in achieving the goals and aspirations for local centres as detailed in the Strategic Community Plan. Through the provision of a grant funding program it is envisioned that the financial assistance will support local businesses to improve amenity, culture, vibrancy and economic outcomes.

The grants will take the form of reimbursement for specified types of expenses related to upgrading local businesses. The purpose of these grants will be to address the disparity in investment between businesses located in the eligible areas and those located in the Kwinana Central Business District (**CBD**) and newer local shopping centres. These smaller centres serve a vital purpose in making goods and services accessible to members of the community who may find it difficult to reach the CBD. The grants will be for the Medina, Parmelia, Orelia and Calista Local Commercial and Activity Centres. There will be a range of exclusions and eligibility criteria for the grants that are detailed in the Policy (Attachment A).

The Policy also requires the formation of a selection panel comprised of two elected members, the Director, City Strategy and the Manager, City Enterprises who will assess the applications against the stated criteria for the Local Commercial and Activity Centre Improvement Grant Fund.

The panel shall be delegated to make decisions and approve disbursement of funds in regard to the Local Commercial and Activity Centre Improvement Grant Funding policy.

LEGAL/POLICY IMPLICATIONS:

There are no specific provisions in the Local Government Act 1995 relating to the distribution of grants by local governments. However, authority for such a grant programme can be found by reading together sections 3.1 and 3.18 of the Local Government Act 1995.

Local Government Act 1995

3.1 General function

(1) The general function of a local government is to provide for the good government of persons in its district.
(2) The scope of the general function of a local government is to be construed in the context of its other functions under this Act or any other written law and any constraints imposed by this Act or any other written law on the performance of its functions.
(3) A liberal approach is to be taken to the construction of the scope of the general function of a local government.

1.18 Performing executive functions

(1) A local government is to administer its local laws and may do all other things that are necessary or convenient to be done for, or in connection with, performing its functions under this Act.

6.8 Expenditure from municipal fund not included in annual budget

(1) A local government is not to incur expenditure from its municipal fund for an additional purpose except where the expenditure —
is incurred in a financial year before the adoption of the annual budget by the local government; or
(b) is authorised in advance by resolution*; or
(c) is authorised in advance by the mayor or president in an emergency.

* Absolute majority required.

(1a) In subsection (1) —

additional purpose means a purpose for which no expenditure estimate is included in the local government's annual budget.

(2) Where expenditure has been incurred by a local government —
(a) pursuant to subsection (1)(a), it is to be included in the annual budget for that financial year; and
pursuant to subsection (1)(c), it is to be reported to the next ordinary meeting of the council.

The grant program can be viewed as being for the good government of the persons in the City's district because it will help ensure that essential services and businesses remain accessible throughout the district. Therefore, the City is performing its function under the Local Government Act 1995 and is therefore authorised by s-3.18 to conduct the grant program.

There is certain similarity between accepting expressions of interest for grants and accepting tenders for goods and services provided to a local government. However, despite a similar process, these grants are not the same as provision of goods and services and therefore those sections of the Local Government Act 1995 relating to tenders will not apply.

A further consideration is that this grant program could potentially provide benefits to a very wide category of businesses and potentially to a large number of those businesses. This increases the chances of financial or impartiality conflicts of interests arising on the part of the City's Councillors and employees. Any such interest will have to be declared as per the City's Code of Conduct – Declaration of Conflict of Interest.

FINANCIAL/BUDGET IMPLICATIONS:

Transfer $30,000 in funding from Economic Development Consultancy (400047.1125.60) to the Economic Development Contribution account (400047.1138.8).

Budget Item Name: (where amount will come from)	Economic Development Consultancy (400047.1125.60)
Budgeted Amount:	$ 80,000
Expenditure to Date:	$ 109
Proposed Cost:	$ 30,000
Balance:	$ 49,891

*NOTE: All figures are exclusive of GST

ASSET MANAGEMENT IMPLICATIONS:

There are no direct asset management implications related to this report.

16.4 LOCAL COMMERCIAL AND ACTIVITY CENTRE IMPROVEMENT GRANT FUNDING

ENVIRONMENTAL IMPLICATIONS:

There are no direct asset management implications related to this report.

STRATEGIC/SOCIAL IMPLICATIONS:

This proposal will support the achievement of the following objectives and strategies detailed in the Strategic Community Plan and Corporate Business Plan.

Plan	Objective	Strategy
Strategic Community Plan	2.3 The City Centre is home to a thriving range of speciality shops, restaurants and family entertainment venues and an active night-life while neighbourhood centres are revitalised.	2.3.3 Implement and regularly review the Local Commercial and Activity Centres Strategy. 2.3.4 Revitalise and develop neighbourhood centres so they are economically viable and best outcomes for community are achieved.

COMMUNITY ENGAGEMENT:

1. Community Engagement has taken place in the following forms:

N/A

2. The following community engagement is proposed to take place:

It should be noted that this program has a very limited scope in terms of eligible businesses and expenses. Council officers will allow for a reasonable period between the release of the EOI and the date that it will be due back to the City. This period will allow extensive outreach to eligible businesses to inform them about the process and potential benefits.

RISK IMPLICATIONS:

The risk implications in relation to this proposal are as follows:

Risk Event	**Inadequate grant process leaves applicants feeling that the process was somehow unfair and that the best outcomes were not achieved**
Risk Theme	Inadequate engagement practices
Risk Effect/Impact	Financial Reputation
Risk Assessment Context	Operational
Consequence	Minor
Likelihood	Possible
Rating (before treatment)	Low
Risk Treatment in place	Reduce - mitigate risk
Response to risk treatment required/in place	Transparent application and selection process which provides clear and equitable assessment of eligible projects that enhance services within the community through development of a robust policy.
Rating (after treatment)	Low

COUNCIL DECISION

430

MOVED CR D WOOD **SECONDED CR B THOMPSON**

That Council:

1. **Adopt the new Local Commercial and Activity Centre Improvement Grant Funding Policy, included in Attachment A;**

2. **Nominate Cr W Cooper, Cr S Lee and Cr S Mills to sit with the Director of City Strategy and the Manager of City Enterprise as the Local Commercial and Activity Centre Improvement Grant Funding Panel;**

3. **Authorise the Local Commercial and Activity Centre Improvement Grant Funding Panel to make decisions regarding the disbursement of funds in accordance with the Local Commercial and Activity Centre Improvement Grant Funding Policy;**

4. **Approve the Transfer $30,000 in funding from Economic Development Consultancy to the Economic Development Contribution account.**

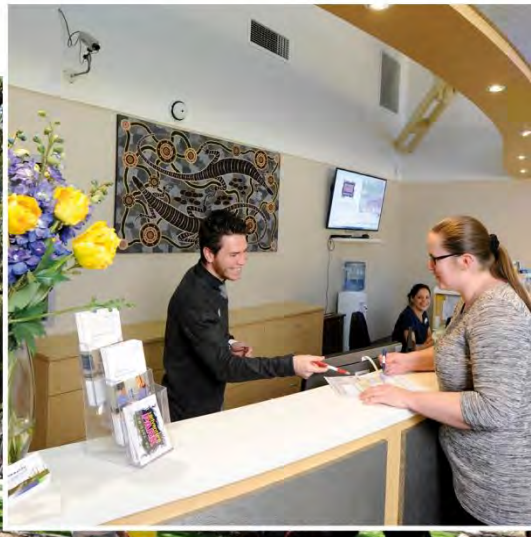
CARRIED BY ABSOLUTE MAJORITY OF COUNCIL 6/0

Note: The officer recommendation has been amended to include a third Councillor

City of Kwinana

Council Policy

Local Commercial and Activity Centre Improvement Grant Funding



Council Policy	
Local Commercial Activity Centre Improvement Grant Funding	D17/4102

1. Title

Local Commercial and Activity Centre Improvement Grant Funding

2. Purpose

The City of Kwinana recognises that Local Commercial and Activity Centres play a vital role in both the local economy and residents' quality of life. In order to ensure that this crucial sector continues to provide essential services to the community, a grant program has been developed which will compliment the City's Local Commercial and Activity Centres Strategy. The grant funds will be allocated on a competitive basis via an Expression of Interest (EOI) process.

3. Scope

3.1 Local Commercial and Activity Centres

The following Local Commercial and Activity Centres are eligible to apply for funding via the EOI as defined by the Local Commercial and Activity Centre Strategy:

- Medina
- Parmelia
- Calista
- Orelia

3.2 Term of Policy

This Policy is initially only valid for the 2016/2017 financial year, however it may be extended beyond this period if Council determines its ongoing strategic importance and allocates funding.

4. Definitions

There are no specific definitions associated with this Policy.

5. Policy Statement

The City of Kwinana's Strategic Community Plan 2015 - 2025 and Corporate Business Plan 2016 - 2021 identify the need to develop a diverse and thriving economy which benefits the residents by providing employment opportunities and enhanced services. Particular emphasis has been placed on Local Commercial and Activity Centres via strategies and recent capital investment. These areas are a focal point for the communities they serve and often reflect the unique sense of place of each community. The objectives of the Policy will ensure the grant funds are distributed in an equitable manner to assist the City and local businesses in achieving the goals and aspirations as detailed in the Strategic Community Plan. Through the provision of a grant funding program it is envisioned that the financial assistance will support local businesses to improve amenity, culture, vibrancy and economic outcomes.

The grants will take the form of reimbursement for specified types of expenses related to upgrading local businesses. The purpose of these grants is to address the disparity in investment between businesses located in the Kwinana Central Business District (**CBD**) and those in other local shopping centres. These smaller centres

serve a vital purpose in making goods and services accessible to members of the community who may find it difficult to reach the CBD.

The Policy also requires the formation of a selection panel comprised of three elected members, the Director, City Strategy and the Manager, City Enterprises who will assess the applications against the eligibility assessment criteria for the Local Commercial and Activity Centre Improvement Grant Funding program.

5.1 The following expenses will be considered for grant funding under this Policy:

5.1.1 The removal and replacement of obtrusive security features to make the property more inviting while providing the necessary security;

5.1.2 External improvements which are permanently affixed to the property (permanent outdoor signage is an eligible expense) or be works directly upon the external premises (must have building owner's written consent);

5.1.3 Enhanced public realm (for which a broad definition shall apply) and will include but not be limited to improvements or creation of alfresco areas or enhanced landscaping such as a flower bed;

5.1.4 A business that has been trading at its current location for a period of 12 months prior to making application to the Local Commercial and Activity Centre Improvement Incentive may apply for items related to internal improvements. Eligible expenses include vital equipment that is permanent in nature, or those which provide for an enhanced consumer experience not currently available within the premise or within businesses in the immediate vicinity.

5.2 In order to be eligible for a grant, a business must meet the following criteria:

5.2.1 Have a lease or ownership for a premise for at least two years from the time of approval;

5.2.2 Have all current or be able to obtain appropriate insurances, permits and licences for business operation including being registered by the City of Kwinana and holding an ABN. These approvals must be obtained prior to any application being approved;

5.2.3 Have all current or be able to obtain appropriate insurances, permits and licences for the works proposed. These approvals must be obtained prior to any funds being dispersed.

5.2.4 All grant applications must have two written quotes for the work. Grants will not be given for works already undertaken. (Disbursement of grant funding will only occur on receipt of final paid invoice);

5.2.5 The grant will not fund operational expenses such as wages, stock or marketing;

5.2.6 The applicant must be the owner operator of that business location (franchises are eligible);

5.2.7 Applicants must provide the most recent financial statements that demonstrate solvency of the business (these documents will be kept strictly confidential);

5.2.8 The project must be complete three months from project approval unless otherwise approved by the City; and

5.2.9 Successful applicants must enter into an agreement with the City. The agreement must include the following information:

- agreed scope of benefits to the business and the community;
- requital of funding; and
- provision to the City on a date determined within the agreement, of the achieved benefit as a result of the grant funding.

5.3 The Local Commercial and Activity Centre Improvement Grant funds will be distributed based upon merit with evaluation based upon:

5.3.1 The leveraging of private funds as a result of the grant;

5.3.2 The benefit to the local community;

5.3.3 The extent to which the proposal brings new products or services to the community;

5.3.4 The extent to which the proposal demonstrates financial viability or sound management;

5.3.5 The extent to which the project is ready to be implemented (investment ready);

5.3.6 The equal distribution of the funds based upon geographic location (to the degree that this is practical based upon quality of submissions);

5.3.7 The minimum and maximum grant allocated to an individual project shall be $1,000 and $3,000 respectively.

6. Financial/Budget Implications

This grant funding program will be subject to allocations as determined by Council in its Annual budget.

7. Asset Management Implications

There are no specific asset management implications associated with this Policy.

8. Environmental Implications

There are no specific environmental implications associated with this Policy.

9. Strategic/Social Implications

Plan	Objective	Strategy
Strategic Community Plan 2015 - 2025	2.3 The City Centre is home to a thriving range of speciality shops, restaurants and family entertainment venues and an active night-life while neighbourhood centres are revitalised.	2.3.3 Implement and regularly review the Local Commercial & Activity Centres Strategy. 2.3.4 Revitalise and develop neighbourhood centres so they are economically viable and best outcomes for community are achieved.

10. Occupational Safety and Health Implications

There are no specific OSH implications associated with this Policy.

11. Risk Assessment

Risk Event	**Inadequate EOI process leaves applicants feeling that the process was somehow unfair and that the best outcomes were not achieved**
Risk Theme	Inadequate engagement practices
Risk Effect/Impact	Financial Reputation
Risk Assessment Context	Operational
Consequence	Minor
Likelihood	Possible
Rating (before treatment)	Low
Risk Treatment in place	Reduce - mitigate risk
Response to risk treatment required/in place	Transparent application and selection process which provides clear and equitable assessment of projects that enhance services within the community through development of a robust policy.
Rating (after treatment)	Low

12. References

Name of Policy	Local Commercial Activity Centre Improvement Grant Funding
Date of Adoption and resolution No	
Review dates and resolution No #	
New review date	
Legal Authority	There are no specific provisions in the Local Government Act 1995 relating to the distribution of grants by local governments. However, authority for such a grant programme can be found by reading together sections 3.1 and 3.18 of the Local Government Act 1995.
Directorate	City Strategy
Department	Economic Development
Related documents	**Acts/Regulations** Local Government Act 1995 **Plans/Strategies** Strategic Community Plan 2015 – 2025 Corporate Business Plan 2016 – 2021 **Policies** Nil **Work Instructions** To be written **Other documents** D17/XXXX Grant Application(to be written) D17/XXXX Agreement Template - Local Commercial Activity Centre Improvement Grant Funding

Note: Changes to References may be made without the need to take the Policy to Council for review.

17 Urgent Business

Nil

18 Councillor Reports

18.1. Councillor Bob Thompson

Councillor Thompson reported that he attended the Australia Day celebration at the Kwinana Adventure Park and that it was a very successful day.

Councillor Thompson advised that both he and Councillor W Cooper attended the first meeting of the multicultural advisory group. It was a very successful meeting.

18.2. Councillor Sandra Lee

Councillor Lee reported that she enjoyed the Australia Day celebrations at the venue Calista Oval this year, congratulations to all the community people and organisations who won awards on the day.

19 Response to Previous Questions

Nil

20 Mayoral Announcements (without discussion)

Nil

21 Matters Behind Closed Doors

Nil

22 Meeting Closure

The Deputy Mayor declared the Meeting closed 7:19pm.

Chairperson: 8 February 2017