DYNAMIC PLANNING AND DEVELOPMENTS

PROPOSED LOCAL DEVELOPMENT PLAN



LOT 201 (NO. 33) TURNER STREET, BOYANUP
PROPOSED LOCAL DEVELOPMENT PLAN

OUR REF: 1724

Our Ref: 1724

14 December 2023

Chief Executive Officer
Shire of Capel
PO Box 369
CAPEL WA 6271

Dear Sir/Madam

LOT 201 (NO. 33) TURNER STREET, BOYANUP
PROPOSED LOCAL DEVELOPMENT PLAN

Dynamic Planning and Developments Pty Ltd (DPD) act on behalf of Aspen Living Villages Pty Ltd, the registered proprietor of Lot 201 (No. 33) Turner Street, Boyanup (herein referred to as the 'subject site').

DPD has prepared the following submission in support of a Local Development Plan (LDP) which is intended replace the prior approved 'Meadowbrooke Lifestyle Estate Development Guide Plan' and associated design guidelines to better guide development at the subject site moving forward.

1.0 Background

Recently the Shire of Capel have undertaken a considerable body of work to have their new Local Planning Scheme 8 (LPS8) approved which was gazetted on the 17 July 2023. Upon gazettal LPS8 dramatically changed the planning framework applicable to the subject site with the primary change being the removal of the 'Special Use' zoning and replacing it with a 'Residential' zoning with an 'Additional Use 7' designation. The effect of this change is that it simplified the planning framework applicable to the subject site.

The new planning framework encourages the continuation of development in the Meadowbrooke Lifestyle Estate for over 55's, commonly referred to as 'Aged and Dependent Persons Dwellings'. The 'Additional Use 7' provisions applicable to the site require due regard to be given to an approved local structure plan and local development plan, which presumably relates to the existing Meadowbrooke Lifestyle Estate Development Guide Plan and associated Design Guidelines. The intent of this proposed Local Development Plan is to supersede these prior approved documents and become the document to be given due regard in accordance with the 'Additional Use 7' provisions.

Development to date within the estate has occurred in accordance with the 'Park Home Park' land use which, through 'Additional Use 7' remains a 'Permitted (P)' land use. Unfortunately, there are a number of restrictions around construction associated with this land use and as such the new 'Residential' zoning and proposed Local Development Plan will also permit 'Grouped Dwelling' development (for aged and dependent persons) at the subject site.

(08) 9275 4433
Suite 15/29 Collier Road, Morley WA 6062
PO Box 688, Inglewood WA 6932
admin@dynamicplanning.net.au
www.dynamicplanning.net.au

2.0 Proposed Local Development Plan

The proposed Local Development Plan (LDP) broadly seeks to replicate the development layout and provisions applicable under the existing approved Meadowbrooke Lifestyle Estate Development Guide Plan and all associated supporting reports. There have been minor variations to the proposed development layout in the undeveloped portion of the subject site as a result of a recent Bushfire Management Plan that has been completed, which is discussed in detail below.

The development provisions contained in the LDP propose to apply those of State Planning Policy 7.3 Residential Design Codes Volume 1 (R-Codes). Should the LDP be adopted, application of its development provisions and any variations allowed under its framework are considered to be acceptable and in line with the orderly and proper planning for the locality.

The LDP also seeks to circumvent the need for consultation where individual proposals satisfy the R-Codes and the provisions of the LDP. This is a common provision of LDP's and as such, is considered to be appropriate in this instance as well.

An overview of the proposed LDP framework has been discussed in detail below with the LDP provided in Attachment 1 of this submission.

Land Use

The intended development at the subject site is likely to be either 'Grouped Dwelling (Aged and Dependent Persons Dwellings)' or 'Park Home Park'. It is commented that the new 'Residential' zoning with the 'Additional Use 7' provisions make both land uses 'Permitted (P)' meaning planning approval is not required subject to compliance with the relevant deemed to comply requirements of the 'R-Codes' and the provisions of the 'Local Development Plan'. It is intended that once approved, development that is consistent with both the R-Codes, the provisions of the LDP and any mentioned supporting reports will be allowed to proceed straight to a building permit.

Development Provisions

The proposed LDP simply seeks to apply the provisions of the R-Codes in combination with any relevant requirements noted in the prior approved supporting reports. This is considered to result in a consistent built form outcome and allow flexibility for the developer in working toward completing the estate.

It is commented that the estate is not likely to be the subject of a subdivision application and the landowner/developer will be responsible for delivering development outcomes at the subject site as opposed to individual purchasers/residents. This will ensure that the provisions of the LDP and any associated supporting reports will be appropriately adhered to.

Supporting Reports

Under the prior planning framework, a range of supporting reports were prepared to guide development at the subject site, these reports were required by the 'Special Use' provisions at the time and included:

1. Bushfire Management Plan.
2. Foreshore Management Plan.
3. Local Water Management Strategy.
4. Sustainability and Implementation Management Plan.
5. Traffic Impact Assessment.
6. Transport Noise Assessment.

A copy of these supporting reports has been included in Attachment 2 of this submission.

Development in accordance with the abovementioned supporting reports and prior approved Development Guide Plan has already commenced on site and moving forward it is proposed to continue development in accordance with these supporting reports to ensure consistency in development outcomes and application of management measures.

One supporting report has been updated in order to address current day requirements is the Bushfire Management Plan (BMP). Bushfire Prone Planning were engaged to prepare an updated BMP for the proposed development which has impacted the modified development layout at the subject site. Critical findings from the revised BMP included:

- Proposed development sites in the western portion of subject site require a larger setback from the reserve vegetation than what was previously approved. This resulted in a reconfiguration of the development sites, a reduction in the area of some sites and an overall loss in yield of one site.
- Existing development sites that have been created all comply with the required bushfire setbacks in accordance with State Planning Policy 3.7 – Planning in Bushfire Prone Areas.
- A public road connection was required back to South Western Highway as well as between Lot 85 to Lot 165 in order to comply with bushfire access requirements.

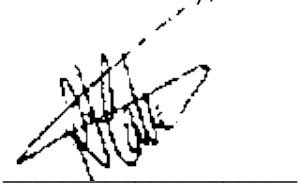
3.0 Conclusion

The proposed LDP is considered to prescribe an appropriate framework for development at the subject site that will replace the prior Meadowbrooke Lifestyle Estate Development Guide Plan and associated design guidelines. Once adopted, the LDP will better reflect the modified planning framework through the adopted LPS8 and enable increased flexibility for development within the estate.

We trust the above satisfies the requirements of the Shire of Capel to enable a favourable determination of the LDP.

Should you have any queries or require any clarification in regard to the matters raised, please do not hesitate to contact the undersigned on 9275 4433.

Yours Faithfully,



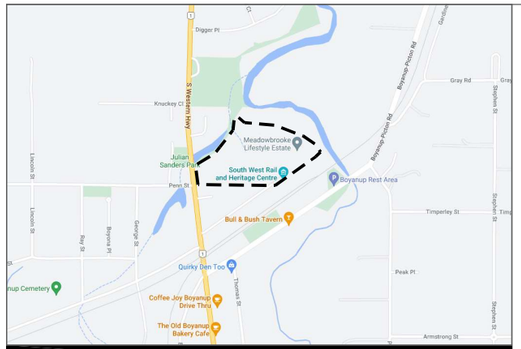
Reegan Cake

Planning Coordinator

(08) 9275 4433
Suite 15/29 Collier Road, Morley WA 6062
PO Box 688, Inglewood WA 6932
admin@dynamicplanning.net.au
www.dynamicplanning.net.au

ATTACHMENT 1 – LDP

(08) 9275 4433
Suite 15/29 Collier Road, Morley WA 6062
PO Box 688, Inglewood WA 6932
admin@dynamicplanning.net.au
www.dynamicplanning.net.au



LOCATION PLAN

LEGEND

- Subject Land
- Indigenous Site
- Foreshore Reserve (Subject to Foreshore Management Plan)
- Water Main
- Sewer Main
- Overhead Powerlines
- Gas Main
- BAL-29 Contour
- Landscaping Strip to achieve shade tree policy requirement
- Proposed Display Homes (Subject to compliance with the Design Guidelines at Building permit application stage)
- Proposed Drainage Basins
- Land Lease Areas to comply with Package A Noise Mitigation Requirements
- Department of Water approved extent of development line
- Bushfire Prone Area



LOCAL DEVELOPMENT PLAN
LOT 201 (No. 33) TURNER STREET, BOYANUP

This Local Development Plan has been prepared pursuant to Clause 52 (1)(a) of the Planning and Development (Local Planning Schemes) Regulations 2015 - Schedule 2 - Deemed Provisions and the Residential Design Codes (R-Codes), and in place of a planning approval for a Single House, Grouped Dwelling and Park Home where it meets:

General

1. The requirements of the Residential Design Codes (Volume 1), applicable to a density of R40.

2. Development shall only be occupied by persons aged 55 years or over.

3. Front fencing is permitted to a height of 1.8m with any fencing above 1.2m in height to be visually permeable.

4. Lots identified as being within a floodplain shall have a minimum floor level of any habitable room of 0.5m above the Department of Water and Environment Regulation 100-year ARI flood level for flood protection, as identified in the approved Local Water Management Strategy.

5. Buildings are to be constructed in accordance with the noise mitigation requirements specified in the Transportation Noise Assessment Report.

6. Any development within the identified bushfire prone area is to demonstrate compliance with the associated Australian Standards.

7. The proponent shall provide uniform fencing along the boundaries of lots adjacent to the South Western Highway to the satisfaction of Main Roads.

The provisions of this Local Development Plan are enforced through the following legislation:
Clause 56 of the *Planning and Development (Local Planning Schemes) Regulations 2015 - Schedule 2 - Deemed Provisions.*
Section 214 of the *Planning and Development Act 2005* - Directions by responsible authority regarding unauthorised development.

APPROVAL

Pursuant to Clause 52(1)(a) of the *Planning and Development (Local Planning Schemes) Regulations 2015* - Schedule 1 - Deemed Provisions this Local Development Plan is hereby approved.

---------- ----------

Executive Manager Engineering & Development Services Date

LOCAL DEVELOPMENT PLAN

LOT 201 (No. 33) TURNER STREET
BOYANUP

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DYNAMIC PLANNING AND DEVELOPMENTS
E: admin@dynamicplanning.net.au
T: (08) 9275 4433
W: www.dynamicplanning.net.au
SUITE 15, 29 COLLIER ROAD
MORLEY WA 6062
ABN: 99 169 411 705

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N W E S

ATTACHMENT 2 – Supporting Reports

(08) 9275 4433
Suite 15/29 Collier Road, Morley WA 6062
PO Box 688, Inglewood WA 6932
admin@dynamicplanning.net.au
www.dynamicplanning.net.au

Bushfire Management Plan Coversheet

This Coversheet and accompanying Bushfire Management Plan has been prepared and issued by a person accredited by Fire Protection Association Australia under the Bushfire Planning and Design (BPAD) Accreditation Scheme.

Bushfire Management Plan and Site Details

Site Address / Plan Reference: Lot 201 (33) Turner Street, Boyanup (Meadowbrooke Lifestyle Estate)		
Suburb: Boyanup	**State:** WA	**P/code:** 6237
Local government area: Shire of Capel		
Description of the planning proposal: Development Application - Local Development Plan (LDP)		
BMP Plan / Reference Number: 230673	**Version:** 1.0	**Date of Issue:** 06/12/2023
Client / Business Name: Reegan Cake (Dynamic Planning and Development)		

Reason for referral to DFES	Yes	No
Has the BAL been calculated by a method other than method 1 as outlined in AS3959 (tick no if AS3959 method 1 has been used to calculate the BAL)?	☐	☒
Have any of the bushfire protection criteria elements been addressed through the use of a performance principle (tick no if only acceptable solutions have been used to address all of the BPC elements)?	☐	☒
Is the proposal any of the following special development types (see SPP 3.7 for definitions)?		
Unavoidable development (in BAL-40 or BAL-FZ)	☐	☒
Strategic planning proposal (including rezoning applications)	☐	☒
Minor development (in BAL-40 or BAL-FZ)	☐	☒
High risk land-use	☐	☒
Vulnerable land-use	☐	☒

If the development is a special development type as listed above, explain why the proposal is considered to be one of the above listed classifications (E.g. considered vulnerable land-use as the development is for accommodation of the elderly, etc.)?

Note: The decision maker (e.g. local government or the WAPC) should only refer the proposal to DFES for comment if one (or more) of the above answers are ticked "Yes".

BPAD Accredited Practitioner Details and Declaration

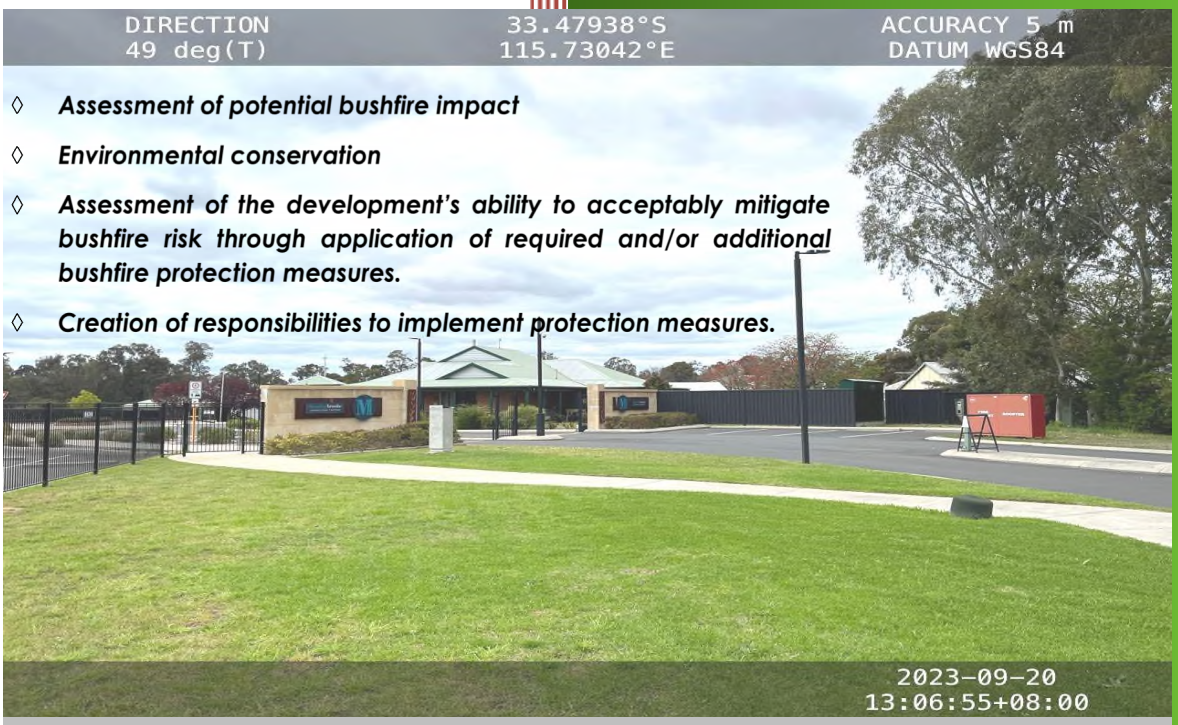
Name	Accreditation Level	Accreditation No.	Accreditation Expiry
Michael Whitelaw	Level 3	BPAD 37265	28/02/2024
Company Bushfire Prone Planning		**Contact No.** 6477 1144	

I declare that the information provided within this bushfire management plan is to the best of my knowledge true and correct

Signature of Practitioner  **Date** 06/12/2023

BUSHFIRE PRONE PLANNING

Bushfire Management Plan (BMP)



Produced to meet the relevant requirements of STATE PLANNING POLICY 3.7 Planning in Bushfire Prone Areas & Guidelines

Lot 201 (No. 33) Turner Street, Boyanup
(Meadowbrooke Lifestyle Estate)

Local Development Plan (LDP)

Shire of Capel

6 December 2023

Job Reference No: 230673

BPP GROUP PTY LTD T/A BUSHFIRE PRONE PLANNING

ACN: 39 166 551 784 | ABN: 39 166 551 784

LEVEL 1, 159-161 JAMES STREET
GUILDFORD WA 6055

PO BOX 388
GUILDFORD WA 6935

08 6477 1144 | admin@bushfireprone.com.au

DOCUMENT CONTROL

PREPARATION		
Author:	Mick Whitelaw (BPAD Level 3 No. 37265)	

VERSION HISTORY		
Version	Details	Date
1.0	Original	6 December 2023

BMP (Master) Template v9.13

DISTRIBUTION					
Destination		Version	No. Copies	Hard Copy	Electronic Copy
Person	Email				
Reegan Cake	<reegan.cake@dynamicplanning.net.au>	1.0	1	☐	☒

Limitations: *The protection measures that will be implemented based on information presented in this Bushfire Management Plan are minimum requirements and they do not guarantee that buildings or infrastructure will not be damaged in a bushfire, persons injured, or fatalities occur either on the subject site or off the site while evacuating.*

This is substantially due to the unpredictable nature and behaviour of fire and fire weather conditions. Additionally, the correct implementation of the required protection measures (including bushfire resistant construction) and any other required or recommended measures, will depend upon, among other things, the ongoing actions of the landowners and/or operators over which Bushfire Prone Planning has no control.

All surveys, forecasts, projections and recommendations made in this report associated with the proposed development are made in good faith based on information available to Bushfire Prone Planning at the time. All maps included herein are indicative in nature and are not to be used for accurate calculations.

Notwithstanding anything contained therein, Bushfire Prone Planning will not, except as the law may require, be liable for any loss or other consequences whether or not due to the negligence of their consultants, their servants or agents, arising out of the services provided by their consultants.

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SUMMARY STATEMENTS

THIS DOCUMENT – STATEMENT OF PURPOSE

The Bushfire Management Plan (BMP)

The BMP sets out the required package of bushfire protection measures to lessen the risks associated with a bushfire event. It establishes the responsibilities to implement and maintain these measures. The BMP also identifies the potential for any negative impact on any environmental, biodiversity and conservation values that may result from the application of bushfire protection measures or that may limit their implementation.

Risks Associated with Bushfire Events

The relevant risks are the potential for loss of life, injury, or destroyed or damaged assets which results in personal loss and economic loss. For a given site, the level of that risk to persons and assets (the exposed elements) is a function of the potential threat levels generated by the bushfire hazard, and the level of exposure and vulnerability of the at-risk elements to the threats.

Bushfire Protection Measures

The required package of protection measures is established by *State Planning Policy 3.7 Planning in Bushfire Prone Areas (SPP 3.7),* its associated *Guidelines* and any other relevant guidelines or position statements published by the Department of Planning, Lands and Heritage. These measures are limited to those considered by the WA planning authorities as necessary to be addressed for the purpose of land use planning. They do not encompass all available bushfire protection measures as many are not directly relevant to the planning approval stage. For example:

- Protection measures to reduce the vulnerability of buildings to bushfire threats is primarily dealt with at the building application stage. They are implemented through the process of applying the Building Code of Australia (Volumes 1 and 2 of the national Construction Code) in accordance with WA building legislation and the application of construction requirements based on a building's level of exposure - determined as a Bushfire Attack Level (BAL) rating); or

- Protection measures to reduce the threat levels of consequential fire (ignited by bushfire and involving combustible materials surrounding and within buildings) and measures to reduce the exposure and vulnerability of elements at risk exposed to consequential fire, are not specifically considered.

The package of required bushfire protection measures established by the Guidelines includes:

- The requirements of the bushfire protection criteria which consist of:
    - Element 1: Location (addresses threat levels).
    - Element 2: Siting and Design of Development (addresses exposure levels of buildings).
    - Element 3: Vehicular Access (addresses exposure and vulnerability levels of persons).
    - Element 4: Water (addresses vulnerability levels of buildings).
    - Element 5: Vulnerable Tourism Land Uses (addresses exposure and vulnerability as per Elements 1-4 but in use specific ways and with additional considerations of persons exposure and vulnerability).
- The requirement to develop Bushfire Emergency Plans / Information for 'vulnerable' land uses for persons to prepare, respond and recover from a bushfire event (this addresses vulnerability levels).

Compliance of the Proposed Development or Use with SPP 3.7 Requirements

The BMP assesses the capacity of the proposed development or use to implement and maintain the required 'acceptable' solutions and any additionally recommended bushfire protection measures - or its capacity to satisfy the policy intent through the justified application of additional bushfire protection measures as supportable 'alternative' solutions.

THE PROPOSED DEVELOPMENT/USE – BUSHFIRE PLANNING COMPLIANCE SUMMARY		
Required Bushfire Protection Measures The Acceptable Solutions of the Bushfire Protection Criteria (Guidelines)		**Assessment Outcome**
Element	The Acceptable Solutions *(Do – Development Application for any other development)*	
1: Location	A1.1 Development location	Fully Compliant
2: Siting and Design of Development	A2.1 Asset Protection Zone (APZ)	Fully Compliant
3: Vehicular Access	A3.1 Public roads	Fully Compliant
	A3.2a Multiple access routes	Fully Compliant
	A3.2b Emergency access way	N/A
	A3.3 Through-roads	N/A
	A3.4a Perimeter roads	N/A
	A3.4b Fire service access route	N/A
	A3.5 Battle-axe legs	N/A
	A3.6 Private driveways	Fully Compliant
4: Water	A4.1 Identification of future water supply	N/A
	A4.2 Provision of water for firefighting purposes	Fully Compliant

EXECUTIVE SUMMARY

Bushfire Prone Planning (BPP Group Pty Ltd) has been commissioned to prepare a Bushfire Management Plan in support of a Local Development Plan for Lot 201 (No. 33) Turner Street, Boyanup (*Meadowbrooke Lifestyle Estate*) in the Shire of Capel. The proposed development area of approximately 9.0 hectares in size is within a designated bushfire prone area and the Proposal requires the application of State Planning Policy No. 3.7: Planning in Bushfire Prone Areas (SPP 3.7).

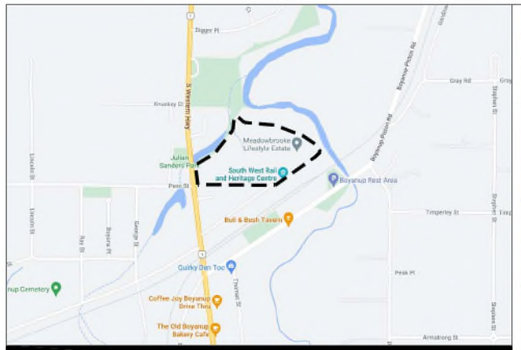
The proposed work has been assessed under multiple assessment criteria in accordance with Department of Planning Lands and Heritage (DPLH) Guidelines for Planning in Bushfire Prone Areas (v1.4)

The assessed bushfire risk is considered to be manageable and will be achieved by the identified stakeholders implementing and maintaining the bushfire risk management measures that are presented in this Plan. The site connects to the public road network which provides safe access and egress to a suitable destination. A reticulated water supply is available to the subject site.

1 PROPOSAL DETAILS AND THE BUSHFIRE MANAGEMENT PLAN

1.1 The Proposed Development/Use Details, Plans and Maps

The Proposal's Planning Stage For which certain bushfire planning documents are required to accompany the planning application.	Development Application - Local Development Plan (LDP)
Total Area of Subject Lot/Site	9.05 hectares
Specific 'Bushfire Planning' Land Use Type When applicable, this classification establishes a requirement to conduct assessments and develop documents that are additional to this Bushfire Management Plan.	Local Development Plan - Meadowbrooke Lifestyle Estate
Description of the Proposed Development/Use	
A Local Development Plan (LDP) has been prepared over Lot 201 (No. 33) Turner Street, Boyanup (Meadowbrooke Lifestyle Estate) in the Shire of Capel which identities both existing and future development. The LDP area is serviced by an existing public road network and an existing reticulated water supply.	



LOCATION PLAN

LEGEND

- Subject Land
- Indigenous Site
- Foreshore Reserve (Subject to Foreshore Management Plan)
- Water Main
- Sewer Main
- Overhead Powerlines
- Gas Main
- BAL-29 Contour
- Landscaping Strip to achieve shade tree policy requirement
- Proposed Display Homes (Subject to compliance with the Design Guidelines at Building permit application stage)
- Proposed Drainage Basins
- Land Lease Areas to comply with Package A Noise Mitigation Requirements
- Department of Water approved extent of development line
- Bushfire Prone Area



LOCAL DEVELOPMENT PLAN
LOT 201 (No. 33) TURNER STREET, BOYANUP

This Local Development Plan has been prepared pursuant to Clause 52 (1)(a) of the Planning and Development (Local Planning Schemes) Regulations 2015 - Schedule 2 - Deemed Provisions and the Residential Design Codes (R-Codes), and in place of a planning approval for a Single House where it meets:

General

1. Aged persons dwellings to be assessed in accordance with the R40 requirements of the R-Codes, unless otherwise varied by this LDP.
2. Where land within thi LDP is within an identifed floodprone area, any approval for the subdivision or development of that land shall require a notification to be registered against the certificate of title to the land (pursuant to Section 165 of the Planning and Development Act in the case of subdivision or Section 70A of the Transfer of Lnad Act in the case of development) advising owners or prospective owners of that land that:
   - The land is within floodprone area and may be subject to flooding; and
   - The development of any habitable room must have a minimum floor level 0.5m above the adjacent department of water 100 year ARI flood level for flood protection.
3. Buildings to be constructed are to comply with the noise mitigation requirements specified in the Transportation Noise Assessment Report.
4. Any developmnt within the identified bushfire prone area is to demonstate compliance with the associated Australian Standards.
5. The proponent shall provide uniform fencing along the boundaries of lots adjacent to the South Western Highway to the satisfaction of Main Roads.

The provisions of this Local Development Plan are enforced through the following legislation:
Clause 56 of the *Planning and Development (Local Planning Schemes) Regulations 2015 - Schedule 2 - Deemed Provisions.*
Section 214 of the *Planning and Development Act 2005* - Directions by responsible authority regarding unauthorised development.

APPROVAL

Pursuant to Clause 52(1)(a) of the *Planning and Development (Local Planning Schemes) Regulations 2015* - Schedule 1 - Deemed Provisions this Local Development Plan is hereby approved.

---------- ----------

Executive Manager Engineering & Development Services Date

LOCAL DEVELOPMENT PLAN

LOT 201 (No. 33) TURNER STREET
BOYANUP

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DYNAMIC PLANNING AND DEVELOPMENTS
E: admin@dynamicplanning.net.au
T: (08) 9275 4433
W: www.dynamicplanning.net.au
SUITE 15, 29 COLLIER ROAD
MORLEY WA 6062
ABN: 99 169 411 705

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N W E S

Figure 1.1

Proposed Development

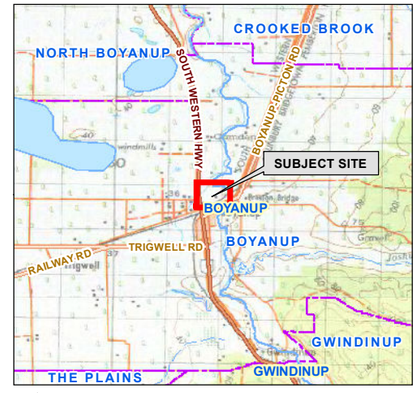
Lot 201 on Plan 400906, Area : 9.0568 ha
33 Turner Street Boyanup
BOYANUP
SHIRE OF CAPEL

------ LEGEND ------

- Subject Site
- Other Lots
- Subdivision
- Bush Fire Brigade
- Hydrant
- Access Point
- New Hydrant

0 20 40 60 80 100
Metres

------ LOCALITY ------



Aerial Imagery : Landgate/SLIP
Image Date : Jan 2023

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator Units: Metre
Map compiled by: Ian Ross 3/12/2023
Map updated by: Ian 3/12/2023
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BUSHFIRE PRONE PLANNING

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Figure 1.2

Proposed Development

Lot 201 on Plan 400906, Area : 9.0568 ha
33 Turner Street Boyanup
BOYANUP
SHIRE OF CAPEL

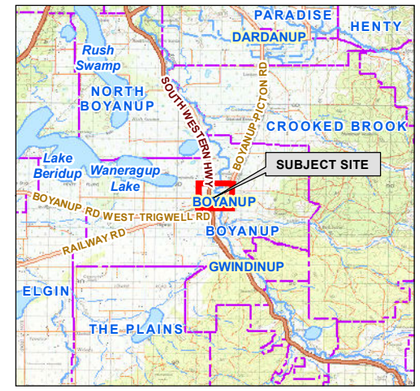
------ LEGEND ------

- Subject Site
- Other Lots
- Subdivision
- Bush Fire Brigade
- Hydrant
- Access Point
- New Hydrant

BOYANUP BFB
SOUTH WESTERN HWY
BRIDGE ST
BOYANUP-PICTON RD
PRESTON RIVER

0 50 100 150 200
Metres

------ LOCALITY ------



N

Aerial Imagery : Landgate/SLIP
Image Date : Jan 2023

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator Units: Metre
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Figure 1.3

Location Plan

Lot 201 on Plan 400906, Area : 9.0568 ha
33 Turner Street Boyanup
BOYANUP
SHIRE OF CAPEL

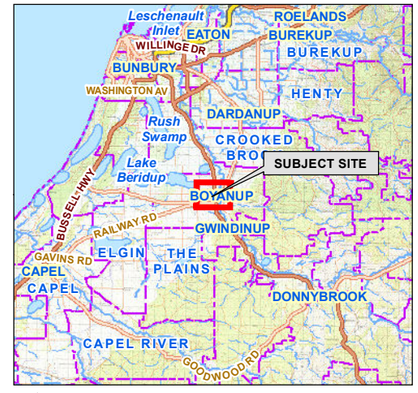
SUBJECT SITE
SHIRE OF CAPEL
BOYANUP BFB
BOYANUP
BOYANUP
PENN ST
WILLIAM ST
PAYNE ST
TRIGWELL RD
BRIDGE ST
SOUTH WESTERN HWY
HURST RD
BOYANUP-PICTON RD
GARDINER RD
STEPHEN ST
Preston River
Preston River

------ LEGEND ------

- Subject Site
- Other Lots
- Bush Fire Brigade
- Hydrant

0 100 200 300 400 500
Metres

------ LOCALITY ------



Aerial Imagery : Landgate/SLIP
Image Date : Jan 2023

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator Units: Metre
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Figure 1.4

Bushfire Prone Area

Lot 201 on Plan 400906, Area : 9.0568 ha
33 Turner Street Boyanup
BOYANUP
SHIRE OF CAPEL

------ LEGEND ------

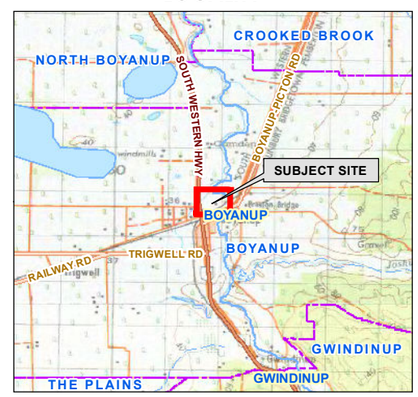
- Subject Site
- Other Lots
- Subdivision
- Bush Fire Brigade
- Hydrant
- Access Point
- New Hydrant

Bush Fire Prone Areas

- Bushfire Prone Areas (2021)

0 20 40 60 80 100
Metres

------ LOCALITY ------



Aerial Imagery : Landgate/SLIP
Image Date : Jan 2023

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator Units: Metre
Map compiled by: Ian Ross 3/12/2023
Map updated by: Ian 3/12/2023
A3 Scale 1:2,000

BUSHFIRE PRONE PLANNING

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1.2 The Bushfire Management Plan (BMP)

1.2.1 Commissioning and Purpose

Bushfire Prone Planning commissioned to produce the BMP by:	Reegan Cake (Dynamic Planning & Developments)
Purpose of the BMP:	To apply the requirements established by State Planning Policy 3.7: Planning in Bushfire Prone Areas (SPP 3.7) and accompany the strategic planning proposal.
BMP to be submitted to:	Shire of Capel

1.2.2 Existing Documents with Implications for Development of this BMP

This section identifies any known assessments, reports or plans that have been conducted and prepared previously, or are being prepared concurrently, and are relevant to the subject site and the proposal/application. They potentially have implications for the assessment of bushfire threats and the implementation of the protection measures that are dealt with in the Bushfire Management Plan.

Table 1.2: Existing documents that may impact threat assessments and protection measure development.

EXISTING RELEVANT DOCUMENTS			
Existing Document	Relevant to the Proposal and the BMP	Copy Provided by Proponent / Developer	Title
Site Plan	Yes	Yes	LDP - 33 TURNER STREET, BOYANUP (27th November 2023)
Historical BMP	Yes	Yes	Meadowbrook Estate – Bushfire Management Plan (Biodiverse Solutions – 19/12/2014)

1.2.3 Other Bushfire Protection Measures not covered in the Bushfire Protection Criteria

This Bushfire Management Plan identifies that there are no areas of non-compliance with the relevant bushfire performance criteria as all of the relevant acceptable solutions can be met. In consultation with applicable project stakeholders, it was identified that this development would benefit from the implementation of additional mitigation measures not covered in the bushfire protection criteria.

Additional Bushfire Protection Measures		
Bushfire Protection Measure	Relevant Site-Specific Details	Application
Ensure the "Landscape Management Plan (LMP)"– (Appendix E) is implemented.	The Landscape Management Plan provides specific instructions to the onsite manager to ensure the site has completed the necessary bushfire prevention and preparedness procedures (Focussed on vegetation management) throughout the year (Appendix E).	To be applied

2 ENVIRONMENTAL CONSERVATION (DESKTOP ASSESSMENT)

Important: *This 'desktop' assessment must not be considered as a replacement for a full Environmental Impact Assessment. It is a summary of potential environmental values at the subject site, inferred from information contained in listed datasets and/or reports, which are only current to the date of last modification.*

These data sources must be considered indicative where the subject site has not previously received a site-specific environmental assessment by an appropriate professional.

Many bushfire prone areas also have high biodiversity values. Consideration of environmental priorities within the boundaries of the land being developed can avoid excessive or unnecessary modification or clearing of vegetation. Approval processes (and exemptions) apply at both Commonwealth and State levels.

Any 'modification' or 'clearing' of vegetation to reduce bushfire risk is considered 'clearing' under the ***Environmental Protection Act 1986*** (EP Act) and requires a clearing permit under the ***Environmental Protection (Clearing of Native Vegetation) Regulations 2004*** (Clearing Regulations) – unless for an exempt purpose.

Clearing native vegetation is an offence, unless done under a clearing permit or the clearing is for an exempt purpose. Exemptions are contained in the EP Act or are prescribed in the Clearing Regulations (note: these do not apply in environmentally sensitive areas).

The ***Department of Water and Environmental Regulation*** (DWER) is responsible for issuing 'clearing' permits and the framework for the regulation of clearing. Approvals under other legislation, from other agencies, may also be required, dependent on the type of flora or fauna present.

Local Planning Policy or Local Biodiversity Strategy: Natural areas that are not protected by the above Act and Regulation (or any other National or State Acts) may be protected by a local planning policy or local biodiversity strategy. Permission from the local government will be required for any modification or removal of native vegetation in these Local Natural Areas (LNA's). Refer to the relevant local government for detail.

For further Information refer to Guidelines v1.4, the Bushfire and Vegetation Factsheet - WAPC, Dec 2021 and https://www.der.wa.gov.au/our-work/clearing-permits

2.1 Identified Requirement for Onsite Vegetation Modification or Removal

IDENTIFICATION OF POTENTIAL NATIVE VEGETATION MODIFICATION OR REMOVAL	
Has a requirement to modify or remove native vegetation to establish the required bushfire protection measures on the subject site been identified?	Likely
Refer to Figure 3.1.1 (Post Development). For the purpose of this assessment, any retained vegetation or proposed revegetation/ landscaping works within the nominated 'Subject Site – Lot 201' will be managed in accordance with the technical requirements established by the Schedule 1: 'Standards for Asset Protection Zones (Guidelines).	

2.2 Bushfire Assessment Considerations

2.2.1 Planned Onsite Vegetation Landscaping

Identification of areas of the subject site planned to be landscaped, creating the potential for increased or decreased bushfire hazard for proposed development.

PLANNED LANDSCAPING	
Relevant to Proposal:	Likely
It is expected that all of the vegetation within the nominated Site Plan boundary (Lot 201- Figure 1.1) will be managed as Low Threat Vegetation in accordance with the technical requirements established by the Schedule 1: 'Standards for Asset Protection Zones (Guidelines).	

2.2.2 Planned / Potential Offsite Rehabilitation or Re-Vegetation

Identification of areas of land adjacent to the subject site on which re-vegetation (as distinct from natural re-generation) will or may occur and is likely to present a greater bushfire hazard for proposed development.

POTENTIAL RE-VEGETATION PROGRAMS		
Land with Environmental, Biodiversity, Conservation and Social Values	Relevant to Proposal	Description
Riparian Zones / Foreshore Areas	Possible	Potential for revegetation works associated with the river system.
Legislated Lands	Unlikely	
Public Open Space	Unlikely	
Road Verges	Possible	Potential for revegetation works inside the Road Reserves
Note:	It is expected that all of the vegetation (including any future rehabilitation or revegetation works) within the nominated Site Plan boundary (Lot 201- Figure 1.1) will be managed as Low Threat Vegetation in accordance with the technical requirements established by the Schedule 1: 'Standards for Asset Protection Zones (Guidelines).	

2.2.3 Landscape Management Plan

A Landscape Management Plan to achieve compliance with Schedule 1 of the Bushfire Guidelines has been prepared for this site (Appendix E). The majority of the plant life within the subject site – Lot 201 (Figure 1.1) is already being managed as 'Low Threat' vegetation (Reticulated Lawns and Managed Gardens).

The bushfire assessment and management strategies contained in the BMP, assume there are no environmental restrictions over the site or clearing permit exemptions will apply. The key assumption used to facilitate the determining of Bushfire Attack Levels on the Proposed development site is that vegetation onsite is under the control of the landowner and therefore can be removed or modified to present a low bushfire threat (Note: any proposed vegetation removal may be subject to local government approval)

Recommendations:

1. It is advised that the proponent seek advice from the Shire for further information on the condition and species contained within the proposed development area and the requirement for referral of the proposal.

3 BUSHFIRE ATTACK LEVEL (BAL) ASSESSMENT

BUSHFIRE ATTACK LEVELS (BAL) - UNDERSTANDING THE RESULTS

The transfer (flux/flow) of radiant heat from the bushfire to a receiving object is measured in kW/m^2. The AS 3959:2018 BAL determination methodology establishes the ranges of radiant heat flux that correspond to each bushfire attack level. These are identified as BAL-LOW, BAL-12.5, BAL-19, BAL-29, BAL-40 and BAL-FZ.

The bushfire performance requirements for certain classes of buildings are established by the Building Code of Australia (Vol. 1 & 2 of the NCC). The BAL will establish the bushfire resistant construction requirements that are to apply in accordance with AS 3959:2018 - Construction *of buildings in bushfire prone areas* and the NASH Standard – *Steel framed construction in bushfire areas (NS 300 2021),* whose solutions are deemed to satisfy the NCC bushfire performance requirements.

DETERMINED BAL RATINGS

A BAL Certificate can be issued for a determined BAL. A BAL can only be classed as 'determined' for an existing or future building/structure when:

1. It's final design and position on the lot are known and the stated separation distance from classified bushfire prone vegetation exists and can justifiably be expected to remain in perpetuity; or

2. It will always remain subject to the same BAL regardless of its design or position on the lot after accounting for any regulatory or enforceable building setbacks from lot boundaries as relevant and necessary (e.g., R-codes, restrictive covenants, defined building envelopes) or the retention of any existing classified vegetation either onsite or offsite.

If the BMP derives determined BAL(s), the BAL Certificate(s) required for submission with building applications can be provided, using the BMP as the assessment evidence.

INDICATIVE BAL RATINGS

A BAL Certificate cannot be issued for an indicative BAL. A BAL will be classed as 'indicative' for an existing or future building/structure when the required conditions to derive a determined BAL are not met.

This class of BAL rating indicates what BAL(s) could be achieved and the conditions that need to be met are stated.

Converting the indicative BAL into a determined BAL is conditional upon the currently unconfirmed variable(s) being confirmed by a subsequent assessment and evidential documentation. These variables will include the future building(s) location(s) being established (or changed) and/or classified vegetation being modified or removed to establish the necessary vegetation separation distance. This may also be dependent on receiving approval from the relevant authority for that modification/removal.

BAL RATING APPLICATION – PLANNING APPROVAL VERSUS BUILDING APPROVAL

1. **Planning Approval**: SPP.3.7 establishes that where BAL- LOW to BAL-29 will apply to relevant future construction (or existing structures for proposed uses), the proposed development may be considered for approval (dependent on the other requirements of the relevant policy measures being met). That is, BAL40 or BAL-FZ are not acceptable on planning grounds (except for certain limited exceptions).

   Because planning is looking forward at what can be achieved, as well as looking at what may currently exist, both determined and indicative BAL ratings are acceptable assessment outcomes on which planning decisions can be made (including conditional approvals).

2. **Building Approval:** The Building Code of Australia (Vol. 1 & 2 of the NCC) establishes that relevant buildings in bushfire prone areas must be constructed to the bushfire resistant requirements corresponding to the BAL rating that is to apply to that building. Consequently, a determined BAL rating and the BAL Certificate is required for a building permit to be issued - an indicative BAL rating is not acceptable.

3.1 BAL Assessment Summary - Contour Map Format

INTERPRETATION OF THE BAL CONTOUR MAP

The BAL contour map is a diagrammatic representation of the results of the bushfire attack level assessment.

The map presents different coloured contours extending out from the areas of classified vegetation. Each contour represents a set range of radiant heat flux that potentially will transfer to an exposed element (building, person or other defined element), when it is located within that contour.

Each of the set ranges of radiant heat flux corresponds to a different BAL rating as defined by the AS 3959:2018 BAL determination methodology.

The width of each shaded BAL contour will vary dependant on both the BAL rating and the relevant parameters (calculation inputs) for the subject site. Their width represents the minimum and maximum vegetation separation distances that correspond to each BAL rating (refer to the relevant table below for these distances).

The areas of classified vegetation to be considered in developing the BAL contours, are those that will remain at the intended end state of the subject development once earthworks, clearing and/or landscaping and re-vegetation have been completed. Variations to this statement that may apply include:

- Both pre and post development BAL contour maps are produced; and/or
- Each stage of a development is assessed independently.

3.1.1 The BAL Determination Method(s) Applied and the Location of Data and Results

Procedure Method (AS 3959:2018)	Applied to the BAL Assessment	Location of the Site Assessment Data			Location of the Results
		Classified Vegetation and Topography Map(s)	Calculation Input Variables		Assessed Bushfire Attack Levels and/or Radiant Heat Levels
			Summary Data	Detailed Data with Explanatory and Supporting Information	
Method 1 (Simplified)	Yes	Figures 3.1 and 3.1.1	Table 3.1	Appendix A1	Table 3.2 BAL Contour Map

Figure 3.1

Classified Vegetation & Topography

Lot 201 on Plan 400906, Area : 9.0568 ha
33 Turner Street Boyanup
BOYANUP
SHIRE OF CAPEL

------ LEGEND ------

- Subject Site
- Other Lots
- Subdivision
- Photo & Direction
- Bush Fire Brigade
- Hydrant
- Access Point
- New Hydrant

150m Vegetation Assessment Area

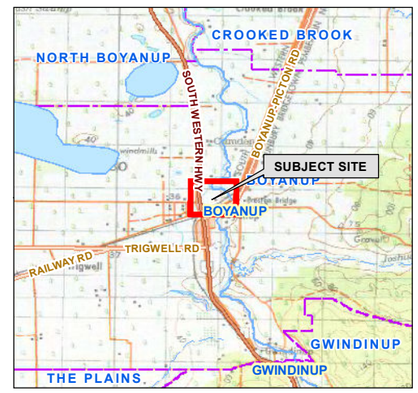
- 150m from Subject Site

Classified Vegetation

- Class (A) Forest
- Class (G) Grassland
- Excluded 2.2.3.2

0 20 40 60 80 100
Metres

------ LOCALITY ------



Aerial Imagery : Landgate/SLIP
Image Date : Jan 2023

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator Units: Metre
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Figure 3.1.1

Classified Vegetation & Topography (Post Development)

Lot 201 on Plan 400906, Area : 9.0568 ha
33 Turner Street Boyanup
BOYANUP
SHIRE OF CAPEL

------ LEGEND ------

- Subject Site
- Other Lots
- Subdivision
- Bush Fire Brigade
- Hydrant
- Access Point
- New Hydrant

Asset Protection

- Indicative APZ

150m Vegetation Assessment Area

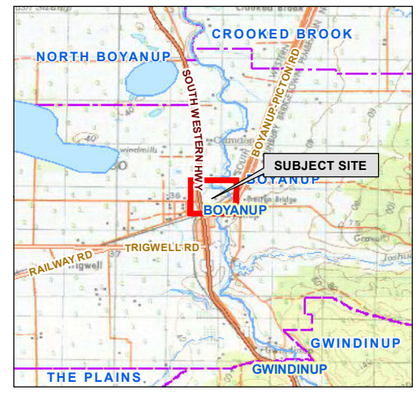
- 150m from Subject Site

Classified Vegetation

- Class (A) Forest
- Class (G) Grassland
- Excluded 2.2.3.2

0 20 40 60 80 100
Metres

------ LOCALITY ------



Aerial Imagery : Landgate/SLIP
Image Date : Jan 2023

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator Units: Metre
Map compiled by: Ian Ross 3/12/2023
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CONSTRUCTION OF THE BAL CONTOUR MAP(S) – RELEVANT CLASSIFIED VEGETATION	
Identification of Classified Vegetation that is Relevant to the Production of the BAL Contour Map(s)	Relevant Map
All identified areas of classified vegetation that exist at the time of the site assessment – both within the subject site (onsite) and external to the subject site (offsite) will be the relevant vegetation.	Figure 3.1
All identified classified vegetation areas, or portions of areas, within the nominated "Development Area – Lot 201" are excluded. It is the classified vegetation external to the "Development Area – Lot 201" boundaries that is the relevant vegetation. This approach is applied to indicate the achievable bushfire attack levels within the specified lot and the resultant area of developable land where buildings will be subject to BAL-29 or less. It is based on the following assumptions: 1. Any classified vegetation within a lot can potentially be managed or removed by the landowner to meet asset protection zone standards; and 2. Future development and consequent removal/management of vegetation that may take place on any adjoining lot cannot be part of considerations for the subject lot.	Figure 3.1.1
The areas of classified vegetation that will remain at the intended end state of the subject development once earthworks, any clearing and/or landscaping and re-vegetation have been completed, will be the relevant vegetation for the post-development BAL contour map.	Figure 3.2

3.1.4 Summary Site Data Applied to Construction of the BAL Contour Map(s)

Table 3.1: Summary of applied calculation input variables applied to determining the site-specific separation distances corresponding to each bushfire attack level.

SUMMARY OF CALCULATION INPUT VARIABLES (INCLUDING SITE DATA) APPLIED TO THE DETERMINATION OF SEPARATION DISTANCES CORRESPONDING TO BUSHFIRE ATTACK LEVELS [1]												
Applied BAL Determination Method		METHOD 1 - SIMPLIFIED PROCEDURE (AS 3959:2018 CLAUSE 2.2)										
Calculation Variables Corresponding to BAL Determination Method												
Methods 1 and 2		Method 1	Method 2									
Vegetation Classification		FDI	Effective Slope		Site Slope	FFDI or GFDI	Flame Temp.	Elevation of Receiver	Flame Width	Fireline Intensity	Flame Length	Modified View Factor
			Applied Range	Measured								
Area	Class		degree range	degrees	degrees		K	metres	metres	kW/m	metres	% Reduction
1	Forest (A - 03) *(Onsite)*	80	Downslope >0-5	d/slope 0-5	N/A	N/A	-	n/a	n/a	n/a	n/a	n/a
2	(G) Grassland *(Onsite)*	80	Upslope or flat 0	flat 0	N/A	N/A	-	n/a	n/a	n/a	n/a	n/a
3	Forest (A - 03)	80	Downslope >0-5	d/slope 0-5	N/A	N/A	-	n/a	n/a	n/a	n/a	n/a
4	(G) Grassland G-26)	80	Downslope >0-5	d/slope 0-5	N/A	N/A	-	n/a	n/a	n/a	n/a	n/a
5	Excluded cl 2.2.3.2(e & f)	-	-	-	N/A	N/A	-	n/a	n/a	n/a	n/a	n/a
6	Excluded cl 2.2.3.2(e & f)	-	-	-	N/A	N/A	-	n/a	n/a	n/a	n/a	n/a

[1] All data and information supporting the determination of the classifications and values stated in this table and any associated justification, is presented in Appendix A.

Where the values are stated as 'default' these are either the values stated in AS 3959:2018, Table B1 or the values calculated as intermediate or final outputs through application of the equations of the AS 3959:2018 BAL determination methodology. They are not values derived by the assessor.

Table 3.2: Vegetation separation distances corresponding to radiant heat levels and illustrated as BAL contours in Figure 3.2.

THE CALCULATED VEGETATION SEPARATION DISTANCES CORRESPONDING TO THE STATED LEVEL OF RADIANT HEAT [1]									
Vegetation Classification		Separation Distances Corresponding to Stated Level of Radiant Heat (metres)							
		Bushfire Attack Level						Maximum Radiant Heat Flux	
Area	Class	BAL-FZ	BAL-40	BAL-29	BAL-19	BAL12.5	BAL-LOW	10 kW/m^2	2 kW/m^2
1	(A) Forest	<20	20-<27	27-<37	37-<50	50-<100	>100	-	-
2	(G) Grassland	<6	6-<8	8-<12	12-<17	17-<50	>50	-	-
3	(A) Forest	<20	20-<27	27-<37	37-<50	50-<100	>100		
4	(G) Grassland	<7	7-<9	9-<13	13-<19	19-<50	>50		

[1] All calculation input variables are presented in Table 3.1. The summary 'printouts' of calculation input and output values for each area of classified vegetation are presented in Appendix A.

Figure 3.2

BAL Contour Map

Lot 201 on Plan 400906, Area : 9.0568 ha
33 Turner Street Boyanup
BOYANUP
SHIRE OF CAPEL

------ LEGEND ------

- Subject Site
- Other Lots
- Subdivision
- Bush Fire Brigade
- Hydrant
- Access Point
- New Hydrant

100m Vegetation Assessment Area

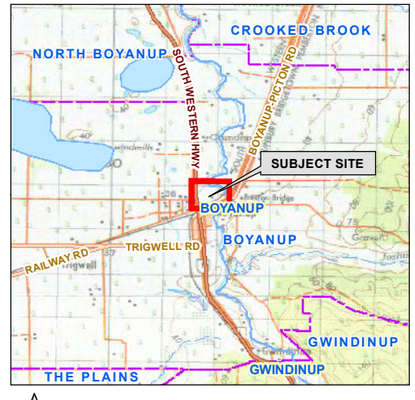
- 100m from Subject Site

Indicative Bushfire Attack Levels

- BAL FZ
- BAL 40
- BAL 29
- BAL 19
- BAL 12.5
- BAL LOW
- Classified Vegetation Boundary

0 20 40 60 80 100
Metres

------ LOCALITY ------



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3.1.6 BAL Ratings Derived from the Contour Map

Table 3.3: Indicative BAL(s) for planned development areas – Vacant Lots (Refer to Figure 3.2).

BUSHFIRE ATTACK LEVEL FOR PLANNED DEVELOPMENT AREAS	
Planned Areas Description (Vacant Lots)	Indicative BAL [2]
(42 - 44) (54 - 59) (69 - 78) (92 - 93) (103 -106) (113 -116) (120 -121) (128 -130) (170 - 174)	BAL-LOW
(1, 6 - 10) (14-18) (25)(31) (34 – 41) (45 - 53) (60 - 68) (79 – 91) (96 – 102) (107 – 112) (117 - 118) (122 – 127) (131 – 137) (166 - 170) (175 - 179)	Maximum of BAL-12.5
(11, 19 & 21) (138 - 143) (150 - 157) (180)	Maximum of BAL-19
(12 - 13) (144 -149) (158 - 165)	Maximum of BAL-29

[1] The assessment data used to derive the BAL ratings is sourced from Table 3.1 and Figure 3.2.

[2] Refer to the start of Section 3 for an explanation of indicative versus determined BAL ratings.

Table 3.4: Determined BAL(s) for existing buildings/ structures (Refer to Figure 3.2).

BUSHFIRE ATTACK LEVEL FOR EXISTING BUILDINGS/STRUCTURE [1]	
Building/Structure Description	Determined BAL [2]
Club House & Lot 26	BAL-LOW
Family Centre Lots (2-5) Lots (22-24, 28-30, 32)	BAL-12.5
Lots (20, 27 & 33)	BAL-19

[1] The assessment data used to derive the BAL ratings is sourced from Table 3.1 and Figure 3.2.

[2] Refer to the start of Section 3 for an explanation of indicative versus determined BAL ratings.

4 IDENTIFICATION OF BUSHFIRE HAZARD ISSUES

The Guidelines for Planning in Bushfire Prone Areas (WAPC 2021 v1.4), Appendix 5, establish that the application of this section of the BMP is intended to support ***strategic planning*** proposals. At the strategic planning stage there will typically be insufficient proposed development detail to enable all required assessments, including the assessment against the bushfire protection criteria.

Strategic Planning Proposals

For strategic planning proposals this section of the BMP will identify:

- Issues associated with the level of the threats presented by any identified bushfire hazard;
- Issues associated with the ability to implement sufficient and effective bushfire protection measures to reduce the exposure and vulnerability levels (of elements exposed to the hazard threats), to a tolerable or acceptable level; and
- Issues that will need to be considered at subsequent planning stages.

All Other Planning Proposals

For all other planning stages, this BMP will address what are effectively the same relevant issues but do it within the following sections:

- Section 2 – Environmental Conservation: Assess environmental, biodiversity and conservation values);
- Section 3 – Potential Bushfire Impact: Assess the bushfire threats with the focus on flame contact and radiant heat; and
- Section 5 – Assessment Against the Bushfire Protection Criteria (including the guidance provided by the *Position Statement: 'Planning in bushfire prone areas – Demonstrating Element 1: Location and Element 2'):* Assess the ability of the proposed development to apply the required bushfire protection measures thereby enabling it to be considered for planning approval for these factors.

Is the proposed development a strategic planning proposal?	No

5 ASSESSMENT AGAINST THE BUSHFIRE PROTECTION CRITERIA (GUIDELINES V1.4)

5.1 Bushfire Protection Criteria Elements Applicable to the Proposed Development/Use

APPLICATION OF THE CRITERIA, ACCEPTABLE SOLUTIONS AND PERFORMANCE ASSESSMENT

The criteria are divided into five elements – location, siting and design, vehicular access, water and vulnerable tourism land uses. Each element has an intent outlining the desired outcome for the element and reflects identified planning and policy requirements in respect of each issue.

The example acceptable solutions (bushfire protection measures) provide one way of meeting the element's intent. Compliance with these automatically achieves the element's intent and provides a straightforward pathway for assessment and approval.

Where the acceptable solutions cannot be met, the ability to develop design responses (as alternative solutions that meet bushfire performance requirements) is an alternative pathway that is provided by addressing the applicable performance principles (as general statements of how best to achieve the intent of the element).

A merit based assessment is established by the SPP 3.7 and the Guidelines as an additional alternative pathway along with the ability of using discretion in making approval decisions (sections 2.5, 2.6 and 2.7). This is formally applied to certain development (minor and unavoidable – sections 5.4.1 and 5.7). Relevant decisions by the State Administrative Tribunal have also supported this approach more generally.

Elements 1 – 4 should be applied for all strategic planning proposals, subdivision or development applications, except for vulnerable tourism land uses which should refer to Element 5. Element 5 incorporates the bushfire protection criteria in Elements 1 – 4 but caters them specifically to tourism land uses. (Guidelines DPLH 2021v1.4)

The Bushfire Protection Criteria	Applicable to the Proposed Development/Use
Element 1: Location	Yes
Element 2: Siting and Design	Yes
Element 3: Vehicular Access	Yes
Element 4: Water	Yes

5.2 Local Government Variations to Apply

Local governments may add to or modify the acceptable solutions to recognise special local or regional circumstances (e.g., topography / vegetation / climate). These are to be endorsed by both the WAPC and DFES before they can be considered in planning assessments. (Guidelines DPLH 2021v1.4).	
Do endorsed regional or local variations to the acceptable solutions apply to the assessments against the Bushfire Protection Criteria for the proposed development /use?	No

5.3 Assessment Statements for Element 1: Location

LOCATION	
Element Intent	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.
Proposed Development/Use – Relevant Planning Stage	(Do) Development application other than for a single dwelling, ancillary dwelling or minor development
Element Compliance Statement	The proposed development/use achieves the intent of the element by being fully compliant with all applicable acceptable solutions.
Pathway Applied to Provide an Alternative Solution	N/A

Acceptable Solutions - Assessment Statements

All details of acceptable solution requirements are established in the Guidelines for Planning in Bushfire Prone Areas, DPLH v1.4 (Guidelines) and apply the guidance established by the Position Statement: 'Planning in bushfire prone areas – Demonstrating Element 1: Location and Element 2: Siting and design' (WAPC Nov 2019) and the 'Bushfire Management Plan Guidance for the Dampier Peninsula' (WA Department of Planning, Lands and Heritage, 2021 Rev B) as relevant. These documents are available at https://www.wa.gov.au/government/document-collections/state-planning-policy-37-planning-bushfire-prone-areas.

Solution Component Check Box Legend	☑ Relevant & met	☒ Relevant & not met	⃠ Not relevant

A1.1 Development location	**Applicable:** Yes	**Compliant:** Yes

ASSESSMENT AGAINST THE REQUIREMENTS ESTABLISHED BY THE GUIDELINES

☑ ☐ ☐ The 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.

Supporting Assessment Details:

The future development of the subject land will provide an area of land within the allotment that can be considered suitable for development, as BAL-40 or BAL-FZ construction standard will not be required to be applied. This meets the requirements established by Acceptable Solution A1.1 and its associated explanatory note.

ASSESSMENTS APPLYING THE GUIDANCE ESTABLISHED BY THE WAPC ELEMENT 1 & 2 POSITION STATEMENT (2019)

"Consideration should be given to the site context where 'area' is the land both within and adjoining the subject site. The hazards remaining within the site should not be considered in isolation of the hazards adjoining the site, as the potential impact of a bushfire will be dependent on the wider risk context, including how a bushfire could affect the site and the conditions for a bushfire to occur within the site."

Strategic Planning Proposals: Consider the threat levels from any vegetation adjoining and within the subject site for which the potential intensity of a bushfire in that vegetation would result in it being classified as an Extreme Bushfire Hazard Level (BHL). Identify any proposed design strategies to reduce these threats.

Structure Plans (lot layout known) and Subdivision Applications: As for strategic planning proposals but within the subject site the relevant threat levels to consider are the radiant heat levels represented by BAL-FZ and BAL-40 ratings.

The Hazard Within the Subject Site

The majority of the onsite vegetation (within the Site Plan boundary – Figure 1.1) is already being managed as Low Threat Vegetation in accordance with the technical requirements established by the Schedule 1: 'Standards for Asset Protection Zones (Guidelines).

The bushfire threat from any remaining native vegetation within the subject site will be mitigated by the application of appropriate building design, bushfire construction requirements and the ongoing maintenance of the APZ to ensure the buildings will not be impacted by consequential fire within combustible materials used, stored or accumulated within the APZ.

The Hazard Adjoining the Subject Site

Bushfire prone vegetation adjoining the development site exists as native vegetation classified as Class A Forest and Class G Grassland (Paddock). The extent of this hazard is shown in Figure 1.2. Most of the land within the locality supports this vegetation except for the residential built out areas associated with the townsite.

The impact of the slope under the vegetation will be dependent on a bushfire's direction of travel but slopes in the range of zero to five degrees downslope do exist in the area. Bushfire travelling upslope will have increased intensity and rate of spread. However, the adjoining land cannot be considered as rugged (which would present greater potential for dynamic fire behaviours to develop leading to increasing fire intensity extreme bushfire events).

Consequently, the potential exists for intense bushfire behaviour to occur within these areas of bushfire prone vegetation. This bushfire threat will be mitigated by the application of appropriate building design, bushfire construction requirements and the ongoing maintenance of the BAL-29 dimensioned APZ, to ensure the buildings will not be impacted by consequential fire within combustible materials used, stored or accumulated within the APZ.

The Potential of the Proposed Development to Reduce Bushfire Risk to the Existing Land Use

When considered in the broader context of existing land use within the surrounding area, the proposed development works can potentially contribute to reducing the level of risk from bushfire to existing landowners.

This can be achieved in various ways and the following assessment points are made for consideration:

- As part of this Proposal, the establishment of a secondary access/egress point onto the public road network (Figure 1.1 – New Crossover onto the SW Highway) will reduce the level of risk from bushfire to existing landowners and improve access to the site for the fire services during a bushfire emergency.

5.4 Assessment Statements for Element 2: Siting and Design

SITING AND DESIGN OF DEVELOPMENT					
Element Intent	To ensure that the siting and design of development minimises the level of bushfire impact.				
Proposed Development/Use – Relevant Planning Stage	(Do) Development application other than for a single dwelling, ancillary dwelling or minor development				
Element Compliance Statement	The proposed development/use achieves the intent of the element by being fully compliant with all applicable acceptable solutions.				
Pathway Applied to Provide an Alternative Solution	N/A				
Acceptable Solutions - Assessment Statements *All details of acceptable solution requirements are established in the Guidelines for Planning in Bushfire Prone Areas, DPLH v1.4 (Guidelines) and apply the guidance established by the Position Statement: 'Planning in bushfire prone areas – Demonstrating Element 1: Location and Element 2: Siting and design' (WAPC Nov 2019) and the 'Bushfire Management Plan Guidance for the Dampier Peninsula' (WA Department of Planning, Lands and Heritage, 2021 Rev B) as relevant. These documents are available at https://www.wa.gov.au/government/document-collections/state-planning-policy-37-planning-bushfire-prone-areas.*					
Solution Component Check Box Legend	☑ Relevant & met	☒ Relevant & not met	⃠ Not relevant		
A2.1 Asset Protection Zone (APZ)	**Applicable**: Yes		**Compliant**: Yes		

UNDERSTANDING THE APZ PLANNING ASSESSMENT VERSUS APZ IMPLEMENTATION REQUIREMENTS

Note: Appendix B: 'Onsite Vegetation Management' provides further information regarding the different APZ dimensions that can be referenced, their purpose and the specifications of the APZ that is to be established and maintained.

To reduce risk to buildings (and indirectly to persons) from a bushfire event, a key bushfire protection measure required to be implemented is reducing the exposure of building elements to the direct bushfire threats of flame contact, radiant heat and embers and the indirect threat of consequential fires that result from the subsequent ignition of other combustible materials that may be constructed, stored or accumulate in the area surrounding buildings.

This is achieved by separating existing and/or proposed buildings from areas of classified bushfire prone vegetation. The total area of separation is identified as the Asset Protection Zone (APZ), which exists as an area of minimal fire fuels (or no fuel) and is considered able and likely to remain a low threat and/or be maintained to a low threat state in perpetuity. The required separation distances will vary according to the site specific conditions.

THE APZ PLANNING ASSESSMENT: To achieve planning approval for this factor it must be demonstrated that separation distances that correspond to a maximum level of radiant transfer to a building (29 kW/m^2), either exist or can be established (with certain exceptions). These separation distances are the dimensions of the **'Planning BAL-29' APZ**.

The purpose of this planning assessment is to identify and justify how this low threat area (the Planning BAL-29' APZ) can exist – or not.

THE DIMENSIONS OF THE 'PLANNING BAL-29' APZ MAY EXTEND OUTSIDE SUBJECT LOT BOUNDARIES. THE APZ MAY NOT BE EQUIDISTANT AROUND A BUILDING AS THE REQUIRED SEPARATION DISTANCES DEPEND ON THE TYPE OF VEGETATION PRESENT IN EACH DIRECTION ALONG WITH OTHER SITE VARIABLES.

IT IS IMPORTANT TO UNDERSTAND THAT THE 'PLANNING BAL-29' APZ IS NOT NECESSARILY THE SIZE OF THE APZ THAT MUST BE PHYSICALLY ESTABLISHED AND MAINTAINED BY A LANDOWNER. IT IS A SCREENING TOOL FOR MAKING PLANNING APPROVAL DECISIONS.

THE APZ TO BE IMPLEMENTED: The required dimensions to be established and maintained by the landowner will be those that correspond to the determined BAL rating of a relevant building but limited to the land of the subject lot

(with limited exceptions). The requirement for a greater dimension within a lot will only exist if it is required by the relevant local government's annual firebreak / hazard reduction notice or the APZ size is increased as an additional bushfire protection measure as a recommendation of this BMP.

> Within this BMP it is the 'Planning BAL-29' APZ that will be identified on maps, diagrams and in tables as necessary.
>
> The exceptions are the data provided in Appendix B part B1 and when a Property Bushfire Management Statement is required to be produced for a development application, in which case the '**Landowner' APZ** dimensions will be shown on the site map (refer to s6.3.1 when relevant).

ASSESSMENT AGAINST THE REQUIREMENTS ESTABLISHED BY THE GUIDELINES

☑ ☐ ☐	**APZ Width:** The proposed (or a future) habitable building(s) on the lot(s) of the proposed development - or an existing building for a proposed change of use – can be (or is) located within the developable portion of the lot and be surrounded by a 'Planning BAL-29' APZ of the required dimensions (measured from any external wall or supporting post or column to the edge of the classified vegetation), that will ensure their exposure to the potential radiant heat impact of a bushfire does not exceed 29 kW/m^2.
☐ ☐ ⊘	**Restriction on Building Location:** It has been identified that the current developable portion of a lot(s) provides for the proposed future (or a future) building/structure location that will result in that building/structure being subject to a BA-40 or BAL-FZ rating. Consequently, it may be considered necessary to impose the condition that a restrictive covenant to the benefit of the local government pursuant to section 129BA of the Transfer of Land Act 1893, is to be placed on the certificate(s) of title of the proposed lot(s) advising of the existence of a restriction on the use of that portion of land (refer to Code F3 of Model Subdivision Conditions Schedule, WAPC June 2021 and Guidelines s5.3.2).
☑ ☐ ☐	**APZ Location:** The required dimensions for a 'Planning BAL-29' APZ can be contained solely within the boundaries of the lot(s) on which the proposed (or a future) habitable building(s) - or an existing building(s) for a proposed change of use – is situated.
☐ ☐ ⊘	**APZ Location:** The required dimensions for a 'Planning BAL-29' APZ can be partly established within the boundaries of the lot(s) on which the proposed (or a future) habitable building(s) - or an existing building(s) for a proposed change of use – is situated. The balance of the APZ would exist on adjoining land that satisfies the exclusion requirements of AS 3959:2018 cl 2.2.3.2 for low threat vegetation and non-vegetated areas.
☐ ☐ ⊘	**APZ Location:** It can be justified that any adjoining (offsite) land forming part of a 'Planning BAL-29' APZ will: • If non-vegetated, remain in this condition in perpetuity; and/or • If vegetated, be low threat vegetation managed in a minimal fuel condition in perpetuity.
☑ ☐ ☐	**APZ Management:** The area of land (within each lot boundary), that is to make up the required 'Landowner' APZ dimensions (refer to Appendix B, Part B1), can and will be managed in accordance with the requirements of the Guidelines Schedule 1 'Standards for Asset Protection Zones' (refer to Appendix B).
☐ ☐ ⊘	**Subdivision Staging:** There are undeveloped future stages of subdivision, containing bushfire prone vegetation, that have been taken into consideration for their potentially 'temporary' impact on the ability to establish a 'Planning BAL-29' APZ on adjoining developed lots. A staging plan is developed to manage this.

Supporting Assessment Details:

The land adjacent to the future buildings/areas/structures will be able to be maintained to Planning BAL-29 APZ standards as it is under the control of the landowner and can be expected to be managed to a low threat state in perpetuity. (Refer to Figure 3.1.1).

ASSESSMENTS APPLYING THE GUIDANCE ESTABLISHED BY THE WAPC ELEMENT 1 & 2 POSITION STATEMENT (2019)

Strategic Planning Proposals: "At this planning level there may not be enough detail to demonstrate compliance with this element. The decision-maker may consider this element is satisfied where A1.1 is met."

Structure Plans (lot layout known) and Subdivision Applications: "Provided that Element 1 is satisfied, the decision-maker may consider approving lot(s) containing BAL-40 or BAL-FZ under the following scenarios.

N/A – This is a Development Application

5.5 Assessment Statements for Element 3: Vehicular Access

VEHICULAR ACCESS	
Element Intent	To ensure that the vehicular access serving a subdivision/development is available and safe during a bushfire event.
Proposed Development/Use – Relevant Planning Stage	(Do) Development application other than for a single dwelling, ancillary dwelling or minor development
Element Compliance Statement	The proposed development/use achieves the intent of the element by being fully compliant with all applicable acceptable solutions.
Pathway Applied to Provide an Alternative Solution	N/A

Acceptable Solutions - Assessment Statements

All details of acceptable solution requirements are established in the Guidelines for Planning in Bushfire Prone Areas, DPLH v1.4 (Guidelines) and apply the guidance established by the Position Statement: 'Planning in bushfire prone areas – Demonstrating Element 1: Location and Element 2: Siting and design' (WAPC Nov 2019) and the 'Bushfire Management Plan Guidance for the Dampier Peninsula' (WA Department of Planning, Lands and Heritage, 2021 Rev B) as relevant. These documents are available at https://www.wa.gov.au/government/document-collections/state-planning-policy-37-planning-bushfire-prone-areas.

The technical construction requirements for access types and components, and for each firefighting water supply component, are also presented in Appendices 2 and 3. The local government will advise the proponent where different requirements are to apply and when any additional specifications such as those for signage and gates are to apply (these are included in the relevant appendix if requested by the local government).

Solution Component Check Box Legend ☑ Relevant & met ☒ Relevant & not met ⊘ Not relevant

A3.1 Public roads **Applicable**: Yes **Compliant**: Yes

☑ ☐ ☐ The technical construction requirements of vertical clearance and weight capacity (Guidelines, Table 6) can and will be complied with (Refer also to Appendix C in this BMP).

☑ ☐ ☐ All other applicable technical requirements of trafficable width, gradients and curves, are required to be in "accordance with the class of road as specified in the IPWEA Subdivision Guidelines, Liveable Neighbourhoods, Ausroad Standards and/or any applicable standard in the local government area" (Guidelines, Table 6 and E3.1. Refer also to Appendix C in this BMP).

The assessment conducted for the bushfire management plan indicates that it is likely unlikely that the proposed development can and will comply with the requirements.

However, the applicable class of road, the associated technical requirements and subsequent proposal compliance, will need to be confirmed with the relevant local government and/or Main Roads WA.

or

The applicable class(s) of road and technical requirements have been confirmed with the relevant local government/Main Roads WA. These can and will be complied with.

☑ ☐ ☐ A traversable verge is available adjacent to classified vegetation (Guidelines, E3.1), as recommended.

Supporting Assessment Details: The combination of Turner Street and the establishment of a new public access/egress directly onto the Southwest Highway (Western Boundary – Refer to Figure 1.1) provides this development with suitable access/egress in a bushfire emergency. There is no access constraint for the subject site with regard to what is considered acceptable from a planning perspective.

A3.2a Multiple access routes	Applicable:	Yes	Compliant:	Yes
☑ ☐ ☐	Two-way public road access is provided in two different directions to at least two different suitable destinations with an all-weather surface.			
☐ ☐ ⊘	The two-way access is available at an intersection no greater than 200m from the relevant boundary of each lot, via a no-through road.			
☐ ☐ ⊘	The two-way access is not available at an intersection within 200m from the relevant boundary of each lot. However, the available no-through road satisfies the established exemption for the length limitation in every case. These requirements are: • Demonstration of no alternative access (refer to A3.3 below); • The no-through road travels towards a suitable destination; and • The balance of the no-through road that is greater than 200m from the relevant lot boundary is within a residential built-out area or is potentially subject to radiant heat levels from adjacent bushfire prone vegetation that correspond to the BAL-LOW rating (<12.5 kW/m^2).			
Supporting Assessment Details: The combination of Turner Street and the establishment of a new public access/egress directly onto the Southwest Highway (Western Boundary – Refer to Figure 1.1) provides this development with suitable access/egress in a bushfire emergency. There is no access constraint for the subject site with regard to what is considered acceptable from a planning perspective.				
A3.2b Emergency access way	**Applicable:**	No	**Compliant:**	N/A
☐ ☐ ⊘	The proposed or existing EAW provides a through connection to a public road.			
☐ ☐ ⊘	The proposed or existing EAW is less than 500m in length and will be signposted and gated (remaining unlocked) to the specifications stated in the Guidelines and/or required by the relevant local government.			
☐ ☐ ⊘	The technical construction requirements for widths, clearances, capacity, gradients and curves (Guidelines, Table 6 and E3.2b. Refer also to Appendix C in this BMP), can and will be complied with.			
A3.3 Through-roads	**Applicable:**	No	**Compliant:**	N/A
☐ ☐ ⊘	A no-through public road is necessary as no alternative road layout exists due to site constraints.			
☐ ☐ ⊘	The no-through public road length does not exceed the established maximum of 200m to an intersection providing two-way access (Guidelines, E3.3).			
☐ ☐ ⊘	The no-through public road exceeds 200m but satisfies the exemption provisions of A3.2a as demonstrated in A3.2a above.			
☐ ☐ ⊘	The public road technical construction requirements (Guidelines, Table 6 and E3.1. Refer also to Appendix C in this BMP), can and will be complied with as established in A3.1 above.			
☐ ☐ ⊘	The turnaround area requirements (Guidelines, Figure 24) can and will be complied with.			

A3.4a Perimeter roads	Applicable: No	Compliant: N/A
☐ ☐ ⊘	The proposed greenfield or infill development consists of 10 or more lots (including those that are part of a staged subdivision) and therefore should have a perimeter road. This is planned to be installed.	
☐ ☐ ⊘	The proposed greenfield or infill development consists of 10 or more lots (including those that are part of a staged subdivision). However, it is not required on the established basis of: • The vegetation adjoining the proposed lots is classified Class G Grassland; • Lots are zoned rural living or equivalent; • It is demonstrated that it cannot be provided due to site constraints; or • All lots have existing frontage to a public road.	
☐ ☐ ⊘	The technical construction requirements of widths, clearances, capacity, gradients and curves (Guidelines, Table 6 and E3.4a) can and will be complied with.	
Supporting Assessment Details: None required.		
A3.4b Fire service access route	**Applicable**: No	**Compliant**: N/A
☐ ☐ ⊘	The FSAR can be installed as a through-route with no dead ends, linked to the internal road system every 500m and is no further than 500m from a public road.	
☐ ☐ ⊘	The technical construction requirements of widths, clearances, capacity, gradients and curves (Guidelines, Table 6 and E3.4b. Refer also to Appendix C in this BMP), can and will be complied with.	
☐ ☐ ⊘	The FSAR can and will be signposted. Where gates are required by the relevant local government, the specifications can be complied with.	
☐ ☐ ⊘	Turnaround areas (to accommodate type 3.4 fire appliances) can and will be installed every 500m on the FSAR.	
Supporting Assessment Details: None required.		
A3.5 Battle-axe access legs	**Applicable**: No	**Compliant**: N/A
☐ ☐ ⊘	A battle-axe leg cannot be avoided due to site constraints.	
☐ ☐ ⊘	The proposed development is in a reticulated area and the battle-axe access leg length from a public road is no greater than 50m. No technical requirements need to be met.	
☐ ☐ ⊘	The technical construction requirements for widths, clearances, capacity, gradients and curves (Guidelines, Table 6 and E3.5. Refer also to Appendix C in this BMP), can and will be complied with.	
☐ ☐ ⊘	Passing bays can and will be installed every 200m with a minimum length of 20m and a minimum additional trafficable width of 2m.	
Supporting Assessment Details: None required.		

A3.6 Private driveways	Applicable: Yes	Compliant: Yes
☑ ☐ ☐	The private driveway (Internal Road network) to the most distant external part of the development site is within a lot serviced by reticulated water, is accessed via a public road with a speed limit of 70 km/hr or less and has a length is no greater than 70m (measured as a hose lay). No technical requirements need to be met.	
☑ ☐ ☐	The technical construction requirements for widths, clearances, capacity, gradients and curves (Guidelines, Table 6 and E3.6. Refer also to Appendix C in this BMP), can and will be complied with.	
☑ ☐ ☐	Passing bays can and will be installed every 200m with a minimum length of 20m and a minimum additional trafficable width of 2m.	
☑ ☐ ☐	The turnaround area requirements (Guidelines, Figure 28, and within 30m of any habitable building) can and will be complied with.	
Supporting Assessment Details: The proposed internal private driveway/ existing internal road network (Figure 1.1) will be upgraded/installed to meet all the requirements in Table 6, Column 4 of the Bushfire Guidelines (Including Passing bays and Turn-around areas as required). The private driveway/ existing internal road network provides emergency egress/access for the onsite occupants, in the event of a bushfire.		

5.6 Assessment Statements for Element 4: Water

FIREFIGHTING WATER					
Element Intent	To ensure water is available to enable people, property and infrastructure to be defended from bushfire.				
Proposed Development/Use – Relevant Planning Stage	(Do) Development application other than for a single dwelling, ancillary dwelling or minor development				
Element Compliance Statement	The proposed development/use achieves the intent of the element by being fully compliant with all applicable acceptable solutions.				
Solution Component Check Box Legend	☑ Relevant & met	☒ Relevant & not met	⊘ Not relevant		
A4.1 Identification of future firefighting water supply	**Applicable**:	No	**Compliant**:	N/A	
☐ ☐ ⊘	It can be demonstrated that reticulated or sufficient non-reticulated water for firefighting can be provided at the subdivision and/or development application stage in accordance with the specifications of the relevant water supply authority or the requirements of Schedule 2.				
A4.2 Provision of water for firefighting purposes	**Applicable**:	Yes	**Compliant**:	Yes	
☑ ☐ ☐	A reticulated water supply is available to the proposed development. The existing hydrant connection(s) are provided in accordance with the specifications of the relevant water supply authority.				
☑ ☐ ☐	A reticulated water supply will be available to the proposed development. Hydrant connection(s) can and will be provided in accordance with the specifications of the relevant water supply authority.				
☐ ☐ ⊘	A static water supply (tank) for firefighting purposes will be installed on the lot each lot that is additional to any water supply that is required for drinking and other domestic purposes. The proposed subdivision will retain an existing habitable building for which the same standard of water supply will be provided.				
☐ ☐ ⊘	A strategic water supply (tank or tanks) for firefighting purposes will be installed within or adjacent to the proposed development that is additional to any water supply that is required for drinking and other domestic purposes. The required land will be ceded free of cost to the local government and the lot or road reserve where the tank is to be located will be identified on the plan of subdivision.				
☐ ☐ ⊘	The strategic static water supply (tank or tanks) will be located no more than 10 minutes travel time from a subject site (at legal road speeds).				
☐ ☐ ⊘	The technical requirements (location, number of tanks, volumes, design, construction materials, pipes and fittings), as established by the Guidelines (A4.2, E4 and Schedule 2) and/or the relevant local government, can and will be complied with.				
Supporting Assessment Details: The proponent has indicated that the site will be connected to reticulated water. Hydrants are to be installed at the required distances of 200 metres. Refer to information contained in Appendix D for the firefighting water supply specifications and technical requirements.					

5.7 Additional Bushfire Protection Measures to be Implemented.

The following bushfire protection measures are recommended to be implemented and maintained. They are additional to, or a variation of, those established by the relevant acceptable solutions applied to the proposed development/use within Sections 5 of this BMP (as applicable to the proposed development).

The intent of their application is to improve the bushfire performance of the proposed development/use and reduce residual risk levels to persons and property from a bushfire event.

When necessary, the implementation responsibility for these additional protection measures will be stated in Section 6 of this BMP and included in other operational documents as relevant.

5.7.1 Additional Protection Measures to Improve Bushfire Performance

The detail of the protection measures is either provided within the relevant Section titled 'Non-compliance – Additional Assessments' or is established on the following pages. The table summarises the additional bushfire protection measures that are required and/or recommended to be implemented and the protection principles being employed.

Additional Protection Measure No. 1:

There is potential that some of the proposed buildings and structures (BAL LOW Ratings) within the LDP area are not required to comply with the bushfire performance requirements established by the Building Code of Australia (Vol. 1 & 2 of the National Construction Code) that are referenced by the Building Regulations 2012 (WA Building Act 2011). However, it is recommended (by the bushfire consultant) that any future residential building works on this site be constructed to the requirements corresponding to a minimum BAL rating of BAL 12.5.

The bushfire construction requirements corresponding to BAL ratings are established by AS 3959:2018 – Construction of buildings in bushfire prone areas and/or the NASH Standard (NS 300 2021) – Steel framed construction in bushfire areas (for Class 1 buildings).

Additional Protection Measure No. 2:

It is recommended (by the bushfire consultant) that the Proponent should prepare a Bushfire Emergency & Evacuation Plan for this site.

- ☐ Prior to operation, provide training to staff to assist with understanding the Bushfire Emergency Plan, learn how it is to be implemented and identify the persons responsible for ensuring its proper application. Promote awareness of the obligation to operate and maintain an environment that reduces the risks from the threats of bushfire and consequential local fire. All relevant staff/employees to complete mandatory training in bushfire awareness and the application of the bushfire procedures and actions contained within this Bushfire Emergency Plan.

- ☐ Conduct simulation drills for assembly, evacuation and sheltering procedures.

- ☐ Assign persons to the 'Onsite Responsible Persons' roles.

Additional Protection Measure No. 3:

It is recommended (by the bushfire consultant) that the "Landscape Management Plan (LMP)"– (Appendix E) is implemented. The Landscape Management Plan provides specific instructions to the onsite manager to ensure the site has completed the necessary bushfire prevention and preparedness procedures (Focussed on vegetation management) throughout the year.

6 RESPONSIBILITIES FOR IMPLEMENTATION AND MANAGEMENT OF THE BUSHFIRE PROTECTION MEASURES

6.1 Developer / Landowner Responsibilities

DEVELOPER/LANDOWNER RESPONSIBILITIES	
No.	Implementation Actions
1	The local government may condition an approval with a requirement for the landowner/proponent to register a notification onto the certificate of title and deposited plan. This will be done pursuant to Section 70A *Transfer of Land Act 1893* as amended ('Factors affecting use and enjoyment of land, notification on title'). This is to give notice of the bushfire hazard and any restrictions and/or protective measures required to be maintained at the owner's cost. This condition ensures that: 1. Landowners/proponents are aware their lot is in a designated bushfire prone area and of their obligations to apply the stated bushfire risk management measures; and 2. Potential purchasers are alerted to the Bushfire Management Plan so that future landowners/proponents can continue to apply the bushfire risk management measures that have been established in the Plan.
2	Establish (Maintain) the Asset Protection Zone (APZ) on the lot to the dimensions and standard stated in this Bushfire Management Plan (Figure 3.1.1) and the Bushfire Guidelines. Any retained vegetation or proposed revegetation/ landscaping works will be managed in accordance with the technical requirements established by the Schedule 1: 'Standards for Asset Protection Zones (Guidelines).
3	Upgrade/Install all of the internal vehicular access routes (Access roads/ driveways as shown in Figure 1.1) within the lot to the required surface condition and clearances as stated in the Bushfire Guidelines Version 1.4. Refer to the requirements in Table 6, Column 4 of the Bushfire Guidelines and Appendix C of this Bushfire Management Plan for the technical specifications.
4	As part of this proposal, the proponent has indicated that the site will be connected to reticulated water. Hydrants are to be installed at the required distances of 200 metres. Refer to information contained in Appendix D for the firefighting water supply specifications and technical requirements.
5	Prior to relevant building work, inform the builder of the existence of this approved Bushfire Management Plan (BMP). The plan identifies that the development site is within a designated bushfire prone area and states the indicative (or determined) BAL rating(s) that may (or will) be applied to buildings/structures. A BAL assessment report may be required to confirm determined ratings and will be required when ratings are indicative. BAL certificates will need to be issued to accompany building applications. The BMP may also establish, as an additional bushfire protection measure, that construction requirements to be applied will be those corresponding to a specified higher BAL rating.
6	Consider implementing the bushfire protection measures that have been established within Section 5.7 of this BMP as measures additional to those established by the acceptable solutions.

6.2 Landowner / Occupier Responsibilities – Ongoing Management

LANDOWNER/OCCUPIER – ONGOING MANAGEMENT	
No.	Management Actions
1	Maintain the 'Landowner' Asset Protection Zone (APZ) around habitable buildings (and other structures as required) to satisfy: • Establish (Maintain) the Asset Protection Zone (APZ) on the lot to the dimensions and standard stated in this Bushfire Management Plan (Figure 3.1.1) • The minimum required dimensions. These are to be the greatest measurements derived from either the separation distances corresponding to the determined BAL rating for the subject building/structure, or the local government's annual firebreak / hazard reduction notice (issued under s33 of the Bushfires Act 1954), or a combination of these requirements [refer to Appendix B]; and • The standards established by the Guidelines DPLH, 2021 v1.4, Schedule 1, or as varied by the local government through their annually issued firebreak / hazard reduction notice when the variations have been endorsed by the WAPC and DFES as per s4.5.3 of the Guidelines.
2	Maintain the private driveways/ access roads and water supply to the standards outlined within this Plan.
3	Maintain all of the additional bushfire protection measures that have been adopted from Section 5.7 of this BMP as measures additional to those established by the acceptable solutions.
4	Ensure that builders engaged to construct structures on the lot, are aware of the existence of this approved Bushfire Management Plan (BMP). The plan identifies that the development site is within a designated bushfire prone area and states the indicative (or determined) BAL rating(s) that may (or will) be applied to buildings/structures. A BAL assessment report may be required to confirm determined ratings and will be required when ratings are indicative. BAL certificates will need to be issued to accompany building applications. The BMP may also establish, as an additional bushfire protection measure, that construction requirements to be applied will be those corresponding to a specified higher BAL rating. Compliance with the Building Code of Australia (Volumes 1 and 2 of the National Construction Code), will require certain bushfire resistant construction requirements be applied to residential buildings in bushfire prone areas (i.e., Class 1, 2 and 3 and associated Class 10a buildings and decks). Other classes of buildings may also be required to comply with these construction when established by the relevant authority or if identified as an additional bushfire protection measure within the BMP.
5	Ensure all future buildings the landowner has responsibility for, are designed and constructed in full compliance with: • The bushfire resistant construction requirements of the Building Code of Australia (Volumes 1 and 2 of the National Construction Code), as established by the Building Regulations 2012 (WA Building Act 2011); and • Any additional bushfire protection measures this Bushfire Management Plan has established are to be implemented.

6.3 Local Government Responsibilities – Ongoing Management

LOCAL GOVERNMENT – ONGOING MANAGEMENT	
No.	Management Actions
1	Monitor landowner compliance with the annual Fire Hazard Reduction Notice and with any bushfire protection measures that are: • Established by this BMP; • Are required to be maintained by the landowner/occupier; and • Are relevant to local government operations.

APPENDIX A: DETAILED BAL ASSESSMENT DATA AND SUPPORTING INFORMATION

A1: BAL Assessment Inputs Common to the Method 1 and Method 2 Procedures

A1.1: FIRE DANGER INDICES (FDI/FDI/GFDI)

When using Method 1 the relevant FDI value required to be applied for each state and region is established by AS 3959:2018, Table 2.1. Each FDI value applied in Tables 2.4 – 2.7 represents both the Forest Fire Danger Index (FFDI) and a deemed equivalent for the Grassland Fire Danger Index (GFDI), as per Table B2 in Appendix B. When using Method 2, the relevant FFDI and GFDI are applied.

The values may be able to be refined within a jurisdiction, where sufficient climatological data is available and in consultation with the relevant authority.

Relevant Jurisdiction:	WA	Region:	Whole State	Method 1	Applied FDI:	80
				Method 2	Applied FFDI:	N/A
					Applied GFDI:	N/A

A1.2: VEGETATION ASSESSMENT AND CLASSIFICATION

Vegetation Types and Classification

In accordance with AS 3959:2018 clauses 2.2.3 and C2.2.3.1, all vegetation types within 100 metres of the 'site' (defined as "the part of the allotment of land on which a building stands or is to be erected"), are identified and classified. Any vegetation more than 100 metres from the site that has influenced the classification of vegetation within 100 metres of the site, is identified and noted. The maximum excess distance is established by AS 3959: 2018 cl 2.2.3.2 and is an additional 100 metres.

Classification is also guided by the Visual Guide for Bushfire Risk Assessment in WA (WA Department of Planning February 2016) and any relevant FPA Australia practice notes.

Modified Vegetation

The vegetation types have been assessed as they will be in their natural mature states, rather than what might be observed on the day. Vegetation destroyed or damaged by a bushfire or other natural disaster has been assessed on its expected re-generated mature state. Modified areas of vegetation can be excluded from classification if they consist of low threat vegetation managed in a minimal fuel condition, satisfying AS 3959:2018 s2.2.3.2(f), and there is sufficient justification to reasonable expect that this modified state will exist in perpetuity.

The Influence of Ground Slope

Where significant variation in effective slope exists under a consistent vegetation type, these will be delineated as separate vegetation areas to account for the difference in potential bushfire behaviour, in accordance with AS 3959:2018 clauses 2.2.5 and C2.2.5.

THE INFLUENCE OF VEGETATION GREATER THAN 100 METRES FROM THE SUBJECT SITE	
Vegetation area(s) within 100m of the site whose classification has been influenced by the existence of bushfire prone vegetation from 100m – 200m from the site:	N/A
Assessment Statement:	Vegetation has been classified within the 150-metre radius from the proposed development site (Lot 201)

VEGETATION AREA 1						
Classification	**A. FOREST**					
Types Identified	Open forest A-03					
Effective Slope	Measured	d/slope 0-5 degrees	Applied Range (Method 1)	Downslope >0-5 degrees		
Foliage Cover (all layers)	30-70%	Shrub/Heath Height	<2m	Tree Height	Up to 30m	
Dominant & Sub-Dominant Layers (species as relevant)	(Onsite) Forest vegetation associated with the River System (Mix of nonnative and native tree species)					
Post Development Assumptions:	Any retained vegetation or proposed revegetation/ landscaping works within the nominated Asset Protection Zone will be managed in accordance with the technical requirements established by the Schedule 1: 'Standards for Asset Protection Zones (Guidelines).					



PHOTO ID: 1a



PHOTO ID: 1b



PHOTO ID: 1c



PHOTO ID: 1d

<table>
<tr><th colspan="5">VEGETATION AREA 2</th></tr>
<tr><td>Classification</td><td colspan="4">G. GRASSLAND</td></tr>
<tr><td>Types Identified</td><td colspan="4">Sown pasture G-26</td></tr>
<tr><td>Effective Slope</td><td>Measured</td><td>flat 0 degrees</td><td>Applied Range (Method 1)</td><td>Upslope or flat 0 degrees</td></tr>
<tr><td colspan="2">Dominant & Sub-Dominant Layers (species as relevant)</td><td colspan="3">(Onsite) Grassland vegetation (Pasture Paddock – Vacant Land – Future Development Area)</td></tr>
<tr><td colspan="2">Post Development Assumptions:</td><td colspan="3">Any retained vegetation or proposed revegetation/ landscaping works within the nominated Asset Protection Zone will be managed in accordance with the technical requirements established by the Schedule 1: ‘Standards for Asset Protection Zones (Guidelines).</td></tr>
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<tr><td colspan="2">PHOTO ID: 2a</td><td colspan="3">PHOTO ID: 2b</td></tr>
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<tr><td colspan="2">PHOTO ID: 2c</td><td colspan="3">PHOTO ID: 2d</td></tr>
</table>

VEGETATION AREA 3						
Classification	**A. FOREST**					
Types Identified	Open forest A-03					
Effective Slope	Measured	d/slope 0-5 degrees	Applied Range (Method 1)	Downslope >0-5 degrees		
Foliage Cover (all layers)	30-70%	Shrub/Heath Height	<2m	Tree Height	Up to 30m	
Dominant & Sub-Dominant Layers (species as relevant)	(Offsite) Forest vegetation associated with the River System (Mix of nonnative and native tree species)					
Post Development Assumptions:	Any retained vegetation or proposed revegetation/ landscaping works within the nominated Asset Protection Zone will be managed in accordance with the technical requirements established by the Schedule 1: 'Standards for Asset Protection Zones (Guidelines).					



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PHOTO ID: 3c



PHOTO ID: 3d

<table>
<tr><th colspan="8">VEGETATION AREA 3</th></tr>
<tr><td>Classification</td><td colspan="7">A. FOREST</td></tr>
<tr><td>Types Identified</td><td colspan="7">Open forest A-03</td></tr>
<tr><td>Effective Slope</td><td>Measured</td><td colspan="2">d/slope 0-5 degrees</td><td colspan="2">Applied Range (Method 1)</td><td colspan="2">Downslope >0-5 degrees</td></tr>
<tr><td>Foliage Cover (all layers)</td><td colspan="2">30-70%</td><td>Shrub/Heath Height</td><td><2m</td><td>Tree Height</td><td>Up to 30m</td></tr>
<tr><td>Dominant & Sub-Dominant Layers (species as relevant)</td><td colspan="6">(Offsite) Forest vegetation associated with the River System (Mix of nonnative and native tree species)</td></tr>
<tr><td>Post Development Assumptions:</td><td colspan="6">Any retained vegetation or proposed revegetation/ landscaping works within the nominated Asset Protection Zone will be managed in accordance with the technical requirements established by the Schedule 1: ‘Standards for Asset Protection Zones (Guidelines).</td></tr>
<tr><td colspan="4"> 
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<tr><td colspan="4">PHOTO ID: 3e</td><td colspan="4">PHOTO ID: 3f</td></tr>
<tr><td colspan="4"> 
</td><td colspan="4"> 
</td></tr>
<tr><td colspan="4">PHOTO ID: 3g</td><td colspan="4">PHOTO ID: 3h</td></tr>
</table>

VEGETATION AREA 4				
Classification	**G. GRASSLAND**			
Types Identified	Sown pasture G-26			
Effective Slope	Measured	d/slope 0-5 degrees	Applied Range (Method 1)	Downslope >0-5 degrees
Dominant & Sub-Dominant Layers (species as relevant)	(Offsite) Grassland vegetation (Pasture Paddock)			



PHOTO ID: 4a



PHOTO ID: 4b



PHOTO ID: 4c



PHOTO ID: 4d

VEGETATION AREA 5	
Exclusion Clause	2.2.3.2 (e) Non-vegetated areas and (f) Low threat vegetation - minimal fuel condition.
Additional Justification:	(Onsite) Residential built out Areas (Lot 201) - Existing Structures, including Reticulated Gardens/ Managed Grassland in accordance with the AS3959 - 2018 Section 2.2.3.2 (f) Low Threat Vegetation.
Post Development Assumptions:	This area will continue to be managed in accordance with the technical requirements established by the Schedule 1: 'Standards for Asset Protection Zones (Guidelines).



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PHOTO ID: 5b



PHOTO ID: 5c



PHOTO ID: 5d

VEGETATION AREA 6	
Exclusion Clause	2.2.3.2 (e) Non-vegetated areas and (f) Low threat vegetation - minimal fuel condition.
Additional Justification:	(Offsite) Residential built out Areas - Existing Structures, including Reticulated Gardens/ Managed Grassland in accordance with the AS3959 - 2018 Section 2.2.3.2 (f) Low Threat Vegetation.
Post Development Assumptions:	This area will continue to be managed in accordance with the technical requirements established by the Schedule 1: 'Standards for Asset Protection Zones (Guidelines).



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PHOTO ID: 6b



PHOTO ID: 6c



PHOTO ID: 6d

A1.3: EFFECTIVE SLOPE

Measuring

Effective slope refers to the slope "under the classified vegetation which most significantly influences bushfire behaviour (AS 3959:2018, clause B4, CB4). It is not the average slope.

It is described as upslope, flat or downslope when viewed from the exposed element (e.g., building) looking towards the vegetation – and measured in degrees. Ground slope has a direct and significant influence on a bushfire's rate of spread and intensity, which increases when travelling up a slope.

The slope under the vegetation in closest proximity to the exposed element(s), over the distance that will most likely carry the entire depth of the flaming front, will be a significant consideration in the determination of the effective slope. This distance is determined as a function of the potential quasi-steady rate of spread and expected residence time (i.e., the flaming combustion period at a single point on the ground), of a bushfire in the specific vegetation type/landscape scenario.

Slope Variation Within Areas of Vegetation

Where a significant variation in effective slope exists under a consistent vegetation type, these will be delineated as separate vegetation areas to account for the difference in potential bushfire behaviour, in accordance with AS 3959:2018 clauses 2.2.5 and C2.2.5.

Slope Variation Due to Multiple Development Sites

When the effective slope, under a given area of bushfire prone vegetation, will vary significantly relative to multiple proposed development sites (exposed elements), then the effective slopes corresponding to each of the different locations, are separately identified.

The relevant (worst case) effective slope is determined in the direction corresponding to the potential directions of fire spread towards the subject building(s).

Differences in Application of Effective Slope - AS 3959:2018 Method 1 versus Method 2 Procedures

The Method 1 procedure provides five different slope ranges from flat (including all upslopes) to 20 degrees downslope to define the effective slope and bushfire behaviour model calculations apply the highest value in each range (i.e., 0^0, 5^0, 10^0, 15^0 or 20^0).

The Method 2 procedure requires an actual slope (up or down in degrees) to be determined. AS 3959:2018, clause B1 limits the effective slope that can be applied to 30 degrees downslope and 15 degrees upslope. Where any upslope is greater than 15 degrees, then 15 degrees is to be used.

SITE ASSESSMENT DETAILS - EXPLANATION & JUSTIFICATION

The effective slopes determined from the site assessment are recorded in Table 3.1 of this Bushfire Management Plan.

A1.4: SEPARATION DISTANCE

Measuring

The separation distance is the distance in the horizontal plane between the receiver (building/structure or area of land being considered) and the edge of the classified vegetation (AS 3959:2018, clause 2.2.4)

The relevant parts of a building/structure from which the measurement is taken is the nearest part of an external wall or where a wall does not exist, the supporting posts or columns. Certain parts of buildings are excluded including eaves and roof overhangs.

The edge of the vegetation, for forests and woodlands, will be determined by the unmanaged understorey rather than either the canopy (drip line) or the trunk (AS 3959:2018, clause C2.2.5).

Measured Separation Distance as a Calculation Input

If a separation distance can be measured because the location of the building/structure relative to the edge of the relevant classified vegetation is known, this figure can be entered into the BAL calculation. The result is a determined BAL rating.

Assumed Separation Distance as a Calculation Input

When the building/structure location within the lot is not known, an assumed building location may be applied that would establish the closest positioning of the building/structure relative to the relevant area of vegetation.

The assumed location would be based on a factor that puts a restriction on a building location such as:

- An established setback from the boundary of a lot, such as a residential design code setback or a restrictive covenant; or
- Within an established building envelope.

The resultant BAL rating would be indicative and require later confirmation (via a Compliance Report) of the building/structure actual location relative to the vegetation to establish the determined BAL rating.

Separation Distance as a Calculation Output

With the necessary site specific assessment inputs and using the AS 3959:2018 bushfire modelling equations, the range of separation distances that will correspond to each BAL rating (each of which represents a range of radiant heat flux), can be calculated. This has application for bushfire planning scenarios such as:

- When the separation distance cannot be measured because the exact location of the exposed element (i.e., the building, structure or area), relative to classified vegetation, is yet to be determined.

  In this scenario, the required information is the identification of building locations onsite that will correspond to each BAL rating. That is, indicative BAL ratings can be derived for a variety of potential building/structure locations; or

- The separation distance is known for a given building, structure or area (and a determined BAL rating can be derived), but additional information is required regarding the exposure levels (to the transfer of radiant heat from a bushfire), of buildings or persons, that will exist at different points within the subject site.

The calculated range of separation distances corresponding to each BAL rating can be presented in a table and/or illustrated as a BAL Contour Map – whichever is determined to best fit the purpose of the assessment.

For additional information refer to the information boxes in Section 3 'Bushfire Attack Levels (BAL) - Understanding the Results and Section 3.2. 'Interpretation of the BAL Contour Map'.

SITE ASSESSMENT DETAILS - EXPLANATION & JUSTIFICATION

For the subject development/use the applicable separation distances values are derived from calculations applying the assessed site data. They are an output value, not an input value and therefore are not presented or justified in this appendix. The derived values are presented in Section 3, Table 3.2 and illustrated as a BAL contour map in Figure 3.2.

APPENDIX B: ONSITE VEGETATION MANAGEMENT - THE APZ

THE ASSET PROTECTION ZONE (APZ) - DESCRIPTION

This is an area surrounding a habitable building containing either no fire fuels and/or low threat fire fuels that are managed in a minimal fuel condition. The primary objectives include:

- To ensure the building is sufficiently separated from the bushfire hazard to limit the impact of its direct attack mechanisms. That is, the dimensions of the APZ will, for most site scenarios, remove the potential for direct flame contact on the building, reduce the level of radiant heat to which the building is exposed and ensure some reduction in the level of ember attack (with the level of reduction being dependent on the vegetation types of present);
- To ensure any vegetation retained within the APZ presents low threat levels and prevents surface fire spreading to the building;
- To ensure other combustible materials that can result in consequential fire (typically ignited by embers) within both the APZ and parts of the building, are eliminated, minimised and/or appropriately located or protected. (Note: The explanatory notes in the Guidelines provide some guidance for achieving this objective and other sources are available. Research shows that consequential fire, ignited by embers, is the primary cause of building loss in past bushfire events); and
- To provide a defendable space for firefighting activities.

B1: The Dimensions and Location of the APZ to be Established and Maintained

UNDERSTANDING THE APZ PLANNING ASSESSMENT VERSUS ITS IMPLEMENTATION REQUIREMENTS

THE 'PLANNING BAL-29' APZ

It is important to understand is that the 'Planning BAL-29' APZ is not necessarily the size of the APZ that must be physically established and maintained by a landowner. It is a screening tool for making planning approval decisions.

The assessment against the Bushfire Protection Criteria is conducted for planning approval purposes. To satisfy acceptable solution 'A2.1: Asset Protection Zone', it must be demonstrated that certain minimum separation distances between the relevant building/structure and different classes of bushfire prone vegetation either exist or can be created and will remain in perpetuity.

The required minimum separation distances are those that will ensure the potential radiant heat impact on relevant existing or future buildings does not exceed 29 kW/m^2. The area of land contained within these separation distances is described as an Asset Protection Zone (APZ) and is to be comprised of non-vegetated land or low threat vegetation managed in a minimal fuel condition.

The applicable minimum separation distances will vary dependent on the vegetation types, the slope of the land they are growing on and other relevant factors specific to the site and its use.

The resulting 'Planning BAL-29' APZ dimensions may extend outside subject lot boundaries.

It is the purpose of the bushfire consultant's 'Supporting Assessment Detail', that is presented in the assessment against the acceptable solution A2.1, that will identify and justify how any offsite land within the 'Planning BAL-29 APZ (which the subject landowner has no authority or responsibility to manage), will meet the requirements of being either non-vegetated land or low threat vegetation managed in a minimal fuel condition and likely to remain in this state in perpetuity. Or otherwise, explain how this condition cannot be met.

It is the 'Planning BAL-29' APZ dimensions that will be stated in relevant tables and shown on maps as necessary in this BMP. The exceptions are the tables that are included within this appendix - when relevant to the subject lot(s) - which will present 'BAL Rating' and 'Landowner' APZ dimensions.

THE 'BAL RATING' APZ

The 'BAL Rating' APZ will ensure that the potential radiant heat exposure of the building/structure will be limited to the level that the applied construction requirements, (i.e., those corresponding to the building/structure's determined BAL rating), are designed to resist.

The minimum dimensions of the 'BAL Rating' APZ to be established and maintained will be those that correspond to the determined BAL rating for the specific building/structure. They will account for the specific conditions on and surrounding the subject lot.

The required dimensions of the 'BAL Rating' APZ establish the size of the APZ that must physically exist either entirely within a subject lot or in combination with an area of adjoining land.

If in combination with adjoining (offsite) land, it must be justified how the offsite land can most reasonably be expected to either remain unvegetated or be able to meet and maintain the APZ Standards in perpetuity, without any actions by the owner of the subject lot.

The applicable determined BAL rating will have been stated in the relevant assessment section of this BMP when it can be assessed as a 'determined' rather than 'indicative' rating. Otherwise, it will be shown on the BAL Certificate that is submitted as part of a building application.

THE 'LANDOWNER' APZ

Dimensions: The 'Landowner' APZ is to be established and maintained by the owner of the subject lot. The minimum dimensions are the 'BAL Rating' APZ dimensions except that they will be limited to the distance that they can be established within the subject lot. (Note: Any removal of native vegetation my require the approval of the relevant authority.

The remaining required separation distance outside the lot has been assessed by the bushfire consultant to be most likely to remain in a low threat state in perpetuity without any actions to be taken by the owner of the subject lot.

These minimum 'within the lot' APZ dimensions will only be greater when the relevant local government's annual firebreak / hazard reduction notice (issued under s33 of the Bushfires Act 1954), specifies the APZ dimensions to be applied within the lot and they are greater. Consequently, the 'Landowner' APZ dimensions can be a combination of the 'BAL Rating' Dimensions and the Local Government requirements. Check their annual notice for revisions to these requirements.

The dimensions of the 'Landowner' APZ establish the size of the APZ that must be established and maintained by the landowner within the subject lot.

Location: The 'Landowner' APZ for which the landowner has the responsibility to establish and maintain, is that which will exist entirely within the boundaries of the relevant lot, unless an approved formal and enforceable agreement allows them to manage a specified area of land external to the subject lot.

In most cases the landowner will only have authority and responsibility to establish and manage the APZ within the subject lot.

Otherwise, when there is a remaining part of the 'BAL Rating' APZ existing outside the subject lot, then these areas of land will, in most situations, include non-vegetated areas (e.g., roads / parking / drainage / water body), formally managed areas of vegetation (e.g., public open space / recreation areas / services installed in a common section of land) or an APZ on a neighbouring lot that is required to be established and maintained by the owner of that adjoining lot.

> *For vulnerable land uses, the 'BAL Rating' APZ and 'Landowner' APZ will also refer to the dimensions corresponding to radiant heat impact levels of 10 kW/m^2 and 2 kW/m^2 (calculated using 1200K flame temperature).*
>
> *For development applications only, the 'Landowner' APZ dimensions are also shown on the Property Bushfire Management Statement in Section 6.3.1 of this BMP when it is a required component of the Bushfire Management Plan.*

Table B1.1: The applicable 'Landowner' APZ Dimensions when indicative BAL ratings have been established by the BMP.

THE 'LANDOWNER' APZ DIMENSIONS TO BE ESTABLISHED AND MAINTAINED							
Relevant Works	Classified Vegetation Refer to Fig 3.1	Minimum Required Separation Distances (m) - Building to Vegetation					
		The 'BAL Rating' APZ Corresponding to the Stated 'Indicative' BAL				As Directed by the Applicable Year Local Government Firebreak / Hazard Reduction Notice	The 'Landowner' APZ (limited to the subject lot boundary unless otherwise justified)
		BAL-29	BAL-19	BAL-12.5	BAL-LOW		
All Proposed Buildings, Structures	Area 1 (Forest)	27	37	50	100	20	Will be dependent on the subsequent 'Determined' BAL rating. It is then to be calculated as the greater of the 'BAL Rating' distance or the 'Firebreak Notice' distance, and no greater than the distance to the lot boundary.
	Area 2 (Grassland)	8	12	17	50	20	
	Area 3 (Forest)	27	37	50	100	20	
	Area 4 (Grassland)	9	14	20	50	20	

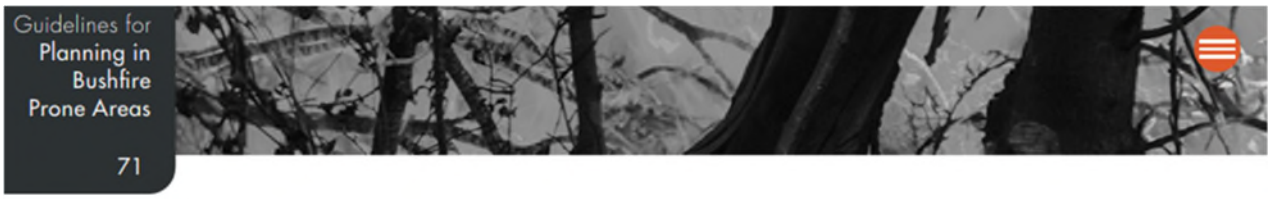
Comments:

The Asset protection zone can meet s2.2.3.2 exclusion requirements of AS 3959-2018. The APZ will be entirely contained within the subject lot boundary (Lot 201 – Figure 3.1.1).

B2: The Standards for the APZ as Established by the Guidelines (DPLH, v1.4)

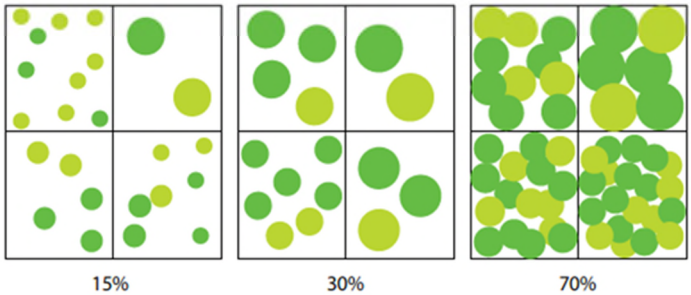
Within the Guidelines (source: https://www.wa.gov.au/government/document-collections/state-planning-policy-37-planning-bushfire-prone-areas), the management Standards are established by:

- Schedule 1: Standards for Asset Protection Zones (see extract below) established by the Guidelines; and
- The associated explanatory notes (Guidelines E2) that address (a) managing an asset protection zone (APZ) to a low threat state (b) landscaping and design of an asset protection zone and (c) plant flammability.



ELEMENT 2: SITING AND DESIGN OF DEVELOPMENT

SCHEDULE 1: STANDARDS FOR ASSET PROTECTION ZONES

OBJECT	REQUIREMENT
Fences within the APZ	• Should be constructed from non-combustible materials (for example, iron, brick, limestone, metal post and wire, or bushfire-resisting timber referenced in Appendix F of AS 3959).
Fine fuel load (Combustible, dead vegetation matter <6 millimetres in thickness)	• Should be managed and removed on a regular basis to maintain a low threat state. • Should be maintained at <2 tonnes per hectare (on average). • Mulches should be non-combustible such as stone, gravel or crushed mineral earth or wood mulch >6 millimetres in thickness.
Trees* (>6 metres in height)	• Trunks at maturity should be a minimum distance of six metres from all elevations of the building. • Branches at maturity should not touch or overhang a building or powerline. • Lower branches and loose bark should be removed to a height of two metres above the ground and/or surface vegetation. • Canopy cover within the APZ should be <15 per cent of the total APZ area. • Tree canopies at maturity should be at least five metres apart to avoid forming a continuous canopy. Stands of existing mature trees with interlocking canopies may be treated as an individual canopy provided that the total canopy cover within the APZ will not exceed 15 per cent and are not connected to the tree canopy outside the APZ. **Figure 19:** Tree canopy cover – ranging from 15 to 70 per cent at maturity  15% 30% 70%

Shrub* and scrub* (0.5 metres to six metres in height). Shrub and scrub >6 metres in height are to be treated as trees.	• Should not be located under trees or within three metres of buildings. • Should not be planted in clumps >5 square metres in area. • Clumps should be separated from each other and any exposed window or door by at least 10 metres.
Ground covers* (<0.5 metres in height. Ground covers >0.5 metres in height are to be treated as shrubs)	• Can be planted under trees but must be maintained to remove dead plant material, as prescribed in 'Fine fuel load' above. • Can be located within two metres of a structure, but three metres from windows or doors if >100 millimetres in height.
Grass	• Grass should be maintained at a height of 100 millimetres or less, at all times. • Wherever possible, perennial grasses should be used and well-hydrated with regular application of wetting agents and efficient irrigation.
Defendable space	• Within three metres of each wall or supporting post of a habitable building, the area is kept free from vegetation, but can include ground covers, grass and non-combustible mulches as prescribed above.
LP Gas Cylinders	• Should be located on the side of a building furthest from the likely direction of a bushfire or on the side of a building where surrounding classified vegetation is upslope, at least one metre from vulnerable parts of a building. • The pressure relief valve should point away from the house. • No flammable material within six metres from the front of the valve. • Must sit on a firm, level and non-combustible base and be secured to a solid structure.

** Plant flammability, landscaping design and maintenance should be considered – refer to explanatory notes*

B3: The Standards for the APZ as Established by the Local Government

Refer to the firebreak / hazard reduction notice issued annually (under s33 of the Bushfires Act 1954) by the relevant local government. It may state Standards that vary from those established by the Guidelines and that have been endorsed by the WAPC and DFES as per Section 4.5.3 of the Guidelines.

A copy of the applicable notice is not included here as they are subject to being reviewed and modified prior to issuing each year. Refer to ratepayers notices and/or the local government's website for the current version.

B4: Maintaining Low Threat and Non-Vegetated Areas Excluded from Classification

AS 3959 establishes the methodology for determining a bushfire attack level (BAL). The methodology includes the classification of the subject site's surrounding vegetation according to their 'type' and the application of the corresponding bushfire behaviour models to determine the BAL. Certain vegetation can be considered as low threat and excluded from classification. Where this has occurred in assessing the site, the extract from AS3959:2018 below state the requirements (including the size of the vegetation area if relevant to the assessment) for maintenance of those areas of land.

2.2.3.2 *Exclusions—Low threat vegetation and non-vegetated areas*

The following vegetation shall be excluded from a BAL assessment:

(a) Vegetation of any type that is more than 100 m from the site.

(b) Single areas of vegetation less than 1 ha in area and not within 100 m of other areas of vegetation being classified vegetation.

(c) Multiple areas of vegetation less than 0.25 ha in area and not within 20 m of the site, or each other or of other areas of vegetation being classified vegetation.

(d) Strips of vegetation less than 20 m in width (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20 m of the site or each other, or other areas of vegetation being classified vegetation.

(e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops.

(f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks.

NOTES:

1 Minimal fuel condition means there is insufficient fuel available to significantly increase the severity of the bushfire attack (recognizable as short-cropped grass for example, to a nominal height of 100 mm).

2 A windbreak is considered a single row of trees used as a screen or to reduce the effect of wind on the leeward side of the trees.

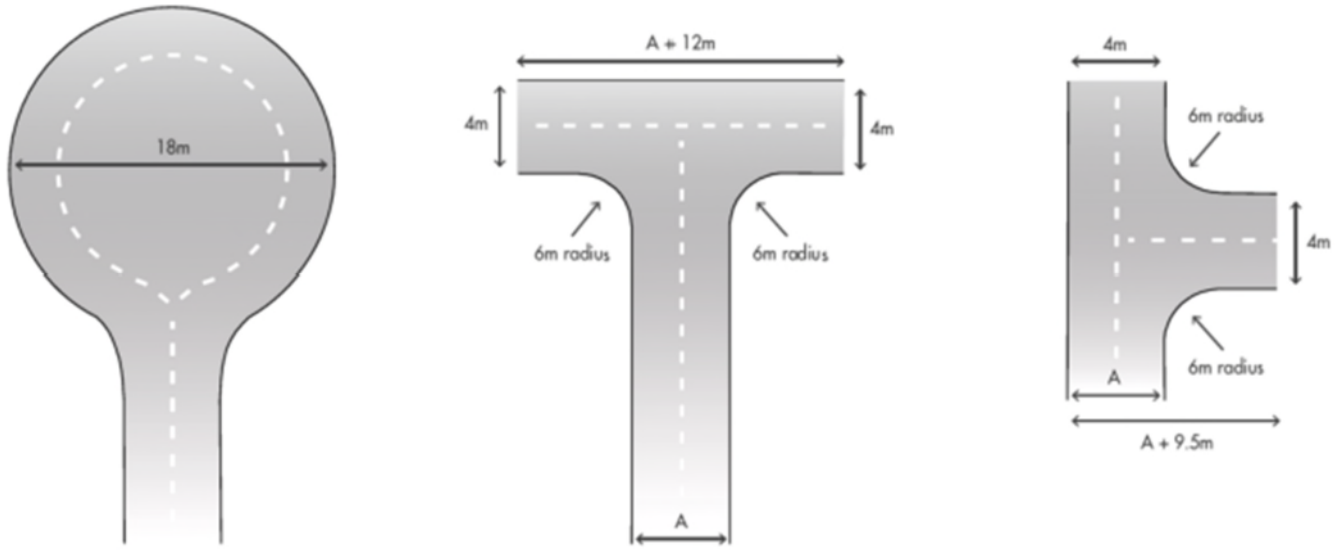
APPENDIX C: TECHNICAL REQUIREMENTS FOR VEHICULAR ACCESS

The design/layout requirements for access are established by the acceptable solutions of the Guidelines (DPLH, 2021 v1.4) Element 3 and vary dependent on the access component, the land use and the presence of 'vulnerable' persons. Consequently, the best reference source are the Guidelines. The technical requirements that are fixed for all components and uses are presented in this appendix.

GUIDELINES TABLE 6, EXPLANATORY NOTES E3.3 & E3.6 AND RELEVANT ACCEPTABLE SOLUTIONS

Technical Component	Vehicular Access Types / Components			
	Public Roads	Emergency Access Way [1]	Fire Service Access Route [1]	Battle-axe and Private Driveways [2]
Minimum trafficable surface (m)	In accordance with A3.1	6	6	4
Minimum Horizontal clearance (m)	N/A	6	6	6
Minimum Vertical clearance (m)	4.5			
Minimum weight capacity (t)	15			
Maximum Grade Unsealed Road [3]	As outlined in the IPWEA Subdivision Guidelines	1:10 (10%)		
Maximum Grade Sealed Road [3]		1:7 (14.3%)		
Maximum Average Grade Sealed Road		1:10 (10%)		
Minimum Inner Radius of Road Curves (m)		8.5		

Turnaround Area Dimensions for No-through Road, Battle-axe Legs and Private Driveways [4]



Passing Bay Requirements for Battle-axe leg and Private Driveway

When the access component length is greater than the stated maximum, passing bays are required every 200m with a minimum length of 20m and a minimum additional trafficable width of 2m (i.e. the combined trafficable width of the passing bay and constructed private driveway to be a minimum 6m).

Emergency Access Way – Additional Requirements

Provide a through connection to a public road, be no more than 500m in length, must be signposted and if gated, gates must be open the whole trafficable width and remain unlocked.

[1] To have crossfalls between 3 and 6%. Where driveways and battle-axe legs are not required to comply with the widths in A3.5 or A3.6, they are to comply with the Residential Design Codes and Development Control Policy 2.2 Residential Subdivision. Dips must have no more than a 1 in 8 (12.5% or 7.1 degree) entry and exit angle.

[4] The turnaround area should be within 30m of the main habitable building.

APPENDIX D: TECHNICAL REQUIREMENTS FOR FIREFIGHTING WATER SUPPLY

D1: Reticulated Areas – Hydrant Supply

The Guidelines state "where a reticulated water supply is existing or proposed, hydrant connection(s) should be provided in accordance with the specifications of the relevant water supply authority."

The main scheme water suppliers / authorities in WA are The Water Corporation, AqWest – Bunbury Water Corporation and Busselton Water Corporation. Various local authority exists in other non-scheme and regional areas. However, most existing fire hydrants are connected to Water Corporation water mains.

Consequently, the hydrant location specifications from The Water Corporation's 'No 63 Water Reticulation Standard' (Ver 3 Rev 15) are provided in the extract below with the key distances relevant to bushfire planning assessments being highlighted. This Standard is deemed to be the baseline criteria for developments and should be applied unless different local water supply authority conditions apply. Other applicable specification will be found in the Standard.

Note: The maximum distance from a hydrant to the rear of a lot/building is generally interpreted as not applicable to large lot sizes where the maximum distance becomes an impractical limitation i.e., typically rural residential areas.

2.2.1.5 Appurtenances

c. Hydrants

Hydrants shall be screw-down hydrant with built-in isolation valve and installed only on DN100 or larger pipes. Hydrants shall be located:

- 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 120m;
- so that spacing (as measured by hose-run) between hydrants in non-residential or mixed use areas shall be maximized and no greater than 100m;
- so that spacing (as measured by hose-run) between hydrants in residential areas with lots per dwelling <10,000m² shall be maximized and no greater than 200m;
- so that spacing between hydrants (as measured by hose-run) in rural residential areas where minimum lots per dwelling is >10,000 m² (1ha) shall be maximized and no greater than 400m;
- centrally along the frontage of a lot to avoid being under driveways, unless the lot features a frontage 6m or less, in which case it shall be placed to the side opposite the driveway;
- at lots that have the widest frontage in the local area;
- where appropriate at the truncation of road junctions or intersections so that they can serve more than one street and can be readily located;
- on both sides of the major roads at staggered intervals where there are mains on both sides of the road;
- at major intersections on dual multi-lane roads, where two hydrants are to be sited on diagonally opposite corners;
- hydrants should be located at least 20m from traffic calming devices i.e., median slow points or chokers, chicanes, mini traffic circles, and intersection 'pop-outs' to ensure traffic is not impeded;
- in a position not less than 10m from any high voltage main electrical distribution equipment such as transformers and distribution boards, liquefied petroleum gas or other combustible storage;
- directly on top of the main using a tee unless proved to be impractical.

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APPENDIX E: LANDSCAPE MANAGEMENT PLAN

LANDSCAPE MANAGEMENT PLAN					
No.	Implementation Action	Timing	Responsibility	Clearance	Comment
1	Where Practical, maintain compliance with the DFES Fact Sheet – "Preparing Your Property"	Ongoing in Perpetuity	Proponent/ Caretaker	☐	
2	An Asset Protection Zone (Figure 3.1.1) will be installed and maintained as outlined in the BMP. TREES: (> 5m in height): trunks at maturity should be a minimum distance of 6 metres from a building, branches at maturity should not touch or overhang the building, lower branches should be removed to a height of 2m above the ground and or surface vegetation, canopy cover should be less than 15% with tree canopies at maturity well spread to at least 5m apart as to not form a continuous canopy. (unless managed gardens). SHRUBS & GROUND COVERS: No tall shrubs or trees should be located within two (2) metres of a building -unless reticulated – managed gardens). Smaller shrubs should not be located under trees or within 3 metres of the building, should not be planted in clumps greater than 5m2 in area, clumps of shrubs should be separated from each other. Shrubs >than 5 metres in height are to be treated as trees. (unless managed gardens).	Ongoing in Perpetuity	Proponent/ Caretaker	☐	
3	Any Grass/ lawn or leaf litter (within Development Area – Lot 201) should either be slashed, mowed, reticulated or managed to a height no greater than 5 cm across the site (Figure 1.1).	Ongoing in Perpetuity	Proponent/ Caretaker	☐	
4	All building gutters and rooftops (within Development Area – Lot 201) should be free of excessive twigs, leaves, grass etc.	Every 6 months	Proponent/ Caretaker	☐	
5	All overhanging branches, trees, limbs (within Development Area – Lot 201) should be trimmed back from the firebreak/ driveways/access roads to a minimum height of four metres.	Every 12 months	Proponent/ Caretaker	☐	



PREPARING YOUR **PROPERTY**

FIREFIGHTERS WILL BE TOO BUSY FIGHTING FIRES ON THE FRONTLINE TO BE ABLE TO DEFEND YOUR HOME AND PROPERTY.
To reduce the spread of fire and provide some shelter, start preparing your property by completing this Property Preparation Checklist.

PROPERTY UPKEEP

Set calendar reminders to complete these preparations monthly **during fire season**.

- ◯ Cut the grass around your property to 10cm or less.
- ◯ Prune shrubs so they are not dense.
- ◯ Ensure gas cylinders are chained/ secured upright.
- ◯ Check gas release valves face away from property.
- ◯ Clean gutters.

For more information visit
dfes.wa.gov.au/bushfire
or contact DFES Community Preparedness:
Community.Preparedness@dfes.wa.gov.au
or **9395 9816**

LASTING PROTECTION

Set calendar reminders to complete these preparations **annually**.

- ◯ Keep gas cylinders away from likely direction of fire (i.e. where bush is) and turn release valves outwards.
- ◯ Remove shrubs, wood, mulch or any flammable material, against or near the house.
- ◯ Block any gaps under floor, in the roof spaces, under eaves, external vents, skylights, chimneys and wall claddings.
- ◯ Install metal fly wire mesh on all windows, vents and install a protective screen on evaporative air conditioner.
- ◯ Create a mineral earth firebreak along the boundary of your property.
- ◯ Install a fire or heat radiant shield such as a solid fence.

RURAL PROTECTION

Complete these preparations **if you own a rural property**.

- ◯ Make sure fire trucks can access and turn around on your property.
- ◯ Check bridge loading and cattle grid loading for fire truck access.
- ◯ Create fire breaks along paddock boundaries.
- ◯ Store petrol and gas safely.
- ◯ Install underground water pumps that lead from dams to the house.
- ◯ If a fire threatens, move livestock to a well grazed paddock.
- ◯ Check generator and pumps are working.

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November/2021/V1.0

GOVERNMENT OF WESTERN AUSTRALIA
DFES Department of Fire & Emergency Services

HOW FIREPROOF IS YOUR PLAN?

Foreshore Reserve Lot 200 Turner Street Boyanup

Foreshore Management Plan



Kathryn Kinnear

Bio Diverse Solutions

17/12/2014

DOCUMENT CONTROL

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Bio Diverse Solutions
55 Peppermint Drive
Albany WA 6330

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APPENDICES

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Appendix C – DPaW Geomorphic wetland mapping
Appendix D – Vegetation Mapping
Appendix E – Revegetation plan
Appendix F – Foreshore Master Plan
Appendix G – Aboriginal Heritage site report

1. Foreshore Management Checklist

Foreshore Management Item	Deliverable	Notes
Aboriginal Sites and Heritage		
Aboriginal sites are protected by legislation	Check of DIA database	Preston River a registered DIA site, See Appendix G.
Drainage Hydrology		
Foreshore area ceded with WAPC (lot 200) no drainage in subject site.	No stormwater infrastructure in the foreshore area.	Detailed engineering design for adjacent development lot 201.
Erosion		
Processes of erosion and accretion need to be determined, methods of reducing identified.	Methods in revegetation to reduce erosion in bare areas.	Detailed landscaping and engineering design to include detail on roads and infrastructure.
Fauna habitat		
Measures should be taken to maintain or enhance native fauna habitats.	Existing native vegetation to be retained to increase diversity of the areas. Fauna habitat retained and increased through revegetation strategies.	Native Vegetation to be retained. Long term Monitoring Plan Section 16.
Fire Management		
Provision should be made to minimise the likelihood of wildfires and provide access in times of fire.	Detailed Bushfire Management Plan prepared by Bio Diverse Solutions. Aligned to AS3959 and Planning for Bushfire Protection Edition 2 2010.Unimpeded access around foreshore areas.	Refer to Detailed Bushfire Management Plan (2014) Bio Diverse Solutions.
Flooding		
All facilities located outside of floodway.	No infrastructure located within floodway or foreshore area.	Stormwater Section 13
Foreshore Vegetation		
Enhancement and management of native vegetation	Increase biodiversity and native vegetation in foreshore area. Weed management & revegetation	Monitoring Plan Section 16.
Land tenure		
Foreshore consolidated into one reserve and vested with one agency.	Foreshore area ceded with WAPC and will be the responsibility of the Shire of Capel.	Foreshore Master Plan Appendix F.
Landscape		
Natural landscape features should be protected and “linked” with surrounding areas	Revegetation of foreshore areas increases bush corridors and ecological linkages.	Revegetation Plan Appendix E & Foreshore Master Plan Appendix F.

Mosquitoes		
Mosquito Control Measures should ensure wetland areas are protected	No standing water bodies, seasonal in Winter, spring receding in floodway's.	Monitoring Plan Section 14.
Management of disease vectors and nuisance insects	Monitoring during and post development	Monitoring Plan Section 14.
Nutrient Export		
Measures taken to minimise export into the waterway.	Deep sewer for effluent disposal, all storm water treated on site.	Geotechnical and Soil Testing Report.
Public Access & Recreation		
Access restricted to defined nodes in order to protect important flora and fauna habitats in Preston River.	Public Access along foreshore paths	River Ramble DUP, See Foreshore Master Plan Appendix F.
Reserve Boundaries		
Reserve should be physically defined.	Foreshore area defined, ceded with WAPC.	See Mapping Appendix A.
Soil Types		
Suitable for vegetation establishment and identify any nutrient leaching problems	Revegetation species aligned to soil types present and existing revegetation strategies in adjacent foreshore areas.	Geotechnical and Soil Testing Report. Section 5.
Stormwater Disposal		
As per Stormwater Management Manual 2009 (DoW)	All stormwater infrastructure located outside of the foreshore (lot 200). Refer to detailed Engineering and Stormwater Management.	Refer to detailed engineering designs for Meadowbrook Estate.
Utility Services		
Corridors for utility Services defined	Refer to detailed engineering designs, no infrastructure requirement within foreshore area.	Refer to detailed engineering designs.
Water Features		
Where proposed an assessment of water quality is required.	Nil Proposed.	
Water Quality		
Measures to ensure ongoing satisfactory water quality should be developed.	Water quality will be improved through increased vegetation cover.	Revegetation Plan Appendix E.
Weed and Feral Animal Control		
Environmentally safe and cost effective measures for weed species and feral animals	Weed Management Plan for control and spread of weeds.	Section 8.

1.1. Introduction

Preston Green Pty Ltd commissioned Bio Diverse Solutions (Environmental Consultants) to prepare a Foreshore Management Plan of Lot 200 adjacent to Meadowbrooke Estate (now Lot 201, formerly Lot 888) Turner Street, Boyanup within the Shire of Capel. The Foreshore Management Plan (FMP) was a condition of the successful rezoning of the site (previous owners) and a current commitment from Preston Green Pty Ltd (current owners) to undertake as part of a Development Approval being lodged in 2014.

Other reports/documents which have been prepared which relate to this project include:

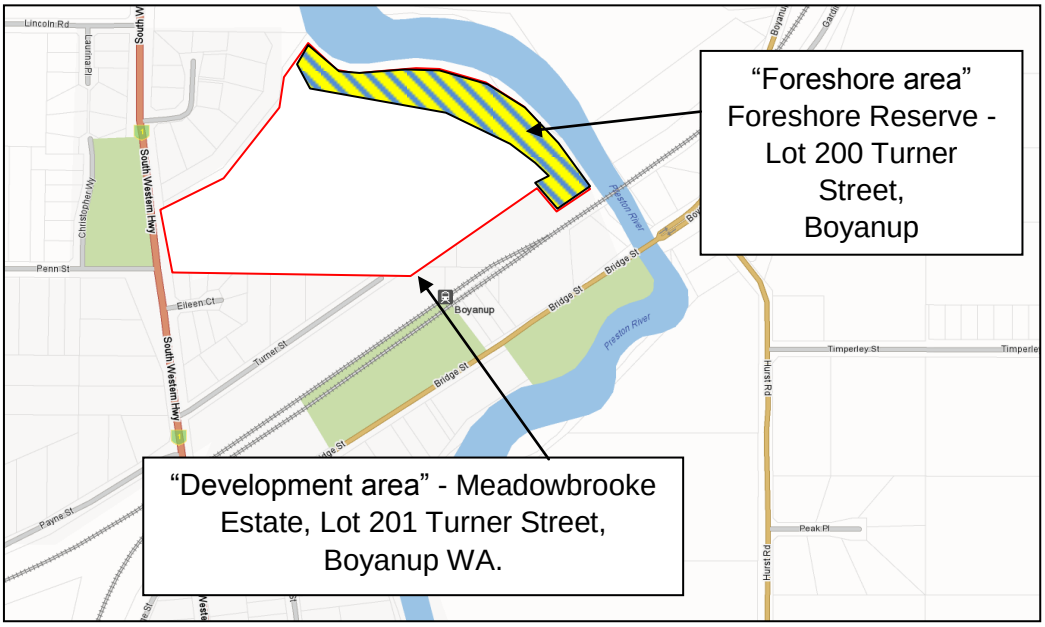
- Bushfire Management Plan (Bio Diverse Solutions, 2014)
- Engineering and stormwater designs (MPM Development Consultants);
- Preston River Flood Study Meadowbrooke Estate Boyanup, Hyd$_2$o, 2014;
- Structure Plan/Rezoning documentation; and
- Shire of Capel TPS 7.

These reports should be consulted individually as required.

1.2. Site details

The foreshore (Lot 200) reserve ("the foreshore area") adjacent to Meadowbrooke Estate, Lot 201 Turner Street Boyanup ("the development site") is located approximately 20km south east of Bunbury along the Preston River in the locality of Boyanup (approximately 700m north of Boyanup town site) in the municipality of the Shire of Capel. The foreshore area is 2.1293ha in size and the development site of Meadowbrooke Estate is 9.0568 ha. Please refer to Figure 1 below - Locality map and Location mapping Appendix A.

Figure 1 – Subject site locality



1.3. Development proposal

It is proposed that Meadowbrooke Estate will be developed to create a lifestyle village designated under the *Caravan Parks and Camping Grounds Act 1995.* The land is currently zoned Special Use Zone under Shire of Capel TPS 7. This report will support a Development Approval process with the Shire of Capel. Please refer to Concept Plan Appendix B.

As part of the previous rezoning of the property to Special Use under TPS 7, there was a requirement from the Shire of Capel for the proponent to prepare and implement a Foreshore Management Plan. This FMP report is to for-fill this requirement and has been prepared in consultation with the Department of Water (DoW), Capel Land Care District Committee (Capel LCDC) and the Shire of Capel (SoC).

This FMP relates to foreshore area of the Preston River (Lot 200) presently designated with the Western Australian Planning Commission (WAPC) along the boundary of Meadowbrooke Estate, Lot 201 Turner Street, Boyanup. This report does not address any other environmental concerns outside the foreshore/impact area of the ceded foreshore reserve of lot 200. Refer to Landgate cadastre as provided by SoC, Appendix A, (Landgate, 2014).

1.4. History and current site land use

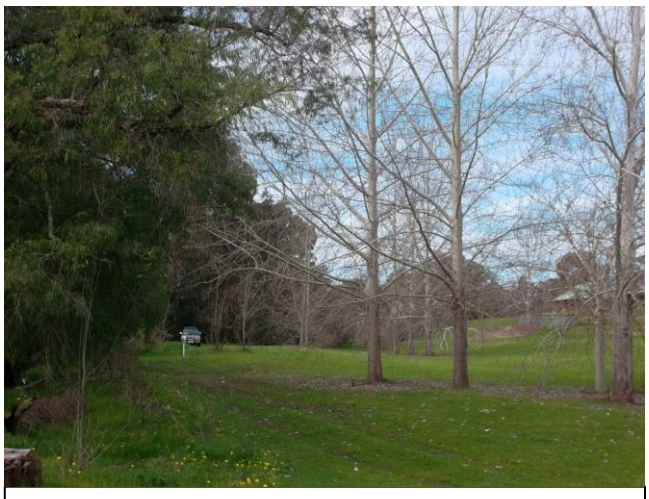
The foreshore area was historically part of Meadowbrooke Estate, Lot 201 Turner Street (formerly lot 888), Boyanup. In the rezoning process a portion of the foreshore (now Lot 200) was relinquished back to the state WAPC, with final designation going to the Shire of Capel. An easement in gross also occurs over lot 200 with the designation with the "Shire of Capel" and Public at Large" for the purpose of "Public Access" (Landgate, 2014) for the purpose of the "Preston River Ramble Walk".

Meadowbrooke Estate has previously been used as a function centre and cabin/chalet accommodation. The grounds of Meadowbrooke Estate are predominantly cleared paddock/grasslands which is maintained through landscaping, mowing and slashing. Management of the foreshore area has been minimal with some weed management along the Preston River foreshore by the Capel LCDC (*Pers comms*. R. McPherson, 2014).

Adjacent to the foreshore area is Unallocated Crown Land (UCL) to the north, Reserve 8333 (north) along the foreshore of the Preston River, Railway Reserve to the south and Reserve 44252 to the north west (Landgate, 2014). Further to the north, private rural land use abuts the foreshore area with pasture and paddocks for grazing. The Preston River flows from the south east to the north west of the subject site. Please refer to Photographs 1 and 2 below.



Photograph 1 – View of the Preston River flowing to the north west from the banks.



Photograph 2 – View of the foreshore area (subject site) Lot 200.

1.5. Aims and objectives

The purpose of this FMP is to provide a mechanism for coordinating and implementing management and protection of the foreshore area (lot 200) along the Preston River based on site characteristics, the impact of surrounding development of Meadowbrooke Estate on the foreshore and the environmental significance of the study area.

The objectives of this plan are to:

- Provide the Developer guidance on remnant vegetation to be protected during the Development process of Meadowbrooke Estate;
- Provide a framework for implementing further revegetation works and weed management across the allocated section of the Preston River adjacent to Meadowbrooke Estate;
- Increase catchment health for downstream wetlands through revegetation and foreshore protection;
- Assist the future landowner (SoC) with managing the foreshore area;
- Provide protection to the Preston River foreshore and increase future biodiversity values to the foreshore area; and
- Increase community involvement along the section of Preston River foreshore.

1.6. Stakeholder and community consultation

Community consultation has not occurred for the preparation of this plan. Stakeholder engagement included informal discussions with the following representatives:

- Capel LCDC;
- Shire of Capel (SoC);
- Department of Fire and Emergency Services (DFES); and
- Department of Water (DoW).

An initial site walk over was held with MPM Development Consultants, Bio Diverse Solutions, SoC and DoW on the 12th August 2014.

1.7. Alignment to Legislation, Policy and Guidelines

In assessing the survey area, Bio Diverse Solutions has prepared this report aligned to the following legislation, please refer to Table 1.

Table 1–Government Legislation Applicable to the Proposal

Legislation	Responsible Government Agency	Aspect
Biosecurity and Agriculture Management Act 2007 (BAM Act)	Department of Agriculture, Western Australia	Weeds and feral pest animals
Conservation and Land Management Act 1984	Department of Parks and Wildlife	Wetlands/Flora and fauna / habitat /weeds / pests / diseases
Environmental Protection Act 1986 (Part IV)	Office of the Environmental Protection Authority	Assessment and Management Environmental Impact
Environmental Protection (Clearing of Native Vegetation) Regulations 2004	Department of Environmental Regulation	Clearing of native vegetation
Local Government Act 1995	Shire of Capel	Town planning approvals
Soil and Land Conservation Act 1945	Department of Agriculture and Food	Protection of soil resources
Wildlife Conservation Act 1950	Department of Parks and Wildlife	Protection of indigenous wildlife
The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).	The Commonwealth Department of Environment.	Protection of Vulnerable and Threatened species of national significance
Aboriginal Heritage Act 1972 (AH Act)	Department of Indigenous Affairs	Protection of aboriginal heritage sites

2. Regional Open Space boundary

The newly ceded foreshore adjacent to Meadowbrooke Estate will form part of the Shire of Capel's future Regional Open Space. Refer to Figure 2 outlining the foreshore reserve.

Figure 2 – Foreshore area Lot 200 Turner Street, Boyanup



Information supplied by the Shire of Capel (C.Burwood, SoC 2014) regarding the foreshore area in question:

- *The foreshore (Lot 200) area consists of a combination of ownership being the Western Australian Planning Commission, UCL (Lands Department)and reserve for public recreation (reserve 44252) (vested to the Shire of Capel through the Lands Department);*
- *The Shire has an easement over the existing path in the WAPC lot and a licence over the paths within the UCL .The easement and licence provides a four metre wide management area measured 2 metres either side of the centreline of the path.*
- *The Shire has a Management Order over Reserve 8333 which adjoins the northern end of the management plan area and which has been the subject of rehabilitation and management by the Capel Land Care District Committee.*

Please refer to the copy of the Landgate query undertaken by the SoC, Appendix A.

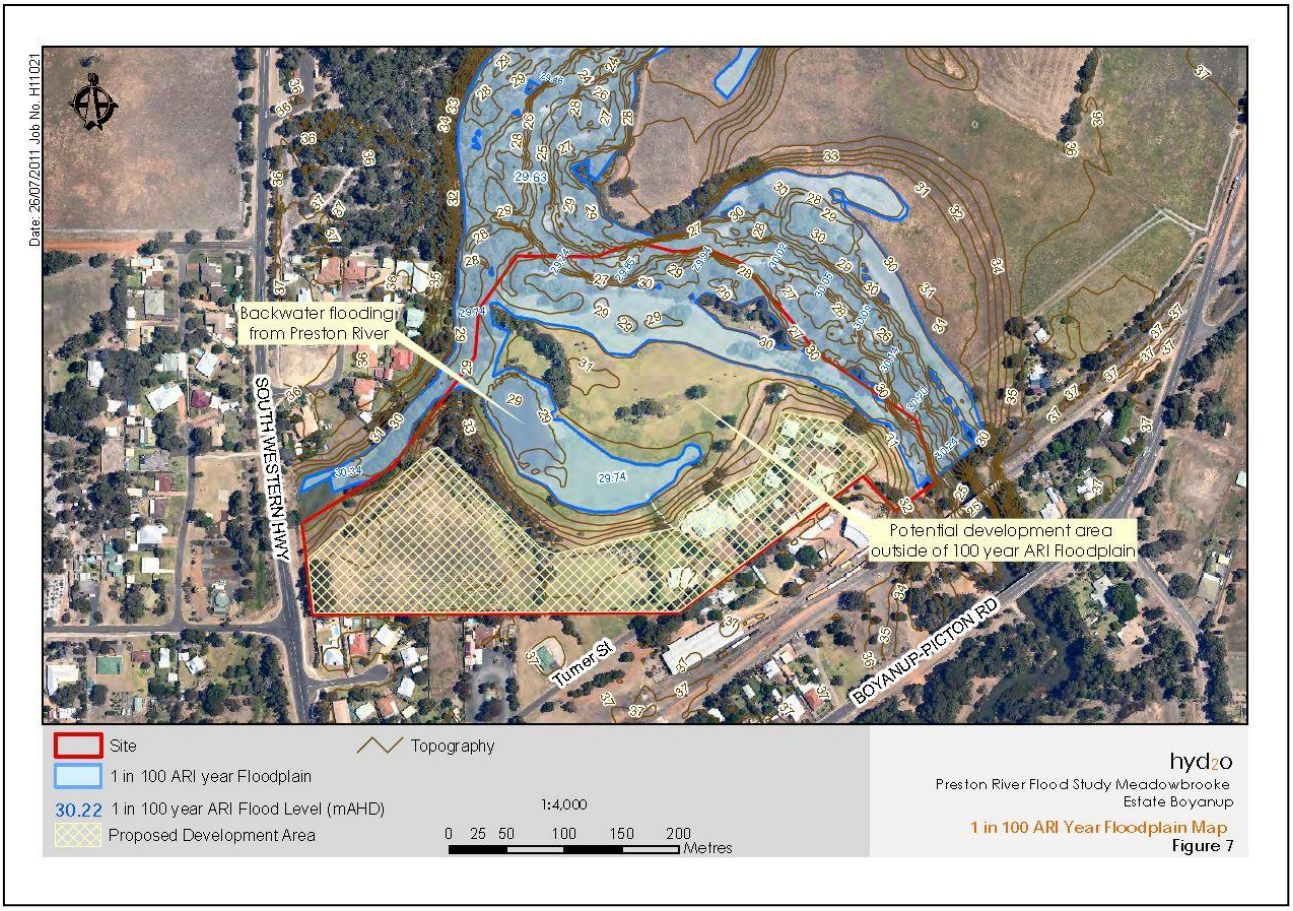
3. 1:100 year ARI

Hyd_2o was commissioned to undertake a flood study of the section of the Preston River. The report considered the impact on flood levels of the flow from the local catchment and the tributary near the north western boundary of the site which flows to the Preston River. No prior records exist from the DoW on peak estimates or flood levels for Boyanup.

Hyd_2o floodplain mapping is shown in Figure 3, which indicates the flooding potential in relation to existing surface levels based on LiD AR data and the proposed development area of Meadowbrooke Estate (Hyd_2o, 2014).

The flooding potential of the Preston River is essentially in the ceded foreshore area which this report focuses on. For more detail on the analysis and the modelling please refer to the Hyd_2o report in full.

Figure 3 – 100 year Flood Mapping Hyd_2o, 2014



4. Preston River Values

The Preston River is located within the southern area of the Leschenault Catchment and has a total catchment area of 957.8 square kilometres. The Preston River is approximately 98km long, extending 61km inland from the coast. The Preston River is one of the six major rivers in the south west region. The Preston River ranges from a saline – brackish waterway in its lower reaches at the southern end of the Leschenault Estuary to a freshwater permanently flowing waterway in the higher rainfall areas on the Darling Scarp. (Derrington, 2007)

The majority of the river catchment has been cleared for agriculture although some remnant forest vegetation exists at the headwaters. The towns of Donnybrook and Boyanup are on the shores of the Preston River. The major tributaries of the river include the Ferguson River and Joshua Creek. Minor tributaries include Thomson Brook, Crooked Brook, Charley Creek, Waterfall Gully, Mininup Brook, Millbrook and Gavin Gully. The Glen Mervyn Dam is along the Preston River.

The river basin is monitored routinely as a result of eutrophication problems within the Leschenault Inlet. The water quality is fresh in many places and generally low in nutrients although some areas are slightly enriched with nitrogen.

A tributary from the west merges along the northern boundary of the foreshore area. The main central channel area is sparsely covered with sedges with minimal floristic diversity. Tree Canopy cover is good in the riverbank areas of the Preston River with weed control historically undertaken by the Capel LCDC. Please refer to Photographs 3 and 4 below, and 5 to 8 over the page.



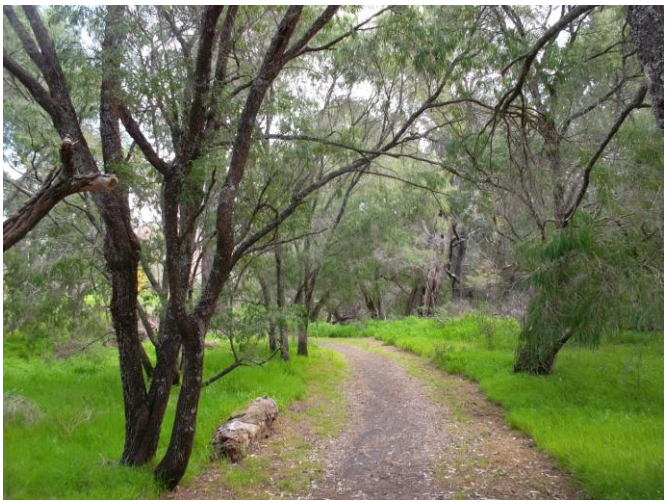
Photograph 3 – View of main edge of bank, minimal understorey species but good tree canopy cover. River Ramble walk in foreground.



Photograph 4 – View of Preston River and river banks.



Photograph 5 – View of fringing in-tact vegetation.



Photograph 6 – View of Preston River Walk trail

4.1. Conservation Values

A search of the Geomorphic Wetlands Swan Coastal Plain Dataset was undertaken revealing 4 Geomorphic Wetlands within the survey area. Geomorphic wetlands are assigned 3 Conservation Management Categories, please refer to Table 2.

Table 2 – Wetland Management Categories

Management Category	General Description	Management Objectives
Conservation	Wetlands which support a high level of attributes and functions.	Highest priority wetlands. Objective is to preserve and protect the existing conservation values of the wetlands through various mechanisms including: • reservation in national parks, crown reserves and State owned land, • protection under Environmental • Protection Policies, and • wetland covenanting by landowners. No development or clearing is considered appropriate. These are the most valuable wetlands and any activity that may lead to further loss or degradation is inappropriate.
Resource Enhancement	Wetlands which may have been partially modified but still support substantial ecological attributes and functions	Priority wetlands. Ultimate objective is to manage, restore and protect towards improving their conservation value. These wetlands have the potential to be restored to Conservation category. This can be achieved by restoring wetland function, structure and biodiversity. Protection is recommended through a number of mechanisms.
Multiple Use	Wetlands with few remaining important attributes and functions	Use, development and management should be considered in the context of ecologically sustainable development and best management practice catchment planning through landcare.

(DPaW, 2014)

The mapped geomorphic wetlands within the survey area included:
(Unique Feature Identifier (UFI)/Conservation Category/Location):

- UFI 14501/Resource Enhancement/north – Preston River
- UFI 1583/ Multiple Use /north in foreshore area (lot 200) and the Preston River
- UFI 1582/ Multiple Use /south of foreshore area (lot 200) in development area; and
- UFI 1589/Multiple Use/over development area

A mapped copy of the DPAW Geomorphic wetlands is provided in Appendix C.

The current values currently associated with the Preston River include:

- Biodiversity - Remnant riparian vegetation (refer to Section 6 for more detail); CCW Wetlands, water bird habitat and sporadic bird use through the river habitat; habitat for amphibians, insects and small mammals.
- Social – Landscape amenity, Walk trail, POS/ROS, linkages to the river walk and town centre;
- Cultural – Preston River is a listed aboriginal heritage site; and.
- Adjacent values – Old rail reserve and heritage trail, proximity to Boyanup town centre.

The local community accesses the foreshore area via the “River Ramble” walk trail which encourages people to access the river and enjoy the amenity of the Preston River. There is existing infrastructure associated with the walk, refer to Photographs 7 to 8 below.



Photograph 7 – View of the start of the River Ramble to the south west of the foreshore area.



Photograph 8 – View of walk trail and bench seating along the trail.

5. Geology and Hydrogeology of the area

Department of Water (DoW) Hydrogeology Map Series (DoW 2001) places the site within the Phanerozoic time period*, Qpgs: Guildford formation - alluvial sand. clay and gravel with minor estuarine and shallow marine lenses Sand member. Aquifer - Surficial aquifer - karstic or unconsolidated, extensive or local major to minor groundwater resources.*

A geological survey was undertaken by Douglas Partners for Preston Green Pty Ltd on the development site (lot 201) as part of the engineering designs and planning process. The findings were that the ground conditions across the site generally consist of clayey sand or sandy clay with varying proportions of silt and gravel.

The results of the geological survey on Lot 201 Turner Street are summarised as:

- ***Topsoil*** *– dark grey-brown, fine to medium grained silty sand topsoil with some rootlets to depths of between 0.1 m and 0.2 m below existing surface level at all test locations.*
- ***Clayey Sand/Clayey Silty Sand/Clayey Gravelly Sand/Silty Sand*** *– generally medium dense, dark grey-brown, orange-brown and red-brown, fine to medium grained clayey sand with varying amounts of silt and gravel, to depths of between 1.0 m and 3.0 m in the eastern site, except at TP01 where it was absent, and at TP10 to a depth of 0.8 m.*
- ***Sandy Clay/Sandy Silty Clay*** *– generally firm to stiff, medium to high plasticity, orange-brown mottled blue-grey sandy clay with varying silt and gravel content. This material was encountered underlying the predominantly sand layer described above in the eastern site and at TP10 from depths of between 0.8 m to 2.5 m to the termination depth of those test pits. It was encountered directly underlying the topsoil in the western site and at TP01 to depths of between 0.6 m and 2.2m.*
- ***Clay –*** *hard, orange-brown mottled blue-grey and red-brown mottled blue-grey, high plasticity clay, encountered underlying the sandy clay from depths of between 0.6 m and 1.1 m to test termination depths at test locations TP11 and TP12, which is the western part of the site*.

(Douglas Partners, 2014)

Test pit 4 (TP04) was located closest to the foreshore reserve and recorded: A Horizon: Topsoil (0-0.15m) dark grey brown, fine to medium grained silty sand, moist; B -Horizon: Clayey silty sand (0.15 to 3m) dry becoming moist at 2.3m. Test pit 07 was located to the south of the foreshore reserve (northern end) and recorded: A Horizon: Topsoil (0-0.1m) dark grey brown, fine to medium grained silty sand, moist; B -Horizon: Clayey silty sand (0.15 to 3m) dry becoming moist at 2.3m. Both test pits were located within 25m of the foreshore reserve. Refer to the Douglas Partners report for more detail.

Detailed soil testing has not been undertaken on the foreshore reserve, it is anticipated that the soil conditions encountered at Test pit 04 and 07 (both similar in nature) would be the likely soils across the foreshore area, with the soils possibly becoming more sandy in nature closer to the riverbank.

Further soil testing may be warranted prior to the revegetation program to test for pH and other soil conditions to assist with final plant/species selection.

5.1. Groundwater conditions

Douglas Partners reported perched groundwater encountered between 0.7 to 2.4m below ground level (BGL) with all test pits encountering groundwater in the lower areas of the site due east of the existing lake in lot 201. No water was encountered at the closest test pit to the foreshore reserve at Test pit 04 or test pit 07.

5.2. ASS - management of works within foreshore area

Acid Sulfate Soils (ASS) are naturally occurring soils containing iron sulphides. These soils are typically benign within an anaerobic environment. However, when they become oxidised through disturbance, acidification of soil and groundwater can occur. The resulting sulphuric acid can also break heavy metal bonds, releasing metals such as aluminium, iron and arsenic into the groundwater and environment.

A desktop assessment aimed at determining the potential for ASS within the project site revealed there was a “High to Moderate Risk” of ASS occurring along the Preston River and “Moderate to Low Risk” adjacent and in the foreshore area (WA Atlas 2014).

The river area has been altered from flooding events, farming practises, weed invasions access and recreational activities. Onsite inspection of the foreshore area revealed there was no evidence of sulphate scarring or deaths to the ecosystem. Detailed engineering design was not available at time of reporting, however there is no development or excavation in the foreshore area as this will be revegetated or landscaped. As not greater than 100m^2 will be excavated and therefore the risk of disturbing ASS in the foreshore (lot 200) is low, it is therefore recommended that there is no requirement for ASS management within the foreshore area.

6. Remnant Vegetation values

The subject lies within the Swan Interim Bio-geographic Regional Area (IBRA bioregion). Hearn *et al* (2002) describe the Swan IBRA region as: "*low lying coastal plain, mainly covered with woodlands. It is dominated by Banksia or Tuart on sandy soils.*" The area is located within the *SWA1- Dandaragan Plateau. The plateau is bordered by Derby and Dandaragan Faults. Cretaceous marine sediments are mantled by sands and laterites. Characterised by Banksia low woodland, Jarrah - Marri woodland, Marri woodland, and by scrub-heaths on laterite pavement and on gravelly sandplains.* (Hearn *et al*., 2002).

The vegetation has been mapped on a broad scale by JS Beard (Shepherd *et al* 2002) in the 1970's, where a system was devised for state-wide mapping and vegetation classification based on geographic, geological, soil, climate structure, life form and vegetation characteristics (Sandiford and Barrett 2010).

A search of JS Beard's vegetation classification database for the general area places the site within 2 broad Vegetation Associations for the site:

1. **System Association: Pinjarra**
- Vegetation Association number: 968
- Vegetation Description: Medium woodland; jarrah, marri & wandoo

2. **System Association: Pinjarra**
- Vegetation Association number: 1182
- Vegetation Description: Medium woodland; *Eucalyptus rudis* & *Melaleuca rhaphiophylla*

This vegetation within the paddock areas of the foreshore has been extensively grazed/mowed and is considered to be in a "*Completely Degraded condition: The structure of the vegetation is no longer intact and the area is completely or almost completely without native species*" (Keighrey, 1994). Species in this cover class included mainly weeds and introduced plants, forming open grassland/herblands and manicured lawns. Refer to Vegetation Mapping Appendix D.

The majority of the riverbank area along the Preston River area has some understorey (native sedges) and intact tree canopy and the vegetation was in *"Good Condition": Vegetation structure significantly altered by very obvious signs of multiple disturbance* (Keighrey, 1994). The trees formed a continuous canopy, however the understory was very weed infested and little to no mid storey species. There was indications of recruitment of trees in the midstorey, however minimal diversity of species. These areas formed a Medium to Low Open forest/Woodland of *E.rudis* and *Agonis flexuosa*, refer to Refer to Vegetation Mapping Appendix D.

In 1999 the section of the Preston River was assessed as being in a "C2" Foreshore Condition Grading. Definitions of the Foreshore Condition Grading (Pen & Scott, 1995) is shown in Table 3.

Table 3 – Foreshore Condition Assessment Grading (Pen & Scott 1995)

Category	Description
A Grade	"Pristine", "Near Pristine" and "Slightly Disturbed": Where the foreshore has healthy native bush, similar to that which you would see in nature reserves, state forests or national parks.
B Grade	"Degraded" including "Weed infested", "Heavily weed infested" and "Weed Dominated": Where the bush along the stream has been invaded by weeds, mainly grasses, and looks like typical roadside bush.
C Grade	"Erosion Prone", "Soil Exposed" and "Eroded": Where the foreshore supports only trees over weeds or pasture, or just plain pasture and bank erosion and subsidence may be occurring, but only in a few spots.
D Grade	"Ditch-eroding", "Ditch-freely eroding" and "Drain-weed dominated": Where the stream is little more than an eroding ditch or a weed infested drain.

Site inspection on the Flora species which were identified within the foreshore area is shown in Table 4.

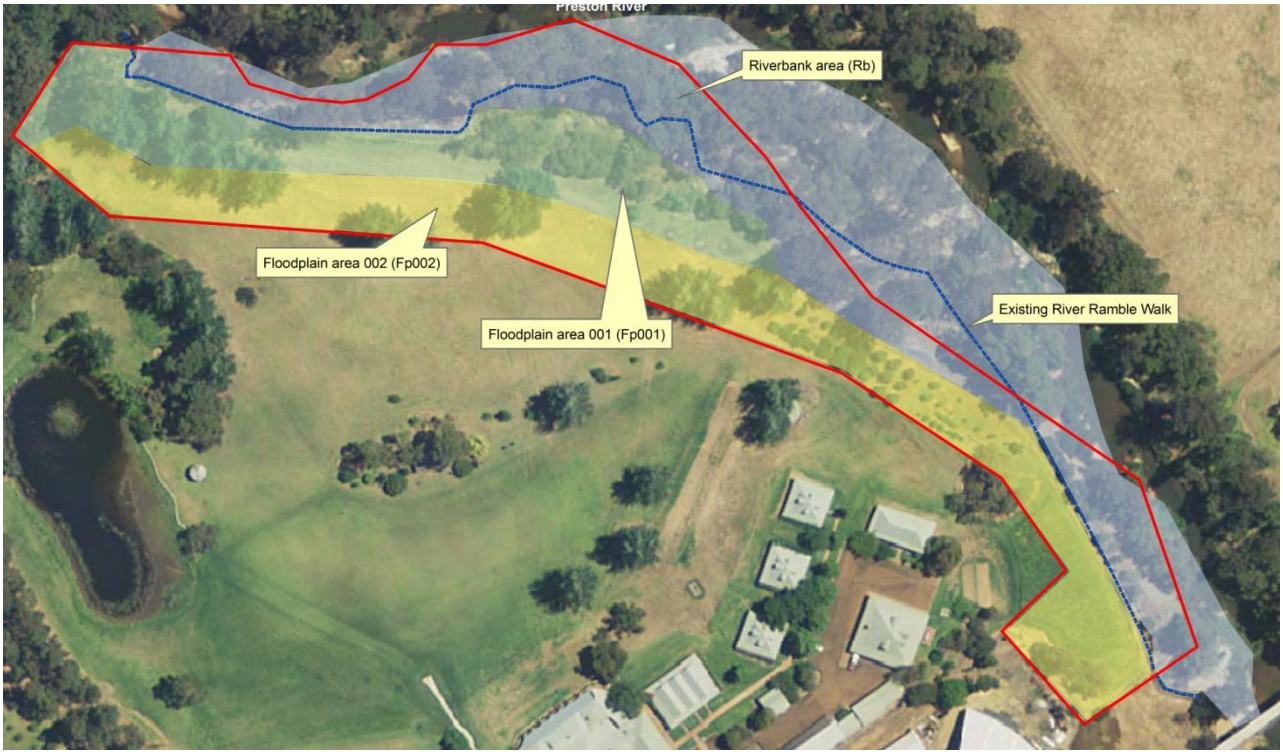
Table 4 – Flora species recorded on site

Family	Species Name	Common Name
Asparagaceae	**Asparagus asparagoides*	Bridal creeper
	**Yucca spp*	
Asteraceae	**Arcotheca calendula*	Daisy
	**Hypochaeris glabra*	Smooth Catsear
	**Conyza bonariensis*	Fleabane
Ariaceae	**Zantedeschia aethiopica*	Arum Lily
Araliaceae	**Schefflera actinophylla*	Australian Ivy-Palm, Octopus Tree, Queensland Umbrella Tree
	**Hedera spp.*	Ivy
Cyperaceae	*Bolboschoenus caldwellii*	Marsh Club-rush
	Gahnia trifida	Coast Saw Sedge
Dennstaedtiaceae	*Pteridium esculentum*	Bracken fern
Fabaceae	*Acacia acuminata*	Jam
	Hardenbergia comptoniana	Native wisteria
Iridaceae	**Romulea rosea*	Guildford Grass
	**Moraea miniata*	Cape Tulip
	Patersonia occidentalis	Purple flag
	**Watsonia meriana* var. *bulbillifera*	Watsonia
Juncaceae	*Juncus pallidus*	Pale Rush
Myrtaceae	*Corymbia calophylla*	Marri
	Eucalyptus rudis	Flooded Gum
	Agonis flexuosa	Peppermint
	Melaleuca rhaphiophylla	Swamp paperbark
	Taxandria parviceps	Tea tree
Oxalidaceae	**Oxalis pes-capre*	Sour sob
	**Oxalis glabra*	Finger leaf oxalis
Papilionaceae	**Trifolium angustifolium*	Clover
Geraniaceae	*Pelargonium australe*	Wild geranium
Phytolaccaceae	**Phytolacca octandra*	Ink weed
Poaceae	**Avena fatua*	Wild oat
	**Briza maxima*	Blowfly grass
	**Ehrharta calycina*	Perennial Veldt Grass
	**Lagurus ovatus*	Hare's tale grass
	**Pennistetum clandestinum*	Kikuyu
	**Paspalum distichum*	Water couch
Salicaceae	*Populus tremula*	
Strelitziaceae	**Ravenala madagascariensis*	Travellers Palm
Solonaceae	**Solanum aviculare*	Kangaroo Apple
Zamiaceae	*Macrozamia riedlei*	Zamia Palm
Zingiberaceae	**Zingiber spp*	Ornamental ginger

** denotes weed species*

The subject site (lot 200) has been divided into two transitional zones, "Riverbank" (Rb) area and "Floodplain" (Fp) area (see Figure 4).

Figure 4 – Transitional zones of subject site



The “Riverbank” (Rb) area (see Figure 4) should be revegetated with midstorey and understorey species to encourage local diversity and restoration of river functions, this would bring this Foreshore Grading up to a “B” classification in the future. The “Floodplain” area (see Figure 4) has further been divided into two zones floodplain001 (Fp001) and Floodplain 002 (Fp002). The floodplain area, specifically Fp001 will need some intensive revegetation work to restore this area back to a “B” grade. There is little to no structure in tact with paddock grasses and fruit trees present. (See Photograph 2).

Preliminary discussions with the Shire of Capel have indicated there should be a landscaped area within the foreshore reserve. This could occur within the Fs002 as shown within figure 4. The Bushfire Management Plan (BMP), (Bio Diverse Solutions, 2014) also recommended to mitigate bushfire risks from the north west and from the River reserve, that this area should be low fuel or low threat vegetation, refer to Section 15 for more detail.

7. Remediation and revegetation works

The Preston River north west of lot 200 has been revegetated by the Capel Land Care District Committee (C.Burwood, SoC 2014, and *Pers comms*, C Derrington, 2014) in previous years. Plants were sourced from the local nursery Boyanup Botanical Nursery and planted by the Capel LCDC volunteers. Work was also undertaken by Green Corps in assisting building infrastructure on site. Please refer to Photographs 9 to 11 below.



Photograph 9 – View of signage form Green Corps work done in the Preston River foreshore.



Photograph 10 – View of signage along the River Ramble

A program and methodology for revegetation and remediation of the foreshore area is proposed in the following sections. This replicates the methodologies which have previously successfully been employed in adjacent river areas. Revegetation is to be carried out within the foreshore area as shown in Figure 4 and Revegetation Plan Appendix E.

7.1. Objectives

- To re-instate vegetation to protect the foreshore area along Preston River (lot 200) within the newly created foreshore area and adjacent river banks.
- Assist naturally regenerating vegetation on the Preston River banks and foreshore areas to return to a B-Grade Classification;
- To have Low threat vegetation buffer at the interface of the foreshore/development area to reduce fire risks to the lifestyle village residents and to allow for permeable visibility to the DUP for security and safety reasons;
- To establish and preserve existing vegetation and regeneration of denuded areas with local endemic with similar composition of adjacent foreshore areas;
- To reduce weed invasions and competition of weeds with native species; and
- To assist with on the ground implementation of the revegetation.

7.2. Strategies

The following strategies will continue to be employed on the site to reach successful revegetation of the creekline/foreshore area:

- To re-instate native vegetation along the banks and foreshore areas to continue the future biodiversity and river qualities of the area.
- Assist naturally rehabilitating areas to return to pre-disturbed state;
- To establish vegetation through revegetation and regeneration of denuded areas with local endemic species;
- To reduce weed invasions and competition of weeds with native species; and
- To assist with on the ground implementation of the revegetation.

7.3. Methodology

The revegetation methodology is proposed to be undertaken using the following steps:

1. The method of revegetation is to use the existing topsoil, with spraying for weed species two months prior to planting seedlings.
2. Top soils are to be imported where required to assist with seedling establishment.
3. Contouring and mounding (200mm) of slopes parallel to the banks or slopes is to occur prior to planting of seedlings.
4. If seeding required, seed will be collected at appropriate seasons from adjacent vegetation and dispersed over constructed soils if required for further revegetation.
5. Any weeds likely to significantly impact on the rehabilitation will be sprayed with Roundup or similar herbicide, or grubbed out, depending on the species involved.
6. Rehabilitation will be carried out promptly after soil disturbance.

7.4. Seed stock

Where practicable plant species used in revegetation works will be of local provenance, defined as propagated from plant in the immediate geographic area or from areas that closely match the physical environment and the plant community types of the area to be planted.

In acknowledgement that sourcing sufficient plant stock can be difficult, particularly wetland species, tubestock from species that are found in the wetland areas in this locality may be sourced from available nurseries that are accredited by the Nursery Industry Accreditation Scheme of Australia (NIASA) which will guarantee the quality of the supplied material. The final species selection will be subject to availability of seed previously sourced from adjacent to the site and/or from NIASA accredited nurseries sourcing dieback free seedling stock.

Different plant species have differing tolerances to ground water levels and as a result, may prefer inundated and lower slope environments over slightly drier areas. The preferred species for revegetation of the revegetation areas and listed in Table 5 and shown in Appendix E.

7.5. Methodology

Revegetation is proposed in Lot 200 in the floodplain area and along the UCL riverbank area of the Preston River. These areas have been identified in the Foreshore Management Plan in three Zones – Riverbank (Rb), Floodplain Zone 1 (Fp001) and Floodplain Zone 2 (Fp002). The foreshore zone is divided into two categories as there will be two separate planting strategies deployed in these areas. Fp001 will be full scale revegetation works to recreate Low Open Forest as found along the Preston River floodplain. Fs002 will be a Low fuel vegetation which will comply with AS3959-2009 definition of *Low Threat Vegetation* and meet the requirement of the SoC request to have visibility to the DUP from the development area for security and safety means. The revegetation areas, zone names and areas are shown below in Table 5.

Table 5 - Revegetation areas

Area and zone name	Zone id	Zone description	Total Area m^2
Riverbank	Rb	Below hydric soil line to water line, infill of understorey and midstorey species	15,116 m^2
Floodplain zone 1	Fp001	Above hydric line in flood zone, full revegetation of all structure.	5, 482 m^2
Floodplain zone 2	Fp002	Above hydric line in flood zone, low fuel zones, possible landscaped area (*TBC)	7, 534m^2
		Total	**28, 132m^2**

The following methodology is proposed, however dependant on the timing may be adapted as required to suit conditions.

Surface preparation
To ensure that native seed germination and seedling survival rates are maximised, weed removal through spraying, grubbing and selective removal (See Section 8 for more detail) and providing optimal soil condition for germination (scarification) and root development (ripping) will be undertaken. Contouring paralleled to any banks or slopes would be undertaken to depths of 200mm, along the banks spot holes/contouring for replanting will be required to a depth of 200mm and 200mm wide along steep banks.

Species selection and plant allocations
Where practicable plant species used in revegetation works will be of local provenance, defined as propagated from plant in the immediate geographic area or from areas that closely match the physical environment and the plant community types of the area to be planted. Seed collection over the site and in adjacent riverbank areas could be undertaken 12-18 months prior to revegetation commencing.

Different plant species have differing tolerances to ground water levels and as a result, may prefer inundated and lower slope environments over slightly drier areas. The preferred species for revegetation of the wetland areas and their associated buffers are listed in Table 6. The list has been compiled on the basis of the existing vegetation found in the adjacent riverbank areas that were surveyed in August 2014 by Bio Diverse Solutions and species that can be sourced from the vegetation types identified on site.
The species have been allocated as per the vegetation type, refer to Table 6 which outlines the vegetation type, zone id, plant species and growth form. Table 6 is a guide and final selection may be subject to budget, soil conditions, availability of stock and finals revegetation areas.

Species allocation/densities have been based on the following matrix:

- Eucalyptus Forest – Overstorey species 30%, Midstorey species 35%, Understorey species 35%.
- Eucalyptus Woodlands – Overstorey species 40%, Understorey species 70%
- Low threat vegetation – understorey species 100%

Densities

Trees	1 stem/10m^2	
Shrubs/herbs	1 stem/5m^2	
Understorey	2 stem/m2	
Sedges	4 Stem/1m^2	
Landscaping areas	1 stem/5m^2	2 stem/m2 depending on landscape design

The Riverbank zone (Rb) will not require densities as outlined below as this is mainly infill plantings and shall be re-assessed at time of implementation. The density listed above and in Table 6 is a guide to assist in recovery of the area to a B1 classification.

Table 6 – Guide for Revegetation Species

Species	Common Name	Zone id	Density	Growth form
Corymbia callophylla	Marri	Rb, Fp001	1 stem/10m^2	Tree
Melaleuca rhaphiophylla	Swamp paperbark	Rb, Fp001	1 stem/10m^2	Tree
Eucalyptus rudis	Flooded gum	Rb, Fp001	1 stem/10m^2	Tree
Eucalyptus gomphocephala	Tuart	Rb, Fp001	1 stem/10m^2	Tree
Agonis flexuosa	Peppermint	Rb, Fp001	1 stem/10m^2	Shrub
Taxandria parviceps	Native tea tree	Rb, Fp001	1 stem/5m^2	Tree
Allocasuarina fraseriana	Casuarina	Fp, Fp001	1 stem/10m^2	Tree
Patersonia occidentalis	Purple Flag	Rb, Fp001	1 stem/5m^2	Herb
Adenanthos cuneatus	Coastal jug flower	Rb, Fp001, Fp002	1 stem/5m^2	Shrub
Astartea fascicularis		Rb, Fp001, Fp002	1 stem/5m^2	Shrub
Acacia acuminata	Jam	Rb, Fp001	1 stem/5m^2	Shrub/tree
Hardenbergia comptoniana	Native hardenbergia	Rb, Fp001	1 stem/5m^2	Herb
Kunzea recurva	Curved-leaf kunzea	Fp001, Fp002	1 stem/5m^2	Shrub
Xanthorrhoea platyphylla	Grass Tree	Rb, Fp001,	1 stem/5m^2	Shrub
Bolboschoenus caldwellii	Marsh club rush	Rb, Fp001, Fp002	4 Stem/1m^2	Sedge/rush
Gahnia trifida	Coast saw-sedge	Rb, Fp001, Fp002	4 Stem/1m^2	Sedge/rush
Hibbertia hypericoides	Cut leaf hibbertia	Fp001, Fp002	2 stem/m2	Herb
Hypocalymma angustifolium	White myrtle	Fp001,	1 stem/5m^2	Shrub
Melaleuca thymoides		Rb, Fp001,	1 stem/5m^2	Shrub
Melaleuca teretifolia	Banabar	Rb, Fp001,	1 stem/5m^2	Shrub
Baumea articulata	Jointed rush	Rb, Fp001, Fp002	4 Stem/1m^2	Sedge/rush
Baumea juncea	Bare twig rush	Rb, Fp001, Fp002	4 Stem/1m^2	Sedge/rush
Anigozanthos manglesii	Mangles kangaroo paw	Fp001, Fp002	4 Stem/1m^2	Sedge/rush
Hakea lissocarpha	Honey bush	Fp001	1 stem/5m^2	Shrub

The above table is a guide and will be refined when seed stock/seedling availability is defined.

Seedling Planting

Planting of seedlings will commence after the season's first major rains (typically May/June) when the soil is sufficiently wet to plant without the need for additional watering and to allow maximum root growth and plant establishment before summer. It is generally an optimum time after three continuous rain days observed in Autumn months. Individual species will be planted irregularly to reflect the distribution found in natural areas.

Infill planting will be carried out in subsequent winters as required. The quantities required for infill planting will be calculated through monitoring between plant installation in

subsequent winters and autumns with final numbers being based on percentage survival rates of initial planting.

Site and Plant Protection
Rabbit proof barriers may need to be installed around seedlings at time of planting, this will be subject to cost and recommendations from the Capel LCDC from pervious revegetation strategies adjacent to the site.

In the steep riverbank areas a technique of planting shrubs and sedges planted in sandbags has been applied in the adjacent riverbank and this could be replicated to ensure the longetivity and establishment of the plants in the steep banked areas (*Pers comm*., R. McPherson , 2014).

Completion Targets
The following completion targets will apply to the revegetation program

- The revegetation target of the FMP is to establish at least 1 plant / m2 throughout the Foreshore area.
- In all revegetation zones the target is less than 40% weed cover, and for all SoC First Schedule Pest Plants to be less than 5%.

Monitoring
The revegetation areas will be monitored and maintained for two years following installation to ensure progress towards the completion targets are met.
Four visits will be conducted to track progress and to initiate remedial action if required:

- First spring - to determine if there are any immediate losses as a result of transplant shock, weed competition, predation or weather related impacts
- First autumn - to determine mortality and survival rates over the first summer period
- Second spring – to assess the long-term success of the revegetation operation and determine the need for further remedial works
- Second autumn – to assess the long-term success of the revegetation operation and determine the need for further remedial works.

Timing of assessments may be adjusted to suit the weather conditions. The results of each monitoring assessment will be compared to determine growth and mortality rates, and provided a quantitative measure of progress.

Maintenance
Revegetation maintenance work will be carried out in response to monitoring to ensure completion targets are met for the duration of the works period. A schedule for revegetation, maintenance works and monitoring is shown in Table 9.

7.6. Implementation

Preliminary discussions have been held with Capel LCDC in regards to undertaking the revegetation. There is also opportunity for a local school to be involved (such as Childside and Boyanup School) in the planting process.

The benefits of using the local community in the planting process are that it will generate community involvement in the site and give ownership over the success of the revegetation project. This will assist the Shire of Capel in the future management of the site and give sound environmental outcomes for the project.

The use of community groups is subject to further consultation and refinement, a draft copy of this report has been emailed to the Capel LCDC for comment. If in the event the community is not involved then a suitably qualified contractor will be engaged by the responsible party implementing this FMP.

8. Weed Management Plan

The following Weed Management Plan is to apply to all aspects of site operations. All operations shall conform to this Weed Management Plan, and monitoring to occur post revegetation for any infestations. Weed management will primarily be undertaken through avoiding introducing new weeds to the foreshore reserve.

8.1. Aims of Weed Management Plan

The aims of the Weed Management at will be to:

- Maintain a weed free environment;
- Ensure all vehicles are clean on entry prior to any soil or vegetation movement;
- Site is to be secured to prevent trespassers illegally accessing, dumping rubbish and green waste;
- All weeds on site removed promptly on discovery;
- Remove weeds from least affected areas to the most affected areas (Bradley Method);
- Do not use weed affected soils for rehabilitation, but remove infected soils to waste disposal; and
- Regularly monitor the site for invasive species.

If weeds are discovered on site they will be treated using the following methodology:

- Large woody weeds will be burned, poisoned or removed from site and disposed to approved green waste;
- Small weeds will be sprayed by a licensed contractor or landholder; and
- Initial follow up spraying will be undertaken at 6 months and 18 months and repeated as necessary.

8.2. Program for weed control

The following program for weed management will be implemented prior to revegetation, revegetation activities, and post revegetation monitoring activities. Table 7 (over the page) is a guide for aggressive common species (adapted from Department of Agriculture and Food recommended techniques) and should be used as a guide to treat any infestations promptly. Further information for any species and recommended treatment not listed in Table 7 should be gained from the Department of Agriculture and Food.

Table 7 – Weed Management Program

Species		Treatment	Responsibility
Grasses			
Kikuyu	*Pennisetum clandestinum*	Control with herbicides whilst growing.	Spray/ Civil Contractor as required
African Love Grass	*Eragrostis curvulata*	Annual Spray during winter, small infestations all year round as required.	Spray/ Civil Contractor as required
Blowfly grass	*Briza maxima*	Hand weed or spraying. Cool burn in late winter to spring before flowering.	Spray/Civil Contractor as required
Flat weed	*Hypochaeris spp*	Annual Spray during winter, small infestations all year round as required.	Spray contractor and Civil contractor
Hare's-tail Grass	*Lagurus ovatus*	Prevent seed set for 2-3 years by the removal of the topsoil through civil works.	Spray and Civil
Woody Weeds			
Poplar	*Populus sp*	Cutting the suckers off and painting the cut ends with “tree and blackberry killer”, or removing trees and suckers completely by ripping	Contractor, machine
Golden wattle	*Acacia longifolia*	Fire not favourable at this site. Spraying (diesel) to lower trunk and/or injection on mature trees. Spraying or wiping on seedlings and juvenile trees.	Contractor, spray contractor, bobcat
Blackberry	*Rubus ulmifolius*	Mechanical control difficult. Annual summer applications of Grazon, 3 applications required, use Glyphosate in sensitive areas (i.e. creeklines).	Contractor, spray contractor, bobcat
Ink weed	*Phytolacca octandra*	Uproot heavy infestations and cut remaining plants 5cm below ground. Spraying is effective.	Spray and civil contractor
Herbs			
Spear thistle	*Cirsium vulgare*	Manual removal or selective spray control.	Spray contractor and civil contractor
Night shade	*Solanum nigrum*	Prevent seed set for several years. Hand remove plants before flowering and/or spray during the plant is growing in summer.	Spray contractor
Fleabane	*Conyza species*	Spray in late spring. Hand removal-remove taproot. Introduction of native species which provide shade.	Spray Contractor/Civil contractor
Dolichos Pea	*Dipogon lignosus*	Manual removal difficult. Burning not recommended. Spraying of Tordon until run-off in August annually.	Spray Contractor/Civil contractor

Ref: Wheeler (2002)

In the ornamental (north western portion of the site) there are numerous introduced plants such as perfumed roses that has been suggested are offered to people in the community, maybe the local school or Boyanup Garden Club. There are some mature exotic trees like a carob which wouldn’t do any harm to stay there (*Pers comm*., R.Mcpherson, 2014).

There are many weeds such as ivy, palms, wild roses, figs, fishbone ferns etc that need to be

removed, again these could be offered to the community or neighbours. Refer to Photographs 11 and 12 below.



Photograph 11 – View of palms and ornamentals within and adjacent to Lot 200 in north west. Photo R.McPherson



Photograph 12 – View of bamboo and ornamentals within and adjacent to Lot 200 in north west. Photo R.McPherson

8.3. Management and Control of weeds

Initial management will be undertaken by the current owners as part of the ongoing management of the property. The annual spraying and weed management shall continue for a period of up to 2 years post revegetation implementation New landowners (SoC) may be required to continue the weed management program to ensure there is successful revegetation implementation and to restrict the movement or further establishment of weeds.

Refer to Table 9 for long term management actions and timeframes.

Briefing information to site personnel during revegetation/planting will include but not be limited to:

- Maintain a weed free working environment through clean vehicles on entry to the site;
- Ensure weeds are not moved into weed-free areas through regular inspections of vehicles;
- Show personnel physical samples of weeds present on site;
- Regular inspections of undercarriage of machines;
- Techniques of topsoil management to be modified if weeds are present via removing infected topsoil's or spraying prior to soil disturbance; and
- Hand/mechanical removal of weeds to green waste.

9. Bank stability works/erosion control

The predominant soil type in the creekline is deep sands with adjacent sands over clay/rock. Loose sands during revegetation works can be subject to prevailing winds and water erosion. Mounding of the revegetation areas will assist with the runoff from the revegetated areas and brushing will reduce the affects of wind erosion. The mounding and contours will also assist in trapping water for seedling germination and growth. Mounding should occur along contours or in flat areas perpendicular to river flow direction.

Specific areas noted for stabilisation are within the Preston River banks (outside subject site), near an overhead power transmission line/power box (outside subject site) and at steep intervals along the river banks. These areas have high slopes into the creek area and are most subject to water erosion, flooding and scouring. Please refer to Appendix F - Foreshore Master Plan.

Stabilisation techniques may need to be applied such as mulching or geo-fabrics can be used wherever possible to ensure there is minimal erosion to the site. This will need to be monitored as time of implementation of this plan. As the revegetated banks recover this in time will lead to less erosion occurring. Refer to Photographs 13 and 14 below.



Photograph 13 – View of flood washout, 2014. Photo R.McPherson

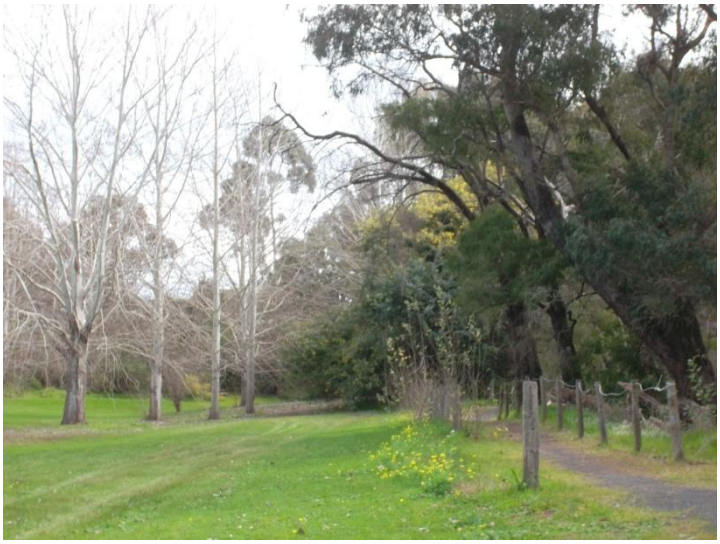


Photograph 14 – View of silting along banks of river, north of subject site (lot 200). Photo R.McPherson.

10. Fencing/retaining walls

There is presently some fencing along the banks of the Preston River adjacent to the “River Ramble” walk. This has been introduced recently and is most likely to do with safety along the steep river banks (*Pers obs* K.Kinnear 2014). A Visitor Risk Assessment has not been undertaken of any existing infrastructure along the River Ramble, however may be warranted in the future to ensure visitor safety is maintained.

Old fencing is eminent along the previous boundary of Meadowbrooke Estate, the SoC has requested that this is removed, possibly some of the historical strainer posts may be retained for historical reasons (*Pers comms.* C.Burwood, SoC 2014). Refer to Photograph 15.



Photograph 15 – View of existing fencing along the river ramble walk.

Integration between the foreshore area and the development site has been discussed with Council staff (MPM, 2014) and agreed that integration between the two sites is preferred to fencing. A low level pine/rail fence may be considered to provide a line of demarcation. The low level pine/rail fence will allow for definition of the lifestyle village as private property while allowing for the visual amenity of the Preston River and local walkers along the River Ramble walk.

11. Access and infrastructure

Recreation activities need to be managed so that:

- Activities can be carried out in a safe environment;
- Disturbance to the natural environment is minimised; and
- Conflicts between incompatible recreational uses are minimised.

The objectives for recreation in the subject site are

- Provide an appropriate level of access whilst preserving the ecological values of the subject site;
- Facilitate appropriate recreational activities by providing suitable resources and infrastructure; and
- Provide a safe environment for passive recreation.

Access management is relevant to recreational use and management of the foreshore. As the two purposes are closely related, and as Dual Use Path (DUP) may be developed for management access will also be used for recreational use and vice versa, the two issues are dealt with together.

11.1. Access

Pedestrian access to recreational areas is of high importance to residents and visitors of the foreshore area; however this must be managed in such a way as to preserve the ecological integrity of the area. This will be achieved by facilitating appropriate access to recreational areas and restricting access that results in the degradation of natural areas. Issues and management of access in the area is explored below. Paths should comply with Australian Standards AS2156.2-2001 Walking Tracks – Infrastructure Design.

Disabled access should be provided wherever possible and should facilitate the independent use of people with a range of disabilities including physical disabilities, hearing and vision impairment. Disabled access should comply with the following Australian Standards:

- AS 1428.1-2001 Design for Access and Mobility – General Requirements for Access – New Building Work;
- AS 1428.2-1992 Design for Access and Mobility – Enhanced and Additional Requirements – Buildings and Facilities;
- AS 1428.3-1992 : Design for access and mobility – Requirements for children and adolescents with physical disabilities; and
- AS NZS 1428.4-2002 Design for Access and Mobility – Tactile Indicators.

Access along the foreshore area is proposed to be along the Existing River ramble walk and a new section/placement in the eastern portion of the site. Refer to Foreshore Master Plan Appendix F. The upgrading of the River Ramble to a Dual Use Path (DUP), concrete and stabilised will allow for access for all persons (mobility, age etc) and could provide a linking walk from the railway reserve (currently subject to landscape mater planning) to the Shire reserve in the north and back to South Western highway (into town). This linking access provides a passive recreation and could be funded through state government grants/initiatives.

There will be no access via the road network to the subject site. Access will be via pedestrian only.

11.2. Parking

Parking will not be a requirement of this foreshore area, parking is available to the east in the railway reserve currently managed by the SoC.

11.3. Community recreational nodes/infrastructure

Passive recreation activities such as walking, jogging etc is one of the primary recreational pursuits in the subject site and is currently facilitated by the River Ramble walk trail. Infrastructure existing to facilitate this activity is:

- Clearly defined paths suitable for walking
- Seating provided at strategic locations
- Car parking to the east in the railway reserve;
- Interpretive and regulatory signage

There is a potential for conflict with cyclists in the study area as these two groups share facilities. Measures to reduce conflict include:

- Physical separation in all areas apart from designated dual-use pathways
- Additional Dual Use Pathways should be built to Australian Standards incorporating appropriate width and line-of-sight.

Pedestrian Access should comply with the following Australian Standards:

- AS 2156.1-2001 Walking Tracks – Infrastructure Design
- AS 2156.2-2001 Walking Tracks – Classification and Signage

Seating within the study area is currently limited to park type benches. These are adequate for the setting/activity, some may need to be relocated if the River Ramble is realigned. Seating should be associated with the lookouts/views of the river. All new seating should be uniform with the existing seats and consistent with the surrounding environment.

11.4. Landscaping

A Landscaping Master Plan shall be prepared for the adjacent Meadowbrooke Estate, the interface of the foreshore area, recreation facilities and the access from the estate should be defined in this process. Preliminary discussions with the Shire of Capel have indicated there should be a landscaped area within the foreshore reserve. The landscape master plan for the adjacent development will be forwarded to the SoC for approval and comment prior to finalisation.

12. Sites of cultural, archaeological or religious significance

A search of the Department of Indigenous Affairs database revealed the Preston River is registered as an Aboriginal heritage site. Please refer to Appendix G for the report. An Archaeological survey has not been undertaken for this project to date and is not deemed necessary as no soil will be removed from within the area.

Social functions pertaining to the river are related to recreation and appreciation/amenity and will not affect any cultural sites. Recreation includes active recreation or passive types such as bird watching, walking and nature studies.

13. Stormwater management

The majority of the site is relatively free draining sandy soils and is a model site for water sensitive urban design to be applied. No stormwater infrastructure from the adjacent development area is proposed to be located within the foreshore reserve or affecting the foreshore area. Water management strategies should be aligned to current **Best Practise** and applied to this development, these include:

1. Maintain and where possible enhance water quality by:
Minimise waterborne sediment loading
Minimise export of pollutants to surface or ground water
Minimise post development flows across the site
Apply point source water management
Encourage prospective adjacent landowners not to use fertilisers on land

2. Encourage water conservation by nearby adjacent landowners:
Minimise the export and use of scheme water
Promote the use of rainwater
Promote ground water recharge
Reduce irrigation requirements

3. Management of the water regime by:
Prevent flood damage in existing and proposed revegetation areas
Prevent erosion of adjacent wetlands, waterways and slopes
Ensure pollutants do not enter into adjacent waterways

14. Midge and mosquito control

A Midge and Mosquito Management Plan is not required for the foreshore area, one will be developed for the adjacent development prior to construction, this will:

- Establish a Baseline Monitoring Programme for mosquitoes
- Implement an Ongoing Monitoring Programme for up to two years after practical completion for mosquitoes
- Keep record of public complaints of nuisance midges and mosquitoes and the number of disease notifications.

Measures that will be undertaken to control populations of mosquitoes and midges will include:

- Physical – physical modification or removal of source such as thick weeds (not native, endemic species) in the wetland area to prevent breeding
- Chemical – larvicides including both ground and aerial applications and adulticides, including fogging and residual surface adulticides will be used on an as needed basis for short term control;
- Cultural – encouragement of public to implement personal preventative measures.

To be effective, a mosquito control programme must utilise an integrated approach to management employing a combination of physical, chemical and cultural control methods and targeting both larva and adult mosquitoes.

In keeping with the requirements of the Department of Health (DoH), the chemical mosquito control programme will be implemented if the number of adult mosquitoes caught in a trap at a single location over a normal sampling period (12-18 hours) exceeds 50 individuals. Larviciding is the preferred method of mosquito control and will be undertaken using a mosquito growth regulator that is approved for use in wetland environments such as s-Methoprene (granules, liquid or briquette form) and Bti (*Bacillus thuringiensis* subspecies *israelensis*). These can be applied as an aqueous suspension for ground or aerial application by Ultra Low Volume (ULV) techniques or diluted with water. An alternative for use when there is a standing body of water present is ProLink XR Briquettes (150 days residual). The use of this larvicide is approved by the DoH as they are the ideal treatment for chronic breeding sites where access is difficult or where regular re-treatment would be impractical. ProLink XR Briquettes can be applied (at a rate of 1 Briquette/10-20 m2) prior to flooding when sites are dry. They can be used in storm drains, ditches, ornamental ponds, septic tanks, waste water ponds, construction sites, salt-marshes, semi-permanent and permanent freshwater larval habitats.

In addition to the use of larvicide to control mosquito larvae populations, the weed control, rehabilitation and the provision of landscaping buffers will provide protection from nuisance levels of midges and mosquitoes.

15. Fire protection measures

A detailed Bushfire Management Plan (BMP) has been prepared aligned to WAPC and DFES Planning for Bushfire Protection (Edition 2) 2010. Site specific information regarding protection of life and property has been identified in this document and should be referred to directly.

The main aspect of bushfire management affecting the foreshore area is to ensure that there is fire fighting access maintained at the perimeter of the foreshore area and this access is unimpeded in emergency situations. The DUP could be utilised for four wheel mounted fast attack units and is gated at the eastern end from the railway reserve. It is recommended that this remains in perpetuity to enable light units to access the river area in a bushfire emergency.

Revegetation is proposed in Lot 200 in the foreshore area, along the UCL area of the Preston River and in the development footprint, along the western boundary. These areas have been identified in the Foreshore Management Plan in three Zones – "Riverbank" (Rb), "Floodplain Zone 1" (Fp001) and "Floodplain Zone 2" (Fp002). The "Floodplain Zone" is divided into two categories as there will be two separate planting strategies deployed in these areas. Fp001 will be full scale revegetation works to recreate Low Open Forest as found along the Preston River banks. Fp002 will be Low fuel vegetation which will comply with AS3959-2009 definition of *Low Threat Vegetation* and/or the BPZ standards. There is a requirement to meet the request of the SoC to have visibility to the DUP from the development area for security and safety means. This will also assist in fire protection to nearby residents.

The revegetation in lot 200 buffer zone (Fp002) is proposed to be a "Low Fuel Zone" as defined by AS39592009, with low understorey species planting proposed this is reflected on the Bushfire Management Plan (Bio Diverse Solutions, 2014). The *Low Threat Vegetation* as defined by AS3959-2009 includes:

- Managed grasslands;
- Maintained lawns;
- Golf courses;
- Reserves and parklands;
- Botanical gardens;
- Vineyards, orchards,
- Cultivated ornamental gardens,
- Commercial nurseries; nature strips and wind breaks.

The standard in this area will be similar to the Building Protection Zone (BPZ) which is:

- Fuels maintained at 2 tonnes per hectare;
- All grasses to maintained to a maximum height of 50mm;
- Trees (crowns) are a minimum of 5 metres apart;
- Trees are low pruned at least to a height of 2 metres;
- No tall shrub or tree is located within 2 metres of a building;
- Shrubs in the BPZ have no dead material within the plant;
- Tall shrubs in the BPZ are not planted in clumps ;
- Shrubs to be less than 500m, generally low planting ground covers of <300mm and
- Trees in the building protection zone have no dead material within the plant's crown or on the bole;

15.1. Shire of Capel Fire Management Strategies

Fire management within the Shire of Capel is administered as per the procedures outlined in the Local Emergency Management Plan, documented by the Shire. The Boyanup Bushfire Brigade (BFB) is the closest emergency services and is less than 100m from entrance to Meadowbrooke Estate along Turner Road. The BFB services maintain 3.4 fire appliance vehicles/trucks and fast attack units, this is also backed up with a modern communication system for call outs as well as

communication on the fire ground. These are typical of bush fire brigades for fire fighting services within Western Australia.

The Boyanup BFB has the following:

- Fully equipped fire station;
- Volunteer trained members;
- A communications and call out system;
- Protective clothing issue to volunteers; and
- DFES approved fire appliances.

Response times can vary depending on commitments of volunteers, fire events current at time and priority of the fire services in the south west of Western Australia during summer periods. DFES recommends that homeowners take care to prepare their individual dwellings for fire season and take precautions against fire as per the ***'Bushfire Preparedness – Prepare. Act. Survive.'***

It is generally acknowledged that during large wildfire events, local resources may not be able to respond to every lot due to strategic deployments of services, priorities within the area or state and/or present commitments of volunteers and resources. It is therefore recommended that land owners implement strategies as recommended by DFES to protect life and property during the fire season.

16. Commitments regarding future maintenance

The following commitments have been made regarding future maintenance of the foreshore area, refer to Table 8.

Table 8 – Foreshore Reserve Maintenance

Responsibility	Tasks
Current Land Owners	• Continue to reduce weed infestations of the foreshore area, limit spread and further infestations occurring.
Shire of Capel	• Implement Foreshore Management Plan. • Ongoing maintenance of foreshore areas • Continue to reduce weed infestations of the foreshore area, limit spread and further infestations occurring. • Infill planting as required. • At the completion of revegetation stages implement maintenance procedures as per Shire policy.
Developer Meadowbrook Estate	• Commission and fund the Foreshore Management Plan document

Table 9 over the page outlines the long term responsibilities for the successful implementation of this Foreshore Management Plan.

16.1. Performance monitoring

The current land owner will implement monitoring procedures to assess the success of management strategies addressing rehabilitation works, weed control activities, water quality and feral animals during the three year management period. This will allow the identification of area requiring augmentation or remedial works to be identified early and appropriately planned. In addition, the monitoring will ensure that an adequate representation of species and plant diversity is achieved.

16.2. Rehabilitation performance criteria and reporting

The completion criteria for the revegetation works are:

1. A 90% survival rate of the planted seedlings within the designated areas. Should this rate not be met, infill planting will be required to raise the surviving plant numbers above 90% of the initial planting density.

2. The revegetation target of the FMP is to establish at least 1 plant / m2 throughout the foreshore area.

3. In all revegetation zones the target is less than 40% weed cover, and for all Shire of Capel First Schedule Pest Plants to be less than 5%.

16.3. Program of Works and Long-term Actions

The following actions outline the Environmental Objectives to be maintained and monitored during and post revegetation and at the implementation of this plan. Please refer to Table 9 below.

Table 9 – Long Term Management and Responsibilities

Management Objective(s)	*Management Aims*	*Management Action(s)*	*Responsibility*	*Performance Indicator*	*Indicator Measurements*	*Monitoring frequency*
Weed Management	Reduce the impact and spread of weeds which are currently on-site.	Remove all weeds through actions including: Hand/mechanical removal; Spot spraying of individual plants; and Slashing of weed species on site to 100mm excluding declared plants, large woody weeds, trees, and pampas grass Refer to Table 7 for species specific methodologies	SoC	Weed populations and re-invasions on site post construction.	The recurrence of weed populations is minimal; and New populations of weeds do not occur.	Undertaken 6, 12 and 18 monthly after construction.
Water Quality, nutrient and Stormwater Management	Treat water on site, reduce nutrients and hydrocarbons; Improve & maintain adjacent creek water quality parameters; Ensure stormwater is carried through stormwater treatment to avoid impacting natural environment; and Reduce the transportation of nutrients generated onsite into waterways and drains.	WSUD principles applied to site design (i.e. runoff, nutrient stripping, recycling, water harvesting) and design implement at construction phases; Ensure water quality controls and structures are in place and in correct working order; and Point source infiltration through construction of swales, rain gardens and detention basins.	Developer/ Contractor at adjacent development site (Lot 201)	Wetland vegetation in POS healthy/diverse; Only stormwater from >1:10 events flow off site; Infiltration basins, swales and living stream condition including water condition (appearance), vegetation condition and flow condition.	No unusual vegetation deaths, sludge or scum forming in and around the swales and detention basins. Water appears to be clean and clear; carrying only suspended natural vegetation from living stream or swales and not carrying any scum or foreign chemicals (i.e. hydrocarbons). Infiltration basins work effectively and may only become overloaded during extended periods of heavy (above average) rain.	Quarterly Monitoring of all stormwater structures.
Rehabilitation of degraded areas from any construction activities.	Rehabilitate degraded areas from construction activities such as trench construction or clearing of native vegetation areas.	Revegetate degraded areas with native plant species; Remove invasive weed species to prevent further degradation; and Prevent erosion through established vegetation and/or erosion control methods.	SoC	The area (m^2) of degraded vegetation (percent weed establishment); Poor native vegetation condition of degraded areas; and Erosion does not occur after heavy rains or high winds during dry periods.	The area (m^2) of degraded vegetation (weeds) has been reduced and continues to reduce in area; Native Vegetation continues to grow without assistance; Deaths in native vegetation natural; and Erosion is minimal during high rainfall months or during dry periods with high winds.	Quarterly Monitoring of any degraded areas post construction for a period of 2 years.
Revegetation of foreshore area	To achieve revegetation of native riparian species in foreshore area. Provide habitat for birds, amphibians and small mammals. Replanting of revegetation areas to accommodate from initial plant losses.	Employ revegetation techniques as per methods Section 6. Monitor revegetation areas for deaths or disease. Monitor weed infestations and treat. Planting or seed dispersal in areas which plant losses occur	SoC	Poor native vegetation condition of degraded areas; and Erosion does not occur after heavy rains or high winds during dry periods.	Native Vegetation continues to grow without assistance; Deaths in native vegetation natural; and Erosion is minimal during high rainfall months or during dry periods with high winds; and	Quarterly Monitoring of any degraded areas post construction for a period of 2 years.
Fire Management	Prevent Fire Hazards within adjacent Development.	Ensure fuel loads in adjacent uncleared areas are managed; Ensure water source is not disrupted; Access around Foreshore area is unimpeded	Contractor/ Developer, neighbours, SoC & DFES	Fire occurrence is minimal or none; and All structures are in good working order from regular checks.	Leaf litter including wood material and grasses poses minimal fire hazard; Regular hydrant inspections indicate they work to specified rates and connections correct for emergency use.	Yearly prior to summer period.

Management Objective(s)	*Management Aims*	*Management Action(s)*	*Stakeholders*	*Performance Indicator*	*Indicator Measurements*	*Monitoring frequency*
Generate and maintain Community involvement	To be informative to neighbours regarding the project; and Involve the Capel LCDC, local schools and community groups as appropriate.	Ensure neighbours are notified of the milestones of the construction period; and Give new landowners a copy of the Foreshore Management Plan as it applies to their property. Encourage community groups to be involved in the implementation of revegetation works.	Developer, Community liaison officer.	Complaints from adjacent residents; and Community groups are involved in the revegetation process.	Amount of complaints during construction actives. Community groups have a sense of belonging and involvement in the project.	Quarterly and informal checks.
Monitoring	Revegetation of foreshore and rehabilitation areas is monitored.	12 Month Maintenance Program is abided.	SoC	Revegetation is successful and there is few deaths of plants and weed invasions are minimal.	Regular maintenance patrols and reports by environmental officer	Quarterly and informal checks.
Fauna Management	Revegetated foreshore attracts native fauna whilst ensuring they do not become pest/nuisance fauna to residents.	Mature trees are conserved to attract native fauna and to be utilised as habitat; Areas of remnant vegetation are conserved to provide shelter and habitat for native fauna; and Household pets are managed as not to disturb or harm native fauna. Retain dead trees and logs for habitat refuge areas for small mammals and reptiles.	SoC	Fauna diversity; Signs of habitat use; and Fauna stay within foreshore and not in residential areas.	Complaints register from residents of nuisance fauna in property; and During maintenance visits, wildlife noticed in foreshore areas.	Informal checks
Mosquito and Pest Insect Management	The potential for mosquito and pest insects to become a health hazard is reduced.	Stagnant water bodies are reduced; The time water sits stagnant is reduced; Nutrients released into waterways are reduced; Vegetation surrounding stagnant water bodies is sufficient enough to act as a buffer and not act as a vector for insect movement; and Identify and indicate areas of high risk.	Adjacent Developer, Contractor	Quantity of mosquito & midges observed in creek and residential areas.	Register of comments made by residents.	Quarterly checks.

17. Conclusions

Preston Green Pty Ltd commissioned Bio Diverse Solutions (Environmental Consultants) to prepare a Foreshore Management Plan of Lot 200 adjacent to Meadowbrooke Estate (now Lot 201, formerly Lot 888) Turner Street, Boyanup within the Shire of Capel. The Foreshore Management Plan (FMP) was a condition of the successful rezoning of the site (previous owners) and a commitment from Preston Green Pty Ltd (current owners) to undertake as part of a Development Approval being lodged in 2014.

The foreshore area (Lot 200) of Preston River in the subject area is quite degraded from previously being contained within the private property of Meadowbrook Estate where there are introduced trees, ornamental plants and landscaped grassed areas. Revegetation is recommended to restore the river foreshore area, generate ecological linkages and enhance the amenity area. This report recommends that a comprehensive weed program is carried out when revegetation strategies occur.

Native endemic species are recommended for planting in the creek, a variety of species are noted, however this can be subject to availability and local nursery sources. Past revegetation strategies have proven successful in the north western adjacent areas of the Preston River and revegetation strategies are aligned to these methods.

The implementation of this plan will be the responsibility of the Shire of Capel. The implementation of the recommendations in this report will enhance the Preston River and downstream water bodies biodiversity values in the future and give social amenity to the site. The funding of the implementation of the foreshore report could be sourced through state and federal environmental/infrastructure sources and should be pursued by the Shire of Capel to assist the successful implementation and ongoing management of the reserve.

It is recommended that the adjacent landowners are given a copy of the Foreshore Management Plan to assist with future management of the foreshore area as it occurs adjacent to their property. This report also recommended the involvement to the local community, LCDC group and others to assist in the revegetation project and to also develop community ownership of the area.

18. References

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Appendices

Appendix A – Location mapping and Landgate extract

Appendix B – Development Guide Plan

Appendix C – DPaW Geomorphic Wetland Mapping

Appendix D – Vegetation Mapping

Appendix E – Revegetation plan

Appendix F – Foreshore Management Plan

Appendix G – Aboriginal Heritage Site report

Appendix A

Location mapping and Landgate extract



Legend

- Foreshore area - Lot 200
- Development area - Lot 201

1:3000 @ A3
GDA MGA 94
Zone 50

0 25 50 100 150 200 Meters

BIO DIVERSE SOLUTIONS
55 Peppermint Drive
Albany, WA 6330
Australia
Tel: 08 9841 3936
Fax: 08 9841 3936
Mob: 0447 555 516

CLIENT Lot 200 and 201
Turner Street
Boyanup WA

Location Mapping

STATUS	FILE	DATE
FINAL	MPM004	18/09/2014

LANDGATE COPY OF ORIGINAL NOT TO SCALE Tue Jul 1 10:42:01 2014 JOB 45054005

Landgate
www.landgate.wa.gov.au

Appendix B

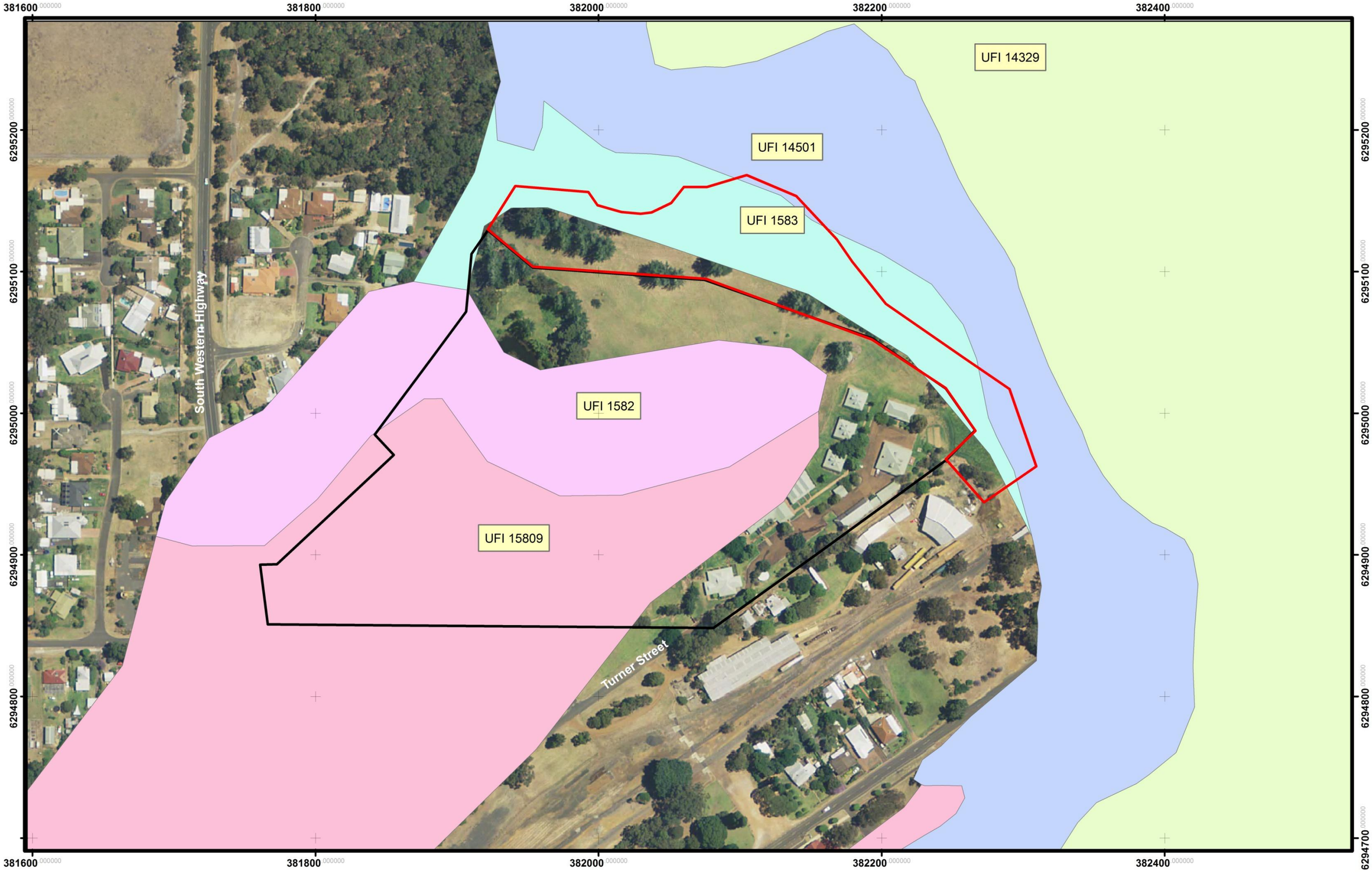
Development Guide Plan



BIO DIVERSE SOLUTIONS

Appendix C

DEC Geomorphic Wetlands Mapping



Legend

Foreshore area - Lot 200

Development area - Lot 201

DEC Geomorphic Wetlands

1:2, 500 @ A3
GDA MGA 94
Zone 50

0 25 50 100 150 200 Meters

BIO DIVERSE SOLUTIONS

55 Peppermint Drive
Albany, WA 6330
Australia
Tel: 08 9841 3936
Fax: 08 9841 3936
Mob: 0447 555 516

CLIENT **Lot 200 and 201 Turner Street Boyanup WA**

DEC Wetland Mapping

STATUS	FILE	DATE
FINAL	MPM004	18/09/2014

Appendix D

Vegetation Mapping

382000 000000 382200 000000 382400 000000

6295300 000000 6295200 000000 6295100 000000 6295000 000000

Introduced palms and ornamentals in adjacent UCL

Low Open Forest to Medium Woodland E.Rudis & A.flexuosa

Open woodland of E.rudis & A.flexuosa

Grasslands, cleared maintaned lawns and deciduous trees

Some non-endemic species from previous revegetation strategies

Fruit trees

382000 000000 382200 000000 382400 000000

Legend

- River Ramble
- Open Woodland of E.rudis and A. flexuosa,
- Low Open Forest E.rudis & A.parviceps
- Grasslands
- Foreshore area - Lot 200

1:1, 750 @ A3
GDA MGA 94
Zone 50

0 12.5 25 50 75 100 Meters

BIO DIVERSE SOLUTIONS
55 Peppermint Drive
Albany, WA 6330
Australia
Tel: 08 9841 3936
Fax: 08 9841 3936
Mob: 0447 555 516

CLIENT **Preston Green Pty Ltd**
Lot 201 Turner Street
Boyanup WA

Vegetation Mapping

STATUS	FILE	DATE
FINAL	MPM004	6/11/2014

Appendix E

Revegetation Plan

382000 000000
382200 000000
6295200 000000
6295100 000000
6295000 000000

Preston River

Riverbank area (Rb)
- Infill tree planting as required
- mostly understorey and midstorey species
- upto B1 classification standards
- 15116m2

Floodplain area 001 (Fp001)
- Full revegetation strategies
- Weed removal
- Overstorey, midstorey and understorey plantings
- Upto B1 classification standards
- 5482m2

Existing River Ramble Walk

Possible DUP extensions into lifestyle village

Floodplain area 002 (Fp002)
- Remove poplars, fruit trees and ornamentals
- Landscaping with grasses and low native shrubs
- Shrubs/herbs to be less than 0.5m
possible relocation of ornamentals and fruit trees
- 7534m2

Align new DUP to assist with weed control/reveg strategies & place within lot 200

Possible DUP extensions into lifestyle village

382000 000000
382200 000000

Legend

- New DUP
- Foreshore area - Lot 200
- River Ramble
- Reveg Fp001
- Reveg Fp002
- Reveg Rb

1:1, 250 @ A3
GDA MGA 94
Zone 50

0 12.5 25 50 75 100 Meters

BIO DIVERSE SOLUTIONS
55 Peppermint Drive
Albany, WA 6330
Australia
Tel: 08 9841 3936
Fax: 08 9841 3936
Mob: 0447 555 516

CLIENT **Lot 200 and 201 Turner Street Boyanup WA**

Revegetation mapping

STATUS	FILE	DATE
FINAL	MPM004	18/09/2014

Appendix F

Foreshore Master Plan

382000 000000

382200 000000

6295200 000000

6295100 000000

6295000 000000

6294900 000000

DUP to tie into existing footbridge

Remove old fencing Visitor Risk Assessment of pathway

Fp001 - Full revegetation 2m buffer to DUP

Upgrade River Ramble to DUP 2.5m stablised Within boundary of Lot 200

Remove ornamental plants

Rb - Reveg inplanting amongst existing veg

Fp002 - Partial revegetation 2m buffer to DUP low shrubs/landscaping for visibility

Rip and revegetate old path

Linking DUP & EAW into development link back onto Turner St

Fp001 - Full revegetation 2m buffer to DUP

Remove orchard species and any ornamental plants

Erosion/bank stability works as required

Possible new section of River Ramble as a DUP

New DUP along outside of access road link back onto Turner St

DUP gated, can be utlised for Fire Service Access

Remove plantation species and any ornamental plants

DUP to tie into adjacent reserve MP presently being developed by SoC

Carparking in railway reserve integrate in new Master Plan

Legend

- Foreshore area - Lot 200
- New DUP
- River Ramble
- Reveg Rb
- Reveg Fp002
- Reveg Fp001

1:2, 500 @ A3
GDA MGA 94
Zone 50

0 10 20 40 60 80 Meters

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55 Peppermint Drive
Albany, WA 6330
Australia
Tel: 08 9841 3936
Fax: 08 9841 3936
Mob: 0447 555 516

CLIENT **Lot 200 Turner Street Boyanup WA**

FMP Master Plan

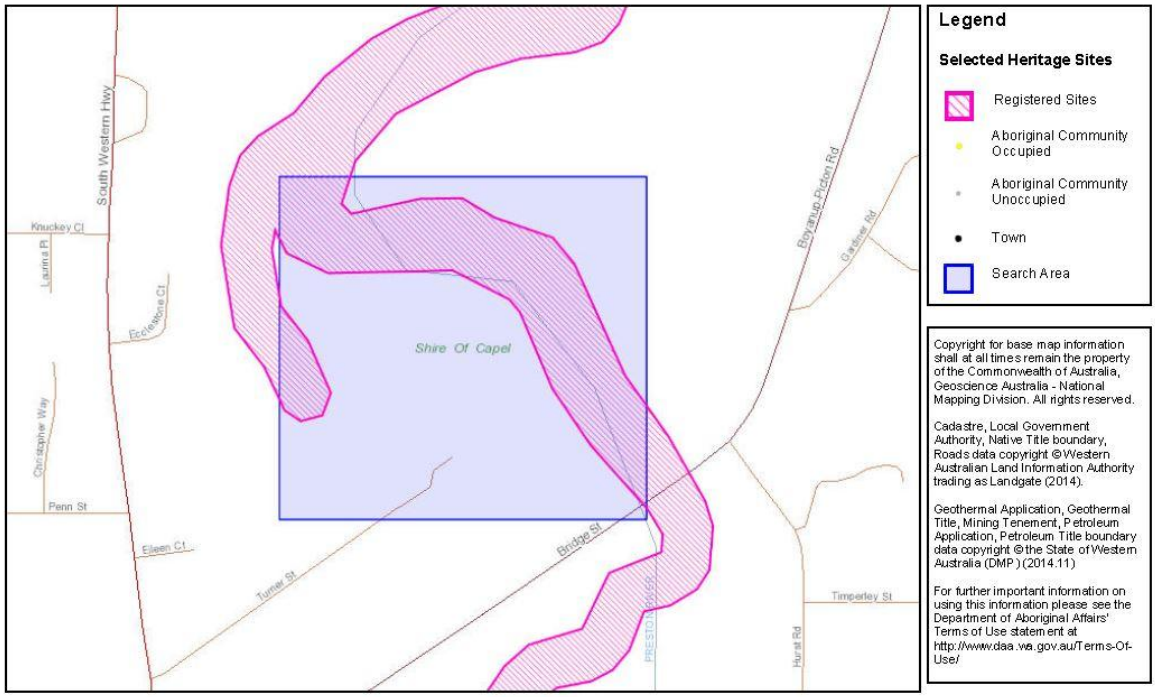
STATUS	FILE	DATE
FINAL	MPM004	18/09/2014

Appendix G

Aboriginal Heritage site report

List of Registered Aboriginal Sites with Map

Site ID	Site Name	File Restricted	Boundary Restricted	Restrictions	Status	Site Type	Knowledge Holders	Coordinates	Legacy ID
19795	Preston River	No	No	No Gender Restrictions	Registered Site	Mythological	*Registered Knowledge Holder names available from DAA	400159mE 6290621mN Zone 50 [Reliable]	



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TECHNICAL MEMORANDUM

Foreshore Implementation Works Summary

PROJECT NUMBER	EP19-140(02)	**DOC. NUMBER**	EP19-140(02)—002 KK
PROJECT	Meadowbrooke Lifestyle Estate	**CLIENT**	Preston Green Pty Ltd (in liquidation)
AUTHOR	KK	**REVIEWER**	KK
VERSION	001	**DATE**	September 2020

1 OVERVIEW

Emerge Associates have been engaged by Preston Green Pty Ltd (in liquidation) (receivers and managers appointed) to provide environmental due diligence advice to support future development of Lot 201 on Plan 400906 (33 Turner Street), Boyanup and herein referred to as 'the site'. The site is located within the Boyanup townsite in the Shire of Capel. Historically the site has been partially developed as a lifestyle village (Meadowbrooke Lifestyle Estate) for people aged over 55 years, with a number of park homes established within the site since 2016.

As part of this, Emerge Associates were asked to review the *Foreshore Management Plan* (Bio Diverse Solutions 2018) prepared for the site, and if possible, work with the Shire of Capel to review and confirm the foreshore management plan works that need to be implemented as part of future development by a new owner/developer.

This technical memorandum has been prepared to summarise the discussions between the Shire of Capel and Emerge Associates on the 5th September 2020, and reflect a revised approach to implementing the *Foreshore Management Plan* (Bio Diverse Solutions 2018).

2 MANAGEMENT PLAN

The *Foreshore Management Plan* (Bio Diverse Solutions 2018) is not clear on the specific requirements for each management zone and does not capture the work undertaken by the previous proponent. While it is acknowledged that minimal works have been undertaken previously, some weed control as well as fencing works have been implemented, and in discussion with the Shire, it has been agreed that the works required, when compared to the *Foreshore Management Plan* (Bio Diverse Solutions 2018), will be modified. The intent of the *Foreshore Management Plan* (Bio Diverse Solutions 2018) should however still be achieved.

2.1 Key management zones

The *Foreshore Management Plan* (Bio Diverse Solutions 2018) identified four zones that required treatment/consideration as part of implementing the required works. These four zones are collectively referred to as the 'foreshore area'. A summary of the key management zones, the intent of each zone and key components of works to be undertaken have been summarised in **Table 1**. An outline of the location of each of the zones is provided in **Plate 1** further below.

Table 1: Summary of management zones and key components of works

Management Zone	Size (ha) (approx.)	Description	Management requirements	
			Intent	Key components of works
Riparian	1.13	This zone directly follows the Preston River and contains mainly remnant riparian vegetation. There are areas of major weed outbreaks, large fallen timbers and a range of foreshore profiles from a steep drop-off to gently sloping banks.	To beautify and increase biodiversity through planting of native species in the top of bank area.	• To be focused on improving biodiversity within the top of bank area (approx. 8500 m^2). No works are required on the banks. • Remove non-native trees. • Undertake weed control. • Undertake planting of native groundcovers, understorey and mid-storey species.
Outfall	0.01	This is where the creek (described below) and associated stormwater from the site flows into the Preston River. It is highly eroded and eroding and contains mainly exotic trees and plants.	To stabilise the eroding banks with native species.	• Undertake site preparation works (in consultation with the Shire), which may include removal of fallen trees, removal of non-native trees etc. • Undertake planting native groundcovers, understorey and mid-storey species using sandbag technique. This will also support control of weeds.
Creek	0.63	This creek runs along the whole western boundary of the site and is the main receiving waterbody for stormwater from the development. There is a mix of remnant riparian trees, weed species trees and kikuyu grass. It is damp most of the year and can flow strongly during storm events. It includes the ornamental garden where many moisture-loving ornamental exotic tree and plant species are growing	To remove non-native trees and replace with native trees, but support ongoing fuel load management (through mowing/slashing or similar of grasses).	• Removing all non-native trees, particularly poplars. • Replanting with native riparian tree species. Spacing of trees to enable ongoing management of grass fuels.
Floodplain	1.39	This is between the riparian zone and the development boundary and is mainly cleared, grassed land except for a small orchard historically installed by a previous owner.	To increase shade and provide a useable space for the community.	• Retain existing orchard. • Retain existing grass areas. • Plant shade trees (*Agonis flexuosa*) and garden areas at base of trees (to provide amenity and help protect trees during mowing). • Planting to achieve low threat in accordance with requirements of the bushfire management plan (Bio Diverse Solutions 2015). This includes trees (with garden beds under trees to be no more than 0.25 ha in size) to be spaced 20 m from buildings, riparian, creek and outfall zones and other trees.



Plate 1: Management zones associated with implementing the Foreshore Management Plan (Bio Diverse Solutions 2018), as provided by the Shire of Capel

2.2 Required foreshore works

A summary of the works required to implement the foreshore management plan have been outlined in **Table 2**, with further detail on each component of work provided in the following sections.

Table 2: Summary of foreshore management implementation and maintenance requirements

Management zone	Weed and tree removal		Revegetation			Grazing control	Disease control	Fencing	Monitoring and maintenance
	Weed control	Non-native tree removal	Planting of native species	Planting of native trees	Garden areas				
Riparian	X	X	X	-	-	X	X	-	X
Outfall	X (site preparation)	X	X (sandbag technique)	-	-	X	X	-	X
Creek	-	X	-	X	-	X	X	-	X
Floodplain	-	-	-	X	X	X	X	-	X

2.2.1 Site preparation

Site preparation works will be mostly restricted to the outfall zone, and may include removal of fallen dead material and/or non-native trees. The requirement for these works should be determined in consultation with the Shire of Capel and be based on minimising erosion and maximising success of the sandbagging technique.

2.2.2 Weed control and non-native tree removal

Weed control may be via manual removal or through the use of a selected herbicide or a combination of both. All herbicide application will be as per the manufacture's recommendations, Material Safety Data Sheet (MSDS) and any guidelines prepared by the Shire of Capel. It is important to note that the selected herbicide used within any wet areas of the site (i.e. riparian zone, creek) must not contain a surfactant.

Weed control will need to be undertaken prior to any revegetation works using appropriate timing and methodology. If weeds are identified they will be treated using the following approach:

- Non-native trees/large woody weeds for removal will be confirmed with the Shire of Capel. Non-native trees/large woody weeds will be poisoned and/or manually removed from site (a combination of both may be required depending upon the species);
- Small weeds will be sprayed by a licensed contractor or landholder.

Follow-up spraying will be undertaken within 6 months of the first treatment and repeated as necessary until the completion criteria have been satisfied.

A list of weeds that may be present within the management zones has been provided in **Table 3**. This list is not exhaustive, and other weeds may be identified at the time of implementation and/or as part of maintenance and should be managed.

Table 3: Weed species that may be present within the management zones

Woody weeds	General weeds	Herbs
Poplar (*Populus sp*)	Kikuyu (*Pennisetum clandestinum*)	Spear thistle (*Cirsium vulgare*)
Silver Birch (*Betula pendula*)	African Love Grass (*Eragrostis curvulata*)	Night shade (*Solanum nigrum*)
Golden wattle (*Acacia longifolia*)	Blowfly grass (*Briza maxima*)	Fleabane (*Conyza spp*)
Blackberry (*Rubus ulmifolius*)	Flat weed (*Hypochaeris spp*)	Dolichos Pea (*Dipogon lignosus*)
Ink weed (*Phytolacca octandra*)	Hare's-tail Grass (*Lagurus ovatus*)	Watsonia (*Watsonia meriana*)

No weed control is to be undertaken within the outfall zone. This is to minimise further destabilisation of the eroding banks. It is envisaged that the sandbags (discussed below) will be placed directly over the weeds, which will assist in weed control in this zone, but maintain the root mass while planting becomes established.

2.2.3 Revegetation

Local endemic plants that are well adapted to the natural environment and can survive on little water and nutrients should be used as much as possible. These plants will act as a natural stabiliser of soils and provide habitat for local fauna species. A general planting list has been provided in **Table 4** (other species can be used, based on discussion with the Shire of Capel).

Planting should commence after the season's first major rains, typically early winter, when the soil is sufficiently wet to plant without the need for additional watering and to allow maximum root growth and plant establishment before summer.

2.2.3.1 Planting of native spaces

General planting approach

Planting within the riparian and outfall zones is limited to groundcovers and understorey species.

The proposed planting program should be undertaken to maximise achievement of the completion criteria outlined in **Section 2.3.1**. This could include planting up to 4 stems per square metre (m^2) as part of the initial year of planting, to minimise requirement for planting in following years.

Planting should be undertaken in an irregular manner to reflect natural variation for location and density of species.

Plants are to be sourced from an accredited nursery supplier and should be dieback free.

Sandbag technique

Within the outfall zone, planting should be undertaken using the sandbagging technique. This technique involves:

1. Fill the jute bag (600 mm X 350 mm) with sand (preferably locally sourced, or an appropriate river sand) and tied off using jute string.
2. Sand bag should be laid directly over any existing weeds and parallel to the bank. Sandbags to placed / stacked on an angle parallel to the flow at an average of two bags per square metre. Sandbag height (which may include stacking multiple bags) to be determined in consultation with the Shire of Capel.
3. Cut two slits in to the top of the bag and plant seeding firmly in each. Two stems to be planted per sandbag to achieve 4 stems per square metre. Species suitable for use as part of sandbagging have been outlined in **Table 4** (other species can be used, based on discussion with the Shire of Capel).
4. Seedling will grow through bottom of the bag, with the bag rotting away over time. The bag provides protection for the plant root system during winter and times o high water flow.

The Shire of Capel can be consulted for further information on implementation of this technique.

2.2.3.2 Planting of native trees

General planting approach

Planting within the creek and floodplain zones is limited to mostly native tree planting and is outlined below. Within the floodplain zone, garden bed planting is required around the base of the planted trees. A general planting list has been provided in **Table 4** (other species can be used, based on discussion with the Shire of Capel).

Plants are to be sourced from an accredited nursery supplier and should be dieback free (mulch should also be dieback free). Where possible, plant stock should be grown from local provenance seed or cuttings.

Creek zone

Following removal of existing non-native trees, native tree species are to be planted to achieve one plant per 5 m^2. This is to facilitate ongoing mowing/slashing of grass fuels present within the creek zone, to assist in minimising fuel loads from a bushfire perspective.

Floodplain zone

Within the floodplain zone, additional planting of shade trees is required to improve the amenity and useability of the current open space area. This includes

- Existing grassed areas to be maintained (except where garden areas proposed under trees). This area will continue to be regularly mowed.
- Existing orchard area within the south-eastern portion of the zone to be retained.
- Additional trees (*Agonis flexuosa*, or as agreed with the Shire of Capel) to be planted based on the following approach (the exact number of trees to be determined in consultation with the Shire of Capel):
    - Tree locations to be randomised where possible.
    - Tree stems to be planted 20 m apart, and more than 20 m from other trees/revegetation areas and buildings.
- Garden areas to be planted under the trees. Garden should be minimum 2 m radius area around each tree and is to be planted with native species (determined in consultation with Shire of Capel) with area to be mulched. Species should be tolerant of shade, with planting to assist in minimising damage to trees from mowing.

Table 4: General species list for revegetation within management zones (Biodiverse Solutions 2018)

General species		Riparian and outfall zones *(in addition to species from the general list, 'green' is sandbagging species)*
Acacia alata	*Hovea trisperma*	*Acacia urophylla*
Acacia dentifera	*Hypocalymma angustifolium*	*Astartea fascicularis* (shrub)
Acacia extensa	*Hypocalymma robustum*	*Baumea articulata* (sedge/rush)
Acacia pulchella	*Jacksonia furcellata*	*Baumea juncea* (sedge/rush)
Agonis flexuosa	*Kennedia prostrata*	*Callistachys lanceolata*
Allocasuarina fraseriana	*Kunzea recurva*	*Carex appressa* (sedge/rush)
Anigozanthos flavidus	*Labichea punctata*	*Darwinia citriodora*
Anigozanthos manglesii	*Lepidosperma squamatum*	*Ficinia nodosa (sedge/rush)*
Astartea fascicularis	*Leucopogon capitellatus*	*Grevillea diversifolia* (shrub)
Banksia grandis	*Leucopogon propinquus*	*Ficinia nodosa* (sedge/rush)
Bossiaea linophylla	*Melaleuca rhaphiophylla*	*Juncus pallidus* (sedge/rush)
Chorizema nanum	*Melaleuca thymoides*	*Lepidosperma effusum*
Clematis pubescens	*Microlaena stipoides*	*Lepidosperma gladiatum* (sedge/rush)
Corymbia calophylla	*Orthrosanthus laxus*	Lepidosperma tetraquetrum (sedge/rush)
Cyathochaeta avenacea	*Patersonia occidentalis*	*Melaleuca lateritia* (shrub)
Dodonaea viscosa	*Patersonia umbrosa*	*Hakea lasianthoides*
Eucalyptus rudis	*Persoonia longifolia*	*Taxandria linearifolia*
Eucalyptus patens	*Phyllanthus calycinus*	*Trymalium floribunda*
Eucalyptus marginata	*Pteridium esculentum*	
Grevillea bipinnatifida	*Taxandria parviceps*	
Hakea lissocarpha	*Xanthorrhoea preissii*	
Hibbertia commutata	*Xanthorrhoea brunonis*	
Hibbertia hypericoides	*Xanthorrhoea gracilis*	

2.2.4 Grazing control

Tree/plant guards may need to be installed around seedlings at time of planting to protect exposed tube stock from potential grazing by kangaroos and rabbits (and/or other species). Use of tree/plant guards is likely to reduce the planting requirements in subsequent years.

2.2.5 Disease control

The primary plant disease consideration relates to the management of *Phytophthora cinnamomi* (commonly known as dieback). Dieback is a soil borne fungal pathogen which spread through surface and sub-surface water flows and soil movement, and is a serious threat to the flora of the south west

Western Australia. The movement of infested water and soil is a key mechanism in how this pathogen is spread.

Human activities have contributed significantly to the rapid and widespread distribution of the pathogen in southwest Western Australia (DPaW 2015). There is no practical large-scale cure for dieback and therefore prevention and containment are the primary options for management.

It is unknown whether this pathogen is present within the site and in nearby areas. However, precautionary measures should be incorporated during implementation activities to minimise the potential for dieback to be introduced. These include:

- Ensuring vehicles, tools, equipment and machinery used as part of implementation are free of mud and soil on entry and exit to the foreshore area. This can be achieved through the use of high-pressure cleaners, stiff brushes, use of disinfectant or Phytoclean (a fungicide) and collection of the residual soil.
- Ensuring plants, soil, gravel, sand, mulch and other materials used within the foreshore area are free of dieback.
- Minimise activities when soil is wet or muddy.

2.2.6 Fencing

No fencing works are required.

The previous proponent removed old fencing (as required by the *Foreshore Management Plan* (Bio Diverse Solutions 2018), and the Shire, in collaboration with Bunbury TAFE have installed other fencing in the foreshore area.

2.2.7 Footpaths and other infrastructure

The footpaths within the foreshore area are appropriate and no additional works are required.

2.3 Implementation

The implementation of the foreshore management works will be the responsibility of the developer/proponent. The developer/proponent will be responsible for the initial maintenance period (which is likely to be a minimum of three years, until the completion criteria have been achieved to the satisfaction of the Shire of Capel), and following handover, the management zones will come under the maintenance of the Shire of Capel.

2.3.1 Completion criteria

The completion targets that will need to be satisfied prior to handover for the various zones as outlined in **Table 5**, unless agreed otherwise with the Shire of Capel.

Table 5: Completion criteria to be achieved with regard to weed control and revegetation/planting

Management zone	Weed cover	Revegetation/planting
Riparian (top of bank)	• No non-native trees • 20% weed cover, and for all declared and/or priority weed species, less than 5% weed cover.	• 2 stems per m^2
Outfall	• No non-native trees • 20% weed cover, and for all declared and/or priority weed species, less than 5% weed cover.	• 4 stems per m^2
Creek	• No non-native trees	• 1 tree per 5 m^2
Floodplain	• Not applicable	• Based on satisfying • Tree stems at least 20 m apart, and 20 m or more from buildings and revegetation areas. • 'Garden areas' to achieve 3 plants per m^2.

2.3.2 Monitoring

All areas will be monitored by the proponent for three years following implementation of initial works to ensure progress towards the completion targets are met, unless agreed otherwise with the Shire of Capel. This should be based on two visits per year, one in spring and one in autumn. This is to assess:

- Losses as a result of transplant shock, weed competition, predation/grazing or weather-related impacts.
- Determine mortality and survival rates (particularly after summer)
- Determine remedial works to be undertaken in the following 6-12 months, including weed control, additional planting, predation/grazing control etc.

Timing of assessments may be adjusted to suit the weather conditions. The results of each monitoring assessment will be compared to determine growth and mortality rates, and will provide a quantitative measure of progress. A monitoring report should be prepared and submitted to the Shire of Capel within 4 weeks of the monitoring event.

2.3.3 Maintenance

The proponent will be responsible for implementing and maintaining the outlined works for a minimum of threes years, until the completion criteria have been satisfied. Following handover, the Shire of Capel will be responsible for the maintenance of the various zones, unless agreed otherwise. This will include regularly mowing grass areas within the creek and floodplain zones.

Infill planting will be carried out in subsequent winters as required until the completion criteria are achieved. The quantities required for infill planting will be calculated through monitoring between plant installations in subsequent autumns (for a period of 3 years post initial planting) based on satisfying the completion criteria.

3 SUMMARY AND CLOSING

This technical memorandum has been prepared to outline the required foreshore management implementation works and is based on a conversation between Emerge Associates and the Shire of Capel on the 5th September 2020 and agreed modified requirements based on the *Foreshore Management Plan* (Bio Diverse Solutions 2018). It is based on achieving the management intent outlined in **Table 1**, and supporting ongoing bushfire management requirements as well as community enjoyment of the foreshore area.

The proponent will be required to consult with the Shire of Capel regarding the implementation and maintenance of the outlined works. Monitoring and maintenance of the outlined works is required for a minimum three years until the completion criteria is satisfied, or as agreed with the Shire of Capel.

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December 14

LOCAL WATER MANAGEMENT STRATEGY

MEADOWBROOKE LIFESTYLE ESTATE

PREPARED FOR: PRESTON GREEN PTY LTD



Submitted by
MPM Development Consultants
107 Beach Road
BUNBURY WA 6230

Telephone
08 9721 4777

Email
reception@mpmdc.com.au

Web
www.mpmdc.com.au

mpm development consultants

DOCUMENT CONTROL

Author (s) : **CRAIG PIPPIN**

Reviewer (s) : **SHELLEY COUTTS**

Job No. : **09016**

Client : **MEADOWBROOKE ESTATE**

Revision

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A	Issued for Approval		CP	19/12/14

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ATTACHMENT J - PRESTON RIVER FLOOD STUDY
ATTACHMENT K - GROUNDWATER QUALITY ANALYSIS

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Executive Summary

This Local Water Management Strategy (LWMS) has been prepared by MPM Development Consultants (MPM) on behalf of Preston Green Pty Ltd in support of the Development Guide Plan (DGP) for the Meadowbrooke Estate. The DGP proposal is to guide the development and infrastructure servicing of the site for a lifestyle village. The LWMS provides the strategy for the implementation of best management practises and principles of water sensitive urban design to ensure that total water cycle management is achieved within the DGP and its development.

The LWMS has been completed in accordance with the Better Urban Water Management (Western Australian Planning Commission, 2008), the constraints and opportunities identified in referenced consultant reports, information from state and local government authorities.

The total development area of Meadowbrooke Estate is approximately 11.18ha. The development is located approximately 400 metres north east of Boyanup. The structure plan area is generally bounded by the Preston River and reserve with a creek to the north and east, private properties and Turner Street to the south, and South West Highway to the west.

The site currently contains two function centres and a range of short stay accommodation options including self contained cottages and villas.

The land is zoned, "Urban" by the Greater Bunbury Region Scheme (GBRS). The Shire of Capel District Planning Scheme No. 7 zones the subject land; Residential R10/15, Special Use (Various) In May 2010, Amendment No. 46 to the Shire of Capel Town Planning Scheme No 7 'District Planning Scheme' was granted final approval resulting in the land being included within the 'Special Use' zone of Council's Scheme with the predominant use for the subject land being an 'Aged Person's Village'

The present Meadowbrooke development sits on relatively level terrain in the eastern portion of the site. The undeveloped western portion of the site is also relatively level however the northern edge of both areas drops away 5 to 6m towards the Preston River.

The preliminary geotechnical assessment generally indicated the presence of dry clayey soil and surface level with silty and sandy clay of medium to high plasticity, grading to clayey/silty sands in parts. GHD described the western portion of the site as Class H in accordance with AS 2870-1996 due to highly reactive clay present on site. It was noted that the site is not suitable for onsite disposal of surface water, due to its low permeability and offsite disposal will be required. This was confirmed in a subsequent report in 2014 by Douglas Partners in 2014, in addition to confirming the lower, central, northern area of the site being Class S.

The current ASS mapping on the WA Atlas website indicates that the development area is within an area of moderate to low risk of ASS occurring within 3m of the natural soil surface.

The proposed development is to consist of approximately 180 units/homes to form a lifestyle village development. The units/homes will be of modular construction, being constructed offsite and trucked to site fully completed. The existing buildings across the estate will be maintained and upgraded into Village Community buildings.

The development will be connected to the existing adjoining reticulated sewer infrastructure and will be provided with reticulated water. These services will be extended to each component of the proposed development, ensuring the entire development is fully serviced.

The 1 in 1 year ARI storm event management will utilise multiple bioretention basins across the development. The use of soakwells for the disposal of roof generated runoff has been considered unsuitable for the site based on geotechnical advice. The 1 year/ 1 hour storm event will be retained on the site within bioretention areas, to be of a minimum size equivalent to 2.0% of the impervious area of each catchment.

A standard network of grated stormwater collection pits and pipe network will convey storm events upto and including 1 in 5 year event to each catchments bioretention basin for treatment and detention. Each of the

basin will be constructed with high flow overflow structures and outlet pipework restricted to only permit outflow at the predevelopment rate.

The 1 in 100 year storm event will be transferred by the road network and the Community areas to the northern drainage reserve and the Preston River. It is not proposed to detain the 1 in 100 year storm event on the site to predevelopment rates, instead allowing the small development catchment to enter and exit the Preston River system prior to the peak flood levels occurring.

Hyd20 completed a flood study of the Preston River in order to determine the 1 in 100 year flood height of the river adjoining the development. Discussions between HyD20 and the Department of Water resolved that development on the site should also consider anecdotal evidence on a flood event that occurred in 1964. Both storm events were modelled and the department of Water recommended a minimum habitable floor level for all development to be 1.2m above the calculated 100 year flood levels. The relevant levels are tabled below;

Location	100 Year Flood Level Estimate	1964 Flood Level Estimate	Minimum Habitable Floor Level
Preston River Downstream Property Boundary	29.72	30.64	30.92
Preston River Upstream Property Boundary	30.24	31.12	31.44

The entire development site will be serviced with a subsoil system that will generally maintain the MGL across most of the site. It is proposed that the subsoil network will act to control the maximum groundwater levels along the southern boundary of the property, where on site groundwater monitoring has indicated that the groundwater is within 0.44m of the natural surface.

The development proposes to promote a range of water sustainability measures from fixtures and fittings through to education policies, including the implementation of rainwater tanks for non potable water sources on each of the proposed units/homes.

This LWMS will be implemented through conditional approval requirements of this DGP and further detailed engineering design details to be submitted for approval by the Shire of Capel, prior to the commencement of civil or building construction on the site. It is not proposed to undertake a subsequent Urban Water Management Plan (UWMP).

Local Water Management Strategy Checklist

Local Water Management Strategy Item	Deliverable	Shown on Page
Executive Summary		
Summary of the development design strategy, outlining how the design objectives are proposed to be met	Table: Design elements and requirements for best management practices and critical control points	5
Introduction		
Total water-cycle management - principles and objectives		12
Planning background		13
Previous studies		
Proposed Development		
Structure plan, zoning and land use	Site context plan	15
Key landscape features	Structure Plan	18
Previous land use		21
Landscape – Proposed public open space areas, public open space credits, water source, bores, lake details, irrigation areas (if applicable)	Landscape Plan	18
Design Criteria		
Agreed design objectives and source of objectives.		19
Pre-Development Environment		
Existing information and more detailed assessments (monitoring).		21
How do the site characteristics affect the design?		
Site conditions – existing topography/contours, aerial photo underlay, major physical features.	Site condition plan	22
Geotechnical – topography, soils including acid sulphate soils and infiltration capacity, test pit locations.	Geotechnical plan	23
Environmental – areas of significant flora and fauna, wetlands and buffers, waterways and buffers, contaminated sites.	Environmental plan plus supporting data where appropriate.	
Surface water – topography, 100 year floodways and	Surface-water plan	27

Local Water Management Strategy Item	Deliverable	Shown on Page
flood fringe areas, water quality of flows entering and leaving (if applicable).		
Ground water – topography, pre development groundwater levels and water quality, test bore locations	Ground water plan plus site investigations	30
Water Sustainability Initiatives		
Water efficiency measures – private and public open spaces including method of enforcement		33
Water supply (fit-for-purpose) strategy, agreed actions and implementation		
Wastewater management		34
Stormwater Management Strategy		
Flood protection – peak flow rates, volumes and top water levels at control points, 100-year flow paths and 100-year detention storage areas.	100-year event plan Long section of critical points	40
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.	5-year event plan	38
Protect ecology – detention areas for the 1-year 1-hour ARI event, areas for water quality treatment and types of agreed structural and non-structural best management practices and treatment trains (including indicative locations). Protection of waterways, wetlands (and their buffers), remnant vegetation and ecological linkages.	1-year event plan Typical cross sections	36
Groundwater Management Strategy		
Post-development ground water levels, existing and likely final surface levels, outlet controls, and subsoil drain areas/exclusion zones.	Ground water/subsoil plan	41
Actions to address acid sulphate soils or contamination		42
The next stage – subdivision and Urban Water Management Plan		
Content and coverage of future urban water management plans to be completed at subdivision. Include areas where further investigations are required before detailed design.		43

Local Water Management Strategy Item	Deliverable	Shown on Page
Monitoring		
Recommended future monitoring plan including timing, frequency, locations and parameters, together with arrangements for ongoing actions.		45
Implementation		
Developer commitments		47
Roles, responsibilities, funding for implementation		
Review		

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1.0 Introduction

Preston Green Pty Ltd propose to undertake development of Lot 888 Turner Road, Boyanup from its current short term accommodation use to a lifestyle village. MPM Development Consultants (MPM) has been engaged to prepare this Local Water Management Strategy (LWMS) to support the Department Guide Plan (DGP) also being prepared by MPM. A copy of the DGP is included as Attachment A.

The development area is located approximately 300 metres north east of the Post Office in Boyanup. The development area is generally bounded by Preston River and a reserve with a creek to the north east, Private properties and Turner Street to the South, and South West Highway to the West. The location of the site is shown in Figure 1 below.



Figure 1 – Location Plan – Courtesy of Landgate

The latest aerial photograph of the site is provided as Figure 2 below to illustrate the site condition and proximity to prominent topographic features.



Figure 2 – Aerial Photography – Courtesy of Google Maps

The LWMS provides the approach to total water management required to be undertaken with development of the land in accordance with the DGP in order to be consistent with Better Urban Water Management (WAPC, 2008).

1.1 Planning Background

The Meadowbrooke Estate area is zoned 'Urban' under the terms of the GBRS, whilst the land surrounding the Preston River is reserved as 'Regional Open Space' under the GBRS. Land to the west of the subject site is zoned 'Urban' whilst land to the east (on the opposite side of the Preston River) is zoned 'Rural'. Land to the south (on the opposite side of Turner Street) is reserved by the GBRS for rail purposes.

The Shire of Capel District Planning Scheme No. 7 zones the subject land; Residential R10/15, Special Use (Various), Foreshore Protection and Regional Open Space.

The Greater Bunbury Region Scheme (GBRS) is the statutory land use planning scheme for the Bunbury region. The functions of the Region Scheme are to reserve and zone land and control development on reserved and zoned land. The GBRS reflects the agreed strategic direction for land within the region and is a catalyst for changes to planning controls at the local level and subsequent local area planning.



Figure 3 – Cadastral Boundaries

1.2 Policies, Guidelines and Strategies

The LWMS utilises and refers to the following State Government Policies, published guidelines and key requirements.

- Better Urban Water Management (WAPC, 2008)
- Decision Process for Stormwater Management WA (DoW, 2009)
- Stormwater Management Manual for WA (DoW, 2007)
- Australian Rainfall and Runoff (Engineers Australia, 1987)
- Australian Runoff Quality (Eng Aust, 2006)

In addition, the following previously completed studies were reviewed and incorporated into this strategy.

- Douglas Partners - Report on Geotechnical Investigation – October 2014
- MPM Development Consultants – Groundwater Level Monitoring Report – December 2014
- GHD – Geotechnical Investigation – May 2008
- Hyd2O – Preston River Flood Study – August 2011
- SWCS – Groundwater Quality Analysis - 2011

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2.0 Proposed Development

In May 2010, Amendment No. 46 to the Shire of Capel Town Planning Scheme No 7 'District Planning Scheme' was granted final approval resulting in the land being included within the 'Special Use' zone of Council's Scheme with the predominant use for the subject land being an 'Aged Person's Village'

The development of Meadowbrooke Lifestyle Estate will address the strategic planning initiatives and objectives promoted by the Shire of Capel and the Western Australian Planning Commission (WAPC) for the Boyanup Townsite while also achieving two key WAPC policy objectives being:

1. greater housing choice and lifestyle opportunities for the ageing population; and,
2. affordability.

The proposal is supported by the Department of Planning's 'Greater Bunbury Strategy' which incorporates as one of its 'key outcomes' "*A range of housing types and lifestyle options will be provided across Greater Bunbury*."

In addition, the proposal is entirely consistent with the stated objectives contained within the Boyanup Townsite Strategy, in particular, the 'Aspiration' to "*Improve the attraction of the town as a retirement destination.*"

Clause 3.4 of the Shire of Capel Town Planning Scheme states:
"*No person shall use land or any building or structure thereon in a Special Use Zone, except for the purpose set against that land in Appendix 4 and subject to compliance with any conditions specified in the Appendix with respect to the land*."

The land is listed within Appendix 4 of the Shire of Capel Town Planning Scheme No.7 under its previous description of Lot 888 Turner Street, Boyanup. The list of permitted uses includes the following:

"*The Uses permitted will be in accordance with the interpretation of Aged Persons Village under the Scheme and the adopted Development Guide Plan relating to the zone.*
The following uses are listed as permitted uses:

- *Residential R40 – Aged Persons Accommodation*
- *Guest house/short term accommodation*
- *Community Centre*
- *Caretakers dwelling*
- *Car parking*
- *Administration office.*

Council may at its discretion determine and approve other uses that are considered to be ancillary and incidental to the objective of the zone.

Ancillary and incidental uses, Recreation Public, Recreation Private and Public Amusement uses may at its discretion of Council be approved in the zone for use of patrons and visitors, not being residents of the zone, subject to compliance with any standards, conditions or requirements specified by Council in conducting the use.

In considering the discretionary uses, the Council may invite public comment in accordance with Clause 8.2.3 of the Scheme prior to determining the use."

Appendix 4 lists the 'Development Standards/Provisions that apply to the land. These are summarised as:

- Council to adopt a Development Guide Plan and Design Guidelines Prior to development commencing on the land;
- Council may consider and adopt modifications to the Development Guide Plan and Design Guidelines.
- The objective of the Special Use Zone being to promote the development of a high quality Aged Persons Village which is in keeping with the character of the Boyanup town site.
- Development and use of the land to be generally in accordance with the Development Guide Plan and Design Guidelines.
- Preparation of a Local Water Management Strategy for endorsement by Council and the Department of Water.
- Aged Persons Accommodation to be developed to a density no greater than and in accordance with the R40 density code.

- Council's Planning Consent shall be obtained for the permitted uses prior to the commencement of the uses.
- A contribution towards community facilities except that Council may, subject to a formal agreement, consider wavering of contributions in part or whole.
- Dual use path linkages and associated facilities to be provided from the zone to the Town Centre facilities and services.
- Provision and possible upgrading of pedestrian and cyclist links.
- A traffic and pedestrian impact and management study to be undertaken.
- A contribution towards the upgrade of Turner Street and it intersection with *South West* Highway may be required.
- Development on the land to have due regard to the following:
  a) endorsed Development Guide Plan.
  b) endorsed Design Guidelines.
  c) parking requirements as required.
  d) connection to reticulated water, waste water and gas services.
  e) implementation of the endorsed Local Water Management Strategy through the preparation and submission of an Urban Water Management Plan.
  f) requirements of the traffic and pedestrian impact and management study.
  g) provisions of the Residential Planning Codes restricting occupancy of residential units on the site to aged persons (that is person aged 55 years or over).
  h) integration of the development with the adjacent local/regional open space and Boyanup urban area.
  i) Such other matters than may arise from the consideration of the integration of the development into the urban area of the town of Boyanup.
- "*Council may at its discretion vary the requirements of the Scheme in relation to the aged person's village where it is satisfied that the development is in accordance with the overall Development Guide Plan*."
- Preparation of a Foreshore Management Plan.
- Preparation of a Noise Management Study.
- Preparation of a Sustainability Outcomes and Implementation Plan.

'Aged Persons Village' is defined in the Scheme as meaning "*a building or group of buildings designed for residential occupation by aged persons and includes buildings and parts of buildings used for communal facilities, food preparation, dining, recreation, laundry or medical care*."

A development application is currently being prepared and lodged with the Shire of Capel. The application relates to the proposed development of a residential lifestyle village on the subject land to be known as '**Meadowbrooke Lifestyle Estate**'. The application also seeks the Shire of Capel's adoption of an amended Development Guide Plan and Design Guidelines for the proposed development

2.1 Site Context

The development site consists of 3 distinct areas, all within the proposed development lot. The entry to the site from Turner Street is the eastern elevated portion of the site and is the location of the existing infrastructure and buildings of the Meadowbrooke Estate. Feature survey of this area indicates elevations of 36.0m AHD. This area is bounded to the south by the railway reserve and the railway buildings presently being utilised by the Boyanup Mens Shed.



Figure 4 – Current Boyanup Mens Shed Courtesy of Google Street Smart

West of the existing infrastructure is an open paddock/grassland that connects the land parcel to the South Western Highway. This open area is bounded to the south by existing residential properties and to the north by a Shire drainage reserve. The open grassland area has indicative elevations varying between 36.0m and 35m AHD. The area exhibits signs of surface water logging in the winter months and likely consists of a clay subsurface.



Figure 5 – Open paddock/grassland Courtesy of Google Street Smart

The Third distinct area of the development site is the lower area to the north east of the site. This area currently contains a feature/landscape lake adjoining a slightly elevated central area containing fruit and decorative trees. With elevations in this area varying between 31.0m and 29.0m AHD, the area appears to be low lying however it does not exhibit signs of subsurface water in the winter, with the exemption of areas near the lake.



Image 1 – Lake Area

2.2 Landscape Concept

Although the central community open space is a major feature of the development site and dominates the overall plan, it is not proposed to implement large scale landscape design across this area.

The dominant feature of the area will be the landscaped lake, which will be tidied, enlarged to suit the stormwater requirements of the site and have its design amended where possible in accordance with the requirements for mosquito control. The second largest feature will be the community garden which is centrally located below the proposed clubhouse. This area will likely consist of a path network, seating areas and barbeques.

The bioretention areas are the next largest areas, which will be landscaped as part of the drainage infrastructure and will likely only be metered for the first summer. The Preston River Foreshore is not proposed to be landscaped at this stage as it is owned by the WAPC.

The remaining areas consist of the sloping terrain or batters to the river and drainage reserve, these areas will remain or be revegetated to native bushland planting areas, again requiring minimum reticulation for the first winter only. A detailed landscape plan will be created upon approval of the DGP, including the total planting areas, species and water use.

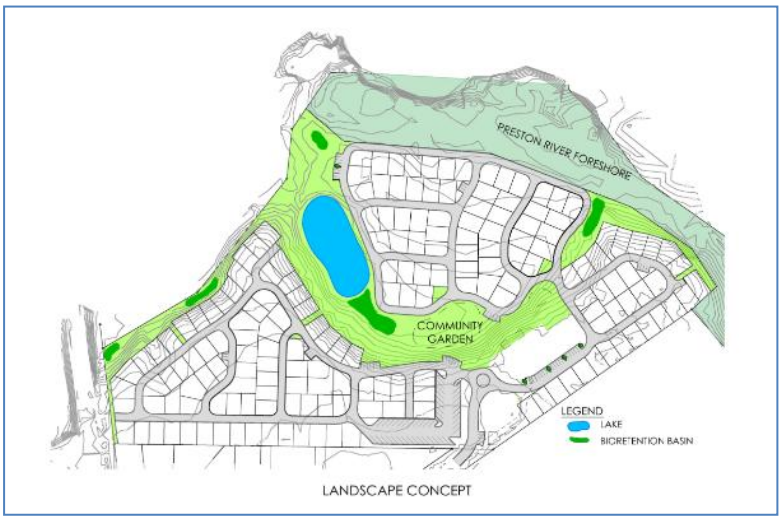


Figure 6 – Landscape Concept

3.0 Design Criteria

Table 2 – Design Criteria

Objective	Design criteria
Water conservation — potable and wastewater	
No potable water should be used outside of homes and buildings and achieve efficient use of scheme water, where alternative water sources are available.	• Consumption target for water of 100 kL/person/yr – as outlined in the *State Water Plan* (2007) – with an aspirational target of not more than 40–60 kL/person/yr scheme water, as provided in *Better urban water management* (2008).
Efficient Water Use	• Encouragement and advice to unit purchasers on water wise practices, such as water wise gardens and rain water re-use. • Implementation of water wise gardens to unit and road frontages. • Water wise, native planting to rehabilitation areas, minimization of grass/lawn/turf seeded areas.
Water supply	• Reticulated water supply to Authority and Australian Standard requirements with education to unit purchasers on water usage.
Wastewater	• Reticulated sewer network to Authority and Australian Standard requirements with education to unit purchasers on water usage and re-use.
Stormwater Management	
Extreme Storm Events	• Ensure overland conveyance to pre-development outlet location • Provision of earthworks to maintain minimum habitable floor levels 0.5m above the 100 year ARI flood event level.
Major Storm Events	• Provision of pit and pipe network designed to convey up to the 5 year ARI storm event. • Ensure site storage capable of maintaining pre-developed outflow rate for storm events up to 5 year ARI.
Environmental Flow	• Implementation of WSUD to all garden areas. • Encourage low nitrogen and phosphorous use by the Village management. • Retain and treat the 1 in 1 year 1 hour storm event on site. • Implementation of WSUD treatment areas at 2.0% of imperious catchment.
Groundwater Management	
Subsoil	• Subsoil drains to be provided with a free drainage outlet. • Subsoil located below the predevelopment GWL in the upper cress of site. • Implementation of subsoil network across the development to control potential post development groundwater rise. • Subsoil to be located at pre-development GWL within the lower areas of the site.

Objective	Design criteria
Development Levels	• Earthwork operations to establish development areas with adequate clearance above groundwater levels.
Infiltration	• All infiltration components to be located a minimum of 300mm above groundwater level.
Disease vector and nuisance insect management	
Mosquito Risk	• Undertake a review of the existing feature lake to bring it in line with the issues outlined in the *Interim position statement: Constructed Lakes (2007)*

4.0 Pre-Development Environment

4.1 Current Land Use

The listed present land use of the site is the Meadowbrooke Estate, consisting of short stay accommodation and restaurant facilities. The existing facilities occupy approximately 20% of the land area and have not been utilised for several years. The current owners of the property have kept up with maintenance and care of the facility inclusive of gardening, reticulation and mowing.

The property contains a small olive grove and an area of fruit trees that were utilised by the restaurant.



Image 2 – From the landscaped garden looking north to the Preston River



Image 3 – From the northern corner of the site looking south to facilities

4.2 Topography

A copy of the Feature Survey Plan is included as Figure 7 and within Attachment C.

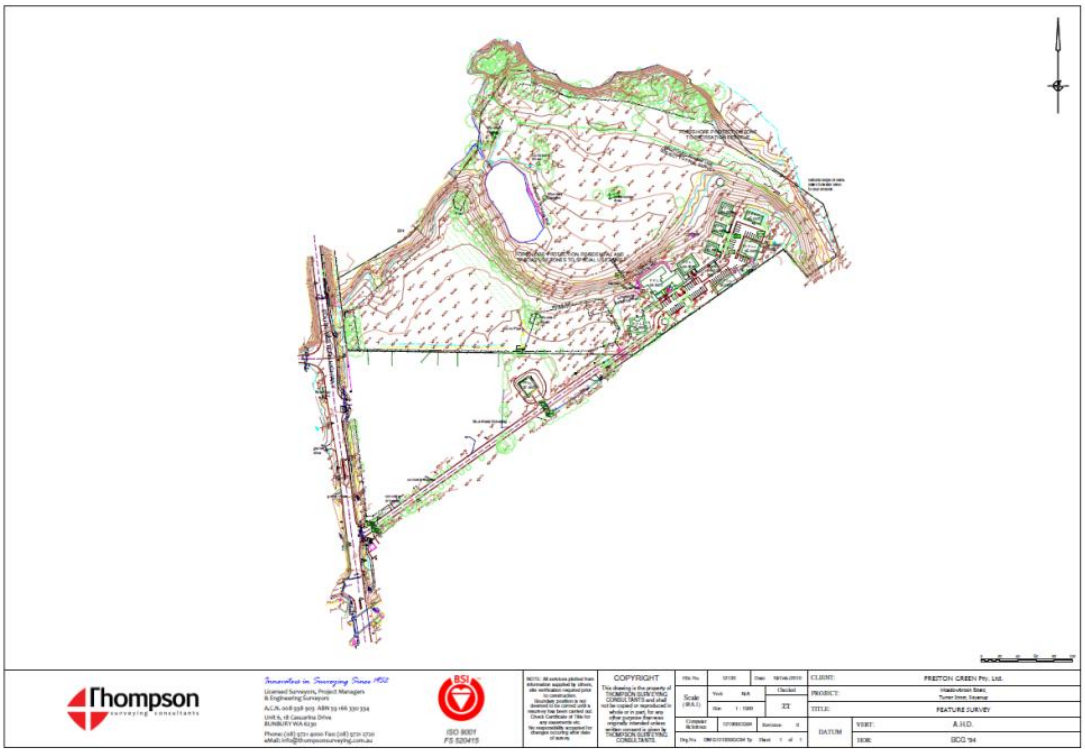


Figure 7 – Feature Survey Plan

The southern extent of the property is relatively flat with elevations of approximately 36.0m AHD to 35m AHD, with this land area 'wrapping' around a central but northerly located feature lake that includes elevations of 29.0m AHD.

The property falls to the north and east via the banks of a drainage reserve to the north and the Preston River to the east.

4.3 Climate

The area experiences a Mediterranean climate with warm dry summers and cool wet winters.

Rainfall monitoring (since 1898) at the Boyanup Bureau of Meteorology site 9503 indicates a mean average annual rainfall of 957.3mm with the highest average monthly rainfalls occurring in June and July.

4.4 Geotechnical

4.4.1 Geology

The site has had two preliminary geotechnical investigations undertaken within it. In May 2008 GHD undertook an investigation into the western portion of the site and in October 2014 Douglas Partners undertook an investigation into the lower eastern portion of the site inclusive of a review into the results from the earlier GHD investigation report. Copies of both reports are included as Attachment B.

The Douglas Partners report described the regional geology as;

"The Bunbury-Burekup 1:50 000 Urban Geology sheet indicates that shallow sub surface conditions beneath the site comprises alluvium and clayey materials of the Guildford Formation. The Guildford Formation is described as mainly alluvial sandy clay but it can be locally variable, comprising a variety of interbedded soils from sand to highly plastic, reactive clay".

The 2008 GHD geotechnical investigation involved 6 test pits excavated to depths between 1.7m and 2.2m and the 2014 Douglas Partners investigation involved 12 test pits excavated to a minimum depth of 3.0m.

The 2008 GHD report described the subsurface conditions in the western portion of the site as;

"In general, most of the test pits encountered clayey soils to depths between 1.7 and 2.2m. The soils variably comprised clay, clay with sand and sandy clay, with colour varying from brown, orange grey and red mottled grey. The strength varied from stiff at shallow depth, becoming very stiff to hard with depth. Laterite was encountered in three test pits below the clay layer. This varying composition of the clay is typical of Guildford formation."

The 2014 Douglas Partners report described the subsurface conditions in the eastern, lower portion of the site as;

"The investigation encountered interbedded soils with varying proportions of sand, silt and clay, which is typical of the Guildford Formation and consistent with the findings of the previous investigation. A summary of the general ground conditions encountered or inferred at the test locations is given below:

- *Topsoil – dark grey-brown, fine to medium grained silty sand topsoil with some rootlets to depths of between 0.1 m and 0.2 m below existing surface level at all test locations.*
- *Clayey Sand/Clayey Silty Sand/Clayey Gravelly Sand/Silty Sand – generally medium dense, dark grey-brown, orange-brown and red-brown, fine to medium grained clayey sand with varying amounts of silt and gravel, to depths of between 1.0 m and 3.0 m in the eastern site, except at TP01 where it was absent, and at TP10 to a depth of 0.8 m.*
- *Sandy Clay/Sandy Silty Clay – generally firm to stiff, medium to high plasticity, orange-brown mottled blue-grey sandy clay with varying silt and gravel content. This material was encountered underlying the predominantly sand layer described above in the eastern site and at TP10 from depths of between 0.8 m to 2.5 m to the termination depth of those test pits. It was encountered directly underlying the topsoil in the western site and at TP01 to depths of between 0.6 m and 2.2 m.*
- *Sandy Clay/Sandy Silty Clay – generally firm to stiff, medium to high plasticity, orange-brown mottled blue-grey sandy clay with varying silt and gravel content. This material was encountered underlying the predominantly sand layer described above in the eastern site and at TP10 from depths of between 0.8 m to 2.5 m to the termination depth of those test pits. It was encountered directly underlying the topsoil in the western site and at TP01 to depths of between 0.6 m and 2.2 m."*

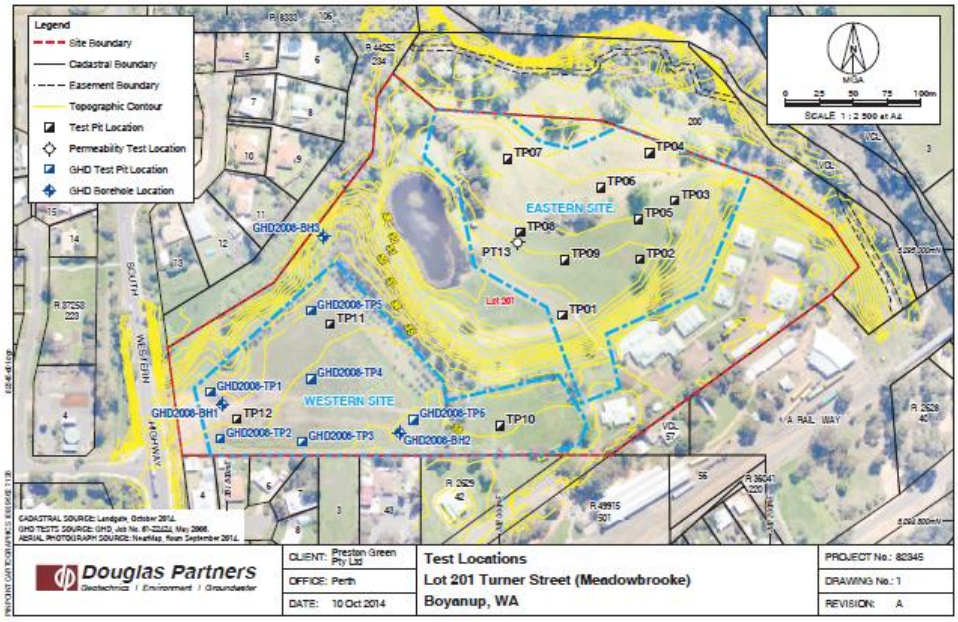


Figure 8 – Douglas Partners Test Pit Location Sketch

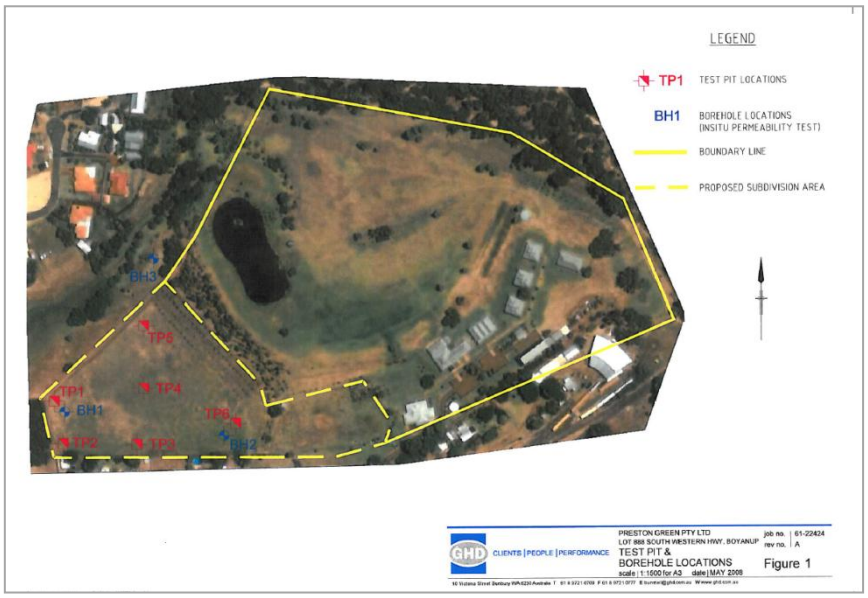


Figure 9 – GHD Test Results

Figures 8 and 9 above note the location of the GHD and Douglas Partners test locations relative to existing infrastructure within the site.

The 2008 GHD report provided the following conclusions and recommendations in relation to the western portion of the site:

"Based on the findings of the investigation, the in-situ material encountered in the proposed subdivision site is not suitable for onsite disposal of surface water, due to its low permeability. Offsite disposal will therefore be required.

In its current conditions, the general site classification of this site is conserved to be Class H in accordance with AS 2870-1996. This is due to the highly reactive clay present on site.

However, the site classification could be upgraded by placing an imported sand fill layer over the entire site. The site drainage will also be improved by raising the site with sand fill material.

In order to achieve Class S, a minimum depth of 1.0m well-compacted sand fill would be required. Prior to placing the sand fill, the site preparation for residential development should be carried out as follows:

- *Removal of the topsoil;*
- *The exposed clay will be susceptible to softening the disturbance, particularly during the wetter months of the year. Care should be taken during construction to ensure that the exposed clay is not disturbed further by keeping construction traffic off stripped areas and trafficking the sand fill;*
- *Place and compact sand fill in maximum 300mm thick layers and extending at least 2.0m beyond the building footprint; and*
- *The density of each layer should be checked by Perth Sand Penetrometer (PSP) testing with accepted criteria of a minimum 8 blows per 300mm penetration.*
- *Both edge beam and stiffening ribs could be founded within the sand fill, as this would be classified as Controlled Fill under AS 2870-1996.*

The earthworks for site should comply with AS 3798-1996 'Guidelines on earthworks for commercial and residential developments'. Upon completion of the site preparation, it is anticipated that the general site can be re-classified as Class S in accordance with AS2870-1996.(GHD 2008)

The 2014 Douglas Partners report provided the following site classification and comments in relation to the eastern and western portions of the site:

"As described in Section 4, the shallow ground conditions encountered at the test locations generally comprise medium dense clayey sand or firm to stiff sandy clay, with varying proportions of silt and gravel. The clay fraction was generally medium to high plasticity.

The predominantly clayey soils are present underlying the topsoil in the western site and at TP01, just below the embankment separating the two areas of the lot. In its current condition, based on the shrink-swell test result, this part of the site should be classified as Class 'H' in accordance with AS 2870-2011. The area of the site considered Class 'H' is indicated on Drawing 1, Appendix A. The site classification of the western portion of the site could be modified to an equivalent Class 'S' if a minimum depth of 0.7 m of well compacted non-reactive filling (clean sand) was placed above the current ground elevation. The site classification of this part of the site could be generally modified to an equivalent Class 'A' by increasing the thickness of the filling to 1.7 m.

Predominantly sandy soils underlie the topsoil in the eastern part of the site. In its current condition, based on the shrink-swell test result from the clayey sand, this part of the site should be classified as Class 'S' in accordance with AS 2870-2011. The site classification of this portion of the site could be generally modified to an equivalent of Class 'A' by placing a minimum depth of 1.7 m of clean sand above the existing surface elevation." (Douglas Partners, 2014)

In addition further discussion with Douglas Partners resolved that the western portion of the site could be improved to a site classification M if a minimum of 0.6m of clear sand fill was placed above the existing ground level.

Reference should be made to both the GHD and Douglas Partners geotechnical reports for site preparation, foundation design and Scope and Limits of the relevant geotechnical investigations.

4.4.2 Acid Sulphate Soils (ASS)

The current ASS mapping on the WA Atlas website, as per Figure 10 below, indicates that the development area is within a single distinct area of ASS mapping, being moderate to low risk of ASS occurring with 3m of the natural soil surface (yellow).

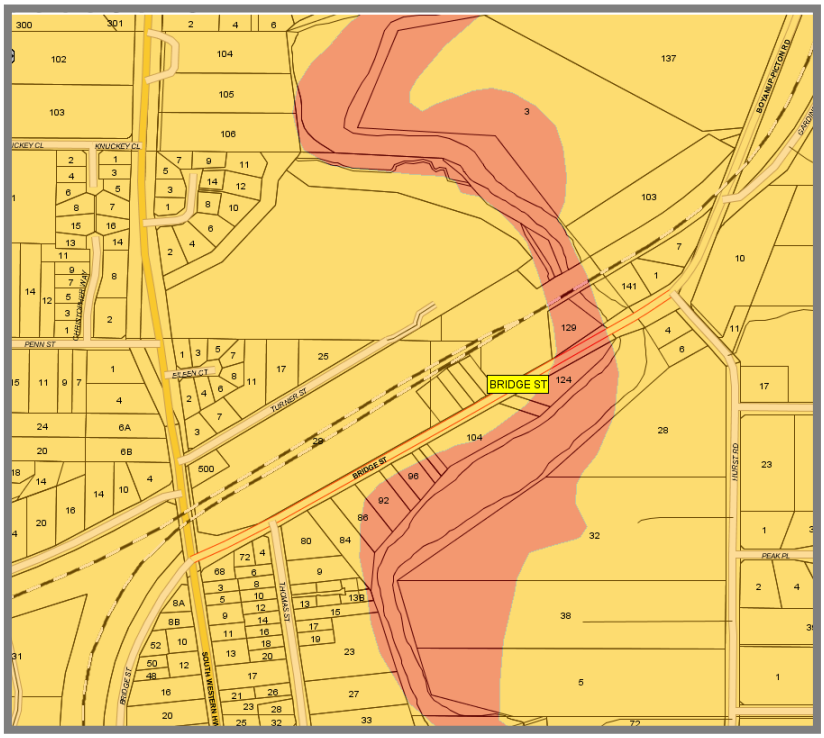


Figure 10, ASS Mapping, WA Atlas

The presence of the high risk area of ASS occurring within 3m of the natural surface as noted over the Preston River needs to be noted and may necessitate further investigation and management throughout design and construction process should major excavation and/or deep servicing be proposed.

Based upon the general ASS mapping and the likely extent of servicing at depth required, a preliminary acid sulphate soil investigation will be required to confirm the current regional scale mapping. Subsequent preliminary investigations may resolve that further detailed Acid Sulphate Soil investigations are required which are specifically based upon the depth and extent of anticipated ASS disturbance during servicing infrastructure installation.

4.4.3 Contamination

A review of the WA Atlas into potential contamination of land noted in December 2014 that the development site is not recorded as contaminated land.

No visual evidence exists on the property as at December 2014, of illegal dumping or potential areas of contamination.

4.5 Surface Water



Image 4 – Preston River in Flood



Image 5– Onsite Lake

4.5.1 Wetlands

The WA Atlas contains the DEC record of Geomorphic Wetlands of the Swan Coastal Plan. A review of this website indicates that a portion of the site is classified as a Multiple Use Wetland and therefore no restriction to development is applicable. The development site adjoins the Preston River, which under geomorphic wetlands classification is Conservation Category. No works are proposed adjacent to the Preston River and the Western Australian Planning Commission has purchased and reserved the Foreshore area between the development site and the river. A copy of the geomorphic wetland information is shown below as Figure 11.

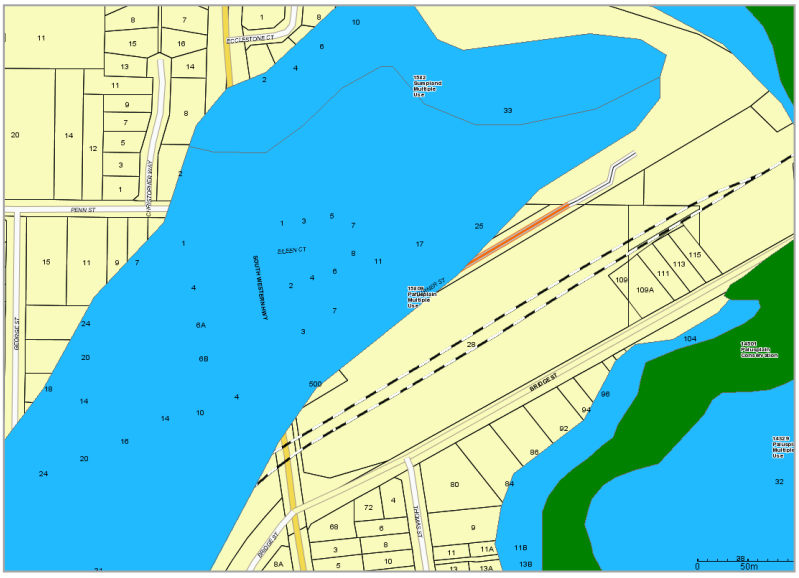


Figure 11 – Geomorphic Wetlands courtesy of WA Atlas

WA Atlas also contains the EPA's Environmental Protection Policy, Swan Coastal Lakes (EPP) record. The record indicates that the site or its near surrounds are not recorded as being part of the EPP.

4.5.2 Surface Water Bodies

The development site contains a manmade, landscaped lake that was previously utilised as a landscape feature by the short stay accommodation and restaurant.

The lake is approximately 3300m^2 in area and over the previous few years has appeared to have a steady top water level, based on observation during the groundwater bore monitoring across the site.

The construction methodology of the lake is unknown and further investigation has not been undertaken however anecdotal evidence from locals indicates that the lake is unlined but may have been created by shaping the subsurface clay.

4.5.3 Surface Water Hydrology

The development site can be simply described as two elevated portions of land overlooking the Preston River and a feature lake.

Essentially, the existing surface water hydrology consists of the land contouring and subsequently draining in a northerly direction to the Shire drain reserve or the Preston River.

There is a small drainage flow path on the western side of the property that has a relatively small catchment. The major drainage flow path is through the centre of the site, through the feature lake and a depression that exists between the elevated southern area and the lower, but marginally elevated area prior to the Preston River.

Attachment E indicates the predevelopment environment plan, clearly defining the existing surface water hydrology.

The site is defined as 6 different surface water catchments however only 2 of these catchments have defined outlet points, being the two flow paths as described above.

4.5.4 Preston River

The development borders the Preston River, which defines the property's eastern and northern boundaries. In order to confirm that the development site would be protected from any flooding of the Preston, the developer engaged Hyd20 to undertake the Preston River Flood Study.

Hyd20 undertook field investigations, research and estimation of design flows to conclude and recommend:

- *"The site has two watercourses requiring consideration in terms of flood management, the Preston River which runs along the north and eastern boundaries of the site and a smaller tributary which drains a local catchment running along its western boundary. The catchment areas of these watercourses are 808 km2 and 0.76 km2 respectively.*
- *Design flow estimates for the Preston River were calculated based on a range of different hydrological techniques. Flood frequency analysis based on gauged local data is considered to provide the best estimate for use in design. This provides a 100 year ARI peak flow estimate of 241 m3/s at the site, which is similar to the Water Authority (1989) estimate.*
- *For the small tributary, a 100 year peak flow of 0.64 m3/s is estimated based on XP-Storm modelling.*
- *A HECRAS model of the Preston River and small tributary was developed based on DoW LiDAR data and successfully calibrated using field observations and anecdotal information.*
- *Based on this model, the 100 year flood level of the Preston River is estimated to range from 29.74 m AHD at the downstream boundary of the site to 30.24 m AHD at the upstream boundary.*
- *Floodplain mapping indicates the proposed development is located outside the 100 year floodplain of the Preston River and small tributary, with existing natural surface levels having a clearance of approximately 5 m – 6 m above the adjacent 100 year flood level.*

- *The area within the site (outside of the main Preston River channel) which floods to 29.74 mAHD occurs due to backflow from the flood level in the Preston River, and filling this area would prevent this from occurring without affecting the 100 year flood level of the Preston River.*
- *The results indicate that there is additional land within the site located outside of the Preston River floodplain which may be also considered for development. It is recommended that advice on a suitable clearance above the 100 year flood level be requested from DoW in review of this report to inform the potential development opportunity of this land. " (Hyd2O, 2011)*

Table 3: 100 Year Flood Level Estimates at Key Locations

Location	100 Year Flood Level Estimate (m AHD)
Preston River Downstream Property Boundary	29.72
Preston River Upstream Property Boundary	30.24
Tributary Watercourse at South Western Highway	30.33

Table 1 – Courtesy of Hyd20 report

Subsequent to this report the DoW requested that additional modelling be undertaken to determine the effect on flood levels utilising the estimated peak flow of a flood event that occurred in 1964 on the Preston River. Hyd20 subsequently produced, in late August 2011, a letter to the DoW indicating the relative flood height increase associated with an estimated 4000m³/s flow occurring at the Boyanup Bridge.

The Hyd20 comparison between calculated flood levels and the 1964 flood level estimate, is shown below:

Table 1: Comparison of 100 Year ARI and 1964 Flood Level Estimates

Location	100 Year Flood Level Estimate (flow ~241 m³/s) (m AHD)	1964 Flood Level Estimate (flow ~400 m³/s) (mAHD)	Relative Flood Height Increase (m)
Preston River Downstream Property Boundary	29.72	30.64	0.92
Preston River Upstream Property Boundary	30.24	31.12	0.88

Table 2 – Comparison of flood level estimated - Courtesy of Hyd20 report

Subsequent to this additional information on the 25th August 2011, the DoW recommended:

"A *minimum habitable floor level 1.20m above the 100 year ARI flood level to ensure adequate flood protection is provided.*" Department of Water, Simon Rodgers, Email 25/8/2011.

A copy of the Preston River Flood Study, subsequent 1964 assessment and all Hyd20 and DoW correspondence is included within Attachment J.

In summary the relevant habitable floor levels for the development shall be;

Location	100 Year Flood Level Estimate	1964 Flood Level Estimate	Minimum Habitable Floor Level
Preston River Downstream Property Boundary	29.72	30.64	30.92
Preston River Upstream Property Boundary	30.24	31.12	31.44

Table 3 – Relevant habitable floor levels

4.6 Groundwater Hydrology

4.6.1 Groundwater Levels

The development site groundwater levels were recorded by MPM Development Consultants and reported in the Groundwater Level Monitoring Report of December 2014. A copy of this report is included as Attachment D.

Groundwater level monitoring took place to record two winter peak maximum ground water (MGL) levels through the 2011 and 2012 winters. A summary of the MGL's is shown below with the bore location plan.


LOT 105
LOT 106
LOT 3
33
129
124
109A
28
25
17
6A
PECKHAM CT
PECKHAM ST
PECKHAM RD
PECKHAM ROAD
PECKHAM ROAD
PECKHAM ROA

The shallow maximum groundwater will necessitate that appropriate strategies and plans are created to manage the groundwater resource.

These may include:

- *Subsurface/Subsoil Drainage to control/maintain maximum groundwater levels.*
- *Importation of fill to create additional separation of proposed infrastructure to maximum groundwater levels.*
- *Management and/or restriction of stormwater infiltration.*
- *Appropriate management of sewer effluent disposal.*

The proximity of the development site to the Ferguson River, a protected water body, will necessitate that any alteration to the existing groundwater regime should be carefully managed and future development should ensure that all groundwater extracted from subsoil networks will be tested to ensure it will not affect the Ferguson River.

A review of the sites groundwater quality will be required should groundwater control mechanisms be put in place with future development.

Groundwater management should be addressed within a subsequent Local Water Management Strategy or Urban Water Management Plan prior to development proceeding to ensure appropriate management and detailed design considers the groundwater resource." (MPM, 2014)

4.6.2 Groundwater Quality

South West Chemical Services (SWCS) undertook a suite of monitoring bore and surface water samples across the development in August 2011.

The report from SWCS noted "The results show nothing outstanding, no Petroleum Hydrocarbons, no Polynuclear Aromatic Hydrocarbons and no Organochlorine or Organophosphate pesticide residences."

A copy of the report is included as Attachment K, for reference.

The report did note monitoring bores 2 and 8 contained elevated levels of total nitrogen. Monitoring bore 2 is located near the old fruit orchard, which is likely the cause of this elevated result.

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5.0 Water Sustainability Initiatives

5.1 Water Supply

A requirement for development will be the connection of the site to the Water Corporations existing reticulated water supply scheme of Boyanup.

The site is currently serviced by a small 58mm water supply main in Turner Street, which will not be of sufficient size to accommodate the proposed development.

A 150mm diameter water main is located to the western boundary (South West Highway). It is proposed that reticulated water will be provided to each of the proposed unit sites via a water plumbing main circulating the site.

The units/homes will be constructed with 5 star building standards inclusive of water wise practises of water efficient fixtures and fittings.

5.2 Rainwater Tanks

It is proposed to implement rainwater tanks to all proposed lifestyle units across the development. As the development is a lifestyle village rather than a green title subdivision the land remains under the ownership and management of Preston Green. This allows for greater direction and control over the unit purchasers and allows the developer to require rainwater tanks rather than the purchase decision being left to the lot purchaser. Rainwater tanks will be provided as part of unit/home purchase.

The tanks will be utilised as a non-potable water supply for the units/homes providing toilet flushing water and a reticulation supply.

5.3 Water Wise Gardens

Lot scale water efficiency can be enhanced through the implementation of Water wise Gardens. The Water Corporation and Department of Water both provide information on the establishment and maintenance of water wise gardens with this information to be actively promoted by the Developer and eventual village manager.

The lifestyle estate will undertake the installation of all garden areas, inclusive of community areas as well as front and rear gardens of the units/homes.



Image 6 – Water Wise Garden

The front and rear gardens will be installed and maintained in accordance with the best water wise garden principles. This not only provides the lifestyle estate with a water sustainable solution but an economic saving with reduced demand for potable supply from the Water Corporations network.

At present the site is reticulated across the central northern area, the garden areas around the existing infrastructure and the olive and fruit tree orchards. The lower area reticulation will be removed along with the olive and fruit tree orchards. These areas are presently reticulated via the onsite bore and with additional supply as required from the landscape lake. It is proposed that these sources of reticulation water will also be utilised by the proposed development. In addition with each home/unit be provided with a rainwater tank for additional localised reticulation water.

5.4 Wastewater

Wastewater will be collected and transferred offsite by a network of developer funded and maintained, sewerage plumbing reticulation, transferring the generated sewer effluent to the Water Corporation sewer network in South West Highway. Based upon the existing contours across the site, the development will be required to install a gravity network of pipes that drain to the central low area of the site which will then be pumped via a small pump station to a new connection to the Water Corporation network.

6.0 Stormwater Management Strategy

The stormwater management strategy for the development of the Meadowbrooke Lifestyle Estate is to be undertaken in accordance with the guidelines of the DoW through Water Sensitive Urban Design (WSUD) and the requirements of the Shire of Capel.

The key components of the stormwater management strategy are;

- Treatment for the 1 in 1 year 1 hour storm event within the biofiltration basin.
- Collection and transfer of storm events up to 1 in 5 year ARI within a standard pit and pipe system.
- Detention of the 5 year major storm event with the biofiltration basin with outflow rate set in accordance with a predevelopment rate.
- Ensure passage of the 100 year extreme storm event directly to the Preston River to ensure it passes through the Preston River system prior to the river going to flood.

6.1 Modelling

The stormwater modelling has been completed utilising the Rational Method, based on the relatively small scale of the development area. The development site exists as multiple catchments and is modelled post development as the same multiple catchments.

A critical design criterion for the rational method includes the runoff coefficients which are shown below in Table 4.

LAND USE	RUN OFF COEFFICIENT		
	1 YEAR ARI	5 YEAR ARI	100 YEAR ARI
Predevelopment	0.15	0.15	0.15
Residential	0.5	0.6	0.8
Road Reserve	0.8	0.8	0.9
Community Garden Areas	0	0.2	0.2
Community Infrastructure Area	0.5	0.7	0.8

Table 4 – Runoff Coefficients

Multiple storm events have been modelled utilising the Rational Method as described in Australian Rainfall and Runoff (AR & R).

6.2 Predevelopment Peak Storm Flows

1 in 5 year event predevelopment out flow rates for each of the catchments have been calculated based upon a general run off coefficient of 0.15 with the peak flows being shown in Table 5 below:

	Runoff Coefficient	Peak Flow (L/S)
Catchment A	0.15	4.49
Catchment B	0.15	14.83
Catchment C	0.15	25.04
Catchment D	0.15	82.31
Catchment E	0.2	27.66
Catchment F	0.15	40.14

Table 5 – Predevelopment outflow rates

Rainfall intensities for the various storm events and storm durations are calculated and provided by the Bureau of Meteorology (BoM) computerised design IFD Data System (www.bom.gov.au).

6.3 Unit/Home/Building Level Stormwater Management

All units, homes and community buildings proposed within the development will be connected to its own rainwater tank with overflow pipework that connects to the proposed stormwater pipework in the road network.

The use of soakwells for the infiltration of roof generated stormwater at source has been deemed unsuitable for this site based upon the Douglas Partners geotechnical investigation which stated:

"Given the high clay content of the soils underlying the site and shallow perched groundwater, on site disposal of stormwater is considered unsuitable on this site."

6.4 Environmental Flow (1 Year ARI)

In accordance with the guidelines as provided by the DoW the development will undertake the retention of the 1 year ARI 1 hour storm event within the development. It is proposed that this retention be undertaken within a series of Bioretention basins at the outlet of each post development catchment. The biggest bioretention basin will be located within central, lower land adjacent to the landscaped lake which will form part of the major and extreme event detention storage areas.

The environmental flow 1 year stormwater strategy is indicated in Attachment F.



Image 7 – Landscape lake, already containing wetland vegetation.

The bioretention basins will be provided with a low flow subsoil outlets, amended soil base and vegetated with suitable, locally sourced nutrient stripping vegetation in accordance with the Stormwater Biofiltration system, Adaption Guidelines by FAWB and the recently released *Vegetation guidelines for stormwater biofilters in the south-west of Western Australia* and its accompanying Practice Notes. The indicative cross section of the largest central bioretention basin and Detention area (Lake) is included as Figure 13 below.

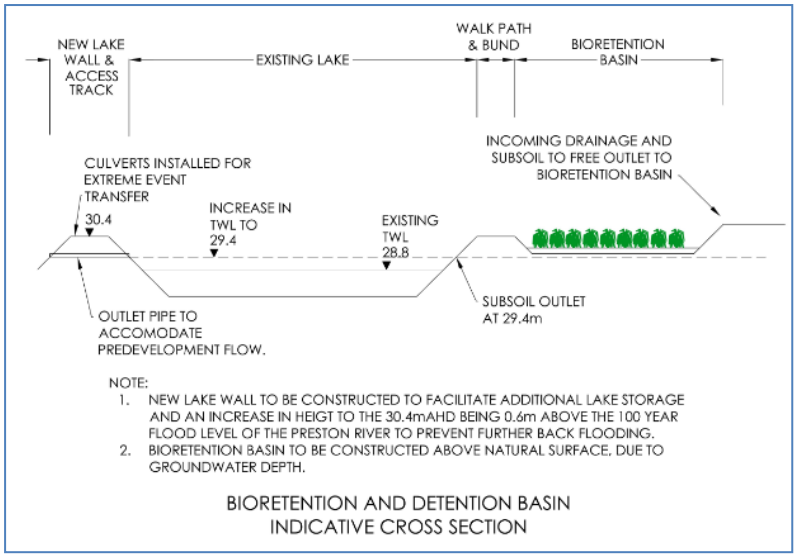


Figure 13 – Cross section of Bioretention Basin and Landscaped Lake Detention Area

The bioretention areas required have been calculated at 2.0% of the equivalent impervious area and are summarised as follows:

Post Development Catchment	Impervious Area (ha)	Retention Volume 1 year/1 hr (m^3)	Bioretention Area @ 2% (m^2)
1	0.238	42.5	48
2	0.427	76	85
3	2.727	485.5	545
4	0.327	58.3	65
5	0.591	105.25	118

Table 6 – Environmental Storm Event

Table 7 below provides a summary of the expected pollutant removal efficiencies for the proposed environmental flow WSUD options, as provided by the DoW's Stormwater Management Manual for WA.

Parameter	Design Criteria via BUWM	Structural Controls Nutrient Output Reduction	
		Vegetated Swales/Bioretention Systems	Detention/Retention Storages
Total Suspended Solids	80%	60-80%	65-99%
Total Phosphorus	60%	30-50%	40-80%
Total Nitrogen	45%	25-40%	50-70%
Gross Pollutants	70%	-	>90%

Table 7 – BMP Water Quality Performance in Relation to Design Criteria

In order to facilitate a single, controlled outflow point for each post development catchment, given that 4 of the existing catchments discharge surface waters via sheet flow, it has been necessary to adjust the predevelopment catchment areas. The post development catchments generally discharge to the same surface water body externally of the site, however a single discharge point allows for treatment and detention of the post development generated stormwater to occur within the site.

The proposed predevelopment peak outflow rates to align with the post development catchments are as follows:

- Catchment 1 to consist of combined predevelopment catchments A and B.
- Catchment 2 to consist of predevelopment catchment C.
- Catchment 3 to consist of predevelopment catchment D.
- Catchment 4 to consist of predevelopment catchment E and 50% of predevelopment catchment F.
- Catchment 5 to consist of 50% of predevelopment catchment F.

6.5 Major Flows (5 Year ARI)

The development proposes a series of grated collection pits within a sealed and kerbed road network for the collection and transfer of major storm events.

Each of the homes/units will be connected to this stormwater network via a pipework connection located at each sites frontage. Stormwater from each home/units gutter will then connect directly to the road network after passing through or overflowing off the home/units rainwater tank.

Although not in accordance with the Best Management Practice of disposing of stormwater as close as possible to source, the existing geotechnical conditions do not allow infiltration adjacent any infrastructure. Therefore it is not proposed to utilise soakwells.

The detailed design of the pipe and pipe network will form part of the detailed engineering designs of the Building License submission. The concept design for the management of the major storm event is included in Attachment G.

The relevant detention volumes, peak discharges and outlet controls are summarised as follows with visual representation included on the stormwater management plan, for each catchment:

Catchment	Peak Flow (L/S)	Predevelopment outflow rate (m^3/s)	Detention required (m^3)	Outlet required (m)	Outlet grade 1 in ?
1	78.92	0.019	43	0.15	90
2	119.40	0.025	76	0.15	55
3	380.80	0.080	626	0.3	220
4	108.1	0.028	58	0.15	50
5	159.2	0.040	125.02	0.225	180

Table 8 – Detention Volumes Major Flows

Levels of outlets, basin base and top water levels have not been provided as part of the LWMS as detailed survey will be required of each basin location to confirm relevant heights and existing vegetation. An indicative cross section of the smaller bioretention areas and associated retention/detention basins is shown below as Figure 14.

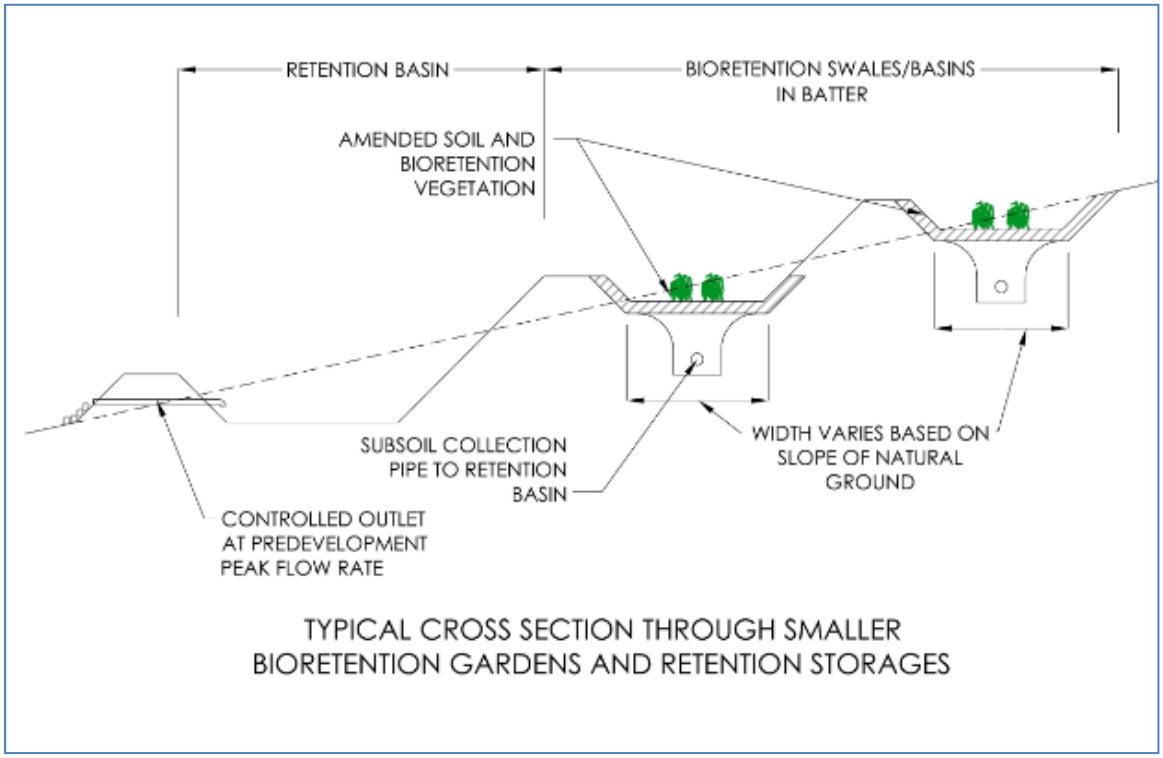


Figure 14 – Cross section of Bioretention Basin and Landscaped Lake Detention Area

6.6 Extreme Flows (100 Year ARI)

The development will include a network of road reserves that will generally grade in accordance with the current natural surface contours of the land. Amendments to these existing contours will occur to ensure that the proposed roads meet minimum grade criteria for drainage and Australian Standards. The detailed design of this road network will occur as part of each building license submission.

The road network in conjunction with the central community garden, bioretention basins and landscape lake will act to convey the extreme event storm from the developments catchment, through the development and directly to the northern drainage channel or the Preston River.

It is not intended to detain the extreme storm event to a predevelopment rate but rather, given the small scale of the development, allow the event to discharge from the site and enter the Preston River. The likely time of concentration for a 100 year event on the site is less than an hour whereas based on the extent of catchments as indicated in the Hyd20 Preston River Flood Study Report the time of concentration from the entire Preston River catchment is likely to be days.

The conveyance direction and flow paths of the extreme event are indicated on the 1 in 100 STORMWATER MANAGEMENT STRATEGY included within Attachment H. The relatively small size of each catchment prior to discharge to the northern drain, the Preston River Foreshore or the central low area containing the bioretention basin will ensure that the proposed road network will be capable of conveying events up to the 1 in 100 year extreme storm event.

The development must not only manage extreme storm events from within its own catchment but it shall undertake management and infrastructure in order for the development, and ultimately people's homes, to protect them from extreme events occurring on the Preston River catchment.

Based upon the advice of the Department of Water, as stated within section 4.5.4 of this strategy, the calculated 1 in 100 year flood levels for the development vary from 30.24m AHD at the upstream property boundary to 29.72m AHD at the downstream property boundary. In addition, the development should take into consideration back flooding in the drainage channel to the north of the property which will have a 1 in 100 year flood level of 30.33m AHD at South Western Highway.

In accordance with DoW recommendations all development will be earthworks and/or filled to ensure that the minimum habitable floor level will be 1.2m above the calculated 1 in 200 year flood levels. These minimum fill levels are shown below in table 9.

Location	**Minimum Fill Level to Habitable Floor Level**
Preston River Downstream Property Boundary	30.92m AHD
Preston River Upstream Property Boundary	31.44m AHD
Tributary Watercourse at South West Highway	31.53m AHD

Table 9 – Minimum fill levels

7.0 Ground Water Management Strategy

The development proposes to install a network of subsoil pipework to manage the groundwater levels and any potential groundwater rise due to development depending on the various maximum groundwater levels recorded across the site. The strategy's core principle is to maintain the existing maximum groundwater levels across the lower, northern portion of the site but control the maximum groundwater levels within the eastern portion, around the existing infrastructure and within the western portion that adjoins existing Turner Street residents.

The groundwater levels through the central northern portion are likely linked to the Preston River, which could be termed a groundwater dependant ecosystem. This area exhibited groundwater levels approximately 3.0m below the surface, well below the 1.2m to 1.5m minimums for separation to infrastructure. The flood management requirements for the development will also require additional fill in this area varying between 1.5m and 0.5m.

Within the eastern portion of the site, below the existing buildings on the site, the groundwater was not recorded. Monitoring Bore 1 recorded a MGL of 0.75 below natural surface to the west and monitoring bore 2 recorded a MGL of 1.39 below natural to the east of the site. It is proposed that the finished earthwork levels within this eastern portion will remain as they currently are, in order that the new modular homes and road network blend with the existing community infrastructure. It is therefore proposed to install a subsoil drain network to the southern boundary of the site and within the road network approximately 1.2m below the natural surface. The control of the maximum groundwater level in this portion of the site will not affect the Preston River, as subsoil inverts will be approximately 34.0 to 35.0m AHD and the standing water level of the Preston River is 25.65m AHD.

This subsoil network will interconnect with the stormwater drainage pipework and outflow to the proposed bioretention basins, ensuring all collected groundwater is treated through biofiltration prior to exiting the site.

Within the western portion of the site, 4 of the onsite groundwater monitoring bores are relevant;

	Depth to MGL
Monitoring Bore No. 1	0.75m
Monitoring Bore No. 7	0.91m
Monitoring Bore No. 8	2.46m
Monitoring Bore No. 9	0.44m

Table 10 – Site Monitoring Bore MGL's

Monitoring Bore 7 and 8 are likely affected by the drawdown of adjoining northern Drainage Reserve and monitoring bores 1 and 9 indicate very shallow groundwater.

The geotechnical report produced by GHD and confirmed by Douglas Partners indicates that this portion of the site is classified as 'H' in accordance with AS2870. Information from the supplier of the modular homes has indicated that they will require an 'M' classification for the proposed building footing requirements. In order to transform the 'H' classification to an 'M' classification Douglas Partners have recommended that a minimum of 0.6m of clean sand be placed above the existing ground.

It is therefore proposed to undertake earthworks across this western area to remove 0.6m of existing clay material along the southern boundary of the site, graduating to 0.3m of fill in the vicinity of monitoring bore 7.

The clay will be replaced and additional fill imported to a minimum of 1.2m of clean sand fill. A sub soil network will be installed along the southern boundary of the property and within the road network. The

subsoil network would be interconnected with the stormwater system with all groundwater treated through the biofiltration areas prior to discharge.

Discussions are currently ongoing with the supplier of the modular homes to determine what is an appropriate level of separation between the base of the modular home footings and a maximum groundwater level. Should the builder allow a reduced separation between footing and maximum groundwater level based upon additional structural amendments to the units/homes, the depth of excavation and depth of fill above natural surface will be reduced.

Fill sand utilised for the development should meet the following specification:

Imported clean sand fill, shall be approved for use by the Superintendent prior to any of the fill being carted onto the site. Imported clean sand fill shall;

- not contain contaminated, organic or deleterious material,
- not contain dangerous or toxic material, metallic objects, rubbish, plastic or any other waste material,
- be free draining, with a hydraulic conductivity greater than 4.0m per day when compacted to the specification,
- have a minimum 4 day soaked CBR value of 15.% when compacted to 95.0% MDD,
- be clean, cohesionless material,
- have a linear shrinkage of 1.0% for the portion of a sample passing the 0.425mm sieve,
- be non-plastic, with a plasticity index of 0.0% for fractions finer than the 0.075mm sieve, and
- have a particle size distribution conforming to the following table.

AS Sieve (mm)	% passing (by mass)
9.5	100
4.75	80 to 100
2.36	40 to 100
1.18	20 to 100
0.425	10 to 60
0.075	0 to 4

Table 11 – Fill Sand PSD

7.1 Acid Sulphate Soil Management

As described in Section 4.4.2 the development site is recorded as having a low to moderate risk of ASS at depths greater than 3.0m. Although ASS is unlikely to be present, it is noted that the subsoil network will be placed below the AMGL but the site is to be filled. Therefore preliminary assessment of the sites subsurface materials to check for the presence of ASS/PASS will be required. Details of this investigation and its results will be included at the detailed engineering design stage.

All assessment and management of ASS will be undertaken in accordance with ASS guidelines of the DER.

7.2 Groundwater Quality Management

In order to maintain or improve the groundwater quality it is proposed that the network of subsoil pipe work, as per the stormwater pipe work will be discharged to bioretention area that forms part of the Detention Basin Area. This will enable all collected subsoil to be treated through a Water Sensitive Urban Design Best Management Practice prior to discharge to the external environment.

8.0 The Next Stage - Subdivision and Urban Water Management Plan

In accordance with the recommendations of the Department of Water, detailed engineering designs will be provided to the Shire for compliance with the LWMS at each stage of building development. Prior to the application for building permits of each of the units/homes the Developer will lodge for approval the designs providing detailed stormwater and groundwater management infrastructure.

This LWMS provides the strategy to address structure planning related water management considerations, the detailed engineering design will clarify and refine these considerations.

The detailed engineering designs will be required to include:

- Confirmation of compliance with the recommendations and criteria of this LWMS.
- A preliminary investigation and assessment of ASS across the development site.
- Detailed stormwater drainage design of the pit and pipe work.
- Detailed detention and bioretention basin design including; batters, inverts, dimensions, depth, access protection, inlet control and outlet control.
- Groundwater subsoil control pipe work
- Earthworks design based on the combined requirements of groundwater separation, flood level separation, geotechnical fill and footing requirements of the modular homes.
- Management of development works.
- POS design, including confirmation of extent of seeded turf/grass and native planting areas.

The preparation of the proposed detailed engineering designs will be the responsibility of the developer as a condition of the approved DGP and will be undertaken prior to construction commencing on the property.

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9.0 Monitoring

9.1 Post Development

Post development monitoring should be undertaken to both surface water flows and groundwater monitoring bores to determine any effects of development.

The location of these monitoring base locations will be determined at detailed design stage based upon the existing monitoring bore locations and should they exist within public or private landholdings. The single outlet of each bioretention basin will provide an obvious test point for post development water quality.

The post-development testing regime shall include 6 monthly (Oct and April) testing of groundwater levels and groundwater quality. The outlet of each bioretention basin should also be tested 6 monthly during or within 24 hours of a storm event.

The groundwater and outlet water should be quality checked for the following parameters:

- pH
- Electrical Conductivity
- Total Nitrogen
- Total Kjeldahl Nitrogen
- Ammonia
- Nitrate
- Nitrile
- Total Phosphorus
- Filterable Reactive Phosphorus
- Arsenic
- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Zinc
- Manganese

All sampling and testing shall be undertaken by a NATA certified at approved testing agency/laboratory.

Monitoring shall continue for 2 years post construction completion.

9.2 Trigger Values and Contingency Action Plan

The trigger values for action shall be those as defined by the Anzecc Guidelines but shall be exactly determined post groundwater quality monitoring. Consideration should be included to consider second trigger like criteria being a significant (20-25%) increase in recorded values between monitoring events.

Should trigger values be exceeded during a monitoring event, the first course of action shall be a simple re-test of the bore or outlet to confirm validity of test.

The second course of action shall be the isolation of exceedence source via testing of the inlet and outlet locations of both the stormwater and subsoil pipe networks to isolate the potential area of exceedence.

The third course of action should determine the location of the exceedence and potential reason which can then be rectified, through notification and education or removal.

Additional monitoring events should be undertaken upon notification and education or removal at monthly intervals to confirm a return to normal results.

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10.0 Implementation

This LWMS provides the water management framework for the proposed DGP. As such amendment of the DGP through its review and adoption by the Shire of Capel and the WAPC may require amendment to the LWMS.

The responsibilities of the LWMS are summarised below in Table 11.

Implementation	Preston Green	Shire of Capel	DoW	Home Purchaser
Geotechnical and ASS review	✓			
Detailed Engineering Water Management Design	✓			
Approval of Detailed Engineering Water Management Design		✓		
Implementation of Unit/House Rainwater Storage and Fe-use system	✓			✓
Construction of Stormwater and Groundwater Infrastructure	✓			
Post Construction Maintenance or Stormwater and Groundwater Infrastructure	✓			
Post Construction Quality monitoring for 2 years	✓			

Table 12 –Responsibilities of LWMS

References

Argue J.R., 2006, WSUD: Basic Procedures for 'Source Control' for Stormwater: a Handbook for Australian Practice.
Department of Water, 2008: Developing a Local Water Management Strategy.
Department of Water, 2007: Stormwater Management Manual for Western Australia.
Engineers Australia, 2006: Australian Rainfall Quality (ARQ).
Engineers Australia, 2001: Australian Rainfall Runoff (ARR) A Guide to Flood Estimation.
FAWB, Stormwater Biofiltration system, Adaption Guidelines
Queensland Urban Drainage Manual (QUDM).
Western Australian Planning Commission (WAPC), 2008: Better Urban Water Management.
Western Australian Planning Commission (WAPC), 2007: Acid Sulphate Soils Risk Mapping (Bulletin 64).

ATTACHMENT A
DEVELOPMENT GUIDE PLAN

N

EMERGENCY ESCAPE ROUTE

MAN-MADE WATER FEATURE (EXISTING)

PEDESTRIAN ACCESS

NOISE WALL

BIORETENTION BASIN

VILLAGE GREEN

GOLF / PUTTING AREA

SHORT STAY

BOWLING

CLUB HOUSE

EMERGENCY ESCAPE ROUTE AND PEDESTRIAN ACCESS

LANDSCAPING STRIP

ONE WAY TRAFFIC FLOWS

ONE WAY TRAFFIC FLOWS

FAMILY CENTRE

ACROD CAR PARKING BAYS

SHED

WORKSHOP

CARPORT

COMMUNITY GARDEN (TO BE SCREENED FROM VIEW)

EXISTING ACCESS TO BE RETAINED FOR INITIAL STAGE(S) AND SUBJECT TO STAGING REQUIREMENTS

TURNER STREET

LEGEND

- INDIGENOUS SITE
- WATER MAIN
- SEWER MAIN
- OVERHEAD POWER LINE
- GAS MAIN
- LANDSCAPING STRIP TO ACHIEVE SHADE TREE POLICY REQUIREMENT
- PROPOSED DISPLAY HOMES (Subject to Separate Application for Planning Consent)
- PROPOSED DRAINAGE BASINS

LAND USE NOTES

1. DEVELOPMENT AND LAND USES SHALL BE GENERALLY IN ACCORDANCE WITH THE ENDORSED DEVELOPMENT GUIDE PLAN. IN ACCORDANCE WITH CONDITION 3 OF APPENDIX 4 OF TPS No. 7 THE SHIRE OF CAPEL MAY CONSIDER AND ADOPT MODIFICATIONS TO THE DEVELOPMENT GUIDE PLAN.
2. PROPOSED LEASE AREAS ARE INDICATIVE ONLY AND ARE SUBJECT TO DETAILED DESIGN, SURVEY AND WAPC APPROVAL IN ACCORDANCE WITH SECTION 136 OF PLANNING AND DEVELOPMENT ACT 2005.
3. LANDSCAPING AND PEDESTRIAN PATHS TO BE SUBJECT TO LANDSCAPE MASTER PLAN.

SHIRE ADOPTION

THIS DEVELOPMENT GUIDE PLAN HAS BEEN ADOPTED BY THE SHIRE OF CAPEL ON _____

DEVELOPMENT GUIDE PLAN

1:750
0 5m 10 15 20 25 30

mpm development consultants
107 Beach Road
PO Box 2035
BUNBURY WA 6231
Website: www.mpmdc.com.au
Telephone: (08)97 214777
Facsimile: (08)97 214666
Email: reception@mpmdc.com.au

Project: MEADOWBROOKE LIFESTYLE ESTATE
Drawing Number: 14041-01 Revision A
Original Size: A1

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ATTACHMENT B
GEOTECHNICAL REPORTS

mpm development consultants

CLIENTS|PEOPLE|PERFORMANCE

23 May 2008

John Taylor
Preston Green Pty Ltd
C/o Thompson Consulting Surveyors
PO Box 1719
BUNBURY WA 6231

Our ref: 61/22424/11204
Your ref:

Dear John,

Lot 888 South Western Highway, Boyanup
Geotechnical Investigation

1 Introduction

Preston Green Pty Ltd has commissioned GHD to undertake a geotechnical investigation of Lot 888 South Western Highway, in Boyanup. We understand that the south west area of this lot is designated for residential zone and it is proposed to develop this area into an aged care facility.

The aims of the geotechnical investigation were to determine the suitability of the in-situ material for onsite disposal surface water drainage and a general site classification in accordance with AS 2870 – 1996.

2 Site Conditions

2.1 Site Description

Lot 888 South Western Highway is located in Boyanup township, which covers a total area of approximately 11.18 ha. The lot is bounded by Preston River and a reserve with a creek to the north and east, private properties and Turner Street to the south, and South Western Highway to the west. The proposed subdivision site is approximately one-third of the total size of Lot 888. The remaining of the lot comprises a resort and a recreational area. Access to the site was via Turner Street, behind the fire station building.

The proposed subdivision site is generally flat and covered with grasses. An olive orchard is located at the north east part of the site. Some mature trees were observed near the west boundary and near the orchard. A small valley, which is located near the north boundary, appears to be a run off waterway and discharging into the creek. At the time of the investigation, the valley was dry. Patches of un-vegetated spots with ground surface cracking were scattered across the site. This was due to the present of dry clayey soil at the surface level.

2.2 Regional Geology

The Bunbury – Burekup 1 : 50,000 geological map indicates that the lot is underlain by Guildford Formation, an alluvial deposit of Pleistocene age. The Guildford Formation is highly variable in composition, reflecting its alluvial origin, but generally consists silty to sandy clay of medium to high plasticity, grading to clayey/silty sand in parts.

3 Ground Investigation

3.1 Fieldwork and Laboratory Testing

The fieldwork was carried out on 24th April 2008 and comprised six test pit excavations and three in-situ permeability test. The works was supervised by a geotechnical engineer from GHD.

The test pits (numbered as TP1 to TP6) were excavated across the proposed subdivision site, using an 11 tonne tracked excavator, supplied and operated by JW Cross and Sons. The pits were excavated to depths between 1.7 and 2.2m.

Perth Sand Penetrometer (PSP) tests to 1.05m depth were carried out adjacent to the test pits to get an indicative consistency of the in-situ material.

Three in-situ permeability tests (BH1 to BH3) were conducted using the constant head method in 100mm diameter holes.

The test pit and borehole locations are presented in Figure 1.

Selected samples from the test pits were sent to Civi Test Sou West, a NATA accredited laboratory in Bunbury, for geotechnical laboratory testing. The tests comprised particle size distribution and Atterberg Limit.

3.2 Subsurface Conditions

In general, most of the test pits encountered clayey soils to depths between 1.7 and 2.2m. The soils variably comprised clay, clay with sand and sandy clay, with colour varying from brown, orange grey and red mottled grey. The strength varied from stiff at shallow depth, becoming very stiff to hard with depth. Laterite was encountered in three test pits below the clay layer. This varying composition of the clay is typical of Guildford Formation.

Groundwater was not encountered in any of the test pits.

Laboratory test results from three samples indicated that the clays have high plasticity. In-situ permeability test results indicated the clays have a very low permeability, in magnitude order of 10^{-7} to 10^{-8} m/sec.

The test pit results and laboratory test results are presented in Tables 1 and 2, respectively. The laboratory test certificates are presented in Appendix A.

4 Conclusions and Recommendations

Based on the findings of the investigation, the in-situ material encountered in the proposed subdivision site is not suitable for onsite disposal of surface water, due to its low permeability. Offsite disposal will therefore be required.

In its current conditions, the general site classification of this site is considered to be **Class H** in accordance with AS 2870–1996. This is due to the highly reactive clay present on site.

However, the site classification could be upgraded by placing an imported sand fill layer over the entire site. The site drainage will also be improved by raising the site with sand fill material.

In order to achieve **Class S**, a minimum depth of 1.0m well-compacted sand fill would be required. Prior to placing the sand fill, the site preparation for residential development should be carried out as follows:

- Removal of the topsoil;
- The exposed clay will be susceptible to softening and disturbance, particularly during the wetter months of the year. Care should be taken during construction to ensure that the exposed clay is not disturbed further by keeping construction traffic off stripped areas and trafficking the sand fill;
- Place and compact sand fill in maximum 300mm thick layers and extending at least 2.0m beyond the building footprint; and
- The density of each layer should be checked by Perth Sand Penetrometer (PSP) testing with accepted criteria of a minimum 8 blows per 300mm penetration.
- Both edge beam and stiffening ribs could be founded within the sand fill, as this would be classified as Controlled Fill under AS 2870–1996.

The earthworks for site should comply with AS 3798–1996 "Guidelines on earthworks for commercial and residential developments". Upon completion of the site preparation, it is anticipated that the general site can be re-classified as **Class S** in accordance with AS 2870–1996.

5 Scope and Limits of Geotechnical Investigation

This report presents the results of a geotechnical investigation prepared for the purpose of this commission. The data and advice provided herein relate only to the project and structures described herein and must be reviewed by a competent geotechnical engineer before being used for any other purpose. GHD Pty Ltd (GHD) accepts no responsibility for other use of the data.

Where drill hole or test pit logs, cone tests, laboratory tests, geophysical tests and similar work have been performed and recorded by others the data is included and used in the form provided by others. The responsibility for the accuracy of such data remains with the issuing authority, not with GHD.

The advice tendered in this report is based on information obtained from the investigation locations tests points and sample points and is not warranted in respect to the conditions that may be encountered across the site at other than these locations. It is emphasised that the actual characteristics of the subsurface materials may vary significantly between adjacent test points and sample intervals and at allocations other than where observations, explorations and investigations have been made. Subsurface conditions, including groundwater levels and contaminant concentrations can change in a limited time. This should be borne in mind when assessing the data.

It should be noted that because of the inherent uncertainties in subsurface evaluations, changed or unanticipated subsurface conditions may occur that could affect total project cost and/or execution. GHD does not accept responsibility for the consequences of significant variances in the conditions and the requirements for execution of the work.

The subsurface and surface earthworks, excavations and foundations should be examined by a suitably qualified and experienced Engineer who shall judge whether the revealed conditions accord with both the assumptions in this report and/or the design of the works. If they do not accord, the Engineer shall modify advice in this report and/or design of the works to accord with the circumstances that are revealed.

An understanding of the geotechnical site conditions depends on the integration of many pieces of information, some regional, some site specific, some structure specific and some experienced based.

Hence this report should not be altered, amended or abbreviated, issued in part and issued incomplete in any way without prior checking and approval by GHD. GHD accepts no responsibility for any circumstances, which arise from the issue of the report, which has been modified in any way as outlined above.

Should you have any further queries, please do not hesitate to contact the undersigned.

Yours faithfully
GHD Pty Ltd

Waldo Dressel
Principal Geotechnical Engineer
61 8 9721 0734

Attachment:
Figure 1 Test Pit and Borehole Locations
Table 1 and Table 2
Appendix A Laboratory Test Certificates



LEGEND

TP1 TEST PIT LOCATIONS

BH1 BOREHOLE LOCATIONS (INSITU PERMEABILITY TEST)

BOUNDARY LINE

PROPOSED SUBDIVISION AREA

GHD CLIENTS | PEOPLE | PERFORMANCE

PRESTON GREEN PTY LTD
LOT 888 SOUTH WESTERN HWY, BOYANUP
TEST PIT & BOREHOLE LOCATIONS
scale | 1:1500 for A3 date | MAY 2008

job no. | 61-22424
rev no. | A

Figure 1

10 Victoria Street Bunbury WA 6230 Australia T 61 8 9721 0700 F 61 8 9721 0777 E bunmail@ghd.com.au W www.ghd.com.au

Date 29 May 2008 - 11:02 AM Cad File No 61-22424 - Figure 1.dwg

Table 1 Test Pit Results – Lot 888 South Western Highway, Boyanup

Test Pit	Depth (m)	Soil Description	Groundwater (mbgl)	PSP
TP1	0.0 – 0.2	TOPSOIL, Silty sand, dark brown, loose, moist, with fine roots.	Not encountered	0.15 – 0.45m: 14 blows
	0.2 – 0.4	SILTY SAND, brown red, loose, moist, with some large roots and pockets of cemented silt.		0.45 – 0.75m: >30 blows
	0.4 – 0.9	CLAY with sand, brown, high plasticity, stiff to very stiff, dry.		
	0.9 – 2.0	CLAY, grey with red mottling, very stiff to hard, dry		
		Terminate at 2m due to near refusal.		
TP2	0.0 – 0.2	TOPSOIL, Silty sand, dark brown, loose, moist, with fine roots.	Not encountered	0.15 – 0.45m: 9 blows
	0.2 – 0.5	CLAY with sand, brown, stiff, slightly moist		0.45 – 0.75m: >30 blows
	0.5 – 2.0	CLAY, grey with orange mottling, stiff to very stiff becoming hard, slight moist.		
		Terminate at 2m due to near refusal.		
TP3	0.0 – 0.2	TOPSOIL, Silty sand, dark brown, loose, moist, with fine roots.	Not encountered	0.15 – 0.45m: 10 blows
	0.2 – 0.9	SANDY CLAY, brown, stiff to very stiff, moist.		0.45 – 0.75m: 16 blows
	0.9 – 1.7	CLAY, orange grey to 1.5m and becoming grey with orange mottling, very stiff to hard, slightly moist.		0.75 – 1.05m: 20 blows
	1.7 – 1.9	Laterite gravel, very dense, dry.		
		Terminate at 1.9m due to refusal on laterite caprock.		
TP4	0.0 – 0.2	TOPSOIL, Silty sand, dark brown, loose, moist, with fine roots.	Not encountered	0.15 – 0.45m: 11 blows
	0.2 – 1.4	CLAY with sand, brown grey, high plasticity, stiff to very stiff, slightly moist		0.45 – 0.75m: 22 blows
	1.4 – 2.2	CLAY, grey with red mottling, very stiff to hard, slightly moist.		0.75 – 1.05m: >30 blows
		Terminate at 2.2m due to near refusal.		

Test Pit	Depth (m)	Soil Description	Groundwater (mbgl)	PSP
TP5	0.0 – 0.2	TOPSOIL, Silty sand, dark brown, loose, moist, with fine roots.	Not encountered	0.15 – 0.45m: 14 blows
	0.2 – 1.7	CLAY, brown becoming orange grey, stiff to very stiff, slightly moist.		0.45 – 0.75m: 20 blows
	1.7 – 1.8	Laterite gravel, very dense, dry.		0.75 – 1.05m: >30 blows
		Terminate at 1.8m due to refusal on laterite caprock.		
TP6	0.0 – 0.2	TOPSOIL, Silty sand, dark brown, loose, moist, with fine roots.	Not encountered	0.15 – 0.45m: 4 blows
	0.2 – 1.8	Sandy CLAY, brown becoming brown grey, high plasticity, firm to stiff becoming very stiff to hard, slightly moist.		0.45 – 0.75m: 9 blows
				0.75 – 1.05m: >30 blows
	1.8 – 2.1	Laterite gravel, very dense, dry.		
		Terminate at 2.1m due to refusal on laterite caprock .		

Table 2 Summary of Laboratory Test Results

Test Pit	Depth (m)	Material & Unified Classification	Particle Size Distribution			Atterberg Limit			
			% Fines (< 75µm)	% Sand	% Gravel (> 2mm)	LL	PL	PI	LS
TP1	0.8	High plasticity CLAY with Sand (CH)	76	24	0	70	20	50	14.2
TP4	0.5	High plasticity CLAY with Sand (CH)	80	20	0	84	23	61	12.6
TP6	0.8	Sandy high plasticity CLAY (CH)	62	37	1	55	21	34	13.8

Appendix A

Laboratory Test Certificates

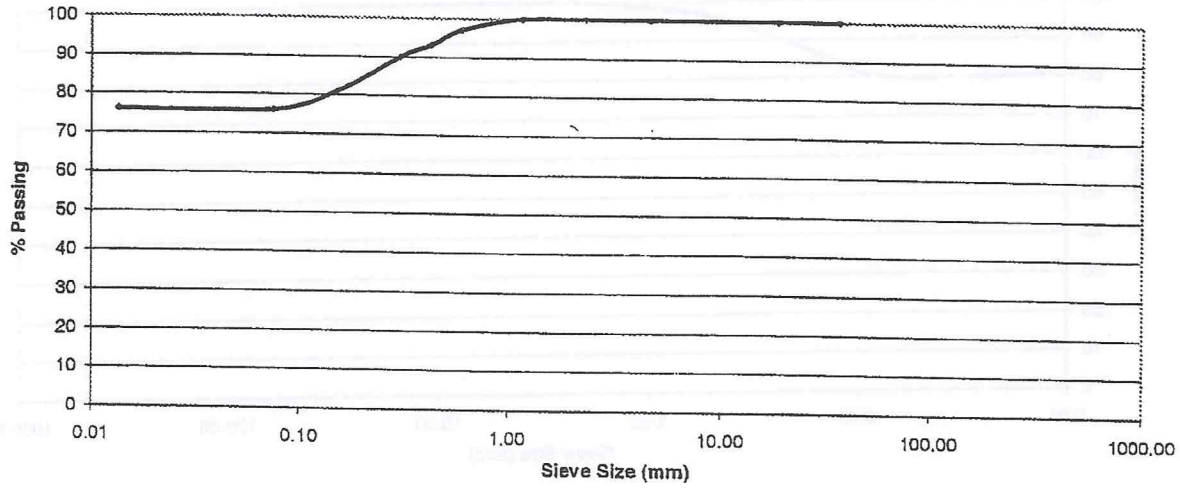
CIVI TEST SOU-WEST
ENGINEERING MATERIALS TESTING LABORATORY
UNIT 4 / 4 MUMMERY CRES. BUNBURY W.A 6230
PH: 08 9721 7022 FAX 08 9721 7033

TEST REPORT

CLIENT:	DEWI BEALING	SAMPLE No.:	CT 21288
PROJECT:	LOT 888 SOUTH WESTERN HIGHWAY	JOB No.:	55-1-1
LOCATION:	BOYANUP- TP 1	FIELD DESCRIPTION:	CLAY
		DATE TESTED:	05-May-08
		DEPTH:	800mm

PARTICLE SIZE DISTRIBUTION

AS 1289 3.6.1/2.1.1



Sieve Size	% Passing
37.50	100
19.00	100
9.50	100
4.75	100
2.36	100
1.18	100
0.600	97
0.425	93
0.300	90
0.150	81
0.075	76

Liquid Limit AS 1289 3.1.2	70
Plastic Limit AS 1289 3.2.1	20
Plasticity Index AS 12859 3.3.1	50
Linear Shrinkage AS 1289 3.4.1	14.2

Sampled in accordance with AS 1289 1.2.1
Sample history: AIR DRIED
Wet/dry sieve: DRY SIEVE

Approved Signatory : S. ARNOLD
Date: 15-May-08
Report Number : CT 21288 / 1

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

NATA Accredited Laboratory 14165
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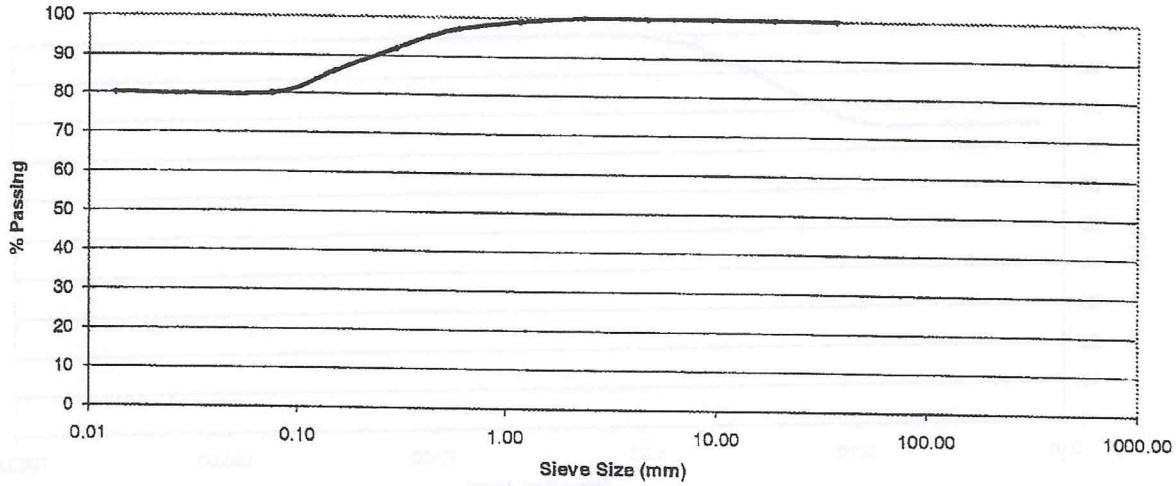
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ENGINEERING MATERIALS TESTING LABORATORY
UNIT 4 / 4 MUMMERY CRES. BUNBURY W.A 6230
PH: 08 9721 7022 FAX 08 9721 7033

TEST REPORT

CLIENT:	DEWI BEALING	SAMPLE No.:	CT 21289
PROJECT:	LOT 888 SOUTH WESTERN HIGHWAY	JOB No.:	55-1-1
LOCATION:	BOYANUP- TP 4	FIELD DESCRIPTION:	CLAY
		DATE TESTED:	05-May-08
		DEPTH:	500mm

PARTICLE SIZE DISTRIBUTION

AS 1289 3.6.1/2.1.1



Sieve Size	% Passing
37.50	100
19.00	100
9.50	100
4.75	100
2.36	100
1.18	99
0.600	97
0.425	95
0.300	92
0.150	86
0.075	80

Liquid Limit AS 1289 3.1.2	84
Plastic Limit AS 1289 3.2.1	23
Plasticity Index AS 12859 3.3.1	61
Linear Shrinkage AS 1289 3.4.1	12.6

Sampled in accordance with AS 1289 1.2.1
Sample history: AIR DRIED
Wet/dry sieve: DRY SIEVE

Approved Signatory : S. ARNOLD
Date: 15-May-08
Report Number : CT 21289 / 1

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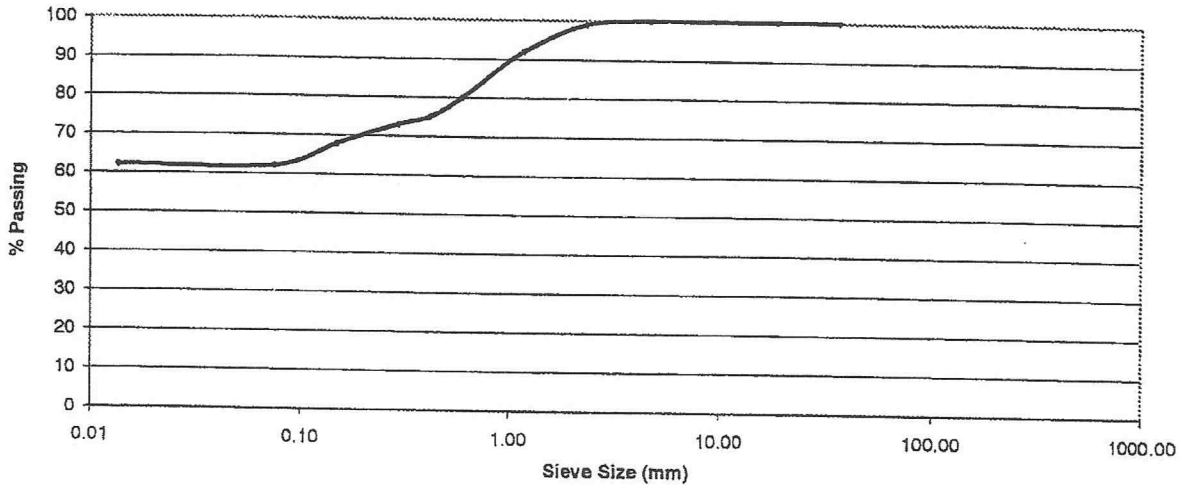
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UNIT 4 / 4 MUMMERY CRES. BUNBURY W.A 6230
PH: 08 9721 7022 FAX 08 9721 7033

TEST REPORT

CLIENT:	DEWI BEALING	SAMPLE No.:	CT 21290
PROJECT:	LOT 888 SOUTH WESTERN HIGHWAY	JOB No.:	55-1-1
LOCATION:	BOYANUP- TP 6	FIELD DESCRIPTION:	CLAY
		DATE TESTED:	05-May-08
		DEPTH:	800mm

PARTICLE SIZE DISTRIBUTION

AS 1289 3.6.1/2.1.1



Sieve Size	% Passing
37.50	100
19.00	100
9.50	100
4.75	100
2.36	99
1.18	92
0.600	80
0.425	75
0.300	73
0.150	68
0.075	62

Liquid Limit AS 1289 3.1.2	55
Plastic Limit AS 1289 3.2.1	21
Plasticity Index AS 12859 3.3.1	34
Linear Shrinkage AS 1289 3.4.1	13.8

Sampled in accordance with AS 1289 1.2.1
Sample history: AIR DRIED
Wet/dry sieve: DRY SIEVE

Approved Signatory : S. ARNOLD
Date: 15-May-08
Report Number : CT 21290 / 1

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Appendix E

Geotechnical Report

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Proposed Residential Development
Lot 201 Turner Street
Boyanup, WA

Prepared for
Preston Green Pty Ltd

Project 82345
October 2014



Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	82345	Document No.	1
Document title	Report on Geotechnical Investigation Proposed Residential Development		
Site address	Lot 201 Turner Street, Boyanup, WA		
Report prepared for	Preston Green Pty Ltd		
File name	P:\82345 Boyanup Lot 201 Turner Street\Docs\82345 Report on Geotechnical Investigation, Lot 201 Turner Street, Boyanup.doc		

Document status and review

Revision	Prepared by	Reviewed by	Date issued
1	Paul Hutchinson	Michael Thom	22 October 2014

Distribution of copies

Revision	Electronic	Paper	Issued to
1	1	1	Shelley Coutts (MDM Development Consultants)

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

	Signature	Date
Author		22.10.2014
Reviewer	P.P.	22.10.2014

NCS INTERNATIONAL
CERTIFIED
QUALITY
MANAGEMENT SYSTEM

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
36 O'Malley Street
Osborne Park WA 6017
Phone (08) 9204 3511
Fax (08) 9204 3522

Ta

Pa

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Appendix A: About this Report
Drawing 1
Results of Field Work

Appendix B Laboratory Test Certificates

a a
P a
201 T S a

1.

This report presents the results of a geotechnical investigation undertaken by Douglas Partners Pty Ltd (DP) for a proposed residential development located at Lot 201 Turner Street in Boyanup, Western Australia. The investigation was commissioned on 8 September 2014, by Ms Shelley Coutts of MPM Development Consultants Pty Ltd on behalf of Preston Green Pty Ltd, and was undertaken in accordance with DP's proposal dated 3 September 2014.

The purpose of this investigation was to determine the sub-surface conditions beneath the site and thus provide comments on:

- the geotechnical suitability of the site for the proposed development;
- site classification in accordance with the requirements of AS 2870-2011 and earthworks requirements to achieve a Class "A" or Class "S" classification, if required;
- site preparation, compaction, and earthworks so as to allow the proposed development;
- appropriate foundation system(s) for the proposed structures;
- foundation design parameters including allowable bearing pressures for pad and strip footings;
- parameters for pavement design, including a design California bearing ratio value based on field observations and laboratory test results;
- the depth to groundwater, if encountered; and
- the permeability of the soils and suitability for on-site stormwater disposal.

The investigation included the excavation of 12 test pits, the performance of Perth sand penetrometer (PSP) tests adjacent to each test pit, the performance of one in situ permeability test, and laboratory testing of selected soil samples.

Details of the field work and the results of the investigation are presented in this report together with comments and recommendations on the issues listed above.

2. S

The overall sites comprises an irregular shaped area and is identified as Lot 201 Turner Street (Meadowbrooke) in Boyanup, Western Australia (Drawing 1, Appendix A). It is bounded by residential properties and holiday chalets to the south and south-east, by vacant land to the east and north and by South Western Highway to the West. The site is divided into two distinct areas known as the western site and the eastern site, with a steep slope between them falling approximately 6 m from

west to east. The areas covered by the two parts of the site are shown on Figure 1, Appendix A. There is a central corridor of land between the two areas which does not form part of the sites.

Most of the total site is currently open grassland, with occasional trees. Two wooden gazebos and a metal shed were observed towards the central, western and northern parts of the eastern site. A stockpile of tree trunks and branches was observed on the western part of the western site.

The western site and eastern site are generally level, though they are separated by a 6 m slope with the western site at the crest elevation of the slope. A lake lies at the base of the slope in the central corridor, and therefore outside the study area. The eastern part of the site has an existing surface elevation varying between RL 29 m AHD to RL 30 m AHD, whilst the western site has an existing surface elevation of between approximately RL 35 m AHD and RL 36 m AHD.

The Bunbury-Burekup 1:50 000 Urban Geology sheet indicates that shallow sub surface conditions beneath the site comprises alluvium and clayey materials of the Guildford Formation. The Guildford Formation is described as mainly alluvial sandy clay but it can be locally variable, comprising a variety of interbedded soils from sand to highly plastic, reactive clay.

A previous geotechnical investigation was undertaken in the western part of the site in May 2008 on behalf of Preston Green Pty Ltd. The investigation comprised six test pits, excavated to depths between 1.7 m to 2.2 m. The test pits encountered variable soils generally comprising stiff to very stiff high plasticity clay, clay with sand and sandy clay.

3. k

Field work was carried out on 16 September 2014 and comprised the excavation of 12 test pits, Perth sand penetrometer (PSP) tests adjacent to the test locations and the performance of one permeability test using the constant head method.

The test pits were excavated using a 5 tonne excavator equipped with a 600 mm wide toothed bucket. Test pits TP01 to TP09 were excavated to a maximum depth of 3.0 m within the eastern portion of the site, and test pits TP10 to TP12 were excavated to a maximum depth of 1.6 m within the western portion of the site. The test pits were logged in general accordance with AS1726-1993 by a suitably experienced geotechnical engineer from DP. Soil samples were recovered from selected locations for subsequent laboratory testing.

The PSP tests were carried out adjacent to the test pit locations in accordance with AS 1289.6.3.2, to assess the in situ density of the shallow soils.

The permeability test PT13 was performed using the constant head method at a depth of 0.35 m.

Test locations were determined using a hand held GPS and are marked on Drawing 1 in Appendix A. Surface elevations at each test location were interpolated from a survey plan provided by the client.

4. k

4.1

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

The investigation encountered interbedded soils with varying proportions of sand, silt and clay, which is typical of the Guildford Formation and consistent with the findings of the previous investigation. A summary of the general ground conditions encountered or inferred at the test locations is given below:

- **T** – dark grey-brown, fine to medium grained silty sand topsoil with some rootlets to depths of between 0.1 m and 0.2 m below existing surface level at all test locations.
- **a Sa a S Sa a a Sa S Sa** – generally medium dense, dark grey-brown, orange-brown and red-brown, fine to medium grained clayey sand with varying amounts of silt and gravel, to depths of between 1.0 m and 3.0 m in the eastern site, except at TP01 where it was absent, and at TP10 to a depth of 0.8 m.
- **Sa a Sa S a** – generally firm to stiff, medium to high plasticity, orange-brown mottled blue-grey sandy clay with varying silt and gravel content. This material was encountered underlying the predominantly sand layer described above in the eastern site and at TP10 from depths of between 0.8 m to 2.5 m to the termination depth of those test pits. It was encountered directly underlying the topsoil in the western site and at TP01 to depths of between 0.6 m and 2.2 m.
- **a** hard, orange-brown mottled blue-grey and red-brown mottled blue-grey, high plasticity clay, encountered underlying the sandy clay from depths of between 0.6 m and 1.1 m to test termination depths at test locations TP11 and TP12, which is the western part of the site.

The previous investigation in 2008 also encountered predominantly clayey soils in the western site.

4.2 a

Perched groundwater was observed at five of the test pits on 16 September 2014. The depth of groundwater is shown on the test pit logs in Appendix B. All test pits were immediately backfilled following sampling, which precluded longer-term monitoring of groundwater levels. A summary of groundwater levels observed during the field investigation is presented in Table 1.

Ta 1 S a a 16 S 2014

T a	a S a H [1]	a	a H [2]
TP01	29.5	0.7	28.8
TP02	30.0	0.8	29.2
TP05	30.4	2.4	28.0
TP08	30.3	1.7	28.6
TP09	29.9	0.7	29.2

Notes for Table 1: [1]: Surface level interpolated from contour plan provided by the client
[2]: Groundwater Level = Interpolated Surface Level – Groundwater Depth.

It should be noted that groundwater levels are affected by climatic conditions and soil permeability and will therefore vary with time.

4.3 S P a T

One in situ permeability test using the constant head method was carried out at test location PT13 at a depth of 0.35 m. A field permeability value was calculated in accordance with the procedure detailed in AS 1547:2012. Results of the permeability analysis are summarised in Table 2.

Ta 2 S a S P a T

T a		a P a	a a
PT13	0.35	4 x 10^{-6}	Clayey Silty Sand

5. a a T

A geotechnical laboratory testing programme was carried out on selected soil samples by a NATA accredited laboratory comprising of the particle size distribution test on three samples.

Results of the testing are summarised in Table 3 and test certificates are presented in Appendix B.

A geotechnical laboratory testing programme was carried out by a NATA registered laboratory and comprised the determination of:

- samples collected from the eastern site:
  - the particle size distributions of three samples;
  - Atterberg limits and linear shrinkage of two samples;
  - shrink/swell index of one sample, if required; and

- California bearing ratio (CBR) and modified maximum dry density (MMDD) on one sample, if required.

o samples collected from the western site:

- the particle size distributions of one sample;
- Atterberg limits and linear shrinkage of one sample; and
- shrink/swell index of one sample, if required;

The detailed test report sheets are given in Appendix D, with the results summarised in Table 3.

Ta 3 a a T

T			Sa		P	P	S	3		S	S k S	a a
Eastern Site												
TP01	0.60	77	23	44	22	22	6.0	-	-	-	-	Sandy Silty Clay
TP03	0.5	54	46	23	19	4	0.5	1.855	18	0.0	-	Clayey Silty Sand
TP03	0.7 – 1.0	-	-	-	-	-	-	-	-	-	0.2	Silty Sand
PT13	0.3	42	58	-	-	-	-	-	-	-	-	Clayey Silty Sand
Western Site												
TP10	1.0	54	46	51	19	32	10.0	-	-	-	-	Clayey Sand
TP11	0.6 – 0.9	-	-	-	-	-	-	-	-	-	2.5	Sandy Clay

Notes on Table 3:
- The % fines is the amount of particles smaller than 75 µm;
- The % sand is the amount of particles larger than 75 µm and smaller than 2.36 mm;
- The % gravel is the amount of particles larger than 2.36 mm and smaller than 60 mm;
-LL: liquid limit -PL: plastic limit -PI: plasticity index -LS: linear shrinkage
-MMDD: Maximum Modified Dry Density -CBR: California Bearing Ratio

6. P

It is understood that the proposed development includes the construction of a residential subdivision development comprising 20 new lots, and associated pavement access ways.

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.1 S a S

The results of the investigation indicate that ground conditions across the site generally consist of clayey sand or sandy clay with varying proportions of silt and gravel. Perched groundwater level was encountered at between approximately 0.7 m to 2.4 m below the existing surface level of the site at the time of the investigation (groundwater levels can fluctuate seasonally).

From a geotechnical standpoint, it is considered the site is suitable for the proposed development described in Section 6, providing the site preparation recommendations described in Sections 7.2 and 7.3 are carried out.

.2 S a a

As described in Section 4, the shallow ground conditions encountered at the test locations generally comprise medium dense clayey sand or firm to stiff sandy clay, with varying proportions of silt and gravel. The clay fraction was generally medium to high plasticity.

The predominantly clayey soils are present underlying the topsoil in the western site and at TP01, just below the embankment separating the two areas of the lot. In its current condition, based on the shrink-swell test result, this part of the site should be classified as Class 'H' in accordance with AS 2870-2011. The area of the site considered Class 'H' is indicated on Drawing 1, Appendix A. The site classification of the western portion of the site could be modified to an equivalent Class 'S' if a minimum depth of 0.7 m of well compacted non-reactive filling (clean sand) was placed above the current ground elevation. The site classification of this part of the site could be generally modified to an equivalent Class 'A' by increasing the thickness of the filling to 1.7 m.

Predominantly sandy soils underlie the topsoil in the eastern part of the site. In its current condition, based on the shrink-swell test result from the clayey sand, this part of the site should be classified as Class 'S' in accordance with AS 2870-2011. The site classification of this portion of the site could be generally modified to an equivalent of Class 'A' by placing a minimum depth of 1.7 m of clean sand above the existing surface elevation.

It is estimated that placing the maximum thickness of filling to attain Class 'A' will result in approximately 10 mm to 15 mm of consolidation settlement, most of which will occur within two months of placement of the filling.

As the constituency of the soil is variable across the site, a more detailed investigation would be required to determine the classification on a lot by lot basis.

It should be noted that AS 2870 - 2011 applies to single houses, townhouses and the like classified as Class 1 and 10a under the Building Code of Australia. It also applies to light industrial and commercial buildings if they are similar in size, loading and superstructure flexibility to those designs included in AS 2870 - 2011.

The site classification for individual building lots should be confirmed after earthworks is completed and the sites have been levelled for house construction.

.3 S P a a

All deleterious material including topsoil, tree roots, and any particles larger than 150 mm should be stripped from the proposed development areas of the site. Tree roots remaining from any clearing operations should be completely removed and the excavation backfilled with sand and suitably compacted. It is recommended that sand backfill be placed in loose lift thickness of not more than 300 mm and compacted to achieve a dry density ratio of not less than 95% relative to modified compaction.

Following removal of unsuitable material and prior to any filling, it is recommended that the exposed subgrade beneath the building envelopes and pavement areas be compacted using a medium to heavy (minimum of 10 tonne) vibrating smooth drum roller. Any areas that show signs of excessive deformation during compaction should be compacted until deformation ceases or, alternatively, the poor quality material should be excavated and replaced with suitable structural filling compacted to achieve a dry density ratio of not less than 95% relative to modified compaction. Care should be taken not to operate heavy plant immediately adjacent to existing buildings and services.

The in situ soils are considered unsuitable for reuse as filling. Imported filling, if required, should comprise free draining cohesionless sand with less than 5% by weight of particles passing a 0.075 mm sieve. The material should be free from organic matter and particles greater than 150 mm in size. It is recommended that naturally occurring sand at this site and imported sand filling be placed in loose lift thickness of not more than 300 mm, within 2% of its optimum moisture content with each layer compacted to achieve a dry density ratio of not less than 95% relative to modified compaction.

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

.4 a

Shallow foundation systems comprising slab, pad and strip footings should be suitable to support the proposed structures. Footings of buildings covered by AS 2870-2011 should be designed to satisfy the requirements of this standard for the suitable site classification discussed in Section 7.2, provided that site preparation is carried out as detailed in Section 7.3.

For structures not covered by AS 2870-2011, a presumptive maximum allowable bearing pressure of 150 kPa is suggested for pad footings up to1.5 m wide and 120 kPa for strip footings up to 1.0 m wide founded at a minimum depth of 0.5 m, provided that site preparation is carried out as discussed in Section 7.2.

In particular, it has been assumed that suitable compaction as described in Section 7.2 will be achieved to a depth of 1.0 m below final footing level and that the base of the footings are at least 0.5 m above the maximum groundwater level. The recommended minimum footing width for strip footings founded on sand is 0.5 m. This should result in the total and differential settlements being less than 15 mm (assuming consolidation from the filling is completed prior to construction of the house).

.5 Pa Pa a

Based on observation of the soils underlying the site, and assuming the recommendations in Section 7.3 are followed, a subgrade California bearing ratio (CBR) of 8% is suggested for pavement design in the eastern site and a CBR of 6% for the western portion, provided the subgrade is compacted to not less than 95% of modified maximum dry density.

In the event the subgrade comprises imported sand filling, the pavement could be designed using an appropriate CBR of that material. A presumptive design CBR value of 12% is suggested for clean sand filling, however, this value should be confirmed prior to pavement construction once the type of filling material is known and its CBR has been assessed.

.6 S P a

The investigation encountered clayey sand and sandy clay, with varying amounts of silt and gravel. Groundwater seepage was encountered at approximately RL 29.2 m AHD in the eastern site.

An in situ falling head permeability test was undertaken in the clayey silty sand at a depth of 0.35 m, as shown in Table 2 above. The estimated permeability arising from the test was 4×10^{-6} m (approximately 0.35 m/day).

A design permeability value of 4×10^{-6} m/s (0.35 m/day) is suggested for the eastern site. The clay content in the western site is higher and so a design permeability value of 1×10^{-6} m/s (0.1 m/day) is suggested for this area.

Given the high fines content of the soils underlying the site and shallow perched groundwater, on-site disposal of stormwater is considered to be unsuitable on this site.

1. Australian Standard AS 1289-2000, Methods of Testing Soils for Engineering Purposes.
2. Australian Standard AS 1289.6.3.3-1999, Soil Strength and Consolidation Tests-Determination of the Penetration Resistance of a Soil – Perth Sand Penetrometer Test.
3. Australian Standard AS 1726-1996, Geotechnical Site Investigation.
4. Australian Standard AS 2870-2011, Residential Slabs and Footings
5. Australian Standard AS 3798-1996, Guidelines on Earthworks for Commercial and Residential Developments.
6. Department of Environment, Perth Groundwater Atlas, Second Edition, December 2004.

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Douglas Partners Pty Ltd (DP) has prepared this report for a proposed residential development at Lot 201 Turner Street, Boyanup, WA in accordance with DP's proposal dated 3 September 2014 and acceptance from Ms Shelley Coutts of MPM Development Consultants on behalf of Preston Green Pty Ltd dated 8 September 2014. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Preston Green Pty Ltd for this project only and for the purposes described in the report. It should not be used for other projects or by a third party. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

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

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

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

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

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

The scope for work for this investigation did not include the assessment of surface or subsurface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

a Pa P

About this Report
Drawing 1
Results of Field Work

About this Report

Douglas Partners

T ese otes e ee ro e to Ps re ort re r to ss to et o s e ro e res t e o e ts se to . Not re e ess r ree t to re orts.

Ps re orts re se o or to e ro te s s r e e to s s e e te o e e o o eo o e ere e. or t s re so t e st e re r e s ter ret e r t er t t o e ts te to so e e te t t es o e o or to o t e re .

T s re ort s t e ro ert o o s P rt ers Pt Lt . T e re ort o e se or t e r ose or t s o sso e or e t t e Co to s o E e e t or t e o sso s e t t e t e o ro os . U t or se se o t s re ort or tsoe er s ro te .

a T P

T e ore o e test t o s rese te t s re ort re e eer or eo o ter ret to o t e s s r e o to s t er re t e e to so e e te t o re e o s t e et o o r or e to . l e o t o s st r e s or ore r ro e t e ost re e ssess e t t t s s ot s r t e or oss e to st o e o o ro s. I se t e ore o es test ts re rese t o er s s e o t e tot s s r e ro e.

I ter ret to o t e or to ts to to es o str to s o t ere ore t e to o t t e s o ore o es or ts t e re e o s t e oss t o ot er t str t e r to s et ee t e test o to s.

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W ere ro ter e e s re e s re ore o es t ere re se er ote t ro e s e

- I o er e t so s ro ter e ter t e o e er so or er s ot t r t et e t e o e s e to o e
- A o se er e ter t e e to erro eo s to o t e tr e ter t e
- W ter t e e e s r ro t e to t e t se so s or re e t e t er es. T e ot e t e s e t t e t e o o str to s re te t e re ort
- T e se o ter or s r s ro ter o . W ter s to e o o to t e o e r st rst e s e o t o t e o e ter e s re e e ts re to e e.

More re e e s re e ts e e st st es re re t ter s o er se er s or er s ee s or o er e t so s. P e o eters se e rt r str t e s e o er e t so s or ere t ere e ter ere e ro er e ter t e.

T e re ort s ee re re e erso e s se o t e or to o t e ro e or tor test s ee ert e to rre t e eer st r s o ter ret to ss. W ere t e re ort s ee re re or s e es ro os t e or to ter ret to ot e ree t t e es ro os s e . I t s e s P e e se to re e t e re ort t e s e o t e est to or .

E er re s t e t t e re ort s t re tes to ter ret to o s s r e o to s s sso o eote e ro e t s e ts re o e to s or s esto s or es o str to . Ho e er P ot s t te or ss e res o s t or

- U e e te r to s ro o to s. T e ote t or t s e e rt o ore o e or t s s re e
- C es o or ter ret to s o o st t tor t or tes or
- T e to s o o tr tors res o to o er ress res.

I t ese o r P e e se to ss st t est to s or e to reso e t e tter.

About this Report

S a

I t e e e t t t o to s e o tere o ste r o str to e r to r ro t ose ere e e te ro t e or to o t e t e re ort P re ests t t t e e te ot e . Most ro e s re ore re reso e e o to s re e ose r t er t t so e ter st e e ter t e e e t.

a a a P

W ere or to o t e ro t s re ort s ro e or te er r oses t s re o e e t t or to t e r tte re ort s ss o e e e. I r st es ere t e s ss o or o e ts se to s ot re e t tto t e o tr t st to t e ro r te to re re s e e te o e t. P o e e se to ss st t s re r or to e to re ort o es e or o tr t r oses t o r e.

S

T e o s e e se to ro e e eer s e to ser es or eote e ro e t s e ts o or to t s re ort s re te . T s o r e ro ste st to o r t t o to s e ose re s e e te to t e e eer rese e o ste.

Sa

S s rre o t r r or test tt to o e eer e to or tor test ere re re o t e so or ro .

st r e s es t e r r ro e or to o oo r t e s o s e e o t e e ree o st r e so e or to o stre t str t re.

U st r e s es re t e s t e s et e tot e so t r t to o t s e o t e so re t e st r e st te. S s es e or to o str t re stre t re e ess r or or tor eter to o s e r stre t o ress t . U st r e s s e er e e t e o o es e so s.

T P

Test ts re s e te t oe or e tor o ose e to o t e st so t s s e to e ter to t e t. T e e t o e to s te to o t 3 or oe to 6 or r e e tor. A ote t s t e o t s est to et o s t e r er re o str e to t e ste.

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ore o es e r e s rot t te or s ort s r er e er 300 or r er eter o o o te o st r r . T e tt s re ret r e to t e s r e t ter s e er ot ore t 0.5 re st r e t s e o st re o te t. I e t to o so str t s e er ore re e t t o t o s s r t ers s s s e e te o so st r e t e s es.

S a

T e ore o e s e s 90 115 eter o t o s s r t ers re t r t ter s to o s or st test . T s s re t e e o o e s o r s s s o e t e ter t e. S es re ret r e to t e s r e or e o e te ter t r o t e er ts t t e re st r e e e t so s ro t e s es o t e o e. I or to ro t e r s st t ro s e s SPTs or st r e s es s o re t e o re t e to t e re o oss e or so te o s es ro ter.

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T e ore o e s e s rot r t t ter or r e e o t e r ro s ret r e t e s rr t e r tt s. O or es str t to e eter e ro t e tt s to et er t so e or to ro t e r te o e etr to . W ere r s se t s s t e tt s re e e t to s o oss e ro se r te s s s SPTs.

A o t o s ore s e e o t e s o t e ore rre s t 50 ter eter. Pro e ore re o er s e e s ot s oss e e ro s r rso s t ste e ro es er re e et o o est to .

Sa a P a T

St r e etr to tests SPT re se s e so o est t e e st or stre t o so s so o o t re t e st r e s e. T e test ro e re s es r e A str St r 1289 Met o s o Test So s or E eer P r oses Test 6.3.1.

T e test s rre o t ore o e r 50 eter s ts e t e er t e to 63 er t ree o 760 . It s or or t e t e to e r e t ree s ess e 150 re e ts t e N e st e ste er o o s or t e st 300 . I ese s s er r s or e ro t e 450 e etr to ot e r t e t e test s s o t e .

T e test res ts re re orte t e o o or .

- I t e se ere e etr to s o t e t s ess e o o ts or e 150 o s 4 6 7 s
  4 6 7
  N 13
- I t e se ere t e test s s o t e e ore t e e etr to e t s ter 15 o s or t e rst 150 30 o s or t e e t 40 s
  15 30 40

Sampling Methods

T e res ts o t e SPT tests e re te e r to t e e eer ro ert es o t e so s.

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P Sa P T

e etro eter tests CP or PSP re rr e o t r stee ro to t e ro s st r e t o er s e e st e. As t e ro e etr tes t e so t e er o o s re re to e etr te e s ess e 150 e t re re or e . Nor t ere s e t t to o 1.2 t t s e e te e ert o to s t e se o e te s o ro s. T o t es o e etro eter re o o se .

- Pert s e etro eter 16 eter t e e ro s r e s 9 er ro 600 AS 1289 Test 6.3.3 . T s test s e e o e or test t e e s t o s s s se r r so s .
- Co e e etro eter 16 eter ro t 20 eter o e e s r e s 9 er ro 510 AS 1289 Test 6.3.2 . T s test s e e o e t or e e t s r e est to s orre to s o t e test res ts t C or e r R to e ee s e ro s ro t or t es.

a a a

T e et o s o es r to ss to o so s ro s se t s re ort re se o A str St r AS 1726 eote Ste I est to s Co e. I e er t e es r to s e stre t or e st oo r str t re so or ro t e so s.

S T

So t es re es r e or to t e re o t rt e s e e t e r o ot er rt es rese t

T e	P rt e s e
o er	200
Co e	63 200
r e	2.36 63
S	0.075 2.36
S t	0.002 0.075
C	0.002

T e s r e s es e rt er s e s o o s

T e	P rt e s e
Co rse r e	20 63
Me r e	6 20
e r e	2.36 6
Co rse s	0.6 2.36
Me s	0.2 0.6
e s	0.075 0.2

T e ro orto s o se o r o stt e ts o so s re es r e s

Ter	Pro orto	E e
A	S e	C 60 S 40
A e t e	20 35	S C
S t	12 20	S t S C
Wt so e	5 12	C t so e s
Wt tr eo	0 5	C t tr e o s

e to so r ter s se re

- We r e oo re rese t to o rt es es
- Poor r e e ess or e e o rt rs es t t e s e r e
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- L str e e e os ts
- Aeo e os ts
- L ttor e e os ts
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- T s s ree or o rse o
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R	Rot r r
S A	S r t ers
NMLC	o ore 52
N	o ore 47
H	o ore 63
P	o ore 81

a

▷	W ter see
▽	W ter e e

Sa a T

A	A ers e s e st r e s e
E	E ro e t s e
U_{50}	U st r e t es e 50
W	W ters e o et e etro eter P
PI	P oto o s to ete tor
PL	Po t o stre t ls 50 MP
S	St r Pe etr to Test
V	S e r e P

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C	C e e
C	Cr s e o e s e o ose se t o t
L	to
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st	ste e t

o	o s e
ro	ro
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Symbols & Abbreviations

a S S a k

a


As t


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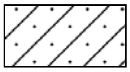
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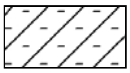

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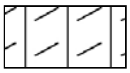

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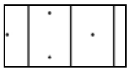

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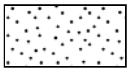

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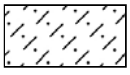

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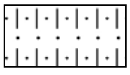

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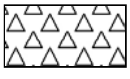

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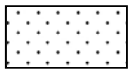

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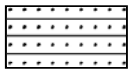

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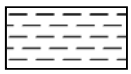

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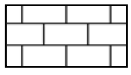

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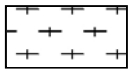

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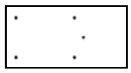

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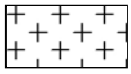
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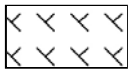

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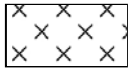

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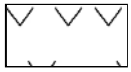

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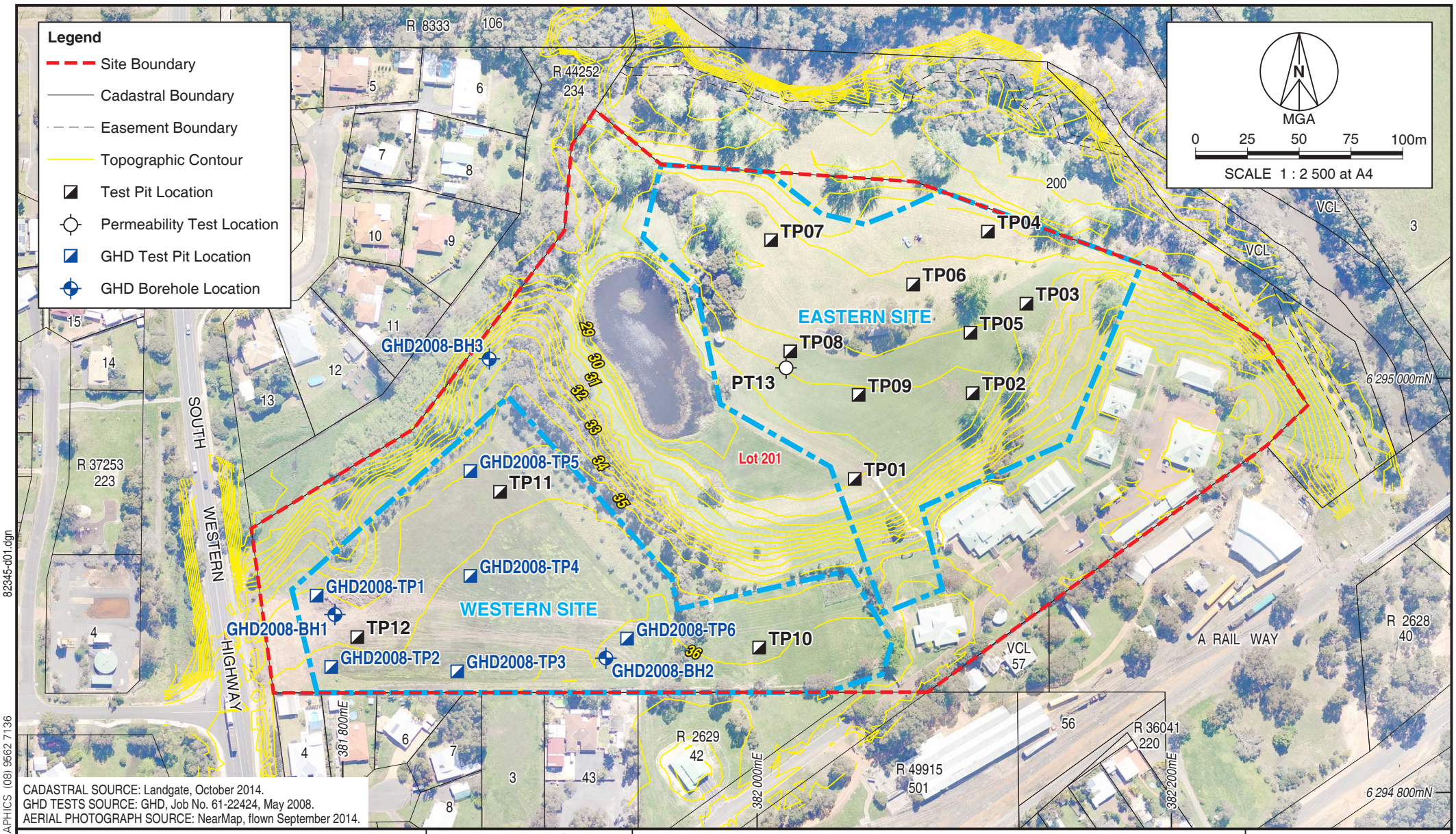

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CADASTRAL SOURCE: Landgate, October 2014.
GHD TESTS SOURCE: GHD, Job No. 61-22424, May 2008.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown September 2014.

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Preston Green Pty Ltd
OFFICE:	Perth
DATE:	10 Oct 2014

Test Locations
Lot 201 Turner Street (Meadowbrooke)
Boyanup, WA

PROJECT No.:	82345
DRAWING No.:	1
REVISION:	A

82345-d01.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136

TEST PIT LOG

CLIENT: Preston Green Pty Ltd
PROJECT: Lot 201 Turner Street
LOCATION: Boyanup, WA

SURFACE LEVEL: 29.5 m AHD*
EASTING:
NORTHING:

PIT No: TP01
PROJECT No: 82345
DATE: 16/9/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
29	0.2	TOPSOIL - dark grey brown, fine to medium grained silty sand topsoil with some rootlets, moist.							
		SANDY SILTY CLAY - firm, orange brown mottled blue grey, medium plasticity sandy silty clay, moist.		D	0.6		pp = 80	▽	
	1	- clay content and stifness increasing with depth.							1
28				D	1.75		pp = 140		
					1.9		pp = 240		
	2								2
	2.2	Pit discontinued at 2.2m(hard digging)							
27									
	3								3
26									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 5.5 tonne excator equipped with 600 mm bucket.
LOGGED: SJ
SURVEY DATUM: MGA94

WATER OBSERVATIONS: Perched groundwater observed at 0.7 m depth.

REMARKS: *Surface level interpolated from survey plan provided by the client.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Preston Green Pty Ltd
PROJECT: Lot 201 Turner Street
LOCATION: Boyanup, WA

SURFACE LEVEL: 30.0 m AHD*
EASTING:
NORTHING:

PIT No: TP02
PROJECT No: 82345
DATE: 16/9/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
30	0.2	TOPSOIL - dark grey brown, fine to medium grained silty sand topsoil with some rootlets, moist.							
		CLAYEY GRAVELLY SAND - medium dense, orange brown mottled blue grey, fine to medium grained clayey gravelly sand, wet. Gravel is fine sized.		D	0.4			▽	
29	1.0	SANDY SILTY CLAY - firm, orange brown mottled blue grey, medium plasticity sandy silty clay, moist.		D	1.3		pp = 70		
		- stiffness increasing with depth.			2.5		pp = 240		
28	2.6	Pit discontinued at 2.6m(due to collapsing conditions)							
27									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20; 1, 2, 3

RIG: 5.5 tonne excator equipped with 600 mm bucket.
LOGGED: SJ
SURVEY DATUM: MGA94

WATER OBSERVATIONS: Perched groundwater observed at 0.8 m depth.

REMARKS: *Surface level interpolated from survey plan provided by the client.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Preston Green Pty Ltd
PROJECT: Lot 201 Turner Street
LOCATION: Boyanup, WA

SURFACE LEVEL: 30.7 m AHD*
EASTING:
NORTHING:

PIT No: TP03
PROJECT No: 82345
DATE: 16/9/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.1	TOPSOIL - dark grey brown, fine to medium grained silty sand topsoil with some rootlets, moist.							
		CLAYEY SILTY SAND - dense, red brown, fine grained clayey silty sand, dry to moist.			0.3		pp = 240		
				B	0.5				
30		- becoming loose from 0.75 m depth.		U	0.7				
	1				1.0				1
		- becoming orange brown and moist from 1.5 m depth.							
29									
	2								2
		- becoming grey brown from 2.6 m depth.							
28									
	2.8	Pit discontinued at 2.8m(hard digging)							
	3								3
27									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 5.5 tonne excator equipped with 600 mm bucket.
LOGGED: SJ
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from survey plan provided by the client.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Preston Green Pty Ltd
PROJECT: Lot 201 Turner Street
LOCATION: Boyanup, WA

SURFACE LEVEL: 30.2 m AHD*
EASTING:
NORTHING:

PIT No: TP04
PROJECT No: 82345
DATE: 16/9/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
30	0.15	TOPSOIL - dark grey brown, fine to medium grained silty sand topsoil with some rootlets, moist.							
		CLAYEY SILTY SAND - loose, red brown, fine grained clayey silty sand, dry to moist.			0.5		pp = 60		
29	1								1
				D	1.9				
28	2	- becoming orange brown and moist from 2.3 m depth.							2
	3								3
	3.0	Pit discontinued at 3.0m (target depth)							
27									

5 10 15 20

RIG: 5.5 tonne excator equipped with 600 mm bucket.
LOGGED: SJ
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from survey plan provided by the client.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Preston Green Pty Ltd
PROJECT: Lot 201 Turner Street
LOCATION: Boyanup, WA

SURFACE LEVEL: 30.4 m AHD*
EASTING:
NORTHING:

PIT No: TP05
PROJECT No: 82345
DATE: 16/9/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
30	0.1	TOPSOIL - dark grey brown, fine to medium grained silty sand topsoil with some rootlets, moist.							
		SILTY SAND - medium dense, red brown and dark grey brown, fine grained silty sand with some clay, dry to moist.							
	1								1
29	1.2	CLAYEY SAND - orange brown mottled blue grey fine grained slightly silty clayey sand, wet.						▽	
	2								2
28	2.5	SANDY SILTY CLAY - firm, orange brown mottled blue grey, medium plasticity sandy silty clay, moist.							
	2.8	Pit discontinued at 2.8m (hard digging)							
	3								3
27									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 5.5 tonne excator equipped with 600 mm bucket.
LOGGED: SJ
SURVEY DATUM: MGA94

WATER OBSERVATIONS: Perched groundwater observed at 2.4 m depth.

REMARKS: *Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Preston Green Pty Ltd
PROJECT: Lot 201 Turner Street
LOCATION: Boyanup, WA

SURFACE LEVEL: 30.5 m AHD*
EASTING:
NORTHING:

PIT No: TP06
PROJECT No: 82345
DATE: 16/9/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
30	0.15	TOPSOIL - dark grey brown, fine to medium grained silty sand topsoil with some rootlets, moist.							
		CLAYEY SILTY SAND - medium dense, dark grey brown, fine grained clayey silty sand, dry to moist.		D	0.5				
		- becoming orange brown from 0.7 m depth.							
29		- with a trace of clay from 1.8 m depth.		D	2.2				
28	3.0	Pit discontinued at 3.0m (target depth)							
27									

RIG: 5.5 tonne excator equipped with 600 mm bucket.
LOGGED: SJ
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Preston Green Pty Ltd
PROJECT: Lot 201 Turner Street
LOCATION: Boyanup, WA

SURFACE LEVEL: 30.7 m AHD* **PIT No:** TP07
EASTING: **PROJECT No:** 82345
NORTHING: **DATE:** 16/9/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
30	0.1	TOPSOIL - dark grey brown, fine to medium grained silty sand topsoil with some rootlets, moist.							
		CLAYEY SILTY SAND - medium dense, dark grey brown, fine grained clayey silty sand, dry to moist.							
		- becoming loose from 0.75 m depth.							
		- becoming brown from 0.8 m depth.							
29		- with a trace of clay from 1.6 m depth.							
		- becoming dense from 1.8 m depth.							
				D	2.0				
	2.1	CLAYEY SILTY SAND - red brown mottled brown, fine grained clayey silty sand, dry to moist.							
28				D	2.4				
	3.0	Pit discontinued at 3.0m (target depth)							
27									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20; 1, 2, 3

RIG: 5.5 tonne excator equipped with 600 mm bucket. **LOGGED:** SJ **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Preston Green Pty Ltd
PROJECT: Lot 201 Turner Street
LOCATION: Boyanup, WA

SURFACE LEVEL: 30.3 m AHD*
EASTING:
NORTHING:

PIT No: TP08
PROJECT No: 82345
DATE: 16/9/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
30	0.2	TOPSOIL - dark grey brown, fine to medium grained silty sand topsoil with some rootlets, moist.							
		CLAYEY SILTY SAND - medium dense, red brown, fine grained clayey silty sand, dry to moist.							
	1								1
29	1.2	CLAYEY GRAVELLY SAND - orange brown mottled blue grey, fine to medium grained clayey gravelly sand, wet. Gravel is fine sized.		D	1.4			▽	
	2								2
28	2.0	SANDY SILTY CLAY - firm, orange brown mottled blue grey, medium plasticity sandy silty clay, moist.		D	2.4		pp = 160		
	2.8	Pit discontinued at 2.8m (hard digging)							
	3								3
27									

RIG: 5.5 tonne excator equipped with 600 mm bucket.
LOGGED: SJ
SURVEY DATUM: MGA94

WATER OBSERVATIONS: Perched groundwater observed at 1.7 m depth.

REMARKS: *Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Preston Green Pty Ltd
PROJECT: Lot 201 Turner Street
LOCATION: Boyanup, WA

SURFACE LEVEL: 29.9 m AHD* **PIT No:** TP09
EASTING: **PROJECT No:** 82345
NORTHING: **DATE:** 16/9/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
29	0.2	TOPSOIL - dark grey brown, fine to medium grained silty sand topsoil with some rootlets, moist.							
		CLAYEY GRAVELLY SAND - medium dense, red brown, fine to medium grained clayey gravelly sand, wet. Gravel is fine sized.		B	0.5			▽	
		- gravel content decreasing with depth.		U	0.8				
28	1.4	SANDY CLAY - very stiff, red brown mottled dark grey brown, high plasticity sandy clay, moist. Sand is fine grained.			1.9		pp = 360		
27	2.7	Pit discontinued at 2.7m (hard digging)							
26									

RIG: 5.5 tonne excator equipped with 600 mm bucket. **LOGGED:** SJ **SURVEY DATUM:** MGA94

WATER OBSERVATIONS: Perched groundwater observed at 0.7 m depth.

REMARKS: *Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Preston Green Pty Ltd
PROJECT: Lot 201 Turner Street
LOCATION: Boyanup, WA

SURFACE LEVEL: 35.9 m AHD*
EASTING:
NORTHING:

PIT No: TP10
PROJECT No: 82345
DATE: 16/9/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
35	0.2	TOPSOIL - dark grey brown, fine to medium grained silty sand topsoil with some rootlets, moist.							
		CLAYEY GRAVELLY SAND - medium dense to dense, orange brown mottled blue grey, fine to medium grained clayey gravelly sand, wet. Gravel is fine sized.							
	0.8	SANDY CLAY - stiff, orange brown mottled blue grey, high plasticity sandy clay, dry to moist. Sand is fine to course grained.		D	1.0		pp = 160	▽	
	1	- stiffness increasing with depth.			1.5		pp = 380		
	1.6	Pit discontinued at 1.6m (hard digging)							
34	2								
33	3								
32									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 5.5 tonne excator equipped with 600 mm bucket.
LOGGED: SJ
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from survey plan provided by the client.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Preston Green Pty Ltd
PROJECT: Lot 201 Turner Street
LOCATION: Boyanup, WA

SURFACE LEVEL: 35.3 m AHD*
EASTING:
NORTHING:

PIT No: TP11
PROJECT No: 82345
DATE: 16/9/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
35	0.2	TOPSOIL - dark grey brown, fine to medium grained silty sand topsoil with some rootlets, moist.							
		SANDY CLAY - very stiff, orange brown mottled blue grey, high plasticity sandy clay, dry to moist. Sand is fine to course grained.		B	0.5		pp = 300		
	0.6	CLAY - hard, red brown mottled blue grey, high plasticity clay, dry to moist.		U	0.6				
34	1				0.9				1
				D	1.1		pp = 560		
	1.5	Pit discontinued at 1.5m (hard digging)							
33	2								2
32	3								3

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 5.5 tonne excator equipped with 600 mm bucket.
LOGGED: SJ
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from survey plan provided by the client.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Preston Green Pty Ltd
PROJECT: Lot 201 Turner Street
LOCATION: Boyanup, WA

SURFACE LEVEL: 35.4 m AHD*
EASTING:
NORTHING:

PIT No: TP12
PROJECT No: 82345
DATE: 16/9/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
35	0.2	TOPSOIL - dark grey brown, fine to m,edium grained silty sand topsoil with some rootlets, moist.							
		SANDY CLAY - very stiff, orange brown mottled blue grey, high plasticity sandy clay, moist. Sand is fine to course grained.						▽	
		- stiffness increasing with depth.			0.7		pp = 320		
	1				1.0		pp = 400		1
34	1.1	CLAY - hard, orange brown mottled blue grey, high plasticity clay, dry to moist.			1.2		pp = 510		
	1.5	Pit discontinued at 1.5m (hard digging)							
	2								2
33									
	3								3
32									

RIG: 5.5 tonne excator equipped with 600 mm bucket.
LOGGED: SJ
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: *Surface level interpolated from survey plan provided by the client.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Preston Green Pty Ltd
PROJECT: Lot 201 Turner Street
LOCATION: Boyanup, WA

SURFACE LEVEL: 30.0 m AHD* **BORE No:** PT13
EASTING: **PROJECT No:** 82345
NORTHING: **DATE:** 16/9/2014
DIP/AZIMUTH: 90°/-- **SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
30	0.2	TOPSOIL - dark grey brown, fine to medium grained silty sand topsoil with some rootlets, moist.							
	0.35	CLAYEY SILTY SAND - medium dense, dark grey brown, fine grained clayey silty sand, moist.		D	0.3				
29	1	Bore discontinued at 0.35m(target depth)							
28	2								
27	3								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 110 mm hand auger. **DRILLER:** SJ **LOGGED:** SJ **CASING:**

TYPE OF BORING:

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Surface level interpolated from survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Laboratory Test Certificates

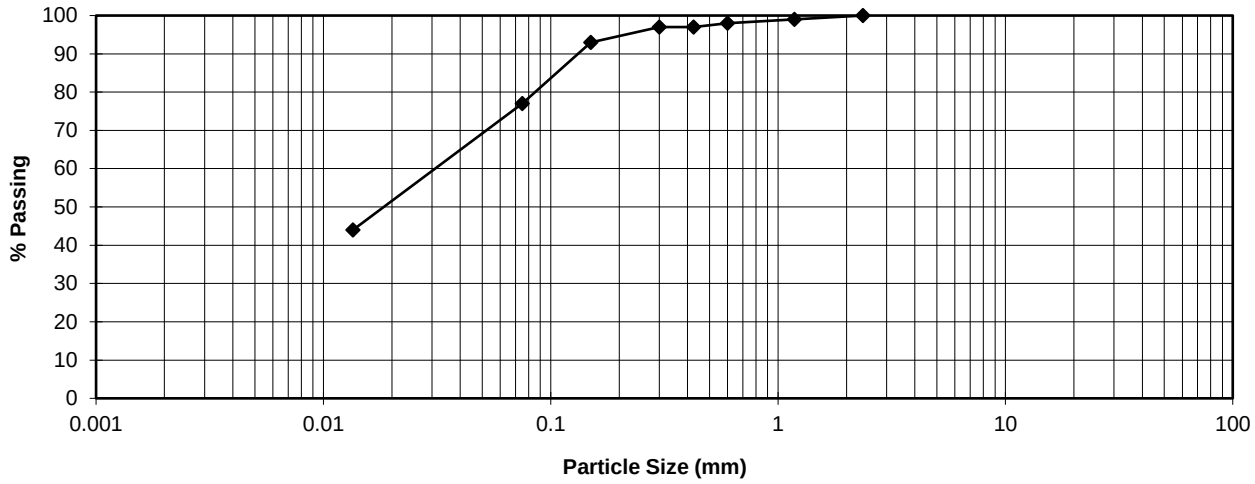
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/3587
Sample No:	P14/3587
Issue Date:	2 October 2014

Client: Preston Green Pty Ltd
Project: Lot 201 Turner Street
Location: Boyanup, WA

Sample ID: TP01
Sample Depth(m): 0.60



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	99
0.600	98
0.425	97
0.300	97
0.150	93
0.075	77
0.0135	44

Plasticity index tests
AS 1289

Liquid limit 3.9.1	44	%
Plastic limit 3.2.1	22	%
Plasticity index 3.3.1	22	%
Linear shrinkage 3.4.1	6.0	%

Cracked ☑
Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

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Matthew van Herk

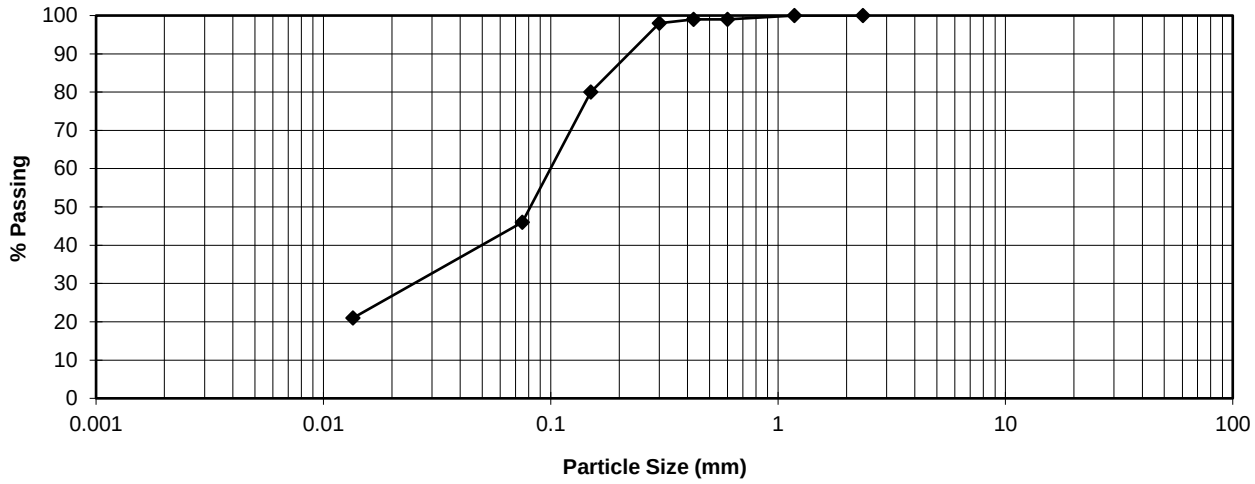
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/3588
Sample No:	P14/3588
Issue Date:	2 October 2014

Client: Preston Green Pty Ltd
Project: Lot 201 Turner Street
Location: Boyanup, WA

Sample ID: TP03
Sample Depth(m): 0.50



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	99
0.425	99
0.300	98
0.150	80
0.075	46
0.0135	21

Plasticity index tests
AS 1289

Liquid limit 3.9.1	23	%
Plastic limit 3.2.1	19	%
Plasticity index 3.3.1	4	%
Linear shrinkage 3.4.1	0.5	%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

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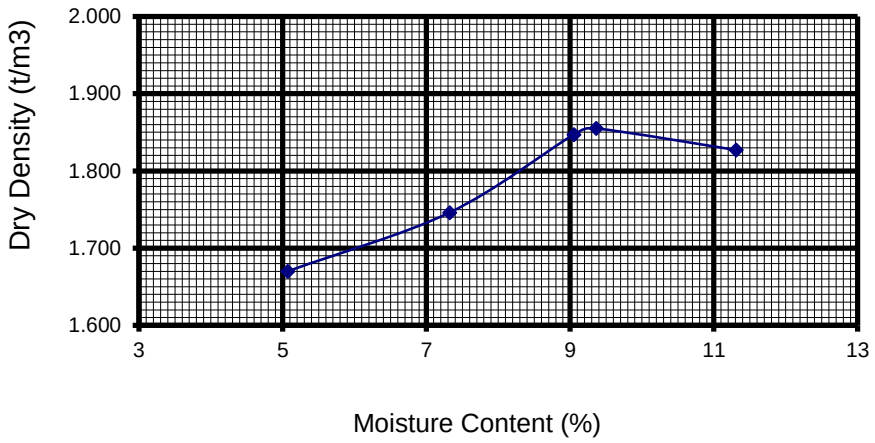
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Civil
Geotest Pty Ltd
Unit 1/1 Pusey Road, JANDAKOT WA 6164
Ph (08) 9414 8022
Fax (08)9414 8011
Email matt@mcgeotest.com.au

Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60017-P14/3588	**Project:**	Lot 201 Turner Street
Sample No:	P14/3588	**Client:**	Preston Green Pty Ltd
Location:	Boyanup, WA	**Date of Issue:**	17 September 2014
	TP03 0.5	**Job No:**	60017

Maximum Dry Density t/m^3:	1.855	**Conditions at Test**	
Optimum Moisture Content %:	9.6	Soaking Period (Days)	4
Desired Conditions:	95/100	Surcharge (kg)	4.5
Compactive Effort		Entire Moisture Content %	17.7
Mass of hammer kg	4.9	Entire Moisture Ratio %	184.5
Number of layers	5	Top 30mm Moisture Content %	16.3
Number of blows/layer	16	Top 30mm Moisture Ratio %	169.5
Conditions after Compaction		Swell %	0.0
Dry Density t/m^3	1.761	C.B.R. at 5.0 mm Penetration %	18
Moisture Content %	9.8	**Conditions after Soaking**	
Density Ratio %	95.0	Dry Density t/m^3	1.761
Moisture Ratio %	101.5	Moisture Content %	17.1
Soaked / Unsoaked	Soaked	Dry Density Ratio %	95.0
		Moisture Ratio %	178.5

Comments:



Client Address: 36 O'Malley Street, Osborne Park

ASMDD-CBR June 2009

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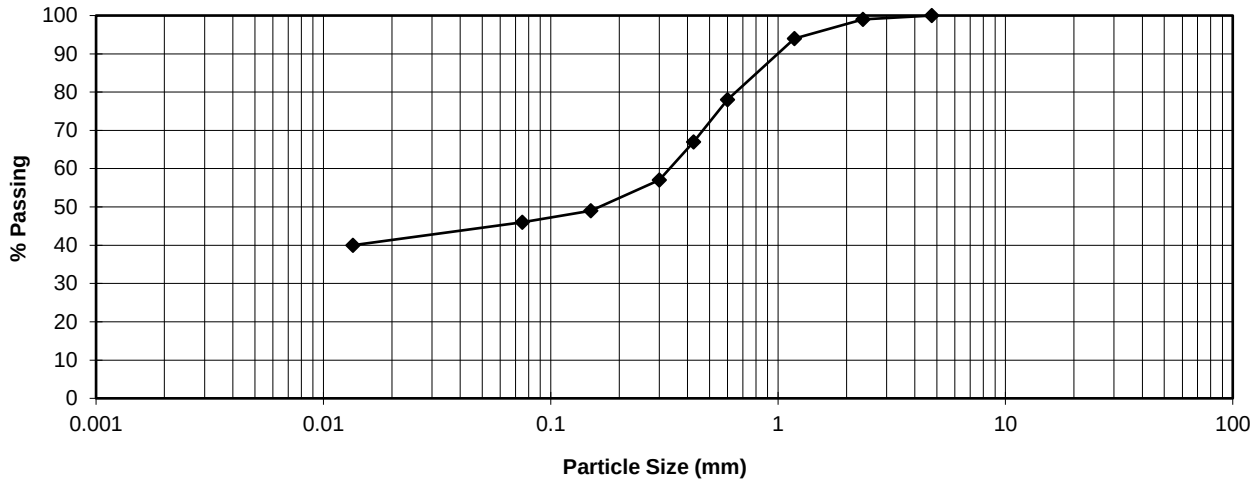
Particle Size Distribution & Plasticity Index tests

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unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/3590
Sample No:	P14/3590
Issue Date:	2 October 2014

Client: Preston Green Pty Ltd
Project: Lot 201 Turner Street
Location: Boyanup, WA

Sample ID: TP10
Sample Depth(m): 1.00



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	100
2.36	99
1.18	94
0.600	78
0.425	67
0.300	57
0.150	49
0.075	46
0.0135	40

Plasticity index tests
AS 1289

Liquid limit 3.9.1	51	%
Plastic limit 3.2.1	19	%
Plasticity index 3.3.1	32	%
Linear shrinkage 3.4.1	10.0	%

Cracked ☑

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

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Matthew van Herk

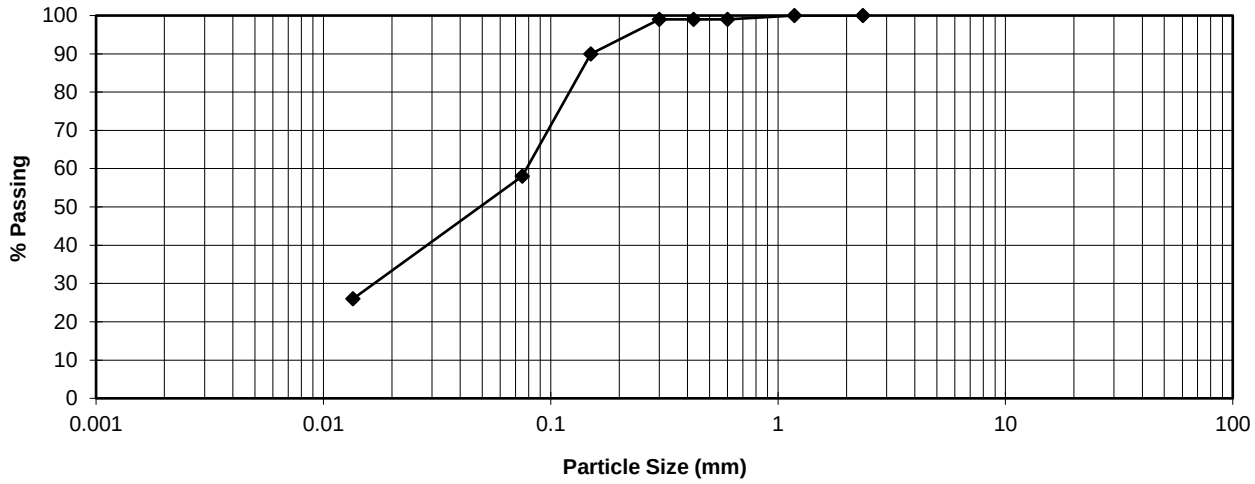
Particle Size Distribution & Plasticity Index tests

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Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60017
Report No:	60017-P14/3592
Sample No:	P14/3592
Issue Date:	2 October 2014

Client: Preston Green Pty Ltd
Project: Lot 201 Turner Street
Location: Boyanup, WA

Sample ID: PT13
Sample Depth(m): 0.30



SIEVE ANALYSIS WA115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	99
0.425	99
0.300	99
0.150	90
0.075	58
0.0135	26

Plasticity index tests
AS 1289

Liquid limit 3.9.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

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Matthew van Herk
AS PSDPI May 2009

Mining & Civil Geotest Pty Ltd

Ph (08) 9414 8022 Fax (08) 9414 8011
Email matt@mcgeotest.com.au
Unit 1/1 Pusey Road, JANDAKOT WA 6164

Determination of the Shrinkage Index of a Soil
Shrink Swell Index
AS 1289.7.1.1

		Job No:	60017
		Report No:	60017-P14/3589
		Date of issue:	2 October 2014
Client:	Preston Green Pty Ltd	Date tested:	25 September 2014
Project:	Lot 201 Turner Street	Tested by:	W Old
Location:	Boyanup, WA	Checked:	M van Herk
Sample:	TP03 0.7-1.0m	Sample No:	P14/3589

Sample details

Sample description : Brown Silty Sand

Sample Type : 63 mm Ø tube sample

Swell Specimen		Shrinkage Specimen	
Dry Density - Initial (t/m$^{3)}$	1.48	Moisture Content Initial (%)	14.7
Moisture Content - Initial (%)	13.6	Length/Diameter Ratio	2.1
Moisture Content - Final (%)	25.2	Extent of Crumbling	Nil
Overburden Pressure (kPa)	25	Extent of Cracking	Nil
Significant Inert Inclusions (%)	0		

Shrink-Swell Index

I_{ss} = **0.2** % Vertical strain per pF change in Total suction

Client address: 36 O'Malley Street, Osborne Park

Tested as received

Approved Signature

Matthew van Herk

Mining & Civil Geotest Pty Ltd

Ph (08) 9414 8022 Fax (08) 9414 8011
Email matt@mcgeotest.com.au
Unit 1/1 Pusey Road, JANDAKOT WA 6164

Determination of the Shrinkage Index of a Soil
Shrink Swell Index
AS 1289.7.1.1

		Job No:	60017
		Report No:	60017-P14/3591
		Date of issue:	2 October 2014
Client:	Preston Green Pty Ltd	Date tested:	25 September 2014
Project:	Lot 201 Turner Street	Tested by:	W Old
Location:	Boyanup, WA	Checked:	M van Herk
Sample:	TP11 0.6-0.9m	Sample No:	P14/3591

Sample details

Sample description : Brown Sandy Clay

Sample Type : 48 mm Ø tube sample

Swell Specimen		Shrinkage Specimen	
Dry Density - Initial (t/m$^{3)}$	1.64	Moisture Content Initial (%)	20.3
Moisture Content - Initial (%)	22.4	Length/Diameter Ratio	2.1
Moisture Content - Final (%)	27.4	Extent of Crumbling	Nil
Overburden Pressure (kPa)	25	Extent of Cracking	Nil
Significant Inert Inclusions (%)	2		

Shrink-Swell Index

I_{ss} = **2.5** % Vertical strain per pF change in Total suction

Client address: 36 O'Malley Street, Osborne Park

Tested as received

Approved Signature

Matthew van Herk

ATTACHMENT C
FEATURE SURVEY PLAN

mpm
development consultants



Thompson surveying consultants

Innovators in Surveying Since 1952

Licensed Surveyors, Project Managers
& Engineering Surveyors

A.C.N. 008 938 903 ABN 59 166 330 334

Unit 6, 18 Casuarina Drive
BUNBURY WA 6230

Phone: (08) 9721 4000 Fax: (08) 9721 2720
eMail: info@thompsonsurveying.com.au

BSI™
ISO 9001
FS 520415

NOTE: All services plotted from information supplied by others, site verification required prior to construction.
Boundary position is not deemed to be correct until a resurvey has been carried out.
Check Certificate of Title for any easements etc.
No responsibility accepted for changes occuring after date of survey.

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File No.	12130	Date:	19/Feb./2010
Scale (@A1)	Vert: N/A	Checked	XX
	Hor: 1 : 1500		
Computer Reference	12130BCG94	Revision-	0
Drg No.	DWG12130BGC94 Tp	Sheet	1 of 1

CLIENT:	PRESTON GREEN Pty. Ltd.	
PROJECT:	Meadowbrook Estate, Turner Street, Boyanup	
TITLE:	FEATURE SURVEY	
DATUM	VERT:	A.H.D.
	HOR:	BCG '94

ATTACHMENT D
GROUNDWATER LEVEL REPORT

development consultants

December 14

GROUNDWATER LEVEL MONITORING REPORT

MEADOWBROOK LIFESTYLE VILLAGE

PREPARED FOR: PRESTON GREEN



Submitted by
MPM Development Consultants
107 Beach Road
BUNBURY WA 6230

Telephone
08 9721 4777

Email
reception@mpmdc.com.au

Web
www.mpmdc.com.au

mpm development consultants

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DOCUMENT CONTROL

Title:	**GROUNDWATER LEVEL MONITORING REPORT MEADOWBROOKE LIFESTYLE VILLAGE**
Author (s) :	**CRAIG PIPPIN**
Reviewer (s) :	**SHELLEY COUTTS**
Job No. :	**09016**
Client :	**PRESTON GREEN PTY LTD**

Revision

Revision	Summary	Revised by	Approved by	Date
A	Issued with LWMS			

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The document has been restricted to those issues that have been agreed between the Client and MPM. It shall be recognised that site conditions change and contain varying degrees of non-uniformity that cannot be fully defined by field investigation. Measurements and values obtained from sampling and testing in this document are indicative within a limited timeframe, and unless otherwise specified, should not be accepted as conditions on site beyond that timeframe.

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3.0 Rainfall 11
4.0 Regional Groundwater 13
5.0 Discussion 14
6.0 Recommendations 15

Attachments

A Recorded Groundwater Levels
B Monitoring Bore Graphical Summaries
C Maximum Groundwater Contours

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1.0 Executive Summary

MPM Development Consultants (MPM) undertook the level monitoring of superficial groundwater within Lot 888 Turner Street, Boyanup, currently known as Meadowbrooke Estate in order to assist in the preparation of a Development Guide Plan (DGP) for the development of the site to a Lifestyle Village.

This report represents those groundwater monitoring levels and the impact on development.

The subject land is located within the Boyanup Townsite, directly north of the rail reserve and currently disused railway buildings. Access to the site is via Turner Street. The land is bounded to the east by the Ferguson River and to the north by a drainage reserve that contributes to the Ferguson River.



Figure 1 – Location Plan – Courtesy of Landgate

The information collected will be utilised for the preparation of groundwater management strategies and ultimately the detailed engineering design for the development infrastructure.

The site is characterised by high groundwater levels through the western portion of the site and groundwater levels of approximately 3.0m deep through the lower northern portion of the site.

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2.0 Introduction

MPM were engaged by Preston Green Pty Ltd to undertake measurement of the depth of groundwater across Lot 888 Turner Street, Boyanup to collect the 2011 and 2012 peak groundwater levels.

9 Groundwater monitoring bores were installed across the site by Australind Water Boring at the locations as shown below in Figure 1.



Figure 1 – Bore Locations

Measurements were taken on 15 occasions from 2nd June 2011 to the 21st November 2012. The measurement of all 9 bores was undertaken on the same day.

3.0 Results

The complete record of groundwater levels in included as Attachment A and a summary of the results is contained below in Table 1.

BORE NO.	LOWEST GWL	DEPTH OF BORE	HIGHEST GWL	HIGHEST GWL (m AHD)	MONTH HIGHEST GWL RECORDED
1	Dry	3.02	0.75	35.48	Sept 2012
2	Dry	3.06	1.39	33.80	Aug 2011
3	Dry	3.01	Dry	-	-
4	Dry	3.04	Dry	-	-
5	Dry	2.98	2.63	26.99	Oct 2011
6	Dry	3.03	1.19	30.92	Aug 2012
7	Dry	3.96	0.91	33.48	Aug 2011
8	Dry	4.05	2.46	32.34	Aug 2011
9	Dry	3.00	0.44	35.54	Aug 2012

Table 1

Notes:
1. Highest/Lowest GWL noted in metres below Natural Surface
2. Depth of bore noted in metres below Natural Surface
3. A dry notation indicates that no groundwater level was recorded.

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4.0 Rainfall

In order to determine if a correlation exists between rainfall and groundwater level, Figure 2 below provies the total monthly rainfall for 2011 and 2012, with Figure 3 providing the Groundwater level for each of the monitoring bores.

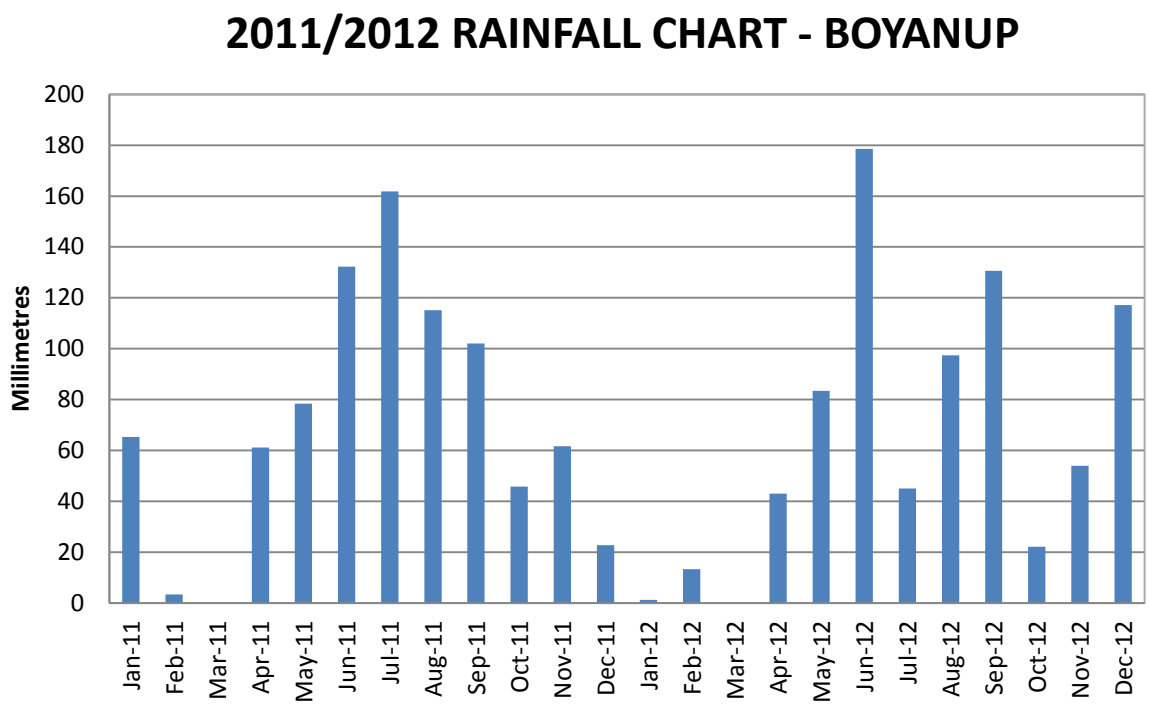


Figure 2 – Monthly Rainfall Chart

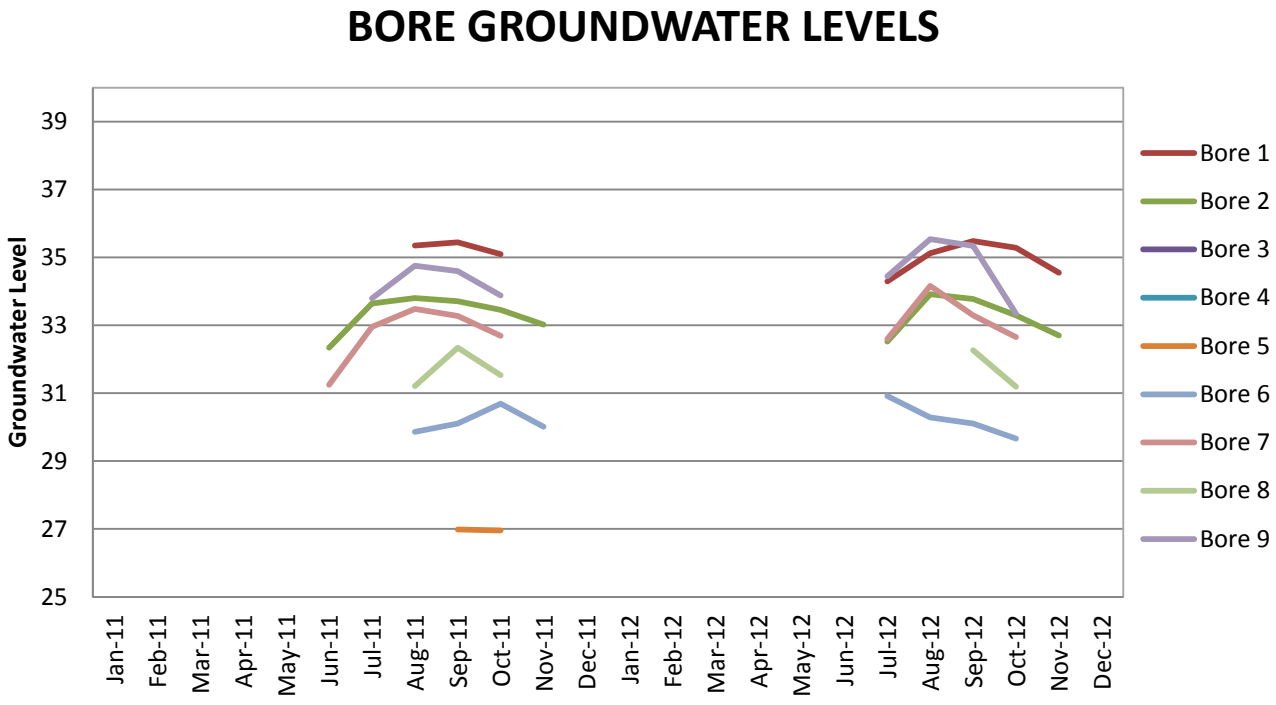
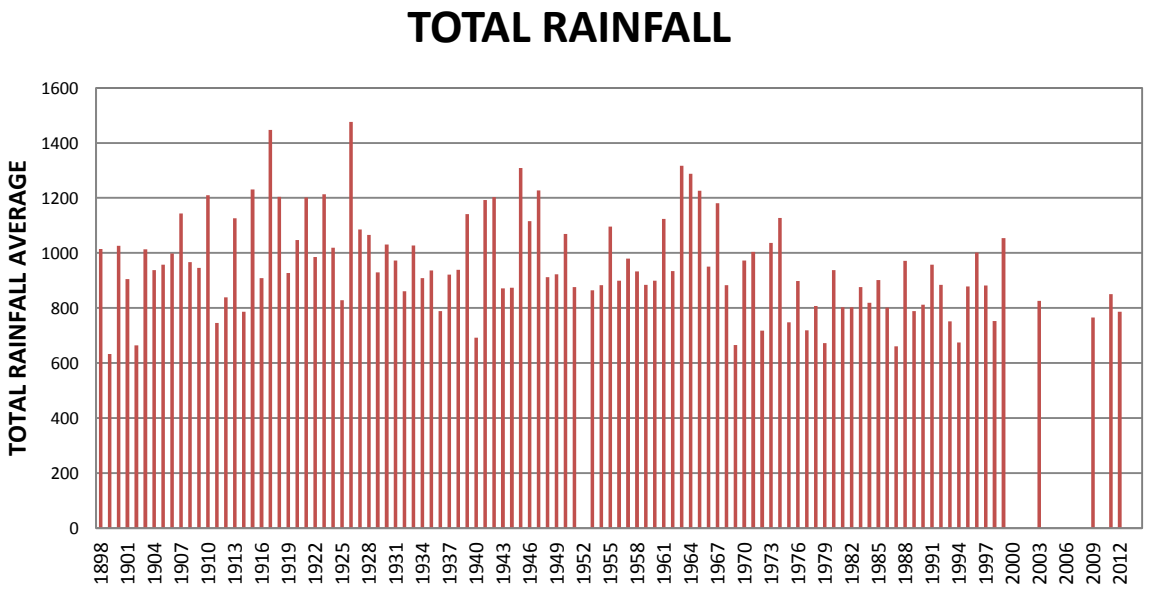


Figure 3 – Bore Groundwater Levels

It can be seen from Figure 2 and 3 above that there is a direct correlation between rainfall and groundwater level. The delay between the month of peak rainfall and peak of groundwater level is approximately 1 month.

A review of the entire rain fall records for the Boyanup area back to the first record in 1898 is shown below in Figure 4.



*Note: Space shows missing daily observations

Figure 4 – Total Rainfall

A review of the average yearly rainfall for the period of 1970 to current day indicates an average total yearly rainfall of 851mm. With the total yearly rainfall for 2011 and 2012 being 849.7 and 786mm respectively it can be determined that neither 2011or 2012 were considered a wet year, therefore marginal higher groundwater levels could be expected when an average yearly rainfall occurs.

5.0 Regional Groundwater

A search of the Department of Water (DoW) groundwater bore website Water Information Reporting indicates that 4 bores are located within relatively close proximity to the site.

- DoW Monitoring site 61118065 is located near Payne Street approximately 2.4km from the site
- DoW Monitoring site 61118066 is located near Payne Street approximately 2.4km from the site
- DoW Monitoring site 61118083 is located on Gray Road approximately 1.8km from the site
- DoW Monitoring site 61118084 is located on Gray Road approximately 1.8km from the site

Figure 5 below indicates the location of the bores relative to the site.

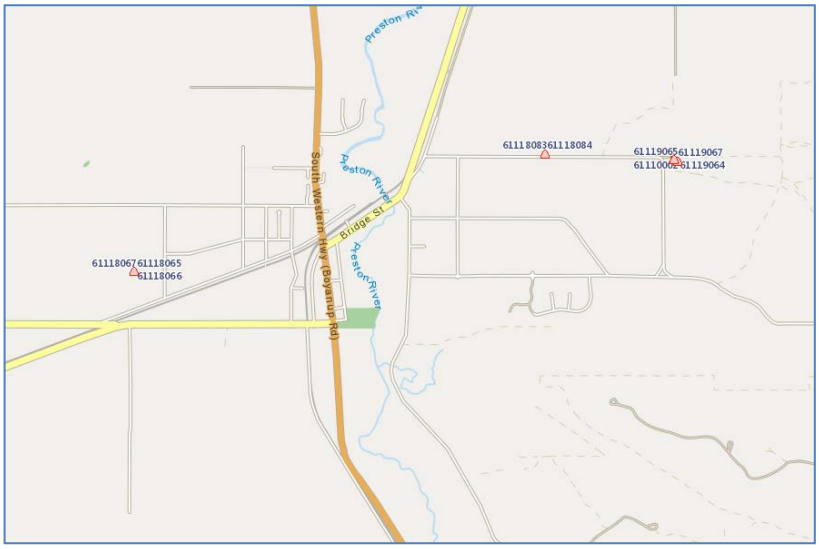


Figure 5 – Location of bores relative to site

The DoW monitoring sites collected a varied number of readings per year although a reading at each bore was generally recorded in September each year, it should be noted that this may not have been the maximum groundwater level for the site. The monitoring sites provided records from 1979 through to the present day, covering the 2011 and 2012 monitoring periods.

Each of the monitoring sites provided control data and an AAMGL was calculated for each site, as follows:

Monitoring	AAMGL	MGL 2011	MGL 2012
61118065	30.33	29.26	28.60
61118066	30.49	29.20	28.67
61118083	33.98	34.68	33.53
61118084	36.13	34.64	34.25

Table 2

A review of this analysis indicates that the 2011 and 2012 maximum groundwater levels for the DoW monitoring bores are an average 1.2m lower than the AAMGL with the exception of monitoring site 8083 which has recorded an MGL approximately 0.7m above the AAMGL.

The regional groundwater bore data therefore agrees with the rainfall data in that in wetter years or years of average rainfall higher groundwater levels can be expected across the development site.

6.0 Discussion

Figure 6 as included below and in larger scale with Attachment C provides an interpretation of the maximum groundwater contours for the development site based upon the recorded maximum groundwater levels for 2011 and 2012.



Based upon the comparison to yearly total rainfall for Boyanup and a comparison to regional Department of Water groundwater bore data, it could be expected that the maximum groundwater levels across the development site could be marginally higher than those recorded in 2011 and 2012.

The southern, elevated sections are evidenced by areas of high groundwater at the winter peak. The northern, lower sections of the site have a significantly deeper groundwater depth due to the effect of the adjoining drainage channel and Preston River. Both the drainage channel and Preston would act to draw down the groundwater to their permanent water levels.

7.0 Recommendations

The shallow maximum groundwater levels across the development site, particularly in the elevated but clayey areas of the site will necessitate groundwater management during construction and for development to occur.

The shallow maximum groundwater will necessitate that appropriate strategies and plans are created to manage the groundwater resource.

These may include:

- Subsurface/Subsoil Drainage to control/maintain maximum groundwater levels.
- Importation of fill to create additional separation of proposed infrastructure to maximum groundwater levels.
- Management and/or restriction of stormwater infiltration.
- Appropriate management of sewer effluent disposal.

The proximity of the development site to the Ferguson River, a protected water body, will necessitate that any alteration to the existing groundwater regime should be carefully managed and future development should ensure that all groundwater extracted from subsoil networks will be tested to ensure it will not affect the Ferguson River.

A review of the sites groundwater quality will be required should groundwater control mechanisms be put in place with future development.

Groundwater management should be addressed within a subsequent Local Water Management Strategy or Urban Water Management Plan prior to development proceeding to ensure appropriate management and detailed design considers the groundwater resource.

ATTACHMENT A
RECORDED GROUNDWATER LEVELS

Groundwater Monitoring Bores
Meadowbrooke

Table 1

BORE ID	EASTING (m)	NORTHING (m)	BORE RL (m)	GROUND RL (m)	DEPTH OF BORE RL (m)	DEPTH OF BORE (m)	DATE :		02/06/2011	DATE :		7/07/11	DATE :		08/08/2011	DATE :		31/08/2011	DATE :		04/10/2011	DATE :	
							RECORDED DEPTH TO WATER TABLE	ACTUAL DEPTH TO WATER TABLE	RL OF WATER TABLE	RECORDED DEPTH TO WATER TABLE	ACTUAL DEPTH TO WATER TABLE	RL OF WATER TABLE	RECORDED DEPTH TO WATER TABLE	ACTUAL DEPTH TO WATER TABLE	RL OF WATER TABLE	RECORDED DEPTH TO WATER TABLE	ACTUAL DEPTH TO WATER TABLE	RL OF WATER TABLE	RECORDED DEPTH TO WATER TABLE	ACTUAL DEPTH TO WATER TABLE	RL OF WATER TABLE	RECORDED DEPTH TO WATER TABLE	ACTUAL DEPTH TO WATER TABLE
MB1			37.198	36.228	33.208	3.020	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	1.85	0.88	35.35	1.76	0.79	35.44	2.11	1.14
MB2			36.141	35.193	32.131	3.062	3.8	2.85	32.34	2.5	1.55	33.64	2.34	1.39	33.80	2.43	1.48	33.71	2.69	1.74	33.45	3.12	2.17
MB3			32.491	31.541	28.531	3.010	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!
MB4			30.993	30.064	27.023	3.041	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!
MB5			30.644	29.621	26.634	2.987	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	3.65	2.63	26.99	3.68	2.66
MB6			33.081	32.113	29.081	3.032	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	3.22	2.25	29.86	2.97	2.00	30.11	2.39	1.42	30.69	3.07	2.10
MB7			35.423	34.390	30.423	3.967	4.17	3.14	31.25	2.47	1.44	32.95	1.94	0.91	33.48	2.15	1.12	33.27	2.73	1.70	32.69	NE	#VALUE!
MB8			35.760	34.803	30.750	4.053	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	4.55	3.59	31.21	3.42	2.46	32.34	4.23	3.27	31.53	NE	#VALUE!
MB9			36.967	35.978	32.977	3.001	NE	#VALUE!	#VALUE!	3.18	2.19	33.79	2.22	1.23	34.75	2.38	1.39	34.59	3.09	2.10	33.88	NE	#VALUE!

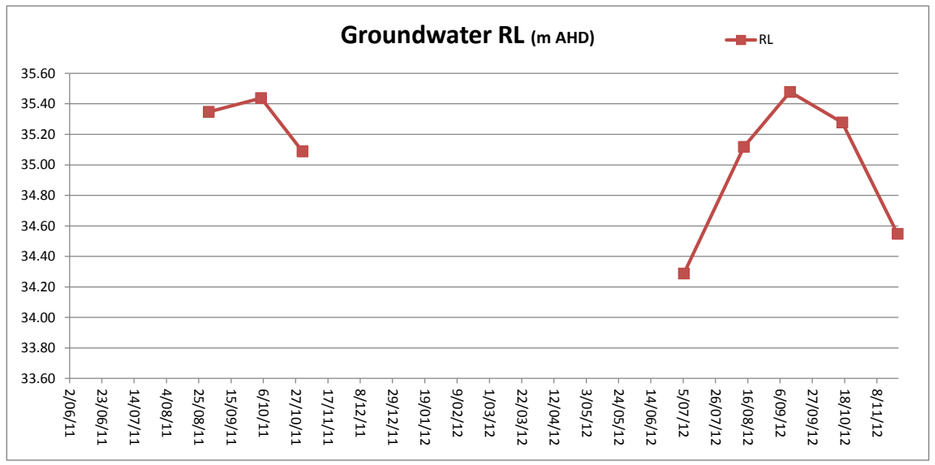
Note : NE = Not Encountered
NR = Not Recorded
SIP = Star Iron Picket
MB = Monitoring Bore

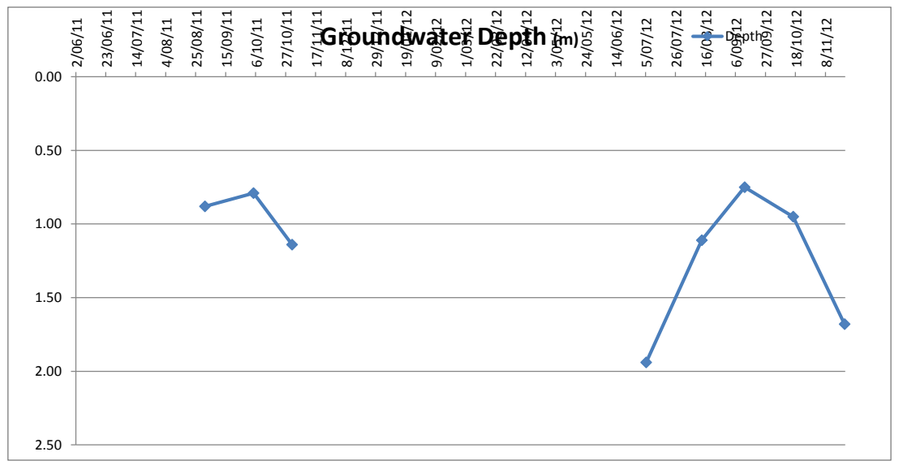
31/10/2011	DATE :		15/02/2012	DATE :		15/05/2012	DATE :		05/07/2012	DATE :		13/08/2012	DATE :		12/09/2012	DATE :		16/10/2012	DATE :		21/11/2012
RL OF WATER TABLE	RECORDED DEPTH TO WATER TABLE	ACTUAL DEPTH TO WATER TABLE	RL OF WATER TABLE	RECORDED DEPTH TO WATER TABLE	ACTUAL DEPTH TO WATER TABLE	RL OF WATER TABLE	RECORDED DEPTH TO WATER TABLE	ACTUAL DEPTH TO WATER TABLE	RL OF WATER TABLE	RECORDED DEPTH TO WATER TABLE	ACTUAL DEPTH TO WATER TABLE	RL OF WATER TABLE	BORE ID	RECORDED DEPTH TO WATER TABLE	ACTUAL DEPTH TO WATER TABLE	RL OF WATER TABLE	RECORDED DEPTH TO WATER TABLE	ACTUAL DEPTH TO WATER TABLE	RL OF WATER TABLE	RECORDED DEPTH TO WATER TABLE	ACTUAL DEPTH TO WATER TABLE	RL OF WATER TABLE
35.09	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	2.91	1.94	34.29	2.08	1.11	35.12	MB1	1.72	0.75	35.48	1.92	0.95	35.28	2.65	1.68	34.55
33.02	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	3.62	2.67	32.52	2.22	1.27	33.92	MB2	2.37	1.42	33.77	2.85	1.90	33.29	3.44	2.49	32.70
#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	MB3	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!
#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	MB4	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!
26.96	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	MB5	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!
30.01	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	2.16	1.19	30.92	MB6	2.79	1.82	30.29	2.97	2.00	30.11	3.42	2.45	29.66
#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	2.82	1.79	32.60	1.26	0.23	34.16	MB7	2.13	1.10	33.29	2.77	1.74	32.65	NE	#VALUE!	#VALUE!
#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	MB8	3.49	2.53	32.27	4.57	3.61	31.19	NE	#VALUE!	#VALUE!
#VALUE!	NE	#VALUE!	#VALUE!	NE	#VALUE!	#VALUE!	2.53	1.54	34.44	1.43	0.44	35.54	MB9	1.53	0.54	35.44	3.63	2.64	33.34	NE	#VALUE!	#VALUE!

ATTACHMENT B
MONITORING BORE GRAPHICAL SUMMARIES

Graph of Monitoring Bore Number **1**

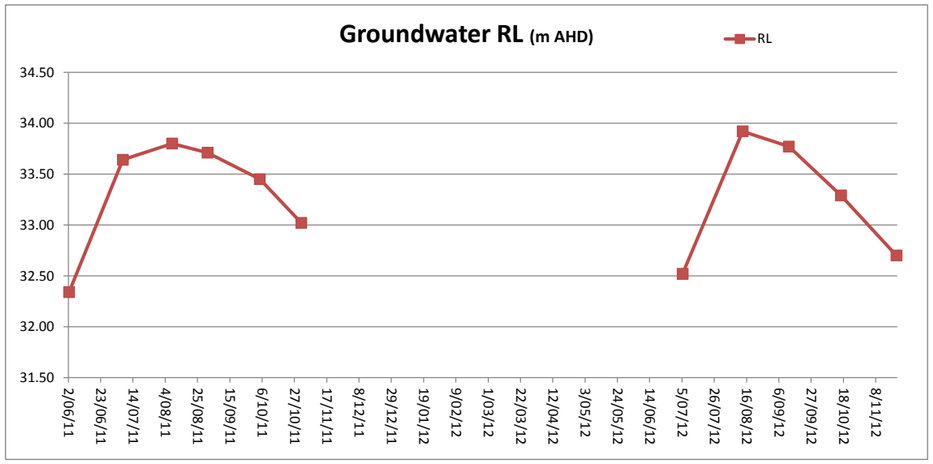
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7/07/11		
8/08/11		
31/08/11	35.35	0.88
4/10/11	35.44	0.79
31/10/11	35.09	1.14
15/02/12		
15/05/12		
5/07/12	34.29	1.94
13/08/12	35.12	1.11
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16/10/12	35.28	0.95
21/11/12	34.55	1.68

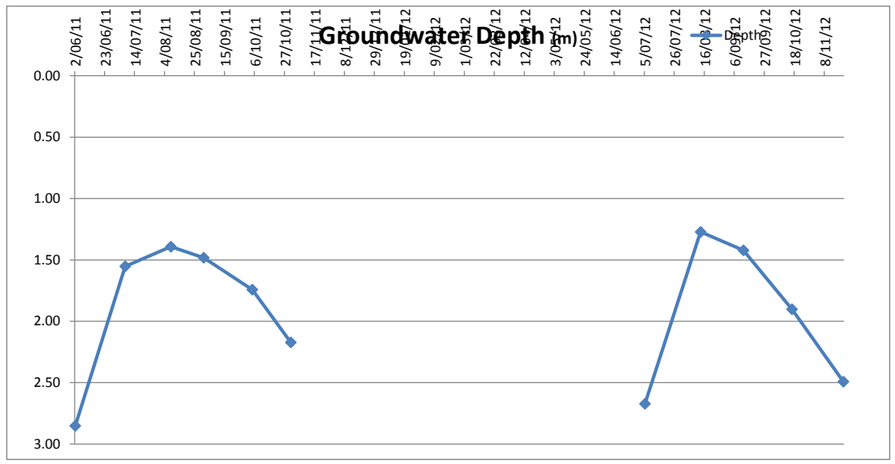




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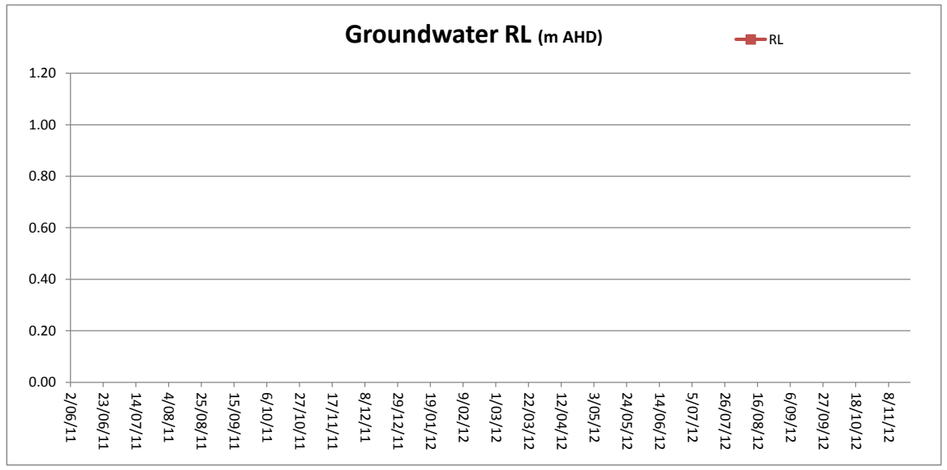
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7/07/11	33.64	1.55
8/08/11	33.80	1.39
31/08/11	33.71	1.48
4/10/11	33.45	1.74
31/10/11	33.02	2.17
15/02/12		
15/05/12		
5/07/12	32.52	2.67
13/08/12	33.92	1.27
12/09/12	33.77	1.42
16/10/12	33.29	1.90
21/11/12	32.70	2.49

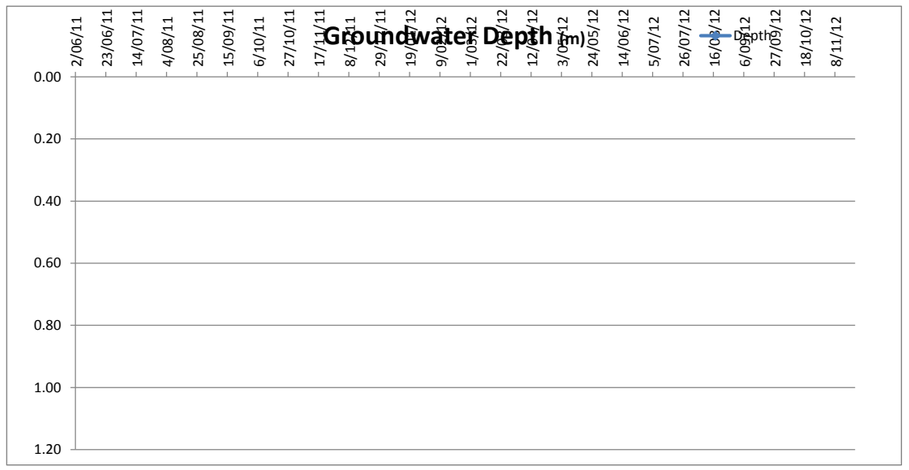




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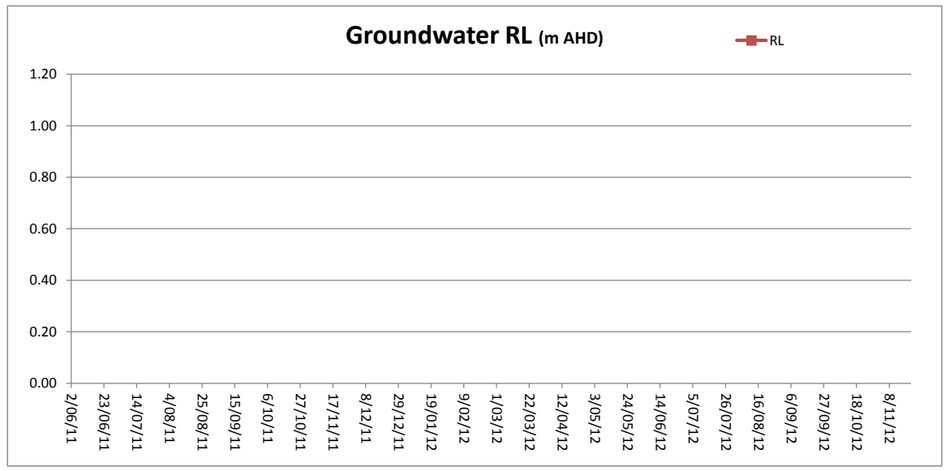
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7/07/11		
8/08/11		
31/08/11		
4/10/11		
31/10/11		
15/02/12		
15/05/12		
5/07/12		
13/08/12		
12/09/12		
16/10/12		
21/11/12		

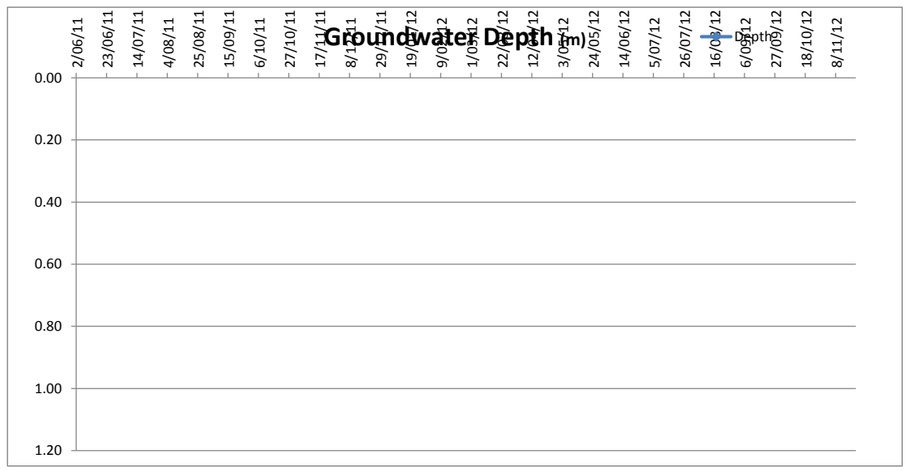




Graph of Monitoring Bore Number **4**

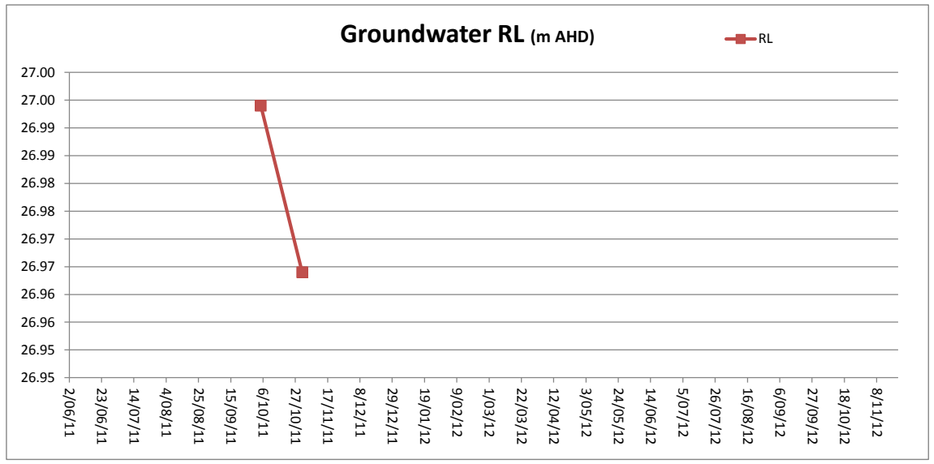
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2/06/11		
7/07/11		
8/08/11		
31/08/11		
4/10/11		
31/10/11		
15/02/12		
15/05/12		
5/07/12		
13/08/12		
12/09/12		
16/10/12		
21/11/12		

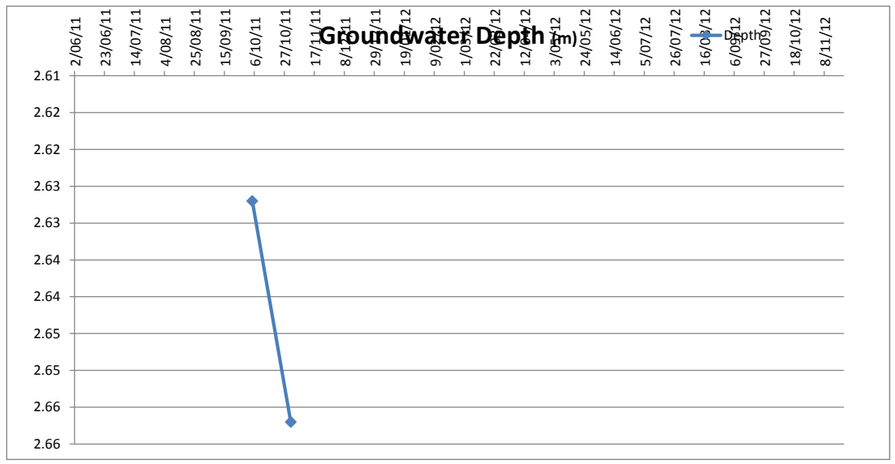




Graph of Monitoring Bore Number **5**

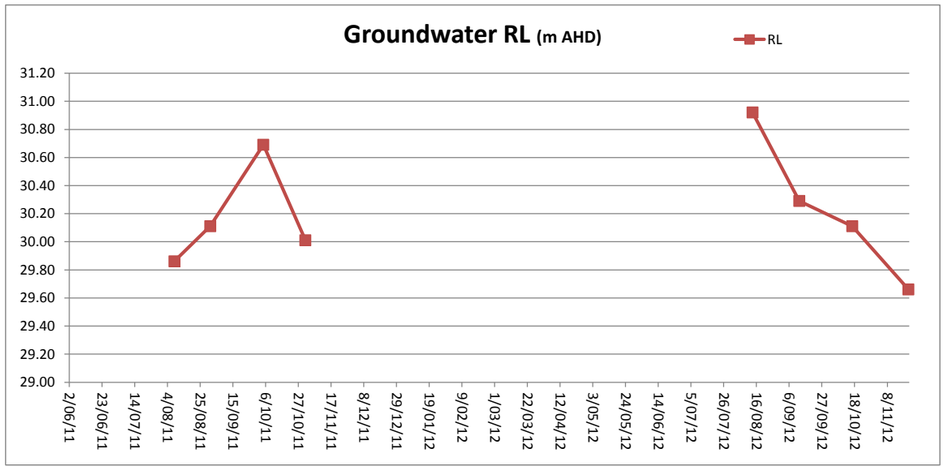
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7/07/11		
8/08/11		
31/08/11		
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31/10/11	26.96	2.66
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13/08/12		
12/09/12		
16/10/12		
21/11/12		

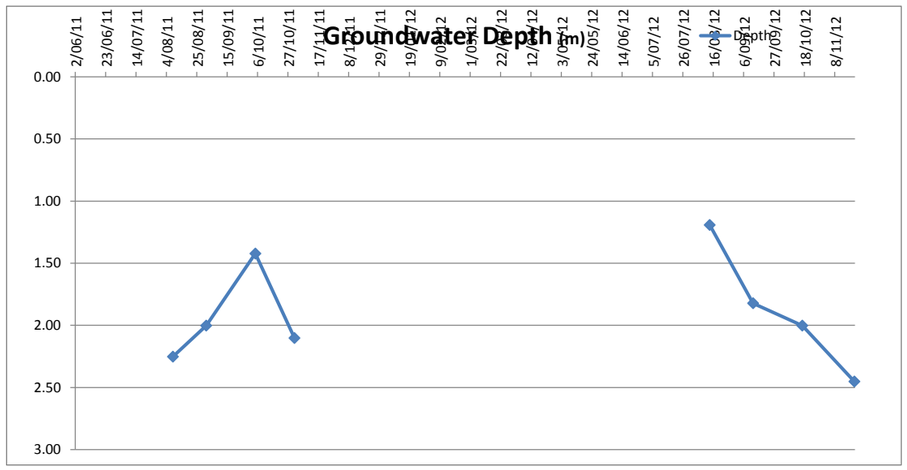




Graph of Monitoring Bore Number 6

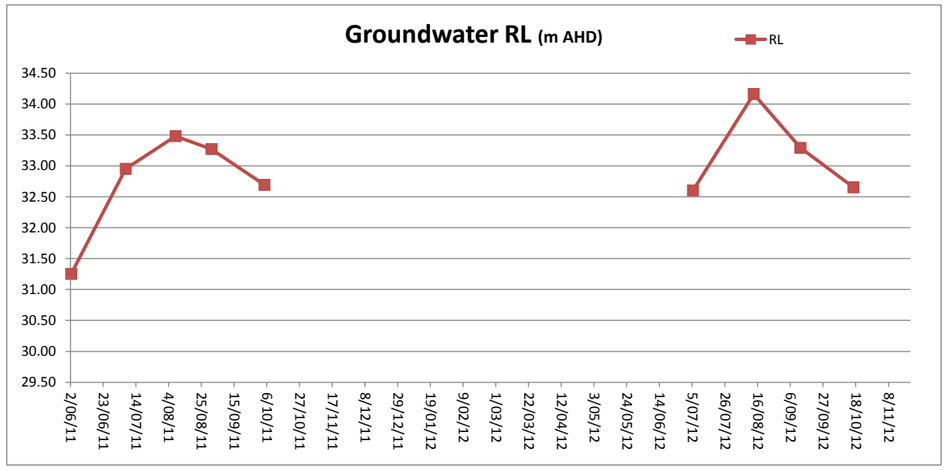
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7/07/11		
8/08/11	29.86	2.25
31/08/11	30.11	2.00
4/10/11	30.69	1.42
31/10/11	30.01	2.10
15/02/12		
15/05/12		
5/07/12		
13/08/12	30.92	1.19
12/09/12	30.29	1.82
16/10/12	30.11	2.00
21/11/12	29.66	2.45

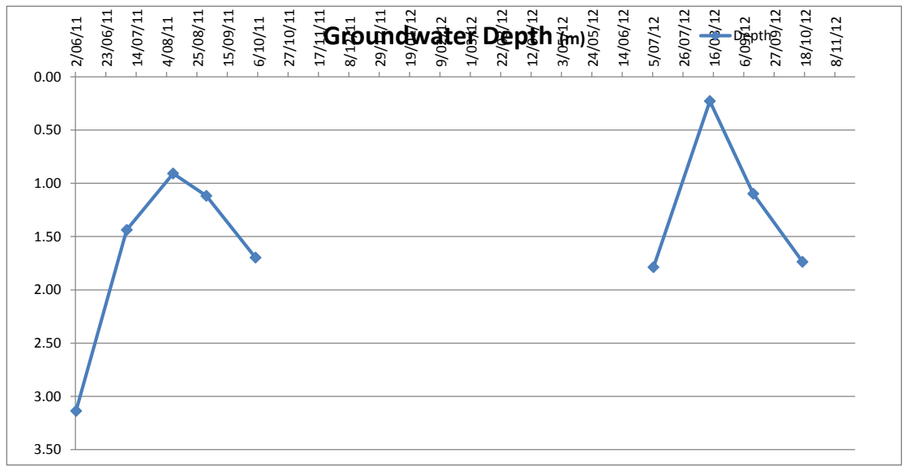




Graph of Monitoring Bore Number **7**

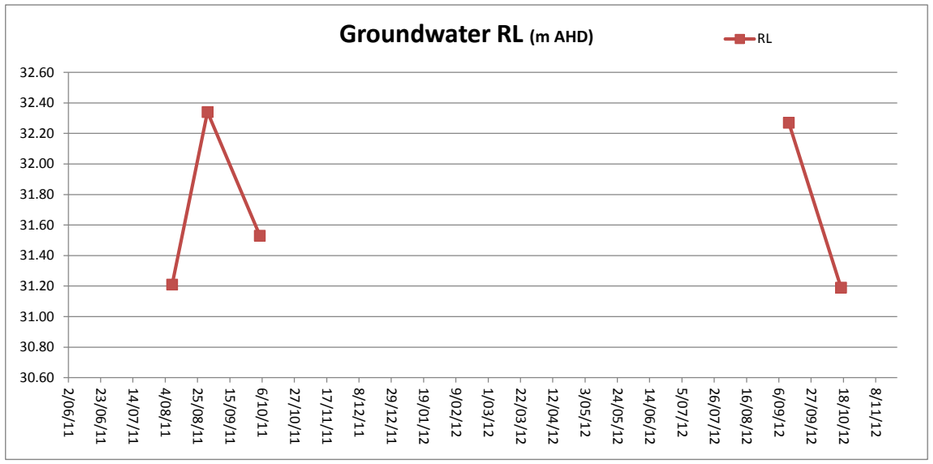
Date	Groundwater RL (m AHD)	Actual Depth to Groundwater (m)
2/06/11	31.25	3.14
7/07/11	32.95	1.44
8/08/11	33.48	0.91
31/08/11	33.27	1.12
4/10/11	32.69	1.70
31/10/11		
15/02/12		
15/05/12		
5/07/12	32.60	1.79
13/08/12	34.16	0.23
12/09/12	33.29	1.10
16/10/12	32.65	1.74
21/11/12		

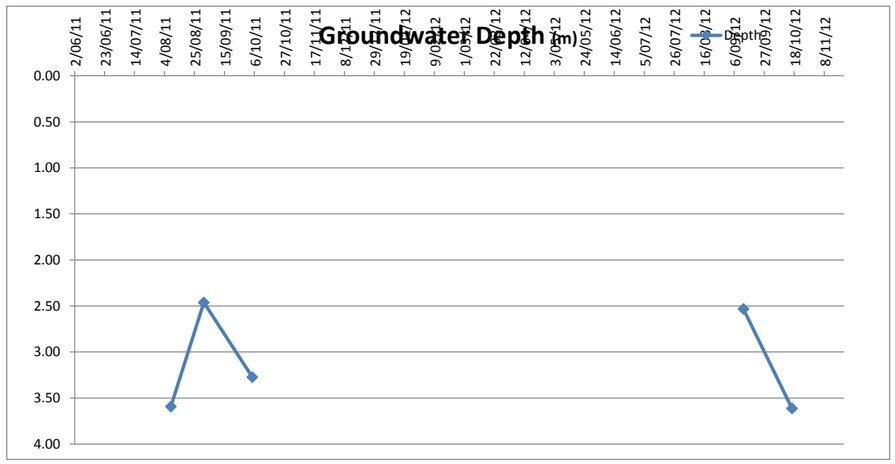




Graph of Monitoring Bore Number **8**

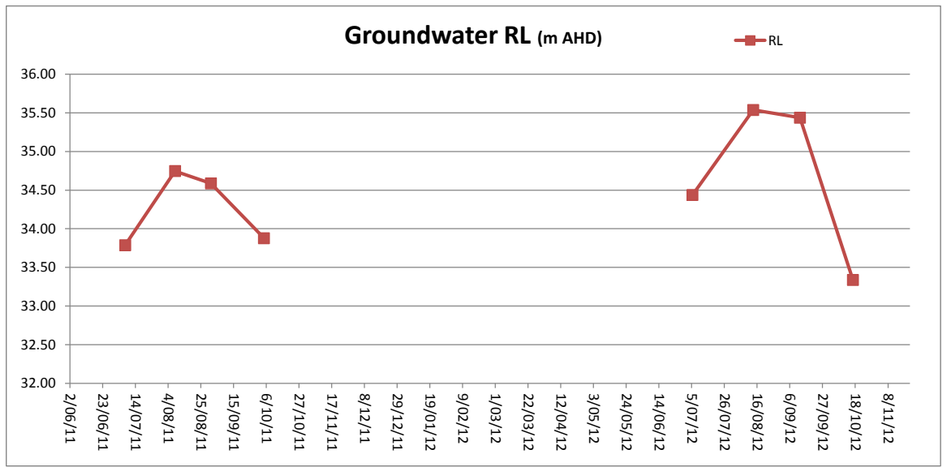
Date	Groundwater RL (m AHD)	Actual Depth to Groundwater (m)
2/06/11		
7/07/11		
8/08/11	31.21	3.59
31/08/11	32.34	2.46
4/10/11	31.53	3.27
31/10/11		
15/02/12		
15/05/12		
5/07/12		
13/08/12		
12/09/12	32.27	2.53
16/10/12	31.19	3.61
21/11/12		

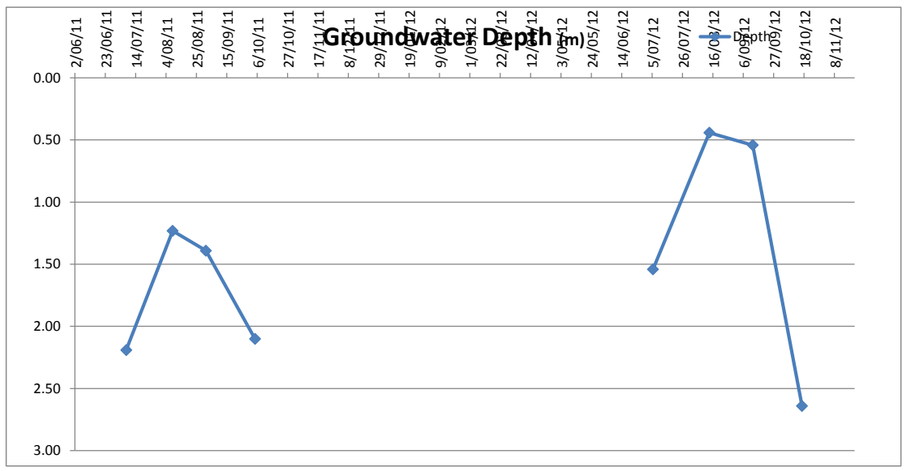


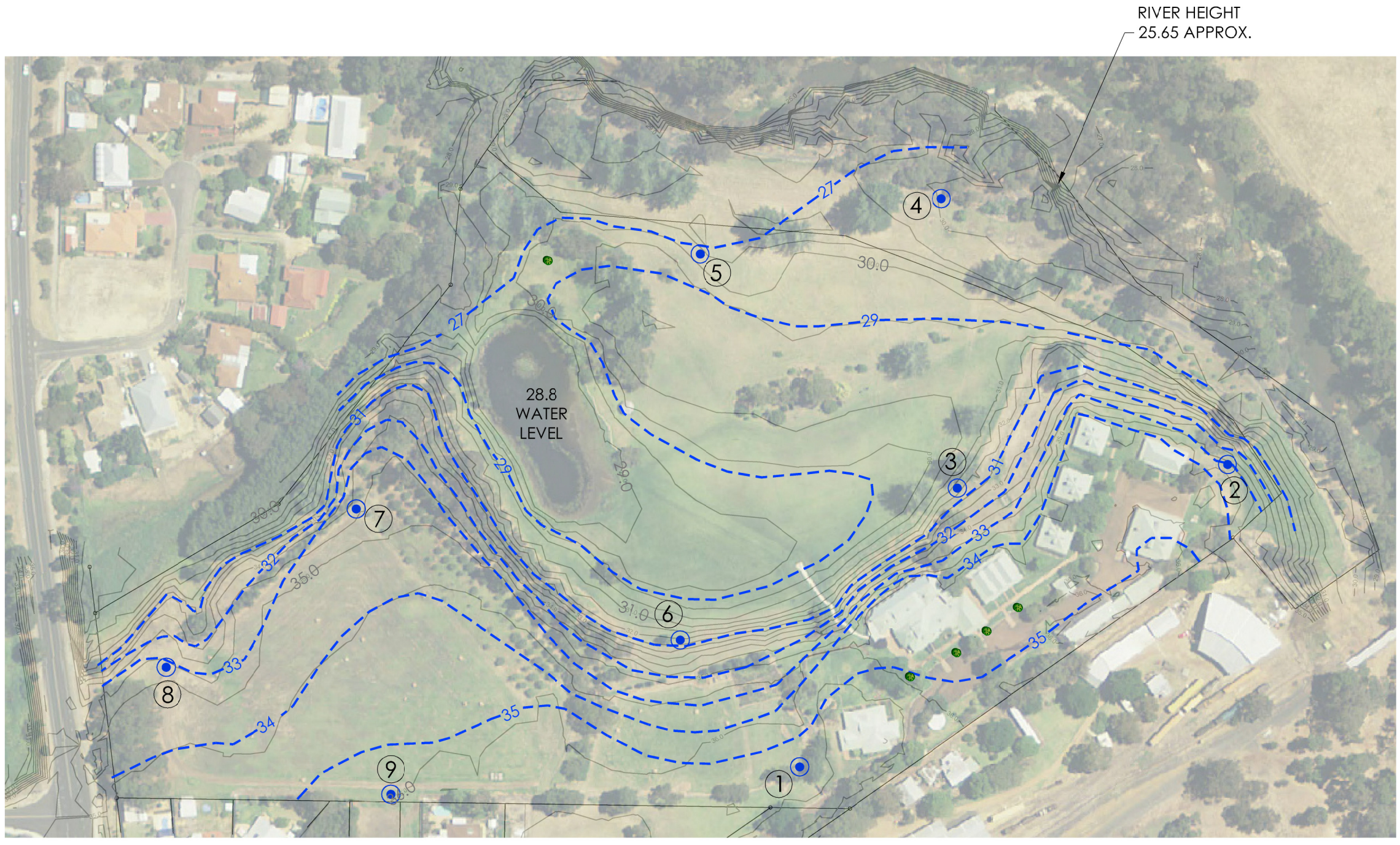


Graph of Monitoring Bore Number **9**

Date	Groundwater RL (m AHD)	Actual Depth to Groundwater (m)
2/06/11		
7/07/11	33.79	2.19
8/08/11	34.75	1.23
31/08/11	34.59	1.39
4/10/11	33.88	2.10
31/10/11		
15/02/12		
15/05/12		
5/07/12	34.44	1.54
13/08/12	35.54	0.44
12/09/12	35.44	0.54
16/10/12	33.34	2.64
21/11/12		







LEGEND

APPROXIMATE, RECORDED MAXIMUM GROUNDWATER WATER LEVEL

EXISTING SURFACE CONTOUR

N

mpm
development consultants
Telephone: (08)97 214777
Email: reception@mpmdc.com.au

Project: MEADOWBROOKE
Title: INTERPOLATED MAXIMUM GROUNDWATER LEVEL
Plan: 14041 14
Do Not Scale

ATTACHMENT E
PREDEVELOPMENT ENVIRONMENTAL PLAN

mpm development consultants

LEGEND

STORMWATER CATCHMENT

0.68 PREDEVELOPMENT FLOW (L/s)

A PREDEVELOPMENT CATCHMENT



N

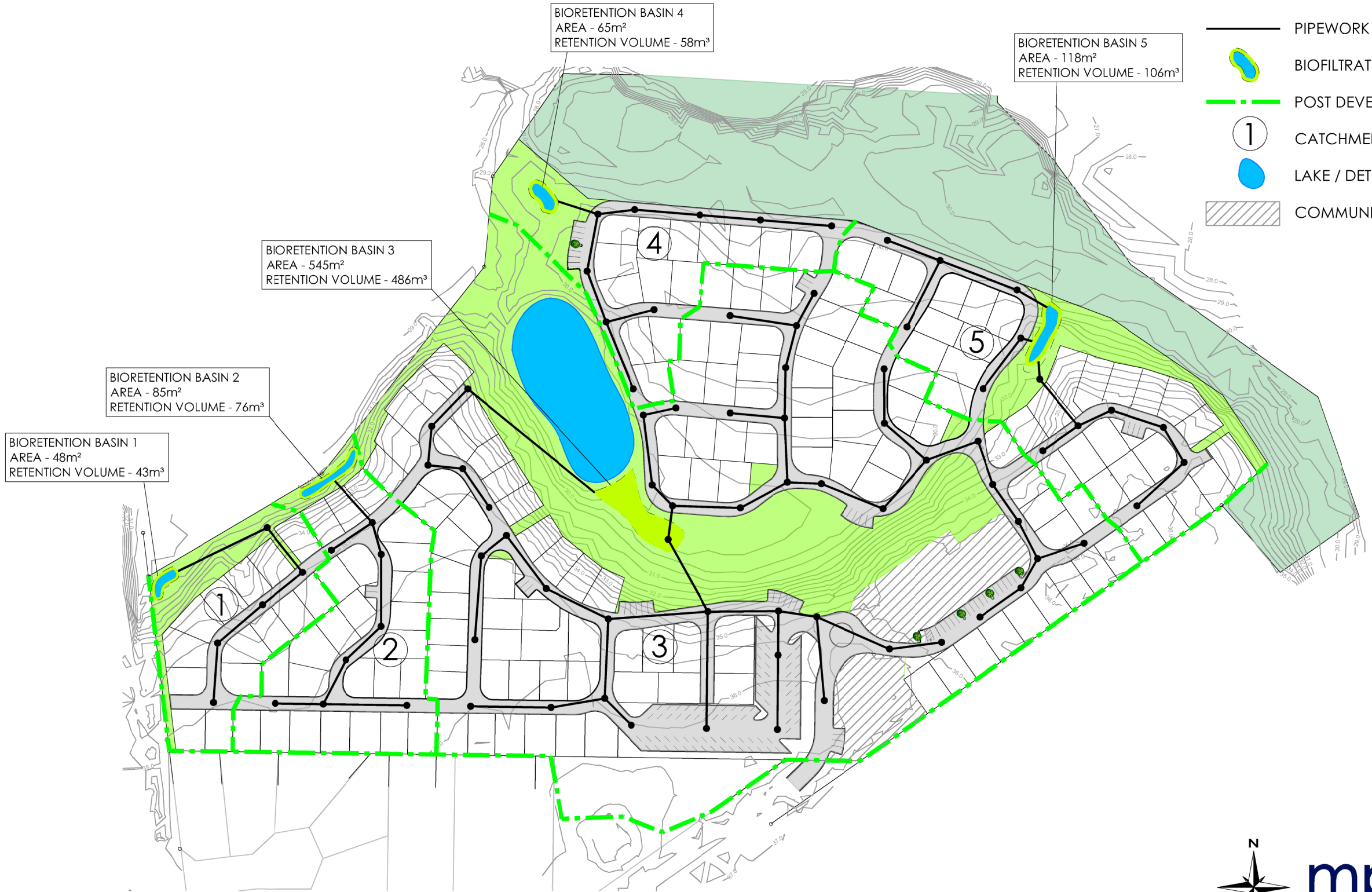
mpm
development consultants

Telephone: (08)97 214777
Email: reception@mpmdc.com.au

Project: MEADOWBROOKE LIFESTYLE ESTATE
Title: PREDEVELOPMENT ENVIRONMENT PLAN
Plan: 14041 10
Do Not Scale

ATTACHMENT F
1 IN 1 YEAR ENVIRONMENTAL FLOW STRATEGY

mpm development consultants



LEGEND

- GRATED INLET PIT
- PIPEWORK
- BIOFILTRATION BASIN
- POST DEVELOPMENT CATCHMENT
- 1 CATCHMENT No.
- LAKE / DETENTION
- COMMUNITY INFRASTRUCTURE AREA

N

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development consultants
Telephone: (08)97 214777
Email: reception@mpmdc.com.au

Project: MEADOWBROOKE LIFESTYLE ESTATE
Title: STORMWATER MANAGEMENT STRATEGY 1 IN 1
Plan: 14041 11
Do Not Scale

ATTACHMENT G
1 IN 5 YEAR MAJOR STORM EVENT STRATEGY

mpm development consultants

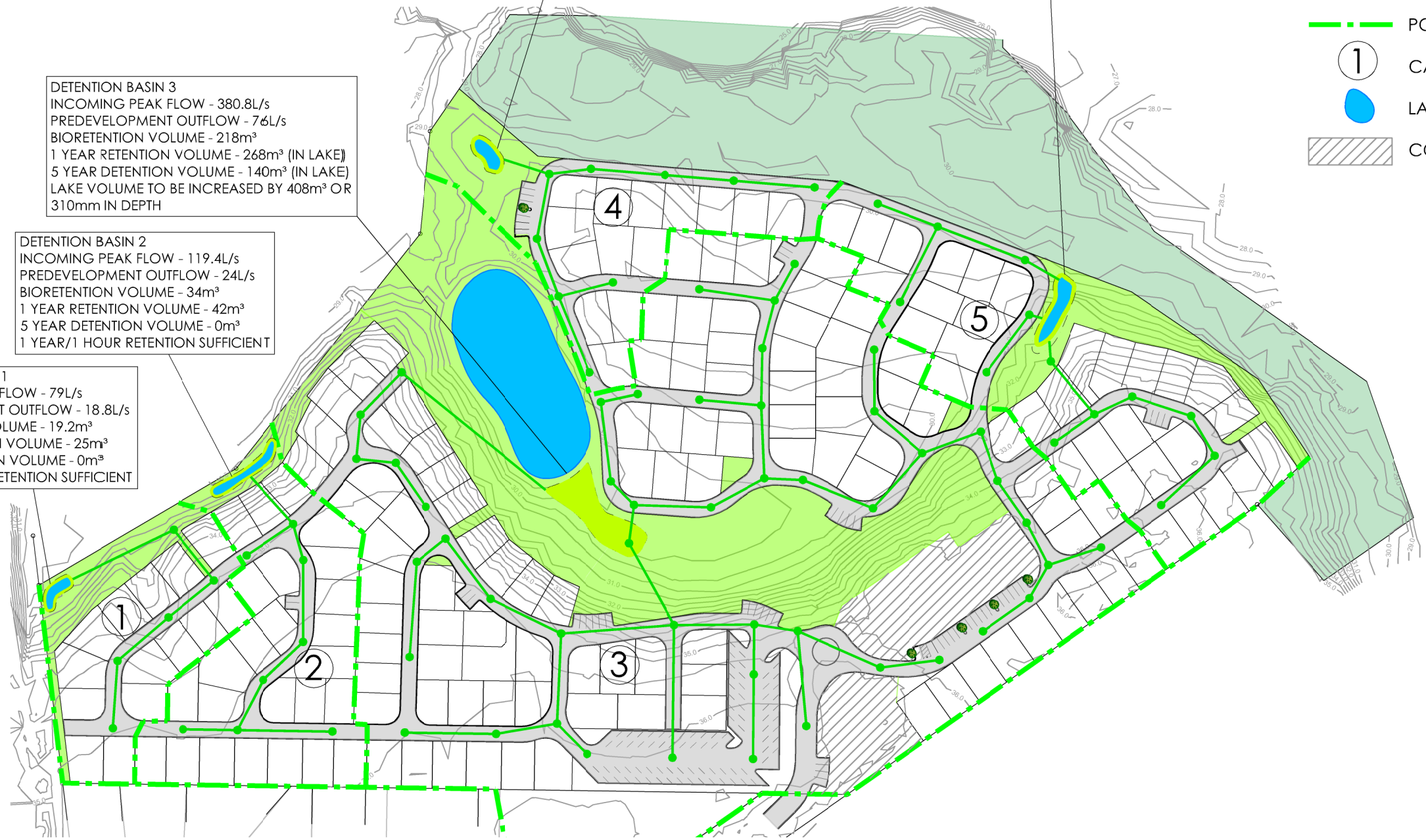
DETENTION BASIN 4
INCOMING PEAK FLOW - 108.1L/s
PREDEVELOPMENT OUTFLOW - 44.8L/s
BIORETENTION VOLUME - 26m³
1 YEAR RETENTION VOLUME - 32m³
5 YEAR DETENTION VOLUME - 0m³
1 YEAR/1 HOUR RETENTION SUFFICIENT

DETENTION BASIN 5
INCOMING PEAK FLOW - 159.2L/s
PREDEVELOPMENT OUTFLOW - 19.6L/s
BIORETENTION VOLUME - 47.2m³
1 YEAR RETENTION VOLUME - 58m³
5 YEAR DETENTION VOLUME - 20m³
ADDITIONAAL 20m³ OF DETENTION TO BE ADDED FOR 5 YEAR EVENT

DETENTION BASIN 3
INCOMING PEAK FLOW - 380.8L/s
PREDEVELOPMENT OUTFLOW - 76L/s
BIORETENTION VOLUME - 218m³
1 YEAR RETENTION VOLUME - 268m³ (IN LAKE)
5 YEAR DETENTION VOLUME - 140m³ (IN LAKE)
LAKE VOLUME TO BE INCREASED BY 408m³ OR 310mm IN DEPTH

DETENTION BASIN 2
INCOMING PEAK FLOW - 119.4L/s
PREDEVELOPMENT OUTFLOW - 24L/s
BIORETENTION VOLUME - 34m³
1 YEAR RETENTION VOLUME - 42m³
5 YEAR DETENTION VOLUME - 0m³
1 YEAR/1 HOUR RETENTION SUFFICIENT

DETENTION BASIN 1
INCOMING PEAK FLOW - 79L/s
PREDEVELOPMENT OUTFLOW - 18.8L/s
BIORETENTION VOLUME - 19.2m³
1 YEAR RETENTION VOLUME - 25m³
5 YEAR DETENTION VOLUME - 0m³
1 YEAR/1 HOUR RETENTION SUFFICIENT



LEGEND

- GRATED INLET PIT
- PIPEWORK
- BIOFILTRATION BASIN
- POST DEVELOPMENT CATCHMENT
- 1 CATCHMENT No.
- LAKE / DETENTION
- COMMUNITY INFRASTRUCTURE AREA

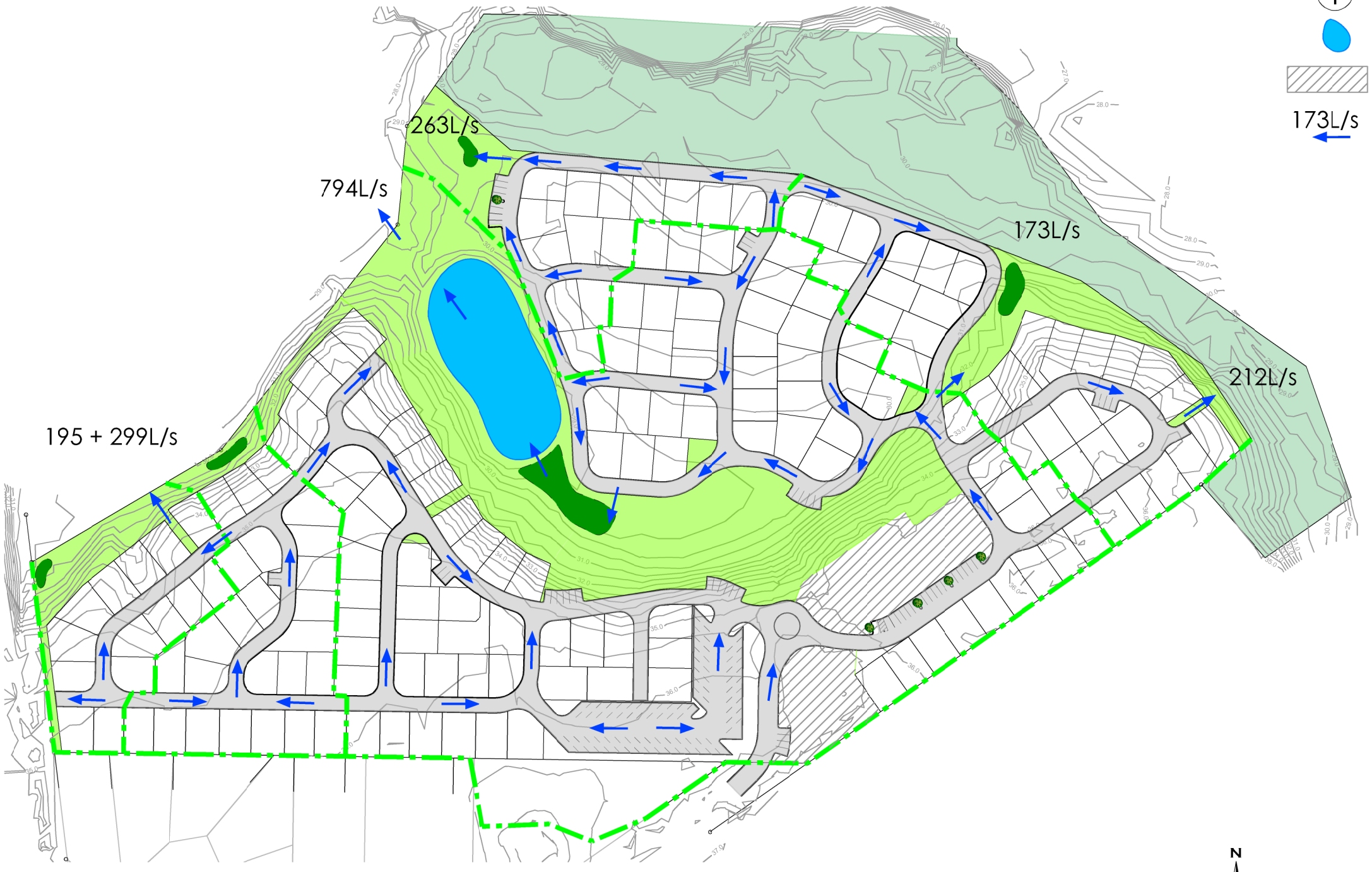
N

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development consultants
Telephone: (08)97 214777
Email: reception@mpmdc.com.au

Project: MEADOWBROOKE LIFESTYLE ESTATE
Title: STORMWATER MANAGEMENT STRATEGY 1 IN 5
Plan: 14041 12
Do Not Scale

ATTACHMENT H
1 IN 100 YEAR EXTREME EVENT STRATEGY

mpm development consultants



LEGEND

- BIOFILTRATION BASIN
- POST DEVELOPMENT CATCHMENT
- 1 — CATCHMENT No.
- LAKE / DETENTION
- COMMUNITY INFRASTRUCTURE AREA
- 173L/s — 100 YEAR FLOW PATH AND PEAK FLOW (L/s)

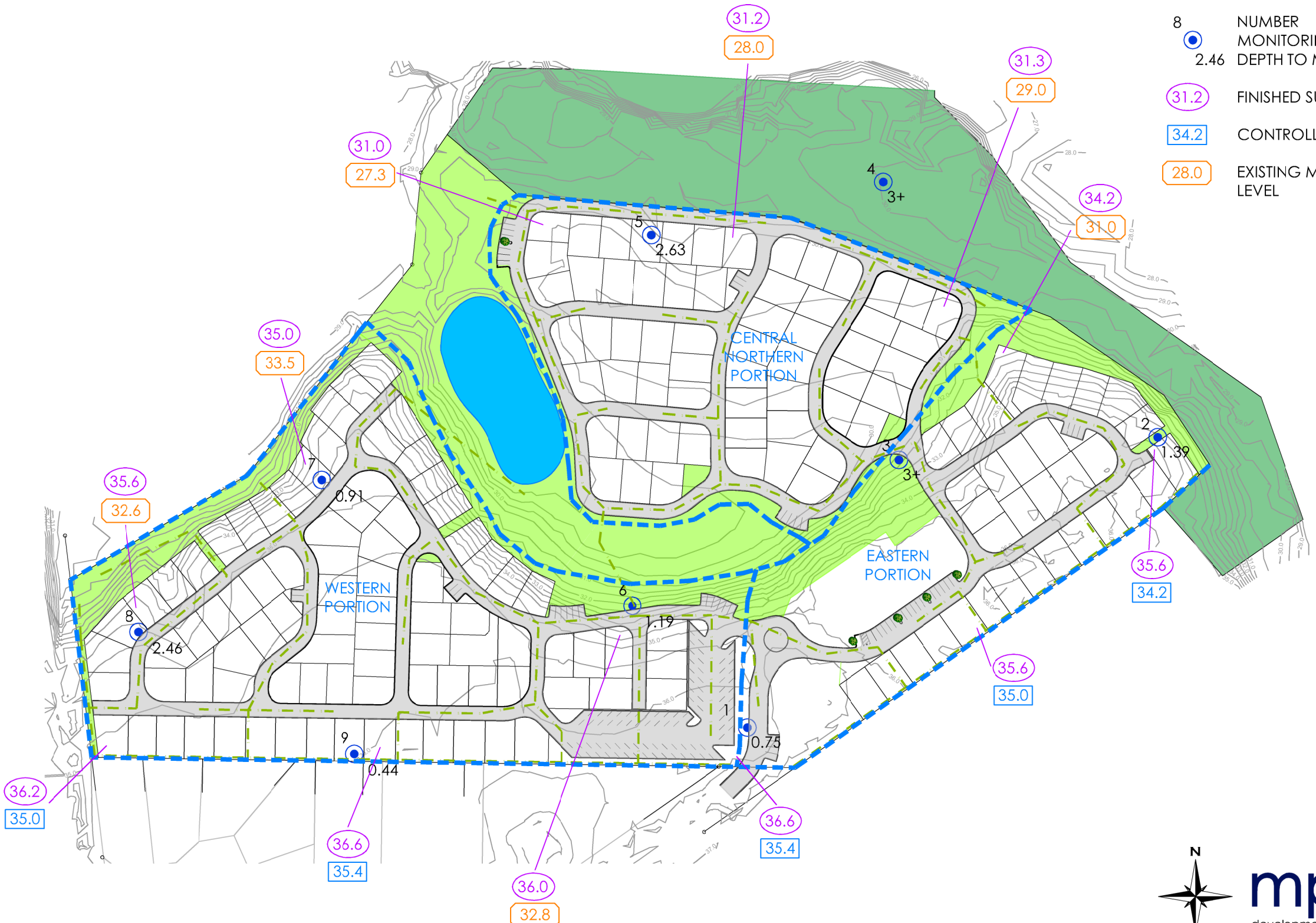
N

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development consultants
Telephone: (08)97 214777
Email: reception@mpmdc.com.au

Project: MEADOWBROOKE LIFESTYLE ESTATE
Title: STORMWATER MANAGEMENT STRATEGY 1 IN 100
Plan: 14041 15
Do Not Scale

ATTACHMENT I
GROUNDWATER STRATEGY

development consultants



N

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development consultants

Telephone: (08)97 214777
Email: reception@mpmdc.com.au

Project: MEADOWBROOKE LIFESTYLE ESTATE
Title: GROUNDWATER MANAGEMENT STRATEGY
Plan: 14041 13
Do Not Scale

ATTACHMENT J
PRESTON RIVER

mpm development consultants

hyd2o
HYDROLOGY

5 August 2011

Your Ref:
Our Ref: H11021Av1

MPM Development Consultants
Unit 1/33 Constitution Street
PO Box 2035
BUNBURY WA 6231

ATTENTION : Craig Pippin

Dear Craig,

RE: PRESTON RIVER FLOOD STUDY, MEADOWBROOKE ESTATE, BOYANUP

Please find below Hyd2o's report detailing the results of our field investigation and analysis to determine the 1 in 100 year average recurrence interval (ARI) flood levels for the Preston River adjacent to Meadowbrooke Estate at Boyanup.

1. BACKGROUND

Meadowbrooke Estate is located in Boyanup, approximately 20 km south east of Bunbury (Figure 1). The site is bounded by South Western Highway to the west, Turner St to the south and the Preston River to the north and east.

The site currently contains two function centres and a range of short stay accommodation options including self contained cottages and villas (Figure 2).

Further development of the site is proposed (Figure 2), which will include an upgrading of the existing facility and conversion into a Lifestyle Village style development.

This report provides estimates of 100 year ARI flood levels and floodplain mapping for the Preston River adjacent to Meadowbrooke Estate to assist the planning process for this development. The report also considers the impact on flood levels of the flow from the local catchment and tributary near the north western boundary of the site which flows to the Preston River.

No previous Department of Water (DoW) estimates of 100 year peak flows or flood levels exist for Boyanup.

2. FIELD INVESTIGATION

A field investigation of the site was conducted by Hyd2o on 13 May, 2011. During this visit, Hyd2o gained familiarity with the site, reviewed the local topography, assessed likely bankfull conditions for the river, and determined the local characteristics of the Preston River channel to enable assessment of Manning's n roughness coefficient for modelling purposes. Structures which were considered likely to affect flood levels were also identified and recorded.

Figure 3 provides a summary of the key hydrologic features and photo's showing typical river cross sections and vegetation both within the main channel and on the river floodplain. With the exception of grassed pasture areas, the river floodplain was observed to more densely vegetated than the main river channel.

Anecdotal information was also collected from employees at Meadowbrooke Estate regarding flood levels within the river to assist in model calibration. This information is also shown on Figure 3.

No significant debris outside of the main river channel was observed during the field investigation indicating recent flooding of the river outside of the main channel had not occurred. This was consistent with anecdotal evidence, which indicated the footpath/walk trail which runs adjacent to the river had not been inundated within the last 5 years.

3. SURFACE HYDROLOGY

As previously discussed the site has two watercourses which are considered in this analysis, the Preston River which runs along the north and eastern boundaries of the site and a smaller tributary which drains a local catchment and runs along the western boundary into the Preston River.

The locality of these watercourses and their catchments are shown in Figure 4.

A summary of the key catchment characteristics are shown in Table 1. These characteristics are used in Section 4 to estimate design flows.

The Department of Water Preston River Boyanup Bridge gauging station (611 004) is located immediately upstream of the site. This site has been operational since 1980.

Table 1: Catchment Characteristics

Catchment	Catchment Area (km²)	Cleared (%)	Equal Area Stream Slope (m/m)
Preston River	808	37	2
Local Tributary	0.76	80	

4. ESTIMATION OF DESIGN FLOWS

Design flow estimates for the Preston River were determined based on comparing outcomes from the application of a range of different hydrological techniques including:

- Rational and Index Flood methods via Australia Rainfall and Runoff (Engineers Australia, 2003). Note, that these methods cannot be directly applied to the catchment as it contains both loamy and lateritic soil types which are only calculated separately using these methods. These methods do however provide a range of values from which the results from other techniques can be validated and assessed against.
- Previously published Preston River estimates from the Water Authority's Preston River Flood Study Hydrology (1989) at Boyanup based on RORB runoff routing modelling and flood frequency techniques.
- Calculating a pro-rata Preston River flow at Boyanup based on Sinclair Knight Merz (2004) flow estimate for Picton Bridge near Bunbury (100 year estimate : 360 m^3/s).
- Using flood frequency analysis of the Boyanup Bridge (611 004) gauging station with data patched to include earlier large floods to 1955 using the Beelerup gauging station (611 049) located on the Preston river upstream of Donnybrook.

For the local watercourse, both XP–Storm modelling and the Rational and Flood Index methods were used to estimate design flows.

A summary of the adopted methods and the respective peak flow estimates for various average recurrence intervals (ARI's) are shown in Table 2, with the flood frequency analysis at Boyanup Bridge included as Figure 5.

For the Preston River at Boyanup, the flood frequency analysis is considered to provide the best estimate for use in design as it is based on gauged local data. This provides a 100 year ARI peak flow estimate of 241 m^3/s, which is very similar to the previous Water Authority (1989) estimate of 233 m^3/s. The pro-rata Preston River estimate based on Sinclair Knight Merz (2004) from Picton Bridge to Boyanup is considered likely to overestimate flow on the basis of the differences in catchment conditions and runoff characteristics on the cleared and partially urban coastal plain compared to runoff from upstream Darling Scarp areas.

For the local watercourse catchment, the XP-Storm model provided the largest flow estimate and this has conservatively been adopted for analysis purposes. A 100 year peak flow of 0.64 m^3/s was adopted for design purposes. Note that this flow estimate is of similar magnitude to the modelled capacity of the existing 375 mm diameter culvert on this watercourse under South Western Highway (Figure 3).

Table 2: Design Flow Estimates

Flow Estimation Method	Design Flow Estimate (m^3/s)				
	2	5	10	50	100
Preston River					
Rational Method (Lateritic Soils)	32	44	55	91	110 [1]
Index Flood Method (Lateritic Soils)	33	50	65	111	130 [1]
Rational Method (Loamy Soils)	69	112	153	281	340 [1]
Index Flood Method (Loamy Soils)	52	90	132	263	300 [1]
via Water Authority (1989)	-	-	123	-	233
via Sinclair Knight Merz (2004) [2]	-	-	140	190	290
Flood Frequency : DoW Station (611004)	53	91	120	201	241
Adopted for Design					241
Local Tributary					
Rational Method	0.11	0.16	0.19	0.35	0.40
Index Flood Method	0.15	0.20	0.24	0.36	0.40
XP-Storm	-	0.36	-	-	0.64
Adopted For Design					0.64

1. Graphically extrapolated based on 2 to 50 year ARI estimates via these methods
2. Pro rata based on catchment area ratio to the power of 0.7.

5. ESTIMATION OF 100 YEAR FLOOD LEVELS

A HECRAS model of the Preston River and tributary were developed based on LiDAR data obtained from the Department of Water (DoW) and peak flow estimates detailed in Section 4.

Figure 6 shows the extent of the modelling performed and the location of cross sections used. Modelled cross sections are shown in Appendix 1. The model was extended approximately 6 km downstream of the site to ensure the starting backwater of the model did not affect estimated flood levels at the site.

Manning roughness coefficients were estimated based on field observations and correlated to Chow (1959). A value of 0.08 was used to represent overbank flow and 0.06 was used for the main river channel for the Preston River. For the local tributary the Manning n varied considerably from 0.03 near South Western Highway where the form of the watercourse was a grass constructed drain, to 0.08 near the confluence of the Preston River where the watercourse had a more natural form.

Use of these Mannings values with flow estimates via Section 4, provided modelling outcomes for 2 and 5 year ARI events showing good general agreement to bankfull field observations and anecdotal evidence.

Estimated 100 year flood levels are shown in Figure 7 and Appendix 1 for each modelled cross section and summarised for several key locations in Table 3.

Adjacent to the site, the 100 year flood level of the Preston River was found to range from 29.72 mAHD at the downstream boundary to 30.24 mAHD at the upstream boundary.

Floodplain mapping is shown in Figure 7 in relation to existing natural surface levels based on LiDAR data and the proposed development area.

The results show the proposed development to be located outside the 100 year floodplain of the Preston River and existing natural surface levels to have a clearance of approximately 5 m – 6 m above the adjacent 100 year flood level.

A sensitivity analysis of the design flow rate indicated that a flow rate increase of 20% above that adopted for design in this study would only increase the 100 year flood level by approximately 0.3 m – 0.4 m adjacent to the site, and would therefore not impact on the extent of the proposed development area.

It should also be noted that the area within the site (outside of the main Preston River channel) which floods to 29.74 mAHD shown in Figure 7 occurs due to backflow from the flood level in the Preston River and not due to flow within the local watercourse. Filling of this area would prevent this from occurring without affecting the 100 year flood level of the Preston River.

The results indicate that there is additional land within the site located outside of the Preston River floodplain which may also be considered for development. With respect to the required development levels of this area, Hyd2o are aware that at Donnybrook DoW have adopted a 1.5m clearance requirement above the 100 year flood level of the Preston River based on observed flood levels in the 1964 event being greater than the estimated 100 year flood levels at this location (Simon Rodgers, DoW pers comm).

DoW typically require development levels to be 0.5m above the 100 year level, and no anecdotal evidence is known to exist for the site to indicate a higher clearance requirement is required. It is however recommended that advice on a suitable clearance above the 100 year flood levels be requested from DoW in review of this report to inform the potential development opportunity of the additional area identified in this document.

Table 3: 100 Year Flood Level Estimates at Key Locations

Location	100 Year Flood Level Estimate (m AHD)
Preston River Downstream Property Boundary	29.72
Preston River Upstream Property Boundary	30.24
Tributary Watercourse at South Western Highway	30.33

6. CONCLUSIONS/RECOMMENDATIONS

- The site has two watercourses requiring consideration in terms of flood management, the Preston River which runs along the north and eastern boundaries of the site and a smaller tributary which drains a local catchment running along its western boundary. The catchment areas of these watercourses are 808 km^2 and 0.76 km^2 respectively.
- Design flow estimates for the Preston River were calculated based on a range of different hydrological techniques. Flood frequency analysis based on gauged local data is considered to provide the best estimate for use in design. This provides a 100 year ARI peak flow estimate of 241 m^3/s at the site, which is similar to the Water Authority (1989) estimate.
- For the small tributary, a 100 year peak flow of 0.64 m^3/s is estimated based on XP-Storm modelling.
- A HECRAS model of the Preston River and small tributary was developed based on DoW LiDAR data and successfully calibrated using field observations and anecdotal information.
- Based on this model, the 100 year flood level of the Preston River is estimated to range from 29.74 mAHD at the downstream boundary of the site to 30.24 mAHD at the upstream boundary.
- Floodplain mapping indicates the proposed development is located outside the 100 year floodplain of the Preston River and small tributary, with existing natural surface levels having a clearance of approximately 5 m – 6 m above the adjacent 100 year flood level.
- The area within the site (outside of the main Preston River channel) which floods to 29.74 mAHD occurs due to backflow from the flood level in the Preston River, and filling this area would prevent this from occurring without affecting the 100 year flood level of the Preston River.
- The results indicate that there is additional land within the site located outside of the Preston River floodplain which may be also considered for development. It is recommended that advice on a suitable clearance above the 100 year flood level be requested from DoW in review of this report to inform the potential development opportunity of this land.

7. REFERENCES

Chow, V.T. (1959) Open Channel Hydraulics

Department of Water (2009), Water Balance Modelling of the Leschenault Catchment, Water Science Technical Series, Report No WST 10, August 2009

Engineers Australia (2003) Australian Rainfall and Runoff – A Guide to Flood Estimation Volumes 1&2

Sinclair Knight Merz (2004), Bunbury Flood Management Strategy, Appendix A Flood Modelling Report, September 2004

Water Authority of WA (1989) Preston River Flood Study Hydrology

Should you have any queries regarding this report, please do not hesitate to contact Sasha Martens or Suzanne Smart of this office.

Yours sincerely,

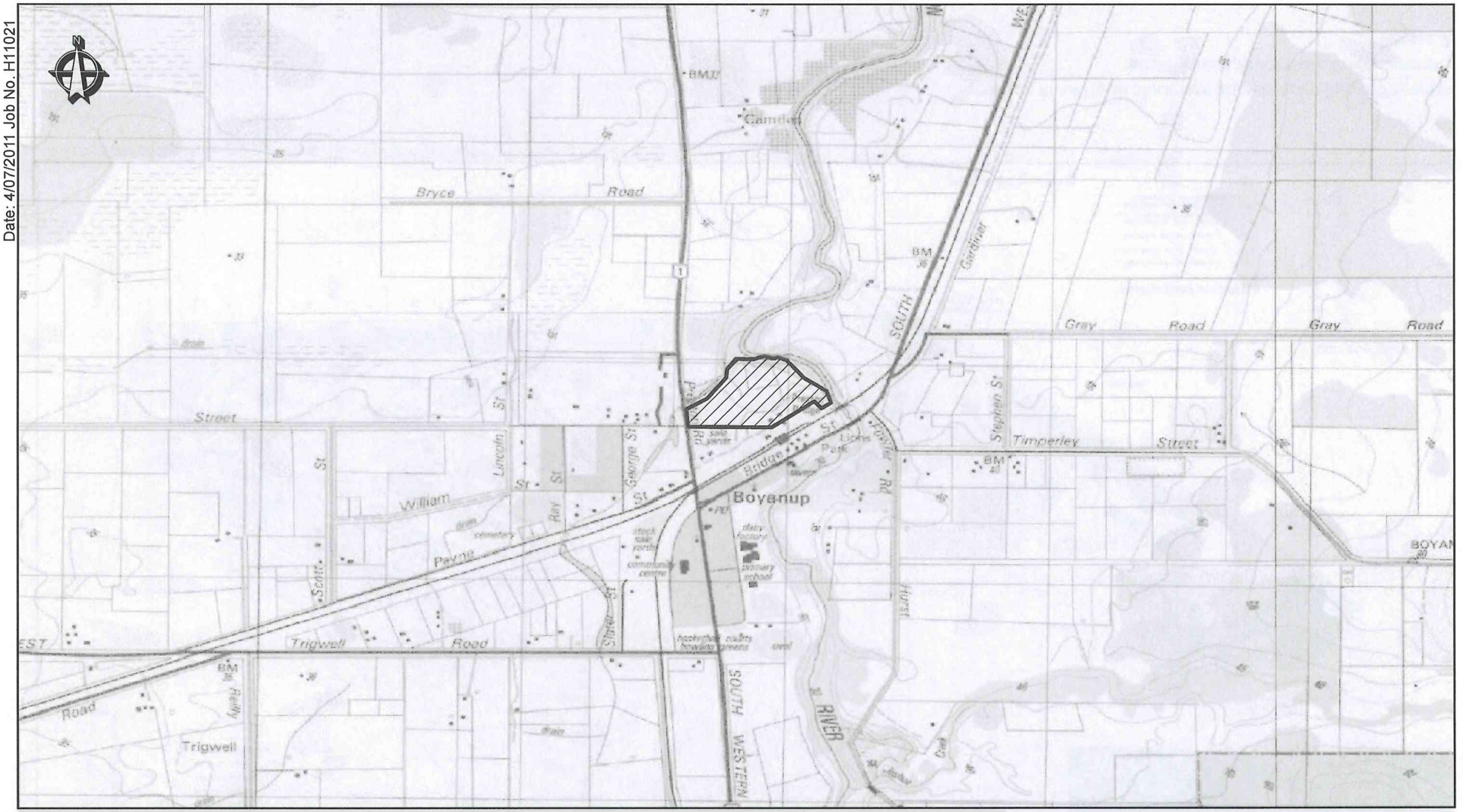


Sasha Martens

Managing Director, Hyd2o

FIGURES

Date: 4/07/2011 Job No. H11021



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0 200 400 600 800 Metres

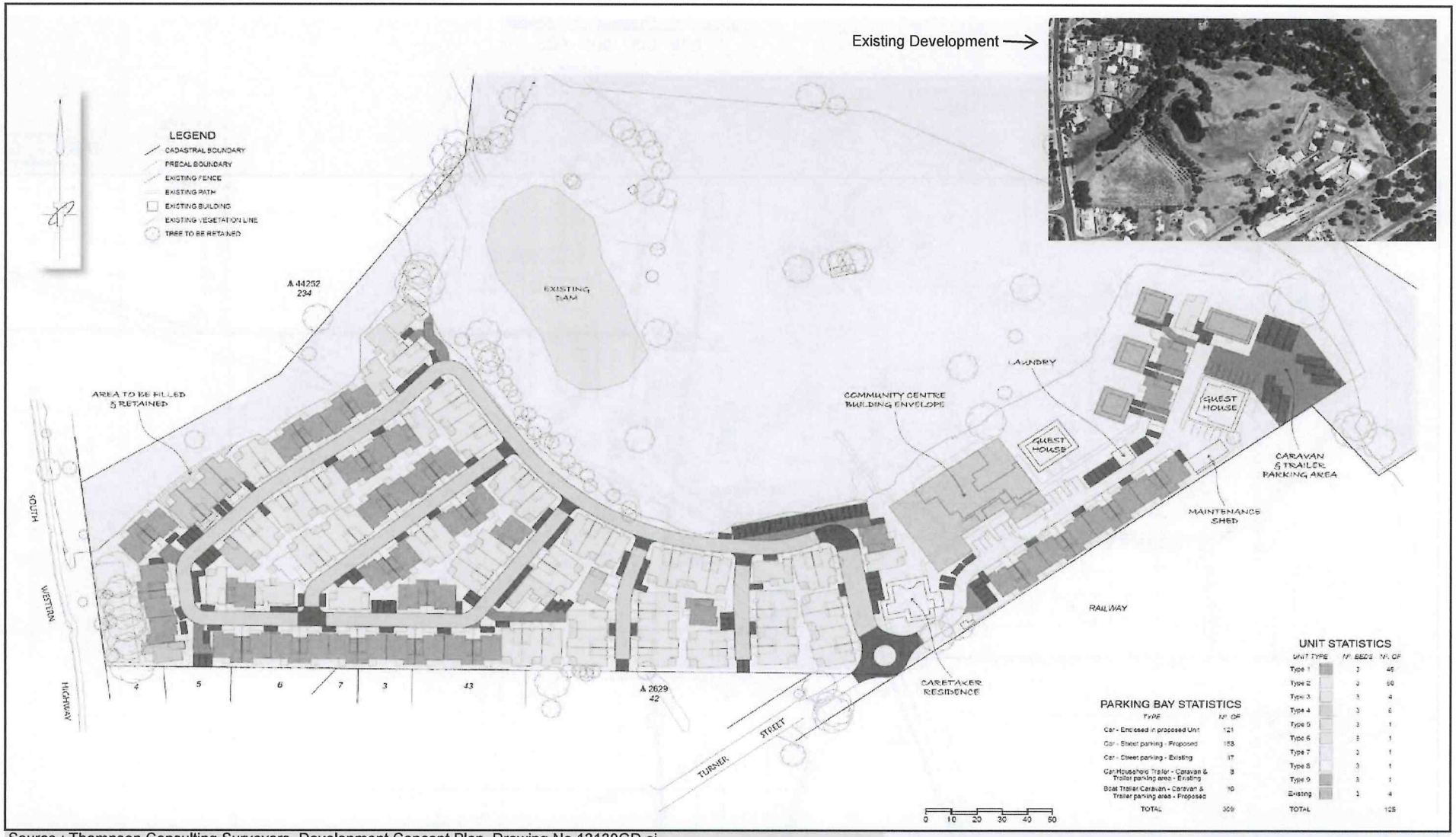
hyd2o

Preston River Flood Study Meadowbrooke Estate Boyanup

Location Plan

Figure 1

Date : 4/7/2011 Job No H11021



Source : Thompson Consulting Surveyors, Development Concept Plan, Drawing No 12130GD.ai

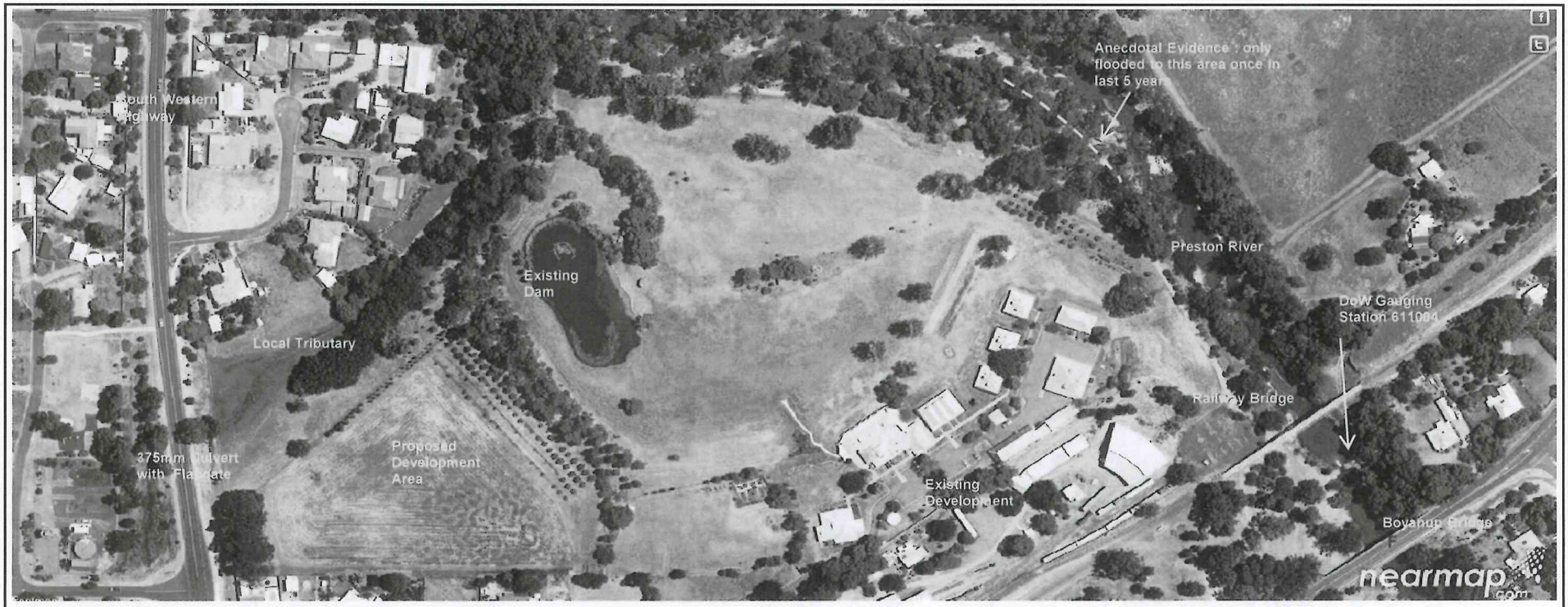
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Preston River Flood Study Meadowbrooke Estate Boyanup

Existing and Proposed Development

Figure 2

Date : 4/7/2011 Job No H11021





A B C D E F

source : Nearmap.com (photo date : 11 Dec 2009)

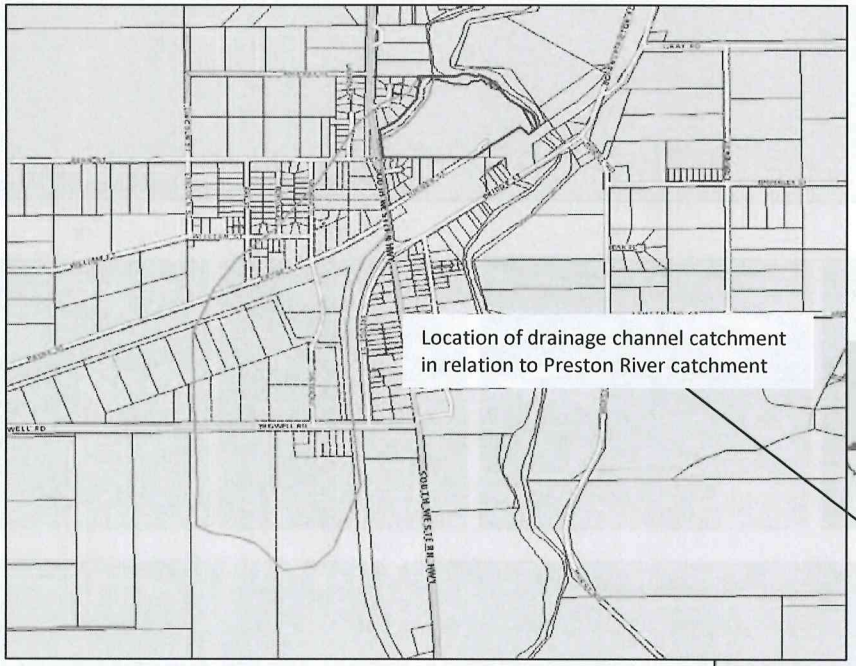
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Preston River Flood Study Meadowbrooke Estate Boyanup

Field Investigation & Hydrological Features

Figure 3

Date : 4/7/2011 Job No H11021

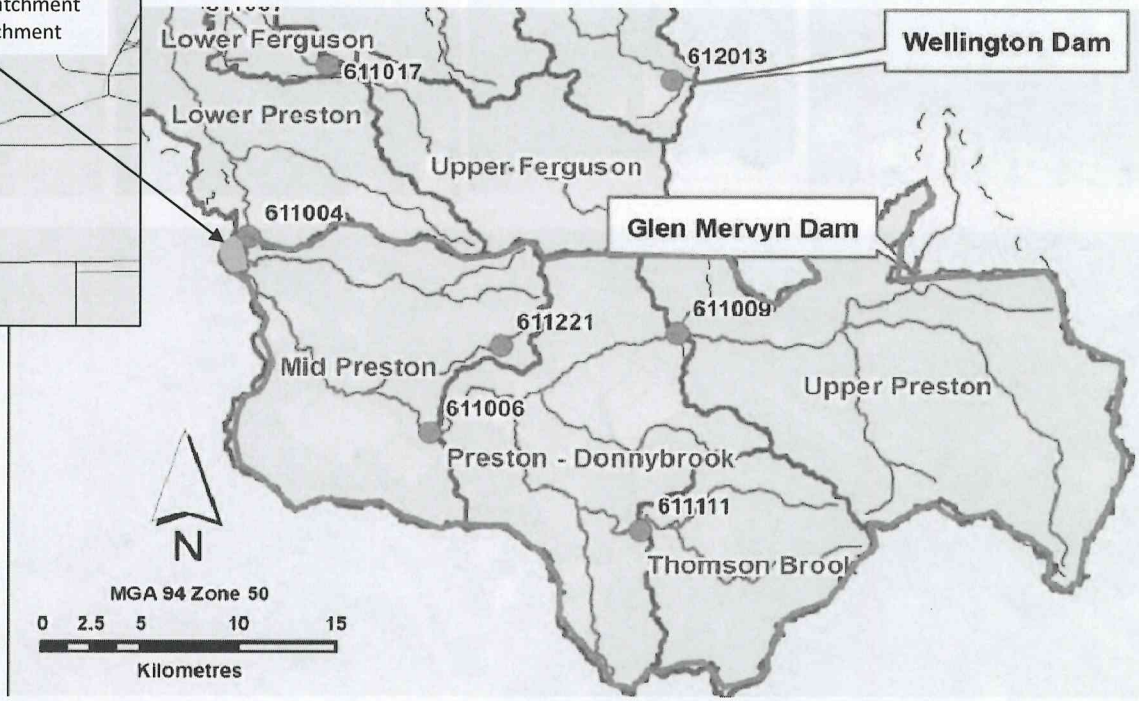


Location of drainage channel catchment in relation to Preston River catchment

Preston River catchment to the site

Drainage channel catchment to the site

Site



Source : Department of Water (2009)

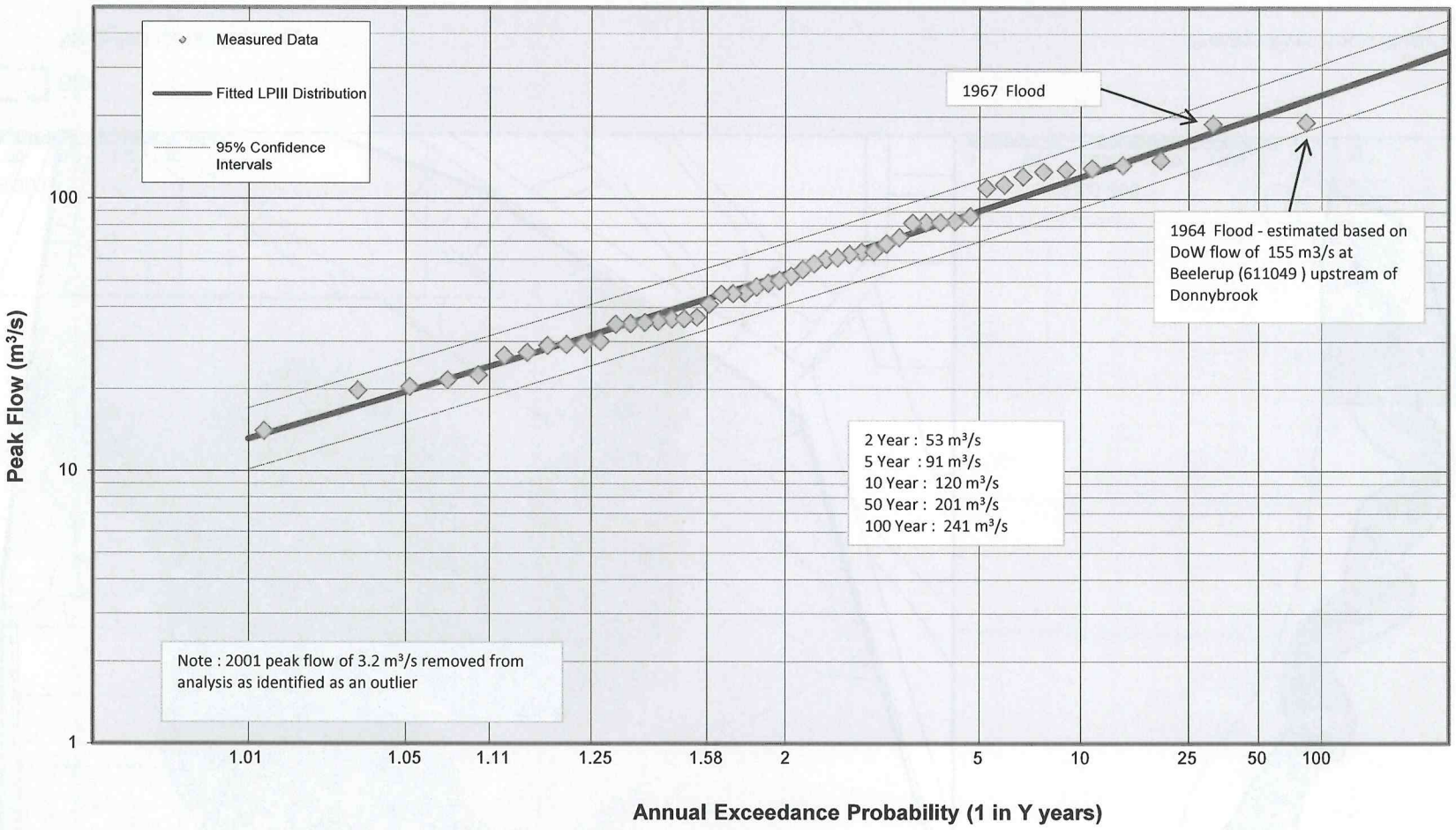
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Preston River Flood Study Meadowbrooke Estate Boyanup

Catchment Map

Figure 4

Date : 4/7/2011 Job No H11021



Data source : Department of Water

Boyanup Bridge (611004) period of record : 1980-2009 (catchment area : 808 km^2)

Beelerup (611049) period of record : 1955-1975 (catchment area 598 km^2)

Beelerup scaled to Boyanup Bridge based on (ratio of catchment areas)$^{0.7}$

hyd$_2$o

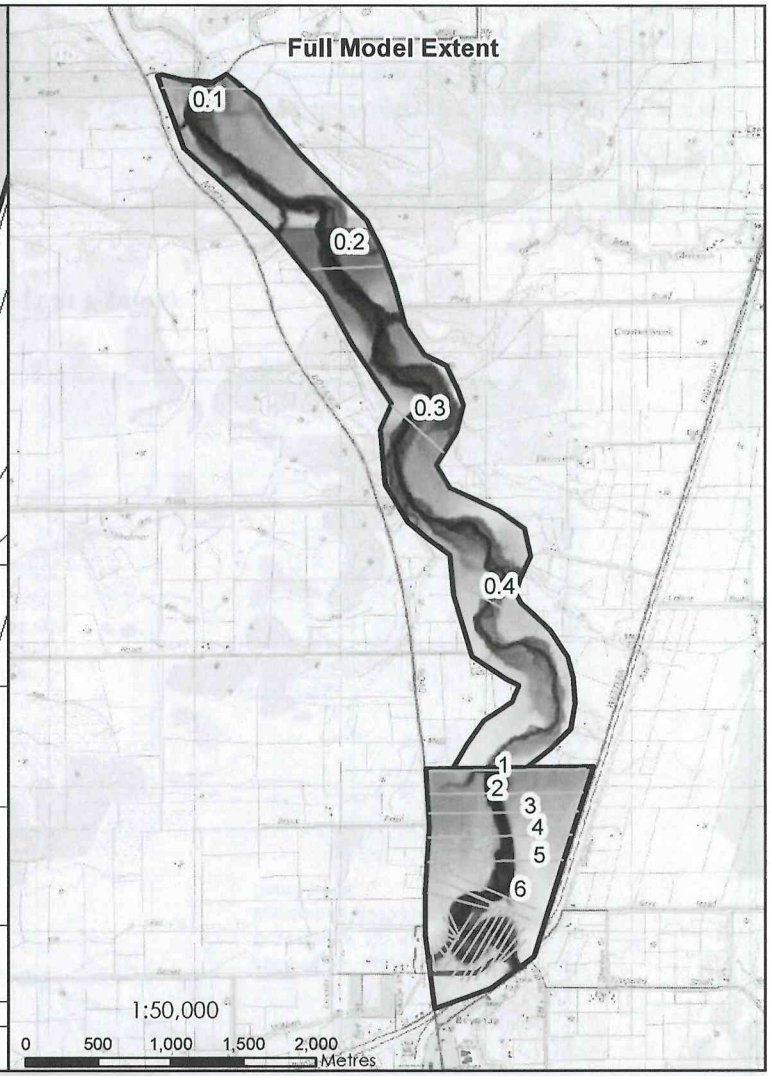
Preston River Flood Study Meadowbrooke Estate Boyanup

Flood Frequency Analysis (DoW Station 611004 : Boyanup Bridge)

Figure 5

Date: 27/07/2011 Job No. H11021





Site

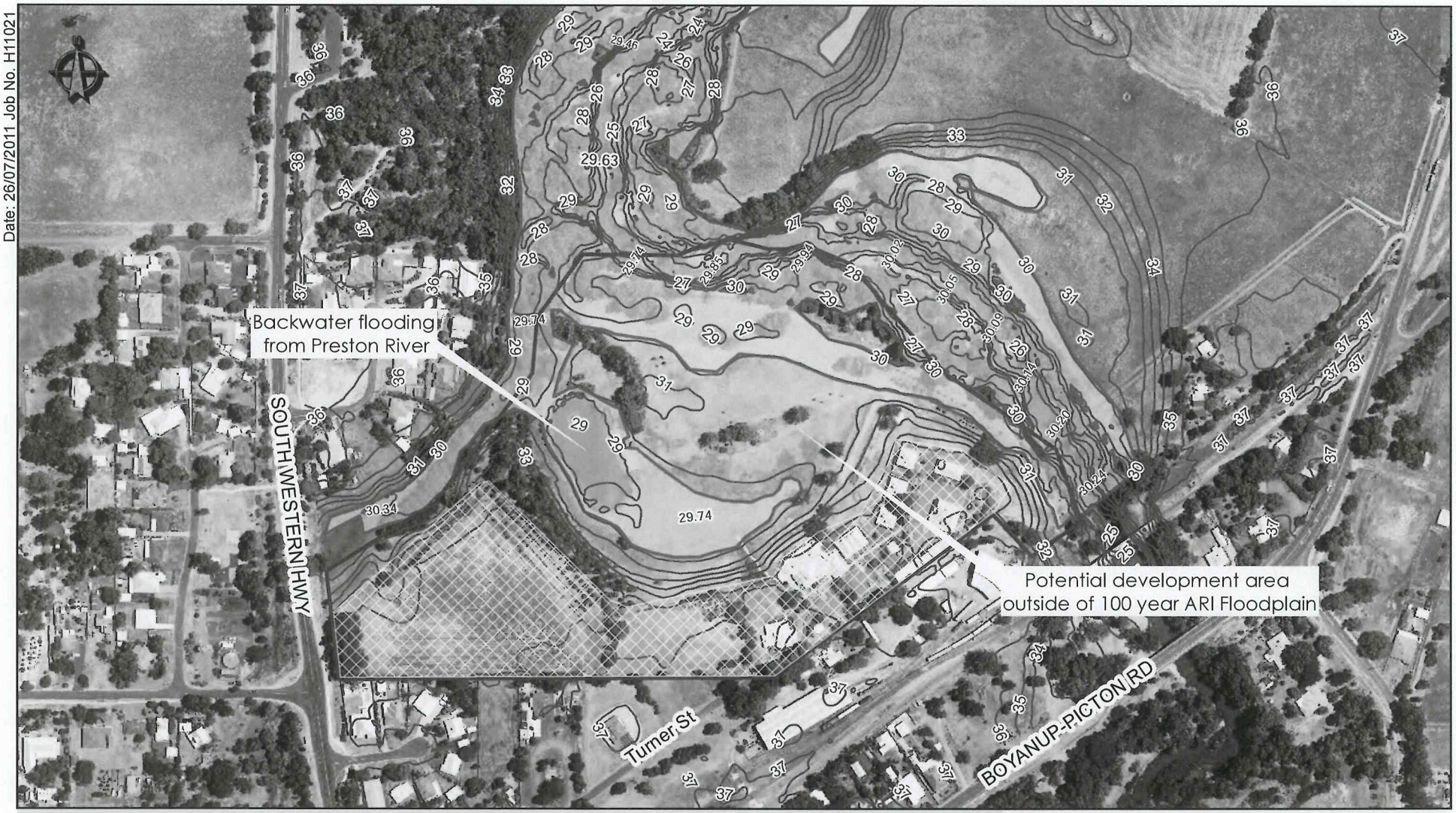
Modelled Cross Section

hyd2o

Preston River Flood Study Meadowbrooke Estate Boyanup

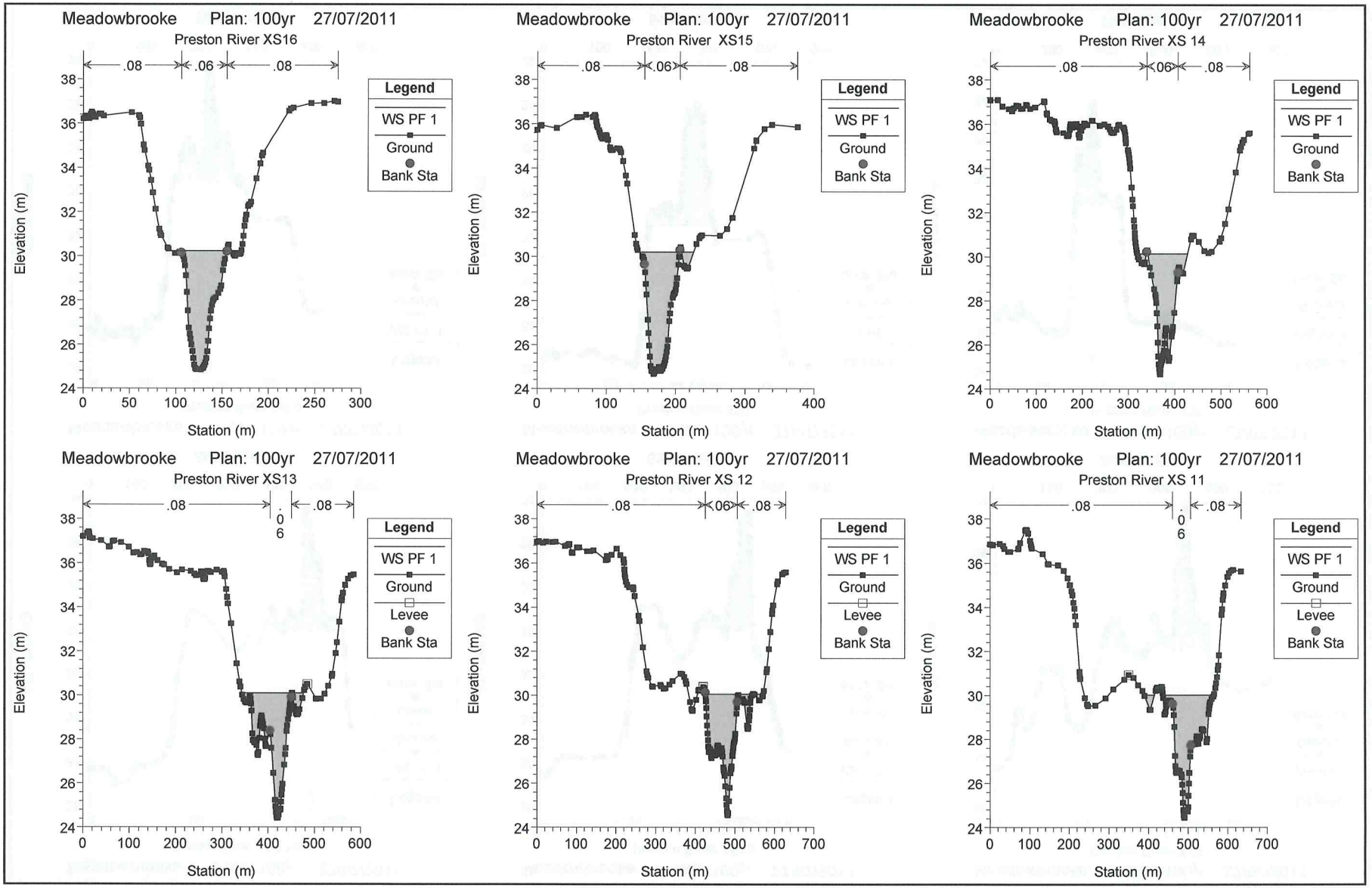
Cross Section Locations

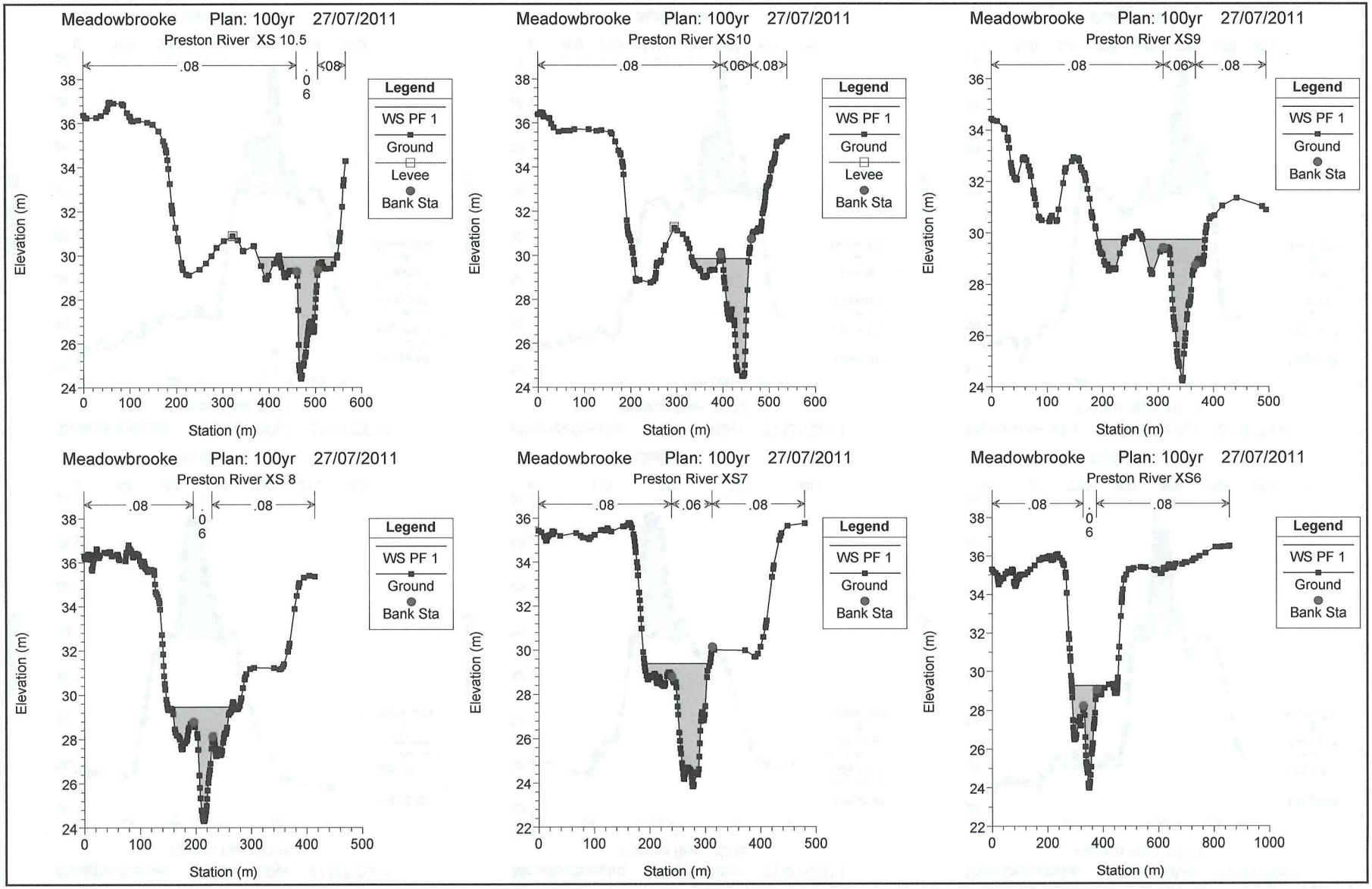
Figure 6

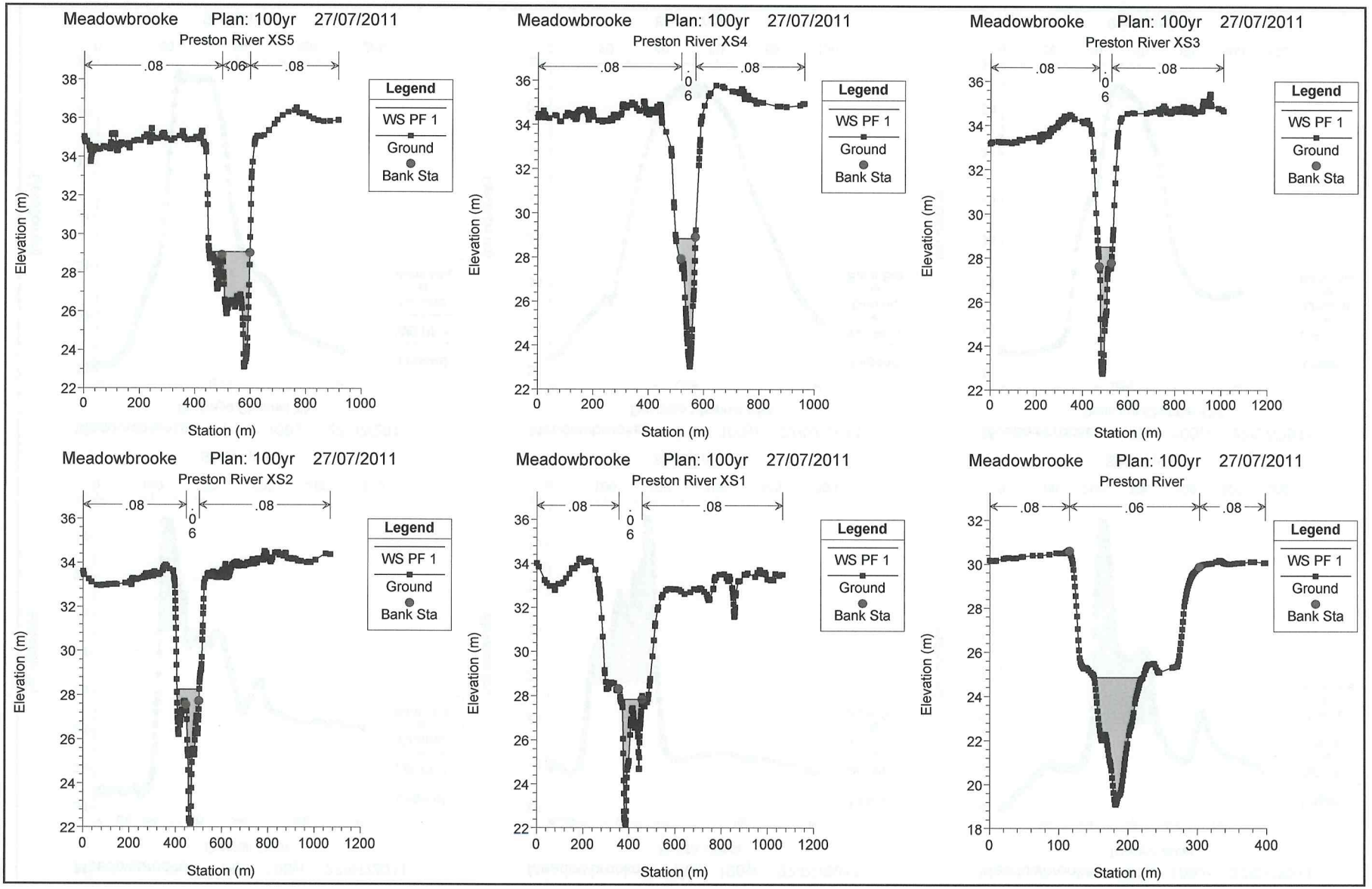

Date: 26/07/2011 Job No. H11021
Backwater flooding from Preston River
Potential development area outside of 100 year ARI Floodplain
SOUTH WESTERN HWY
Turner St
BOYANUP-PICTON RD
Site
Topography
1 in 100 ARI year Floodplain
30.22 1 in 100 year ARI Flood Level (mAHD)
Proposed Development Area
1:4,000
0 25 50 100 150 200
Metres
hyd2o
Preston River Flood Study Meadowbrooke Estate Boyanup
1 in 100 ARI Year Floodplain Map
Figure 7

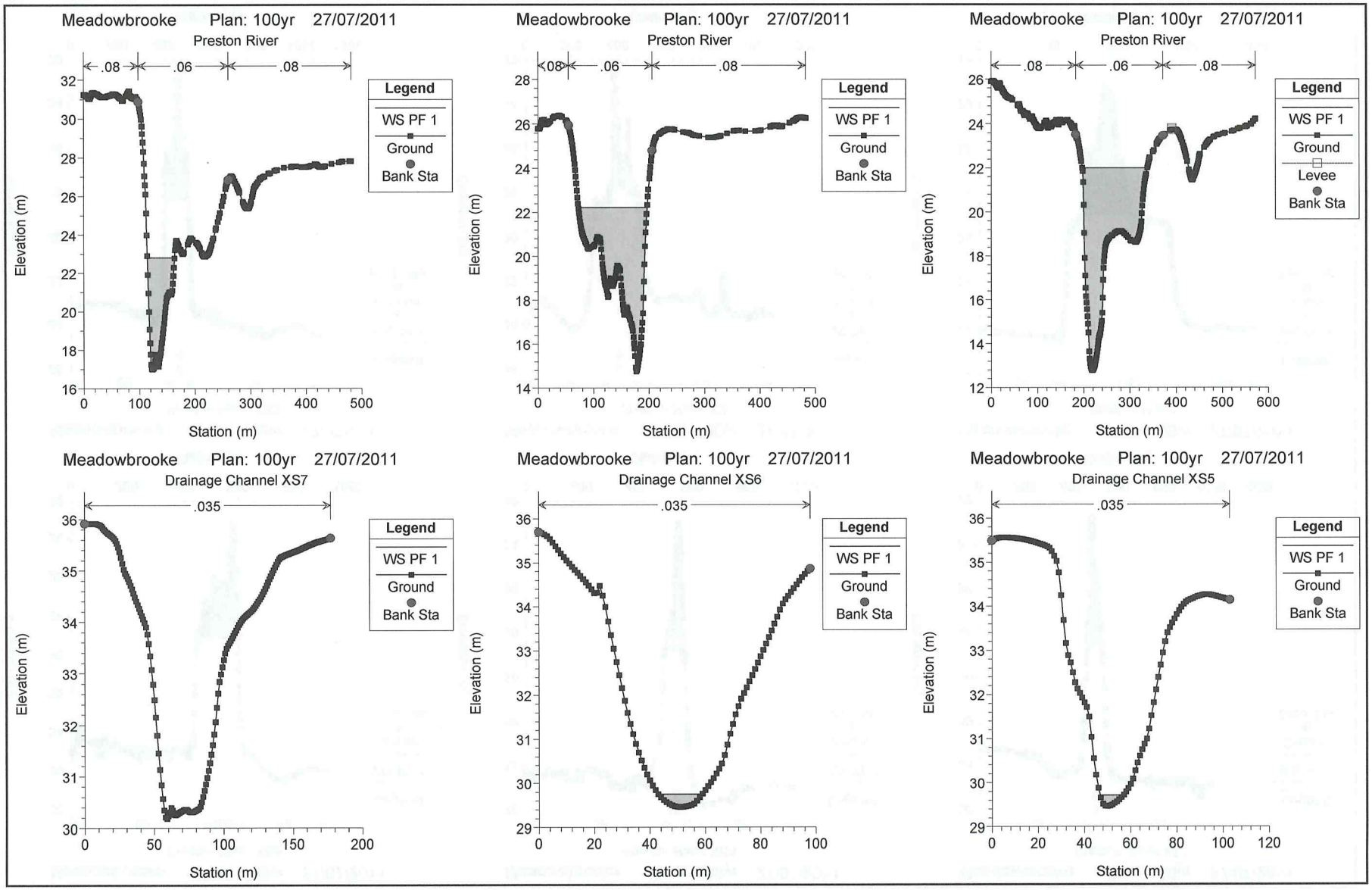
APPENDIX 1

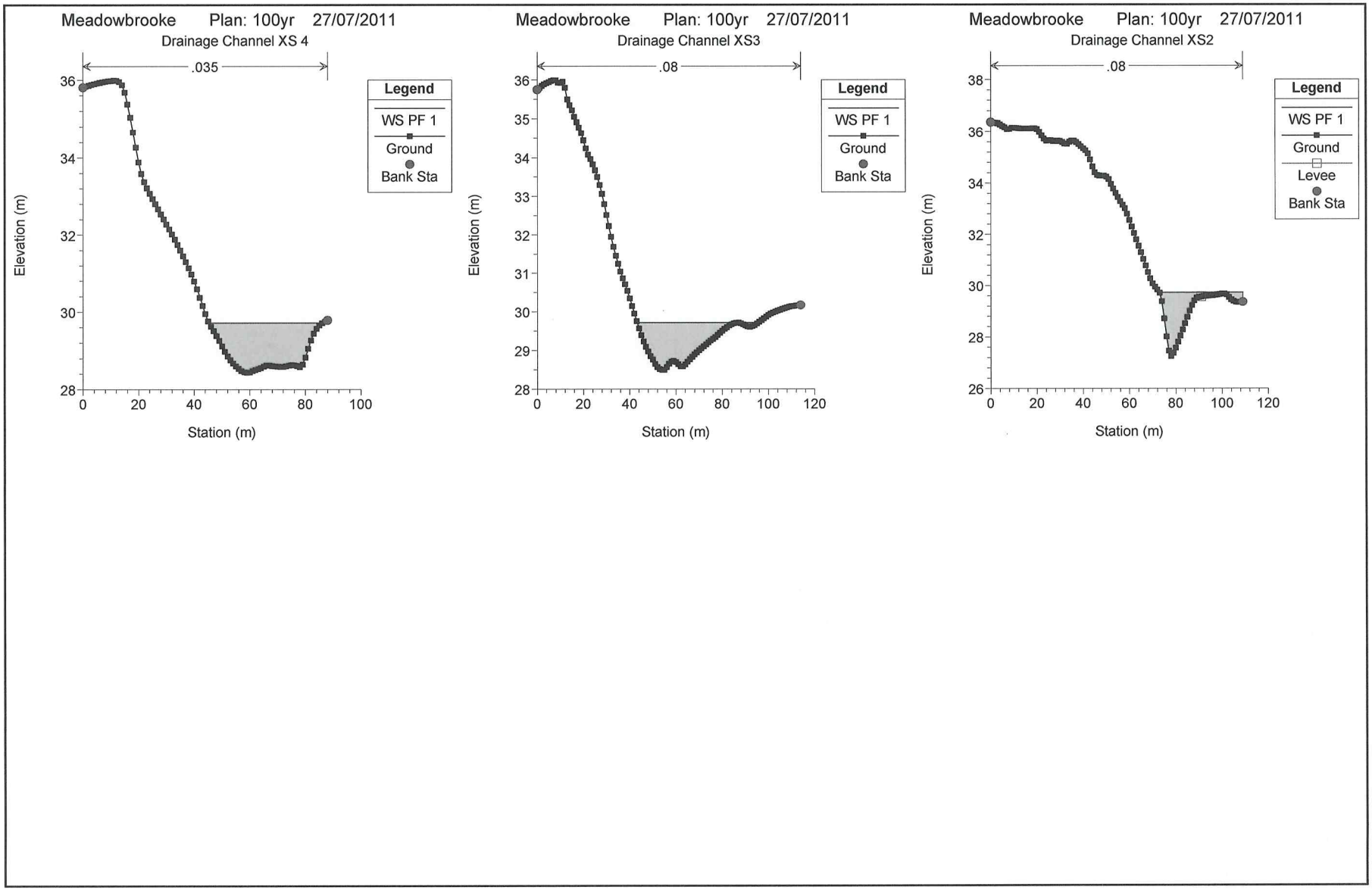
Modelled Cross Sections


Meadowbrooke Plan: 100yr 27/07/2011
Preston River XS16
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Meadowbrooke Plan: 100yr 27/07/2011
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Meadowbrooke Plan: 100yr 27/07/2011
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Meadowbrooke Plan: 100yr 27/07/2011
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Meadowbrooke Plan: 100yr 27/07/2011
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Meadowbrooke Plan: 100yr 27/07/2011
Preston River XS6
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Meadowbrooke Plan: 100yr 27/07/2011
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Preston River XS1
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Meadowbrooke Plan: 100yr 27/07/2011
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Meadowbrooke Plan: 100yr 27/07/2011
Preston River
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Meadowbrooke Plan: 100yr 27/07/2011
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Meadowbrooke Plan: 100yr 27/07/2011
Drainage Channel XS7
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WS PF 1
Ground
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Elevation (m)
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Meadowbrooke Plan: 100yr 27/07/2011
Drainage Channel XS6
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Meadowbrooke Plan: 100yr 27/07/2011
Drainage Channel XS5
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Meadowbrooke Plan: 100yr 27/07/2011
Drainage Channel XS 4
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Meadowbrooke Plan: 100yr 27/07/2011
Drainage Channel XS3
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WS PF 1
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Bank Sta
Elevation (m)
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Meadowbrooke Plan: 100yr 27/07/2011
Drainage Channel XS2
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Ground
Levee
Bank Sta
Elevation (m)
Station (m)

hyd2o
HYDROLOGY

22 August 2011

Your Ref:
Our Ref: H11021Bv1

Department of Water
PO Box K822
PERTH WA 6842

ATTENTION : Simon Rodgers

Dear Simon,

RE : PRESTON RIVER FLOOD STUDY, MEADOWBROOKE ESTATE, BOYANUP.
MODELLING OF ESTIMATED 1964 FLOOD EVENT

Following from our previously submitted report (Hyd2o, 2011) and the Department of Water's (DoW) assessment and advice on this report, please find below the results of modelling of a flow of 400 m^3/s in the Preston River, estimated by DoW as the likely flow at Boyanup during the 1964 flood event.

Flood levels are shown in Appendix 1 and in Table 1 at the upstream and downstream boundaries of the property in relation to the previously estimated 100 year average recurrence interval (ARI) flood levels presented in Hyd2o(2011). In summary, modelling of the 1964 event results in flood levels approximately 0.9 m above the estimated 100 year flood level.

Based on this result, we seek formal advice from DoW on a suitable clearance to be adopted above the 100 year flood level for development at Meadowbrooke.

This clearance will be used to inform the establishment of finished lot levels for the site and to consider opportunities for filling and developing the additional land identified as outside the 100 year floodplain of the Preston River.

Table 1: Comparison of 100 Year ARI and 1964 Flood Level Estimates

Location	100 Year Flood Level Estimate (flow ~241 m^3/s) (m AHD)	1964 Flood Level Estimate (flow ~400 m^3/s) (mAHD)	Relative Flood Height Increase (m)
Preston River Downstream Property Boundary	29.72	30.64	0.92
Preston River Upstream Property Boundary	30.24	31.12	0.88

Suite 6b 103 Rokeby Rd Subiaco WA 6008 | PO Box 1055 Subiaco WA 6904
p +61 8 9382 8683 | f +61 8 6380 1910 | www.hyd2o.com.au

REFERENCES

Hyd2o (2011), Preston River Flood Study Meadowbrooke Estate Boyanup, August 2011

Should you have any queries regarding this letter, please do not hesitate to contact Sasha Martens or Suzanne Smart of this office.

Yours sincerely,

Sasha Martens

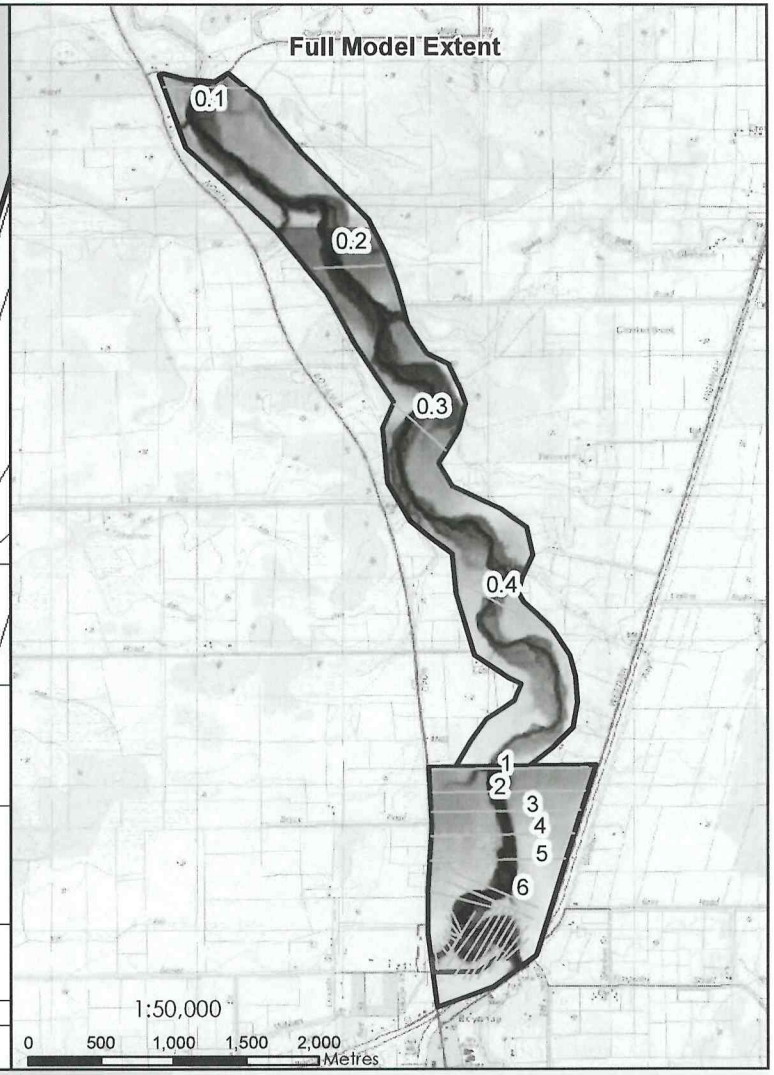
Managing Director, Hyd2o

APPENDIX 1

Modelled Cross Sections 1964 Flood Event

Date: 27/07/2011 Job No. H11021





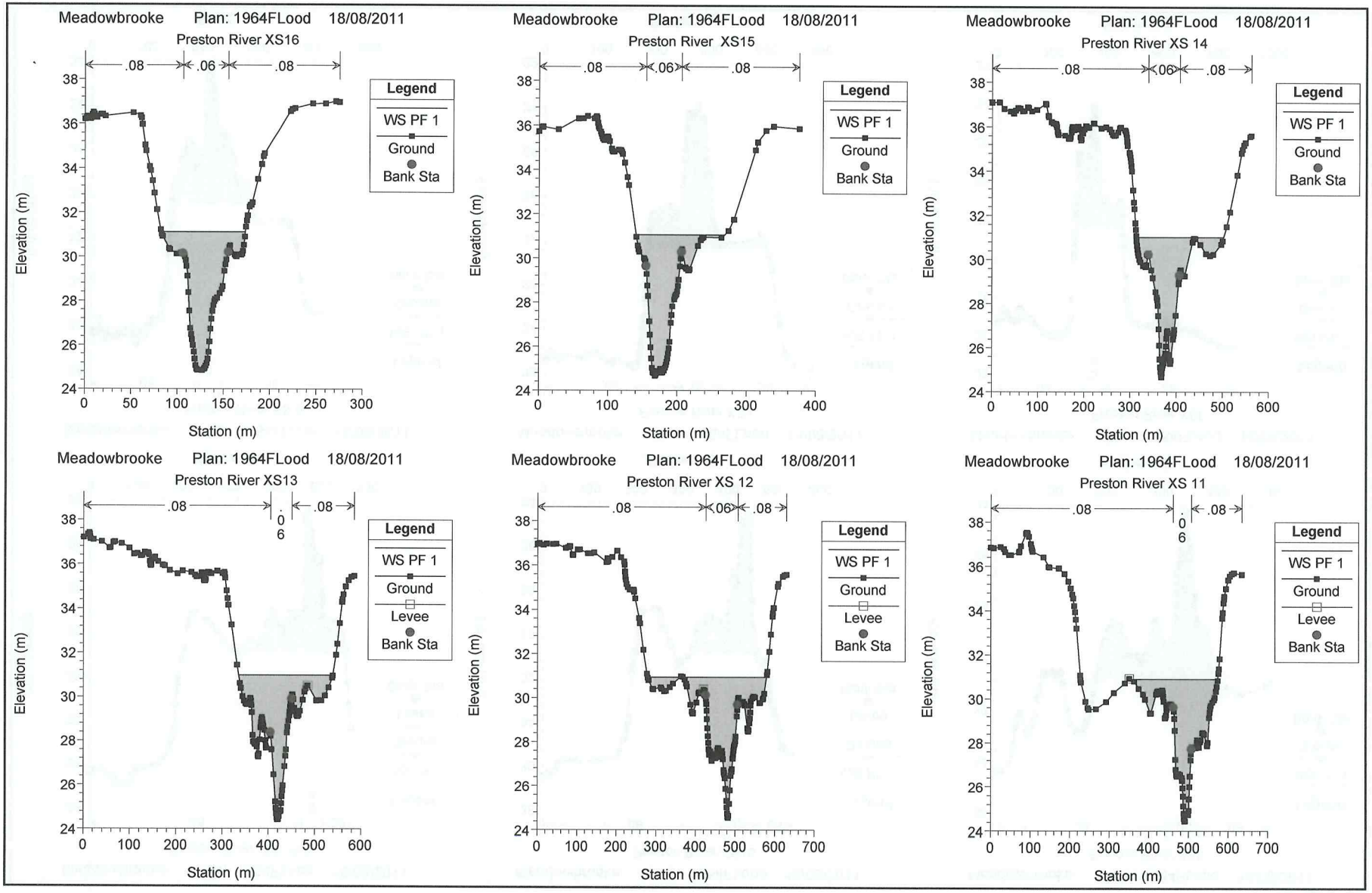
Site

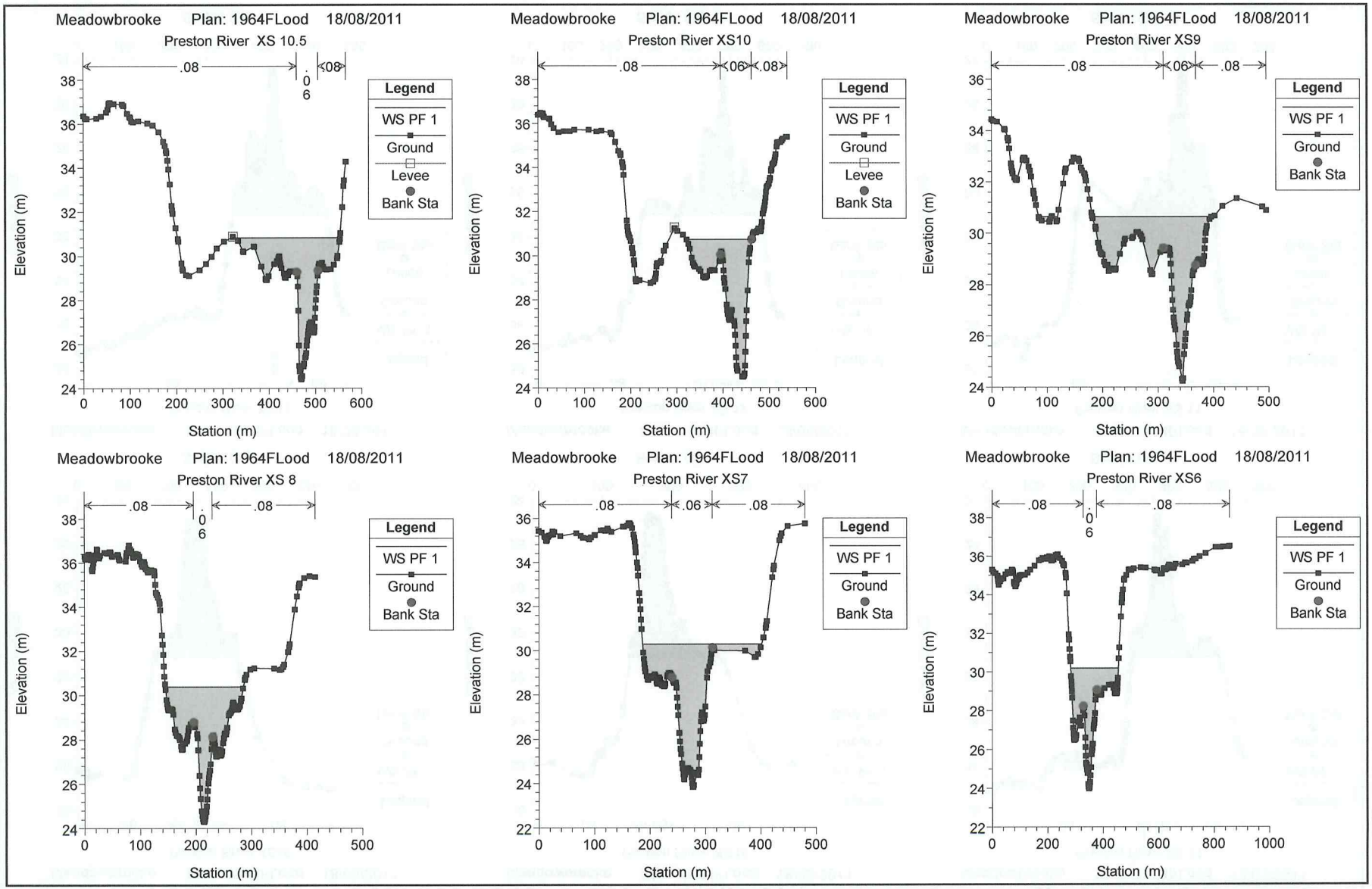
Modelled Cross Section

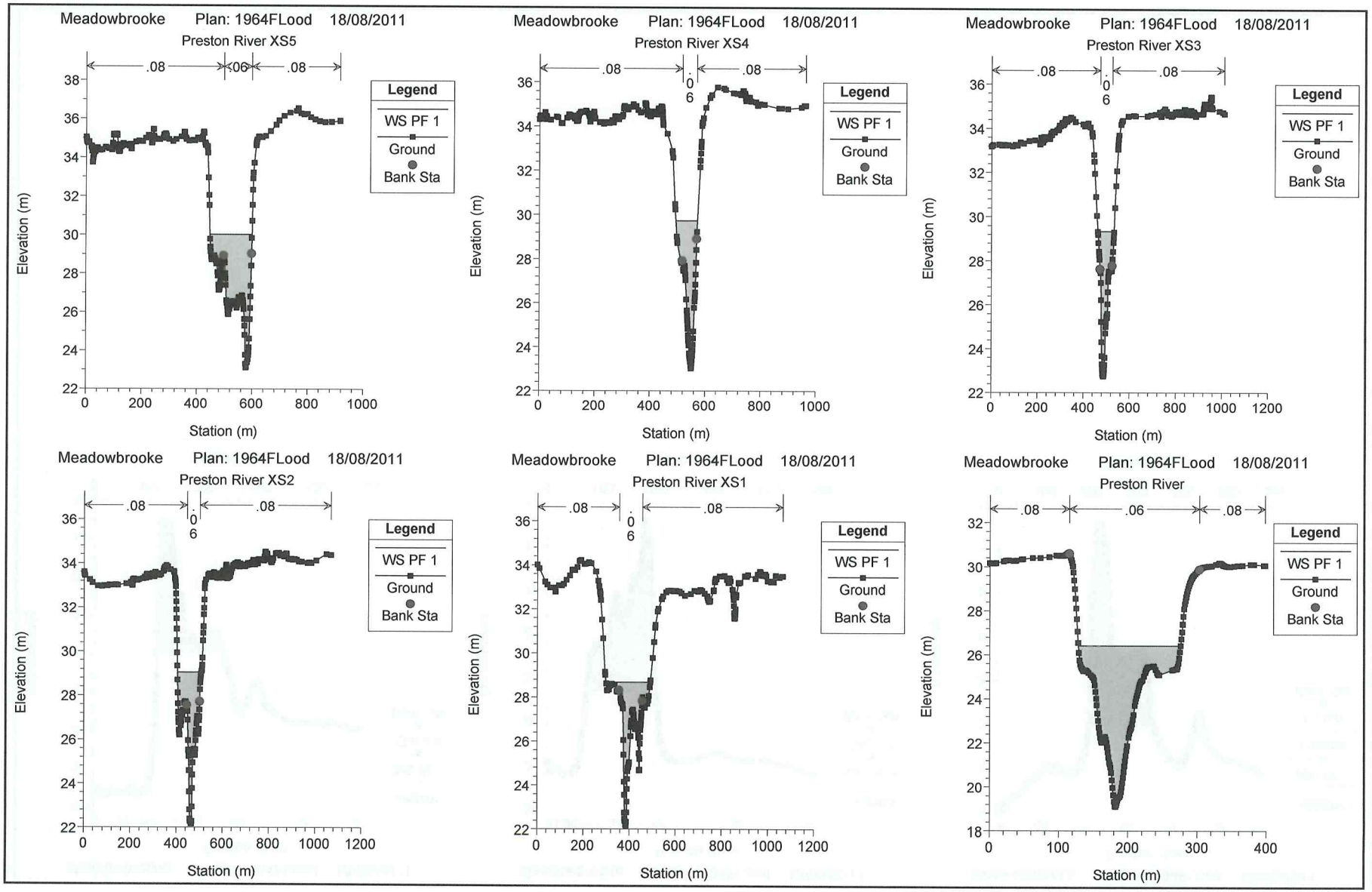
hyd2o

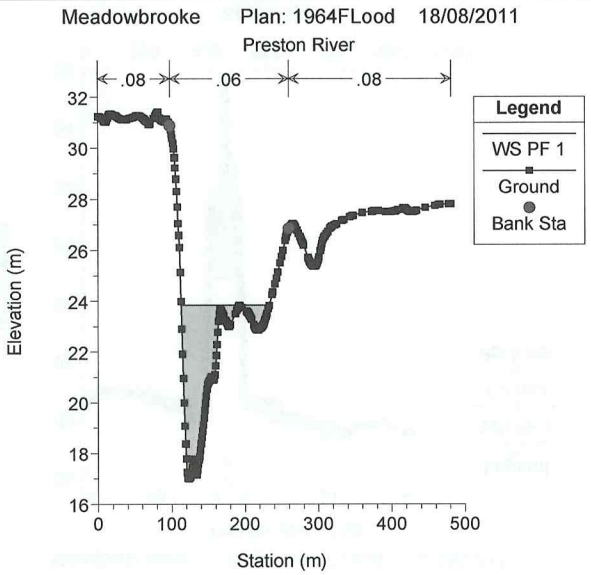
Preston River Flood Study Meadowbrooke Estate Boyanup

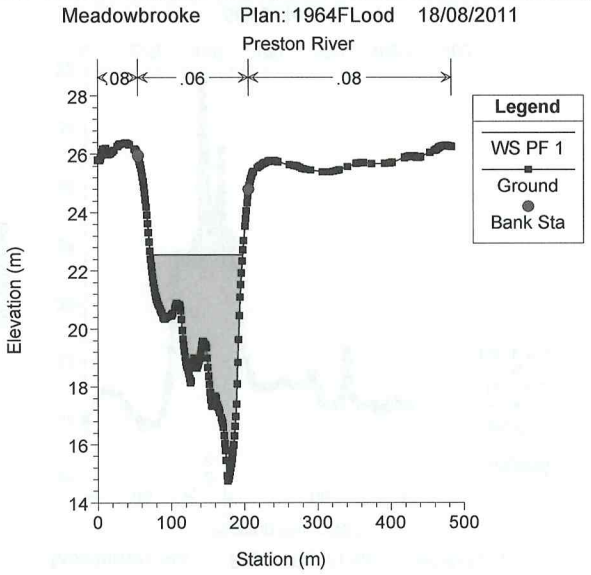
Cross Section Locations

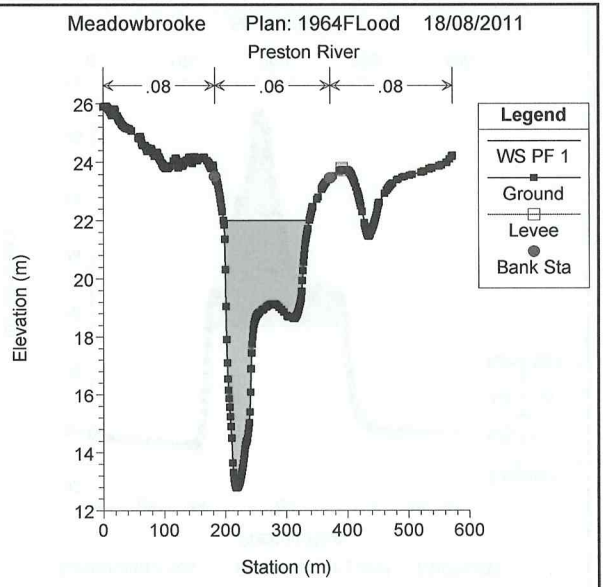

Meadowbrooke Plan: 1964FLood 18/08/2011
Preston River XS16
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Legend
WS PF 1
Ground
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Elevation (m)
Station (m)
Meadowbrooke Plan: 1964FLood 18/08/2011
Preston River XS15
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Meadowbrooke Plan: 1964FLood 18/08/2011
Preston River XS 14
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WS PF 1
Ground
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Elevation (m)
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Meadowbrooke Plan: 1964FLood 18/08/2011
Preston River XS13
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Elevation (m)
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Meadowbrooke Plan: 1964FLood 18/08/2011
Preston River XS 12
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Elevation (m)
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Meadowbrooke Plan: 1964FLood 18/08/2011
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Meadowbrooke Plan: 1964FLood 18/08/2011
Preston River XS 10.5
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Preston River XS 8
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Meadowbrooke Plan: 1964FLood 18/08/2011
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Preston River XS6
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Meadowbrooke Plan: 1964FLood 18/08/2011
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Meadowbrooke Plan: 1964FLood 18/08/2011
Preston River XS3
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Meadowbrooke Plan: 1964FLood 18/08/2011
Preston River XS2
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Meadowbrooke Plan: 1964FLood 18/08/2011
Preston River XS1
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Meadowbrooke Plan: 1964FLood 18/08/2011
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Meadowbrooke Plan: 1964FLood 18/08/2011
Preston River
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Elevation (m)
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Meadowbrooke Plan: 1964FLood 18/08/2011
Preston River
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Craig Pippin

From: Sasha Martens [sasha@hyd2o.com.au]
Sent: Thursday, 25 August 2011 2:36 PM
To: Craig Pippin
Cc: Andrew McRobert
Subject: FW: Meadowbrooke Modelling of 1964 Flood Event
Attachments: H11021Bv1.pdf

Hi Craig,

Advice for development levels via DoW below (Ive attached a copy of our letter to DoW on the 1964 flood modelling – as not sure if I forwarded you a copy earlier this week).

Overall a good outcome, and should provide the flexibility to consider some development in the lower area if required.

Give me a call if need to discuss or if we can be of any further assistance on the project.

Regards,
Sasha

Sasha Martens
Principal Engineering Hydrologist

hyd2o

Suite 6B, 103 Rokeby Rd Subiaco WA 6008
PO Box 1055, Subiaco WA 6904
p +61 8 9382 8683 | f +61 8 6380 1910 | m 0419 510 073

From: RODGERS Simon [mailto:Simon.RODGERS@water.wa.gov.au]
Sent: Thursday, 25 August 2011 1:44 PM
To: 'Sasha Martens'
Subject: RE: Meadowbrooke Modelling of 1964 Flood Event

Hi Sasha

We recommend a minimum habitable floor level of 1.20 m above the 100 year ARI flood level to ensure adequate flood protection is provided.

Regards

Simon Rodgers

Supervising Engineer, Floodplain Management
Water Resource Assessment Branch
Department of Water (WA)
Ph: 08 6364 6923
fax: 08 6364 6515
email: simon.rodgers@water.wa.gov.au

From: Sasha Martens [mailto:sasha@hyd2o.com.au]
Sent: Monday, 22 August 2011 4:23 PM
To: RODGERS Simon
Subject: Meadowbrooke Modelling of 1964 Flood Event

Hi Simon,

Brief letter report regarding 1964 event flood modelling at Boyanup attached. Advice from DoW regarding suitable clearance above 100 year flood level would be appreciated.
Similar to Donnybrook, we found 1964 event resulted in ~ 0.9m flood level above 100 year event.

Regards,
Sasha

Sasha Martens
Principal Engineering Hydrologist

hyd2o

Suite 6B, 103 Rokeby Rd Subiaco WA 6008
PO Box 1055, Subiaco WA 6904
p +61 8 9382 8683 | f +61 8 6380 1910 | m 0419 510 073

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Craig Pippin

From: RODGERS Simon [Simon.RODGERS@water.wa.gov.au]
Sent: Wednesday, 17 August 2011 11:23 AM
To: 'Sasha Martens'
Subject: RE: Preston River Flood Sudy at Boyanup

Sasha

In this instance we would not consider it necessary to undertake pre and post development modelling as the current modelling suggests that the area is not an active flow area during major flooding up to the 100 year ARI event. However, estimated flood levels for a flow similar in magnitude to the 1964 event would be necessary to establish appropriate minimum habitable floor levels that would protect against a recurrence of this event. This is similar to the approach we have adopted for the Preston River in Donnybrook.

Regards

Simon Rodgers

Supervising Engineer, Floodplain Management
Water Resource Assessment Branch
Department of Water (WA)
Ph: 08 6364 6923
fax: 08 6364 6515
email: simon.rodgers@water.wa.gov.au

From: Sasha Martens [mailto:sasha@hyd2o.com.au]
Sent: Wednesday, 17 August 2011 10:03 AM
To: RODGERS Simon
Subject: RE: Preston River Flood Sudy at Boyanup

Thanks Simon, much appreciated.

I will advise my client, and see if they wish to proceed with further considerations of the "backwater flooding" area.

I presume from DoW's perspective we would need to run our model with ~400 m3/s (1964 flow estimate) and provide an assessment of the difference in flood levels within the main Preston River channel if this area was filled.

Regards,
Sasha

Sasha Martens
Principal Engineering Hydrologist

hyd2o

Suite 6B, 103 Rokeby Rd Subiaco WA 6008
PO Box 1055, Subiaco WA 6904
p +61 8 9382 8683 | f +61 8 6380 1910 | m 0419 510 073

From: RODGERS Simon [mailto:Simon.RODGERS@water.wa.gov.au]
Sent: Tuesday, 16 August 2011 4:51 PM
To: 'Sasha Martens'
Subject: RE: Preston River Flood Sudy at Boyanup

Hi Sasha

We have reviewed your report (H11021Av1 – dated 5 August 2011) and provide the following comments:

- The hydrologic/hydraulic assessment are considered adequate in estimating the 100 year ARI flow / levels
- The Preston River Beelerup gauge was inundated during the 1964 flood and the peak level/discharge for this event is considered doubtful.
- The 1964 flow estimate at Boyanup is expected to be ~ 400m3/s based on the estimates at Donnybrook (370m3/s) and Picton Bridge (430 m3/s) – refer to attached
- Based on some recently obtained anecdotal information for the 1964 flood event, a peak flood level of ~33.0 m AHD was observed at a site ~ 500 metres upstream of the Boyanup – Picton Road Crossing
- The current proposed development area is located outside of the 100 year ARI flood extent and is also expected to be above the peak 1964 flood level.
- Future development within the area described as backwater flooding in Figure 7 would need further assessment to ensure
    - It has adequate flood protection against an event similar in magnitude to the August 1964
    - The existing flooding regime during an event similar in magnitude to August 1964 is not detrimentally affected.

Consequently, the proposed development is considered acceptable with regard to major flooding.

Please note that a failure to adhere to these recommendations will result in a greater exposure to risks of flood damage. It should be noted that this advice is related to major flooding only and other planning issues, such as environmental and ecological considerations, may also need to be addressed.

Regards

Simon Rodgers

Supervising Engineer, Floodplain Management
Water Resource Assessment Branch
Department of Water (WA)
Ph: 08 6364 6923
fax: 08 6364 6515
email: simon.rodgers@water.wa.gov.au

From: Sasha Martens [mailto:sasha@hyd2o.com.au]
Sent: Friday, 5 August 2011 1:32 PM
To: RODGERS Simon
Cc: ANDERSON Carol
Subject: Preston River Flood Sudy at Boyanup

Hi Simon,

Following from our meeting earlier this week, please find attached a copy of our report and analysis of the 100 year flood levels at Boyanup adjacent to Meadowbrooke Estate for your consideration.
Should you have any queries, please do not hesitate to call to discuss.

Regards,

Sasha

Sasha Martens
Principal Engineering Hydrologist

hyd2o

Suite 6B, 103 Rokeby Rd Subiaco WA 6008
PO Box 1055, Subiaco WA 6904
p +61 8 9382 8683 | f +61 8 6380 1910 | m 0419 510 073

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ATTACHMENT K
SWCS

development consultants

SWCS
Environmental & Analytical Consulting

Sept 25, 2011

MPM Development Consultants
Unit 1, 33 Constitution Street
Bunbury, WA, 6230

Attn: Craig Pippin

Dear Craig

Attached are the analysis results for the Monitoring Bore and Surface Water samples collected from Meadowbrooke, Boyanup on August 29, 2011

The results show nothing outstanding, no Petroleum Hydrocarbons , no Polynuclear Aromatic Hydrocarbons and no Organochlorine or Organophosphate pesticide residues.

Monitoring Bore MB2 is significantly different to the others, it has a higher Total Dissolved Salts, high Sulphates, high Alkalinity, and significantly higher Calcium and sodium than the other monitoring bores.
MB2 and MB8 have very high Total Nitrogen levels which are primarily made up of NOx-N. This is usually as a result of fertilizer application.

Best regards

David Dodds
Dip App Chem A. G.Inst. Tech

South West Chemical Services,
Unit 5, 4 Mummery Cres, Bunbury, WA, 6230
ABN 71 111 052 218 Phone/Fax 08 9721 7170 Mobile 0417 149 645
Email admin@swchemservices.com.au

South West Chemical Services
Unit 5, 4 Mummery Cres.,
Bunbury, WA, 6230
ABN 71 111 052 21
Phone/Fax 08 9721 7170
Mobile 0417 149 645
Email admin@swchemservices.com.au

Certificate of Analysis

Client Name:	MPM Development Consultants
Address:	Unit 1, 33 Constitution Street, Bunbury, WA, 6230
Tel No:	9721 4777
Job No:	5769
Date Sampled:	29-Aug-11
Test Method:	Samples are analysed on an as received basis, using methods Inorg-001, 002, 006, 018, 055, 057, 060, Metals-020, 024, Org-003, 005, 008, 013/014
Sample Locations	Meadowbrooke, Boyanup, WA
Certification:	This analysis was performed to NATA certification Accreditation No 2901 Analytical report reference number 114273

Results are attached



David Dodds
Dip. App. Chem. A.G.Inst.Tech

25-Sep-11

South West Chemical Services
Unit 5, 4 Mummery Cres.,
Bunbury, WA, 6230
ABN 71 111 052 218
Phone/Fax 08 9721 7170
Mobile 0417 149 645
Email admin@swchemservices.com.au

Client Name:	MPM Development Consultants Attn: Craig Pippin	Job No:	5769
Address:	Unit 1, 33 Constitution St., Bunbury, WA 6230	Mobile:	0488 910 222
Tel No:	9721 4777	Sample Date:	29/08/2011
		Sampled By:	D. Dodds

Meadowbrooke, Boyanup sampling

Analyte	Limit of Detection	Unit	MB2	MB6	MB7	MB8	MB9
Easting			382243	382012	381868	381785	381804
Northing			6294996	6294922	6294976	6294909	6294854
On Site sampling							
SWL		m	2.29	2.81	1.94	2.91	2.57
Temperature		°C	17.2	18.7	17.5	18	16.8
pH	0.05		6.4	6.2	5.6	5.55	6.25
Dissolved Oxygen	0.1	mg/l	2.7	4.0	1.1	2.4	2.6
Dissolved Oxygen	0.1	%sat	27.7	43.3	11.6	25.3	26.5
Electrical conductivity	1	µS/cm	1150	330	420	250	860
Redox Potential	1	RmV	421	426	459	443	419
Laboratory Testing							
pH	0.05		6.4	6.0	5.4	5.6	6.2
Electrical conductivity	0.1	µS/cm	1200	270	440	270	940
Total Dissolved Solids (180°C)	100	mg/l	960	590	350	210	680
Chloride	1	mg/l	89	64	120	53	210
Sulphate	1	mg/l	150	13	29	9	100
Bicarbonate as CaCO3	1	mg/l	220	40	6	10	57
Carbonate as CaCO3	1	mg/l	<1	<1	<1	<1	<1
Hydroxide as CaCO3	1	mg/l	<1	<1	<1	<1	<1
Total Alkalinity as CaCO3	1	mg/l	220	40	6	10	57
Calcium	0.1	mg/l	30	7.7	6.2	1.5	5.8
Potassium	0.1	mg/l	1.1	1.5	3.3	0.8	0.4
Magnesium	0.1	mg/l	24	12	16	6.9	17
Sodium	0.5	mg/l	190	41	40	40	150
Hardness		mg/l	170	70	83	32	86
Aluminium	0.02	mg/l	<0.02	<0.02	0.03	<0.02	<0.02
Arsenic	0.001	mg/l	0.001	<0.001	<0.001	0.002	<0.001
Cadmium	0.002	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002
Cobalt	0.005	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	0.005	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	0.005	mg/l	0.013	0.009	0.011	0.009	0.01
Iron	0.02	mg/l	<0.02	<0.02	0.02	<0.02	<0.02
Mercury	0.0001	mg/l	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Manganese	0.005	mg/l	<0.005	0.01	<0.005	<0.005	0.03
Nickel	0.005	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005
Lead	0.001	mg/l	<0.001	0.002	0.002	0.002	<0.001
Selenium	0.001	mg/l	0.002	<0.001	0.001	0.002	0.002
Zinc	0.01	mg/l	<0.01	<0.01	0.01	0.01	<0.01
Total Nitrogen	0.05	mg/l	36	0.05	0.85	19	0.1
NOx as N	0.005	mg/l	28	0.023	0.6	14	0.011
Ammonia as N	0.005	mg/l	0.02	0.01	0.02	0.01	0.02
Total Phosphorus	0.01	mg/l	0.02	<0.01	0.02	0.02	<0.01
Phosphate as P	0.005	mg/l	0.02	0.006	0.02	0.005	<0.005
Benzene	1	µg/l	<1	<1	<1	<1	<1
Toluene	1	µg/l	<1	<1	<1	<1	<1
Ethylbenzene	1	µg/l	<1	<1	<1	<1	<1
m+p Xylene	2	µg/l	<2	<2	<2	<2	<2
o Xylene	1	µg/l	<1	<1	<1	<1	<1
TRH C6-C9	10	µg/l	<10	<10	<10	<10	<10
TRH C10-C14	50	µg/l	<50	<50	<50	<50	<50
TRH C15-C28	100	µg/l	<100	<100	<100	<100	<100
TRH C29-C36	100	µg/l	<100	<100	<100	<100	<100

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Client Name:	MPM Development Consultants Attn: Craig Pippin	Job No:	5769
Address:	Unit 1, 33 Constitution St., Bunbury, WA 6230	Mobile:	0488 910 222
Tel No:	9721 4777	Sample Date:	29/08/2011
		Sampled By:	D. Dodds

Meadowbrooke, Boyanup sampling

Analyte	Limit of Detection	Unit	MB2	MB6	MB7	MB8	MB9
Polynuclear Aromatic Hydrocarbons							
Naphthalene	1	µg/l	<1	<1	<1	<1	<1
Acenaphthylene	1	µg/l	<1	<1	<1	<1	<1
Acenaphthene	1	µg/l	<1	<1	<1	<1	<1
Fluorene	1	µg/l	<1	<1	<1	<1	<1
Phenanthrene	1	µg/l	<1	<1	<1	<1	<1
Anthracene	1	µg/l	<1	<1	<1	<1	<1
Fluoranthene	1	µg/l	<1	<1	<1	<1	<1
Pyrene	1	µg/l	<1	<1	<1	<1	<1
Benz(a)anthracene	1	µg/l	<1	<1	<1	<1	<1
Chrysene	1	µg/l	<1	<1	<1	<1	<1
Benzo(b) &(k)fluoranthene	2	µg/l	<2	<2	<2	<2	<2
Benzo(a)pyrene	1	µg/l	<1	<1	<1	<1	<1
Indeno(123-cd)pyrene	1	µg/l	<1	<1	<1	<1	<1
Dibenz(ah)anthracene	1	µg/l	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	1	µg/l	<1	<1	<1	<1	<1
OrganoChlorine Pesticide Residues							
HCB	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
alpha-BHC	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
gamma-BHC(Lindane)	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
beta-BHC	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Heptachlor	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
delta-BHC	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Aldrin	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Heptachlor epoxide	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
gamma-Chlordane	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
alpha-Chlordane	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Endosulfan I	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
p,p-DDE	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Dieldrin	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Endrin	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
p,p-DDD	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Endosulfan II	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
p,p-DDT	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Endrin aldehyde	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Endosulfan sulfate	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Methoxychlor	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
OrganoPhosphate Pesticide Residues							
Diazinon	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Dimethoate	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Chlorpyriphos-methyl	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Ronnel	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Chlorpyriphos	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Fenitrothion	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Bromophos ethyl	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2
Ethion	0.2	µg/l	<0.2	<0.2	<0.2	<0.2	<0.2

David Dodds
Dip.App.Chem.A.G.Inst.Tech.

22-Sep-11

South West Chemical Services
Unit 5, 4 Mummery Cres.,
Bunbury, WA, 6230
ABN 71 111 052 218
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Tel No:	9721 4777	Sample Date:	29/08/2011
		Sampled By:	D. Dodds

Meadowbrooke, Boyanup sampling

Analyte	Limit of Detection	Unit	Preston River	Lake			
Easting			381968	381973			
Northing			6295177	6295001			
On Site sampling							
SWL		m					
Temperature		°C	18	19			
pH	0.05		7.5	7.05			
Dissolved Oxygen	0.1	mg/l	5.7	4.0			
Dissolved Oxygen	0.1	%sat	55.4	43.3			
Electrical conductivity	1	µS/cm	470	750			
Redox Potential	1	RmV	376	375			
Laboratory Testing							
pH	0.05		6.2	6.2			
Electrical conductivity	0.1	µS/cm	780	490			
Total Dissolved Solids (180°C)	100	mg/l	550	370			
Chloride	1	mg/l	220	120			
Sulphate	1	mg/l	<1	15			
Bicarbonate as CaCO3	1	mg/l	36	34			
Carbonate as CaCO3	1	mg/l	<1	<1			
Hydroxide as CaCO3	1	mg/l	<1	<1			
Total Alkalinity as CaCO3	1	mg/l	36	34			
Calcium	0.1	mg/l	7.7	8.8			
Potassium	0.1	mg/l	8.2	2.4			
Magnesium	0.1	mg/l	16	12			
Sodium	0.5	mg/l	110	73			
Hardness		mg/l	85	70			
Aluminium	0.02	mg/l	<0.02	<0.02			
Arsenic	0.001	mg/l	0.001	0.001			
Cadmium	0.002	mg/l	<0.002	<0.002			
Cobalt	0.005	mg/l	<0.005	<0.005			
Chromium	0.005	mg/l	<0.005	<0.005			
Copper	0.005	mg/l	0.01	0.009			
Iron	0.02	mg/l	0.05	0.16			
Mercury	0.0001	mg/l	<0.0001	<0.0001			
Manganese	0.005	mg/l	0.09	0.047			
Nickel	0.005	mg/l	<0.005	<0.005			
Lead	0.001	mg/l	<0.001	<0.001			
Selenium	0.001	mg/l	<0.001	<0.001			
Zinc	0.01	mg/l	<0.01	<0.01			
Total Nitrogen	0.05	mg/l	0.21	1			
NOx as N	0.005	mg/l	0.009	0.77			
Ammonia as N	0.005	mg/l	0.01	0.04			
Total Phosphorus	0.01	mg/l	<0.01	<0.01			
Phosphate as P	0.005	mg/l	<0.005	0.007			
Benzene	1	µg/l	<1	<1			
Toluene	1	µg/l	<1	<1			
Ethylbenzene	1	µg/l	<1	<1			
m+p Xylene	2	µg/l	<2	<2			
o Xylene	1	µg/l	<1	<1			
TRH C6-C9	10	µg/l	<10	<10			
TRH C10-C14	50	µg/l	<50	<50			
TRH C15-C28	100	µg/l	<100	<100			
TRH C29-C36	100	µg/l	<100	<100			

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Fluorene	1	µg/l	<1	<1			
Phenanthrene	1	µg/l	<1	<1			
Anthracene	1	µg/l	<1	<1			
Fluoranthene	1	µg/l	<1	<1			
Pyrene	1	µg/l	<1	<1			
Benz(a)anthracene	1	µg/l	<1	<1			
Chrysene	1	µg/l	<1	<1			
Benzo(b) &(k)fluoranthene	2	µg/l	<2	<2			
Benzo(a)pyrene	1	µg/l	<1	<1			
Indeno(123-cd)pyrene	1	µg/l	<1	<1			
Dibenz(ah)anthracene	1	µg/l	<1	<1			
Benzo(g,h,i)perylene	1	µg/l	<1	<1			
OrganoChlorine Pesticide Residues							
HCB	0.2	µg/l	<0.2	<0.2			
alpha-BHC	0.2	µg/l	<0.2	<0.2			
gamma-BHC(Lindane)	0.2	µg/l	<0.2	<0.2			
beta-BHC	0.2	µg/l	<0.2	<0.2			
Heptachlor	0.2	µg/l	<0.2	<0.2			
delta-BHC	0.2	µg/l	<0.2	<0.2			
Aldrin	0.2	µg/l	<0.2	<0.2			
Heptachlor epoxide	0.2	µg/l	<0.2	<0.2			
gamma-Chlordane	0.2	µg/l	<0.2	<0.2			
alpha-Chlordane	0.2	µg/l	<0.2	<0.2			
Endosulfan I	0.2	µg/l	<0.2	<0.2			
p,p-DDE	0.2	µg/l	<0.2	<0.2			
Dieldrin	0.2	µg/l	<0.2	<0.2			
Endrin	0.2	µg/l	<0.2	<0.2			
p,p-DDD	0.2	µg/l	<0.2	<0.2			
Endosulfan II	0.2	µg/l	<0.2	<0.2			
p,p-DDT	0.2	µg/l	<0.2	<0.2			
Endrin aldehyde	0.2	µg/l	<0.2	<0.2			
Endosulfan sulfate	0.2	µg/l	<0.2	<0.2			
Methoxychlor	0.2	µg/l	<0.2	<0.2			
OrganoPhosphate Pesticide Residues							
Diazinon	0.2	µg/l	<0.2	<0.2			
Dimethoate	0.2	µg/l	<0.2	<0.2			
Chlorpyriphos-methyl	0.2	µg/l	<0.2	<0.2			
Ronnel	0.2	µg/l	<0.2	<0.2			
Chlorpyriphos	0.2	µg/l	<0.2	<0.2			
Fenitrothion	0.2	µg/l	<0.2	<0.2			
Bromophos ethyl	0.2	µg/l	<0.2	<0.2			
Ethion	0.2	µg/l	<0.2	<0.2			

David Dodds
Dip.App.Chem.A.G.Inst.Tech.

22-Sep-11

Town Planning

Engineering

Project Management









Meadowbrooke Lifestyle Estate – Sustainability Outcomes & Implementation Plan

December 2014

SHIRE of CAPEL

Meadowbrooke LIFESTYLE ESTATE BOYANUP

mpm development consultants

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1.0 INTRODUCTION

This 'Sustainability Outcomes and Implementation Plan' has been prepared to support the Application for Planning Consent for a proposed lifestyle village development at Lot 201 Turner Street, Boyanup. The Plan has also been prepared to meet the provisions of the Shire of Capel Town Planning Scheme No.7 relating to the subject land.

Preston Green Pty Ltd proposes to develop the site to accommodate a fully serviced residential lifestyle estate (i.e. for aged 55 years and over) together with a range of ancillary uses and community facilities.

The development of Meadowbrooke Lifestyle Estate will address the strategic initiatives promoted by the Shire of Capel for the Boyanup Townsite while also achieving two key Western Australian Planning Commission objectives being greater:

1. housing choice and lifestyle opportunities for the ageing population; and
2. affordability.

The Western Australian State Sustainability Strategy (Government of WA, 2003) defines sustainability as "*meeting the needs of current and future generations through an integration of environmental protection, social advancement and economic prosperity*."

The Sustainability Outcomes and Implementation Plan is guided by Councils stated vision of "*a community of diverse lifestyle experiences accommodating progressive growth, sharing in prosperity and valuing the unique environment*".

The Shire of Capel has produced its own overarching sustainability strategy that focuses on reducing environmental impacts in the areas of energy, transport, water, waste and carbon.

The strategy provides some useful background information in relation to activities carried out by the Shire to date, their current status, sets targets for future improvements and outlines actions that Council intends to take to achieve the targets.

Council's document, "Sustainability Strategy 2013-2018" is focused on steps Council can take to improve sustainability in the Shire, while the subject 'Sustainability Outcomes and Implementation Plan' is focused specifically on Meadowbrooke Lifestyle Estate and the sustainability incentives proposed by this development.

The initiatives proposed in this 'Sustainability Outcomes and Implementation Plan' have also been derived to respond to the foundation principles of the State Sustainability Strategy.

2.0 BACKGROUND INFORMATION

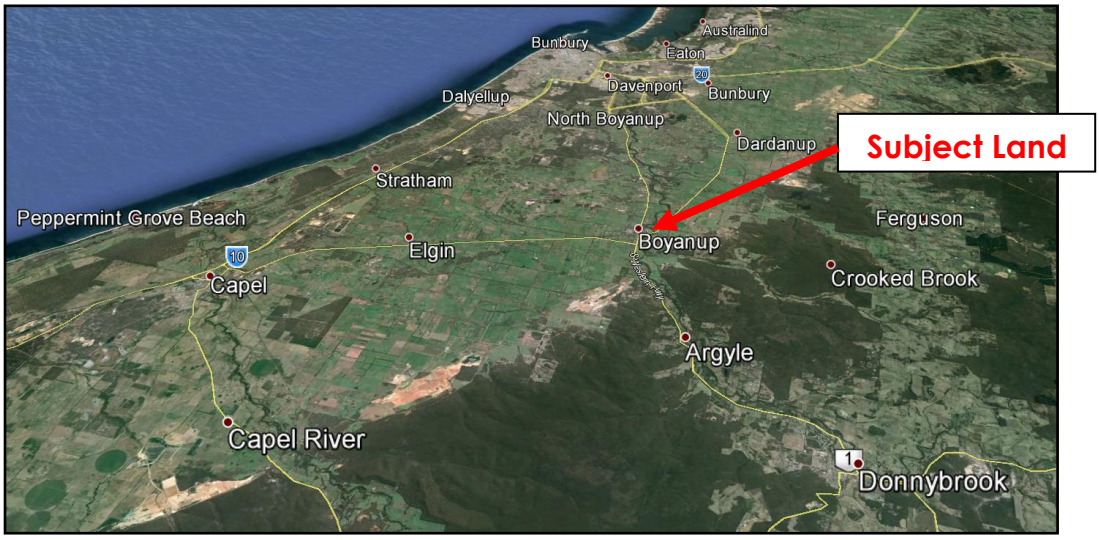
2.1 Location & Property Details

The subject land lies within the municipality of the Shire of Capel at the northern end of the Boyanup Townsite (refer **Figures 1 & 2**). The Preston River and associated foreshore area borders the land to the north and north-east.

The land is situated on the South Western Highway 21.4 kilometres by road from Bunbury and 16.4 and 19.2 kilometres from Donnybrook and Capel, respectively. Consequently, this high level of connectivity results in the land being well located to not only the Boyanup town centre but also other towns and the Bunbury Regional Centre.

The land is described as Lot 201 Turner Street, Boyanup and comprises an area of 9.0568 hectares. The land is owned by Preston Green Pty Ltd.

Figure 1
Regional Context



Source: Google Earth

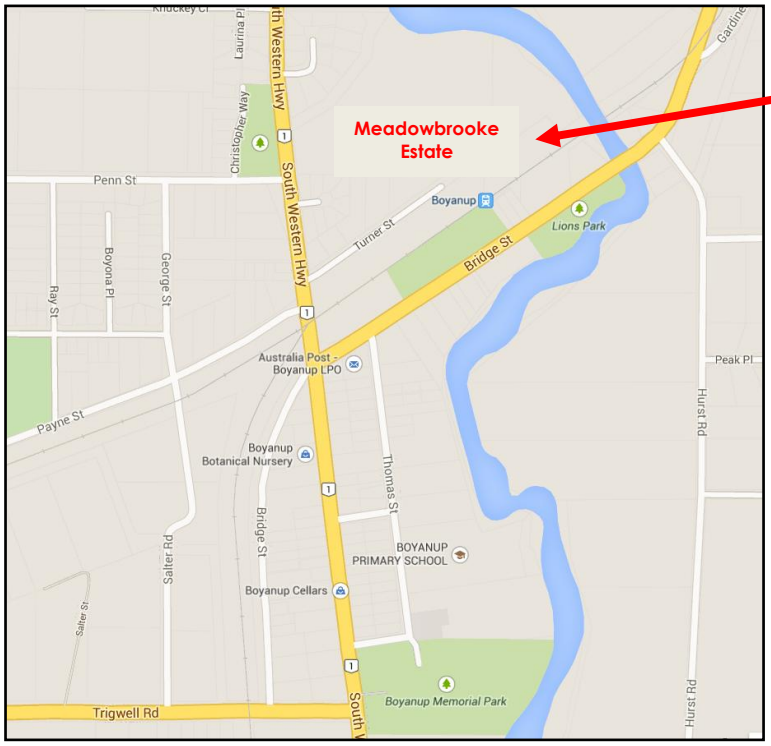
2.2 Site Characteristics

The subject land fronts South Western Highway but is accessed via Turner Street. Tuner Street connects with the South Western Highway (an Important Regional Road) at its western end which, in turn, connects with Bunbury to the north-west and Donnybrook to the south-east.

The subject land is characterised by its distinctive change in elevation, existing development, proximity to the Preston River and vegetation. The land's setting adjacent to the Preston River, the extensive central lawn area and proximity to farming land results in the property retaining an attractive and unique semi-rural character notwithstanding its location within the Boyanup Townsite.

The land rises from a height of 29m AHD at the edge of the man-made pond rising to a height of approximately 36m AHD along the southern boundary.

Figure 2
Location Map



Source: Google Maps

The majority of the land has been cleared with a number of introduced species (eucalypts and olive trees) having been planted along the slope which divides the higher portions of the land from the lower northern central section. The land does not contain any significant remnant vegetation. Remnant vegetation is situated within the foreshore reserve which adjoins the Preston River and this provides an attractive backdrop to the property (refer to **Figure 3** – Aerial Photograph).

Figure 2
Location Map



Source: www.nearmap.com

The Preston River and foreshore area adjoins the subject land along its northern and eastern boundaries. Further to the north and east land is predominantly used for rural purposes.

To the south-east the land adjoins a railway reserve containing the Capel Men's Shed, a disused railway line and the South West Rail and Heritage Centre.

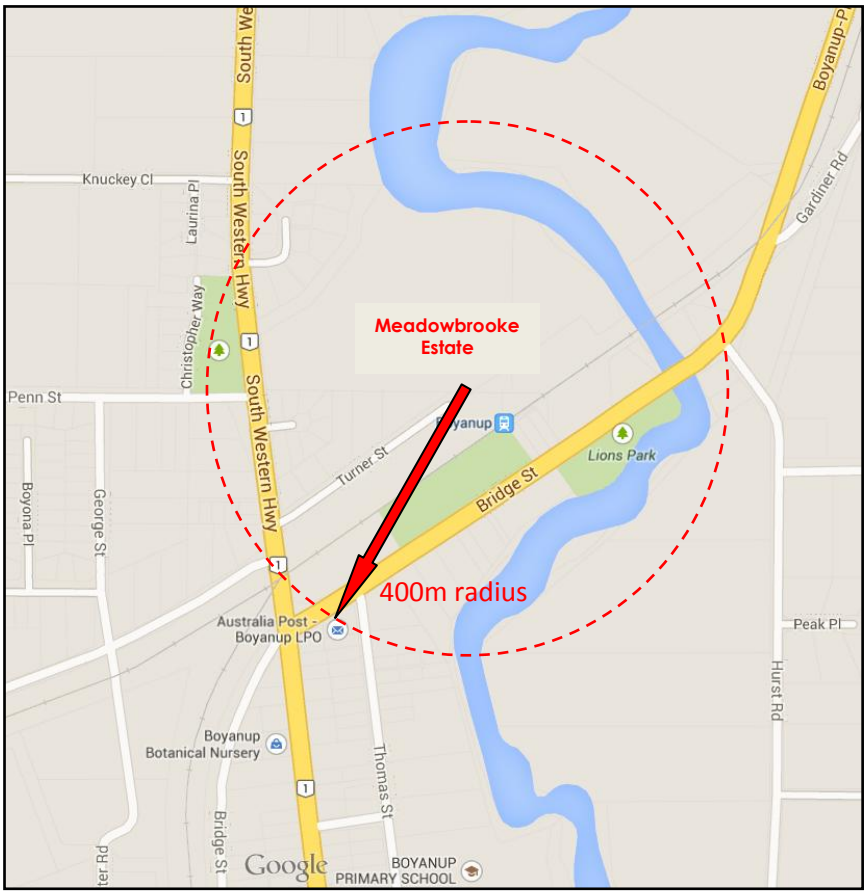
To the north-west the land adjoins a drainage reserve further to the north of which lies residential development.

Along its southern boundary the subject land adjoins a reserve currently occupied by the Boyanup Volunteer Bush Fire Brigade. A St John's Ambulance depot is proposed to be developed on the reserve in the near future. It is understood that a police station is also planned to be built on the reserve in the future. To the west of the reserve, the subject land adjoins residential lots which front Turner Street.

To the west the land lies adjacent to the South Western Highway further to the west of which is residential development.

The land lies approximately 200 metres from the Bull and Bush Tavern situated on Bridge Street, 400 metres from the local post office (also on Bridge Street and approximately 480 metres from the local general store (refer to **Figure 4**).

Figure 4
Proximity to Post Office



Source: Google Maps

3.0 KEY SUSTAINABILITY INITIATIVES

The initiatives outlined in this Plan have been established so that the Meadowbrook Lifestyle Estate is capable of achieving the seven foundation principles of the WA State Sustainability Strategy (2003), being:

1) *Long term economic health* (sustainability recognises the needs of current and future generations for long term economic health, innovation, diversity and productivity of the earth);
2) *Equity and human rights* (sustainability recognises that an environment needs to be created where all people can express their full potential and lead productive lives and that significant gaps in sufficiency, safety and opportunity endanger the earth);
3) *Biodiversity and ecological integrity* (sustainability recognises that all life has intrinsic value and is interconnected, and that biodiversity and ecological integrity are part of the irreplaceable life support system upon which earth depends);
4) *Settlement efficiency and quality of life* (sustainability recognises that settlements need to reduce their ecological footprint while they simultaneously improve their quality of life);
5) *Community, regions, sense of place and heritage* (sustainability recognises the significance and diversity of community and regions for the management of the earth, and the critical importance of 'sense of place' and heritage in any plans for the future);
6) *Net benefit from development* (sustainability means that all development, and particularly development involving extraction of non-renewable resources, should strive to provide net environmental, social and economic benefit for future generations); and
7) *Common good from planning* (sustainability recognises that planning for the common good requires equitable distribution of public resources so that ecosystem functions are maintained and a shared resource is available to all).

Achieving the above principles results in settlements, that, reduce the ecological footprint and enhance quality of life at the same time.

The Meadowbrooke Lifestyle Estate aims to create a development that supports the foundation principles of the State Sustainability Strategy through identifying priority objectives for sustainability.

The priority areas of focus for the sustainability initiatives for Meadowbrooke Lifestyle Estate are:

1. Lifestyle Diversity & Affordability;
2. Water Use & Efficiency;
3. Water Quality Management; and,
4. Biodiversity.

4.0 LIFESTYLE DIVERSITY AND AFFORDABILITY

Meadowbrooke Lifestyle Estate will afford residents the following benefits:

1. affordability and sustainability;
2. lifestyle and housing choices;
3. a secure village atmosphere;
4. via the land-lease model, the potential to free up existing equity;
5. reduce maintenance requirements;
6. provide a range of resort style facilities in a single location;
7. cater for 'lock and leave' lifestyle options; and,
8. a village aimed at active, fit and healthy residents who are looking for an alternative to the traditional retirement village/aged care living.

The target market are clients who have or are considering retirement, downsizing, owning their own first "brand new" home or achieving a "Tree Change" experience and/or a "Lock and Leave" premise in or around the Bunbury and Boyanup LGA.

4.1 Proximity to Town

The Meadowbrooke Lifestyle Estate lies approximately 200 metres from the Bull and Bush Tavern situated on Bridge Street, 400 metres from the local post office (also on Bridge Street and approximately 480 metres from the local general store. Pedestrian pathways will provide connection to Turner Street, South Western Highway and the river foreshore. These connections will enable linkages to the Town Centre and provide for greater community integration opportunities.

This close proximity provides opportunities for future residents to utilise non-vehicular transport.

The provision of a communal bus from the initial stage of the village will also assist in providing greater accessibility for residents.

4.2 Rural & Bushland Landscapes

The residents of Meadowbrooke Lifestyle Estate as well as the local Boyanup community access the foreshore area via the "River Ramble" walk trail which encourages people to access the river and enjoy the amenity of the Preston River.

Pedestrian access to recreational areas is of high importance to residents and visitors of the foreshore area however this must be managed in such a way as to preserve the ecological integrity of the area.

This will be achieved by facilitating appropriate access to recreational areas and restricting access that results in the degradation of natural areas. Paths should comply with Australian Standards AS2156.2-2001 Walking Tracks – Infrastructure Design. (Bio Diverse Solutions, 2014 Lot 200 Turner St, Foreshore Management Plan)

Disabled access should be provided wherever possible and should facilitate the independent use of people with a range of disabilities including physical disabilities, hearing and vision impairment. Disabled access should comply with the relevant Australian Standards.

4.3 Affordability

Modular housing as proposed by McGrath Homes in conjunction with Meadowbrooke Lifestyle Estate provides an affordable option when compared with more conventional housing types.

Affordability of the Meadowbrooke Lifestyle product goes beyond the housing style and includes different approaches to land tenure, whereby the residents will own their own home and lease the land. The lease of the land agreement is to be for 60 years or for the term of the residents' home ownership.

The land-lease model enables residents to release the equity that they have established in their homes by offering an affordable housing and lifestyle choice in a secure community based development. In doing so, the model also provides the opportunity for down-sizing as well as reducing maintenance requirements and costs.

4.4 Climate Responsive Design and Energy

Meadowbrooke Lifestyle Estate will aim to reduce consumption of non-renewable resources via climate responsive design, efficient use of energy and water and increased use of renewable energy.

McGrath Homes are the designated builders of the modular homes. McGrath Homes is committed to minimising the impact of its operations on the environment and to the overall reduction of waste that is disposed of through dumping at landfill sites. This will be done by implementing management practices and building techniques that control the impact on the surrounding environment and reduce waste.

Although McGrath homes recognise that waste is best reduced or avoided at the point of production or generation, they also recognise the need for strategies for re-using and recycling those wastes. Inevitably some waste will need to be disposed of to landfill, but this is recognised as a last resort which needs to be carried out in an environmentally effective and efficient manner.

In keeping with the development principle of McGrath Homes in minimising the impact on the environment and the overall reduction of waste, the developers are also recycling and re-modelling some of the existing buildings rather than demolishing and rebuilding. The existing caretaker's house, function room/kitchen/office and motel units will be remodelled into a community centre, family centre and short stay accommodation units for visiting guests.

4.5 Sustainability Initiatives

Dwellings shall be sited and planned to best achieve passive solar benefits. Planning and Building licence applications for dwellings shall demonstrate that the design has given regard to this requirement.

Water conservation strategies relating to the home and garden shall be used to assist in reducing water use and water costs for the occupants. The development shall use a Water Management programme for building construction and all gardens shall utilize Water Wise garden principles. A water storage tank shall be installed with each dwelling.

Consideration of dwelling orientation and appropriate appliance and lighting options can reduce high energy consumption. The dwellings shall use inverter split system reverse cycle air conditioning and LED lighting were practicable.

Hot water systems will be positioned as close as possible to the area of most use.

Consideration will be given to the installation of photovoltaic or renewable energy systems. This includes on the rooves of the Club House, Family Centre and Motel Units.

Consideration will also be given to the use of solar panels within open space areas that will assist in running BBQ facilities and or street lighting.

Homeowners should be encouraged to sign up for "EasyGreen" or "NaturalPower" packages on offer by Synergy. When they choose to purchase EasyGreen or NaturalPower, Synergy will use their premiums to purchase renewable energy certificates (RECs) from nationally accredited GreenPower™ renewable energy sources. The RECs purchased will match the amount of residents' EasyGreen or NaturalPower contribution.

The developers will be providing an enclosed swimming pool area to reduce heat loss. Solar pool heating will be investigated.

5.0 WATER USE AND EFFICIENCY

5.1 Reduce Demand

The demand for scheme water can be reduced by simple measures such as encouraging home owners to use water wise appliances and fittings, planting of garden areas and Public Open Space areas with water wise native plants and general awareness programs about reducing overall water usage.

5.2 Rainwater Harvesting

Rainwater will be encouraged to be harvested via roof top collection and captured in tanks for re-use inside and outside of the dwelling.

5.3 Sustainability Initiatives

The sustainability initiatives to be promoted within the development include:

- Providing each house with a rainwater tank.
- Dishwashers, washing machines, toilets, shower heads, taps etc where possible fitted with high WELS water rating.
- Landscape Master Plan to address water-wise principles, including indigenous vegetation and recommendations regarding irrigation and other watering regimes.



6.0 WATER QUALITY MANAGEMENT

6.1 Household & POS Nutrient Management

Householders will be encouraged to plant nutrient wise gardens that require little to no fertilising, or if necessary, use only low water soluble fertilisers. This limits the amount of nutrients that enter the groundwater.

6.2 Swales & Bio-retention units

The village layout is focussed around a central 'green' corridor incorporating the man-made pond, proposed bio-retention basin, village green and landscaped areas. As far as possible strong visual linkages are achieved with the surrounding open space areas with a high level of permeability for pedestrians.

6.3 Sustainability Initiatives

The Sustainability initiatives to be promoted in relation to Water Quality management include:

- Providing water wise landscaping.
- Landscaping of communal areas and the front gardens of individual dwellings will be installed by the developer and will be maintained in accordance with the best water wise garden principles.

7.0 BIODIVERSITY

Biodiversity is identified as one of the key priority areas of sustainability within the Meadowbrooke Lifestyle Estate development.

The ecological functioning of the Preston River foreshore area is paramount to providing an attractive and unique development and where possible, the natural biodiversity of the area should be enhanced.

7.1 Foreshore Management

The foreshore area (Lot 200) which adjoins the subject land, is quite degraded. The foreshore area includes introduced trees, ornamental plants and landscaped grassed areas. Revegetation is recommended to restore the river foreshore area, generate ecological linkages and enhance the amenity area. The Foreshore Management Plan report recommends that a comprehensive weed program is carried out when revegetation strategies occur (Bio Diverse Solutions, 2014).

7.2 Household Gardens



Landscaping of front gardens should be encouraged with native species that attract birds and other fauna, assisting to provide linkages to facilitate fauna movement through the development to the foreshore area.

Planting native gardens also has the added benefit of the residents developing a personal appreciation of the environment and its natural systems. Achieving this 'sense of place' assists in the fifth foundation principle of the State Sustainability Strategy.

7.3 Community Garden

Community gardens get people involved in both gardening and the community that surrounds it. The benefits not only result in community building and engagement but also environmentally sustainable benefits result.



Community gardens act as a demonstration site for living and consuming in a sustainable manner; foster local solutions to climate change; and provide organic waste management solutions for the residents of Meadowbrook Lifestyle Estate.

As simple as providing a community garden sounds it meets a number of the fundamental principles of the State Sustainability Strategy.

7.4 Drainage Reserve & POS

As discussed in relation to household gardens, it is suggested that the drainage reserves and POS will be landscaped with local native species. This will assist in enhancing the ecological function of Meadowbrooke Lifestyle Estate.

7.5 Landscaping

The Shire of Capel has developed 'The Shire of Capel Urban Landscape Strategy' with the principal aim of the strategy being to:

"Enhance amenity, environmental, sustainability and cultural outcomes in relation to the landscaping of public spaces and development sites in urban areas."

A Landscape Master Plan is to be prepared as a condition of development approval for the proposed lifestyle village and will be the subject of a separate report. It is anticipated that the Landscape Master Plan will place a strong focus on the use of endemic native species that are water wise and low maintenance in the landscaping of the development. The landscaping plan should also investigate the use of local or recycled materials for hard landscaping structures for park and street furniture/fixtures.

7.6 Sustainability Initiatives

The sustainability initiatives to be promoted in relation to Biodiversity include:

- Provide the residents of Meadowbrooke Lifestyle Estate with a Community Garden.
- Integration of urban water management functions with POS including management of stormwater to improve water quality and reduce runoff.
- Use of hydro zoning and water wise, indigenous plants and climate appropriate turf.
- Use of durable, longer lasting local or recycled materials in hard landscaping (park/street furniture etc).
- Investigate the use of renewable water sources for irrigation purposes (e.g. water re-use, sustainable bore use etc).
- Use of sub-surface or drip irrigation systems with sensors.

8.0 SPECIFIC APPLICATION OF INITIATIVES

The following table provides a summary of the sustainability initiatives or options to be considered and/or promoted as part of the development of Meadowbrooke Lifestyle Estate and identifies where they fit within the context of the overall development.

Area	Potential sustainability initiative	Benefits	Sustainability Priority Area
Individual homes			
Home design	North facing glazed areas with eaves over	Increase heat gain in winter / improve comfort / reduce heating requirement and energy use Eaves prevent heat gain in summer	Lifestyle Diversity & Affordability
	Main living areas on north side of home	Solar heat gain to areas where it's most valuable during the day	
	Minimal glazed areas facing east and west	Reduce heat gain in summer / improve comfort / reduce cooling requirement	
	Shading over east and particularly west facing glazed areas, e.g. wide eaves / verandah	As above	
Building materials	'Eco' building materials, e.g. plantation timber, products made from recycled materials	Various environmental benefits	Lifestyle Diversity & Affordability
	Building materials with lower embodied energy	Avoid materials with high embodied energy, e.g. solid bricks, concrete, tiles	
Home hot water	Solar with gas booster	Lowest GHG emissions	Lifestyle Diversity & Affordability
	High efficiency gas	Similar GHG emissions to electric boost solar & heat pump	
	Electric heat pump	Similar GHG emissions to electric boost solar & gas Avoids need for reticulated gas	

Home cooking	Gas hot plate / stove	Lower GHG emissions compared to electric	Lifestyle Diversity & Affordability
Home heating / cooling	High efficiency reverse cycle (split systems)	Lower GHG emissions compared to panel, fan or oil heaters which may be used otherwise High star rated models can use about 20% less energy than low star rated models Can provide heating and cooling	Lifestyle Diversity & Affordability
Home power	PV solar power	Reduce GHG emissions Lower electricity bills for residents	Lifestyle Diversity & Affordability
Home lighting	LED lighting	Lower energy use – valuable for lights on a lot of the time Longer life – less maintenance	Lifestyle Diversity & Affordability
	CFLs & other fluoros	Lower energy use compared to halogen Cheaper than LED	
	Glazed areas & possibly skylights for natural lighting	Reduce energy use & GHG emissions	
Appliances & fixtures	Dishwashers, washing machines, fridges, TVs, etc with high energy star rating	Reduce GHG emissions Reduce ongoing energy bills High energy star rated appliances can use 20-50% less energy than low start rated ones	Water Use & Efficiency
	Dishwashers, washing machines, toilets, shower heads, taps with high WELS water rating	Reduce water use High WELS rated appliances & fixtures can use up to 50% less water than low start rated ones	
Water supply	Rain water tank to supply water for toilets	Reduce water use If up on stand to provide some pressure could avoid need for booster pump if used for toilet only	Water Use & Efficiency

Waste	3 bins in homes to encourage dry & organic recycling	Increase recycling, reduce waste going to landfill Reduce GHG emissions	Biodiversity
Education	Provide education materials & information sessions on how to save energy, water & reduce waste Maybe even run an ongoing 'Green Village' education program	Reduces energy & water use & waste Reduces bills for residents	Biodiversity
Common area buildings and facilities			
Common use buildings	Similar measures as above, e.g. building design, 'eco' building materials, hot water, lighting, appliances, etc		Lifestyle Diversity & Affordability
Internal lighting & air-conditioning	Timer or sensor controls to automatically turn equipment on or off and prevent it being left on when not required	Reduce energy use and associated GHG emissions	Lifestyle Diversity & Affordability
Power supply	PV solar power	Reduce GHG emissions Cost effective against current power prices	Lifestyle Diversity & Affordability
Reticulated gas		Allows use of gas hot water systems & cook tops, which have lower GHG emissions than electric alternatives	Lifestyle Diversity & Affordability
External lighting	LED street lights, security & external lights	Lower energy use - especially for lights that are on a lot of the time Longer life – less maintenance	Lifestyle Diversity & Affordability
	CFL & other fluoro street lights, security & external lights	Lower energy use compared to incandescent - especially for lights that are on a lot of the time	
	Timer or sensor controls to automatically turn lights on or off as required	Reduce energy use and associated GHG emissions	

Swimming pool	Solar pool heating with gas or electric heat pump boosting	Reduce energy use and GHG emissions	Lifestyle Diversity & Affordability
	Enclose swimming pool area to reduce heat loss and if possible have large north facing glazing for heat gain in winter	Reduce energy use for heating and associated GHG emissions	
Waste	Use third bin system for organic wastes	Substantial GHG reductions compared to putting organic wastes into the general rubbish bin Could also use to dispose of some garden wastes from grounds	Biodiversity
Education	Provide information sessions or materials for staff on how to save energy & water & reduce waste in common facilities	Reduce GHG emissions, water use & waste	All priority areas
Grounds			
Water supply for irrigation	Grey water collection from homes and onsite treatment plant	Recycle water Overcome problem of fully allocated ground water in East Bunbury area	Water Quality Management
	Collect storm water in lake and use for irrigation in summer	Recycle water Overcome problem of fully allocated ground water in East Bunbury area	
Landscaping	Soil preparation for garden beds	Reduce water use Improve plant health	Biodiversity
	Mulching of garden beds	As above	
	Use native and other water wise plants	Reduce water use	
	Use paving, aggregate and maybe even artificial turf instead of lawn	No watering requirement & less maintenance	
	Shade trees	Reduce 'urban island heat	

		effect' Aesthetic benefits for residents	
	Timing of landscaping works	Best done in cooler, wet months for successful establishment without intensive early maintenance	
Irrigation system	Use controller with water saving features and sensors	Reduce water use, better control of irrigation	Biodiversity
	Use sub-surface or drip irrigation systems	Less wastage compared to sprinklers	
Food/Community Garden	Veggie gardens, fruit trees, chooks	Produce food onsite and avoid GHG emissions and other impacts associated with production and transport Generate activities for residents	Biodiversity
Land care	Re-vegetate area next to river using local species	Plants absorb CO2 from atmosphere Provide habitat and food sources for local fauna Community benefits for walkway	Biodiversity
Storm water disposal	GPTs, rain gardens, constructed wetland, etc	Reduce pollutants from entering river such as rubbish, nutrients & sediment	Water Quality Management
Education	Provide information sessions or materials for garden staff on how to save water for irrigation	Reduce water use	All Priority areas



November 2014

Draft

Meadowbrooke Lifestyle Village

Prepared For:

Preston Green Pty Ltd



Transport Impact Assessment Report

T: +61 8 9274 7076
F: +61 8 9274 4854
E: Admin@dvcworld.com

6 Burgess St Midland WA 6056
PO Box 5060 Midland WA 6056
www.dvcworld.com

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Donald Veal Consultants Pty Ltd

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1. INTRODUCTION

1.1 Background

Preston Green Pty Ltd has commissioned Donald Veal Consultants (DVC) to prepare this report to support the planning application relating to the development of a lifestyle village, comprising up to 200 residential units, only available to the over 55s.



Figure 1.1: Site Location
Source: Nearmap



Figure 1.2: Site Boundary
Source: Nearmap

The site is located to the east of South Western Highway (SWH) and just north of Turner Street, in the northern part of Boyanup. The general location of the site is shown in **Figure 1.1**, and highlights the site location in relation to the local road network. The location is shown in more detail in **Figure 1.2**.

A plan of the proposed development layout is shown in **Appendix A**.

1.2 Scope of this Report

The Shire of Capel requires a transport impact assessment (TIA) to demonstrate the site and surrounding road networks' capability to accommodate the planned use. The TIA would typically include the following, in line with the Western Australia Planning Commission (WAPC) guidelines:

- Description of the development;
- Assessment of the likely parking demand;
- Consideration of nearby developments;
- Assessment of accessibility of the site by non-car modes;
- Assessment of the impact of the development traffic on existing pedestrians, cyclists and public transport users; and
- Assessment of the potential impact on the amenity of the surrounding area.

This report addresses these items and concludes that the proposed development can appropriately and safely be realised with no adverse impact on the capacity or safety of the surrounding road network.

2. EXISTING CONDITIONS

2.1 Location and Road Hierarchy

The site is located to the east of South Western Highway, in the northern part of Boyanup, just to the north of Turner Street.

Turner Street is constructed as a single carriageway with one lane in either direction. It has no edge or centre lines, except near its intersection with South Western Highway, but is kerbed along both sides. (See **Photo 1**).



Photo 1: Typical section of Turner Street. Kerbed, but with no white line marking.



Photo 2: Turner Street intersection looking north along South Western Highway

In the vicinity of the Turner Street intersection, South Western Highway is constructed with one lane in each direction, median islands and edge lines. It is fully kerbed and has wide grass verges with a footpath along the east side.



Photo 3: Start of the South West Highway 50 km/h zone just to the north of Turner Street.



Photo 4: Turner Street, looking east.

The Main Roads WA (MRWA) Road Hierarchy Classification covering the roads in the vicinity of the development site is shown in **Figure 2.1**.



Figure 2.1: Road Hierarchy
Source: MRWA

Turner Street will fall under the default urban speed limit of 50 kilometres per hour (km/h). The speed limit on South Western Highway is posted as 50 km/h in the vicinity of the Turner Street intersection, with a 60 km/h zone commencing some 60m to the north. The published data available from MRWA on the wider road network is shown in **Figure 2.2**.



Figure 2.2: Road Speed Limit
Source: MRWA

2.2 Existing Traffic Volumes and Operation

The site was previously used as a Function Centre and Restaurant, but has been closed down for some time. It is therefore no longer generating any traffic.

Other traffic generators along Turner Street include a handful of private residences, a Fire Station occupied by the Boyanup Bush Fire Brigade, the South West Rail and Heritage Centre and the newly opened "Capel Men's Shed".



Photo 5: Traffic generators on Turner Street

Current traffic flows on Turner Street are therefore extremely low, with less than ten trips observed in each peak hour period. The data recorded for DVC's ***Boyanup Transport Infrastructure Study*** showed similar levels, with 13 vehicles recorded in each peak period.

Recent counts carried out by DVC along South Western Highway indicate that peak hour through flows past the Turner Street intersection would be approximately 320 northbound and 170 southbound in the am peak, and 150 northbound and 270 southbound in the pm peak.

2.3 Crash History

The MRWA CARS database reveals no recorded crashes at the intersection of South Western Highway and Turner Street (listed as Turner Road), but does show that 11 crashes occurred along SWH in the last 5 year period up to December 2013 between the Payne Street and Bridge Street intersections. These included 3 requiring medical attention. Eight of the crashes involved vehicles travelling in the same direction.

3. PROPOSED DEVELOPMENT

3.1 Description of Proposed Development

The development will consist of up to 200 residential units, set out in a 'Lifestyle Village'. There will be a minimum age limit of at least 55 years for all permanent residents, and it is therefore expected that a significant proportion of the population will be made up of 'Grey Nomads', who will treat their homes as a 'lock and leave' asset whilst travelling around Australia.

The main access to the development will be via the existing Function Centre driveway at the eastern end of Turner Street. An alternative emergency vehicular exit may be required from the western side of the development out onto South Western Highway, but if provided, this would normally be gated and locked. However, it may provide a permanent additional pedestrian access.

It is expected that development on the site will be phased over a number of years, depending on demand. The analysis in this report is based on the 'worst case' scenario, whereby the full complement of approximately 200 units has been constructed.

The layout plan for the proposed development is attached in **Appendix A**.

3.2 Traffic Generation, Distribution and Assignment

Whilst the trip generation rates per unit for the 'Lifestyle Village' may tend to be slightly higher than those quoted for a 'Retirement Village' or for 'Aged Persons' housing, it is expected that the average occupancy rates will be much lower.

Three different sources of published traffic generation rates have been used to determine a representative rate for the Lifestyle Village development. These are the NSW Road Traffic Authority's (RTA), 'Guide to Traffic Generating Developments (2002), the Director General of Transport South Australia's 'Land Use Traffic Generation Guidelines', and the Institute of Traffic Engineering's (ITE) publication, 'Trip Generation Rates (8th Edition)'.

RTA

3.3.4 Housing for aged and disabled persons.

Rates.

Daily vehicle trips = 1 - 2 per dwelling
Evening peak hour vehicle trips = 0.1 - 0.2 per dwelling.

Factors.

These figures at the lower end of the above rates are based on research conducted by the Authority. This research concentrates on *subsidised* developments (often run by religious organisations). Generation rates of *resident funded* developments are often greater, as indicated at the higher end of the range.

SOUTH AUSTRALIA

C. Retirement Villages

Daily Vehicle Trips = 1.5 to 3 trips per unit.

A trip rate of 3 trips per unit applies to new developments in the upper price range. Lower trip rates can be expected at villages where the car ownership is lower and trip rates can be expected to decline as the occupants become older.

ITE 8th Edition

Description	Units	ITE Vehicle Trip Generation Rates (peak hours are for peak hour of adjacent street traffic unless highlighted)						
		Week day	AM	PM	AM In	AM Out	PM In	PM Out
Senior Adult Housing-Detached	DU	3.71	0.22	0.27	35%	65%	61%	39%
Senior Adult Housing-Attached	Occ.DU	3.48	0.13	0.16	36%	64%	60%	40%
Congregate Care Facility	Occ.DU	2.15	0.06	0.17	61%	39%	56%	44%
Congregate Care Facility	DU	2.02	0.06	0.17	59%	41%	55%	45%
Assisted Living	Occ. Beds	2.74	0.17	0.29	73%	27%	52%	48%
Assisted Living	Beds	2.66	0.14	0.22	65%	35%	44%	56%
Assisted Living	Employees	3.93	NA	0.55	NA	NA	NA	NA
Retirement Community	Occ. Units	2.81	0.18	0.29	64%	36%	48%	52%

A previous DVC project involving a similar 'Lifestyle Village' development in the Shire of Mundaring used a daily trip generation rate of 3.18 daily trips, based on surveys carried out at an existing facility in Joondalup, in December 2005.

Whilst this figure is clearly at the high end of the published rates, for the purposes of this analysis, we will use this as a worst case scenario, with an assumed peak hour generation of 10% of the daily rate.

The above rates indicate that, with 200 units in place and all fully occupied, the development will generate a maximum of 64 trips in the peak hour periods (41 in / 23 out for the am peak and 31 in / 33 out for the pm peak). However, it is extremely unlikely that the occupancy rate will reach anything near 100% at any time.

4. TRAFFIC ANALYSIS

4.1 Access Driveway

As the main access driveway is to be located at the eastern termination of Turner Street, there is no issue with either visibility or operational efficiency. The access may be gated with a remote communications facility, but this has yet to be confirmed, and would have no significant effect in terms of traffic safety or capacity.

4.2 Road Network Impact

The major impact of traffic generated by the development will be at the intersection of Turner Street with South Western Highway. Visibility here is excellent, as can be seen in **Photos 6 & 6a**.

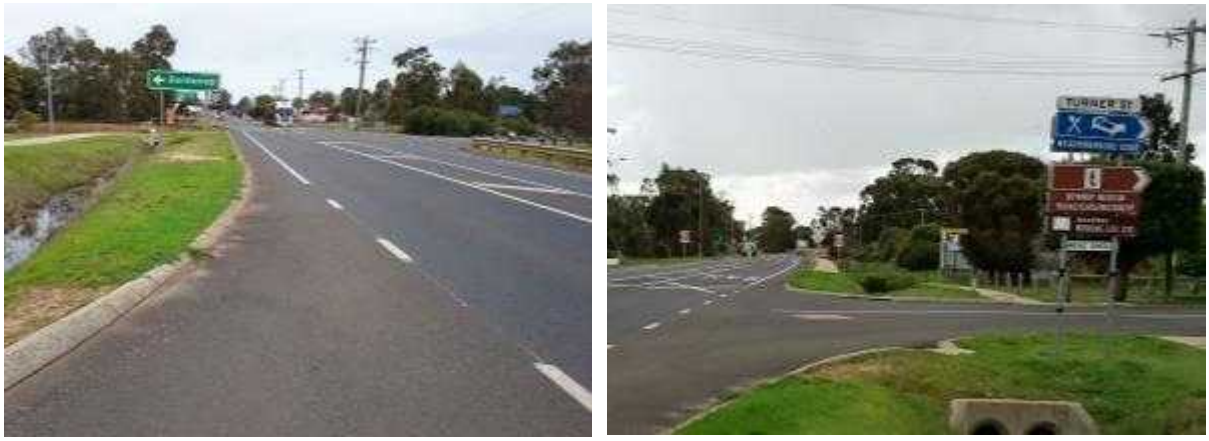


Photo 6 & 6a: Visibility along South Western Highway from Turner Street.

The results of the SIDRA analysis of the intersection under current traffic conditions can be seen in **Tables 4.1 and 4.2**.

MOVEMENT SUMMARY

Site: South Western Highway / Turner Street existing am peak

South Western Highway / Turner Street existing am peak
Giveway / Yield (Two Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: South Western Highway											
5	T1	340	0.0	0.178	0.7	LOS A	1.1	8.0	0.32	0.01	58.5
6	R2	5	0.0	0.178	6.1	LOS A	1.1	8.0	0.32	0.01	58.4
Approach		345	0.0	0.178	0.7	NA	1.1	8.0	0.32	0.01	58.5
East: Turner Street											
7	L2	1	0.0	0.003	7.1	LOS A	0.0	0.1	0.38	0.68	52.4
9	R2	2	0.0	0.003	7.0	LOS A	0.0	0.1	0.38	0.68	51.9
Approach		3	0.0	0.003	7.0	LOS A	0.0	0.1	0.38	0.68	52.1
North: South Western Highway											
10	L2	3	0.0	0.092	5.5	LOS A	0.0	0.0	0.00	0.01	58.3
11	T1	177	0.0	0.092	0.0	LOS A	0.0	0.0	0.00	0.01	59.9
Approach		180	0.0	0.092	0.1	NA	0.0	0.0	0.00	0.01	59.9
All Vehicles		528	0.0	0.178	0.6	NA	1.1	8.0	0.21	0.01	58.9

Table 4.1: SWH Turner Street intersection, Existing flows, am peak period

MOVEMENT SUMMARY

Site: South Western Highway / Turner Street existing pm peak

South Western Highway / Turner Street existing pm peak
Giveway / Yield (Two Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: South Western Highway											
5	T1	161	0.0	0.086	1.0	LOS A	0.5	3.8	0.39	0.02	58.2
6	R2	4	0.0	0.086	5.5	LOS A	0.5	3.8	0.39	0.02	56.1
Approach		165	0.0	0.086	1.2	NA	0.5	3.8	0.39	0.02	58.1
East: Turner Street											
7	L2	2	0.0	0.003	5.7	LOS A	0.0	0.1	0.35	0.56	52.6
9	R2	1	0.0	0.003	5.0	LOS A	0.0	0.1	0.35	0.56	52.1
Approach		3	0.0	0.003	5.5	LOS A	0.0	0.1	0.35	0.56	52.4
North: South Western Highway											
10	L2	3	0.0	0.140	5.6	LOS A	0.0	0.0	0.00	0.01	58.3
11	T1	265	0.0	0.140	0.0	LOS A	0.0	0.0	0.00	0.01	59.9
Approach		269	0.0	0.140	0.1	NA	0.0	0.0	0.00	0.01	59.9
All Vehicles		457	0.0	0.148	0.5	NA	0.5	3.8	0.14	0.01	59.2

Table 4.2: SWH Turner Street intersection, Existing flows, pm peak period

The results show that the intersection currently operates at a small fraction of its capacity, and all movements at Level of Service A. There are no significant delays or queuing at any of the approaches for either peak hour period.

The intersection was then reanalysed with the addition of the forecast peak hour traffic to be generated by the Lifestyle Village development. The subsequent results are shown in **Tables 4.3 and 4.4**.

MOVEMENT SUMMARY

Site: South Western Highway / Turner Street am peak with dev traffic

South Western Highway / Turner Street am peak with dev traffic
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: South Western Highway											
5	T1	340	0.0	0.197	0.8	LOS A	1.3	8.9	0.35	0.05	58.1
6	R2	33	0.0	0.197	8.2	LOS A	1.3	8.9	0.35	0.05	56.0
Approach		373	0.0	0.197	1.2	NA	1.3	8.9	0.35	0.05	57.9
East: Turner Street											
7	L2	17	0.0	0.026	6.8	LOS A	0.1	0.6	0.29	0.59	52.7
9	R2	11	0.0	0.026	6.7	LOS A	0.1	0.6	0.29	0.59	52.2
Approach		27	0.0	0.026	6.8	LOS A	0.1	0.6	0.29	0.59	52.5
North: South Western Highway											
10	L2	19	0.0	0.101	5.5	LOS A	0.0	0.0	0.00	0.05	57.9
11	T1	177	0.0	0.101	0.0	LOS A	0.0	0.0	0.00	0.05	59.5
Approach		196	0.0	0.101	0.5	NA	0.0	0.0	0.00	0.05	59.3
All Vehicles		596	0.0	0.197	1.3	NA	1.3	8.9	0.23	0.08	58.1

Table 4.3: SWH Turner Street intersection, am peak period with full development

MOVEMENT SUMMARY

Site: South Western Highway / Turner Street pm peak with dev traffic

South Western Highway / Turner Street pm peak with development traffic
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: South Western Highway											
5	T1	181	0.0	0.103	1.1	LOS A	0.6	4.5	0.40	0.09	57.6
6	R2	27	0.0	0.103	6.5	LOS A	0.6	4.5	0.40	0.09	56.5
Approach		188	0.0	0.103	1.9	NA	0.6	4.5	0.40	0.09	57.3
East: Turner Street											
7	L2	25	0.0	0.035	6.8	LOS A	0.1	0.9	0.38	0.61	52.5
9	R2	13	0.0	0.035	6.7	LOS A	0.1	0.9	0.38	0.61	52.0
Approach		38	0.0	0.035	6.8	LOS A	0.1	0.9	0.38	0.61	52.4
North: South Western Highway											
10	L2	13	0.0	0.158	5.6	LOS A	0.0	0.0	0.00	0.08	58.1
11	T1	285	0.0	0.153	0.0	LOS A	0.0	0.0	0.00	0.00	59.7
Approach		298	0.0	0.153	0.2	NA	0.0	0.0	0.00	0.03	59.7
All Vehicles		524	0.0	0.153	1.3	NA	0.6	4.5	0.17	0.09	58.2

Table 4.4: SWH Turner Street intersection, pm peak period with full development

It can be seen that following completion of the development, and even assuming full occupancy of the 200 units, the forecast peak hour traffic movements can be easily accommodated within the existing capacity of both Turner Street and South West Highway, and have minimal impact on the intersection of these two roads.

All movements at the intersection continue to perform with LoS A, with negligible delays or queuing. Clearly there will be no need for any upgrades to the intersection as a direct result of the development.

4.3 Planned Future Changes

There are a number of future planned changes in the Boyanup area, which may have an effect on the distribution and levels of traffic some years into the future.

A Boyanup Bypass has been planned for within the Greater Bunbury Region Scheme (WAPC, 2011) and is also reflected in the Boyanup Structure Plan. **Figure 4.1** illustrates the proposed alignment of this road.

The Boyanup Bypass is considered a long-term planning item (20+ years away). MRWA advised that there are no funds allocated to this project within the foreseeable future. The WAPC, through the Greater Bunbury Region Scheme, is progressively acquiring land associated with the bypass.

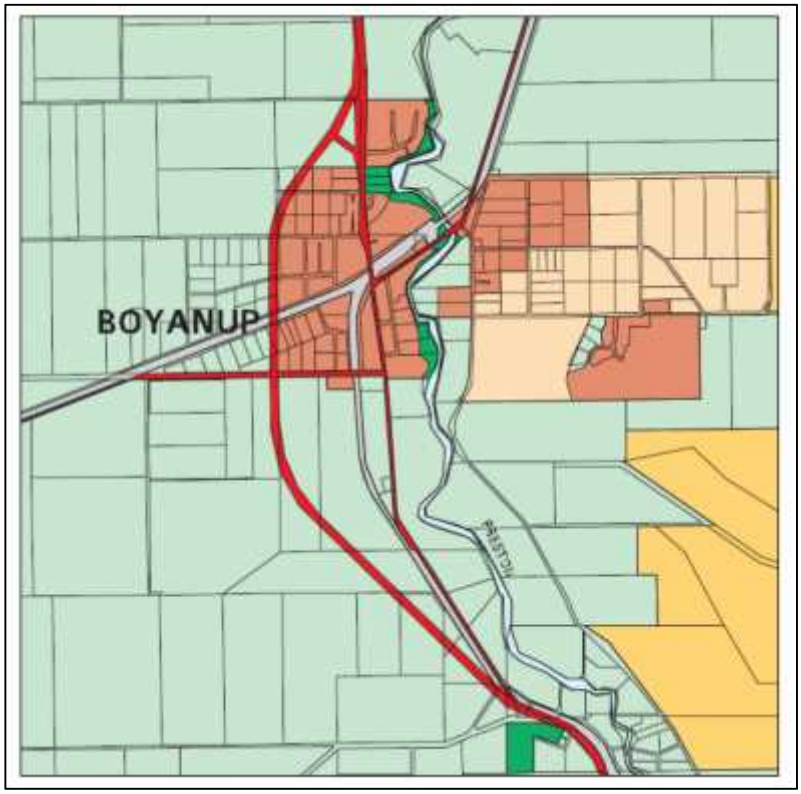


Figure 4.1 Boyanup Bypass (WAPC, 2011)

In addition to this, various areas have been set aside for either residential or commercial development. Traffic generation forecasts for these areas have been made in DVC's draft report for the ***Boyanup Transport Infrastructure Study***, currently being carried out for the Shire of Capel. These include different planning horizons, with the long term scenario stretching to beyond 15 years into the future.

Clearly, significant additional traffic is forecast to be generated by these proposed developments. However, the estimated reductions in traffic along South Western Highway, as a result of the construction of the Boyanup Bypass, assist in limiting the traffic volumes to 12,600 vpd and 15,800 vpd in the medium and long term, respectively.

Using these forecast future flows, SIDRA analyses were then carried out for various intersections along South Western Highway.

As part of the assessment of the impact of the Meadowbrooke development, these same through volume forecasts have again been used to carry out similar future year analysis of the Turner Street intersection, including the forecast Lifestyle Village development traffic. Each of the peak hour periods has been assumed to produce 10% of the predicted all-day flows on South Western Highway.

The results for the long term scenario are shown below in **Tables 4.5 and 4.6**.

MOVEMENT SUMMARY

Site: South Western Highway / Turner Street Future year am peak with dev traffic

South Western Highway / Turner Street am peak with dev traffic
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: South Western Highway											
5	T1	1091	0.0	0.595	7.8	LOS A	12.2	85.6	1.00	0.04	59.0
6	R2	33	0.0	0.595	13.3	LOS B	12.2	85.6	1.00	0.04	61.2
Approach		1126	0.0	0.595	8.0	NA	12.2	85.6	1.00	0.04	59.0
East: Turner Street											
7	L2	17	0.0	0.127	20.1	LOS C	0.4	2.5	0.78	0.86	44.2
9	R2	11	0.0	0.127	20.0	LOS C	0.4	2.5	0.78	0.86	43.8
Approach		27	0.0	0.127	20.1	LOS C	0.4	2.5	0.78	0.86	44.0
North: South Western Highway											
10	L2	19	0.0	0.302	5.6	LOS A	0.0	0.0	0.00	0.02	58.1
11	T1	585	0.0	0.302	0.0	LOS A	0.0	0.0	0.00	0.02	59.8
Approach		597	0.0	0.302	0.2	NA	0.0	0.0	0.00	0.02	59.7
All Vehicles		1741	0.0	0.595	5.6	NA	12.2	85.6	0.66	0.04	54.9

Table 4.5: SWH Turner am peak with dev traffic, Long Term Scenario

MOVEMENT SUMMARY

Site: South Western Highway / Turner Street future year pm peak with dev traffic

South Western Highway / Turner Street pm peak with development traffic
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: South Western Highway											
5	T1	600	0.0	0.377	15.9	LOS C	7.8	54.7	1.00	0.05	47.4
6	R2	27	0.0	0.377	21.3	LOS C	7.8	54.7	1.00	0.05	46.0
Approach		627	0.0	0.377	16.1	NA	7.8	54.7	1.00	0.05	47.3
East: Turner Street											
7	L2	25	0.0	0.187	22.4	LOS C	0.5	3.8	0.87	0.95	43.0
9	R2	13	0.0	0.187	22.4	LOS C	0.5	3.8	0.87	0.95	42.6
Approach		38	0.0	0.187	22.4	LOS C	0.5	3.8	0.87	0.95	42.9
North: South Western Highway											
10	L2	13	0.0	0.552	5.6	LOS A	0.0	0.0	0.00	0.01	58.1
11	T1	1063	0.0	0.552	0.1	LOS A	0.0	0.0	0.00	0.01	59.7
Approach		1076	0.0	0.552	0.2	NA	0.0	0.0	0.00	0.01	59.7
All Vehicles		1741	0.0	0.552	0.4	NA	7.8	54.7	0.98	0.04	54.2

Table 4.6: SWH Turner pm peak with dev traffic, Long Term Scenario

As can be seen, even with the added long term scenario traffic on South Western Highway, all movements at the intersection perform adequately, and remain well within capacity. However, there is some queuing on the south approach, with the right turning traffic into Turner Street causing some delays to through traffic. Whilst these are not excessive, it would be expected that, as part of the general widening works required for South Western Highway along this section in the long term scenario, the provision of a right turning pocket would be beneficial. However, it should be noted that this is not a direct result of the Meadowbrooke development, but rather a result of the increased traffic along the major road.

5. OTHER ISSUES

5.1 Car Parking Provision

Each home site within the development will be provided with 2 parking bays, arranged either in tandem or side by side.

The current layout concept plan, as shown in **Appendix A**, indicates that there will also be approximately 54 visitor bays spread throughout the development, with 20 of these located near the Club House, and 4 near the Turner Street entry point. An additional 44 elongated bays have been provided in a dedicated boat and caravan parking area, served by a one way link road system. All vehicles here will be reverse parked.

5.2 Pedestrians and Cyclists

Currently, there are no footpaths along Turner Street, but there is a path along South Western Highway. This is shown in **Photos 7 and 7a**.



Photos 7 & 7a: Footpath on South Western Highway north and south of Turner Street.

There are currently two pedestrian routes between the proposed development and the town centre. The first is the more direct, and leads across the railway lines towards the tavern. The alternative would be to walk down Turner Street to South Western Highway and turn left, using the existing footpath along the highway.

The Shire considers that both of these routes should be provided with shared use paths and linkages where required to allow for safe direct access to the Town Centre. However, whilst some pedestrian movements would be expected, and the provision of a suitable, safe route to accommodate these movements would be recommended, it is unlikely that the level of cycling trips to be generated by the development would warrant the provision of a shared path on either route.

The railway lines already have a pedestrian crossing facility between the development and the Tavern, which dates back to the days when trains still ran. A formal pedestrian facility could readily be constructed to link the development to the Tavern and the Town Centre via this existing crossing.

The route along the highway, however, would necessitate the provision of a new crossing just north of South Western Highway, which would require the asset owners' permission (PTA). It is understood that this has been sought in the past by the Shire, but to no avail. A renewed effort by the Shire, with support from the developer, may result in the required approvals being gained. Such a link would be advantageous to other road users, such as school children, who currently have to cross SWH twice to remain on the existing footpath, due to the present rail crossing being located on the west side of the highway.

5.3 Public Transport

There are no known public transport services available in the vicinity of the site. Whilst a railway line runs adjacent the site, this is understood to have been a goods line and has been disused for a number of years. Some school bus services may travel along South Western Highway.

5.4 Service and Emergency Vehicles

It is assumed that each home site will have individual refuse bins, which will be wheeled out to suitable locations along the verges of the internal road system, for collection by a standard Shire contracted rubbish truck.

There do not appear to be any areas of immediate concern within the current concept plan layout in this regard, with the exception of one or two culs-de-sac. However, residents of these properties would easily be able to wheel their bins out onto the main loop roads. These sorts of issue will be addressed more fully in the detailed design layout drawings.

Similarly, there do not appear to be any issues regarding the ability of emergency service vehicles accessing the properties within the site. The design of the roundabout near the main entry will need to allow for the passage of such vehicles, either within the circulatory pavement width, or using a mountable apron.

6. SUMMARY AND CONCLUSION

6.1 Summary

The development will consist of up to 200 residential units, set out in a 'Lifestyle Village'. There will be a lower age limit of 55 for all permanent residents, and it is therefore expected that a significant proportion of the population will be made up of 'Grey Nomads', who will treat their homes as a 'lock and leave' asset whilst travelling around Australia.

The main access to the development will be via the existing Function Centre driveway at the eastern end of Turner Street. An alternative emergency vehicular exit may be required from the western side of the development out onto South Western Highway (SWH), but if provided, this would normally be gated and locked. However, it may provide a permanent additional pedestrian access.

It is expected that development on the site will be phased over a number of years, depending on demand. The analysis in this report is based on the 'worst case' scenario, whereby the full complement of approximately 200 units has been constructed.

The level of additional traffic forecast to be generated by the fully developed Lifestyle Village is not high, amounting to only 64 trips in each peak hour period. Analysis of the intersection of Turner Street with SWH showed that the intersection is easily able to cater for this additional traffic under current flows on SWH. However, in the longer term scenario, there are a number of future planning elements that need to be considered. These include the provision of a bypass to the west of South Western Highway, and a number of significant developments in different areas around the existing town.

Again, analysis of the Turner Street intersection was carried out, this time with the long term forecast traffic flows on SWH. Again, the intersection coped with the flows, but with reduced Levels of Service. The provision of a right turn lane may be beneficial, as art of the general long term upgrades of SWH in this area.

It is also recommended that the existing pedestrian facilities serving the site are upgraded to provide safer, more direct routes to the Town Centre. This might include formalisation of the footpath link to the tavern using the existing rail crossing, and investigations into a potential new rail crossing for pedestrians north of SWH.

6.2 Conclusion

We conclude that the development proposal has no significant adverse impact on the capacity or safety of the surrounding road network. We therefore fully support the development application in terms of its traffic and road safety impact and recommend its approval.

APPENDIX A: PROPOSED DEVELOPMENT


N
EMERGENCY ESCAPE ROUTE
POND
234
PEDESTRIAN ACCESS
BIORETENTION SWALE
VILLAGE GREEN
CLUB HOUSE
SHORT STAY
EMERGENCY ESCAPE ROUTE
FAMILY CENTRE
SHED
WORKSHOP
CARPORT
TURNER STREET
CONCEPT PLAN
mpm
development consultants
MEADOWBROOKE LIFESTYLE ESTATE
Drawing Number: 14041-01
Revision: A
Original Size: A1

Lloyd George Acoustics
PO Box 717
Hillarys WA 6923
T: 9401 7770 F:9300 4199
E: terry@lgacoustics.com.au W: www.lgacoustics.com.au

Transportation Noise Assessment

Meadowbrook Estate Lifestyle Village, Boyanup

Reference: 14072858-01 Draft.docx

Prepared for:
Preston Green Pty Ltd

Member Firm of Association of Australian Acoustical Consultants

Report: 14072858-01 Draft.docx

Lloyd George Acoustics Pty Ltd

ABN: 79 125 812 544

PO Box 717
Hillarys WA 6923

T: 9300 4188 / 9401 7770
F: 9300 4199

Contacts	Daniel Lloyd	Terry George	Mike Cake	Matt Moyle
E:	daniel@lgacoustics.com.au	terry@lgacoustics.com.au	mike@lgacoustics.com.au	matt@lgacoustics.com.au
M:	0439 032 844	0400 414 197	0438 201 071	0412 611 330

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Prepared By:	Terry George 
Position:	Project Director
Date:	6 September 2014

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B Terminology

1 INTRODUCTION

It is proposed to construct a lifestyle village in Boyanup, located as shown below in *Figure 1-1*. The site will comprise of a number of modular type buildings with some located to the west, in close proximity to South Western Highway. As such, this report considers the impact from road traffic noise to the site and provides recommendations to comply with relevant criteria in Western Australia.

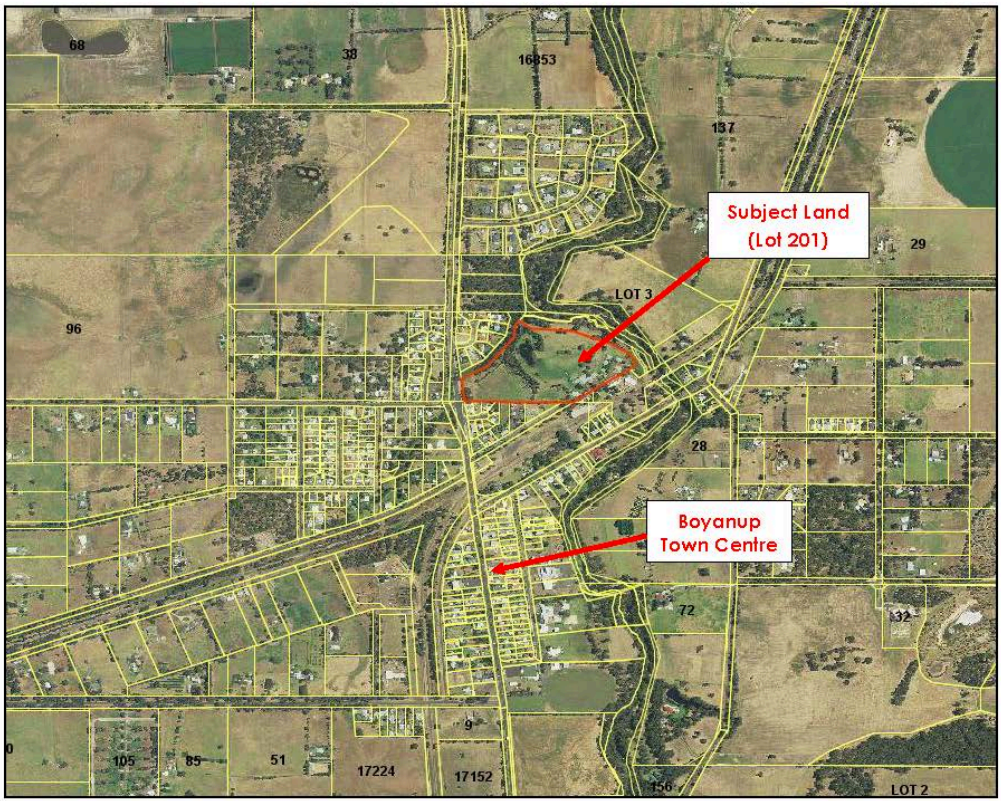


Figure 1-1 Site Locality

In addition to the road traffic noise, there is an existing freight line to the south of the site, which is separated from the site by a number of buildings. Advice from Public Transport Authority (PTA) and Brookfield Rail (BR) is that there are no trains between Picton and Boyanup or Boyanup and Donnybrook and it is unknown at this stage whether the line will be used again in the future. Irrespective of the current status of the line, consideration has been given to potential noise and vibration levels.

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

2 CRITERIA

2.1 Noise Criteria

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

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

The Policy's outdoor noise criteria are shown below in *Table 2-1*. These criteria applying at any point 1-metre from a habitable façade of a noise sensitive premises and in one outdoor living area.

Table 2-1 Outdoor Noise Criteria

Period	Target	Limit
Day (6am to 10pm)	55 dB $L_{Aeq(Day)}$	60 dB $L_{Aeq(Day)}$
Night (10pm to 6am)	50 dB $L_{Aeq(Night)}$	55 dB $L_{Aeq(Night)}$

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

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

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

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

In areas where the *target* is exceeded, customised noise mitigation measures should be implemented with a view to achieving the *target* in at least one outdoor living area on each residential lot, or if this is not practicable, within the *margin*. Where indoor spaces are planned to be facing outdoor areas that are above the *target*, mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces.

2.2 Vibration Criteria

Exposure limits for vibration are normally defined in terms of a multiplying factor that is applied to the base curves defined in Australian Standard 2670.2:1990 *Evaluation of Human Exposure to Whole-Body Vibration Part 2: Continuous and Shock Induced Vibration in Buildings (1 to 80Hz)*. The base curve is the point at which adverse comment is considered rare. It also states that at levels above the base curve, vibration may or may not give rise to adverse comment depending on circumstances. The measure of human annoyance is a velocity (mm/s) root mean squared (rms). The multiplying factors are given in Appendix A of AS 2670.2-1990 and it is typical for Curve 2 to be used. The Curve 2 vibration level varies with direction (radial, transverse, vertical) and frequency. For the vertical direction, the vibration level is consistent at 0.199mm/s from 8 to 80Hz.

It should be noted that AS2670.2 has been withdrawn, however is still used by the Department of Environment Regulation (DER) for such assessments.

3 METHODOLOGY

Noise measurements alongside the road and modelling have been undertaken in accordance with the requirements of the Policy as described below in *Sections 3.1 and 3.2*.

3.1 Site Measurements

Noise monitoring was undertaken alongside South Western Highway in order to:

- Quantify the existing noise levels;
- Determine the differences between different acoustic parameters ($L_{A10,18hour}$, $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$); and
- Calibrate the noise model for existing conditions.

The instrument used was an ARL Type 316 noise data logger (refer *Figure 3-1*), located 3 metres within the western boundary of the site, with the microphone 1.4 metres above ground level. The logger was programmed to record hourly L_{A1}, L_{A10}, L_{A90}, and L_{Aeq} levels. This instrument complies with the instrumentation requirements of *Australian Standard 2702-1984 Acoustics – Methods for the Measurement of Road Traffic Noise*. The logger was field calibrated before and after the measurement session and found to be accurate to within +/- 1 dB. Lloyd George Acoustics also holds current laboratory calibration certificate for the loggers.

The noise data collected was verified by inspection and professional judgement. Where hourly data was considered atypical, an estimated value was inserted and highlighted by bold italic lettering.

As the freight railway is not currently in use, noise and vibration measurements could not be undertaken. As such, file data has been referenced to allow assessment to be undertaken.



Figure 3-1 Typical Logger Field Set-up

3.2 Noise Modelling

The computer programme *SoundPLAN 7.3* was utilised, where for road traffic the *Calculation of Road Traffic Noise* (CoRTN) algorithms were incorporated, modified to reflect Australian conditions. The modifications included the following:

- Vehicles were separated into heavy (Austroads Class 3 upwards) and non-heavy (Austroads Classes 1 & 2) with non-heavy vehicles having a source height of 0.5 metres above road level and heavy vehicles having two sources, at heights of 1.5 metres and 3.6 metres above road level, to represent the engine and exhaust respectively. By splitting the noise source into three, allows for less barrier attenuation for high level sources where barriers are to be considered. Note that corrections are applied to the exhaust of –8.0 dB (based on Transportation Noise Reference Book, Paul Nelson, 1987) and to the engine source of –0.8 dB, so as to provide consistent results with the CoRTN algorithms for the no barrier scenario;
- An adjustment of –1.7 dB has been applied to the predicted levels based on the findings of An Evaluation of the U.K. DoE Traffic Noise Prediction; Australian Road Research Board, Report 122 ARRB – NAASRA Planning Group 1982.

For freight trains, the Nordic Rail Prediction Method (Kilde Rep. 130) has been used within *SoundPLAN 7.3*. The Nordic Rail Prediction Method (Kilde Rep. 130) algorithm is for generic train types in Europe and requires modification to align with measured noise levels of locomotives and wagons used in the Perth region. In addition, to accurately predict the effect of barriers (hills, buildings or walls), the noise source height of the locomotive was raised from the model standard of 0.5 metres to 4.0 metres above the railhead.

Predictions are made at heights of 1.4 metres above ground floor level and at 1.0 metre from an assumed building façade (resulting in a + 2.5 dB correction due to reflected noise).

Various input data are included in the modelling such as ground topography, road design, traffic volumes etc. These model inputs are discussed below.

3.2.1 Ground Topography, Road Design & Cadastral Data

Topographical data was based on that provided by MPM.

Existing buildings have also been included as these can provide barrier attenuation when located between a source and receiver, in much the same way as a hill or wall provides noise shielding. All buildings are assumed to be single storey with a height of 3.5 metres.

Finished floor levels were not available at the time of this study so the assumed levels have been shown on the contour drawings.

Should the layout or levels of the proposed dwellings change, then the assessment should be reviewed.

3.2.2 Traffic Data

Traffic data includes:

- Road Surface – The noise relationship between different road surface types is shown below in *Table 3-1*.

Table 3-1 Noise Relationship Between Different Road Surfaces

Road Surfaces						
Chip Seal			Asphalt			
14mm	10mm	5mm	Dense Graded	Novachip	Stone Mastic	Open Graded
+3.5 dB	+2.5 dB	+1.5 dB	0.0 dB	-0.2 dB	-1.0 dB	-2.5 dB

The existing and future road surface is assumed to be a worn chip seal.

- Vehicle Speed – The existing and future posted speeds are 60km/hr.

- Road Traffic Volumes – Main Roads were contacted to obtain relevant traffic volumes. It was advised that the existing volumes are 6,500 vehicles per day, with 14% of these being heavy vehicles. Assuming a growth rate of 4% per annum, future (2031) volumes will be around 12,600 vehicles per day. The percentage heavy vehicles are assumed to be the same in the future as existing.

- Rail Traffic Volumes – With the line currently not in use, an assumption of 1 freight train per hour has been assumed with each train being 400 metres long pulled by a D Class locomotive. This results in the $L_{Aeq(Night)}$ being more critical for trains.

3.2.3 Ground Attenuation

The ground attenuation has been assumed to be 0.2 (20%) for the road and 0.5 (50%) elsewhere. Note 0.0 represents hard reflective surfaces such as water and 1.00 represents absorptive surfaces such as grass.

4 RESULTS

4.1 Noise Monitoring

The results of the noise monitoring are summarised below in *Table 4-1* and shown graphically in *Figure 4-1*.

Table 4-1 Measured Average Noise Levels: South Western Highway

Date	Average Weekday Noise Level, dB			
	$L_{A10,18hour}$	$L_{Aeq,24hour}$	$L_{Aeq\ (Day)}$	$L_{Aeq\ (Night)}$
Tuesday 29 July 2014	65.0	63.1	64.3	58.8
Wednesday 30 July 2014	65.4	63.1	644	57.7
Thursday 31 July 2014	64.8	62.5	63.7	57.4
Friday 1 August 2014	66.0	62.6	63.9	57.3
Monday 4 August 2014	65.2	62.5	63.8	57.8
Weekday Average	**65.3**	**62.7**	**64.0**	**57.8**

The average differences between the weekday $L_{A10,18hour}$ and $L_{Aeq(Day)}$ is 1.3 dB and this conversion has been used in the modelling. The average differences between the weekday $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$ is 6.2 dB. This same difference has been assumed to exist in future years. As such, it is the daytime noise levels that will dictate compliance for road traffic since these are at least 5 dB more than night-time levels.

4.2 Noise Modelling

The road noise model was initially set-up to reflect existing conditions to enable model calibration. The existing $L_{Aeq(Day)}$ noise level contours are shown on *Figure 4-2*.

The road model was then changed to reflect future conditions, including increased traffic volumes and proposed dwellings. The contours associated with this future scenario are shown on *Figure 4-3*. More detailed analysis shows that the closest dwellings to South Western Highway are calculated to experience noise levels of up to 69 dB $L_{Aeq(Day)}$.

The results of the rail model are shown on *Figure 4-4* showing that the $L_{Aeq(Night)}$ is around x dB at the nearest dwellings.

Figure 4-5 shows the results of typical vibration measurements, 25 metres from the railway track.

Figure 4-1: Noise Monitoring Results

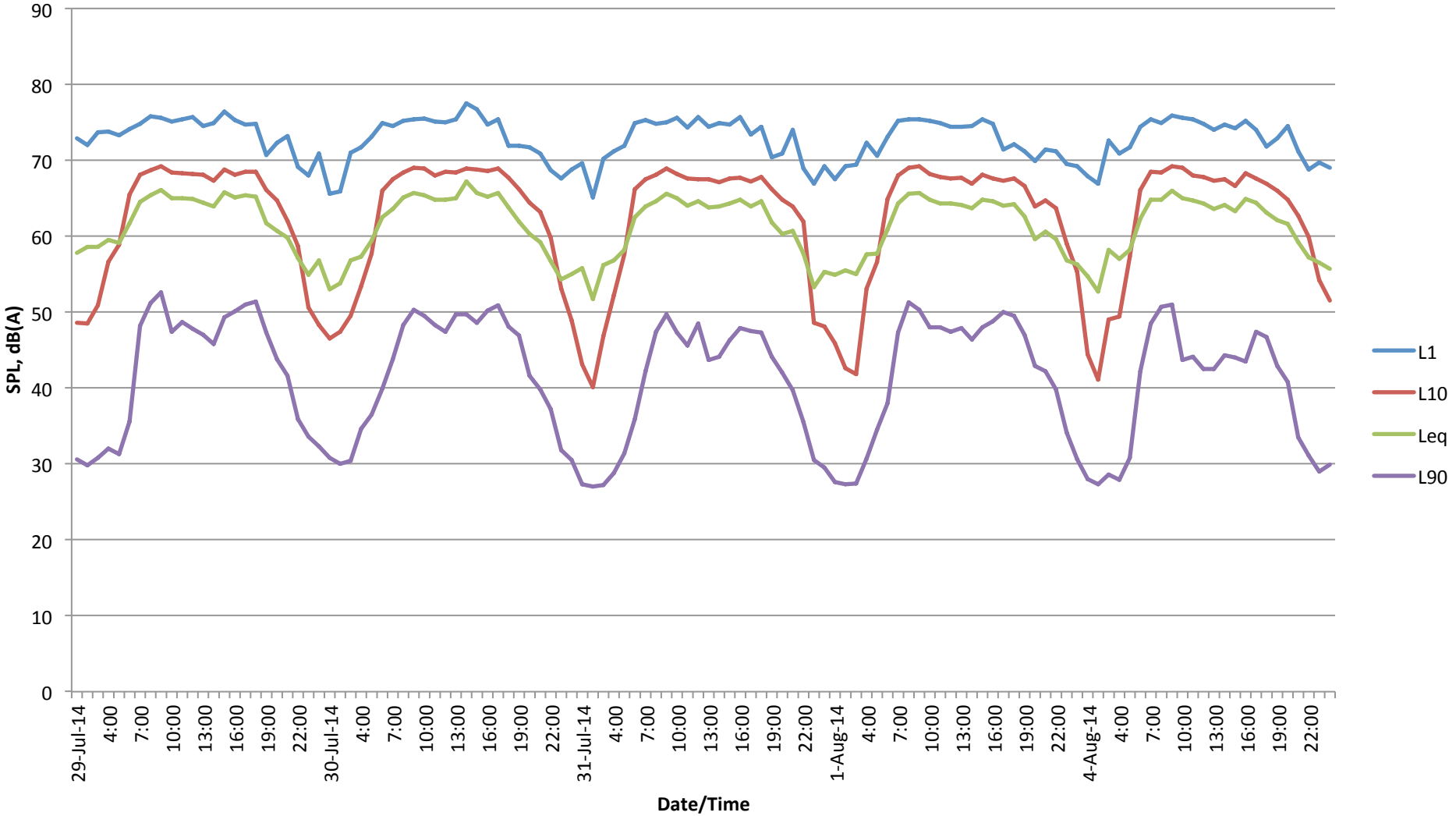
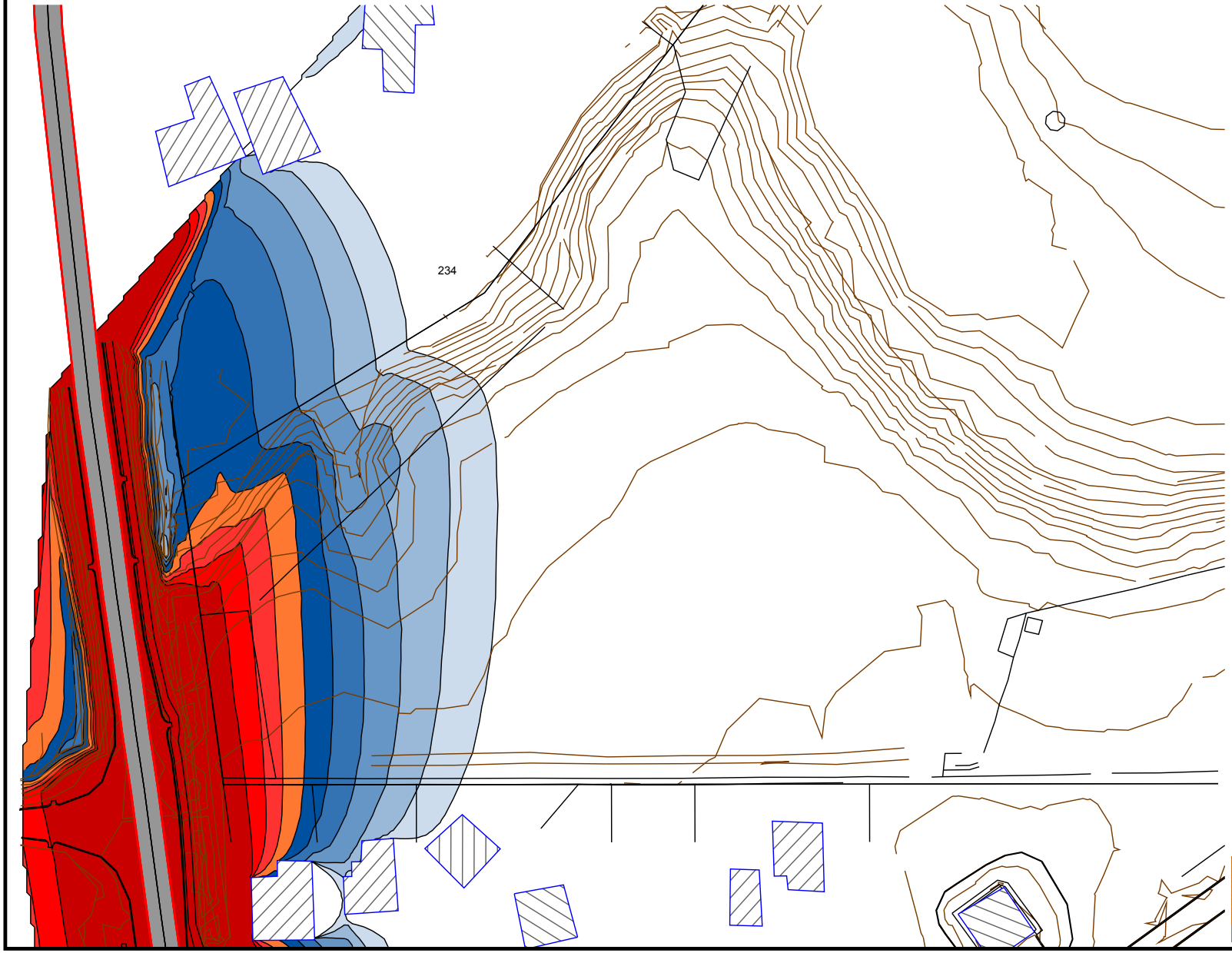


Figure 4-2

Pro ose L est e V e o

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No se e e s
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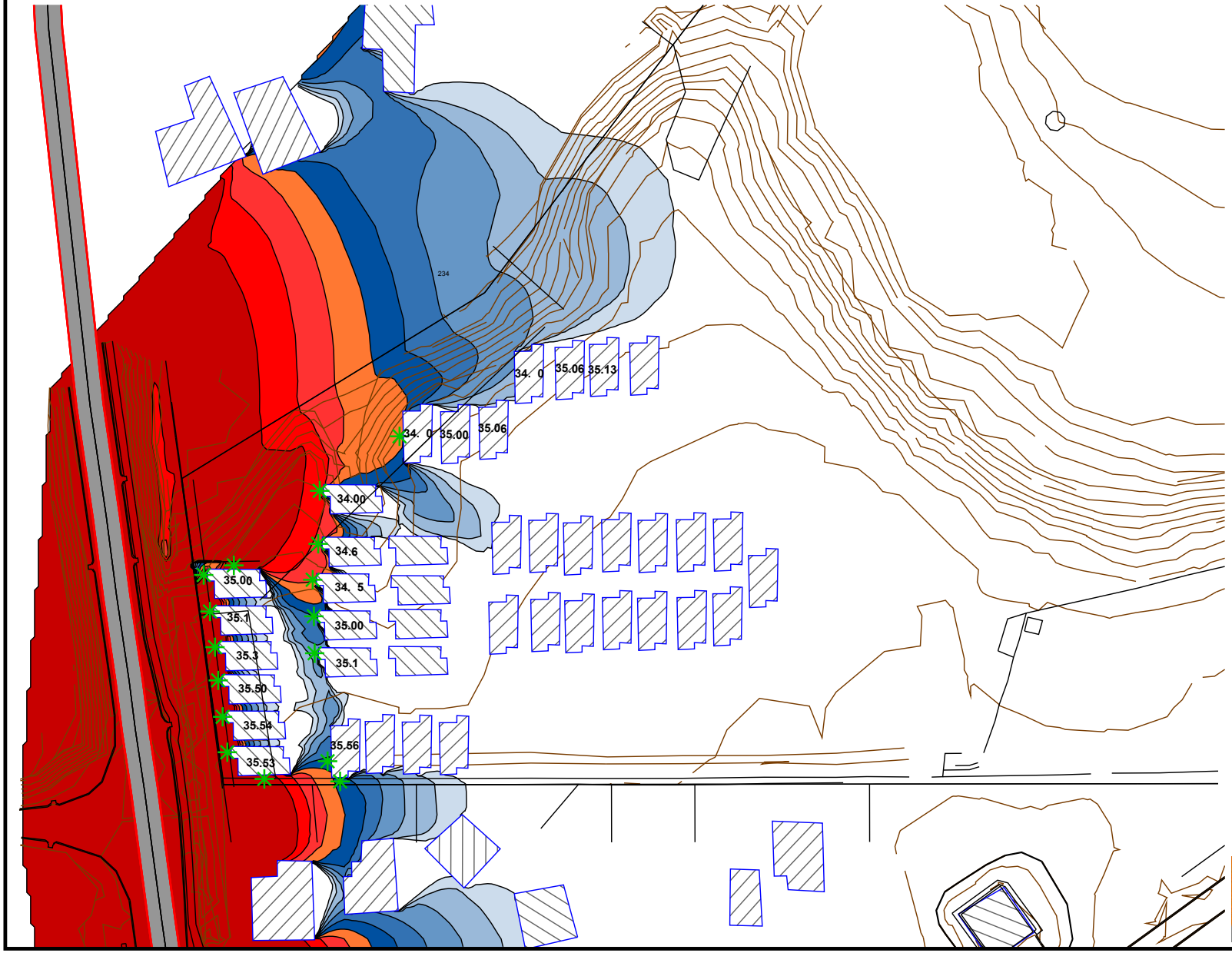
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Figure 4-3

Pro ose L est e V e o
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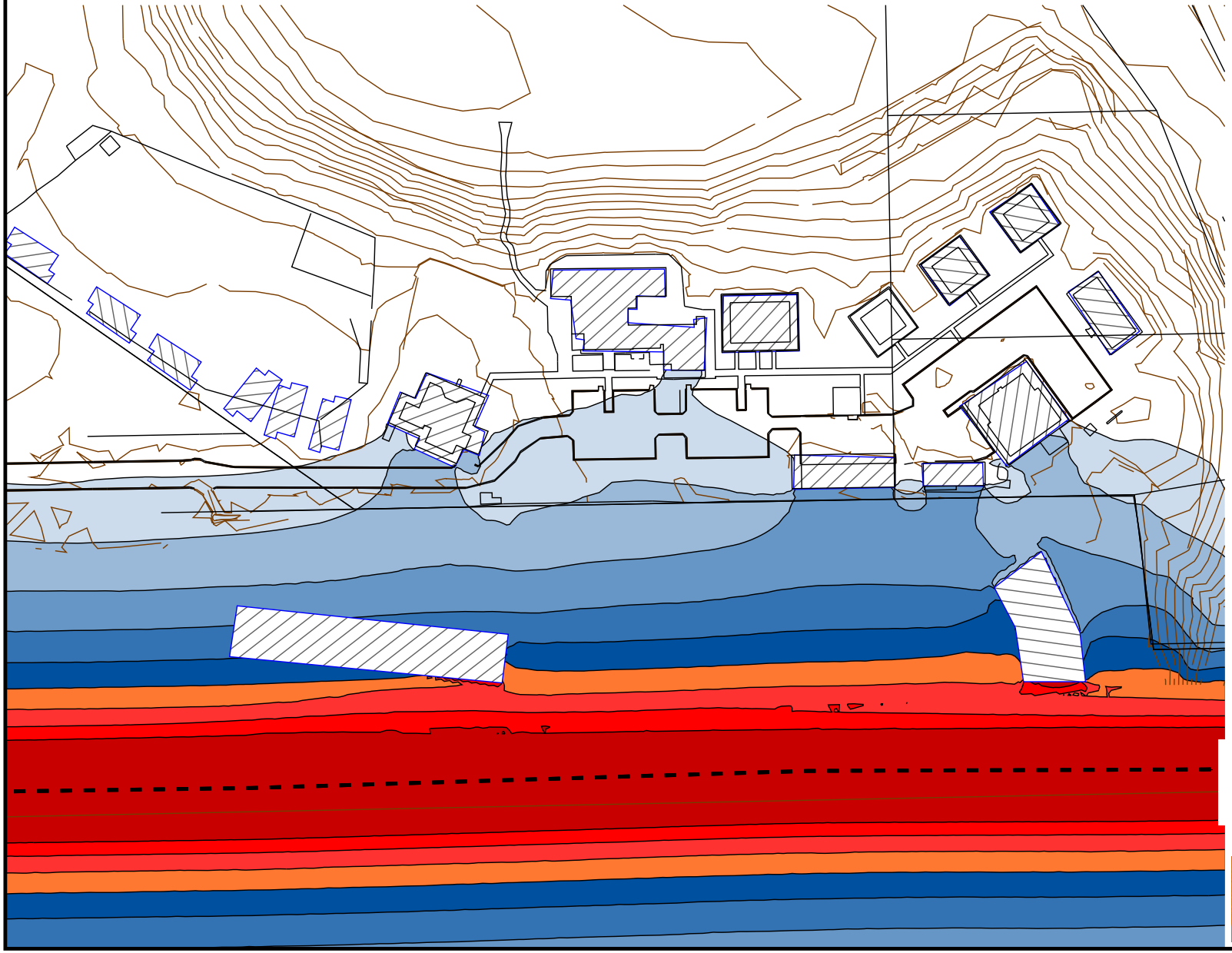
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Pro ose L est e V e o
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Figure 4-4



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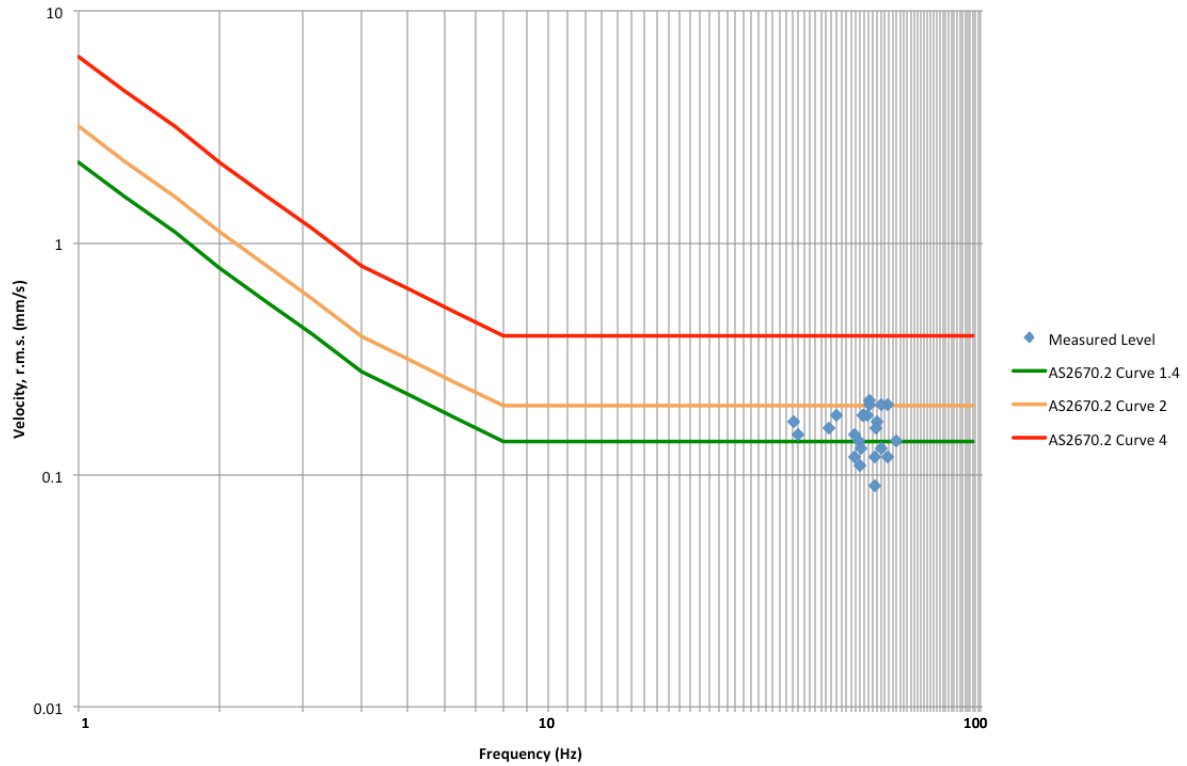


Figure 4-5 25m From Railway Track Vertical RMS Vibration Velocity

5 ASSESSMENT

The objectives of the criteria are for noise at all houses to be no more than the *limit* and preferably no more than the *target*. Where the *target* is achieved, no further controls are required. Where the *limit* is achieved or noise levels are within the *margin* (between the *limit* and *target*), further controls are necessary.

With no noise control, road traffic noise levels for future dwellings will be above the ***target***. As such, consideration has been given to the construction of noise walls. It is considered impracticable to achieve the ***target*** with the construction of noise walls alone with the height of the wall needing to be above 4 metres, which is a commonly adopted maximum acceptable wall height in Western Australia.

A minimum wall height (relative to finished floor level) to achieve the *limit* was determined to be 2.3 metres high alongside South Western highway with two returns at 1.8 metres high as shown on *Figure 5-1*, noise contour plot. Note that the wall is to be of free of gaps and be constructed of a minimum surface mass of 15kg/m^2. Whilst this wall will protect the closest row of houses, there are still others further away that will be exposed to noise levels above the ***target***.

With regards to rail noise, on the basis of 1 train movement per hour, noise levels at the nearest future dwellings will be below the ***target*** and therefore no further treatment is required.

Vibration is likely to comply at a distance of 25 metres from the railway. The closest dwelling is at a distance of around 85 metres and therefore vibration compliance will be achieved.

With reference to *Figure 5-2*, the following is recommended:

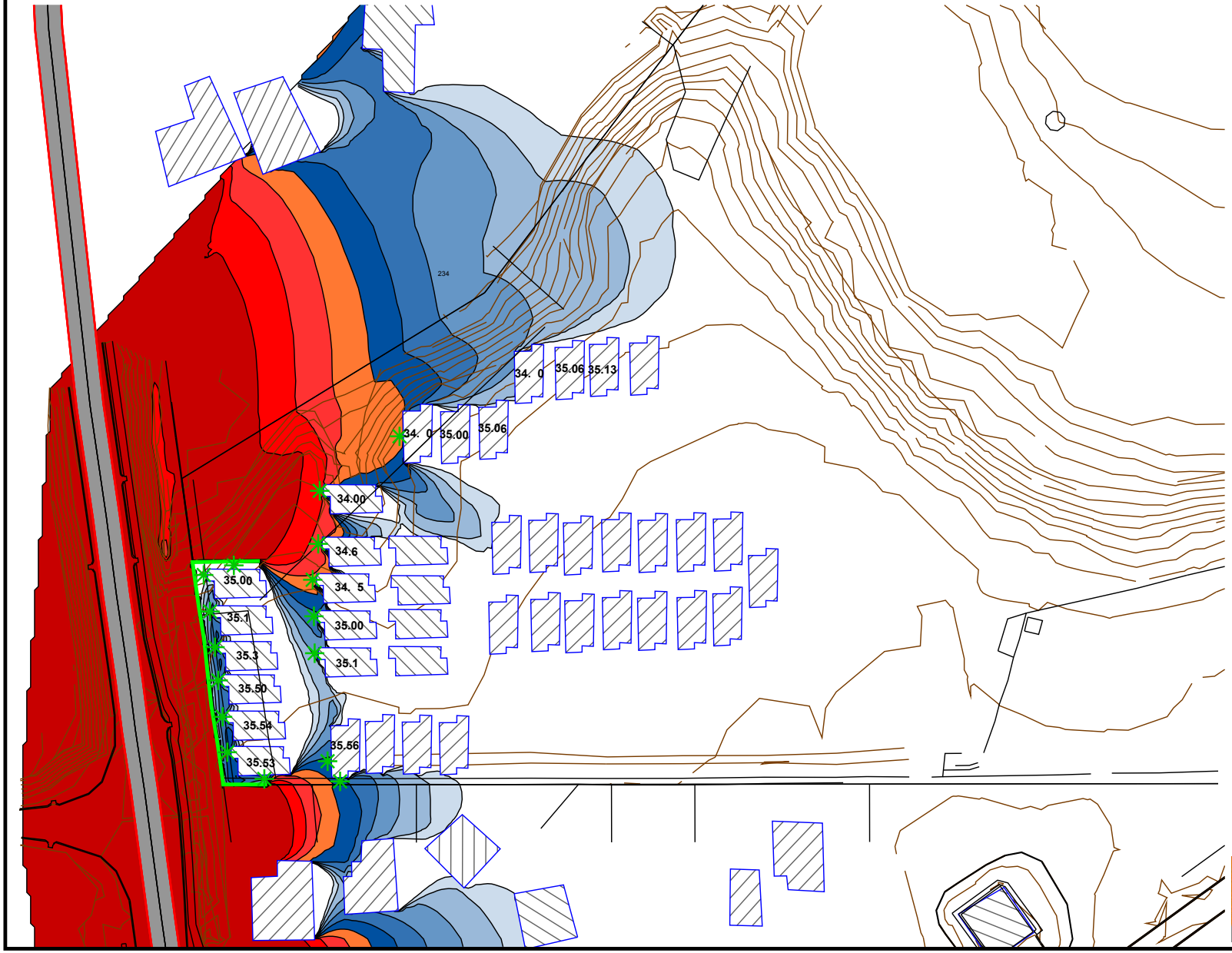
- Where residences are predicted to experience future noise levels between, and including, 61 dB and 63 dB $L_{Aeq(Day)}$, Package B is to be incorporated (refer *Appendix A*). Alternative constructions may be acceptable if supported by a report undertaken by a suitably qualified acoustical consultant (member from of the Association of Australian Acoustical Consultants (AAAC)) once the lots specific building plans are available.

- Where residences are predicted to experience future noise levels between, and including, 56 dB and 60 dB $L_{Aeq(Day)}$, Package A is to be incorporated (refer *Appendix A*). Alternative constructions may be acceptable if supported by a report undertaken by a suitably qualified acoustical consultant once the lots specific building plans are available.

- All affected lots are to have notifications on lot titles as per the Policy requirements – refer *Appendix A*.

Pro ose L est e V e o
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Figure 5-1



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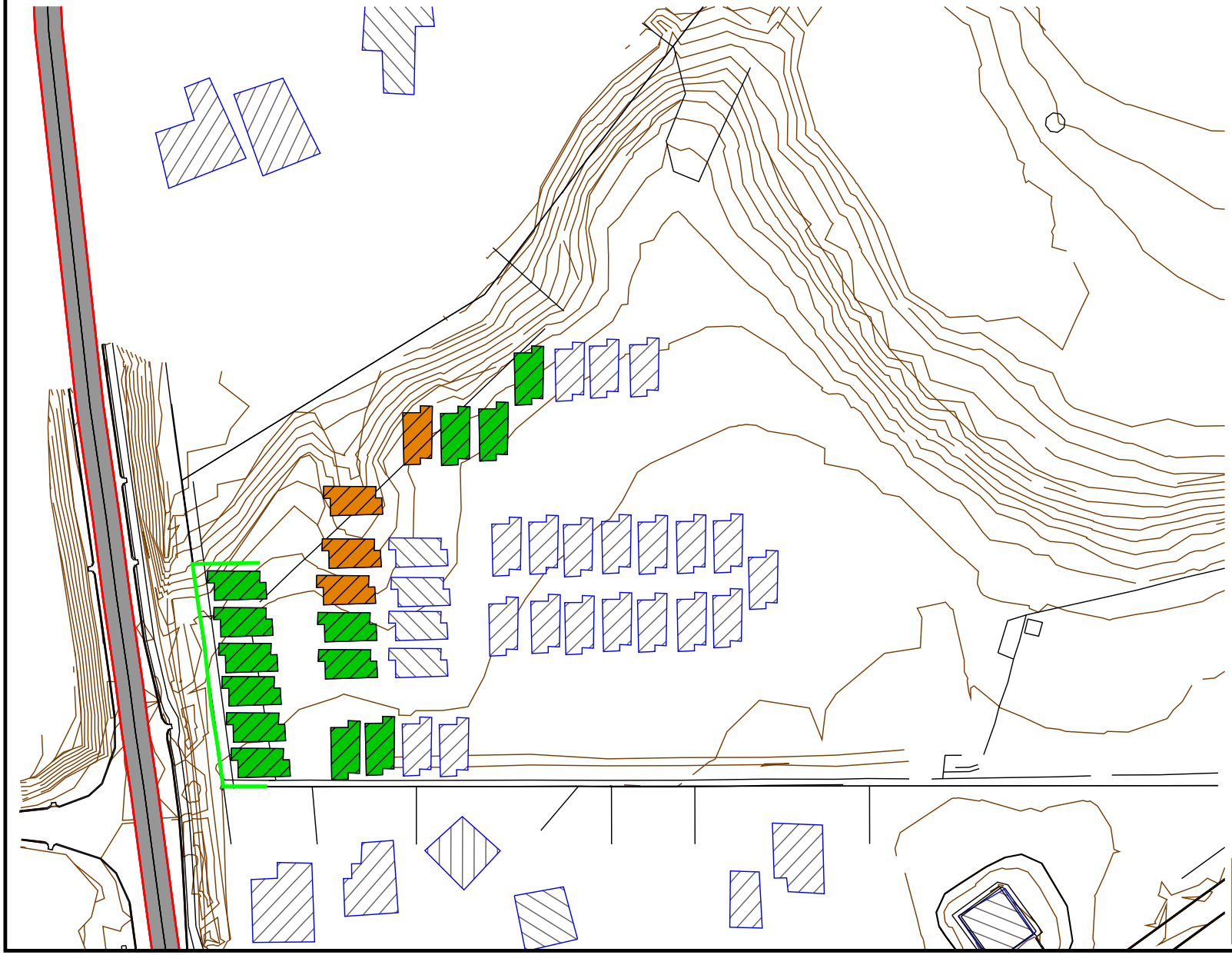
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Pro ose L est e V e o
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Figure 5-2



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Appendix A

DEEMED TO SATISFY CONSTRUCTION STANDARDS

Package A: Noise levels within the *margin*

The following noise insulation package is designed to meet the indoor noise standards for residential developments in areas where noise levels exceed the noise *target* but are within the *limit*.

Area type	Orientation	Package A measures
Indoors		
Bedrooms	Facing SWH	• 6mm (minimum) laminated glazing • Fixed, casement or awning windows with seals • No external doors • Closed eaves • No vents to outside walls/eaves • Mechanical ventilation/airconditioning[1]
	Side-on to SWH	• 6mm (minimum) laminated glazing • Closed eaves • Mechanical ventilation/airconditioning
	Away from SWH	No requirements
Living and work areas[2]	Facing SWH	• 6mm (minimum) laminated glazing • Fixed, casement or awning windows with seals • 35mm (minimum) solid core external doors with acoustic seals[3] • Sliding doors must be fitted with acoustic seals • Closed eaves • No vents to outside walls/eaves • Mechanical ventilation/airconditioning
	Side-on to SWH	• 6mm (minimum) laminated glazing • Closed eaves • Mechanical ventilation/airconditioning
	Away from SWH	No requirements
Other indoor areas	Any	No requirements
All	All	• Walls, roof/ceiling and elevated floors to be minimum R_w 45 construction

[1] See section on Mechanical ventilation/airconditioning for further details and requirements.
[2] These deemed-to-comply guidelines adopt the definitions of indoor spaces used in AS 2107-2000. A
[2] These deemed-to-comply guidelines adopt the definitions of indoor spaces used in AS 2107-2000. A
comparable description for bedrooms, living and work areas is that defined by the Building Code of Australia as a "habitable room". The Building Code of Australia may be referenced if greater clarity is needed. A living or work area can be taken to mean any "habitable room" other than a bedroom. Note that there are no noise insulation requirements for utility areas such as bathrooms. The Building Code of Australia describes these utility spaces as "non-habitable rooms".
[3] Glazing panels are acceptable in external doors facing the transport corridor. However these must meet the minimum glazing requirements.

Package B: Noise levels above the *limit* but within 3 dB

The following noise insulation package is designed to meet the indoor noise standards for residential developments in areas where noise levels exceed the *limit* by no more than 3 dB.

Area type	Orientation	Package B measures
Indoors		
Bedrooms	Facing SWH	• 6.5mm (minimum) VLam Hush glazing • Fixed, casement or awning windows with seals • No external doors • Closed eaves • No vents to outside walls/eaves • Mechanical ventilation/airconditioning[4]
	Side-on to SWH	• 6.5mm (minimum) VLam Hush glazing • Closed eaves • Mechanical ventilation/airconditioning
	Away from SWH	No requirements
Living and work areas[5]	Facing SWH	• 6.5mm (minimum) VLam Hush glazing • Fixed, casement or awning windows with seals • 40mm (minimum) solid core external doors with acoustic seals[6] • Sliding doors must be fitted with acoustic seals • Closed eaves • No vents to outside walls/eaves • Mechanical ventilation/airconditioning
	Side-on to SWH	• 6mm (minimum) laminated glazing • Closed eaves • Mechanical ventilation/airconditioning
	Away from SWH	No requirements
Other indoor areas	Any	No requirements
All	All	• Walls, roof/ceiling and elevated floors to be minimum R_w 50 construction

Mechanical ventilation/airconditioning

[4] See section on Mechanical ventilation/airconditioning for further details and requirements.
[5] These deemed-to-comply guidelines adopt the definitions of indoor spaces used in AS 2107-2000. A comparable description for bedrooms, living and work areas is that defined by the Building Code of Australia as a "habitable room". The Building Code of Australia may be referenced if greater clarity is needed. A living or work area can be taken to mean any "habitable room" other than a bedroom. Note that there are no noise insulation requirements for utility areas such as bathrooms. The Building Code of Australia describes these utility spaces as "non-habitable rooms".
[6] Glazing panels are acceptable in external doors facing the transport corridor. However these must meet the minimum glazing requirements.

Where outdoor noise levels are above the "target", mechanical ventilation or airconditioning is required to ensure that windows can remain closed in order to achieve the indoor noise standards.

In implementing ventilation, the following need to be observed:

- Evaporative airconditioning systems may not meet the requirements because windows need to remain open. Where evaporative is preferred, the design is to be reviewed and approved by a suitably qualified acoustical consultant being a member firm of the Association of Australian Acoustical Consultants (AAAC);
- Refrigerative airconditioning systems need to be designed to achieve fresh air ventilation requirements;
- air inlets need to positioned facing away from the transport corridor where practicable; and
- ductwork needs to be provided with adequate silencing to prevent noise intrusion.

Notification

Notifications on certificates of title and/or advice to prospective purchasers advising of the potential for noise impacts from road and rail corridors can be effective in warning people of the potential impacts of transport noise. Such advice can also bring to the attention of prospective developers the need and opportunities to reduce the impact of noise through sensitive design and construction of buildings and the location and/or screening of outdoor living areas.

Notification should be provided to prospective purchasers, and required as a condition of subdivision (including strata subdivision) for the purposes of noise-sensitive development or planning approval involving noise-sensitive development, where external noise levels are forecast or estimated to exceed the "target" criteria as defined by the Policy. In the case of subdivision and development, conditions of approval should include a requirement for registration of a notice on title, which is provided for under section 12A of the Town Planning and Development Act and section 70A of the Transfer of Land Act. An example of a suitable notice is given below.

Notice: This property is situated in the vicinity of a transport corridor, and is currently affected, or may in the future be affected, by transport noise. Further information about transport noise, including development restrictions and noise insulation requirements for noise-affected property, are available on request from the relevant local government offices.

Appendix B

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)
The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting
An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

L_1
An L_1 level is the noise level which is exceeded for 1 per cent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{10}
An L_{10} level is the noise level which is exceeded for 10 per cent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{90}
An L_{90} level is the noise level which is exceeded for 90 per cent of the measurement period and is considered to represent the "*background*" noise level.

L_{eq}
The L_{eq} level represents the average noise energy during a measurement period.

$L_{A10,18hour}$
The $L_{A10,18\ hour}$ level is the arithmetic average of the hourly L_{A10} levels between 6.00 am and midnight. The *CoRTN* algorithms were developed to calculate this parameter.

$L_{Aeq,24hour}$
The $L_{Aeq,24\ hour}$ level is the logarithmic average of the hourly L_{Aeq} levels for a full day (from midnight to midnight).

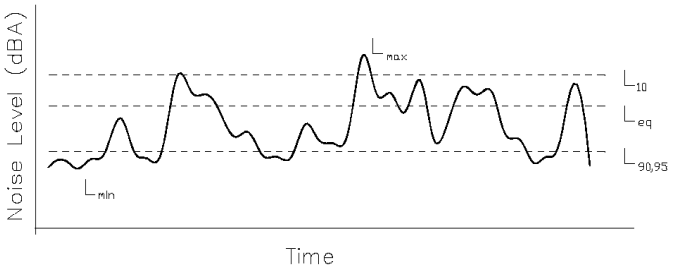
$L_{Aeq,8hour}$ / $L_{Aeq\ (Night)}$
The $L_{Aeq\ (Night)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 10.00 pm to 6.00 am on the same day.

$L_{Aeq,16hour}$ / $L_{Aeq\ (Day)}$
The $L_{Aeq\ (Day)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 6.00 am to 10.00 pm on the same day. This value is typically 1-3 dB less than the $L_{A10,18hour}$.

Satisfactory Design Sound Level
The level of noise that has been found to be acceptable by most people for the environment in question and also to be not intrusive.

Maximum Design Sound Level
The level of noise above which most people occupying the space start to become dissatisfied with the level of noise.

Chart of Noise Level Descriptors



Austroads Vehicle Class

AUSTROADS Vehicle Classification System

Level 1 Length (indicative) Type	Level 2 Axles and Axle Groups Axles	Groups	Level 3 Vehicle Type Typical Description	AUSTROADS Classification Class	Parameters	Typical Configuration
			LIGHT VEHICLES			
Short up to 5.5m		1 or 2	**Short** Sedan, Wagon, 4WD, Utility, Light Van, Bicycle, Motorcycle, etc	1	d(1) ≤ 3.2m and axles = 2	
	3, 4 or 5	3	**Short - Towing** Trailer, Caravan, Boat, etc	2	groups = 3 d(1) > 2.1m, d(1) ≤ 3.2m, d(2) ≥ 2.1m and axles = 3, 4 or 5	
			HEAVY VEHICLES			
Medium 5.5m to 14.5m	2	2	**Two Axle Truck or Bus**	3	d(1) > 3.2m and axles = 2	
	3	2	**Three Axle Truck or Bus**	4	axles = 3 and groups = 2	
	> 3	2	**Four Axle Truck**	5	axles > 3 and groups = 2	
Long 11.5m to 19.0m	3	3	**Three Axle Articulated** Three axle articulated vehicle, or Rigid vehicle and trailer	6	d(1) > 3.2m, axles = 3 and groups = 3	
	4	> 2	**Four Axle Articulated** Four axle articulated vehicle, or Rigid vehicle and trailer	7	d(2) < 2.1m or d(1) < 2.1m or d(1) > 3.2m axles = 4 and groups > 2	
	5	> 2	**Five Axle Articulated** Five axle articulated vehicle, or Rigid vehicle and trailer	8	d(2) < 2.1m or d(1) < 2.1m or d(1) > 3.2m axles = 5 and groups > 2	
	≥ 6	> 2	**Six Axle Articulated** Six axle articulated vehicle, or Rigid vehicle and trailer	9	axles = 6 and groups > 2 or axles = 6 and groups = 3	
Medium Combination 17.5m to 36.5m	> 6	4	**B Double** B Double, or Heavy truck and trailer	10	groups = 4 and axles > 6	
	> 6	5 or 6	**Double Road Train** Double road train, or Medium articulated vehicle and one dog trailer (M.A.D.)	11	groups = 5 or 6 and axles > 6	
Large Combination Over 33.5m	> 6	> 6	**Triple Road Train** Triple road train, or Heavy truck and three trailers	12	groups > 6 and axles > 6	

Definitions: Group: Axle group, where adjacent axles are less than 2.1m apart; Groups: Number of axle groups; Axles: Number of axles (maximum axle spacing of 10.0m); d(1): Distance between first and second axle; d(2): Distance between second and third axle

Typical Noise Levels

