Harley Dykstra

PLANNING & SURVEY SOLUTIONS

Structure Plan

Lot 21 (583) Rockingham Road, Munster

Prepared by Harley Dykstra Pty Ltd

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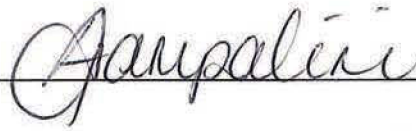
This structure plan is prepared under the provisions of the City of Cockburn Town Planning Scheme No.3

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON: 22 March 2017

Signed for and on behalf of the Western Australian Planning Commission



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



Witness

23 March 2017

Date

22 March 2037

Date of Expiry: ~~22 March 2027~~

TABLE OF AMENDMENT(S)

Amendment No.	Summary of Amendment	Amendment Type	Date approved by WAPC

Executive Summary

Structure Plan
Lot 21 (583) Rockingham Road, Munster

This report represents an application to the City of Cockburn to consider a proposed Structure Plan over Lot 21 (583) Rockingham Road, Munster ("the subject land"). The subject land has a total area of 8018m^2 and is situated approximately 20km south-west of the Perth CBD, 2.5km east of the Indian Ocean coastline, 250m south-west of the Stock Road/Beeliar Drive intersection, and 7km west of Cockburn Central and the Kwinana Freeway.

The proposed Structure Plan will facilitate future subdivision and development to create green-title residential lots at densities of Residential 30 (R30) a grouped dwelling site (survey-strata lots) at Residential 40 (R40) and a potential Residential 60 (R60) multiple dwelling site.

The Structure Plan Summary Table below details the nature and key outcomes of the Structure Plan.

Table 1

ITEM	DATA	STRUCTURE PLAN REF (section no.)
Total area covered by the Structure Plan	8018m^2	Section 1.2.1, 3.2.2
Area of each land use proposed: Residential	 5998m^2 (74.8%)	 Section 3.3.1
Total estimated lot yield (Includes survey–strata lots)	15 lots	Section 1.1
Estimated number of dwellings	24 dwellings	Section 3.3.1
Estimated population	62 persons	Section 3.3.1
Estimated residential site density	40 dwellings per site hectare	Section 3.3.1
Estimated area and percentage of Public Open Space given over to: - Regional open space - Local parks	 Nil 805m^2 (10.0%)	 - Section 3.2.2

Part One - Implementation

1.0 Structure Plan Area

This Structure Plan shall apply to Lot 21 (583) Rockingham Road, Munster being the land contained within the inner edge of the line denoting the Structure Plan boundary on the Structure Plan Map (**Plan 1**).

2.0 Operation

The date the Structure Plan comes into effect is the date the Structure Plan is approved by the WAPC.

3.0 Staging

Staging of the Structure Plan is dependent upon a Structure Plan being approved and subdivision implemented over Lot 22 Mayor Road, including road construction to service R40 coded lots depicted on the Structure Plan.

4.0 Subdivision and Development Requirements

4.1	Land Uses & Permissibility	The land use designations for the Structure Plan Area are as indicated on the 'Structure Plan Map'. These will guide the future subdivision and development of the land for residential purposes. Land use permissibility within the Structure Plan Area shall be generally in accordance with the corresponding Zone under the City of Cockburn Town planning Scheme No.3
4.2	Residential Density	Residential densities applicable to the Structure Plan Area shall be those residential densities shown on the 'Structure Plan Map'.
4.3	Waste collection access	The lot on the northern end of the 15m road reserve should include a temporary easement for the provision of a cul-de-sac head providing for waste collection access (see Part Two – Section 3.8.2 Waste Collection).
4.4	Staging of subdivision and development	Subdivision/development is to proceed in two stages. The Public Open Space reserve shall be developed and ceded as part of the first stage of subdivision. The grouped dwelling site shall comprise stage 2 and shall only be developed/subdivided once the road along the northern boundary of the site is constructed to its full width.
4.5	Provision for Visitor Parking	Visitor car parking for the Stage 2 grouped dwelling site to be provided within the verge of the full width road running along the northern boundary of the site to the satisfaction of the Local Government.

Subdivision and Development Requirements Cont.

4.6	Notifications on Title	In respect of applications for subdivision of land the City of Cockburn shall recommend to the Western Australian Planning Commission that a condition be imposed on the grant of subdivision approval for a notification to be placed on the Certificate(s) of Title(s) to advise of the following: *Land or lots may be affected by midge infestation.*

5.0 Local Development Plans

Local Development Plans (LDPs) are required to be prepared and implemented pursuant to the provisions of the City of Cockburn Town Planning Scheme No.3 and the *Planning and Development (Local Planning Schemes) Regulations 2015*, for lots comprising one (1) or more of the following site attributes:

1. Lots where specific vehicle access and egress control is required; and
2. Lots abutting public open space (POS).

6.0 Other Requirements

The developer is to make satisfactory arrangements with the City of Cockburn to provide proportional contributions toward those items of development infrastructure defined in the City of Cockburn Town Planning Scheme No. 3 for Development Contribution Area 13 (DCA 13) and Development Contribution Area 6 (DCA 6).

Plan 1

Structure Plan Map



STRUCTURE PLAN MAP

Lot 21 on P 3562
583 Rockingham Road, MUNSTER

Plan No.	20777-04B
Date	3/8/16
Drawn	JV
Checked	DM
Revision	B
Scale	1:500@A3

0 5m 10m 15m

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NOTE: This plan has been prepared for planning purposes. Areas, Contours and Dimensions shown are subject to survey

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Part Two - Explanatory Report

DOCUMENT CONTROL

Control Version	DATE	Status	Distribution	Comment
A	26/05/2016	Draft	Client	Review
B	16/06/2016	Final	Local Authority	For Lodgement
C	14/09/2016	Amended Report	Local Authority	For Lodgement
D	19/10/2016	Amended Report	Local Authority	For Lodgement
E	15/03/2017	Amended Report	WAPC	For Endorsement

Prepared for: M & S Oreb
Prepared by: DM
Date: March 2017
Job No: 20777
Ref: RevE-15.03.2017

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DISCLAIMER

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This document has been exclusively drafted. No express or implied warranties are made by the Consultant regarding the research findings and data contained in this report. All of the information details included in this report are based upon the existent land area conditions and research provided and obtained at the time the Consultant conducted its analysis.

Please note that the information in this report may not be directly applicable towards another client. The Consultant warns against adapting this report's strategies/contents to another land area which has not been researched and analysed by the Consultant. Otherwise, the Consultant accepts no liability whatsoever for a third party's use of, or reliance upon, this specific document.

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Appendix 3 - Local Water Management Strategy and Geotechnical Investigation
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1 PLANNING BACKGROUND

1.1 Introduction and Purpose

This submission has been prepared by Harley Dykstra on behalf of M & S Oreb in respect of Lot 21 (583) Rockingham Road, Munster ("the subject land"). Structure Plans are being prepared or have been implemented over lots to the west, north and south of the subject land. Accordingly, it is timely for a Structure Plan over Lot 21 to be progressed, as one of the few remaining lots in the immediate locality to still require a Structure Plan.

The ultimate objective of this submission is to facilitate the subdivision and development of the land for residential land uses in a manner that interacts appropriately with the developing urban environment in this locality.

The intended land uses within the Structure Plan include:

- Eleven (11) residential lots including one (1) grouped dwelling lot and one (1) multiple dwelling lot at density codings R30, R40 and R60; and
- One (1) area of public open space (POS) located along the western boundary of the Structure Plan area, linking to identified POS on Lot 20 to the south and proposed POS over Lot 51 Mayor Road to the west.

This proposal is accompanied by a Structure Plan Map (**Plan 1**) prepared in accordance with the *Planning and Development (Local Planning Schemes) Regulations 2015*, which is included at Part One of this Report.

The Explanatory Section of this Structure Plan Report includes a detailed description of the proposal, provides an evaluation of the relevant town planning, local water management and servicing considerations applicable to the land, and details the rationale supporting the proposed Structure Plan.

The Structure Plan has been formulated by Harley Dykstra in collaboration with specialist consultants, who have provided input in relation to matters as follows:

Bioscience	-	Local Water Management Strategy, Contaminated Sites Investigations, Landscape Concept Plan, Geotechnical Investigations
Porter Consulting Engineers	-	Servicing Report

Copies of the relevant consultant Reports are appended to this submission and key findings incorporated within the body of the Report. The Consultants' Reports confirm there are no significant constraints to progressing urban development of the land. This Structure Plan Report also acknowledges previous planning, environmental and engineering work undertaken on land in the locality which has informed the preparation of this proposal.

1.2 Land Description

1.2.1 Location

The subject land is located within the suburb of Munster and is situated approximately 20km south of the Perth CBD, 2.5km east of the Indian Ocean coastline, 250m south-west of the Stock Road/Beeliar Drive intersection, and 7km west of Cockburn Central and the Kwinana Freeway (**Figure 1** *refers*). Beeliar Village is located 970m east of the subject land and includes a Coles supermarket, fuel station, a number of fast food outlets, and medical consulting rooms. South Coogee Primary School and St Jerome's Primary School are located 900m east and 630m north-west of the subject land respectively. Santich Park and Radonich Park are located 260m north-east and 630m east of the subject land respectively and offer both passive and active recreational opportunities.

The subject land is 8018m^2 in area and has frontage to Rockingham Road.



Figure 1 – Location Plan

1.2.2 Area and land use

The subject land is located within the City of Cockburn, with lots to the south currently being redeveloped as residential dwellings under approved Structure Plans. A Structure Plan has recently been submitted to the City of Cockburn over Lots 22 and 51 Mayor Road to the north and west which will facilitate the development of this land for residential dwellings. Market Garden Swamp No.3 is located approximately 150m south-west of the subject land and thus will not have any significant impact on the subject land.

The endorsed and proposed Structure Plans surrounding the subject land have informed the preparation of the Lot 21 Structure Plan and thus the proposed Structure Plan is compatible with the existing and proposed land uses in the locality.

The subject land currently contains a single residential dwelling fronting Rockingham Road and several outbuildings and sheds, with the balance of the lot remaining vacant of development. The historical use of surrounding land was for market gardening and farm houses. Whilst several of the original dwellings remain, market gardens are no longer operating. Progressive residential redevelopment of surrounding land is now occurring through the Structure Plan process. The Aerial Photograph at (**Figure 2** *below*) depicts the nature of existing land use.



Figure 2 – Aerial Photograph

1.2.3 Legal description and ownership

The table below provides details in respect to the legal ownership of the subject land.

Table 1

Lot No.	House No.	Plan / Diagram	Volume	Folio	Registered Proprietor(s)
21	583	P3562	488	128A	Mick Oreb Sjajna Oreb

A copy of the Certificate of Title is included at **Appendix 1.**

1.3 Planning Framework

1.3.1 Zoning and reservations

City of Cockburn Town Planning Scheme No. 3

The subject land is designated "Development Zone" under Town Planning Scheme No.3 (TPS 3). The objective of the Development Zone is to provide for future residential, industrial or commercial development in accordance with a comprehensive Structure Plan prepared under the Scheme. Thus, this proposal is consistent with the intention of the Development Zone and will facilitate future residential development at the subject land.

Schedule 11 – *Development Areas* enables additional provisions applicable to subdivision and development to be incorporated into the Scheme. The subject land is located within Development Area 5 for which the following provisions apply:

Ref No.	Area	Provisions
DA 5	Munster (Development Zone)	1. An approved Structure Plan together with all approved amendments shall apply to the land in order to guide subdivision and development. 2. To provide for residential development except within the buffers to the Woodman Point WWTP, Munster Pump Station and Cockburn Cement. 3. The local government will not recommend subdivision approval or approve land use and development for residential purposes contrary to Western Australian Planning Commission and Environmental Protection Authority Policy on land within the Cockburn Cement buffer zone.

The subject land is not located within any of the above mentioned buffers.

In addition, the land is included within a Special Control Area – Development Contribution Area 6 (DCA6) and Development Contribution Area 13 (DCA13) of the Scheme, which details common infrastructure costs applicable to DCA 6 and DCA 13. Special provisions apply to the subject land as set out in Schedule 12 – *Development Contributions Plans*.

1.3.2 Planning Strategies

1.3.2.1 (Draft) Perth and Peel@3.5million

The WAPC's (Draft) Perth and Peel@3.5million document establishes the vision for future growth of the Perth and Peel Metropolitan Regions and provides a framework to guide the delivery of housing, infrastructure and services necessary to accommodate anticipated population growth over the next 35 years. The document is expected to be finalised in 2016.

The document includes the Sub-Regional Planning Framework consisting of three sub-frameworks, namely for the North-West, the North-East and the South Metropolitan Region. The subject land has been identified as 'Urban' under the draft South Metropolitan Peel Sub-Regional Planning Framework as have surrounding properties.

Land further south-west along the eastern edge of Lake Coogee is identified as "Industrial Investigation" due to this land's location within the Woodman Point Waste Water Treatment Plant Buffer.

Thus, development of the subject land for residential land use is consistent with the draft South Metropolitan Peel Sub-Regional Planning Framework and works to consolidate existing and planned residential development in the locality.

1.3.2.2 City of Cockburn Local Planning Strategy

The City of Cockburn Local Planning Strategy sets out the 15 year planning direction for the municipality and focuses on strategies to increase housing densities, employment, shopping and business activities, encourage walking, cycling and public transport use and reduce car use. The proposed Structure Plan is consistent with this philosophy in that it provides for a range of dwelling types and public open space within walking distance of nearby residences, as well as a permeable road network. The increase in density will provide greater housing opportunity within the locality which will support nearby shopping facilities and businesses, resulting in increased employment opportunities. The Structure Plan is consistent with the planning already commenced in the locality and corresponds to the surrounding approved and planned Structure Plans.

1.3.3 Statutory Planning Framework

1.3.3.1 Munster – Phase 3 Local Structure Plan

The Munster-Phase 3 Local Structure Plan has been adopted by the City of Cockburn and endorsed by the WAPC in relation to land to the west of Lot 21, extending across Fawcett Road and north to Beeliar Drive. A portion of this Structure Plan to the west of Market Garden Swamp adjacent to Fawcett Road has been implemented and developed with residential dwellings, whilst land adjacent to Beeliar Drive is in the process of being developed. The Structure Plan depicts indicative lot and road layouts over the subject land and surrounding lots to the north and south. In some instances, Structure Plans have subsequently been approved and hence this indicative layout has largely been superseded.

1.3.3.2 Munster – Rockingham Road – Lot 20

A Structure Plan was adopted by the City of Cockburn and subsequently endorsed by the WAPC in September 2015 over Lot 20 Rockingham Road, immediately south of the subject land. Subdivision works have progressed on the site in accordance with the approved Structure Plan and subsequent subdivision approval. A copy of the Lot 20 Structure Plan and Plan of Subdivision is included at **Appendix 2**. The proposed Structure Plan design and road network will be integrated with the Structure Plan over Lot 20. The approved road over Lot 20 will continue through Lot 21 to be integrated with the proposed road layout over Lot 22 and Lot 51 Mayor Road. The proposed Lot 21 Structure Plan is consistent with the approved R30, R40 and R60 residential densities in the Lot 20 Structure Plan.

1.3.4 *Planning Policies*

1.3.4.1 State Planning Policy 3 – Urban Grown and Settlement

State Planning Policy 3 (*SPP 3*) sets out the principles and considerations which apply to planning for urban growth and settlement in Western Australia. The Policy seeks to ensure well planned and coherent management of urban growth having regard to a range of social, economic and environmental objectives.

The key objectives of the Policy are:

- *"To promote a sustainable and well planned pattern of settlement across the State, with sufficient and suitable land to provide for a wide variety of housing, employment, recreation facilities and open space.*
- *To build on existing communities with established local and regional economies, concentrate investment in the improvement of services and infrastructure and enhance the quality of life in those communities.*
- *To manage the growth and development of urban areas in response to the social and economic needs of the community and in recognition of relevant climatic, environmental, heritage and community values and constraints.*
- *To promote the development of a sustainable and liveable neighbourhood form which reduces energy, water and travel demand whilst ensuring safe and convenient access to employment and services by all modes, provides choice and affordability of housing and creates an identifiable sense of place for each community.*
- *To coordinate new development with the efficient, economic and timely provision of infrastructure and services."*

The proposed Structure Plan is consistent with each of the abovementioned objectives.

1.3.4.2 State Planning Policy 3.7 – Planning in Bushfire Prone Areas

State Planning Policy 3.7 (SPP 3.7) seeks to guide the implementation of effective risk based land use planning and development to preserve life and reduce the impact of bushfire on property and infrastructure. SPP 3.7 applies to strategic planning proposals, including Structure Plans over land designated as bushfire prone by the Map of Bushfire Prone Areas prepared by the Department of Fire and Emergency Services. Given Lot 20 is not designated as Bushfire Prone, SPP 3.7 is not applicable to the Structure Plan area.

An extract from the Map of Bushfire Prone Areas Mapping, as it relates to Lot 21 is included at **Figure 3** *below*.

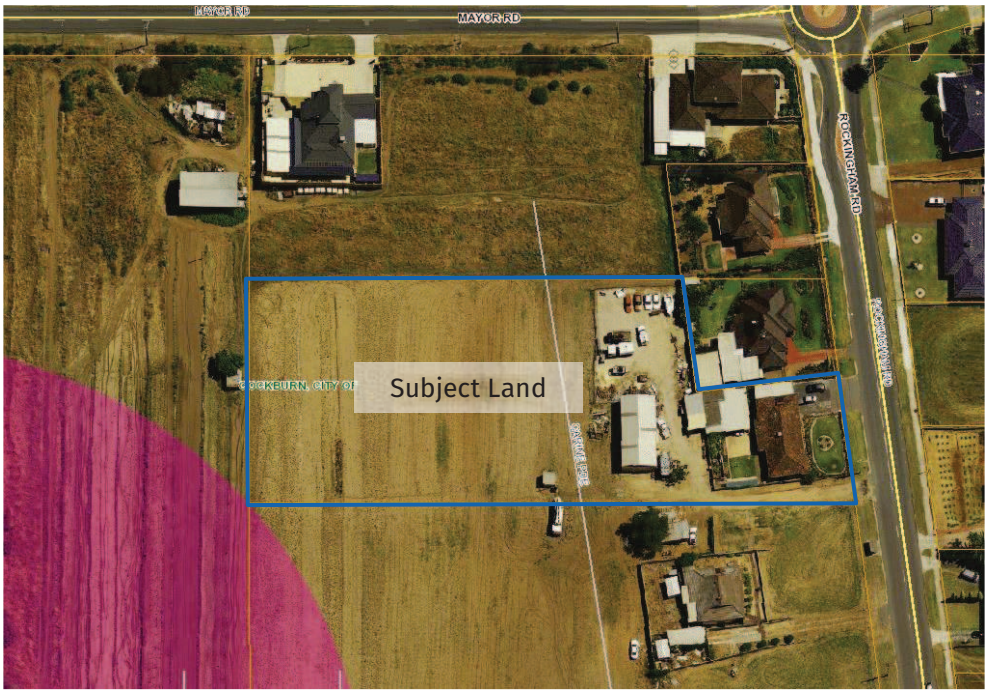


Figure 3 – Bushfire Prone Areas Mapping

1.3.4.3 Liveable Neighbourhoods

The WAPC's Liveable Neighbourhoods is an operational policy that guides the design and assessment of Structure Plans (regional, district and local) and subdivision for new urban neighbourhoods in the metropolitan area and country centres, on greenfield and large urban infill sites. Liveable Neighbourhoods includes the following Principle Aims that are particularly relevant to the Study Area:

- *To foster a sense of community and strong local identity and sense of place in neighbourhoods and towns.*
- *To ensure the avoidance of key environmental areas and the incorporation of significant cultural and environmental features of a site into the design of an* area.
- *To provide for a more integrated approach to the design of open space and urban water management.*
- *To ensure cost-effective and resource-efficient development to promote affordable housing.*
- *To maximise land efficiency wherever possible.*
- *To provide a variety of lot sizes and housing types to cater for the diverse housing needs of the community at a density that can ultimately support the provision of local services.*

Liveable Neighbourhoods outlines that Structure Plans should depict:

- walkable neighbourhood catchments of approximately 400m–450m radius around proposed commercial centres;
- density targets expressed as dwellings per hectare;
- existing and proposed commercial centres;
- natural features to be retained;
- proposed street block layout;

- proposed street network, including street types and path networks;
- proposed transportation corridors, public transport network and cycle and pedestrian networks;
- proposed land uses, including distribution of higher, medium and lower density residential;
- proposed schools and community facilities;
- public parkland; and
- proposed urban water management measures.

Table 1 of Liveable Neighbourhoods identifies the elements that are required to be addressed by the structure plan and/or subdivision application to allow assessment under this policy.

A significant amount of research and reporting has been previously undertaken in support of the development of surrounding land through the preparation of Structure Plans. Relevant considerations pertaining to the abovementioned planning elements have been addressed in this Report, in order to demonstrate compliance with the intent of Liveable Neighbourhoods.

1.3.4.4 Local Planning Policies

Relevant Local Planning Policies prepared by the City of Cockburn have been considered during the preparation of the proposed Structure Plan design and documentation.

The land is located within 500 metres of Market Garden Swamp No.3.

Council Policy LPP1.11 states:

"The City will require subdivider(s)/developer(s) of land between 500 meters and 800 metres of the lake or wetland edge to impose a Notification, pursuant to Section 165 of the Planning and Development Act 2005 on the title of each new residential lot advising prospective purchaser(s) that the land may be affected by midge infestation. Notice of this Notification is to be included on the Deposited Plan and shall state the following: This land may be affected by midge from nearby lakes and/or wetlands. Enquiries can be made with the City of Cockburn Environmental Services."

The above notification will also be required to be imposed on any infill residential subdivision, strata and development on land already zoned 'Residential' within 500 metres. The Notification will be included on the Deposited Plan(s) of all new lots created at subdivision stage, in accordance with Council requirements.

1.4 Pre Lodgement Consultation

The City of Cockburn's Strategic Planning section was contacted on 12 January 2016 to discuss the status of structure planning over adjacent lots, including Lots 51 and 22 Mayor Road. On 24 February 2016, the City provided a further update via email correspondence, including a draft Structure Plan over Lots 51 and 22 submitted for assessment by the City and the City's suggested modifications to the draft Structure Plan. Preliminary verbal advice was also sought from the City in relation to proposed residential densities, road layout and POS configuration as part of the preparation of the Structure Plan over Lot 21 Rockingham Road.

2 SITE CONDITIONS AND CONSTRAINTS

2.1 Biodiversity and Natural Area Assets

The subject land is entirely cleared of native vegetation to provide for residential development and market gardening. Market gardening has since ceased and thus there is no vegetation remaining on site aside from some landscaping associated with the existing house as illustrated by the Aerial Photograph at **Figure 2**. Given the historic use of the land, flora and fauna investigations to support this proposal are not necessary. A Resource Enhancement Wetland exists approximately 130m south-west of the subject land. It is not anticipated this wetland or its buffer would be affected by subdivision and development within the Structure Plan area.

2.2 Landform and Soils

The site slopes gently to the west from a height of approximately 11m AHD along the eastern boundary to 6m AHD at the south-western corner of the site.

The LWMS prepared by Bioscience at **Appendix 3** includes a Geotechnical Investigation (Appendix 1 of the LWMS) which confirms the site has a typical soil profile consisting of between 300mm and 600mm of topsoil underlain by orange brown medium grained sand over limestone pinnacles in some locations.

Department of Environment (DER) mapping indicates the site has low risk of ASS being present within the top 3m of soil.

2.3 Groundwater and Surface Water

The Department of Water Groundwater Atlas indicates a depth to groundwater ranging between 9.5m from the natural surface along the eastern boundary to 4.5m below the natural ground level along the western boundary.

The LWMS provides further details pertaining to groundwater levels measured by monitoring bores in close proximity to the site. There are no natural water courses on the subject land. Surface water flows generated during larger rainfall events are directed towards the wetland area to the west of the site due to the natural topography of the land.

2.4 Site Contamination

Given the historic use of the subject land for market gardening, which under the DER Contaminated Sites Guidelines is considered a "potentially contaminating activity," Bioscience conducted a Tier 1 screening risk assessment.

Based on landowner interviews, geotechnical investigation and visual assessment, Bioscience concluded the site is very unlikely to be contaminated due to past land use. A copy of the Contamination Assessment is included at **Appendix 4**.

3 LAND USE AND SUBDIVISION REQUIREMENTS

3.1 Land Use

3.1.1 Design overview

The Structure Plan design has been developed having regard to broad strategic planning objectives for the locality, local water management planning, provision of access and the interface with nearby Structure Plan areas.

The Structure Plan has been prepared to guide the development of the 8018m^2 site for residential subdivision. The Structure Plan will contribute to the development of a high quality, liveable urban precinct offering a diversity of lot products, and hence, housing choice, with access to the full range of urban services and facilities in the area, including neighbourhood centres, public open space and primary schools.

The design has regard to the existing approved Structure Plan over Lot 20 Rockingham Road, and the proposed Structure Plan prepared over Lots 22 and 51 Mayor Road, Munster which have highly influenced the proposed road, lot and public open space layout. The urban development of the land will facilitate significant improvement to underutilised lots previously used for market gardening, and will enhance public access and use of public open space throughout the locality.

Further details relating to the relevant design opportunities and constraints are provided below.

3.1.2 Integration with adjoining lots

The Structure Plan is bounded by Lot 20 Rockingham Road to the south, Lot 22 Mayor Road to the north, Lot 51 Mayor Road to the west and Rockingham Road to the east. A Structure Plan has been endorsed by the WAPC over Lot 20 to the south and provides for residential subdivision and development at densities of R30, R40 and R60, public open space, a north-south aligned road (Carine Parade) and a portion of east-west aligned road continuing from Monger Road (refer to **Appendix 2**). A Structure Plan is currently being prepared over Lot 22 and Lot 51 Mayor Road which anticipates the continuation of Carine Parade though Lot 21 connecting to an east-west road adjacent to and partly within, the northern boundary of Lot 21.

The design of the Structure Plan has regard for these Structure Plans prepared over adjacent land and is essentially an extension of the layout and density of land to the south. The POS over Lot 20 is to extend over Lot 21, and connect to POS within Lot 51 to provide consolidated areas of POS. R40 grouped dwellings are to be orientated to address this public open space to increase passive surveillance of public spaces.

Linkages to the developing Structure Plan areas to the north and south shall also be reinforced by the provision of footpaths and shared paths.

3.2 Public Open Space

3.2.1 Existing POS

The subject land is well served by public open space and recreational opportunities afforded by the site's proximity to Santich Park 260m north-east, Radonich Park 630m east and the Market Garden Swamp No.3 foreshore reserve 150m south-west of the subject land. The foreshore is progressively being improved and developed as public open space following implementation of approved Structure Plans and residential development.

3.2.2 Proposed POS

The design and location of Public Open Space (POS) with the Structure Plan area is intended to achieve the following aims:

- Integration with adjoining POS to the south to create a larger, more useable area of POS and provide pedestrian linkages between subdivisional roads and throughout the wider locality.
- To maximise available areas for a range of uses and functions, as well as achieving improved efficiencies in terms of maintenance and management;
- Increasing passive interaction opportunities with other residents as a means to address social isolation and improve wellbeing;
- Encourage maximum surveillance of POS areas to discourage opportunities for anti-social behaviour.

A total of 805m^2 of Public Open Space has been provided as unrestricted POS, in accordance with the 10% site contribution required by Liveable Neighbourhoods. No POS is required to accommodate drainage basins associated with 1 year ARI and 5yr ARI rainfall events, as detailed in the LWMS at **Appendix 3**.

3.3 Residential

3.3.1 Land Use and Residential Density

The Structure Plan has regard for the progressive residential development occurring to the south of the Structure Plan area, and the proposed residential development over Lots 22 and 51 Mayor Road to the north and west of the Structure Plan area. Thus, retail, commercial and industrial land uses are not proposed.

The proposed residential density is consistent with the strategic direction of the Sub-Regional Planning Framework which promotes higher densities in undeveloped areas zoned for urban use, particularly in areas close to transit corridors and high amenity. The Sub-Regional Planning Frameworks encourage new urban development to use an average residential density target of 15 dwellings per gross hectare of urban zoned land to guide the allocation of residential densities.

The site benefits from high amenity due to its proximity to Beeliar Village and a number of areas of POS, as well as being in a strategic location along Rockingham Road and in close proximity to Stock Road, which is a Primary Regional Road under the Metropolitan Region Scheme. Thus, the Structure Plan is proposed for residential development at density codings of R30, R40 and R60 to capitalise on these attributes. This achieves an appropriate

residential density of 40 dwellings per site hectare. Based on 2011 ABS statistics and an expected dwelling yield of 24 dwellings, the estimated population of the Structure Plan area is 62 persons at 2.6 persons per dwelling.

3.3.2 Residential lot layout

The road network has been designed to facilitate the creation of regular shaped lots, capable of accommodating an appropriate mix of single, grouped and multiple residential dwellings, with direct access from each green title lot to a public street. Common property will provide access to grouped and multiple dwellings over the R40 and R60 coded land, respectively.

Single residential lots coded R30 are proposed to be provided with direct access from the north-south extension of Carine Parade, whilst access to the R60 site will be derived via Rockingham Road. Access to the R40 site will be via the proposed road running east west along the northern boundary of Lot 21 and partly located within Lot 22 Mayor Road. Visitor car parking for the R40 site is to be provided within the road verge of the east west road. Development / subdivision of the R40 site could only occur once the road is constructed to its full width. R40 dwellings are expected to front the POS to allow for passive surveillance of this area.

3.3.3 Residential lot size

The Structure Plan proposes the creation of standard street blocks that are robust and adaptable to accommodate a variety of lot sizes. A Concept Subdivision Plan is included at **Appendix 5**, which illustrates a potential lot layout. The R40 site would be capable of accommodating five (5) grouped dwellings serviced by a 6m wide common property access. The R60 site would be capable of accommodating approximately 10-11 multiple dwellings (assuming a typical unit size of 70m^2) in the event the existing dwelling was removed and the site was redeveloped in the future.

3.4 Movement Networks

3.4.1 Existing Movement Network

Regional Road Network

The subject land is well connected with the metropolitan and wider regional road network, given its frontage to Rockingham Road and close proximity to Stock Road and Beeliar Drive. The regional road network provides efficient access to the wider Perth Metropolitan Region including commercial and employment centres.

Local Road Network

The local road network has not yet been established but as shown in the LSP for Lot 20 at **Appendix 2,** Carine Parade will be extended as a 6m wide red asphalt kerbed road with a 1.5m path to service the green title lots depending on the timing of subdivision of Lot 22, a temporary turnaround may be required and could utilise the partial road reserve along the northern boundary. Based on developments to the south, if no agreement is made with the owner to the north to construct a cul-de-sac head on Lot 22, temporary easements will be required over the cul-de-sac head where it impacts on Lots within Lot 21.

Public Transport Network

The site is located adjacent to a Transperth bus route running along Rockingham Road and providing a service between Rockingham Train Station and Fremantle Train Station, with

stops at Kwinana Bus Station and Phoenix Shopping Centre. A bus stop is available along Beeliar Drive approximately 130m north-east of the subject land and is serviced by two bus routes providing access between Cockburn Central Train Station and Fremantle Train Station operating relatively frequently. The bus services also stop at Divine Mercy College, Emmanuel Catholic College and Cockburn Gateway Shopping City.

Bus routes linking the subject land to the rail system will ensure that future residents have convenient access to an efficient public transportation network.

Cycle Network

A Principal Shared Path currently exists along Beeliar Drive originating 340m north-east of the subject land and providing cycle paths from Stock Road to Cockburn Central, ultimately linking in with the cycle network along the Kwinana Freeway.

The Department of Transport's Principal Shared Path Program for 2014-2023 proposes a cycle path extending from Fremantle towards Rockingham, utilising Stock Road and Rockingham Road as the primary route.

Thus, the subject land has convenient access to the existing and proposed Principal Shared Path network which provides access to a high level of services and facilities.

Pedestrian Network

The progressive development of the area will facilitate the provision of a significantly upgraded pedestrian network. Future subdivision within the locality will facilitate the provision of a connected network of pedestrian paths linking various areas of POS and the Market Garden Swamp No.3 foreshore, and the existing surrounding footpath network. A pedestrian path is proposed along the entire length of Carine Parade.

3.4.2 Proposed movement network

Access/egress to R60 coded lots will be from Rockingham Road, access/egress to R30 lots will be via the extension of Carine Parade and access/egress to R40 lots will be via the proposed subdivisional road along the southern boundary of Lot 22. Carine Parade is to be a 15m wide road reserve and will be constructed to City of Cockburn specifications, including kerbing and piped drainage and provision of footpaths. Access to R40 and R60 dwellings is expected to be via common property with sufficient road verge available for rubbish collection.

3.4.3 Traffic generation

The proposed subdivisional road network for the locality has been designed to service future subdivision and development over Lot 21 and thus is capable of accommodating the increased traffic associated with residential development of the subject land. Access to the various proposed lots over the subject land will be derived from two different roads (Rockingham Road and Carine Parade) and thus vehicles will be disbursed across the local road network minimising traffic impact.

The anticipated total daily traffic volume associated with the proposed residential development of the subject land is minimal. A total of 24 dwellings are anticipated within the Structure Plan area, comprising nine (9) green title and five (5) survey-strata lots serviced by subdivisional roads. An additional ten (10) dwellings may be developed on the R60 site at a later stage. Based on an average traffic generation rate of 8 vehicles per day (vpd) per dwelling, *Transport Assessment Guidelines for Development (WAPC 2006)* 112 vpd would be distributed within the new subdivisional road network and up to 80 vpd would

utilise Rockingham Road. Therefore, it is concluded that the proposed road network has the capacity to accommodate the anticipated Structure Plan traffic and the Structure Plan will not have an adverse impact on traffic operations.

3.5 Water Management

The WAPC's Better Urban Water Management (BUWM) document identifies the requirement to prepare a Local Water Management Strategy (LWMS) to support a proposed Structure Plan. The LWMS (**Appendix 3**) has been prepared to support the proposed Structure Plan in accordance with the requirements of the BUWM document. The LWMS outlines the key elements required to achieve best practice stormwater management for the site and presents the management strategy for groundwater, surface water, and water use. The LWMS:

- Describes the predevelopment environment;
- Sets out a Local Water Management Strategy for the Structure Plan Area, including details relating to:
    (a) Water Use and sustainability initiatives;
    (b) Surface Water Management;
    (c) Groundwater Management;
    (d) Water Quality Management; and
    (e) Construction Management.
- Describes implementation of the LWMS including requirements for subsequent investigations (i.e. Urban Water Management Plan).

The following stormwater management measures are proposed:

Lots

- 20 year ARI events to infiltrate close to source within soak wells;
- Overland flow to drainage in road reserve and POS (soak wells and storage chambers) in 100 year ARI events.
- Sub-catchment D4 (R60 lots) fronting Rockingham Road to provide storage for the 20yr ARI event in soak wells, with surface water runoff in excess of the 20 year ARI event having an overload flow path to Rockingham Road.

Road Reserves

- Roads and POS to infiltrate 100 year events at source via soak wells and chambers.

3.6 Education Facilities

South Coogee Primary School and St Jerome's Primary School are located 900m east and 630m north-west of the subject land respectively. Divine Mercy College and Emmanuel Catholic College are located 3.6km and 5km east of the subject land respectively.

Lakeland Senior High School is located 5.75km north-east of the site. Hamilton Senior High School and South Fremantle Senior High school are located 5.0km and 7.0km north of the site respectively, although it is noted these two high schools will amalgamate with a new school to open in 2018. The new school, Fremantle College, will be located on the existing South Fremantle Senior High School site.

3.7 Activity Centres and Employment

The subject land is located approximately 6.4km west of Cockburn Central which offers a high level of commercial, retail, medical, community, entertainment and specialty facilities including Gateway Shopping Centre as well as a high level of employment opportunities.

Cockburn Commercial Park is located 1.5km north-east of the subject land and extends north-west to North Lake Road and north to Phoenix Road. The Commercial Park incorporates over 100 businesses and thus offers a high level of commercial and industrial services as well as employment opportunities at a local and regional level.

The Australian Marine Complex is located approximately 1.9km south-west of the subject land and also offers a high level of employment opportunities and industrial services.

3.8 Infrastructure Coordination, Servicing and Staging

3.8.1 Servicing

Porter Consulting Engineers have prepared a Servicing Report, a copy of which is attached as **Appendix 6**. Details of service infrastructure available to the site are included below:

Reticulated Sewer
There is existing sewer reticulation in Carine Parade that can be extended to service the proposed green title lots. The proposed strata lots will need to be serviced in the future when Lot 22 to the north is developed, as the sewers in Carine Parade are not deep enough. Sewers along Rockingham Road will need to be extended immediately in front of the existing dwelling fronting Rockingham Road, with the sewer in a 3m easement. This will be required to be extended the full frontage of the lot to cater for future development north of the site.

Power Supply
Extending the existing HV and LV power in Carine Parade will service the green title lots. Power to the strata lots will need to occur when Lot 22 to the north is developed. The Western Power Network Capacity Mapping Tool confirms that there is sufficient power supply in the area with over 20MVA available in the area. This means that no network upgrades will be required.

However, the determination of whether a new transformer and substation for the additional 8 green title lots and Strata development cannot be determined until an application is made to Western Power for a Design Information Package at detailed design stage as it is specific to load calculations in the immediate area. If a substation is required, this would be placed in the POS area and would not impact on the developable area that is proposed.

If the existing dwelling on Rockingham Road is to initially remain, it will be required to have the existing overhead consumer line undergrounded as part of the power works to the development.

Water Supply
Currently there is a 100mm water main along the western side Rockingham Road servicing the existing dwelling on the subject land.

New water pipes have been constructed to service the residential development to the south over parent Lots 18 and 19 Rockingham Road and are proposed to continue through Lot 20 to service new lots. It is expected that these services can be extended along Carine Parade and other subdivisional roads to service the proposed development. The proposed R60 development can be serviced by the water main within the Rockingham Road reserve.

Retaining Walls

Due to the gradient across the site, a 2.5-3.0m high retaining wall is expected to be required along the eastern boundary of the 5 strata lots. This is because the green title lots facing Carine Parade extension will need to be level with this road.

Retaining walls up to 0.5m high may be required along the western boundary of the two existing dwellings depending on finished ground levels. Finished Levels would be determined following feature survey and detailed design.

It is assumed battering from along the northern boundary from Lot 21 into Lot 22 will be permitted, however, should battering not be allowed, a temporary retaining wall up to 0.5m high may be required. Once Lot 22 is developed, this temporary wall can be removed.

Drainage

The site will need to contain up to the 1:100 year storm event for runoff from the proposed road reserves due to there being no outlet to an existing street system or drainage network system. Lots are required to store up to the 1 in 20 year storm event on site and excess stormwater from the lots over and above this event up to the 1 in 100 year event, also will need to be catered for.

Whilst the Servicing Report advises stormwater from the 1 in 100 year event could be contained in the POS area via a basin or underground drainage structures, the LWMS recommends storage within a combination of soak wells and chambers located within road reserves and the POS area. The City of Cockburn has accepted underground storage systems within road reserves to service previous developments to the south. Underground storage would also be the preferred outcome for this development, subject to detail design at UWMP stage. In any event, the ultimate drainage design will not impact on the area of creditable (unrestricted) POS.

Telecommunications

The extension of the existing NBN infrastructure along Carine Parade will service the proposed green title lots. It is expected that the strata lots will be serviced with NBN when the road within Lot 22 is developed. Whilst the development is under 100 lots, NBN will likely be the service provider given they have the infrastructure immediately adjacent. Application to NBN to be the service provider would be made at detailed design stage.

NBN is expected to be extended along Rockingham Road in front of the southern existing home as part of the works to the development.

Gas

Gas mains are located within the Rockingham Road reserve, which would be suitable to service future development of the R60 lot. It is expected that gas pipework within Carine Parade can be extended to service green title lots, with survey-strata lots capable of being serviced following the construction of the east-west continuation of Carine Parade.

3.8.2 *Waste Collection*

Lots created as part of Stage 1 shall be serviced by the City's general waste and recycling disposal trucks via the provision of a temporary cul-de-sac at the northern end of the north-south road.

Stage 2 lots/development shall be provided with a bin presentation area within the proposed east-west road reserve along the northern lot boundary, comprising one bin presentation pad per dwelling, a minimum 1.8m long by 1m wide. The indicative location of a bin presentation area of suitable dimensions is illustrated on the Concept Subdivision Plan at **Appendix 5**.

3.8.3 *Staging*

The landowner intends to progress the subdivision in two (2) stages. Staging of the subdivision is illustrated on the Concept Subdivision Plan at **Appendix 5**.

Stage 1 will comprise:

- the creation of nine (9) R30 lots serviced by the north-south road;
- a lot fronting Rockingham Road which may be developed in the future at a density of R60;
- the POS reserve; and
- a balance R40 lot.

Prior to the R40 coded survey-strata lots being created (stage 2) construction of the east-west section of Carine Parade along the northen boundary of the site is required.

In the event the subdivision over Lot 22 and Lot 51 Mayor Road precedes the subdivision of Lot 21, subdivision within the Structure Plan area could proceed in a single stage.

3.9 Developer Contribution Arrangements

Under the City of Cockburn Town Planning Scheme No.3, clause 6.3.1-*Development Contribution Areas* provides for a cost contribution scheme to be established, to ensure the equitable sharing of costs between owners towards infrastructure required as a result of the subdivision and development of land within the Developer Contribution Area (DCA). The subject land is included within Development Contribution Area 6 (DCA6) and Development Contribution Area 13 (DCA13), which details common infrastructure costs applicable to DCA 6 and DCA 13. Special provisions apply to the subject land as set out in Schedule 12 – *Development Contributions Plans*.

3.10 Implementation

The proposed Structure Plan has been prepared in accordance with the requirements of the *Planning and Development (Local Planning Schemes) Regulations 2015*. Further, the Structure Plan complies with the applicable State and Local Planning Policy Framework as set out in section 1.3 of this Report.

The *Planning and Development (Local Planning Schemes) Regulations 2015* stipulates the manner by which the Structure Plan will be processed by the City of Cockburn and thereafter, the Western Australian Planning Commission to enable final approval.

Following adoption of the Structure Plan, Local Development Plans, Development and Subdivision Applications can be considered and approved where they comply with the Structure Plan.

APPENDICES INDEX

Appendix No.	Nature of Document	Assessment Agency	Approval Status
1	Certificate of Title	N/A	N/A
2	Lot 20 Rockingham Road Approved Plans	WAPC	Approved
3	Local Water Management Strategy	Local Authority/ Department of Water	For Assessment
4	Contamination Assessment	DER	For Assessment
5	Concept Subdivision Plan	N/A	N/A
6	Servicing Report	Local Authority	N/A

APPENDIX 1

Certificate of Title

WESTERN AUSTRALIA

REGISTER NUMBER	
21/P3562	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	N/A

RECORD OF CERTIFICATE OF TITLE

VOLUME 488 FOLIO 128A

UNDER THE TRANSFER OF LAND ACT 1893

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

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 21 ON PLAN 3562

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

MICK OREB
SJAJNA OREB
BOTH OF 587 ROCKINGHAM ROAD, SPEARWOOD
AS JOINT TENANTS

(T A383291) REGISTERED 22 MARCH 1971

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

1. THE LAND THE SUBJECT OF THIS CERTIFICATE OF TITLE EXCLUDES ALL PORTIONS OF THE LOT DESCRIBED ABOVE EXCEPT THAT PORTION SHOWN IN THE SKETCH OF THE SUPERSEDED PAPER VERSION OF THIS TITLE. VOL 488 FOL 128A.

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

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

STATEMENTS:

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

SKETCH OF LAND:	488-128A (21/P3562).
PREVIOUS TITLE:	411-104A.
PROPERTY STREET ADDRESS:	583 ROCKINGHAM RD, MUNSTER.
LOCAL GOVERNMENT AREA:	CITY OF COCKBURN.

LANDGATE COPY OF ORIGINAL NOT TO SCALE Tue Feb 2 10:57:27 2016 JOB 50025654

Landgate
www.landgate.wa.gov.au

APPENDIX 2

Lot 20 Rockingham Road Approved Plans

Local Structure Plan

Plan of Subdivision

CITY OF COCKBURN
STRUCTURE PLAN

This Structure Plan was adopted by Council on 09 / 04 / 2015

Signed

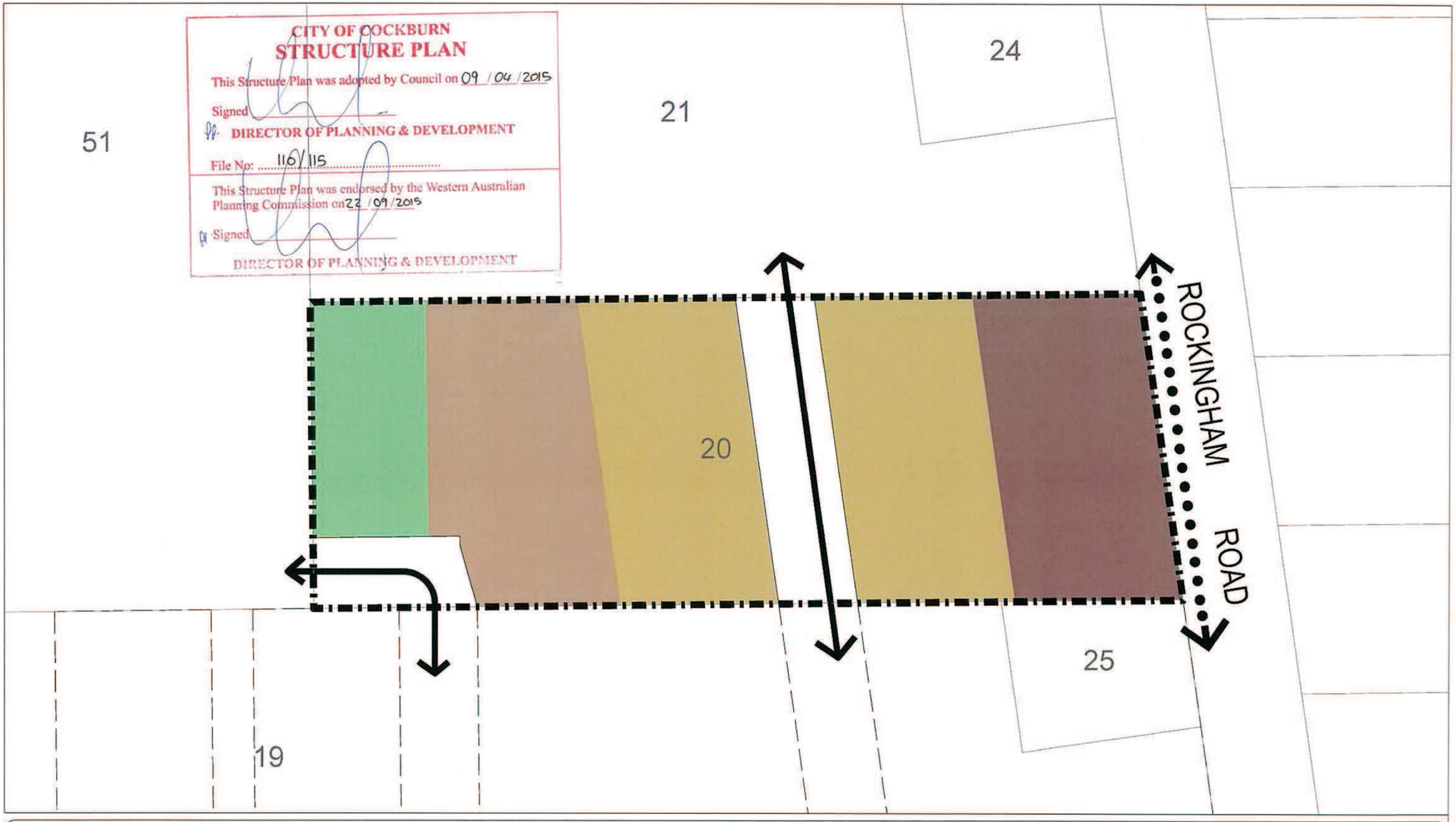
DIRECTOR OF PLANNING & DEVELOPMENT

File No: 116/115

This Structure Plan was endorsed by the Western Australian Planning Commission on 22 / 09 / 2015

Signed

DIRECTOR OF PLANNING & DEVELOPMENT



Plan No. : 20319-2
Revision : REV.4
Scale : 1:1000@A4

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Member Practice
Suite 4 First Floor 40 Hasler Road Osborne Park WA 6017 www.whelans.com.au

LEGEND
- Pathway - Dual Use Path
- Structure Plan Boundary
- Local Access Roads (Indicativly shown with final design at subdivision stage)

ZONES/RESERVES
- Parks and Recreation
- R30 Residential
- R40 Residential
- R60 Residential

LOCAL STRUCTURE PLAN
LOT 20 ROCKINGHAM ROAD MUNSTER

Plan 1

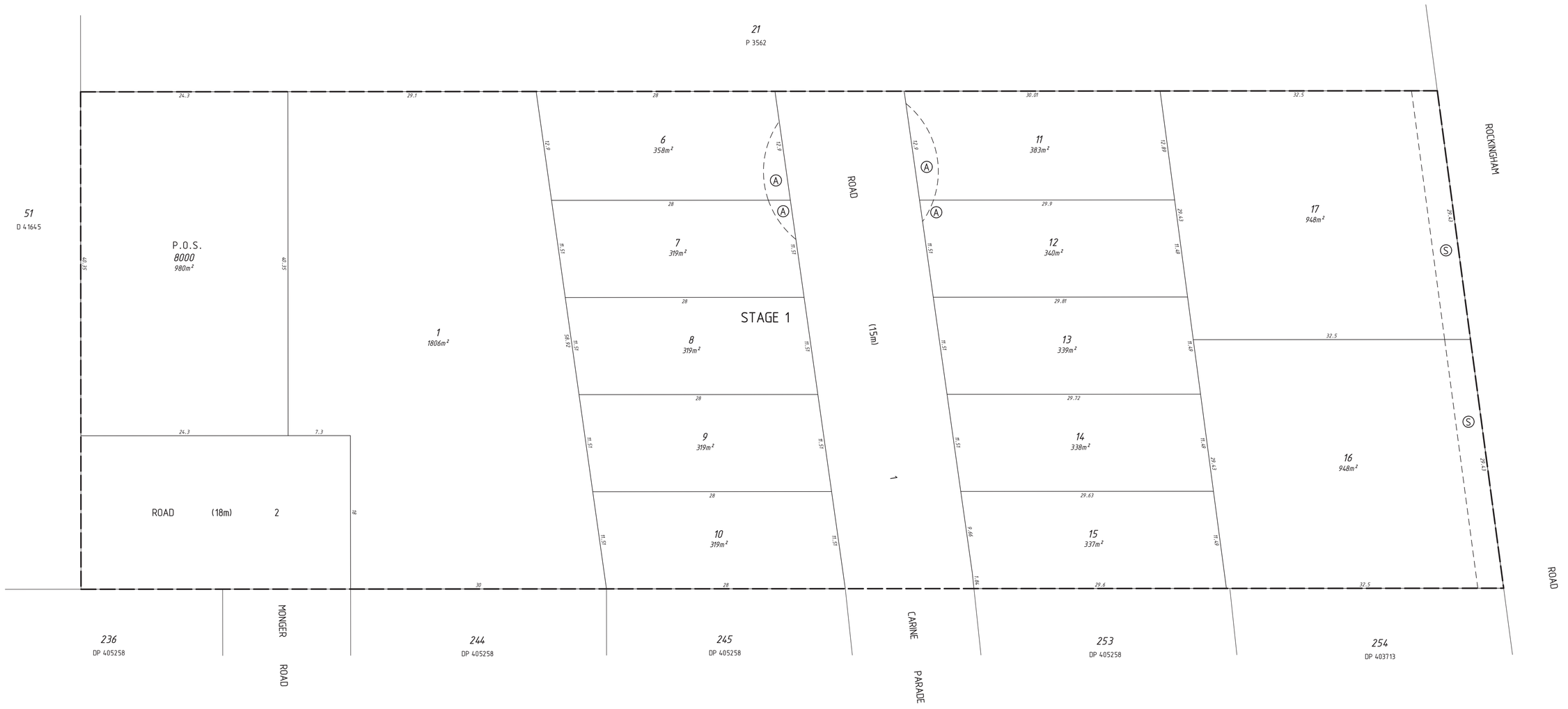
DATE DRAWN: 12/03/2015
DRAWN BY: CdeL
CHECKED BY: JP
FILE: 140813 LSP Rockingham Road Munster.dgn
V DATUM: AHD
H DATUM: MGA94 (50)

whelans TOWN PLANNING

LAND USE / STATISTICS			
STAGE 1		WAPC Ref:-	
PARCEL TYPE	MAP SYMBOL	NUMBER OF PARCELS	AREA (ha)
Traditional Lots		12	0.5267
Public Open Space	P.O.S.	1	0.0980
Roads (inc. truncations)			0.1453
STAGE TOTAL			0.9506

Ⓐ - Denotes Public Access Easement (sec 195 & 196 of the LAA)

Ⓢ - Denotes Sewerage Easement



Ver.	Description	Drawn	Date	Checked
D	Add sewer easement over Lots 16 & 17	PLJ	07/01/16	AMJ
C	Remove 1m easement in P.O.S.	PLJ	01/12/15	SDW
B	Add 1m easement around cul de sac	PLJ	24/11/15	SDW
A	Initial Issue	AMJ	10/09/15	SDW

SCALE 1 : 250 @ A1

5 0 20

ALL DISTANCES ARE IN METRES

For a true to scale reproduction of this plan, plot it to A1 with the Paging Scaling set to None.

The contents of this plan are current and correct as of the date stated within the revision panel. All consultants and persons wishing to utilise this data should satisfy themselves of this plans currency by contacting the McMullen Nolan Group.

FILES
mapCOGO:- Plan2
Control Register:-
File Name:- 98769pr-002d.dgn

PRECAL LEGEND
See below Lot Stats table for further information
Stage Boundary
Vehicle Access Restriction
(15) Potential Dwellings / Lot

N

PLANNER'S DESIGN SOURCE for Rev A
Planner :- Whelans Town Planning
Received date:- 09/09/2015
File name:- 140730 Subidivision plan rev 5

ENGINEER'S DESIGN SOURCE for Rev B
Engineer :- Porter
Received date:- 24/11/15
Data purpose:- Add 1m easement around cul de sac

All areas and dimensions depicted on this plan are subject to survey and Landgate registration. All cadastral information external to the stage/s which form the subject of this plan are not guaranteed and are supplied as a guide only.

Lot 20 Rockingham Road MUNSTER

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CLIENT: terranovis

Project Mngr.	Mark DOBSON	Datum	PCG94

98769 - 002 - D
Job Number | Plan Number | Version

APPENDIX 3

Local Water Management Strategy

Local Water Management Strategy

Lot 21 Rockingham Road
Munster
Western Australia
October 2016

Local Water Management Strategy
Lot 21 Rockingham Road, Munster, Western Australia

Prepared for:	Harley Dykstra
Prepared by:	Nadine Benker B.Eng (Hons)
Project Supervisor:	Peter Keating, B.Sc. (Hons) PhD

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Document Control

Issue	Date	Author	Reviewer	Approved
1	01/06/2016	N. Benker	P. Keating	P. Keating
2	01/09/2016	D. Alanoix	T. Lynn	P Keating
3	20/10/2016		T Lynn	P Keating

Local Water Management Strategy Checklist in accordance with Better Urban Water Management (WAPC, 2008)

LWMS Item	Deliverable	Section
Executive Summary		
Summary of the development design strategy, outlining how the design objectives are proposed to be met	Design elements and requirements for best management practices and critical control points	Executive Summary & Design Criteria in Section 3
Introduction		
Total water-cycle management principles and objectives Planning background Previous studies		Section 3 Introduction Section 1.1
Proposed Development		
Structure plan, zoning and land use Key landscape features Previous land use	Location plan Structure Plan Site context plan or a combination of above	Section 2 Figures 2 Section 4.2
Landscape – proposed public open space areas, public open space credits, water source, bores, lake details, irrigation details	Landscape Plan	To be provided at UWMP stage
Design Criteria		
Agreed design objectives and source of objectives.		Section 3
Pre-Development Environment		
Existing information and more detailed assessments (monitoring) of site; explanation of how the site characteristics affect the design		Section 4 Figures 3-7
Site conditions – existing topography/contours, aerial photo underlay, major physical features.	Site condition plan	Section 4 Figure 3
Geotechnical – topography, soils including acid sulphate soils and infiltration capacity, test pit locations.	Geotechnical plan	Section 4.4 Report in Appendix
Environmental – sensitive or significant vegetation areas, wetland areas and buffers, waterways and buffers, contaminated sites.	Environmental plan plus supporting detail where appropriate.	Section 4.8
Surface water – topography, 100 year floodway and flood fringe areas, 100 year proposed flow paths, water quality of flows entering and leaving (if applicable).	Surface water plan	Section 4.7 Figure 7
Ground water – topography, test bore locations, ground water pre- and post-development, water quality, ground water variation hydrograph.	Ground water plan plus details of ground water monitoring and testing.	Section 4.6 Figure 6

Water Sustainability Initiatives		
Water efficiency measures – private and public open spaces including method of enforcement		Section 5
Fit-for-purpose strategy and agreed actions and implementation		
Waste water management		
Stormwater Management Strategy		
Flood protection – peak flow rates, Volumes and top water levels at control points, 100- year flow paths – flood ways and flood fringe zones and/or along roads and reserves, 100-year detention areas.	100-year flood plan Long section of critical points	Section 6 Figures 8 and 9
Manage serviceability – storage and retention required for the critical 5-year ARI storm events. Minor roads should be passable in the 5-years ARI event.	5-year event plan	
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	Typical cross sections	
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	Section 7.
Actions to address acid sulphate soils or contamination	Acid sulphate soil and dewatering management plans	Section 8.1
Subdivisions and UWMP		
Content and coverage of future urban water management plans to be completed at subdivision. Include areas where further investigations are required before detailed design.		Section 10.3
Monitoring Program		
Recommended future monitoring plan including timing, frequency, locations and parameters, together with arrangements for ongoing actions.		Section 9
Implementation		
Developer commitments Roles, responsibilities, funding for implementation Assessment and review		Section 10

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Figure 8.3: Post Development Surface Water and Soakwell Concept Plan, 1:100 yr ARI Event

Executive Summary

This Local Water Management Strategy (LWMS) has been prepared by Bioscience on behalf of Harley Dykstra in support of the Local Structure Plan (LSP) for Lot 21 Rockingham Road and is designed to comply with the City of Cockburn Town Planning Scheme No.3 and Better Urban Water Management (WAPC, 2008a). A summary of the water management strategy is provided in the table below.

Principle	Key LWMS Element
Water Conservation Water efficient approaches to better manage water consumption	• Target consumption rates for scheme water both internally and externally of buildings • Use of native flora in POS to reduce irrigation dependency
Water Quality Maintain and, if possible, improve surface and ground water quality to pre-development levels	• Change in land use to reduce nutrient input • Source controls including street sweeping, education schemes, native planting in landscaping • At source infiltration to be maximised • Visual inspections of basin water
Water Quantity A comparison of pre and post-development for annual discharge should be maintained	• Management of run-off up to 1 in 100 year ARI event throughout the development • Maintenance of existing flow regimes and levels • Maximise infiltration where possible • Maintain groundwater levels
Ecosystem Health Maintain and improve sensitive areas	• Maintain critical 1 in 1 year flow regimes post development
Economic Viability To implement stormwater systems that are economically viable in the long term	• Implement a proven technology • Minimise pollutant and sediment entering the drainage system and environment
Public Health To minimise the public risk	• Design in accordance with relevant design standards, BMPs, council regulations and government agency requirements
Protection of Property To protect the built environment from flooding and water logging	• Developments designed to offer protection against storm events up to 1 in 100 year ARI
Social Values Ensure social aesthetic and cultural values are recognised	• Drainage infrastructure to enhance and improve the local residential community

1 Introduction

Water is a valued resource across Western Australia and owing to its relative scarcity, management is focused on protection and improvement of current sources. Sustainable approaches are taken to ensure protection of the environment and a reduced risk of flooding and other negative effects of water mismanagement.

This Local Water Management Strategy (LWMS) has been prepared by Bioscience on behalf of Harley Dykstra for Lot 21 Rockingham Road (**Figure 1**) in support of the Local Structure Plan (LSP) (**Figure 2**) and is designed to comply with the City of Cockburn Town Planning Scheme No.3.

The LWMS will inform designs for total water cycle management objectives including;

- Water Conservation - Maximising the efficient use of water resources
- Water Quality - Maintaining and, if possible, improving water quality
- Water Quantity - Maintaining and managing the predevelopment water conditions
- Protection of Infrastructure - Ensure protection of infrastructure
- Protection of Public Health - Ensure safe passage and storage of water including the suppression of nuisance insects and disease vectors
- Economic Viability - management of water shall be financially viable in the long term
- Social Values - recognise, promote and protect social, aesthetic and cultural values

The Lot 21 Rockingham Road LSP is designed to be compliant with the frameworks set out in the following State Government Policies in order to achieve sustainability across the development;

- State Water Strategy (Government of WA, 2003).
- State Water Plan (Government of WA, 2007)
- Statement of Planning Policy No 3 Urban Growth and Settlement (WAPC, 2006a)
- State Planning Policy 2.9 Water Resources (WAPC, 2006b)
- Planning Bulletin 92 Urban Water Management (WAPC, 2008b).
- Planning Bulletin 64/2009 Acid Sulphate Soils (WAPC, 2009).
- Liveable Neighbourhoods (WAPC, 2009).
- Better Urban Water Management (WAPC, 2008a).
- Developing a Local Water Management Strategy (DoW, 2008).
- Stormwater Management Manual for Western Australia (DoW, 2004-2007).
- Decision Process for Stormwater Management in Western Australia (DoW 2004-2007).
- Stormwater Quality Management Manual for WA (DoE, 2004).
- National Water Quality Management Strategy (ANZECC, 2000).

The LWMS provides an understanding of the existing surface water and groundwater for the study area and advice on stormwater drainage, water quality considerations and flood management. It will also take into consideration the interaction between the development and regional drainage flows.

1.1 Previous Studies

In addition to the State Government Policies regulating this development, local studies have been undertaken to offer guidance for future work. Some of the local documents referenced within this LWMS are listed as follows;

- *City of Cockburn Guidelines and Standards for the Design, Construction and Handover of Subdivision within the Municipality*
- *Geotechnical Investigation. Proposed Residential Development Lot 21 Rockingham Road, Munster, WA. (Appendix A)*

2 Proposed Development

The proposed Lot 21 Rockingham Road LSP is to be a residential development of approximately 0.8 ha located 20km south south-west of Perth CBD and 2.5km east of the coast within the City of Cockburn (**Figure 1**). Lot 21 is bounded by Rockingham Road to the east and future developments on all other sides.

The Lot 21 Rockingham Road LSP (**Figure 2**) provided by Harley Dykstra has been designed in consideration of site restrictions and proposes that the development is to comprise of:

- Residential zones of varying densities (R30-R60)
- Subdivision into residential pads
- Road Reserves acting as common property access
- Public Open Space

The client wishes to proceed with the development based on two stages. Stage 1 will include eight lots associated with the internal road (R3); while Stage 2, the grouped housing lot is to be developed/ subdivided once the road along the northern boundary of the site is constructed to its full width. This is identified in Figure 2.

3 Design Criteria

This development manages the total water cycle in a sustainable, well-integrated manner, whilst adhering to the principles of Water Sensitive Urban Design (WSUD) outlined in:

- State Planning Policy 2.9: Water Resources (WAPC, 2006b)
- Liveable Neighbourhoods (WAPC, 2009b)
- Stormwater Management Manual for WA (DoW, 2004-2007)
- Better Urban Water Management (WAPC, 2008a).

The LWMS will tie in with regional and local principles and objectives of total water cycle management (**Table 1**).

Table 1: Principles of Water Sensitive Urban Design

Principle	Key LWMS Element
Water Conservation Restrict the use of potable scheme water throughout the development and maximise the reuse of rainwater	• Target consumption rates for scheme water both internally and externally of buildings including; State Water Plan target for water use of 100kL/person/yr with an aspirational target of 40-60kL/person/yr by utilising fit-for-purpose infrastructure and water efficient fixtures and fittings in buildings, 7500kL/ha/year of water irrigation in landscaped areas • Use of native flora in drainage areas to minimise irrigation dependency • Use of rainwater harvesting systems • Reduce evaporation where possible
Water Quality Maintain surface and ground water quality at pre-development winter	• Pollutant source controls to be implemented including reduced nutrient application, WSUDs, education schemes • Use of structural and non-structural best management

concentration levels and if possible, improve the quality	practices
Water Quantity A relative comparison between pre and post-development for annual discharge volume and peak flow should be maintained. Groundwater levels to be maintained	• Management of run-off up to 1 in 100 year ARI event throughout the development • Retain the 1 year 1 hour event from modified surfaces i.e. roofs, paved areas, road reserves • Detain flows from 5 to 100 year ARI storm events within the boundary of the development • Minor roads to remain passable in the 5 year ARI event • Major roads to remain passable during the 100 year ARI storm event • Maintenance of existing flow paths and maximise infiltration • All finished floor levels should have a clearance of 0.3m from the 100 year ARI water storage level
Ecosystem Health Determine ecological requirements to maintain and improve sensitive areas including the REW to the west	• 1 year ARI events post development kept relative to pre development levels • Identification of impacts affecting significant environments and maintenance of desirable hydrological flow regimes
Economic Viability To implement stormwater systems that are economically viable in the long term	• Implement a proven technology • Minimise pollutant and sediment entering the drainage infrastructure to reduce future maintenance
Public Health To minimise the public risk, including risk of injury or loss of life to the community	• Design in accordance with relevant design standards, best management practices, council regulations and government agency requirements • All drainage infrastructure to empty retained water within 96 hours to minimise disease vectors and nuisance insect growth
Protection of Property To protect the built environment from flooding	• Developments designed to offer protection against storm events up to 1 in 100 year ARI and designed in relation to MGL
Social Values To ensure that social aesthetic and cultural values are recognised and maintained when managing stormwater	• Integration of drainage and POS functions to enhance and improve the local residential community • Minimise the impacts of construction activities

4 Pre-Development Environment

Understanding the pre-development environment conditions within a study area is essential to providing the context in which future water management strategies occur.

4.1 Site Description

The proposed Lot 21 Rockingham Road LSP is approximately **0.8ha** located 20km south south-west of Perth CBD and 2.5km east of the coast within the City of Cockburn (**Figure 1**). Lot 21 is bounded by Rockingham Road to the east and future developments on all other sides.

4.2 Land use and Topography

The study area is classified 'urban' under the Metropolitan Regional Scheme (WAPC, 2013) and is currently used for residential and has been formerly cleared. There is a residential building, shed and hardstand area located towards Rockingham Road (**Figure 2**).

The western two thirds of the site generally slope from east to west from 11m AHD to 6mAHD. The remainder of the site is graded towards Rockingham Road to the east. There are no significant topographical features on the site that will inhibit development (**Figure 3**).

4.3 Climate

The south west of Western Australia is characterised by a Mediterranean climate comprising hot dry summers and cool wet winters. According to the Bureau of Meteorology (BoM) the mean annual rainfall is 745mm (Kwinana BP Refinery Station, BoM, average since 1955) (**Table 2**). Perth also experiences frequent periods of strong winds. In hotter and dryer months this can lead to elevated evaporation rates for surface water causing concern when considering irrigation techniques. Potential evapotranspiration of the region is in excess of 1800 mm/yr.

Table 2: Rainfall at Kwinana BP Refinery Station (1955-2012)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	11.4	14.8	15.6	43.0	102.3	155.9	156.8	105.0	66.9	40.1	23.3	9.1	744.9

4.4 Geology

The Geological Survey of Western Australia Environmental Geological Series Fremantle Map sheet (**Figure 4**) indicate that the study area will contain the following soils:

- SAND – Derived from Tamala Limestone - pale yellowish brown, medium to coarse-grained sub-angular quartz, trace of feldspar, moderately sorted, of residual origin
- LIMESTONE – Tamala Limestone & Safety Bay Sand in part - pale yellowish brown, fine to coarse-grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of eolian origin

4.4.1 Geotechnical Investigation

Bioscience undertook a geotechnical investigation on the 26/02/16 with ten bore holes excavated to a depth of 2.5m or until refusal. The site has a typical soil profile consisting of between 300mm and 600mm of 0mm-2500mm (total depth) topsoil underlain by orange brown medium grained sand over limestone pinnacles in some locations. The geotechnical investigation has been included in **Appendix A**. In-situ testing indicated a permeability between $0.3x10^{-4}$ m/s and $0.8x10^{-4}$ m/s for the sand at 0.3m depth.

4.5 Acid Sulphate Soil

The Department of Environment Regulation (DER, 2007) has compiled maps of Acid Sulphate Soil (ASS) risk areas for several coastal regions of Western Australia. The map indicates that the site has a low risk of ASS being present within the top 3m of soil (**Figure 5**).

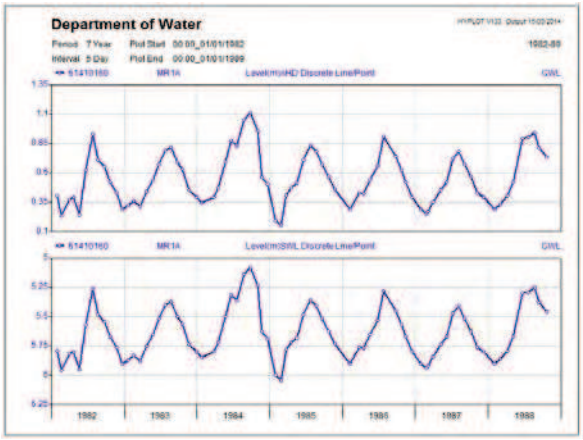
As most of the development activities are unlikely to be greater than 3m below natural surface level no further ASS investigations have been undertaken as part of this LWMS. Deep excavation of services, such as main sewer lines, may require further ASS investigation assessed against the Water Corporation ASS and Dewatering Management Strategy.

4.6 Groundwater Level

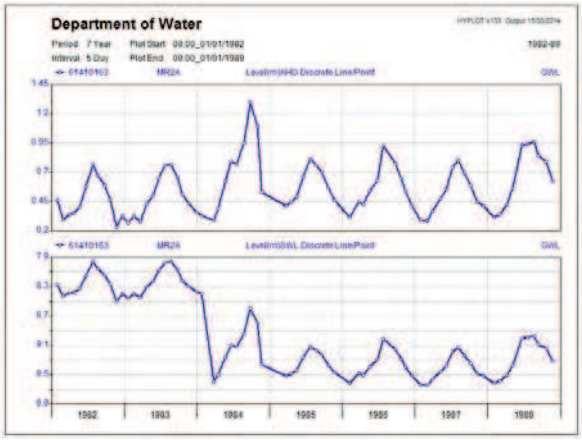
The Department of Water (DoW) Perth Groundwater Atlas identifies the site as having a groundwater level of approximately 1.5m AHD with the hydraulic gradient line being from east to west (DoW, 2009). **Figure 6** shows that the water table is approximately 9.5m below ground level (BGL) along the eastern boundary and 4.5m BGL along the western boundary. Seasonal fluctuations of groundwater levels are of 0.5m in this region depending on seasonal conditions.

There are two DoW historical monitoring bores in close proximity to the site. Bores ID 3122 and 3125 are about 200m north west and 300m north of Lot 21, respectively. Groundwater levels have been recorded monthly by the DoW; seasonal fluctuation has been consistent over the monitoring period as shown in **Graphs 1** and **2**.

Graph 1: DoW bore ID 3122 (1982-1988)



Graph 2: DoW bore ID 3125 (1982-1988)



Generally, the annual maximum groundwater levels ranged from 0.78mAHD (3122) and 0.77mAHD (3125) to 0.94mAHD (3122) and 0.96mAHD (3125), however, exceptionally higher levels were recorded in 1984 that are 1.12mAHD (3122) and 1.30mAHD (3125), respectively. For conservative reasons, the historical maximum groundwater level for DoW Bore ID 3125 (i.e. 1.30mAHD) was selected to be a suitable estimate for the MGL within the vicinity of the site. Given the ground elevation ranging from 6mAHD along the western boundary to 10mAHD along the eastern boundary of the site, the maximum groundwater table is therefore estimated to be 4.7mBGL and 8.7mBGL along the western and eastern boundary respectively. **Table 3** below summarises DoW monitoring data for the two bores.

Table 3: Historical Annual Maximum Groundwater Levels DoW bores

	Bore ID 3122	Bore ID 3125
	Ground level (m AHD)	Ground level (m AHD)
	5.554	9.062
YEAR	MAX level (m AHD)	MAX level (m AHD)
1982	0.932	0.77
1983	0.822	0.77
1984	1.112	1.3
1985	0.832	0.813
1986	0.912	0.923
1987	0.782	0.803
1988	0.942	0.963

It has been confirmed by the DoW for neighbouring Lots 18, 19, 20 and 25 that groundwater monitoring is not required prior to the development for the following reasons;

- The developable yield of the subject lot is low
- A large distance to groundwater for the majority of the subject lot will reduce urban environmental impacts on groundwater
- Nutrient inputs of the proposed land use is less intensive than the previous land use

4.7 Surface Water Hydrology

Understanding the predevelopment surface water characteristics is fundamental to outlining an effective post development water management plan. This LWMS describes the predevelopment flow rates and volumes in order to maintain them post development.

The existing drainage strategy for Lot 21 Rockingham Road relies heavily on rapid infiltration in the sandy soil for frequently occurring rainfall events. Surface water flow generated in larger events will typically flow towards the wetland area to the west of the site and ultimately Lake Coogee. The existing buildings utilise soakwells for frequently occurring events. A portion of Lot 21 adjacent to Rockingham Road has surface elevations sloping towards the road and surface water flows onto the road in major events (**Figure 7** shows surface elevations and surface water flow direction).

Of the 8018m² approximately 1500m² is currently hardstand or roof area. The remaining area is cleared. Lot 21 is not connected to the council drainage and relies on infiltration to dispose of stormwater; either through soakwells or surface infiltration in the sandy soils. **Table 3** gives the results from the XP SWMM computer modelling of the predevelopment conditions as per catchments shown in **Appendix B**.

Table 4: Predevelopment Volumes and Flow Rates

	Duration (h)	Peak Outflow (m3/s)	Storm Volume (m3)
C1 (to Market Garden Swamp)			
1 Year 1 Hour ARI	6	0.007	3.4
5 Year 1 Hour ARI	2	0.047	17.4
100 Year 1 Hour ARI	0.5	0.269	120.7
C2 (to Rockingham Rd)			
1 Year 1 Hour ARI	6	0.002	2.6
5 Year 1 Hour ARI	1	0.008	5.5
100 Year 1 Hour ARI	0.5	0.025	21.2

In infrequent storm events (100 year), surface water would flow west towards the sump wetland following the surface contours of the site. Provision of flow paths and/or storage will be required to maintain this predevelopment condition.

4.7.1 Surface Water Quality

Surface water quality has not been monitored as there is very little opportunity to collect a sample as the site is rapidly drained by infiltration and no ponding occurs.

4.8 Environmental Assets

In order to maintain and improve the existing environmental features and habitats within the LSP area it is important to identify and understand what environmental assets are present.

4.8.1 Flora

The site is completely cleared of all vegetation owing to the historical clearing. There are a few imported trees around the perimeter of the buildings.

4.8.2 Fauna

Market Garden Swamp No.3 provides some breeding habitat for ducks within fringing vegetation. The Eucalypts provide habitat for nesting birds however no hollows were observed for large parrot species. Market Garden Swamp No.3 also provides some habitat for native freshwater fishes although due to historical land use surrounding the wetland as well as being vested in private property, aiding to poor management, the wetland is eutrophic and polluted.

4.8.3 Wetlands

The Geomorphic Wetlands Dataset displays the location, boundary, geomorphic classification and management category of wetlands on the Swan Coastal Plain. According to the data set the study area does not contain any wetlands. The sump land resource enhancement wetland (REW) No.6369 is located approximately 130m to the west. One of the Market Garden Swamps situated in the area, which is classified as an Environmental Protection Policy (EPP) Lake, is within 230m of the lot.

4.9 Contamination

There are no identified contaminated sites within Lot 21. A desktop study of the reported contaminated sites database for the surrounding area has been completed. There are three contaminated sites that are 170m west, 550m south and 350m west North West, respectively, of Lot 21.

5 Water Use and Sustainability

Developments increase water resource demands and the Better Urban Water Planning (WAPC, 2008a) guidelines indicate that a development should sustainably manage and utilise the supply and usage of water within it. This LWMS includes strategies aimed at achieving a better management of water resources to reduce the impact that the development has on resources and the surrounding environment.

5.1 Water Conservation

Water is an essential requirement and valuable resource for all developments and practical water conservation methods should be considered to maintain an appropriate efficiency of water consumption. Conservation methods should incorporate both the use of potable and non-potable water sources. There are several methods discussed in this section to achieve the Better Urban Water Management (WAPC, 2008a) target consumption reductions.

5.1.1 Fixtures and Fittings

Residential lots will be constructed consistent with the Building Codes for Australia water efficiency standards and to the State Government 5 Star Plus scheme. Lot owners will be offered water wise landscape rebates by the developer as part of the contract of sale for the land.

5.1.2 Waterwise Landscaping

Waterwise landscaping forms a large portion of water conservation strategy to reduce the quantity of water required for irrigation and also reduce the total runoff. The public open space (POS) will be designed to meet the requirements of Liveable Neighbourhoods (WAPC, 2009b) and the City's POS Development Guide (CoC, 2013).

Any irrigation required will be from a fit-for-purpose source and a target of 7500kL/ha/year is to be used. All turf areas are to be irrigated and shall be easily accessible by maintenance staff and vehicles. Irrigation designs shall be prepared in accordance with the CoC 'Standard Specifications for Irrigation' and submitted prior to construction.

The development will achieve water conservation through landscaping by planting drought tolerant indigenous species in the POS, increasing pervious areas and improving soil water holding capacity. Soak away systems should also be incorporated to maximise infiltration where possible.
Indigenous vegetation has minimal or no irrigation requirements and will be planted throughout the development including within the road reserves and POS. Plants suitable to the Swan Coastal Plain will be selected to promote a natural ecological environment and minimise the introduction of alien species whilst offering a habitat for native species.

Road reserve vegetation shall be protected from vehicular damage by a kerb stone perimeter. The road gradient will also act to convey surface water directly into the entry points in an efficient manner to achieve rapid entry into infiltration drainage systems. Appropriate ground surfaces will also be chosen where possible to achieve higher infiltration and lower the evaporation rate i.e. mulch, porous paving, gravel. Plant species should facilitate low maintenance with minimal requirements for irrigation and upkeep.

5.2 Groundwater Availability

The POS will be irrigated. A review of the allocation report of the Kogalup subarea of the Cockburn Groundwater Management Area suggests there is water available within the Superficial aquifer. It is also noted that a Form 1 and a Form 3G will be submitted to DoW to obtain both a licence to construct a well and a groundwater licence. An allocation of 5,000 kL/yr will be sought. This water supply will be used for the irrigation of the POS and dust suppression during construction.

5.3 Pre- and Post-Development Water Balance

This water balance aims at assessing the impacts of the development on wetlands through groundwater changes and does not consider imported potable scheme water for external use.

Rainfall				
	mm	m	Rainfall Total	
	744.9	0.7449	**5.97**	**ML**
PRE				
Evapotranspiration rural 600mm (JDA 209)	8018	0.6	**3.6**	**ML**
Recharge Pre Development			**2.39**	**ML**
POST				
	m2	Recharge Coefficient		
Public Open Space				
P1	805	0.8	0.48	ML
Residential				
D1	1130	0.8	0.67	ML
D2	1735	0.8	1.03	ML
D3	1726	0.8	1.03	ML
D4	1137	0.8	0.68	ML
Road				
R1	269	0.1	0.02	ML
R2	1216	0.1	0.09	ML
Recharge Post Development			**4.0**	**ML**
Difference			**1.6**	**ML**

The potential groundwater recharge post development is approximately 1.6ML/year which will directly support the Market Garden Swamp No.3 in a drying climate.

6 Surface Water Management

This LWMS addresses management of surface and storm water quality and quantity to protect ecological, socio-economic and cultural values. It will assist decision making ensuring structural and non-structural remedial measures in developments are undertaken in a cost-effective, integrated and coordinated manner within a close proximity to the guidance given in the Stormwater Management Manual for WA (DoW). The approach will also be consistent with the key design objectives of water sensitive urban design practices detailed in **Table 1**.

6.1 Conceptual Management Strategy

Surface water generated in a rainfall event flows over a catchment and can potentially inundate a development by exceeding the storage capacity of drainage infrastructure. Developments decrease the effective permeability of the overall site, and hence, increase peak runoff rates and flooding potential. Suspended particles and pollutants in carried water can cause long term damage to drainage systems, groundwater and ecosystems. Risk will be managed by disconnecting constructed impervious areas from receiving water bodies (preventing direct discharge) and by reducing the amount of constructed impervious areas (DoW, 2009b).

Surface water flows are to be managed at both lot level and development scale to maintain predevelopment hydrology by retaining or detaining surface water, and to infiltrate runoff close to source. Drainage is split into two categories, minor and major, based on capacity requirements of varying ARI events;

- Minor Drainage: Rooftop guttering, underground pipes, culverts and gullies
- Major drainage: Specific road arrangements for overland flows, drainage basin reserves, overland swale systems, attenuation and infiltration areas

Residential minor drainage systems are designed to accommodate ARI events of a frequency up to 1 in 5 years whilst major drainage is designed to convey stormwater from events up to, and including, magnitudes of 1 in 100 year ARI critical storm events. Drainage systems are designed to attenuate the peak volume and flow rates safely allowing time for controlled release into the downstream network and infiltration whilst offering water quality treatment prior to disposal.

In compliance with the City of Cockburn's Onsite Drainage Requirements, residential lots will provide storage capacity for the 20-year rainfall event either through soakwells or an approved method. The reserve will manage lot runoff contributions above the 20-year event, manage surface water generated in the 5-year events within pipes and soakwells, maintain predevelopment 100-year ARI storm event flow paths and maximise infiltration opportunities.

6.2 Best Management Practices

To maintain and improve water quality the development will use the treatment train approach to 'source control' pollutants using best management practices (BMPs) as detailed in the DoW report Stormwater Management Manual for WA (DoW, 2004). BMPs are cost effective methods to reduce operation and maintenance expenditure post-development. BMPs are used in two forms; non-structural and structural.

Non-structural BMPs control pollutants at source using "soft" measures to minimise contaminant input. These methods have the potential, if used correctly, to be an efficient and cost effective water quality management option.

Structural BMPs, like their non-structural counterparts, offer source control of pollutants and nutrients whilst offering maximum infiltration opportunities, the difference being, it is achieved in physical way by the implementation of civil infrastructure.

The Department of Water stormwater management manual for WA gives the expected pollutant removal efficiencies of the above structural BMPs as being;

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

6.2.1 BMP Implementation

Lot 21 Rockingham Road will implement the following BMP elements to achieve a high quality discharge at each level of development; lot, street and regional levels. **Table 4** highlights the level at which each BMP will be used and the ownership.

Table 5: Implementation of BMPs

Level	Ownership	Best Management Practice
Lot	**Lot Owner**	• Soakwells will be used for direct infiltration at source of runoff generated from roofs and roads in the 20-year 1-hour ARI event • Rainwater tanks shall be made available during planning and construction stages to reduce load on downstream systems • Education campaigns to increase awareness of pollutant control i.e. using fertilisers correctly and using techniques for minimising stormwater runoff pollutants. Information is to be provided to lot owners by developers and builders • Inclusion of native planting suitable to Perth soil conditions in landscaping strategies
Street	**Local Authority**	Structural controls to limit and contain nutrients, heavy-metals, hydrocarbons and other pollutants. Infrastructure to include; • Infiltration systems such as leaky manholes or soakage chambers to be included in the road reserve or POS • Street sweeping to remove sediment and other pollutants to prevent entry into the stormwater drainage system • Dust control during construction activities
Catchment		• Landscape management across the catchment to reduce nutrient application and irrigation requirements

6.2.2 Disease Vector and Nuisance Insect Management

Mosquitoes breed in both natural and man-made standing water, as well as a range of water bodies and storage containers in urban environments. To reduce health risks from mosquitoes, retention and detention treatments are designed to ensure that between the month of November and May, detained stormwater is fully infiltrated or discharged in a time period not exceeding 96 hours. The high permeability rate across Lot 21 will support rapid infiltration in all structures.

The presence of seasonal water within the wetland and fringing vegetation also provides ideal habitat for midge breeding. Midge populations across Perth are generally higher in areas containing rivers and lakes and generally managed by local authorities and the Department of Health. Pursuant to section 165 of the Planning and Development Act 2005 the title of each new Lot within the proposed development shall inform prospective buyers that the land may be affected by midge infestation.

The City of Cockburn's policy APD6 more explicitly states that as the subdivision is within 500 m of part of the Market Garden Swamp system, a Notification in the Deposited Plan must say "This land may be

affected by midge from nearby lakes and/or wetlands. Enquiries can be made to the City of Cockburn Environmental Services"

6.3 Surface Water Flow Management

Predevelopment flows onto neighbouring developments cannot be assumed as a critical flow path in the post development drainage scenario as surface gradient and high infiltration rates limit flow. Localised recharge of groundwater will be maximised through infiltration.

The following calculations are to detail post-development surface water runoff based on the Indicative Subdivision Concept using the Rational Method and were further optimized by XP STORM 2016 modelling. The model parameters used are listed in **Appendix B.**

To calculate the storage and infiltration requirements for Lot 21, the development is split into sub-catchments draining to soakage and infiltration areas (**Figure 8.1-3**).

Lots:

- 20 year ARI events to infiltrate close to source in soakwells
- Overland flow to street drainage (soakwells and storage chambers) in events greater than 20 year ARI events
- As authorised by the City of Cockburn sub-catchment D4 (R60 lots) fronting Rockingham Road, will provide storage and infiltration for the 20-year event in soakwells with surface water in excess of the 20 year ARI event having an overland flow path onto Rockingham Road.
- All habitable building floors to be a minimum 0.3m above 100-year flood storage levels and a minimum of 1.2m above the predevelopment MGL
- A minimum 0.5m clearance from base of soakwell to MGL

Road Reserves:

- Roads (Carine Parade) to infiltrate 100 year events at source via combination of SEP soakwells and Stormtech chamber(s).
- Stormtech chambers to be located within POS areas.
- 1800x1800mm soakwells are utilised; standard drawings are attached (**Appendix C**)
- Roads graded and defined with kerbs (where required) to direct surface water flow towards drainage infrastructure
- Bases and inverts of infiltration drainage infrastructure to be a minimum 0.5m above MGL to maintain dry bases
- All vegetation will be appropriate for Western Australian local soils and selected by landscape designer or suitably qualified person

As authorised by the City of Cockburn sub-catchment D4, fronting Rockingham Road, will provide storage and infiltration for the 20-year event in soakwells or similar on-site with surface water in excess of the 20-year ARI event having an overland flow path onto Rockingham Road.

The geotechnical report identified that within the proposed eastern road reserve the depth of limestone pinnacles below the surface was 0.4m – 0.8m (Holes 6, 7, 8). 1800mm deep soakwells can be utilised in the road reserve after removal of underlain limestone.

Table 6 provides the critical post development peak flows.

Table 6: Post Development Runoff Volumes

Sub-Catchments	R1	R2	R3	D1	D2	D3	D4	POS
Catchment Areas								
Total Catchment area (m²)	269	360	856	1130	1735	1726	1137	805
Road & Road Reserve area (m^2)	269	360	856	-	-	-	-	-
Residential (m^2)	-	-	-	1130	1735	1726	1137	-
POS (m^2)	-	-	-	-	-	-	-	805
Critical Events and Peak Flow (m^3)								
1 Year ARI	30min 0.004	30min 0.005	30min 0.011	12h 0.001	24h 0.001	24h 0.001	24h 0.001	1h <0.001
5 Year ARI	30min 0.006	30min 0.008	30min 0.018	12h 0.005	24h 0.006	24h 0.006	24h 0.006	6h 0.002
20 Year ARI	30min 0.008	30min 0.011	30min 0.025	6h 0.009	6h 0.012	6h 0.012	6h 0.011	6h 0.004
100 Year ARI	30min 0.010	30min 0.014	30min 0.031	1h 0.013	1h 0.017	1h 0.017	1h 0.017	1h 0.007

The pipe network is sized to convey all flows from the above listed critical storm events.

Storage requirements for each sub-catchment for the 1-hour storm events outside of lots are provided in **Table 7** below:

Table 7: Storage Requirements outside Lots

ARI Rainfall Event	1 Year ARI (m^3)	5 Year ARI (m^3)	20 Year ARI (m^3)	100 Year ARI (m^3)
POS	-	-	5.7	14.1
R1	2.7	5.9	8.1	11.5
R2	3.5	7.9	10.8	15.3
R3	8.3	18.7	25.6	36.4
D1	-	-	-	13.6
D2	-	-	-	20.6
D3	-	-	-	20.5
D4	-	-	-	13.9

1800x1800mm soakwells have capacity for 4.58m³ of water with approximately 0.5m³ of water infiltrating per hour based on the tested in-situ permeability rate. Soakwells will be installed to City specifications as per the City of Cockburn Standard Drawings included in **Appendix C**.

Figure 8.1-3 shows the conceptual locations of soakwells and soakage chambers, however, their ultimate locations will be determined at UWMP stage taking into account the positions of driveways and other infrastructure. Calculations are based on an infiltration rate of 5m/day. Allowing for 0.5m³ of infiltration per soakwell per hour and soakwell blockage over time.

Drainage requirements and indicative soakwell requirements for R2 are provided within the calculations and shown in Figures 8.1-3. It should be noted that this area is the verge area (4.5m) of the overall 15m road reserve. The rest of the road reserve is located within Lot 22. The drainage requirements for this road reserve should be completed in conjunction with Lot 22 to ensure adequate drainage is provided

with no redundancy of the system, if one is completed before the other. The drainage system has been provided to show that the design has sufficient capacity to handle up to the 100 year ARI. Detailed design will finalise these requirements and will take into account the development within Lot 22.

It should also be noted that due to this layout, the proposed plan will be completed on a staged approach with R2 being part of a balance lot waiting to be developed. This will not proceed until such time as the R2 road is complete (within Lot 22) and access can be granted to the group housing area. It is also understood that Lot 22 is currently in the advertising stages for its structure plan and therefore is proceeding quicker than Lot 21. Therefore, in practise there is not likely to be any boundary issues associated with R2.

The POS area will consist of mulch and native vegetation enhancing natural values. Mulch is to be fully composted and certified Dieback (Phytophthora cinnamomi) free. A detailed landscaping plan will be provided at UWMP stage.

Once this Structure Plan and associated LWMS has been approved, a detailed landscape design must be submitted with the UWMP to identify the best location for the storm chambers within the POS, to the satisfaction of the City of Cockburn Parks Department.

7 Groundwater Management

The primary objectives for groundwater protection and management in the proposed development must show compliance and compatibility with planning policies for Western Australia and local government. These are to include;

- Protection of infrastructure and assets from groundwater intrusion
- Maintaining and managing groundwater levels and quality during and following development
- Maintain and, if possible, improve the groundwater quality
- Protection of groundwater dependent ecosystems

7.1 Groundwater Levels

Fluctuating groundwater levels can have damaging consequences to the structural integrity of infrastructure. Excessive water leads to soil swelling and reduced soil moisture content creates shrinkage. Both can induce excessive deflections and cracking in foundations, building structures, pipes etc.

Common post development influences on groundwater are;

- Increased runoff resulting in reduced localized infiltration
- Excessive infiltration and localized groundwater mounding
- Increased groundwater extraction for development use (irrigation)

Groundwater levels are to be maintained at predevelopment levels. Groundwater monitoring was not required as the separation between surface and groundwater in excess of 2m naturally occurs. The separation to groundwater will also be increased in the western area adjacent to the wetland by earthworks to provide the required sewer inverts to connect to neighbouring infrastructure and flat residential building pads for construction. Subsoil drainage is not required to control groundwater level.

7.2 Groundwater Quality

Best management practices (BMP) are the most effective way of reducing contaminants and nutrients into the groundwater system. The BMPs were highlighted in Section 6.2 and will be incorporated into the development to ensure groundwater quality is maintained and, if possible, improved post development.

7.3 Protection of Groundwater Dependent Ecosystems

Changes in groundwater levels and quality can have negative effects on dependent ecosystems, especially wetlands. Historically much of the study area has been cleared for residential use and surface water generated in rainfall events infiltrates directly into the sandy soils. The development relies on infiltration to manage frequently occurring events with larger, less frequent rainfall events being conveyed to the POS drainage area. Groundwater levels are to be maintained at predevelopment levels. Planted vegetation will be used in drainage areas to strip nutrients and settle particulate matter. Amended soil to a depth of 0.5m will be used in drainage areas to strip nutrients.

8 Construction Management

Construction activities are to be managed in a manner that reduces potential risk of harm to the environment. The management practices take into consideration elements of the study area that have been identified in earlier sections of this report.

8.1 Acid Sulfate Soil

Section 4.5 indicated that the Department of Environment Regulation (DER, 2003) maps, the risk of Acid Sulphate Soils (ASS) as being low within the top 3m of the site.

During construction, if any ASS is located then appropriate measures will be undertaken by the construction contractor to ensure correct treatment of the situation. These treatment methods should be in accordance with the ASS Guidelines Series Treatment and Management of Disturbed Acid Sulphate Soils (DoE, 2004b).

8.2 Dewatering

It is considered that there will be no requirement for dewatering due to the depth to groundwater and the constructed ground level as finished lot levels will be modified using earth retaining walls to create level pads.

8.3 Dust Control

During any construction work that generates airborne contaminants damaging to health and the environment must be undertaken in compliance with the *Prevention of Air Quality Impacts from Land Development Sites* document (EPA, 2000). A suitable approach would be limit and suppress dust production. Performance environmental protection measures for dust management can be listed as follows;

- Stabilisation matting to protect soil surface integrity
- Define haul roads and speed restrictions
- Covering stockpiles and transported loads
- Wet down roads for transport using non potable water i.e. bowser tank
- Groundwater abstraction for dust suppression, i.e. spraying
- Wind limiting fencing
- Limit dust generating activities to damp and windless days if possible
- Street sweeping as and when required and to council requirements

8.4 Sediment and Erosion Control

Performance summary of environmental protection measures for sediment and erosion management can be listed as below;

Erosion prevention activities;

- Stage works to minimise soil exposure
- Minimise runoff with use of rainwater harvesting and infiltration systems
- Catch and cut off drains to reduce sediment into drainage system and neighbouring properties
- Earth banks and level spreader to minimise gradient cross falls
- Lined channels and pipework on water diversion routes
- Energy dissipater i.e. baffles, scour-proof spillways, vegetated swales roughed flow surfaces
- Stabilisation matting and mulch

Sediment retention structures;

- Straw bales, silt fence, grass filter strip
- Silt fence sediment trap, floating silt curtain
- Sandbag sediment barrier, gravel sausage
- Block and gravel kerb inlet filter
- Mesh and aggregate drop inlet protection

Consideration should also be given to the management of the above methods and infrastructure during construction to ensure that all are operating to the designed levels of effectiveness.

9 Monitoring

A post development monitoring programme and contingency plan is designed to allow a qualitative assessment of water in the drainage catchment.

9.1 Post Development Monitoring

Due to the small size of the development (0.8ha) and with stormwater infiltrated at source and in the POS drainage area, a post development groundwater monitoring program is not required.

10 Implementation

This LWMS is set out to ensure that the study area manages the total water cycle in a sustainable manner. This section will highlight the key participants and their roles and responsibilities in achieving total water management.

10.1 Developer Commitments

The developer is committed to deliver the UWMP, in consultation with the City of Cockburn and the Department of Water, and to subsequently develop detailed engineering designs.

10.2 Roles, Responsibilities and Funding

The key stakeholders are:

- Developer
- City of Cockburn
- Department of Water
- Water Corporation

Their roles, responsibilities and funding are summarised below:

Table 8: Key Stakeholders and Responsibilities

Organisation	Role/Responsibility	Funding
City of Cockburn	• Assumes future long term responsibility for roads and storm water infrastructure including the ongoing operation and maintenance agreed at handover by the developer.	Rates
Water Corporation	• Assumes future responsibility for the potable water supply and sewerage infrastructure including the ongoing operations and maintenance	Rates

Developer	• Obtain approval of the UWMP • Implement approved Acid Sulphate Soils and Dewatering Management Plans if required, Taking Water and Disposal Licences during construction of subdivision works if required • Demonstrate that the proposed designs support the UWMP ability to achieve the water quantity and quality objectives and criteria set by this document • Construct and maintain stormwater control measures until handover to the City	Developer

10.3 Future Work for the UWMP

The Urban Water Management Plan (UWMP) is mostly an extension of the work developed through DWMS and LWMS stages and often requires further work to help define future requirements including;

- Development of the LSP to design stage, including all surface and drainage invert levels and the inclusion of a landscape management plan
- Further surface water volume calculations using the finalised development layout plans
- The post-development monitoring requirements for the POS drainage area as defined by the City
- Detailed design of all drainage infrastructure to City of Cockburn Standards

10.4 Technical Review

Subdivision approvals require a UWMP to provide the detail to concepts included in this document, and implemented in the detailed engineering design and construction of the proposed development.

In addition to the above and in the event of non-completion of construction activities within 10 years of approval being granted then the local water management strategy will require review ensuring the contents remains relevant allowing updates to be made. The design objectives shall be revised to ensure that targets are consistently met. Similar boundaries shall be maintained to ensure the proposed development meets the specific drainage plan and that calculations achieve their intended targets and arising problems can be easily identified.

The review shall be undertaken by competent persons and cover, but not be limited to, the following:

- Impacts of the development
- Design objectives
- Water management strategies
- Receiving water body management including the health of dependent ecosystems

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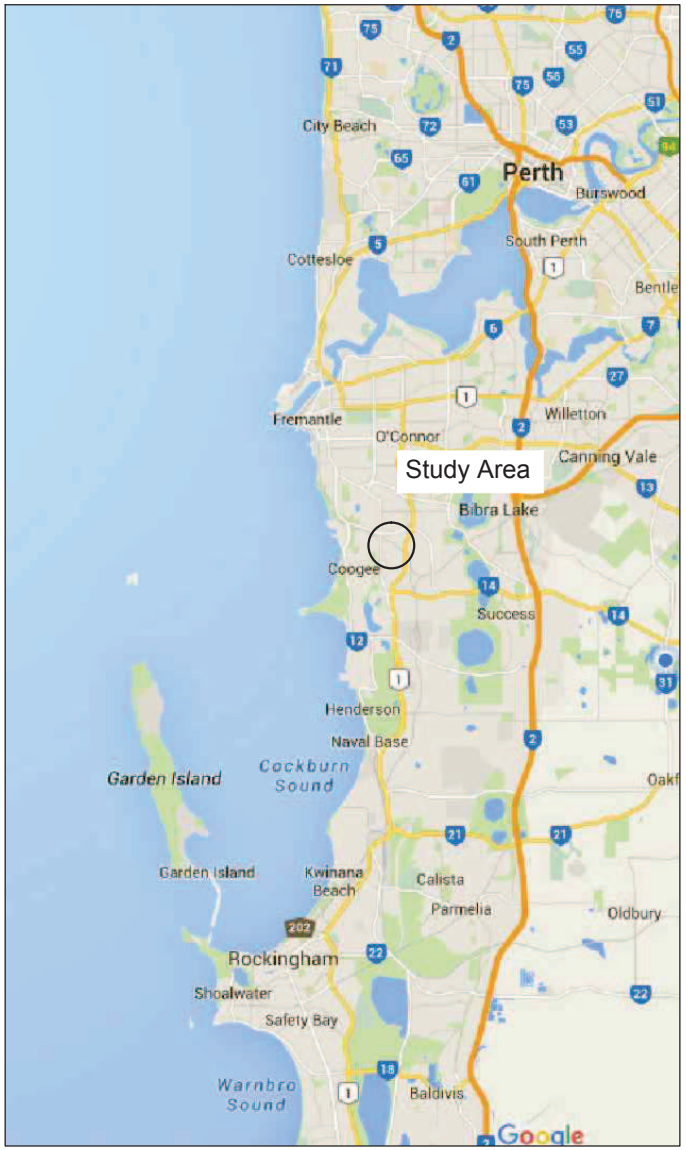
Figures





Bioscience

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PHONE: (08) 9397 2446 FAX: (08) 9397 2447
EMAIL: bioscience@biosciencewa.com
WEBSITE: www.biosciencewa.com

Legend:

Site Boundary

Data Source: Nearmap & Google Maps (April 2016)

Project Title: Lot 21 Rockingham Rd, Local Water Management Strategy
Location: Munster, Perth, WA
Client: Harley Dykstra
Date: 18/04/2016

Drawn: NB
Checked: PK

Figure 1: Location

CONCEPT SUBDIVISION PLAN

Lot 21 on P 3562
583 Rockingham Road, MUNSTER

Plan No.	20777-05C	
Date	14/10/16	
Drawn	BdR	
Checked	DM	
Revision	C	
Scale	1:500@A3	

PERTH OFFICE:
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W: www.harleydykstra.com.au
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Busselton and Kelmscott

0 5m 10m 15m

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NOTE: This plan has been prepared for planning purposes. Areas, Contours and Dimensions shown are subject to survey

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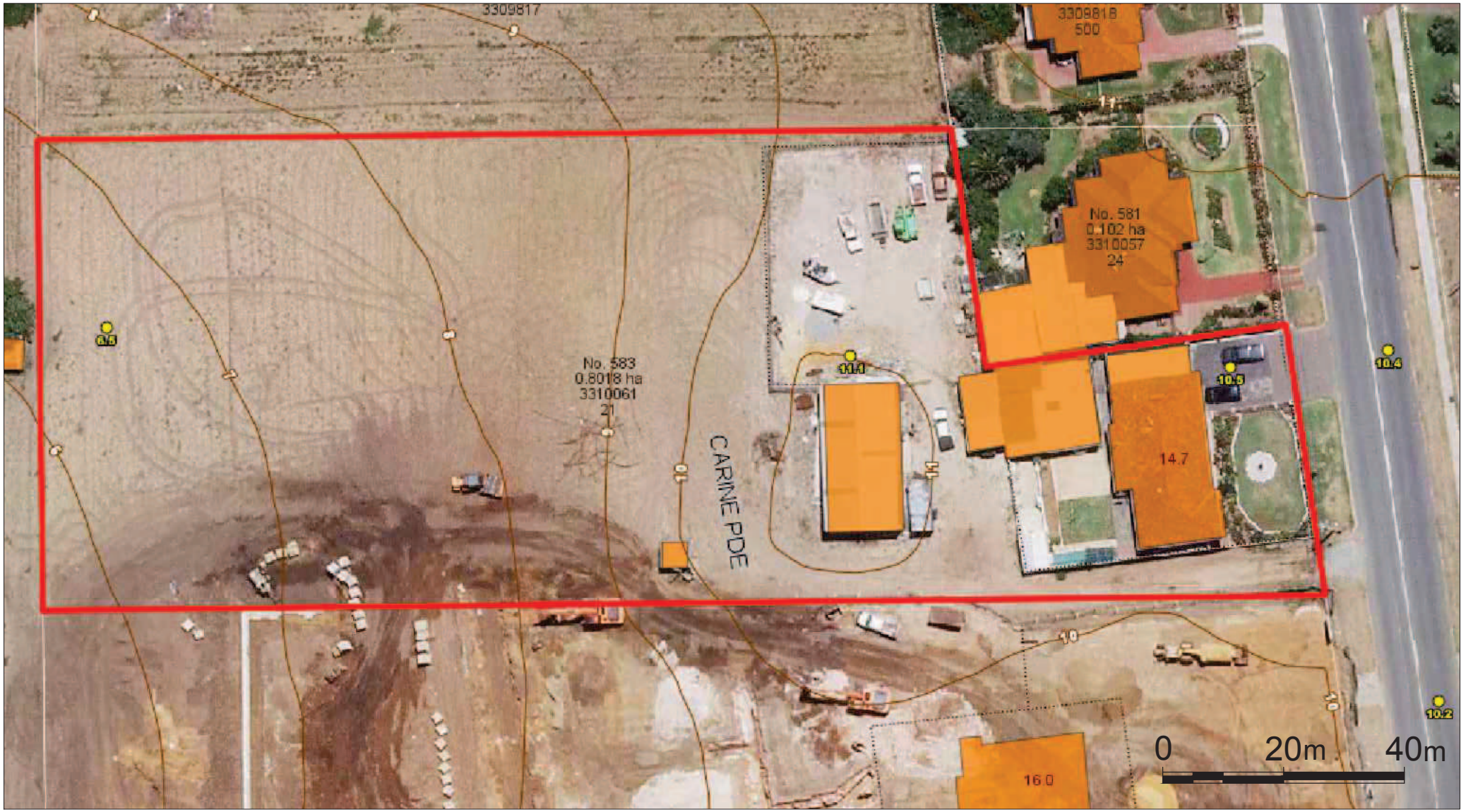
LEGEND

- Residential R30
- Residential R40
- Residential R60
- Public Open Space
- Bin Pads (1m x 2m)
- Stage 1 Lots
- Stage 2 Development



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WEBSITE: www.biosciencewa.com

Legend:

Lot Boundary

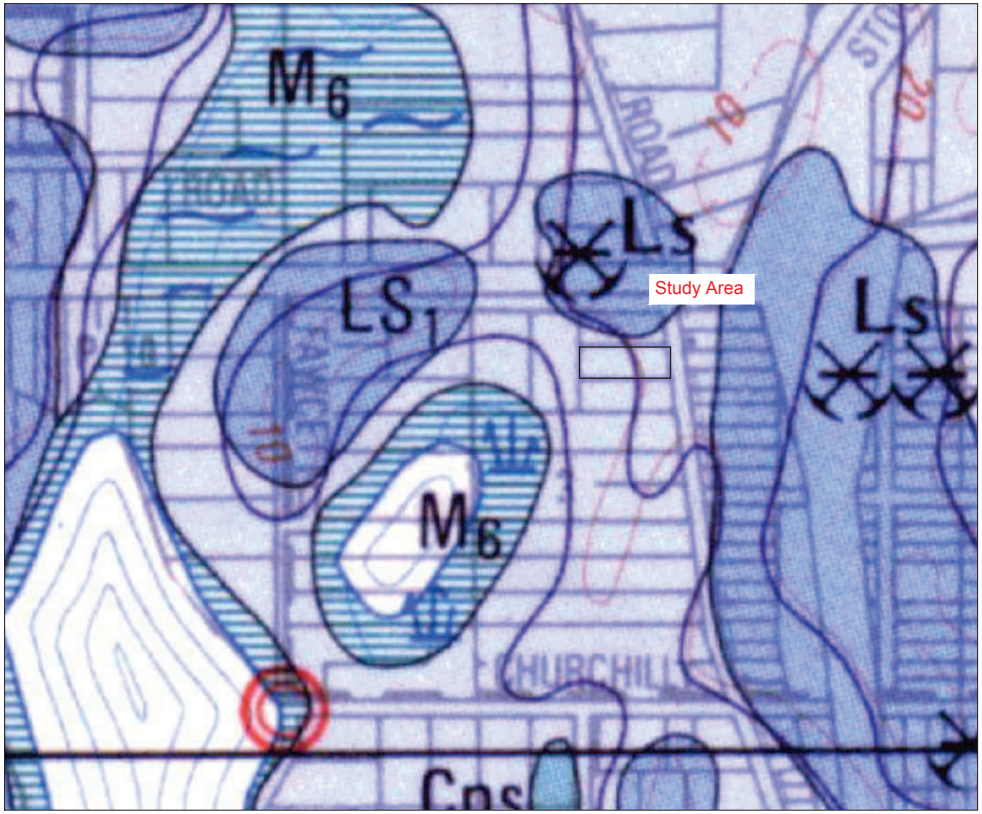
5m contours (mAHD)

Data Source: City of Cockburn, Intramaps (April 2016)

Project Title: Lot 21 Rockingham Rd Local Water Management Strategy
Location: Munster, Perth, WA
Client: Harley Dykstra
Date: 21/04/2016

Drawn: NB
Checked: PK

Figure 3: Topography



Fremantle

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

SHEETS 2033 I & 2033 IV

S7 — SAND - pale yellowish brown, medium to coarse-grained sub-angular quartz, trace of feldspar, moderately sorted, of eolian origin

Sand derived from Tamala Limestone (Qts)

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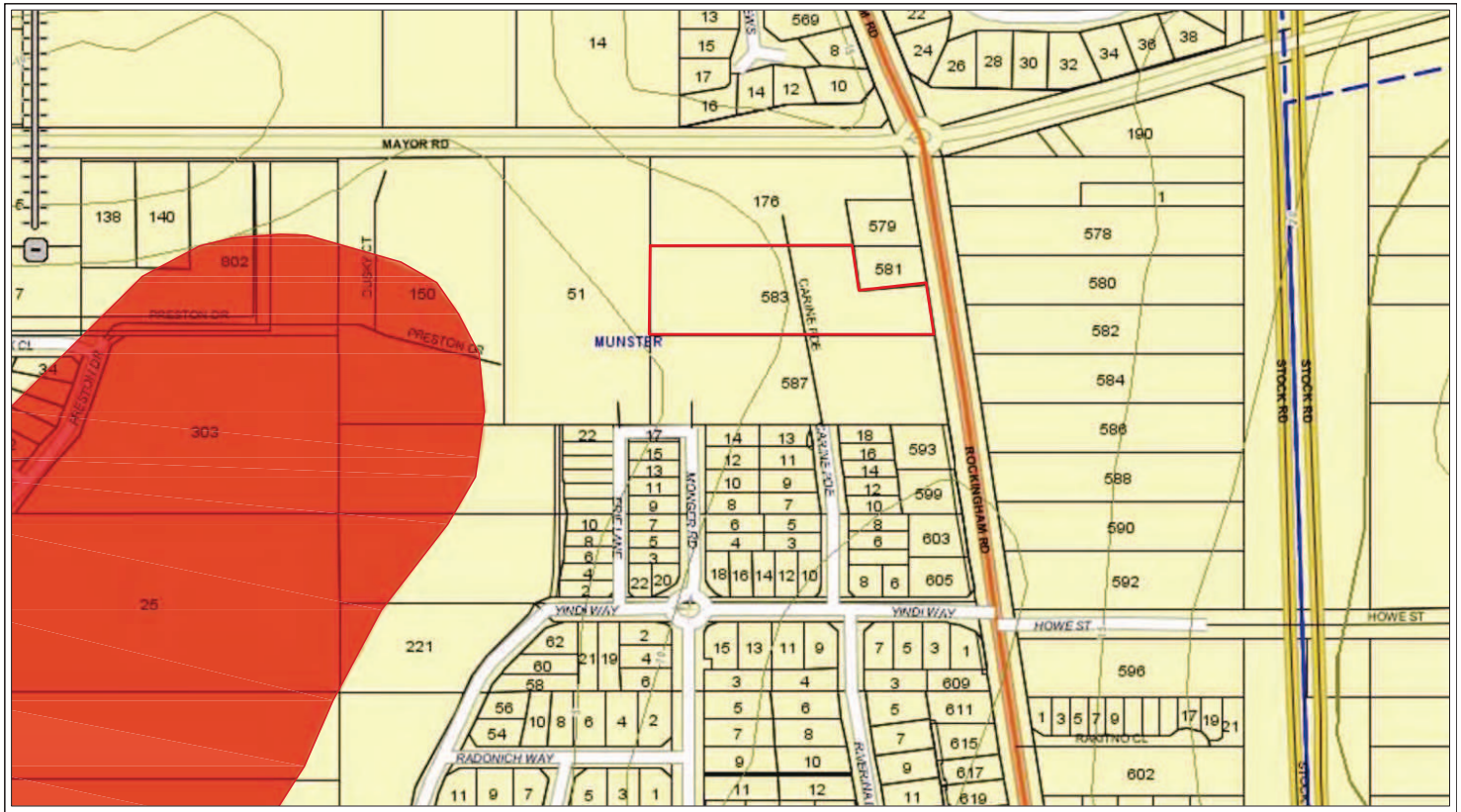
Legend:

Project Title: Lot 21 Rockingham Rd, Local Water Management Strategy
Location: Munster, Perth, WA
Client: Harley Dykstra
Date: 21/03/2016

Drawn: NB
Checked: PK



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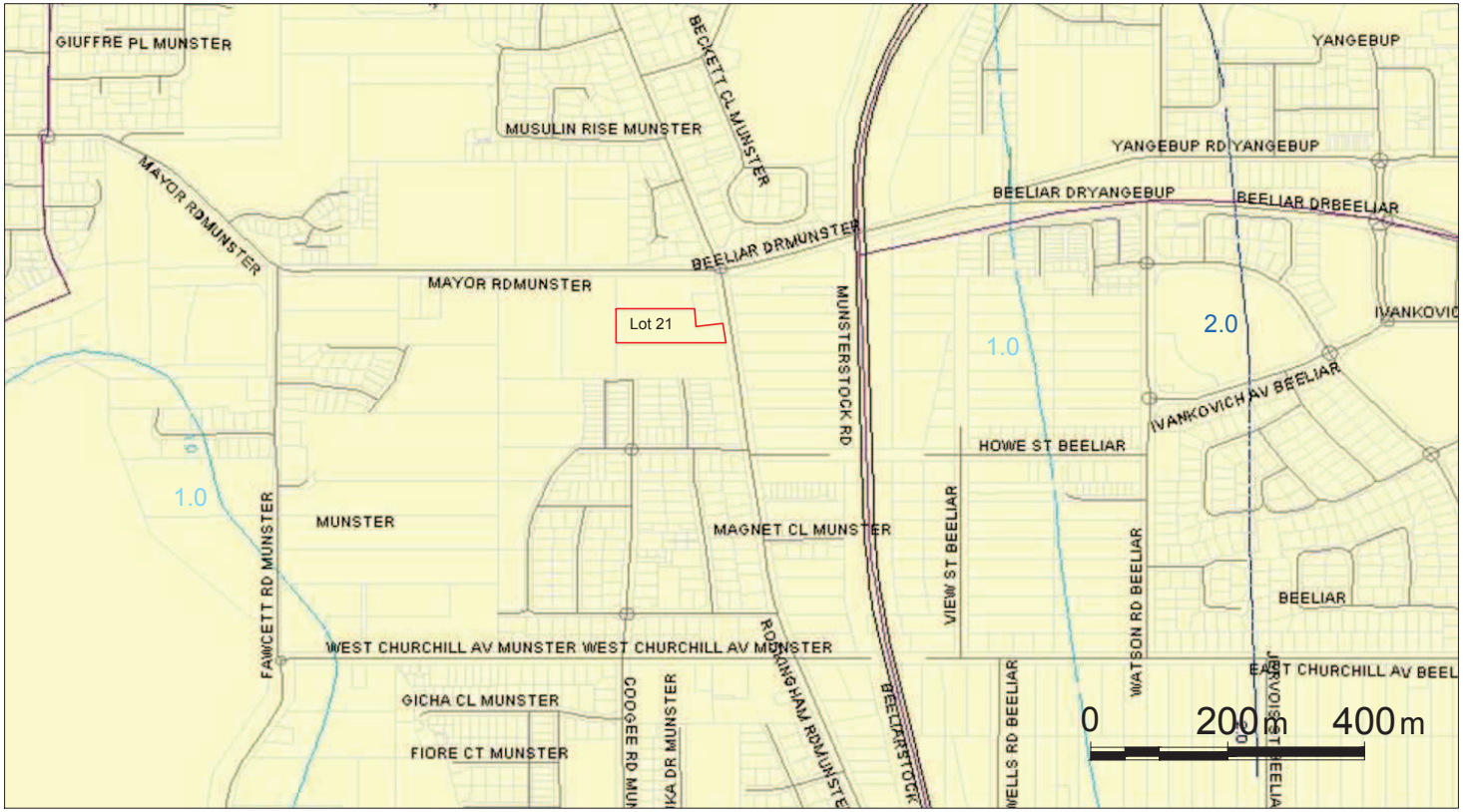
Legend:

- Lot Boundary
- High to moderate risk of ASS occuring within 3m of natural soil surface (and beyond)
- Moderate to low risk of ASS occuring within 3m of natural soil surface but high to moderate risk of ASS beyond m of natural soil surface

Project Title: Lot 21 Rockingham Rd Local Water Management Strategy
Location: Munster, Perth, WA
Client: Harley Dykstra
Date: 21/04/2016

Drawn: NB
Checked: PK

Figure 5: Groundwater



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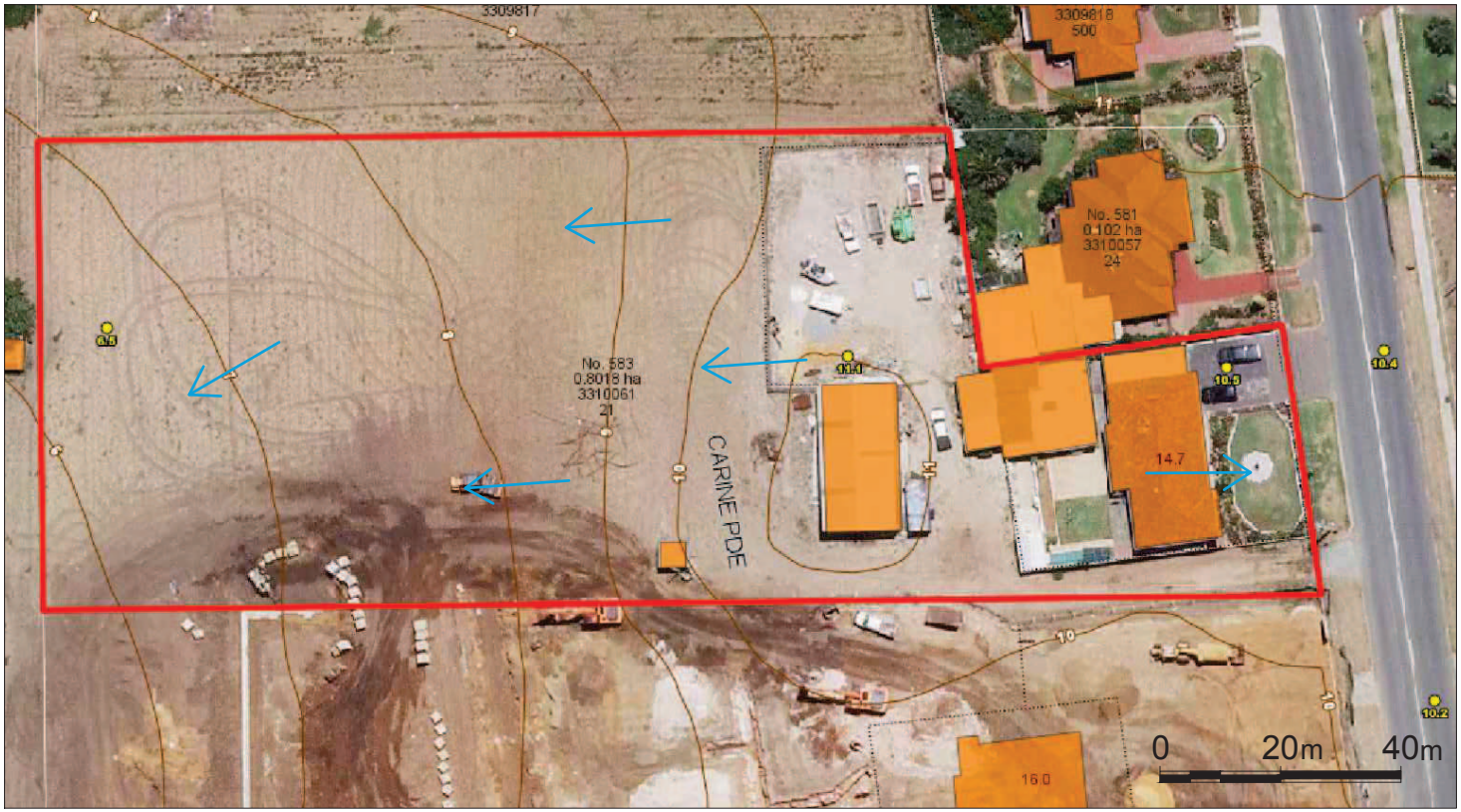
Legend:

- Lot Boundary
- Historical Maximum Groundwater Contours (m AHD)
- Groundwater Contours, May 2003 (m AHD)

Project Title: Lot 21 Rockingham Rd Local Water Management Strategy
Location: Munster, Perth, WA
Client: Harley Dykstra
Date: 21/04/2016

Drawn: NB
Checked: PK



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Legend:

- Lot Boundary
- Elevation Contours (m AHD)
- Predevelopment Surface Water Flow Direction

N

Project Title: Lot 21 Rockingham Rd Local Water Management Strategy
Location: Munster, Perth, WA
Client: Harley Dykstra
Date: 21/04/2016

Drawn: NB
Checked: PK



Bioscience

Integrating Resource Management

BIOSCIENCE PTY LTD

Legend:

- Conceptual Ø 1800x1800mm soakwell locations
- Conceptual pipes
- Stormtech chambers
- Surface Water Flow Direction
- Group housing indicative stormwater design

Project Title: Lot 21 Rockingham Rd Local Water Management Strategy
Location: Munster, Perth, WA
Client: Harley Dykstra
Date: 29/08/2016

Drawn: DA
Checked: PK



Bioscience
Integrating Resource Management
BIOSCIENCE PTY LTD

Legend:

- Conceptual Ø 1800x1800mm soakwell locations
- Conceptual pipes
- Stormtech chambers
- Surface Water Flow Direction
- Group housing indicative stormwater design

N

Project Title: Lot 21 Rockingham Rd
Local Water Management Strategy
Location: Munster, Perth, WA
Client: Harley Dykstra
Date: 29/08/2016

Drawn: DA
Checked: PK



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Integrating Resource Management

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Legend:

- Conceptual Ø 1800x1800mm soakwell locations
- Conceptual pipes
- Stormtech chambers
- Surface Water Flow Direction
- Group housing indicative stormwater design

Project Title: Lot 21 Rockingham Rd Local Water Management Strategy
Location: Munster, Perth, WA
Client: Harley Dykstra
Date: 29/08/2016

Drawn: DA
Checked: PK

Appendix A: Bioscience Geotechnical Investigation

Bioscience

Geotechnical Report

Lot 21 Rockingham Rd
Munster, Western Australia

March 2016

Geotechnical Investigation Report

Lot 21 Rockingham Road, Munster, WA

Date:	24/03/2016
Prepared for:	Harley Dykstra
Prepared by:	Nadine Benker
Approved by:	Peter Keating

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Document Control

Issue	Date	Author	Reviewer	Approved
1	24/03/2016	N. Benker	P. Keating	P. Keating

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1.0 Introduction

This report describes the geotechnical investigations undertaken by Bioscience Pty Ltd across the proposed subdivision area on the eastern side of Lot 21 Rockingham Road in Munster, Western Australia. The investigation was commissioned by the land owners to determine ground conditions to inform further planning and support the proposed subdivision. Lot 21 covers about 0.8ha.

2.0 Proposed Development

The proposed development is to be residential (R30 – R60).

3.0 Site Description

3.1 Site Location

Lot 21 is located in Munster, approximately 20km south west of Perth within the south western corridor of the Perth Metropolitan Region. The site is bounded by Rockingham Rd to the east and urban as well as rural developments on all other sides (**Figure 1**).

Geotechnical investigation was undertaken across the site based on the location of the proposed future location of subdivision lots and road reserve (**Appendix A**).

3.2 Land Use

The current land use of the area is residential and rural living. The whole study area is zoned "Urban" in the Metropolitan Reginal Scheme (MRS). The land has historically been cleared for rural living and was used as a market garden. It is now generally covered in grass. The study area includes features associated with market garden activities i.e. shed.

3.3 Topography

The topography of the site gently slopes with a gradient of approximately 3.5% from the east / north east to the south west from 11m AHD to 6m AHD and is located away from the edge of the darling scarp. (**Figure 2**). There are no permanent water bodies in the study area.

3.4 Geology and Geomorphology

The geology at the site (**Figure 3**) as per the Geological Survey of Western Australia Fremantle Sheets 2033 I and 2033 IV is:

- S7 - SAND – pale yellowish brown, medium to coarse-grained sub-angular quartz, trace of feldspar, moderately sorted, of eolian origin. Sand derived from Tamala Limestone (Qts).

3.5 Groundwater

The Perth Groundwater Atlas (2004) indicates that groundwater flows from east to west from approximately 2m AHD and falling to 1m AHD in the west (**Figure 4**).

Additionally, long term monitoring data of a Department of Water bore (T220, Lake Thomson, Ref. No. 6141052) within close proximity to the north west of the site shows the maximum groundwater levels being at least 2m below the surface since 2006 (**Graph 1**).

3.6 Wetlands

The Geomorphic Wetlands Dataset displays the location, boundary, geomorphic classification and management category of wetlands on the Swan Coastal Plain. According to the data set the study area does not contain any wetlands. The sumpland resource enhancement wetland (REW) No.6369 is located approximately 130m to the west. One of the Market Garden Swamps situated in the area, which is classified as an Environmental Protection Policy (EPP) Lake, is within 230m of the lot.

3.7 Acid Sulphate Soils

The Department of Environment Regulation (DER) has compiled maps of Acid Sulphate Soil (ASS) risk areas for several coastal regions of Western Australia. The map indicates that there is no risk of ASS being present within the top 3m of soil.

4.0 Geotechnical Investigation

4.1 Objectives

- Determine soil conditions and groundwater level (if encountered) to a depth of 2.5 metres below current ground level
- Provide advice on any need for groundwater control or subsoil drainage and potential for onsite stormwater disposal
- Determine the site classification according to AS 2870 (2011), and recommend measures to upgrade classification if required
- Determine Acid Sulphate Soil presence
- Provide advice in relation to excavation control requirements, site preparation earthworks, characteristics of fill requirements and compaction control

4.2 Field Investigations

Field investigations took place on the 26/02/2016 with ten test pits excavated with a 3.5 tonne excavator to a depth of 2.5m or until refusal.

Soil samples were logged at layer profile changes and collected for laboratory testing. Locations of test pits are shown in **Figure 4**.

4.2.1 Soil Profiles

The site has a typical soil profile consisting of up to 200mm of sandy topsoil over fine to medium sands and clayey gravelly sands over orange gravelly clay (Guildford formation). All soil profile logs are provided in **Appendix B**.

4.2.2 Hydraulic Conductivity

In-situ permeability testing was conducted during field investigations to determine the hydraulic conductivity of the soil present on site. Permeability was tested 300mm below the surface in two locations, as shown in **Figure 5**. Hydraulic conductivity ranged between 100mm/h and 200mm/h. Test Results are attached in **Appendix C**.

4.3 Groundwater

Groundwater was not encountered in any of the excavation pits.

4.4 Laboratory Investigations

Upon completion of the fieldwork, laboratory testing was performed on selected soil samples. Test results have been used to assist with the classification and determination of engineering properties of the soil for this geotechnical investigation.

- Particle size distribution – AS1289.3.6.1

The laboratory tests were carried out in accordance with the requirements specified in AS 1289 by the Bioscience soil laboratory in Forrestdale.

4.4.1 Particle Size Distribution

Particle size distribution (PSD) was determined for selected soil samples of the soil layer below the organic topsoil layer from different depths across the study area. Results can be found in **Appendix D**.

The soils are uniform across the site being moderately graded from gravels to fines and identified to be medium to coarse grained sands. The gravel content ranged from 10.6 to 12%.

All results of particle size distribution are summarised in **Table 1** below.

Table 1: Particle Size Distribution Summary

Sample Ref:	Sample Depth (mm)		Particle Size Distribution					Moisture Content (%)
			Fines (%)	Sand			Gravel + Organic (%)	
	From	To		Fine (%)	Medium (%)	Coarse (%)		
@ Hole 5	500	1000	2.79	17.45	25.83	42.01	11.92	2.1
@ Hole 10	200	600	2.20	20.78	33.83	32.58	10.61	2.9

5.0 Site Evaluation and Recommendations

5.1 Site Classification

The Residential Slab and Footings Australian Standard 2870 provides a site classification system and associated generic foundation design recommendations for residential developments. The site classification system is based on the potential soil reactivity, and associated ground movements attributed to seasonal soil moisture variations or potential problems due to adverse geotechnical conditions.

The soil profiles on site show approximately 0mm – 2500mm Bassendean sand over limestone not taking into account the 300mm – 600mm organic topsoil layer. As a result, the site is classified as Class P in accordance with AS 2780-2011. With the removal of 150 mm of topsoil which contains the majority of the roots and the import of 300 mm of clean sand fill across the building footprints as required, the site can be modified to "Class A". The removed topsoil can be used in the Public Open Space or other landscaped areas.

Adequate compaction of soils shall be met for all natural soils as outlined in Section 5.3.

5.2 Soil Permeability and Drainage

The sand layer is suitable for the disposal of stormwater by infiltration. No groundwater was encountered in this area and the sands were loose with moderate drainage properties.

5.3 Site Preparation

The following site preparation procedure is recommended:

- Identification and diversion or protection of any buried services
- Removal of topsoil, organics, root, old services and other deleterious material from the site and stock piled
- Contouring/shaping of the ground surface to ensure surface runoff during construction
- Proof compact the exposed surface using a suitable compaction plant. A minimum of 12 tonne static mass vibratory smooth drum roller is preferred to achieve compaction of sandy soil at depth. A minimum of eight overlapping passes should be provided
- Where the surface deforms excessively during compaction or wet and/or weak material is exposed, over-excavation and replacement with compacted free draining sand fill may be required.
- Should compaction to satisfactory depth not be achieved by surface compaction it may be necessary to over excavate, compact the base of the excavation and replace the soil in compacted layers
- Place and compact approved clean free draining fill material in layers no greater than 0.3m thickness

5.4 Excavation and Dewatering

Excavations in sand areas are prone to instability; consequently, care must be exercised in such excavation and appropriate safety measures adapted where necessary i.e. tapered and stepped banks of restricted heights, trench supports.

Groundwater will generally be 2m or more from the surface. Deeper excavation may require dewatering, and may require a dewatering license and management plan to be implemented.

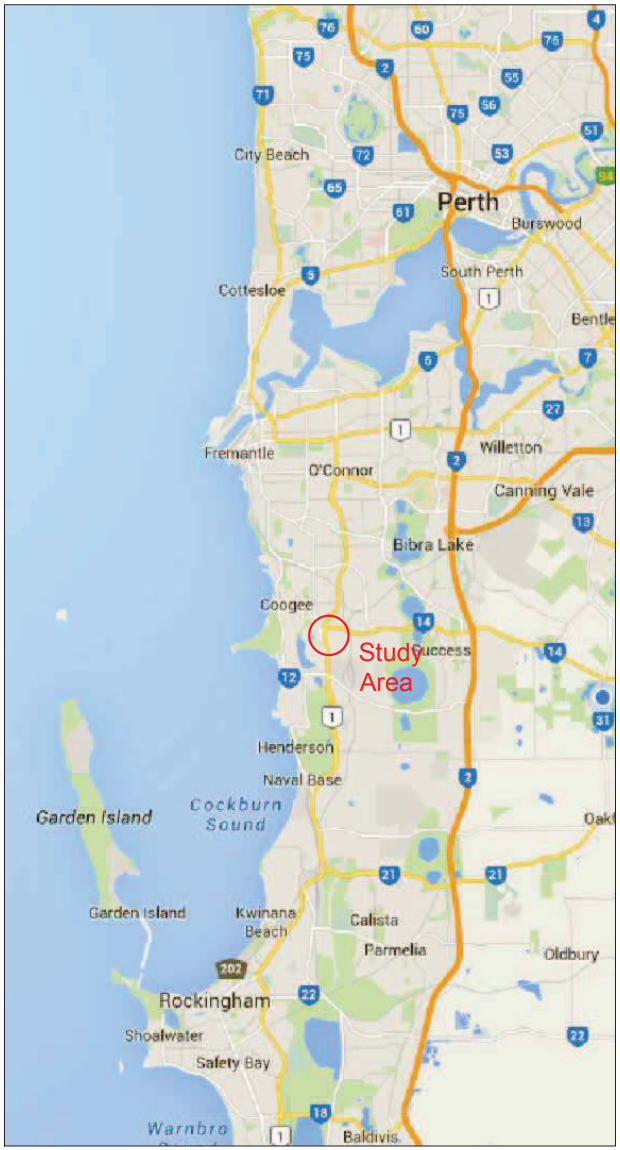
5.5 Compaction

Fill material placement and compaction methods and quality control should comply with relevant structure fill requirements in *AS 3798 Guidelines on Earthworks for Commercial and Residential Developments*. The fill should be placed in loose layers not exceeding 300mm thickness and each layer should be compacted with suitable equipment to a minimum of 95% modified maximum density (MMDD) or 70% density index as appropriate.

A Perth Sand Penetrometer, in accordance with AS1289.6.3.3, may be used for compaction control in sand provided it is calibrated for each material type on-site. All areas within the building envelopes should be compacted to achieve a minimum blow count of 8 blows per 300mm penetration to a depth of 1 m below the existing ground level. If difficulties arise in achieving this blow count, then in situ density testing in accordance with AS 1289 should be performed to confirm the correlation between blow counts and density to ensure that a density index of 70% is achieved. asphalt wearing course with a minimum compacted thickness of 25 millimetres.

Figures





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PHONE: (08) 9397 2446 FAX: (08) 9397 2447
EMAIL: bioscience@biosciencewa.com
WEBSITE: www.biosciencewa.com

Legend:

Lot Boundary

Data Source: Nearmap and Google Maps (March 2016)

Project Title: Lot 21 Rockingham Rd Geotechnical Investigation
Location: Munster, Perth, WA
Client: Harley Dykstra
Date: 24/03/2016

Drawn: NB
Checked: PK

Figure 1: Site Location



Bioscience

BIOSCIENCE PTY LTD
488 NICHOLSON ROAD FORRESTDALE WA 6112

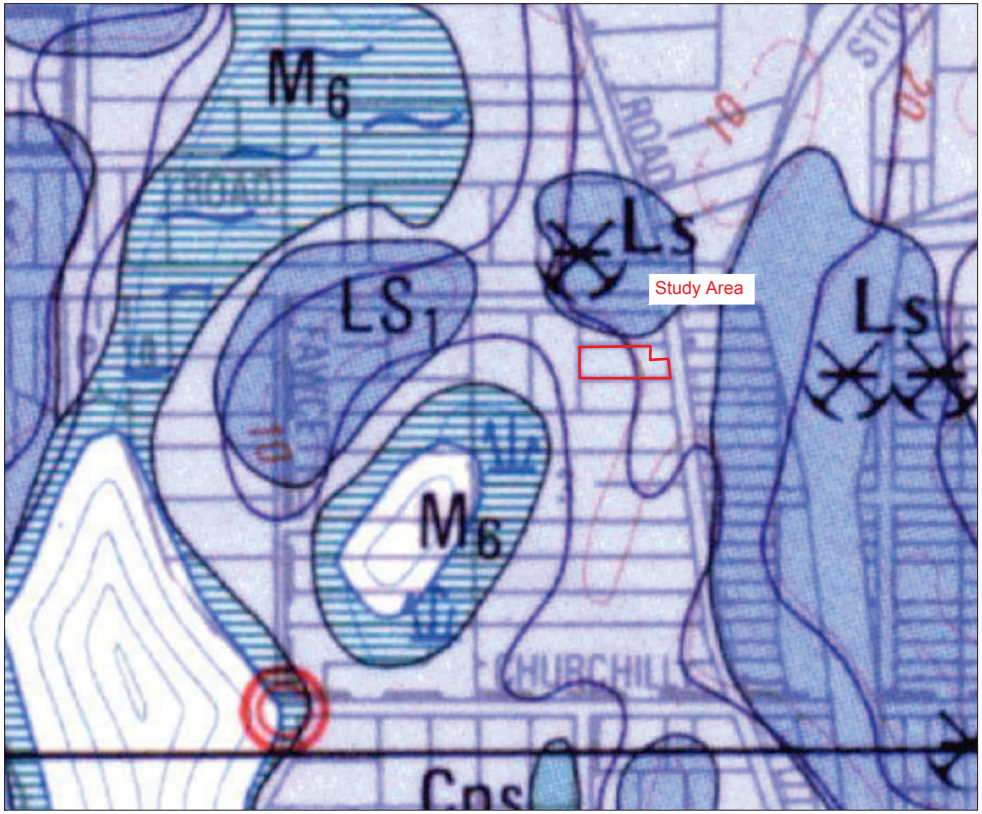
Legend:

Lot Boundary

5m contours (mAHD)

Project Title: Lot 21 Rockingham Rd Geotechnical Investigation
Location: Munster, Perth, WA
Client: Harley Dykstra
Date: 21/03/2016

Drawn: NB
Checked: PK



Fremantle

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

SHEETS 2033 I & 2033 IV

S7	SAND - pale yellowish brown, medium to coarse-grained sub-angular quartz, trace of feldspar, moderately sorted, of eolian origin Sand derived from Tamala Limestone (Qts)

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Legend:

Project Title: Lot 21 Rockingham Rd, Geotechnical Investigation
Location: Munster, Perth, WA
Client: Harley Dykstra
Date: 21/03/2016

Drawn: NB
Checked: PK



Bioscience

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488 NICHOLSON ROAD FORRESTDALE WA 6112

Legend:

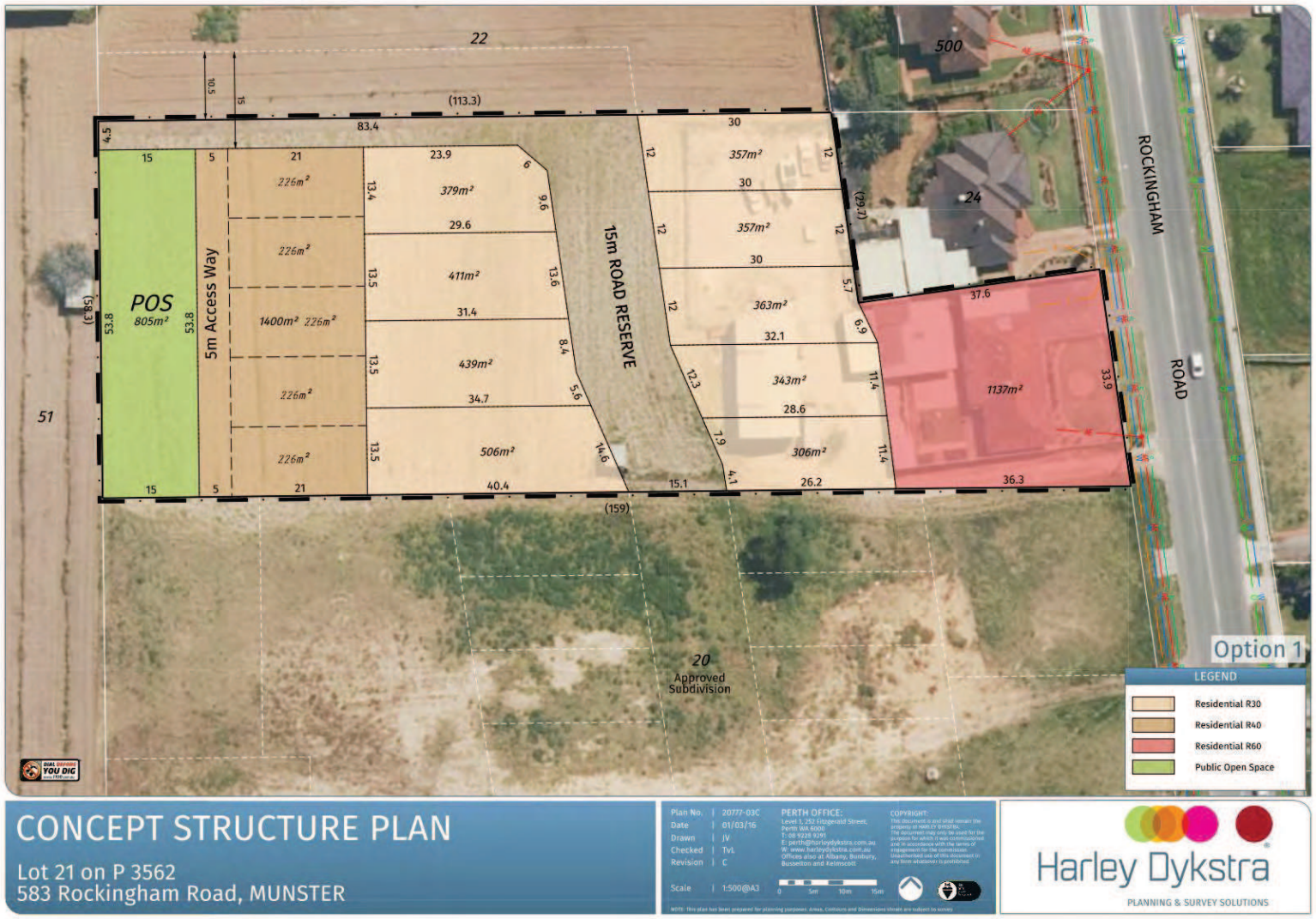
Infiltration test location and ID

Excavation pit locations and ID

Project Title: Lot 21 Rockingham Rd Geotechnical Investigation
Location: Munster, Perth, WA
Client: Harley Dykstra
Date: 21/03/2016

Drawn: NB
Checked: PK

Appendix A – Proposed Subdivision



Appendix B – Bore Logs

BIOSCIENCE PTY LTD
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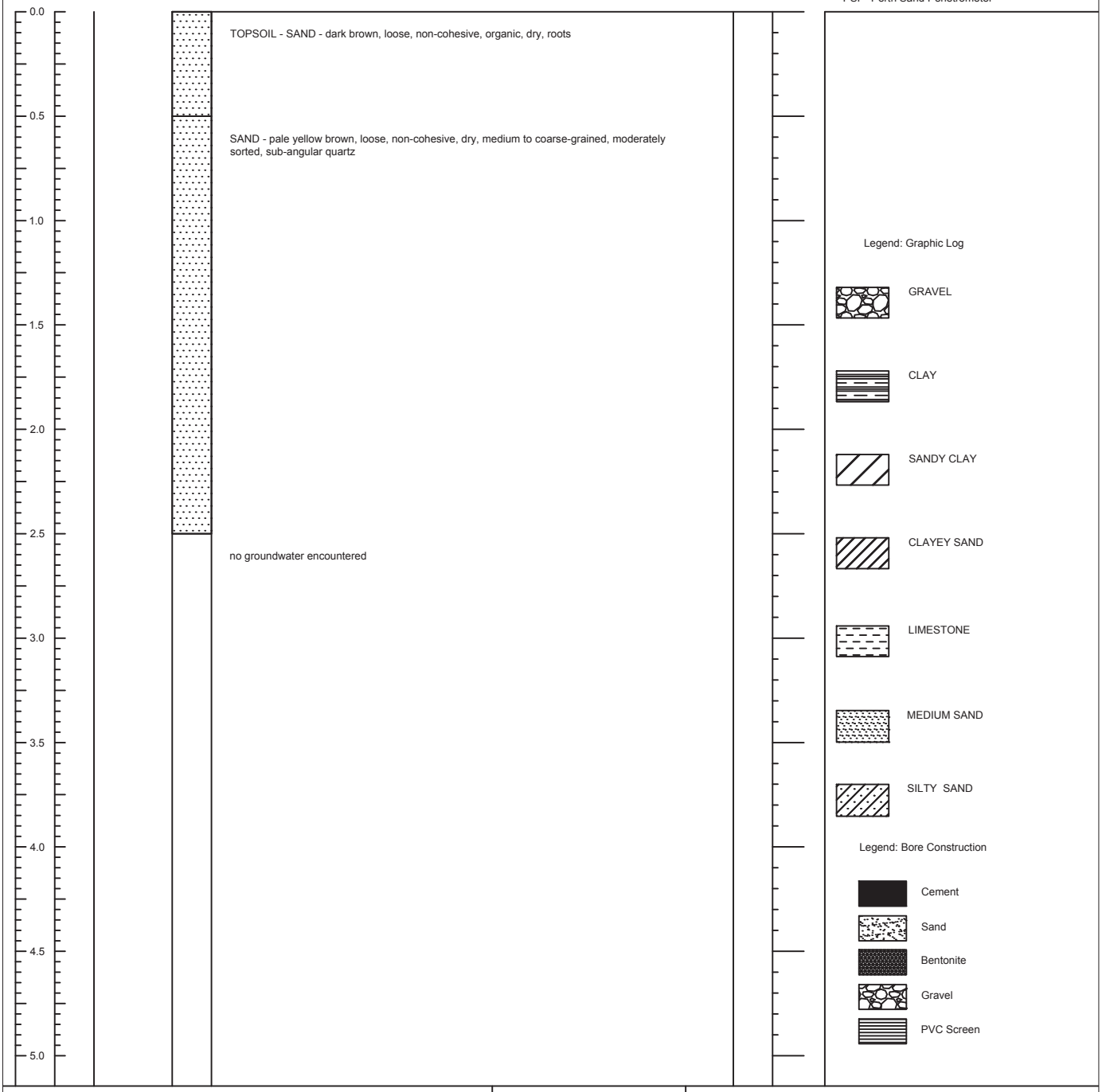
WEBSITE: www.biosciencewa.com

ENGINEERING PROFILE LOG

Client: Harley Dykstra
Project: Geotechnical Investigation
Location: Lot 21 Rockingham Road, Munster, Western Australia
Date: 26/02/2016

Hole No. H1
Sheet No. 1 of 10
Logged by: NB

Position: E: 385364 N: 6444628 Surface Elevation: N/A Rig Type: 3.5T Excavator



Further Testing Notes:
SPT- Standard Penetration Test
PL- Point Load
UCS- Uniaxial Compressive Strength Test
PSP- Perth Sand Penetrometer

Legend: Graphic Log

- GRAVEL
- CLAY
- SANDY CLAY
- CLAYEY SAND
- LIMESTONE
- MEDIUM SAND
- SILTY SAND

Legend: Bore Construction

- Cement
- Sand
- Bentonite
- Gravel
- PVC Screen

SOIL CLASSIFICATION & DESCRIPTORS

COURSE GRAINED
BOULDERS: > 200mm
COBBLES: 63-200mm
GRAVELS- GW: Well-graded gravel/sand mix
GP: Poorly-graded gravel/sand mix
GM: Silty gravel/sand/silt mix
GC: Clayey gravel/sand/clay mix
SANDS- SW: Well-graded sand/gravel
SP: Poorly-graded uniform sands
SM: Silty sands
SC: Clayey sands

FINE GRAINED
SILTS & CLAYS (liquid limit <50%)
ML: Inorganic silts and v. fine sands, rock dust
CL, CI: Inorganic clays of low- med plasticity
OL: Organic silts & clays of low plasticity
SILTS & CLAYS (liquid limit >50%)
MH: Inorganic silts of low-med strength
CH: Inorganic clays of high plasticity
OH: Organic clays of med- high plasticity
Pt: Peats & other organic soils

CONSISTENCY TERMS
COHESIVE SOILS

V.soft	≤12kPa
Soft	12-25kPa
Firm	25-50kPa
Stiff	50-100kPa
V.stiff	100-200kPa
Hard	>200kPa

NON-COHESIVE SOILS (density index)

V.loose	≤ 15%
Loose	15-35%
Medium Dense	35-65%
Dense	65-85%
V.dense	>85%

ROCK CLASSIFICATION
CEMENTATION
VWc: v. weakly cemented
Wc: weakly cemented
MWc: mod. weakly cemented
Mc: moderately cemented
Hc: well cemented
VHc: v. well cemented
WEATHERING
RS: residual soil
XW: extremely weathered
HW: highly weathered
MW: moderately weathered
SW: slightly weathered
FR: fresh rock

STRENGTH (Point Load Index)
EL: extremely low- material crumbles under finger pressure
VL: very low - material crumbles under blow from pick & can be easily peeled with knife (<0.1MPa)
L: low - Easily scored with knife. Cores 150x50mm can be easily broken by hand (0.1-0.3MPa)
M: medium - Readily scored with knife. Core 150x50mm can be broken by hand with difficultly (0.3-1MPa)
H: high - Cores 150x50mm cannot be broken by hand but with a single blow from a pick (1-3MPa)
VH: very high - More than 1 blow required to break specimen (3-10MPa)
EH: extremely high - Specimen requires many blows with pick to break (>10MPa)

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ENGINEERING PROFILE LOG

Client: Harley Dykstra
Project: Geotechnical Investigation
Location: Lot 21 Rockingham Road, Munster, Western Australia
Date: 26/02/2016

Hole No. H2
Sheet No. 2 of 10
Logged by: NB

Position: E:385368 N: 6444660 Surface Elevation: N/A Rig Type: 3.5T Excavator

Depth (m) | Water | Bore Construction | Graphic Log | Graphic Log Notes | Cohesion and Cementation | Drilling Time ($/0.5m)

0.0 TOPSOIL - SAND - dark brown, loose, non-cohesive, organic, dry, roots

0.5 SAND - pale yellow brown, loose, non-cohesive, dry, medium to coarse-grained, moderately sorted, sub-angular quartz

1.0

1.5 some limestone conglomerates

2.0

2.5 no groundwater encountered

3.0

3.5

4.0

4.5

5.0



Further Testing Notes:
SPT- Standard Penetration Test
PL- Point Load
UCS- Uniaxial Compressive Strength Test
PSP- Perth Sand Penetrometer

Legend: Graphic Log

- GRAVEL
- CLAY
- SANDY CLAY
- CLAYEY SAND
- LIMESTONE
- MEDIUM SAND
- SILTY SAND

Legend: Bore Construction

- Cement
- Sand
- Bentonite
- Gravel
- PVC Screen

SOIL CLASSIFICATION & DESCRIPTORS

COURSE GRAINED
BOULDERS: > 200mm
COBBLES: 63-200mm
GRAVELS- GW: Well-graded gravel/sand mix
GP: Poorly-graded gravel/sand mix
GM: Silty gravel/sand/silt mix
GC: Clayey gravel/sand/clay mix
SANDS- SW: Well-graded sand/gravel
SP: Poorly-graded uniform sands
SM: Silty sands
SC: Clayey sands

FINE GRAINED
SILTS & CLAYS (liquid limit <50%)
ML: Inorganic silts and v. fine sands, rock dust
CL, CI: Inorganic clays of low- med plasticity
OL: Organic silts & clays of low plasticity
SILTS & CLAYS (liquid limit >50%)
MH: Inorganic silts of low-med strength
CH: Inorganic clays of high plasticity
OH: Organic clays of med- high plasticity
Pt: Peats & other organic soils

CONSISTENCY TERMS
COHESIVE SOILS

V.soft	≤12kPa
Soft	12-25kPa
Firm	25-50kPa
Stiff	50-100kPa
V.stiff	100-200kPa
Hard	>200kPa

NON-COHESIVE SOILS (density index)

V.loose	≤ 15%
Loose	15-35%
Medium Dense	35-65%
Dense	65-85%
V.dense	>85%

ROCK CLASSIFICATION
CEMENTATION
VWc: v. weakly cemented
Wc: weakly cemented
MWc: mod. weakly cemented
Mc: moderately cemented
Hc: well cemented
VHc: v. well cemented
WEATHERING
RS: residual soil
XW: extremely weathered
HW: highly weathered
MW: moderately weathered
SW: slightly weathered
FR: fresh rock

STRENGTH (Point Load Index)
EL: extremely low- material crumbles under finger pressure
VL: very low - material crumbles under blow from pick & can be easily peeled with knife (<0.1MPa)
L: low - Easily scored with knife. Cores 150x50mm can be easily broken by hand (0.1-0.3MPa)
M: medium - Readily scored with knife. Core 150x50mm can be broken by hand with difficultly (0.3-1MPa)
H: high - Cores 150x50mm cannot be broken by hand but with a single blow from a pick (1-3MPa)
VH: very high - More than 1 blow required to break specimen (3-10MPa)
EH: extremely high - Specimen requires many blows with pick to break (>10MPa)

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WEBSITE: www.biosciencewa.com

ENGINEERING PROFILE LOG

Client: Harley Dykstra
Project: Geotechnical Investigation
Location: Lot 21 Rockingham Road, Munster, Western Australia
Date: 26/02/2016

Hole No. H3
Sheet No. 3 of 10
Logged by: NB

Position: E: 385386 N: 6444648 Surface Elevation: N/A Rig Type: 3.5T Excavator

Depth (m) | Water | Bore Construction | Graphic Log | Graphic Log Notes | Cohesion and Cementation | Drilling Time (s/0.5m)

0.0
TOPSOIL - SAND - dark brown, loose, non-cohesive, organic, dry, roots

0.5
SAND - orange, loose, non-cohesive, dry, medium to coarse-grained, moderately sorted, sub-angular quartz

1.0

1.5
weakly cemented limestone conglomerates

2.0

2.5
no groundwater encountered

3.0

3.5

4.0

4.5

5.0



Further Testing Notes:
SPT- Standard Penetration Test
PL- Point Load
UCS- Uniaxial Compressive Strength Test
PSP- Perth Sand Penetrometer

Legend: Graphic Log
- GRAVEL
- CLAY
- SANDY CLAY
- CLAYEY SAND
- LIMESTONE
- MEDIUM SAND
- SILTY SAND

Legend: Bore Construction
- Cement
- Sand
- Bentonite
- Gravel
- PVC Screen

SOIL CLASSIFICATION & DESCRIPTORS

COURSE GRAINED
BOULDERS: > 200mm
COBBLES: 63-200mm
GRAVELS- GW: Well-graded gravel/sand mix
GP: Poorly-graded gravel/sand mix
GM: Silty gravel/sand/silt mix
GC: Clayey gravel/sand/clay mix
SANDS- SW: Well-graded sand/gravel
SP: Poorly-graded uniform sands
SM: Silty sands
SC: Clayey sands

FINE GRAINED
SILTS & CLAYS (liquid limit <50%)
ML: Inorganic silts and v. fine sands, rock dust
CL, CI: Inorganic clays of low- med plasticity
OL: Organic silts & clays of low plasticity
SILTS & CLAYS (liquid limit >50%)
MH: Inorganic silts of low-med strength
CH: Inorganic clays of high plasticity
OH: Organic clays of med- high plasticity
Pt: Peats & other organic soils

CONSISTENCY TERMS
COHESIVE SOILS

V.soft	≤12kPa
Soft	12-25kPa
Firm	25-50kPa
Stiff	50-100kPa
V.stiff	100-200kPa
Hard	>200kPa

NON-COHESIVE SOILS (density index)

V.loose	≤ 15%
Loose	15-35%
Medium Dense	35-65%
Dense	65-85%
V.dense	>85%

ROCK CLASSIFICATION
CEMENTATION
VWc: v. weakly cemented
Wc: weakly cemented
MWc: mod. weakly cemented
Mc: moderately cemented
Hc: well cemented
VHc: v. well cemented
WEATHERING
RS: residual soil
XW: extremely weathered
HW: highly weathered
MW: moderately weathered
SW: slightly weathered
FR: fresh rock

STRENGTH (Point Load Index)
EL: extremely low- material crumbles under finger pressure
VL: very low - material crumbles under blow from pick & can be easily peeled with knife (<0.1MPa)
L: low - Easily scored with knife. Cores 150x50mm can be easily broken by hand (0.1-0.3MPa)
M: medium - Readily scored with knife. Core 150x50mm can be broken by hand with difficultly (0.3-1MPa)
H: high - Cores 150x50mm cannot be broken by hand but with a single blow from a pick (1-3MPa)
VH: very high - More than 1 blow required to break specimen (3-10MPa)
EH: extremely high - Specimen requires many blows with pick to break (>10MPa)

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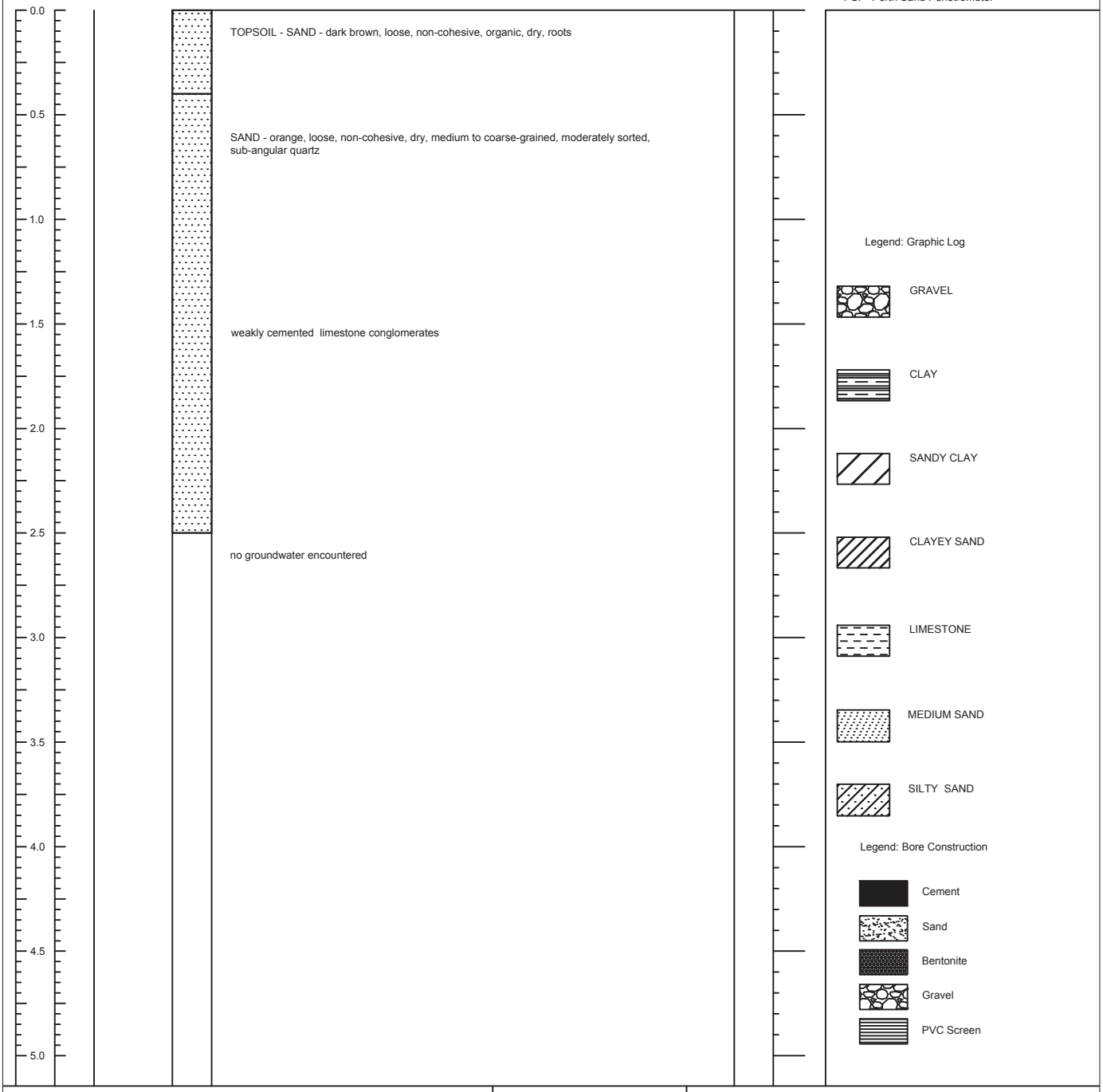
WEBSITE: www.biosciencewa.com

ENGINEERING PROFILE LOG

Client: Harley Dykstra
Project: Geotechnical Investigation
Location: Lot 21 Rockingham Road, Munster, Western Australia
Date: 26/02/2016

Hole No. H4
Sheet No. 4 of 10
Logged by: NB

Position: E: 385401 N: 6444652 Surface Elevation: Rig Type: 3.5T Excavator



Further Testing Notes:
SPT- Standard Penetration Test
PL- Point Load
UCS- Uniaxial Compressive Strength Test
PSP- Perth Sand Penetrometer

Legend: Graphic Log

- GRAVEL
- CLAY
- SANDY CLAY
- CLAYEY SAND
- LIMESTONE
- MEDIUM SAND
- SILTY SAND

Legend: Bore Construction

- Cement
- Sand
- Bentonite
- Gravel
- PVC Screen

SOIL CLASSIFICATION & DESCRIPTORS

COURSE GRAINED
BOULDERS: > 200mm
COBBLES: 63-200mm
GRAVELS- GW: Well-graded gravel/sand mix
GP: Poorly-graded gravel/sand mix
GM: Silty gravel/sand/silt mix
GC: Clayey gravel/sand/clay mix
SANDS- SW: Well-graded sand/gravel
SP: Poorly-graded uniform sands
SM: Silty sands
SC: Clayey sands

FINE GRAINED
SILTS & CLAYS (liquid limit <50%)
ML: Inorganic silts and v. fine sands, rock dust
CL, CI: Inorganic clays of low- med plasticity
OL: Organic silts & clays of low plasticity
SILTS & CLAYS (liquid limit >50%)
MH: Inorganic silts of low-med strength
CH: Inorganic clays of high plasticity
OH: Organic clays of med- high plasticity
Pt: Peats & other organic soils

CONSISTENCY TERMS
COHESIVE SOILS

V.soft	≤12kPa
Soft	12-25kPa
Firm	25-50kPa
Stiff	50-100kPa
V.stiff	100-200kPa
Hard	>200kPa

NON-COHESIVE SOILS (density index)

V.loose	≤ 15%
Loose	15-35%
Medium Dense	35-65%
Dense	65-85%
V.dense	>85%

ROCK CLASSIFICATION
CEMENTATION
VWc: v. weakly cemented
Wc: weakly cemented
MWc: mod. weakly cemented
Mc: moderately cemented
Hc: well cemented
VHc: v. well cemented
WEATHERING
RS: residual soil
XW: extremely weathered
HW: highly weathered
MW: moderately weathered
SW: slightly weathered
FR: fresh rock

STRENGTH (Point Load Index)
EL: extremely low- material crumbles under finger pressure
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M: medium - Readily scored with knife. Core 150x50mm can be broken by hand with difficultly (0.3-1MPa)
H: high - Cores 150x50mm cannot be broken by hand but with a single blow from a pick (1-3MPa)
VH: very high - More than 1 blow required to break specimen (3-10MPa)
EH: extremely high - Specimen requires many blows with pick to break (>10MPa)

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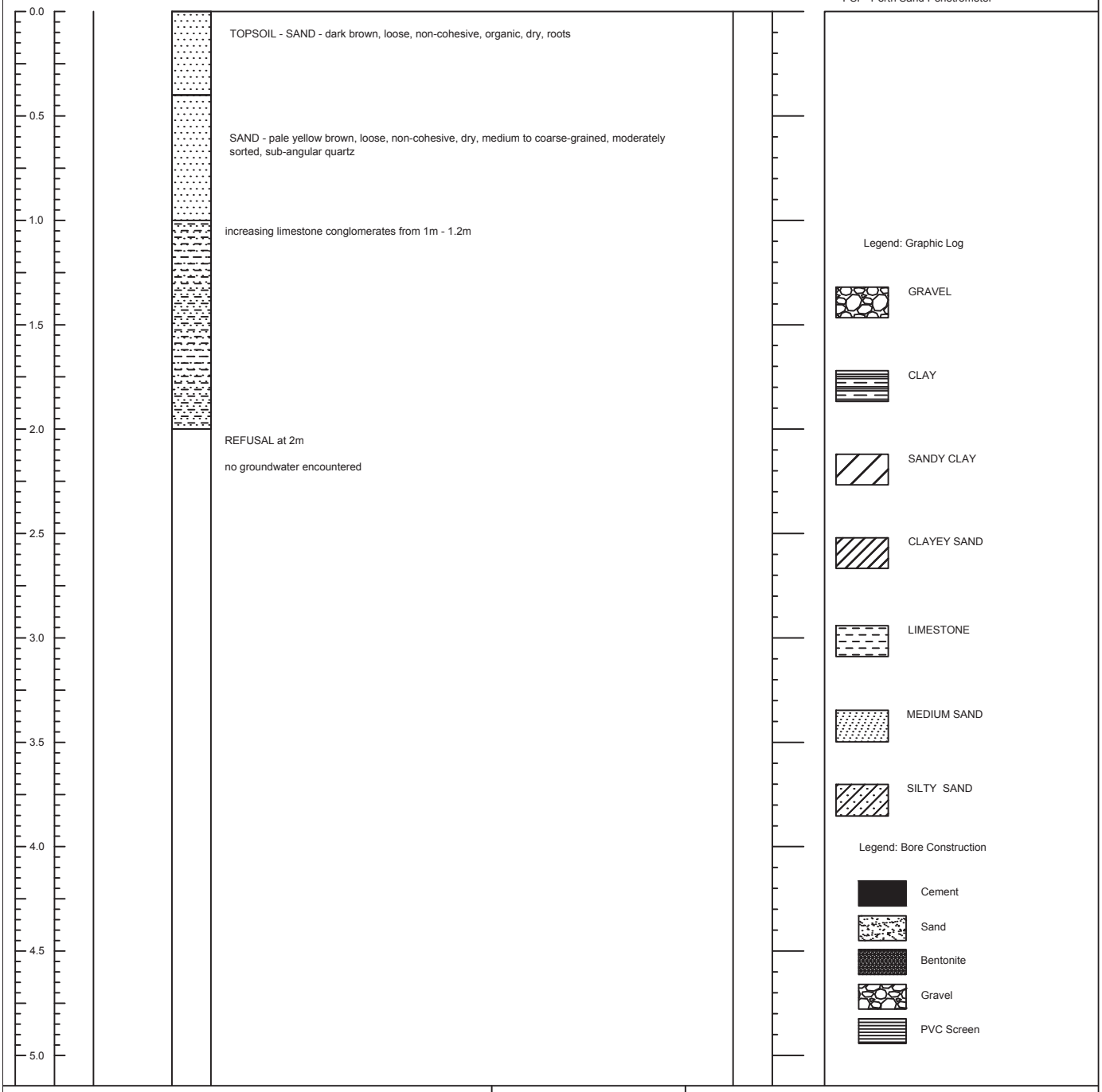
ENGINEERING PROFILE LOG

Client: Harley Dykstra
Project: Geotechnical Investigation
Location: Lot 21 Rockingham Road, Munster, Western Australia
Date: 26/02/2016

Hole No. H5
Sheet No. 5 of 10
Logged by: NB

Position: E: 385411 N: 6444621 Surface Elevation: Rig Type: 3.5T Excavator



Further Testing Notes:
SPT- Standard Penetration Test
PL- Point Load
UCS- Uniaxial Compressive Strength Test
PSP- Perth Sand Penetrometer

Legend: Graphic Log

- GRAVEL
- CLAY
- SANDY CLAY
- CLAYEY SAND
- LIMESTONE
- MEDIUM SAND
- SILTY SAND

Legend: Bore Construction

- Cement
- Sand
- Bentonite
- Gravel
- PVC Screen

SOIL CLASSIFICATION & DESCRIPTORS

COURSE GRAINED
BOULDERS: > 200mm
COBBLES: 63-200mm
GRAVELS- GW: Well-graded gravel/sand mix
GP: Poorly-graded gravel/sand mix
GM: Silty gravel/sand/silt mix
GC: Clayey gravel/sand/clay mix
SANDS- SW: Well-graded sand/gravel
SP: Poorly-graded uniform sands
SM: Silty sands
SC: Clayey sands

FINE GRAINED
SILTS & CLAYS (liquid limit <50%)
ML: Inorganic silts and v. fine sands, rock dust
CL, CI: Inorganic clays of low- med plasticity
OL: Organic silts & clays of low plasticity
SILTS & CLAYS (liquid limit >50%)
MH: Inorganic silts of low-med strength
CH: Inorganic clays of high plasticity
OH: Organic clays of med- high plasticity
Pt: Peats & other organic soils

CONSISTENCY TERMS
COHESIVE SOILS

V.soft	≤12kPa
Soft	12-25kPa
Firm	25-50kPa
Stiff	50-100kPa
V.stiff	100-200kPa
Hard	>200kPa

NON-COHESIVE SOILS (density index)

V.loose	≤ 15%
Loose	15-35%
Medium Dense	35-65%
Dense	65-85%
V.dense	>85%

ROCK CLASSIFICATION
CEMENTATION
VWc: v. weakly cemented
Wc: weakly cemented
MWc: mod. weakly cemented
Mc: moderately cemented
Hc: well cemented
VHc: v. well cemented
WEATHERING
RS: residual soil
XW: extremely weathered
HW: highly weathered
MW: moderately weathered
SW: slightly weathered
FR: fresh rock

STRENGTH (Point Load Index)
EL: extremely low- material crumbles under finger pressure
VL: very low - material crumbles under blow from pick & can be easily peeled with knife (<0.1MPa)
L: low - Easily scored with knife. Cores 150x50mm can be easily broken by hand (0.1-0.3MPa)
M: medium - Readily scored with knife. Core 150x50mm can be broken by hand with difficultly (0.3-1MPa)
H: high - Cores 150x50mm cannot be broken by hand but with a single blow from a pick (1-3MPa)
VH: very high - More than 1 blow required to break specimen (3-10MPa)
EH: extremely high - Specimen requires many blows with pick to break (>10MPa)

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ENGINEERING PROFILE LOG

Client: Harley Dykstra
Project: Geotechnical Investigation
Location: Lot 21 Rockingham Road, Munster, Western Australia
Date: 26/02/2016

Hole No. H6
Sheet No. 6 of 10
Logged by: NB

Position: E: 385423 N: 6444637 Surface Elevation: Rig Type: 5T Excavator

Depth (m) | Water | Bore Construction | Graphic Log | Graphic Log Notes | Cohesion and Cementation | Drilling Time (s/0.5m)

0.0
TOPSOIL - SAND - dark brown, loose, non-cohesive, organic, dry, roots

0.5
SAND - pale yellow brown, loose, non-cohesive, dry, medium to coarse-grained, moderately sorted, sub-angular quartz

REFUSAL at 0.8m due to limestone

1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0



Further Testing Notes:
SPT- Standard Penetration Test
PL- Point Load
UCS- Uniaxial Compressive Strength Test
PSP- Perth Sand Penetrometer

Legend: Graphic Log

- GRAVEL
- CLAY
- SANDY CLAY
- CLAYEY SAND
- LIMESTONE
- MEDIUM SAND
- SILTY SAND

Legend: Bore Construction

- Cement
- Sand
- Bentonite
- Gravel
- PVC Screen

SOIL CLASSIFICATION & DESCRIPTORS

COURSE GRAINED
BOULDERS: > 200mm
COBBLES: 63-200mm
GRAVELS- GW: Well-graded gravel/sand mix
GP: Poorly-graded gravel/sand mix
GM: Silty gravel/sand/silt mix
GC: Clayey gravel/sand/clay mix
SANDS- SW: Well-graded sand/gravel
SP: Poorly-graded uniform sands
SM: Silty sands
SC: Clayey sands

FINE GRAINED
SILTS & CLAYS (liquid limit <50%)
ML: Inorganic silts and v. fine sands, rock dust
CL, CI: Inorganic clays of low- med plasticity
OL: Organic silts & clays of low plasticity
SILTS & CLAYS (liquid limit >50%)
MH: Inorganic silts of low-med strength
CH: Inorganic clays of high plasticity
OH: Organic clays of med- high plasticity
Pt: Peats & other organic soils

CONSISTENCY TERMS
COHESIVE SOILS

V.soft	≤12kPa
Soft	12-25kPa
Firm	25-50kPa
Stiff	50-100kPa
V.stiff	100-200kPa
Hard	>200kPa

NON-COHESIVE SOILS (density index)

V.loose	≤ 15%
Loose	15-35%
Medium Dense	35-65%
Dense	65-85%
V.dense	>85%

ROCK CLASSIFICATION
CEMENTATION
VWc: v. weakly cemented
Wc: weakly cemented
MWc: mod. weakly cemented
Mc: moderately cemented
Hc: well cemented
VHc: v. well cemented
WEATHERING
RS: residual soil
XW: extremely weathered
HW: highly weathered
MW: moderately weathered
SW: slightly weathered
FR: fresh rock

STRENGTH (Point Load Index)
EL: extremely low- material crumbles under finger pressure
VL: very low - material crumbles under blow from pick & can be easily peeled with knife (<0.1MPa)
L: low - Easily scored with knife. Cores 150x50mm can be easily broken by hand (0.1-0.3MPa)
M: medium - Readily scored with knife. Core 150x50mm can be broken by hand with difficultly (0.3-1MPa)
H: high - Cores 150x50mm cannot be broken by hand but with a single blow from a pick (1-3MPa)
VH: very high - More than 1 blow required to break specimen (3-10MPa)
EH: extremely high - Specimen requires many blows with pick to break (>10MPa)

BIOSCIENCE PTY LTD
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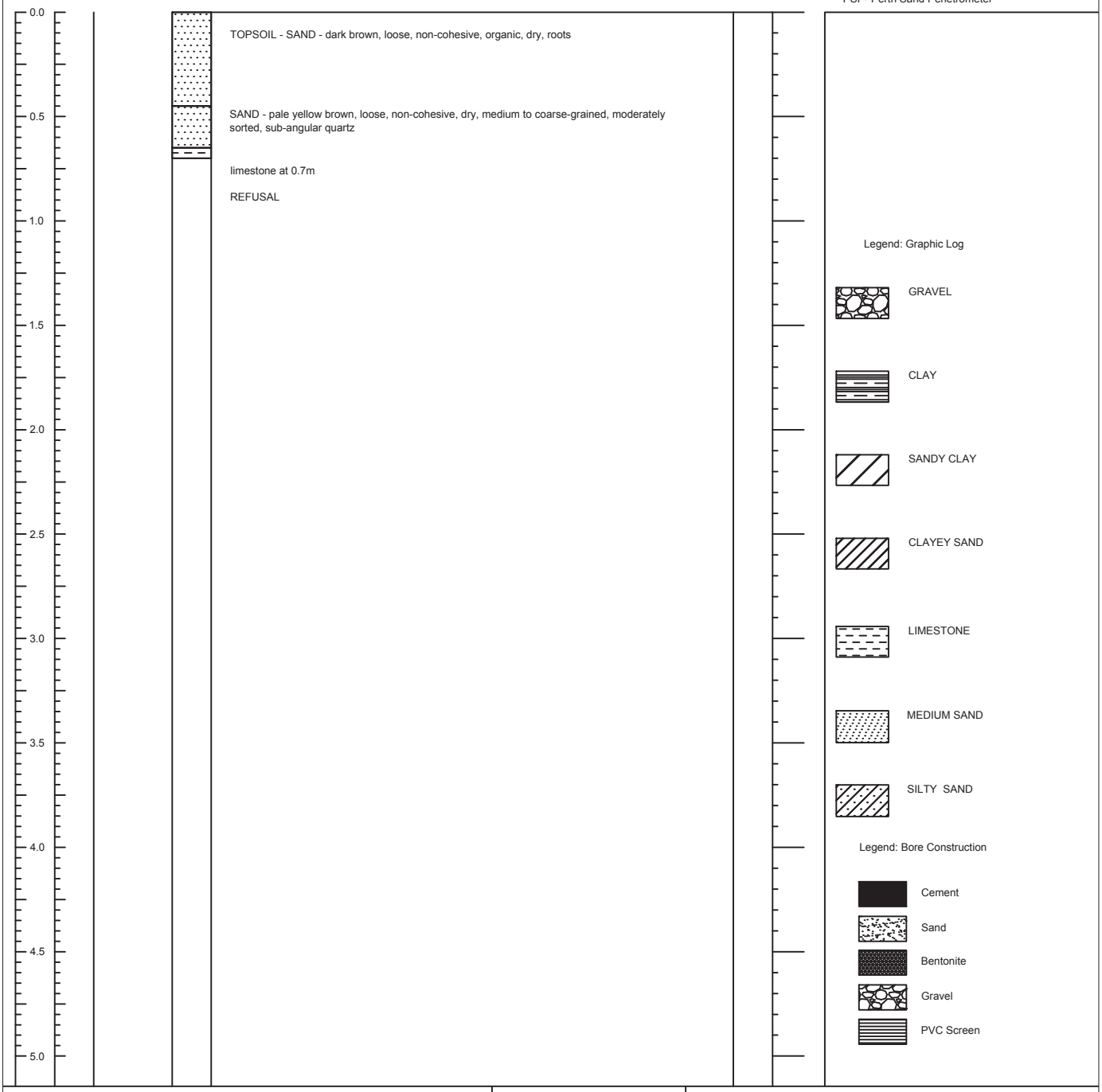
EMAIL: bioscience@biosciencewa.com
WEBSITE: www.biosciencewa.com

ENGINEERING PROFILE LOG

Client: Harley Dykstra
Project: Geotechnical Investigation
Location: Lot 21 Rockingham Road, Munster, Western Australia
Date: 26/02/2016

Hole No. H7
Sheet No. 7 of 10
Logged by: NB

Position: E: 385440 N: 6444651 Surface Elevation: N/A Rig Type: 5T Excavator



Further Testing Notes:
SPT- Standard Penetration Test
PL- Point Load
UCS- Uniaxial Compressive Strength Test
PSP- Perth Sand Penetrometer

Legend: Graphic Log

- GRAVEL
- CLAY
- SANDY CLAY
- CLAYEY SAND
- LIMESTONE
- MEDIUM SAND
- SILTY SAND

Legend: Bore Construction

- Cement
- Sand
- Bentonite
- Gravel
- PVC Screen

SOIL CLASSIFICATION & DESCRIPTORS

COURSE GRAINED
BOULDERS: > 200mm
COBBLES: 63-200mm
GRAVELS- GW: Well-graded gravel/sand mix
GP: Poorly-graded gravel/sand mix
GM: Silty gravel/sand/silt mix
GC: Clayey gravel/sand/clay mix
SANDS- SW: Well-graded sand/gravel
SP: Poorly-graded uniform sands
SM: Silty sands
SC: Clayey sands

FINE GRAINED
SILTS & CLAYS (liquid limit <50%)
ML: Inorganic silts and v. fine sands, rock dust
CL, CI: Inorganic clays of low- med plasticity
OL: Organic silts & clays of low plasticity
SILTS & CLAYS (liquid limit >50%)
MH: Inorganic silts of low-med strength
CH: Inorganic clays of high plasticity
OH: Organic clays of med- high plasticity
Pt: Peats & other organic soils

CONSISTENCY TERMS
COHESIVE SOILS

V.soft	≤12kPa
Soft	12-25kPa
Firm	25-50kPa
Stiff	50-100kPa
V.stiff	100-200kPa
Hard	>200kPa

NON-COHESIVE SOILS (density index)

V.loose	≤ 15%
Loose	15-35%
Medium Dense	35-65%
Dense	65-85%
V.dense	>85%

ROCK CLASSIFICATION
CEMENTATION
VWc: v. weakly cemented
Wc: weakly cemented
MWc: mod. weakly cemented
Mc: moderately cemented
Hc: well cemented
VHc: v. well cemented
WEATHERING
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ENGINEERING PROFILE LOG

Client: Harley Dykstra
Project: Geotechnical Investigation
Location: Lot 21 Rockingham Road, Munster, Western Australia
Date: 26/02/2016

Hole No. H8
Sheet No. 8 of 10
Logged by: NB

Position: E: 385447 N: 6444622 Surface Elevation: N/A Rig Type: 5T Excavator

Depth (m) | Water | Bore Construction | Graphic Log | Graphic Log Notes | Cohesion and Cementation | Drilling Time (s/0.5m)

0.0
TOPSOIL - SAND - dark brown, loose, non-cohesive, organic, dry, roots

0.5
Limestone at 0.4m

REFUSAL

1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0



Further Testing Notes:
SPT- Standard Penetration Test
PL- Point Load
UCS- Uniaxial Compressive Strength Test
PSP- Perth Sand Penetrometer

Legend: Graphic Log

- GRAVEL
- CLAY
- SANDY CLAY
- CLAYEY SAND
- LIMESTONE
- MEDIUM SAND
- SILTY SAND

Legend: Bore Construction

- Cement
- Sand
- Bentonite
- Gravel
- PVC Screen

SOIL CLASSIFICATION & DESCRIPTORS

COURSE GRAINED
BOULDERS: > 200mm
COBBLES: 63-200mm
GRAVELS- GW: Well-graded gravel/sand mix
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SP: Poorly-graded uniform sands
SM: Silty sands
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FINE GRAINED
SILTS & CLAYS (liquid limit <50%)
ML: Inorganic silts and v. fine sands, rock dust
CL, CI: Inorganic clays of low- med plasticity
OL: Organic silts & clays of low plasticity
SILTS & CLAYS (liquid limit >50%)
MH: Inorganic silts of low-med strength
CH: Inorganic clays of high plasticity
OH: Organic clays of med- high plasticity
Pt: Peats & other organic soils

CONSISTENCY TERMS
COHESIVE SOILS

V.soft	≤12kPa
Soft	12-25kPa
Firm	25-50kPa
Stiff	50-100kPa
V.stiff	100-200kPa
Hard	>200kPa

NON-COHESIVE SOILS (density index)

V.loose	≤ 15%
Loose	15-35%
Medium Dense	35-65%
Dense	65-85%
V.dense	>85%

ROCK CLASSIFICATION
CEMENTATION
VWc: v. weakly cemented
Wc: weakly cemented
MWc: mod. weakly cemented
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VHc: v. well cemented
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VH: very high - More than 1 blow required to break specimen (3-10MPa)
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ENGINEERING PROFILE LOG

Client: Harley Dykstra
Project: Geotechnical Investigation
Location: Lot 21 Rockingham Road, Munster, Western Australia
Date: 26/02/2016

Hole No. H9
Sheet No. 9 of 10
Logged by: NB

Position: E: 385452 N: 6444638 Surface Elevation: N/A Rig Type: 3.5T Excavator

Depth (m) | Water | Bore Construction | Graphic Log | Graphic Log Notes | Cohesion and Cementation | Drilling Time (s/0.5m)

0.0 TOPSOIL - SAND - dark brown, loose, non-cohesive, organic, dry, roots

SAND - pale yellow brown, loose, non-cohesive, dry, medium to coarse-grained, moderately sorted, sub-angular quartz

Limestone at 0.4m

REFUSAL

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

Further Testing Notes:
SPT- Standard Penetration Test
PL- Point Load
UCS- Uniaxial Compressive Strength Test
PSP- Perth Sand Penetrometer

Legend: Graphic Log

- GRAVEL
- CLAY
- SANDY CLAY
- CLAYEY SAND
- LIMESTONE
- MEDIUM SAND
- SILTY SAND

Legend: Bore Construction

- Cement
- Sand
- Bentonite
- Gravel
- PVC Screen

SOIL CLASSIFICATION & DESCRIPTORS

COURSE GRAINED
BOULDERS: > 200mm
COBBLES: 63-200mm
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SANDS- SW: Well-graded sand/gravel
SP: Poorly-graded uniform sands
SM: Silty sands
SC: Clayey sands

FINE GRAINED
SILTS & CLAYS (liquid limit <50%)
ML: Inorganic silts and v. fine sands, rock dust
CL, CI: Inorganic clays of low- med plasticity
OL: Organic silts & clays of low plasticity
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MH: Inorganic silts of low-med strength
CH: Inorganic clays of high plasticity
OH: Organic clays of med- high plasticity
Pt: Peats & other organic soils

CONSISTENCY TERMS
COHESIVE SOILS

V.soft	≤12kPa
Soft	12-25kPa
Firm	25-50kPa
Stiff	50-100kPa
V.stiff	100-200kPa
Hard	>200kPa

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V.loose	≤ 15%
Loose	15-35%
Medium Dense	35-65%
Dense	65-85%
V.dense	>85%

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ENGINEERING PROFILE LOG

Client: Harley Dykstra
Project: Geotechnical Investigation
Location: Lot 21 Rockingham Road, Munster, Western Australia
Date: 26/02/2016

Hole No. H10
Sheet No. 10 of 10
Logged by: NB

Position: E: 385457 N: 6444655 Surface Elevation: N/A Rig Type: 3.5T Excavator

Depth (m) | Water | Bore Construction | Graphic Log | Graphic Log Notes | Cohesion and Cementation | Drilling Time (s/0.5m)

0.0 MADE EARTH

SAND - dark brown, loose, non-cohesive, organic, dry, roots

0.5

SAND - dark orange / red, loose, non-cohesive, dry, medium to coarse-grained, moderately sorted, sub-angular quartz

few limestone

1.0

1.5

2.0

2.5 no groundwater encountered

3.0

3.5

4.0

4.5

5.0

Further Testing Notes:
SPT- Standard Penetration Test
PL- Point Load
UCS- Uniaxial Compressive Strength Test
PSP- Perth Sand Penetrometer

Legend: Graphic Log

- GRAVEL
- CLAY
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- CLAYEY SAND
- LIMESTONE
- MEDIUM SAND
- SILTY SAND

Legend: Bore Construction

- Cement
- Sand
- Bentonite
- Gravel
- PVC Screen

SOIL CLASSIFICATION & DESCRIPTORS

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SM: Silty sands
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FINE GRAINED
SILTS & CLAYS (liquid limit <50%)
ML: Inorganic silts and v. fine sands, rock dust
CL, CI: Inorganic clays of low- med plasticity
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SILTS & CLAYS (liquid limit >50%)
MH: Inorganic silts of low-med strength
CH: Inorganic clays of high plasticity
OH: Organic clays of med- high plasticity
Pt: Peats & other organic soils

CONSISTENCY TERMS
COHESIVE SOILS

V.soft	≤12kPa
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V.stiff	100-200kPa
Hard	>200kPa

NON-COHESIVE SOILS (density index)

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Dense	65-85%
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ROCK CLASSIFICATION
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VHc: v. well cemented
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VH: very high - More than 1 blow required to break specimen (3-10MPa)
EH: extremely high - Specimen requires many blows with pick to break (>10MPa)

Appendix C – In-situ Infiltration Testing

LABORATORY TEST CERTIFICATE

BIOSCIENCE PTY LTD
488 NICHOLSON ROAD FORRESTDALE WA
PO BOX 5466 CANNINGVALE SOUTH WA 6155
PHONE: (08) 9397 2446 FAX: (08) 9397 2447
EMAIL: bioscience@biosciencewa.com
WEBSITE: www.biosciencewa.com

Client: Harley Dykstra

Project: Geotechnical Investigation Lot 21 Rockingham Rd

Location: Munster, WA

Tested: 26/02/2016

PERMEABILITY

In - situ measurement of field- saturated soil hydraulic conductivity

#	Test Ref	Northing	Easting	Test Depth (mBGL)	Permeability (mm/hr)	Comments
1	#1	6444635	385381	0.3	101.9	-
2	#2	6444664	385433	0.3	198.1	-

Notes: GPS instrument used accurate to 3m. All permeabilities measured in-situ onsite using a constant head permeameter with soils in an unsaturated state

Tested by: NB Approved by: PK

Appendix D – Particle Size Distribution

LABORATORY TEST CERTIFICATE

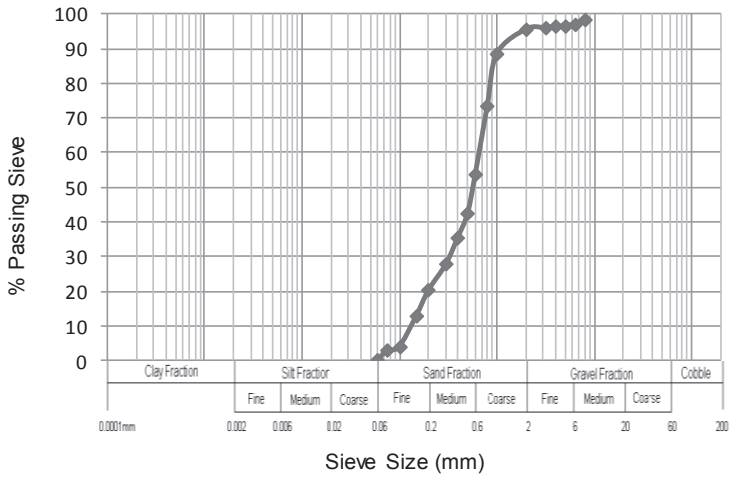
BIOSCIENCE PTY LTD
488 NICHOLSON ROAD FORRESTDALE WA 6112
PO BOX 5466 CANNINGVALE SOUTH WA 6155
PHONE: (08) 9397 2446 FAX: (08) 9397 2447
EMAIL: bioscience@biosciencewa.com
WEBSITE: www.biosciencewa.com

Client: Lot 21 Rockingham Rd
Project: Geotechnical Investigation
Location: Munster, WA
Sample ID: @ Hole 5 Depth From: 500 Depth to: 1000

Tested: 1/03/2016

PARTICLE SIZE DISTRIBUTION

Standard: AS1289.3.6.1



Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)
8.00	98.03	0.50	42.21
6.30	96.91	0.40	35.53
5.00	96.47	0.30	27.64
4.00	96.17	0.20	20.23
3.15	95.89	0.15	12.84
1.00	88.39	0.10	3.86
0.80	73.55	0.075	2.79
0.60	53.47		

Notes: Sample oven dried and dry sieved.

Tested by: NB Approved by: PK

LABORATORY TEST CERTIFICATE

BIOSCIENCE PTY LTD
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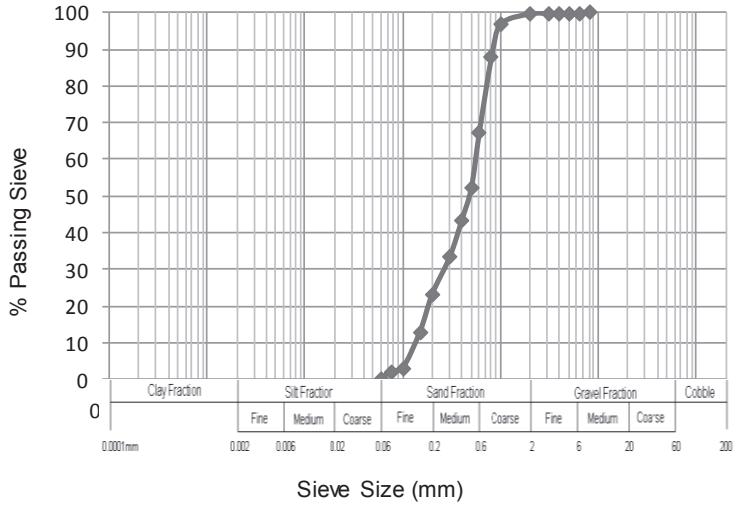
PO BOX 5466 CANNINGVALE SOUTH WA 6155
PHONE: (08) 9397 2446 FAX: (08) 9397 2447
EMAIL: bioscience@biosciencewa.com
WEBSITE: www.biosciencewa.com

Client: Lot 21 Rockingham Rd
Project: Geotechnical Investigation
Location: Munster, WA
Sample ID: @ Hole 10 Depth From: 200 Depth to: 600

Tested: 1/03/2016

PARTICLE SIZE DISTRIBUTION

Standard: AS1289.3.6.1



Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
8.00	100.00	0.50	52.29
6.30	99.74	0.40	43.46
5.00	99.74	0.30	33.25
4.00	99.71	0.20	23.32
3.15	99.70	0.15	13.05
1.00	96.85	0.10	3.09
0.80	87.69	0.075	2.20
0.60	67.08		

Notes: Sample oven dried and dry sieved

Tested by: NB Approved by: PK

Appendix B: XP SWMM Modelling Parameters

Surface water runoff and peak flows were calculated using the XP STORM modelling software with runoff being simulated based on the Laurenson non-linear runoff-routing method.

An *Initial Loss / Continuing Loss* infiltration model was used for pre- and post-development modelling based on the following assumptions:

- An infiltration rate of $0.58x10^{-4}$m/s was used as identified in the geotechnical investigation ($0.3x10^{-4}$ m/s – $0.8x10^{-4}$ m/s)
- Garden and POS areas have high infiltration rates (sand/mulch) and therefore infiltration losses are increased.
- All residential lots and roads infiltrate the 20 year ARI rainfall event (33.1mm) at source with excess runoff in larger events flowing onto the access road, Carine Pde and Rockingham Rd, respectively.
- Soakwells in the road reserves were accounted for with infiltration within the model. They are sized to store the 100 year events

The adopted parameters are shown in Table B1.

Table B1: XP SWMM Infiltration Loss Parameters

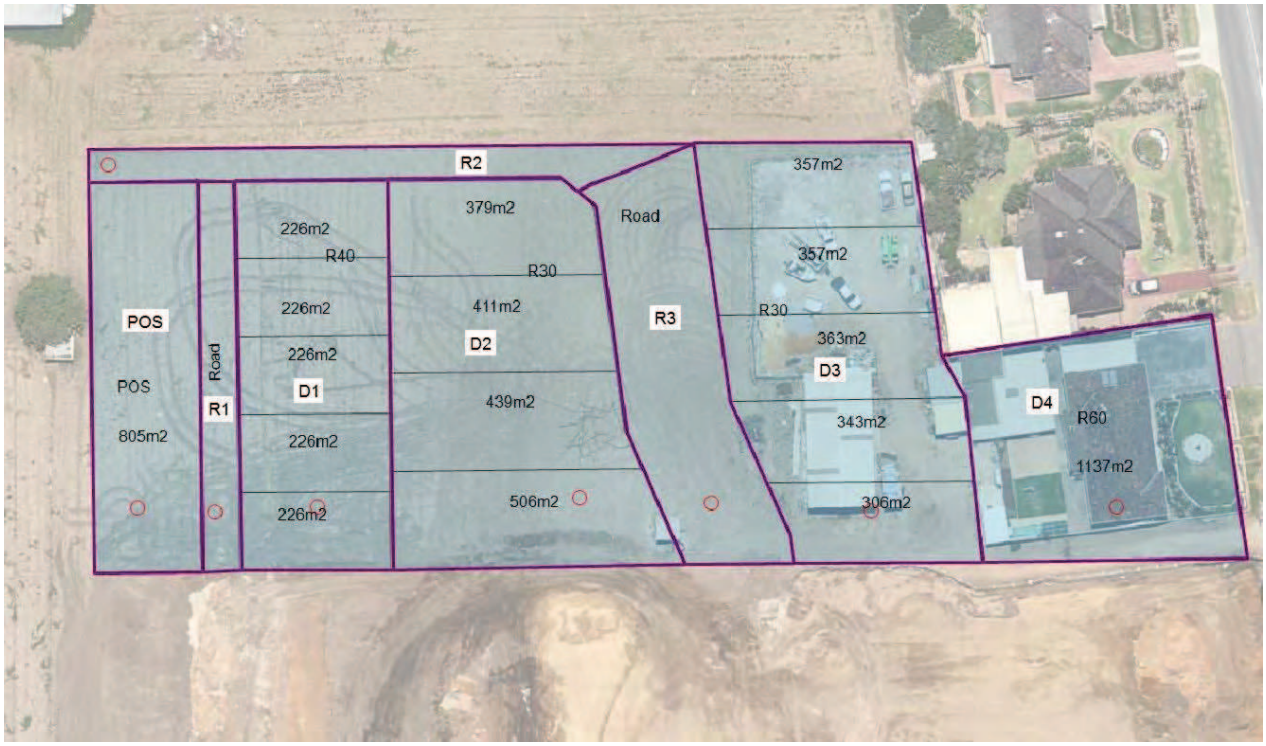
Land Type	Initial Loss (mm)	Continuing Loss - Absolute (mm/hr)
POS	18	15
Roads	2.5	1
Post Development impervious 20yr	33.1	1.5
Post Development pervious 20yr	33.1	3.5
Pre Development cleared	16	15
Pre Development residential	16	5

AR&R IFD intensities have been generated for the subject site.

Figure B.1 XP Storm modeling catchments Pre-Development

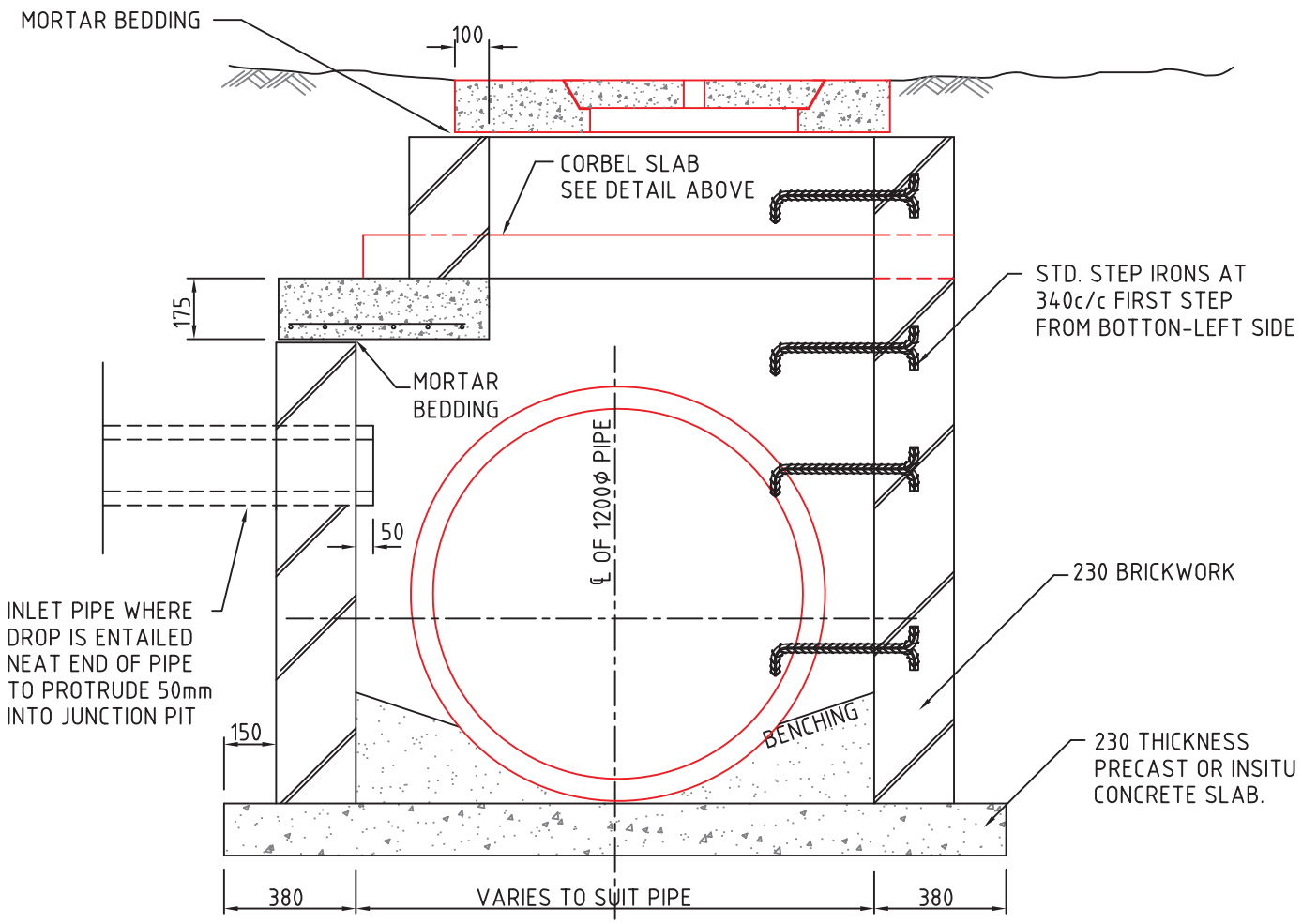


Figure B.2 XP Storm modeling catchments Post-Development



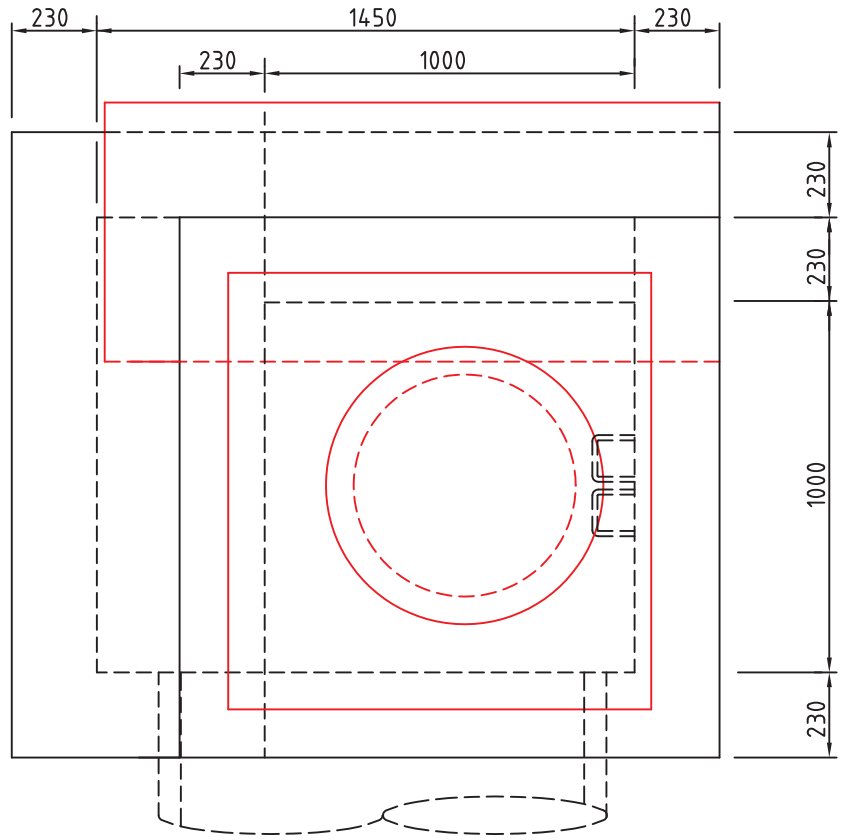
Appendix C: City of Cockburn Standard Drawings

NOTE: WHERE JUNCTION PIT FOR 1050ϕ OR 1200ϕ PIPE IS REQUIRED FOR SIDE ENTRY PIT A SPECIAL COVER IS REQUIRED - OFFSET SEE ABOVE.



JUNCTION PIT FOR 1200 DIA. PIPES OR GREATER

SCALE 1:20



800mm 200 0 400 800m

1:20

No.	Revision-	Chk'd	App'd	Date

CITY OF COCKBURN WOULD LIKE TO ACKNOWLEDGE AND THANK GUTTERIDGEHASKINS & DAVEY PTY. LTD. FOR THEIR ASSISTANCE IN THE PRODUCTION OF THESE STANDARD DETAIL DRAWINGS

CITY OF COCKBURN

9 COLEVILLE CRESCENT, SPEARWOOD WA 6163

PHONE: (08) 9411 3444 FAX: (08) 9411 3416

STANDARD DETAILS

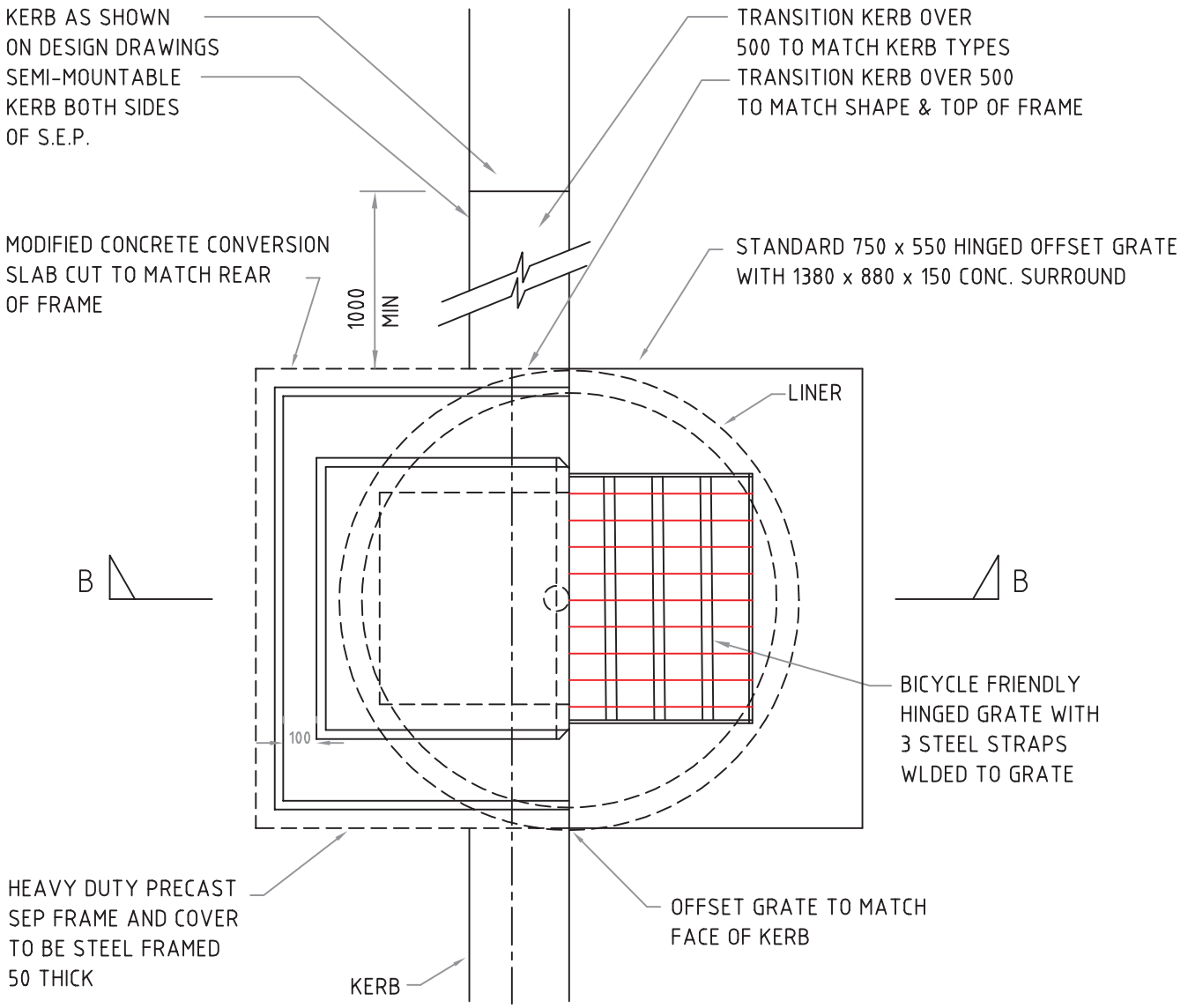
Title

DRAINAGE JUNCTION PIT FOR 1200ϕ PIPES OR GREATER

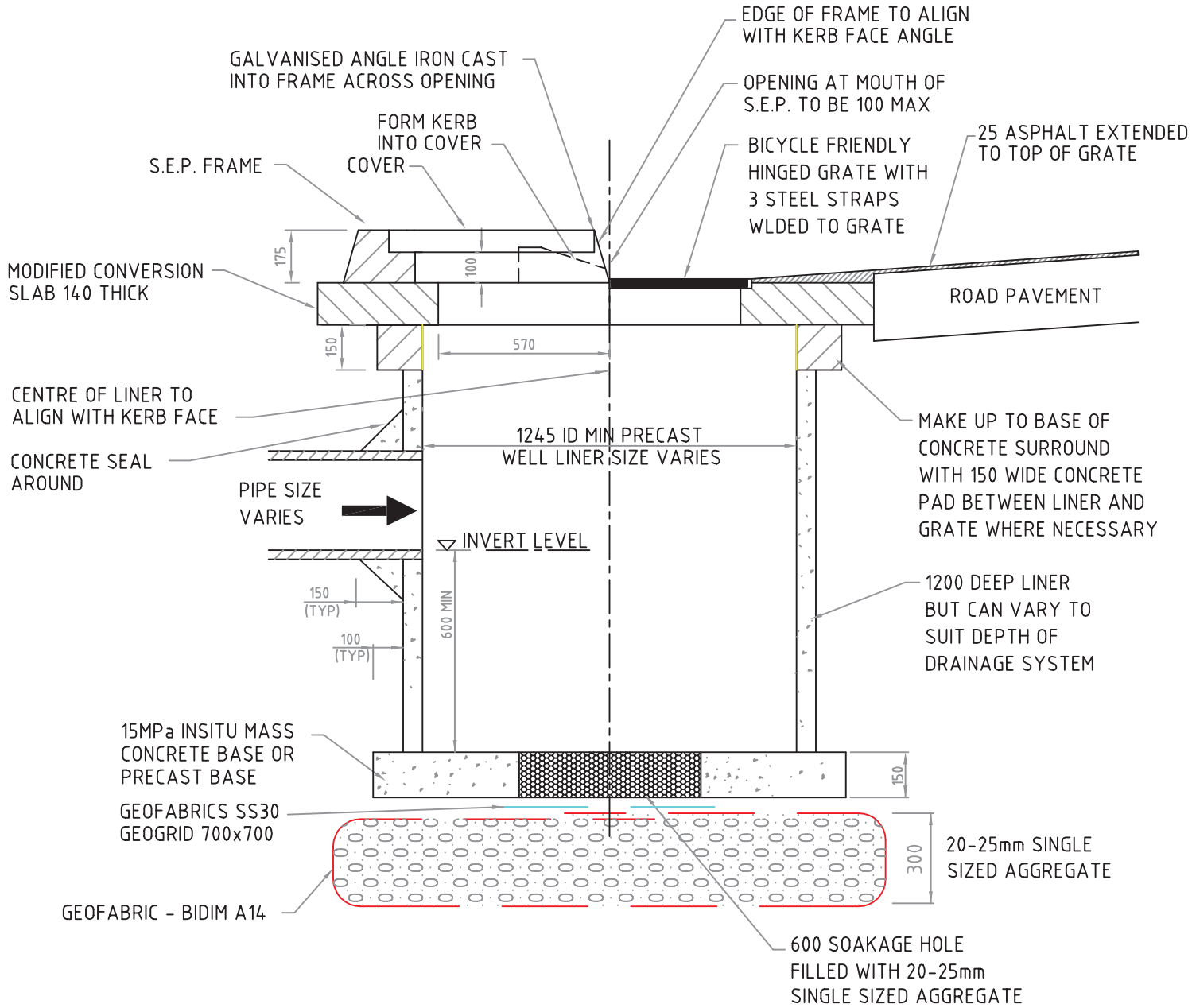
DESIGNED	GHD	APPROVED	
DRAWN	KMF/SYC		
CHECKED	KR	DATE	

SCALE AS SHOWN JOB No

DWG No 2423B03 SHEET No 13 REV



PLAN



SECTION BB

COMBINATION SIDE ENTRY PIT AND GRATE

FOR USE AT LOW POINTS.
SCALE 1:20

NOTE
GEOFABRIC-BIDIM A14 & AGREGATE
SOAKAGE UNDERLAY NOT APPLICABLE
WHEN BASE IS LESS THAN 500mm
ABOVE AAMGL.

400 200 0 400 800mm
1:20

No.	Revision-	Chk'd	App'd	Date

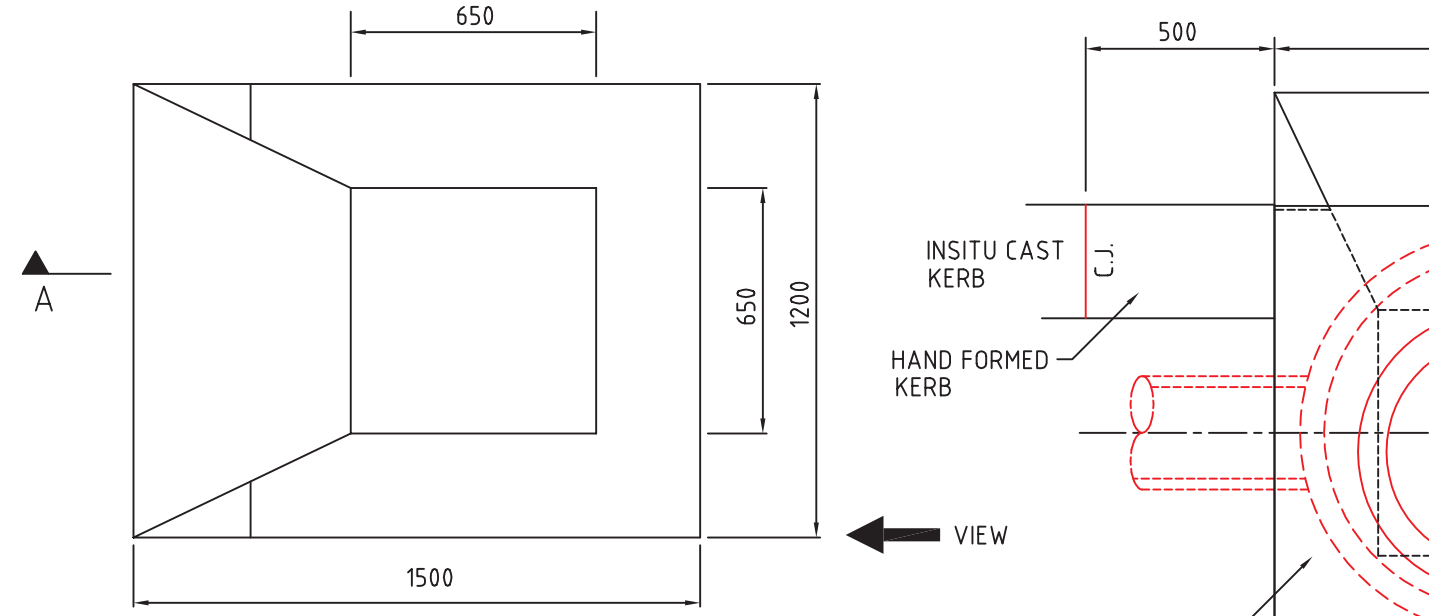
CITY OF COCKBURN WOULD LIKE TO ACKNOWLEDGE AND THANK GUTTERIDGEHASKINS & DAVEY PTY. LTD. FOR THEIR ASSISTANCE IN THE PRODUCTION OF THESE STANDARD DETAIL DRAWINGS

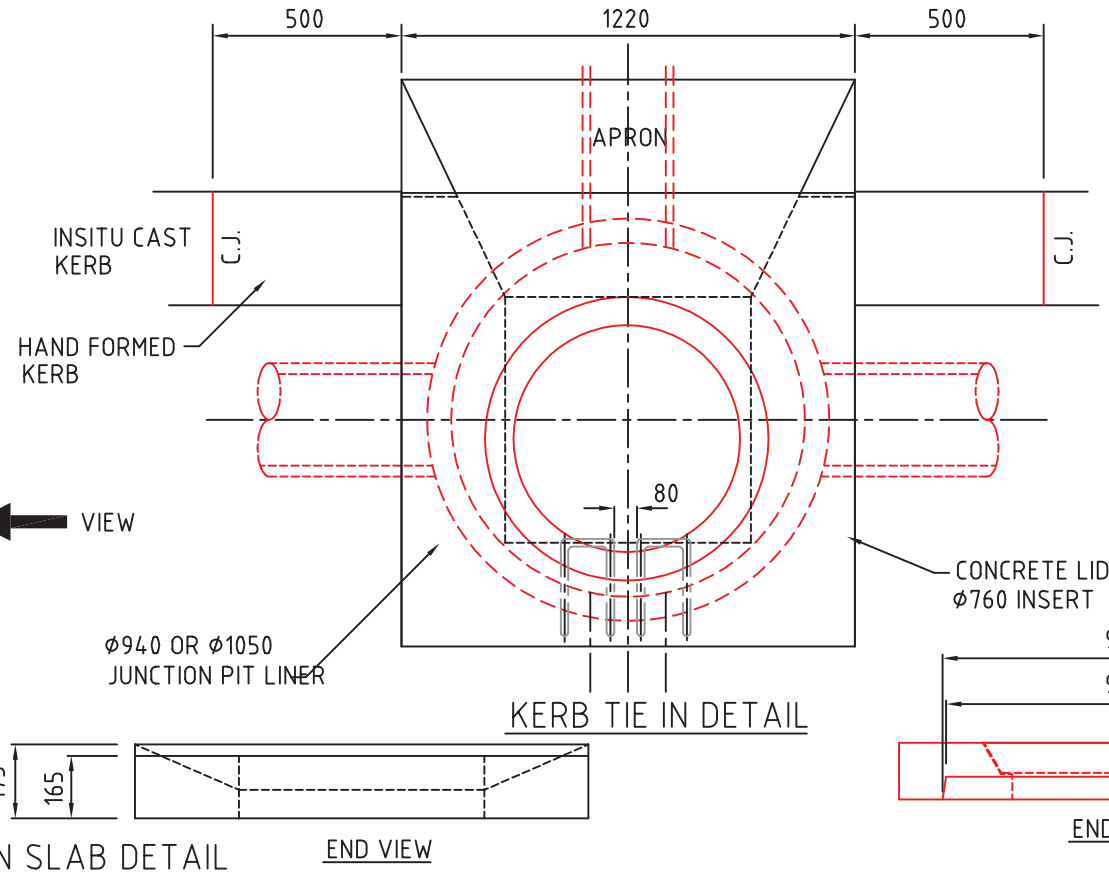
CITY OF COCKBURN
9 COLEVILLE CRESCENT, SPEARWOOD WA 6163
PHONE: (08) 9411 3444 FAX: (08) 9411 3416

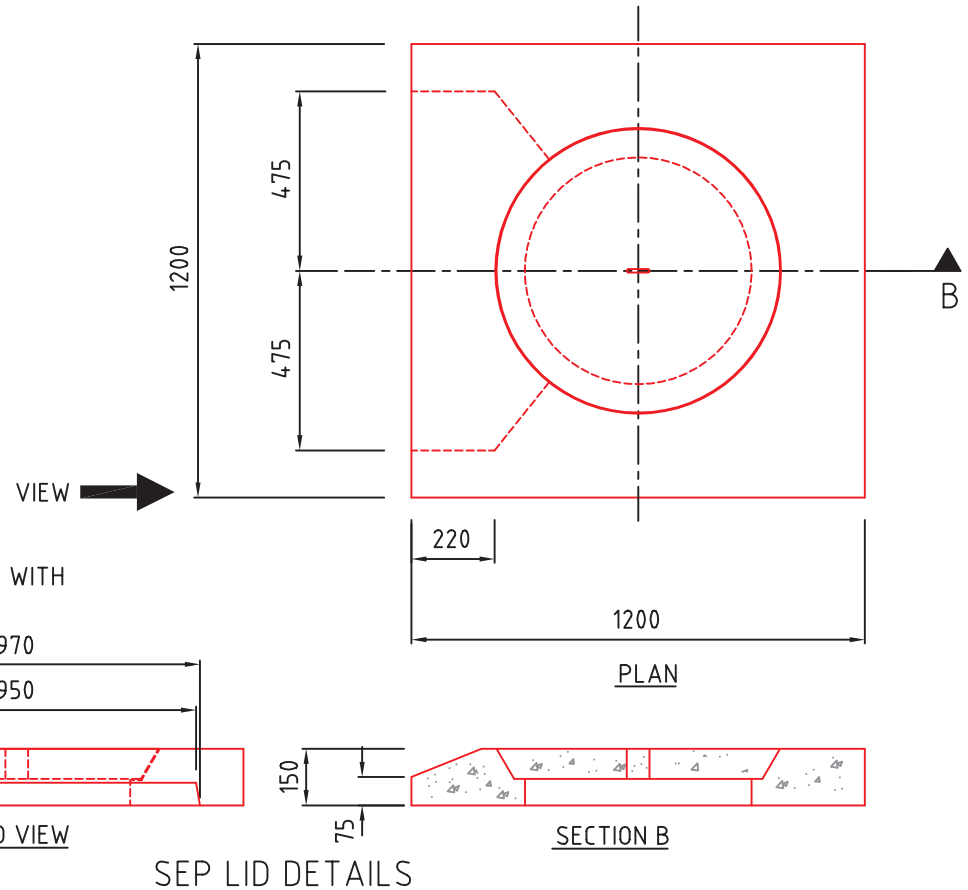
STANDARD DETAILS

Title
DRAINAGE
SIDE & DOUBLE SIDE ENTRY PITS

DESIGNED GHD	APPROVED	SCALE AS SHOWN	JOB No
DRAWN KMF/SYC		DWG No 2423B03	SHEET No 10
CHECKED KR	DATE		REV



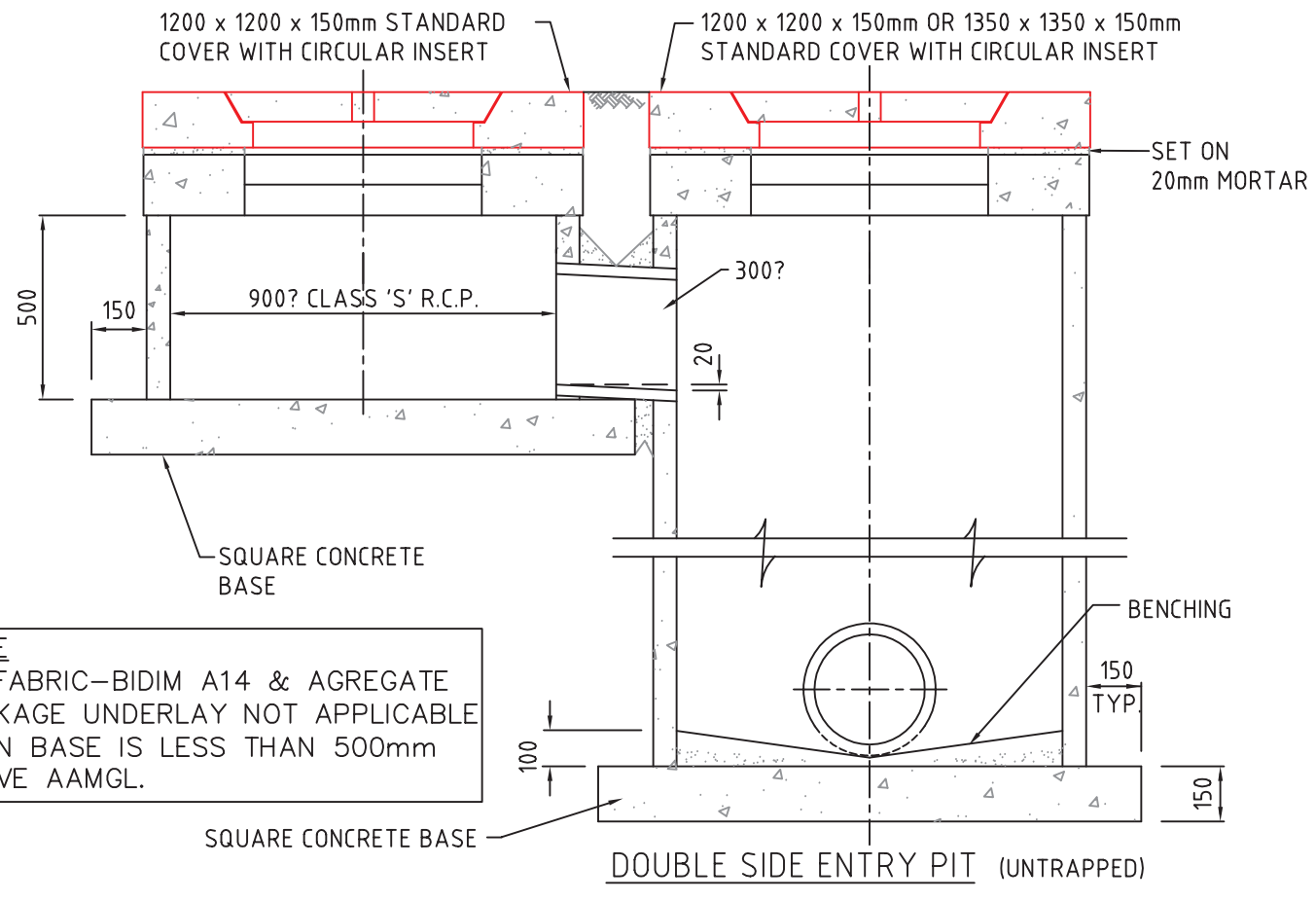




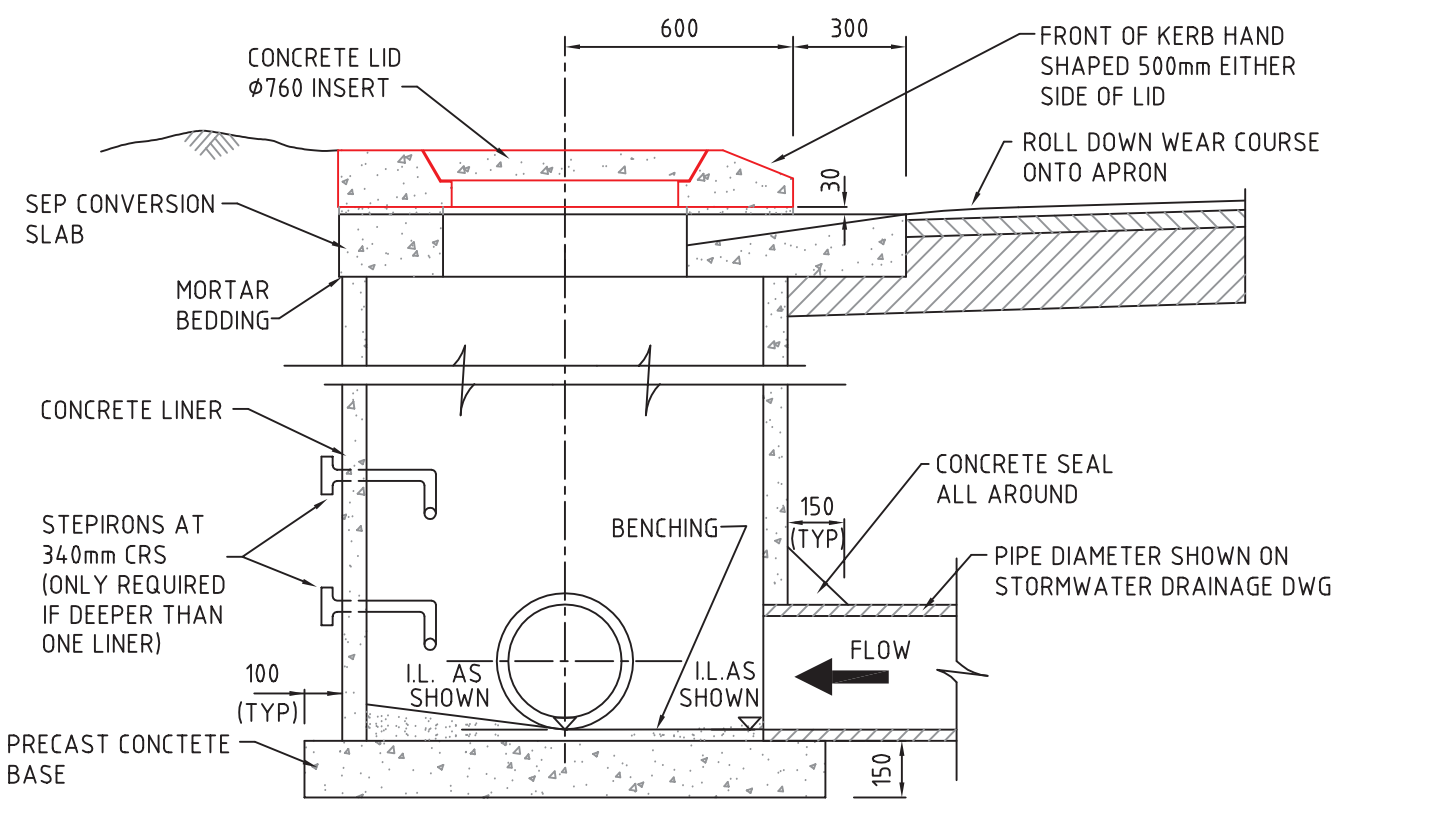
SEP CONVERSION SLAB DETAIL

END VIEW

SEP LID DETAILS



DOUBLE SIDE ENTRY PIT (UNTRAPPED)



SINGLE SIDE ENTRY PIT

400 200 0 400 800mm

1:20

No.	Revision-	Chk'd	App'd	Date

CITY OF COCKBURN WOULD LIKE TO ACKNOWLEDGE AND THANK GUTTERIDGEHASKINS & DAVEY PTY. LTD. FOR THEIR ASSISTANCE IN THE PRODUCTION OF THESE STANDARD DETAIL DRAWINGS

CITY OF COCKBURN
9 COLEVILLE CRESCENT, SPEARWOOD WA 6163
PHONE: (08) 9411 3444 FAX: (08) 9411 3416

STANDARD DETAILS

Title

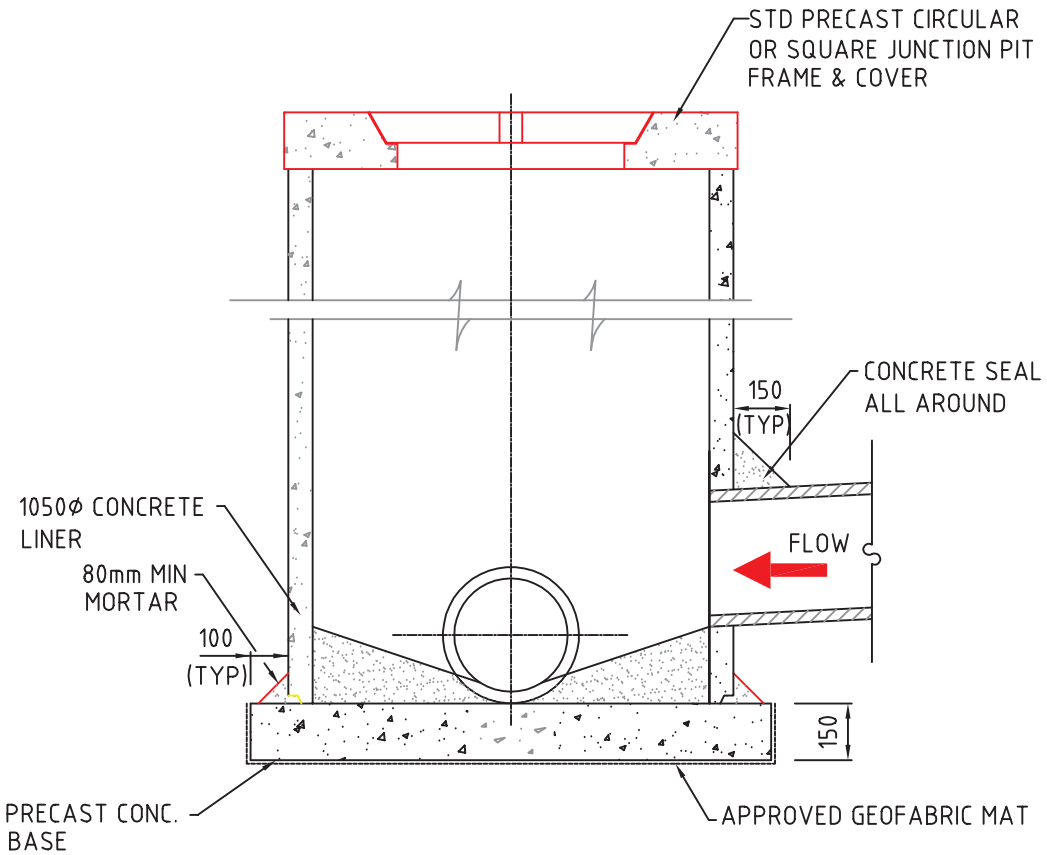
DRAINAGE
SIDE & DOUBLE SIDE ENTRY PITS

DESIGNED	GHD	APPROVED	
DRAWN	KMF/SYC		
CHECKED	KR	DATE	

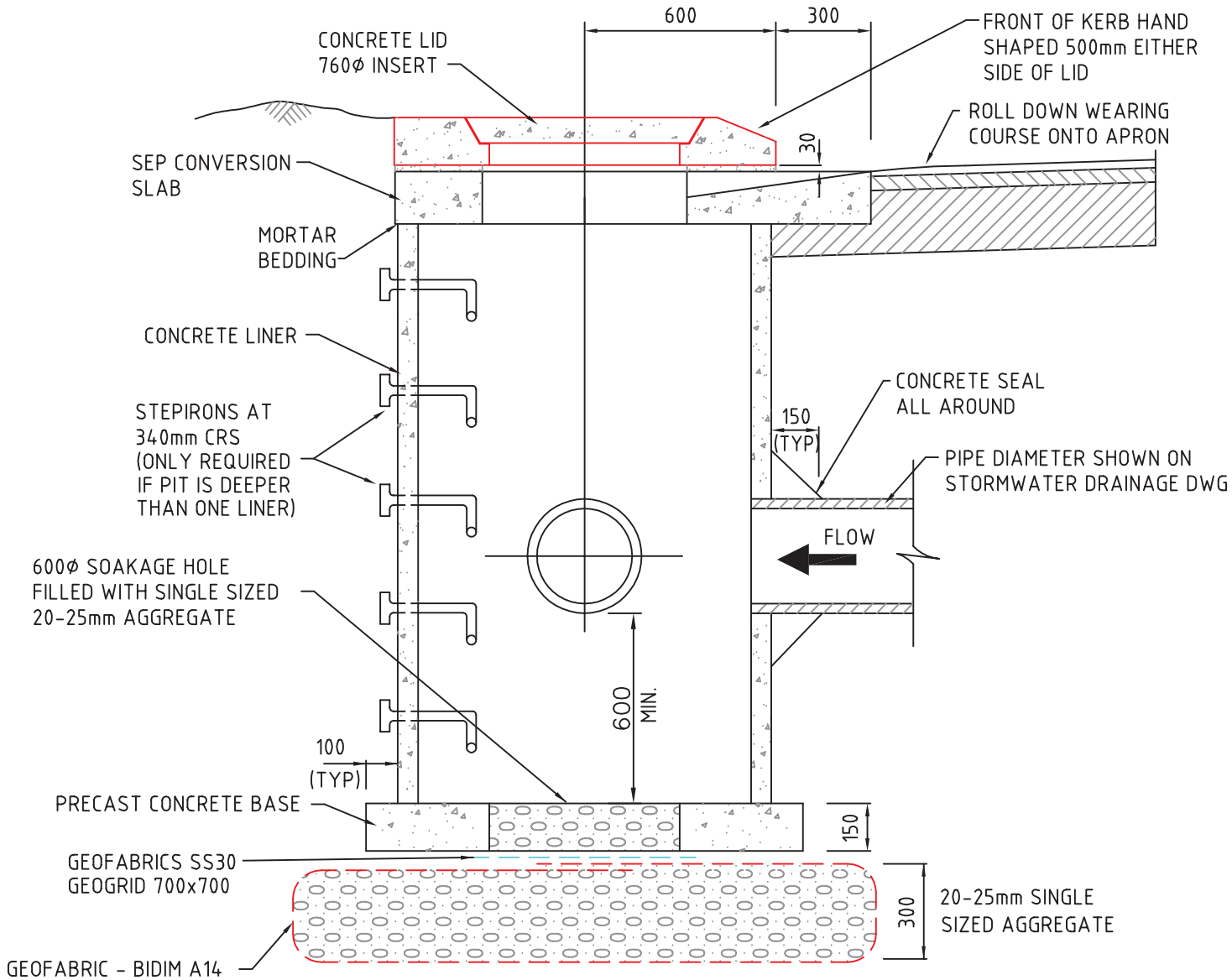
SCALE	AS SHOWN	JOB No	
DWG No	2423B03	SHEET No	09
REV			

NOTES
1. GEOFABRIC BIDIM A14 AND AGGREGATE SOAKAGE UDERPLAY IS REQUIRED FOR PITS WHEN BASE IS MORE THAN 500mm ABOVE AAMGL FOR THE SITE

2. LESS THAN 500mm ABOVE AAMGL PITS TO BE BENCHED



STD LINER JUNCTION PIT
BASE SHOWN FOR WET CONDITIONS



SINGLE SIDE ENTRY PIT WITH SOAKAGE
BASE SHOWN FOR WET CONDITIONS

400 200 0 400 800mm
1:20

No.	Revision-	Chk'd	App'd	Date

CITY OF COCKBURN WOULD LIKE TO ACKNOWLEDGE AND THANK GUTTERIDGEHASKINS & DAVEY PTY. LTD. FOR THEIR ASSISTANCE IN THE PRODUCTION OF THESE STANDARD DETAIL DRAWINGS

CITY OF COCKBURN
9 COLEVILLE CRESCENT, SPEARWOOD WA 6163
PHONE: (08) 9411 3444 FAX: (08) 9411 3416

STANDARD DETAILS

Title
DRAINAGE
SEP SOAKWELL & STD LINEAR JUNCTION PIT

DESIGNED	GHD	APPROVED	
DRAWN	KMF/SYC		
CHECKED	KR	DATE	

SCALE AS SHOWN | JOB No
DWG No 2423B03 | SHEET No 08 | REV

APPENDIX 4

Contamination Assessment

BIOSCIENCE PTY LTD ABN 26 547 517 746

488 NICHOLSON ROAD FORRESTDALE WA 6112
PO BOX 5466 CANNINGVALE SOUTH WA 6155
PHONE (08) 9397 2446 FAX (80) 9397 2447
EMAIL bioscience@biosciencewa.com
WEB www.biosciencewa.com

Lot 21 Rockingham Rd Munster:

Tier 1 Contamination Assessment. May 2016

Under DEP Contaminated Sites Guidance, Intensive Horticulture is considered a "Potentially Contaminating Activity" due to the possible legacy of pesticide residues, heavy metals and hydrocarbons such as petroleum, diesel or lubricating oils being present in soils.

In order to determine whether any potential contamination risks have resulted from past land use, Bioscience has interviewed the family of the current owners about past activities, undertaken desk top reviews based on archival aerial photography, and done a detailed site inspection and geotechnical investigation. Bioscience was also guided by recent experience and findings from an Audited Detailed Site Investigations for nearby Lots 18 and 19 Rockingham Rd

Lot 21 was sold to the current owners, Mr and Mrs Oreb in March 1971 by a Mr Corello, who had originally owned and developed all of the surrounding land as market gardens. Mr Corello had irrigated the western 15 m western edge of the property with east/west oriented sprinkler rows. Mr Corello had ceased growing on the (now) Oreb land by 1965. When the Orebs purchased the 2.5 acres of land, they sunk their own well, and installed new irrigation oriented north/south.

The historic evidence confirms the reports of the landowners that their gardening activity was of low intensity, and only undertaken to supplement their income from Mr Orebs work as a mechanic. Aerial photography (16 images from 1974 to 2006) shows either no gardening activity, or cultivation at about ½ intensity, covering the western ½ of the property. From 2001, the intensity declined to only cultivating a few rows, then by 2004, crops were no longer produced.

This is in marked contrast to Lots 18 and 19 which, throughout this period of 1953 to 2002 were under much more intensive cultivation. The Detailed Site Investigation of those sites (Bioscience, August 2014) involved sampling of soil and groundwater throughout that area. The only potential contaminant of concern detected was DDE, a metabolite of DDT, however where it was detected, the level was well below the Environmental Investigation threshold, and one thousand times below the Health Investigation Threshold. We can conclude that the probability of pesticide residues being present at detectable levels on Lot 21 is extremely low.

Bioscience undertook a geotechnical investigation of the site, wherein a 20 tonne excavator was used to dig 10 investigation pits over the site. This work provided the opportunity to determine both the nature of the soil, and whether there was evidence of any foreign materials buried on the site. Without exception, none of the pits revealed anything other than deep, uniform brown sandy soil under a 350 mm organic rich sandy soil layer at the surface. Based on the absence of any staining, odour or imported materials, there was no evidence of contamination.

Bioscience

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EMAIL bioscience@biosciencewo
WEBSITE www.biosciencewo

As asbestos products were commonly used in the past for shed cladding and fencing, bioscience undertook an intensive "emu stalk" over the property looking for evidence of Asbestos Containing Materials (ACM) according to Department of Health guidance. No ACM was found.

We are confident from this Tier 1 assessment that the site is very unlikely to be contaminated due to past land use.

Peter Keating B.Sc(Hons) Ph.D

Senior Consultant.

Attachment: Aerial Photography of Lot 21 from 1985 to 2004

Bioscience

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PO BOX 5466 CANNINGVALE WESTERN AUSTRALIA
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EBSITE www.bioscience

ATTACHMENT

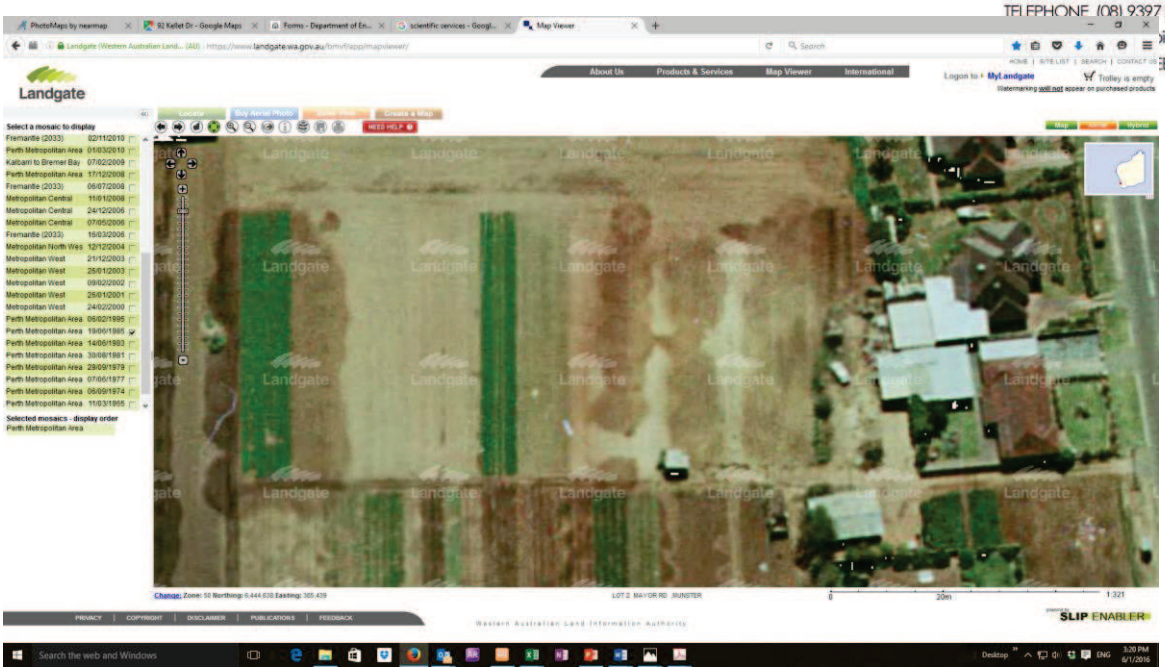

Photo 1: 1985 aerial image shows grading activity of low activity, consistent with family report.



Photo 2: 1995 aerial image again shows only low intensity production.

BIOSCIENCE PTY LTD ACN 054 8
DALE WESTERN AUSTRALIA
VALE WESTERN AUSTRALIA
2446 FACSIMILE (08) 9397
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EBSITE www.biosciencewo

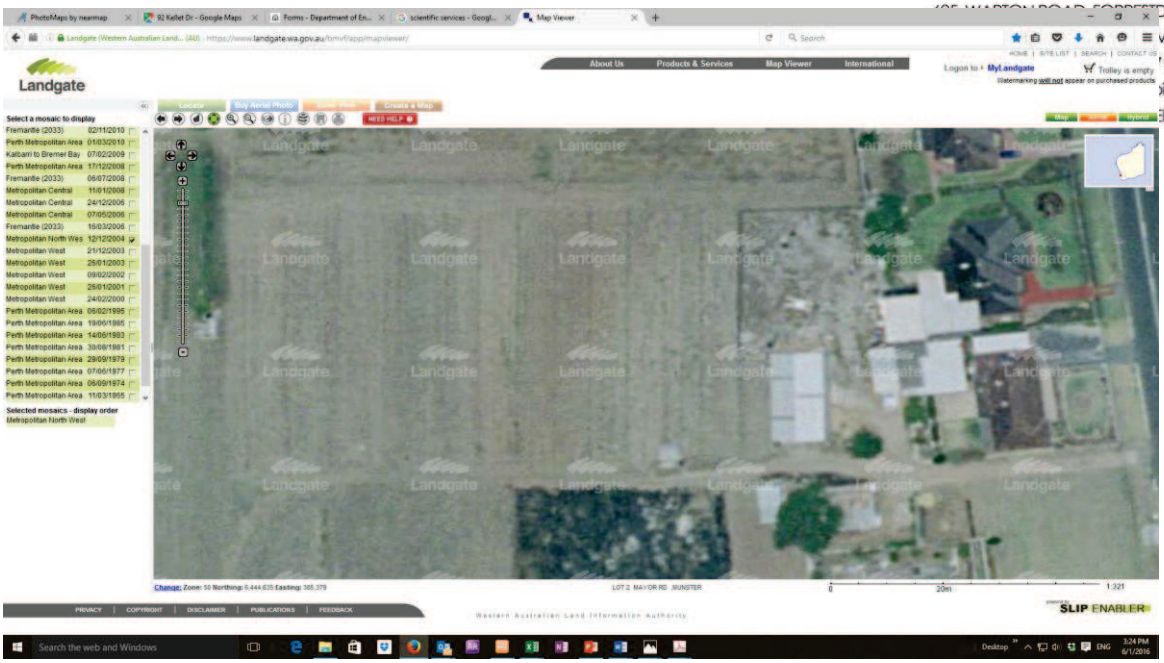

Photo 3 2004 Aerial image shows market gardening activity had stopped.

APPENDIX 5

Concept Subdivision Plan

CONCEPT SUBDIVISION PLAN

Lot 21 on P 3562
583 Rockingham Road, MUNSTER

Plan No.	20777-05C	
Date	14/10/16	
Drawn	BdR	
Checked	DM	
Revision	C	
Scale	1:500@A3	

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Busselton and Kelmscott

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0 5m 10m 15m

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APPENDIX 6

Servicing Report

Our Ref: BH/MC/L0505.16
Job No: 16-02-017

Porter
Consulting Engineers

Level 2 Kishorn Court
58 Kishorn Road
Mount Pleasant WA 6153

PO Box 1036
Canning Bridge WA 6153

Tel: (08) 9315 9955
Fax: (08) 9315 9959
Email: office@portereng.com.au
www.portereng.com.au

15 September 2016

Harley Dykstra
PO Box 316
KELMSCOTT, WA, 6991

Attention: David Maiorana

Dear David

LOT 21 (#583) ROCKINGHAM ROAD, MUNSTER
SERVICING REPORT

Lot 21 (#583) Rockingham Road in Munster, is approximately an 8,000m2 lot as shown in Figure 1. The proposed development includes 9 green title lots fronting the proposed extension of Carine Parade, 5 strata lots and a POS as shown in Attachment 1.

There is an existing brick and tile home fronting Rockingham Road, with this house to initially remain but suitable for future strata development. However, the large shed to the south of this house will need to be demolished for future green title lot development.



Figure 1 – lot 21 (#583) Rockingham Rd, Muster

Land form – The site has a rising 5% gradient from approximately RL6m AHD on the western boundary to RL10.5m along Rockingham Road.

The expected soil is brown sand over limestone pinnacles, with the pinnacles likely to be encountered near the surface at the eastern end of the site and groundwater expected at approximately RL2m AHD.

It is assumed that Acid Sulphate Soil treatment would not be required due to expected clearance to groundwater.

Previous land use – As the former land use was a market garden, consideration to pesticides or contamination assessment may be required. This may arise as a WAPC condition of subdivision. It is noted that the site is not registered on the DER contaminates sites database. This would be the subject of further environmental investigation and due diligence reporting.

Demolition – The existing sheds immediately behind the existing house will need to be demolished. There is also a minor outbuilding that would require removal.

Earthworks – As rock pinnacles are expected to be near the surface, cross ripping across the whole site to a depth of 600mm below finished surface level will be required. Due to the gradient across the site some cut to fill earthworks and imported sand fill is expected to be required. The likely order of magnitude of sand fill is estimated to be approximately up to 5,000m^3. Whilst the limestone is present, the development to the immediate south demonstrated that the rock can be broken with a 24T excavator with rock bucket, without additional requirement of rock breaking.

There appears to be very little topsoil on the site, with the remaining topsoil able to be blended and spread as part of the earthworks. The area used as market garden is likely to be slightly higher with organic materials and will require blending to ensure it meets the clean fill requirements.

It is expected that the site will achieve a post works site classification of a Class A; however a geotechnical investigation will need to confirm this.

Retaining walls – Due to the gradient across the site, a 2.5-3.0m high retaining wall is expected to be required along the eastern boundary of the 5 strata lots. This is because the green title lots facing Carine Parade extension will need to be level with this road.

Retaining walls up to 0.5m high may be required along the western boundary of the two retaining homes depending on finished ground levels. Where possible, levels will try and blend into existing lot levels to reduce the requirement for walls along this boundary and can be determined following feature survey and detailed design.

It is assumed that battering from along the northern boundary from lot 21 into lot 22 will be permitted, however, should battering not be allowed, a temporary retaining wall up to 0.5m high may be required. Once lot 22 is developed, this temporary wall can be removed.

Fencing – Fencing is not expected to be required as part of the civil works conditions however, due to the high retaining wall along the eastern boundary of the strata lots, temporary safety fencing will be required or alternatively the 1.8m high colourbond fencing can be installed. If the existing house is retained, the existing fence to this boundary may require upgrading or relocation to the boundary line.

Sewer reticulation – There is existing sewer reticulation in Carine Parade that can be extended to serve the proposed green title lots. The proposed strata lots will need to be serviced in the future when lot 22 to the north is developed, as the sewers in Carine Parade are not deep enough.

Sewers along Rockingham Road will need to be extended immediately in front of the southern home fronting Rockingham Road, with the sewer in a 3m easement. Reinstatement of the front garden is expected to be required. This will be required to be extended the full frontage of the lot to cater for future development north of the site.

Water servicing - The existing water reticulation in Carine Parade can be extended to serve the proposed green title lots. The proposed strata lots can be served in the future when lot 22 to the north is developed.

The existing homes fronting Rockingham Road will have a 'deferred' water service, which can be installed by the Water Corporation off the existing 100mm main in the verge when required for any future group development.

Roads – Carine Parade will be extended as a 6m wide red asphalt kerbed road with a 1.5m path to serve the green title lots. A temporary cul-de-sac turn around is expected to be required as shown in the proposed subdivision plan in Attachment 1, with the cul-de-sac to be wholly contained within the site. The placement of services will need to located to avoid the cul-de-sac. An easement will be required on the proposed lot to the area where the temporary cul-de-sac intrudes into the lot.

Construction of the east-west road to the north of the boundary will need to occur when lot 22 to the north is developed as the majority of the road reserve is within Lot 22 Access to the strata development is not possible without this road construction taking place.

Drainage - The site will need to contain up to the 1:100 year storm event for runoff from the proposed road reserves due to there being no outlet to an existing street system or drainage network system. Lots are required to store up to the 1 in 20 year storm event on site and excess stormwater from the lots over and above this event up to the 1 in 100 year event, also will need to be catered for.

Due to the gradient of the site, stormwater flows will grade and be contained in the POS either via a basin or underground drainage structures which will need to be installed as part of the lot 21 civil works. The City of Cockburn has accepted underground storage systems in the previous developments to the south and therefore it is expected that underground storage would be the preferred outcome for this development also.

Power - Extending the existing HV and LV power in Carine Parade will service the green title lots. Power to the strata lots will need to occur when lot 22 to the north is developed. The Western Power Network Capacity Mapping Tool confirms that there is sufficient power supply in the area with over 20MVA available in the area. This means that no network upgrades will be required.

However, the determination of whether a new transformer and substation for the additional 8 green title lots and Strata development cannot be determined until an application is made to Western Power for a Design Information Package at detailed design stage as it is specific to load calculations in the immediate area. If a substation is required, this would be placed in the POS area and would not impact on the developable area that is proposed.

If the existing home on Rockingham Road is to initially remain, it will be required to have the existing overhead consumer line undergrounded as part of the power works to the development.

Communications - The extension of the existing NBN infrastructure along Carine Parade will serve the proposed green title lots. It is expected that the strata lots will be served with NBN when the road within lot 22 is developed. Whilst the development is under 100 lots, NBN will likely be the service provider given they have the infrastructure immediately adjacent. Application to them to be the service provider would be made at detailed design stage.

NBN is expected to be extended along Rockingham Road in front of the southern existing home as part of the works to the development.

Gas – Extending the gas in Carine Parade will serve the proposed green title lots. Gas to the strata lots is expected to be installed as part of the road within lot 22.

There is existing gas mains along Rockingham Road which appears to be suitable for future gas consumer connections if required.

CONCLUSION

Servicing in general will be an extension of the existing servicing installed for Lot 20 Rockingham Rd to the south of this site. A copy of the servicing plans for lot 20 is attached for background information at Attachment 2.

There are no servicing factors that will prevent development of the site. However, items that require specific consideration in the development servicing and timing are:

- Existing limestone material affecting earthworks and service installation expected in the eastern part of the site.
- Construction of the northern road and services is required to be undertaken when Lot 22 develops in order to provide access to the strata development site.

If you have any queries regarding the indicative development costs, please give me a call to discuss.

Yours faithfully

BRAD HARRIS
DIRECTOR PROJECTS

Attachment 1 – Proposed Subdivision

CONCEPT SUBDIVISION PLAN

Lot 21 on P 3562
583 Rockingham Road, MUNSTER

Plan No.	20777-05C	
Date	14/10/16	
Drawn	BdR	
Checked	DM	
Revision	C	
Scale	1:500@A3	

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0 5m 10m 15m

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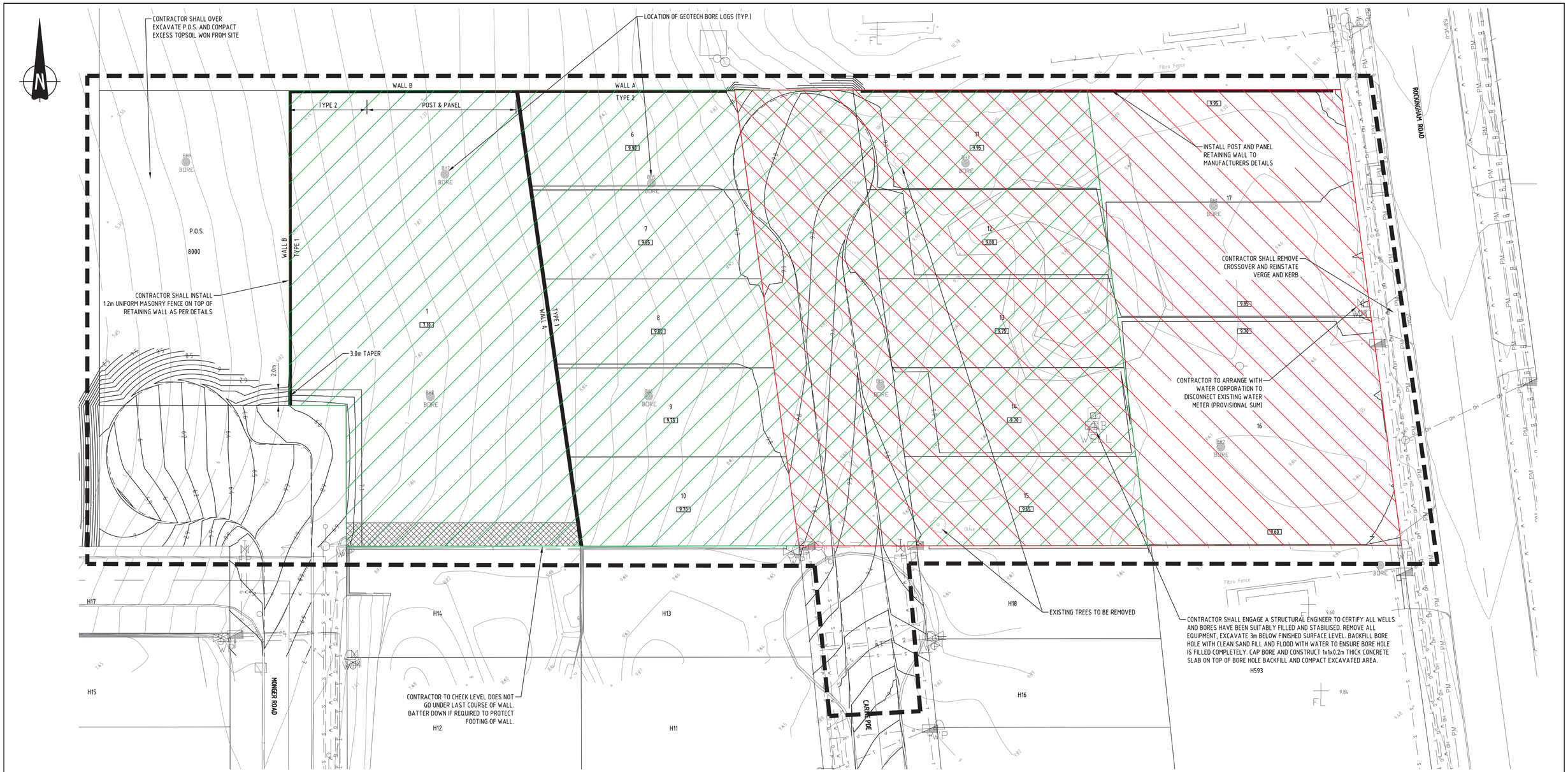
Attachment 2 – Adjoining Lot 20 Development Servicing



SITEWORKS AND EARTHWORK NOTES

1. VERTICAL DATUM : AUSTRALIAN HEIGHT DATUM.
   HORIZONTAL DATUM : PERTH COASTAL GRID 1994 (PCG94)
2. EXISTING SURVEY/CONTOURS FROM SITE SURVEY BY MCMULLEN NOLAN GROUP
3. THE CONTRACTOR SHALL GRADE EVENLY BETWEEN DESIGN CONTOURS AND MATCH INTO EXISTING SURFACE AT LIMIT OF EARTHWORKS BOUNDARY WHERE APPROPRIATE.
4. THE CONTRACTOR SHALL HAVE IN PLACE A PROJECT SAFETY AND RISK MANAGEMENT SYSTEM WHICH COMPLIES WITH THE OCCUPATIONAL SAFETY AND HEALTH ACT AND WORK SAFE WA REQUIREMENTS
5. THE CONTRACTOR SHALL PREPARE A DUST MANAGEMENT PLAN IN ACCORDANCE WITH THE DEPARTMENT OF ENVIRONMENT AND CONSERVATION GUIDELINES. THE CONTRACTOR SHALL PAY ALL FEES AND OBTAIN ALL APPROVALS FROM THE LOCAL AUTHORITY FOR THIS DUST MANAGEMENT PLAN PRIOR TO ANY WORKS STARTING ON SITE.
6. DUST SUPPRESSION METHODS SHALL BE APPLIED BY THE CONTRACTOR IN ACCORDANCE WITH THE PROJECT SPECIFICATION. CONTRACTOR TO ALLOW IN TENDER FOR HYDROMULCHING LOTS AND VERGES AT COMPLETION OF CONSTRUCTION WORKS.
7. THE CONTRACTOR SHALL LIMIT ACCESS TO THE WORKS TO THE EARTHWORKS BOUNDARY. EXISTING VEGETATION OUTSIDE OF BOUNDARY TO BE PROTECTED.
8. REMOVE FROM SITE ALL RUBBISH (ie: CAR BODIES, DRUMS, ETC.) WITHIN SITEWORKS BOUNDARY TO AN APPROVED DISPOSAL SITE.
9. THE CONTRACTOR SHALL REMOVE REDUNDANT CROSSOVERS AND CONSTRUCT KERB TO MATCH EXISTING, VERGE TO BE MADE GOOD.
10. ALL SHEDS, INTERNAL FENCES, HARDSTAND AREAS, IRRIGATION PIPES AND SIMILAR STRUCTURES ON-SITE SHALL BE REMOVED BY THE CONTRACTOR AND DISPOSED OFFSITE.
11. CONTRACTOR SHALL CROSS-RIP SITES TO CHECK FOR EXISTING SOAKWELLS. ANY SOAKWELLS SO LOCATED SHALL BE REMOVED
12. TOPSOIL SHALL BE PLACED IN ACCORDANCE WITH THE REQUIREMENTS OF THE SPECIFICATION.
13. THE CONTRACTOR SHALL CLEAR LOTS AND REMOVE ALL VEGETATION FROM SITE. LOTS TO BE GRADED TO PRODUCE A SMOOTH EVEN FINISH AND TIDIED.
14. **ALL SITEWORKS & EARTHWORKS SHALL BE TO THE REQUIREMENTS OF THE GEO-TECHNICAL INVESTIGATION. ANY SITE CONDITIONS NOT REPORTED ON THE GEOTECHNICAL INVESTIGATION SHALL BE REFERRED TO THE ENGINEER FOR FURTHER INVESTIGATION PRIOR TO THE BACKFILL OF THE AREA.**
15. ALL FILL SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE GEOTECHNICAL REPORT.
16. ALL FILL SHALL BE PLACED IN ACCORDANCE WITH THE REQUIREMENTS OF THE GEOTECHNICAL REPORT.
17. CONTRACTOR TO ENGAGE A GEOTECHNICAL ENGINEER TO CERTIFY THAT ALL COMPLETED EARTHWORKS SATISFY THE REQUIREMENTS OF THE GEOTECHNICAL REPORT. THE CERTIFICATION SHALL CONFIRM THAT THE SITE HAS BEEN COMPACTED TO MINIMUM CLASSIFICATION AS NOTED IN THE GEOTECHNICAL INVESTIGATION.
18. ALL WORKS SHALL BE TO THE PROJECT SPECIFICATION, BUT WHERE NO DETAIL IS PROVIDED, TO THE REQUIREMENTS OF THE LOCAL AUTHORITY.
19. **SERVICES, SUCH AS SEWER, WATER, GAS, TELEPHONE, ELECTRICITY, AND DRAINAGE MAY BE ENCOUNTERED DURING CONSTRUCTION OF THE WORKS. SERVICES INFORMATION SHOWN ON DRAWINGS IS INDICATIVE ONLY AND MAY NOT BE COMPLETE. BEFORE EXCAVATION COMMENCES THE LOCATION OF ALL SUCH SERVICES SHALL BE OBTAINED FROM THE RELEVANT AUTHORITIES.**
20. **CO-ORDINATE THE LOCATION OF ALL EXISTING AND PROPOSED SERVICES PRIOR TO COMMENCEMENT OF WORK. ANY CONFLICTS ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.**
21. THE CONTRACTOR SHALL ENSURE THE TOE COURSING OF THE RETAINING WALLS ALIGN WITH THE PROPERTY BOUNDARIES UNLESS OTHERWISE DIMENSIONED. CONTRACTOR SHALL ENSURE ALL PARTS OF THE RETAINING WALLS ARE LOCATED WITHIN THE LOT UNLESS OTHERWISE NOTED.
22. THE CONTRACTOR SHALL PREPARE AS-CONSTRUCTED EARTHWORKS DRAWINGS (INCLUDING SURVEY) TO THE SATISFACTION OF THE LOCAL AUTHORITY. AS CONSTRUCTED PLANS TO BE ISSUED TO THE ENGINEER FOR SIGNING AND PRESENTATION TO THE LOCAL AUTHORITY.
23. THE CONTRACTOR SHALL PROVIDE A SAFE WORKING SITE FOR THE DURATION OF THE CONSTRUCTION WORKS. THIS SHALL INCLUDE, BUT NO LIMITED TO, TEMPORARY FENCING ON RETAINING WALLS AND TEMPORARY PERIMETER FENCING WHERE REQUIRED.

NOTE:
CONTRACTOR TO INSTALL TEMPORARY SITE FENCING WITH DUST CONTROL FABRIC AND MAINTAIN FOR DURATION OF WORKS

NOTE:
OPTIC FIBRE CABLE IN VICINITY OF WORKS. CONTRACTOR TO CONTACT 1800 806 246 AT LEAST TWO (2) BUSINESS DAYS BEFORE STARTING ACTIVITY

LEGEND

- EXISTING GROUND CONTOUR
- PROPOSED GROUND CONTOUR
- EXISTING GROUND LEVELS
- SITEWORKS BOUNDARY
- EXISTING PAVEMENT
- EXISTING FENCE
- EXISTING TREE TO BE REMOVED
- EXISTING GAS LINE
- EXISTING SEWER PIPE
- EXISTING TELSTRA CABLE
- EXISTING WATER MAIN
- EXISTING POWER LINE
- EXISTING DRAINAGE LINE
- PROPOSED EARTHWORK LEVELS
- PROPOSED RETAINING WALL
- EXISTING RETAINING WALL

AREA 1:
CONTRACTOR TO ALLOW TO CROSS-RIP SITE TO DEPTH OF 600mm BELOW FINISHED GROUND LEVEL AND REMOVE REDUNDANT SERVICES OR LIMESTONE PINNACLES AND COMPACT IN ACCORDANCE WITH GEOTECHNICAL REPORT

AREA 2:
CONTRACTOR TO ALLOW TO BLEND EXISTING FILLING SAND (0.2 TO 0.4m DEPTH) WITH CLEAN FILL AT RATIO 2:1 (CLEAN FILL: EXISTING) AND OBTAIN GEOTECHNICAL CERTIFICATION TO CONFIRM, THIS WILL MEET CLASS A SITE REQUIREMENTS

1:250 0 2.5 5 10 15
Half Size 1:500 - SCALE (m)

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WAPC: 151517

PROJECT:
LOT 20 ROCKINGHAM ROAD MUNSTER

No	DATE	REVISION	BY
0	18-12-2015	ISSUED FOR CONSTRUCTION	MEG
D	14-10-2015	LOT 1 WALL AND LEVELS AMENDED	DLC
C	8-10-2015	WALL NOTES MODIFIED, EARTHWORKS NOTES FOR AREA 1 AND 2 ADDED	MEG
B	6-10-2015	ISSUED FOR APPROVAL	DLC
A	23-9-2015	ISSUED FOR COMMENT	MEG

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ONLY PLANS WITH NUMERICAL REVISION (REV '0' OR HIGHER) AND SIGNED AS APPROVED SHALL BE USED FOR CONSTRUCTION.

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58 Kisharn Road
Mt Pleasant 6153 WA
PO Box 1036
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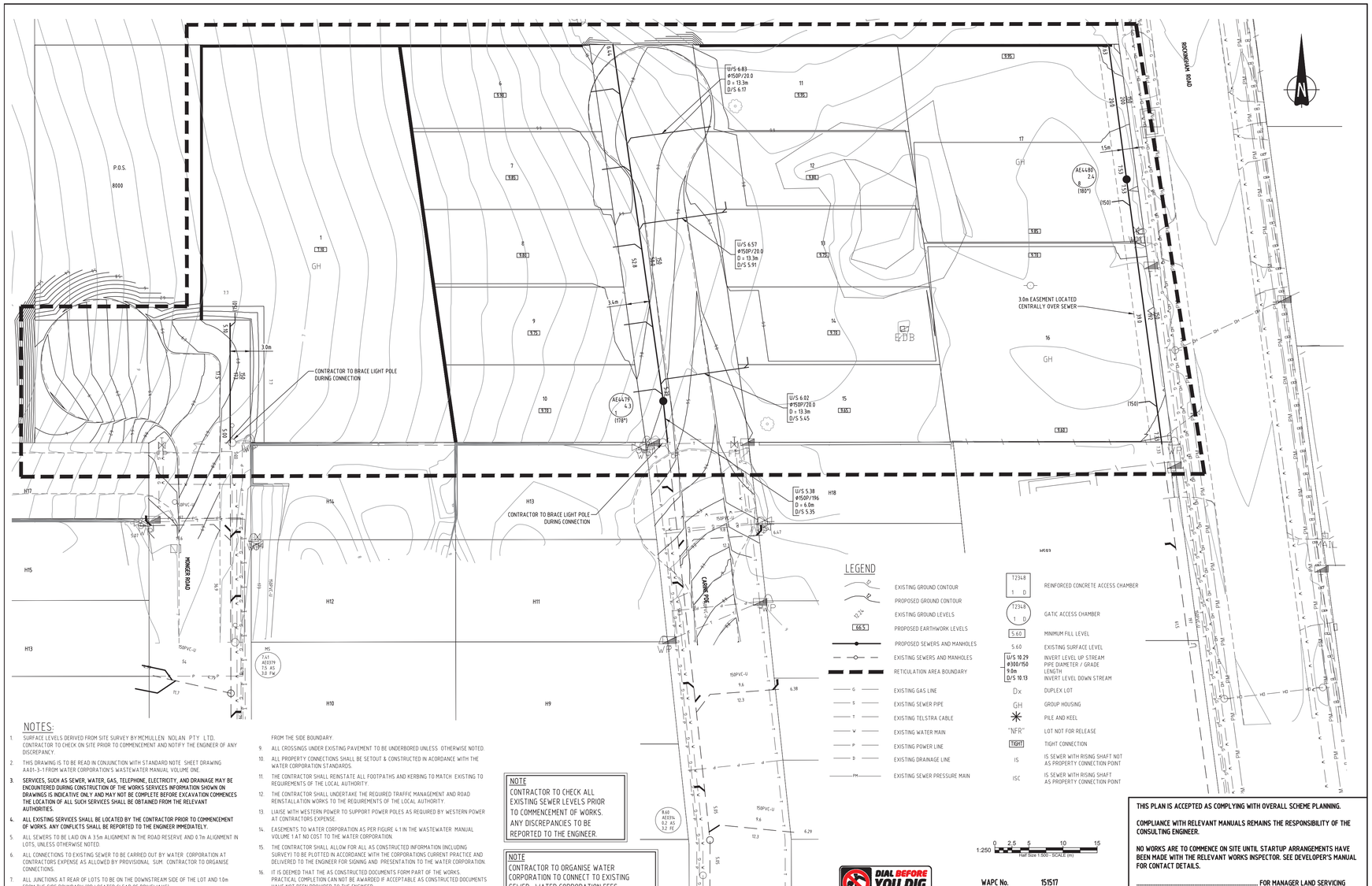
YUSHO Pty Ltd ACN 010 091 148 as trustee for the Consulting Engineering Unit Trust trading as Porter Consulting Engineers ABN 78 636 396 385

CLIENT:
FEYMORE PTY LTD

DRAWING:
SITEWORKS AND EARTHWORKS PLAN

STATUS: **FOR CONSTRUCTION**

SCALE	1:250
DATE	SEPT 2015
DESIGN	BIH
DRAWN	MEG
CHECK	
DRAWING No.	14-7-116/100
REV No.	0
ORIGINAL DRAWING SIZE	A1
FILE NAME	S:\ACTIVE PROJECTS\14-07-116\ACAD\147116-100.dwg
APP'D	



NOTES:

1. SURFACE LEVELS DERIVED FROM SITE SURVEY BY MCMULLEN NOLAN PTY LTD. CONTRACTOR TO CHECK ON SITE PRIOR TO COMMENCEMENT AND NOTIFY THE ENGINEER OF ANY DISCREPANCY.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH STANDARD NOTE SHEET DRAWING AA01-3-1 FROM WATER CORPORATION'S WASTEWATER MANUAL VOLUME ONE.
3. **SERVICES, SUCH AS SEWER, WATER, GAS, TELEPHONE, ELECTRICITY, AND DRAINAGE MAY BE ENCOUNTERED DURING CONSTRUCTION OF THE WORKS SERVICES INFORMATION SHOWN ON DRAWINGS IS INDICATIVE ONLY AND MAY NOT BE COMPLETE BEFORE EXCAVATION COMMENCES THE LOCATION OF ALL SUCH SERVICES SHALL BE OBTAINED FROM THE RELEVANT AUTHORITIES.**
4. **ALL EXISTING SERVICES SHALL BE LOCATED BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF WORKS. ANY CONFLICTS SHALL BE REPORTED TO THE ENGINEER IMMEDIATELY.**
5. ALL SEWERS TO BE LAID ON A 3.5m ALIGNMENT IN THE ROAD RESERVE AND 0.7m ALIGNMENT IN LOTS, UNLESS OTHERWISE NOTED.
6. ALL CONNECTIONS TO EXISTING SEWER TO BE CARRIED OUT BY WATER CORPORATION AT CONTRACTORS EXPENSE AS ALLOWED BY PROVISIONAL SUM. CONTRACTOR TO ORGANISE CONNECTIONS.
7. ALL JUNCTIONS AT REAR OF LOTS TO BE ON THE DOWNSTREAM SIDE OF THE LOT AND 1.0m FROM THE SIDE BOUNDARY (OR LOCATED CLEAR OF DRIVEWAYS).
8. ALL JUNCTIONS AT FRONT OF LOTS TO BE ON THE DOWNSTREAM SIDE OF THE LOT AND 1.0m FROM THE SIDE BOUNDARY.
9. ALL CROSSINGS UNDER EXISTING PAVEMENT TO BE UNDERBORED UNLESS OTHERWISE NOTED.
10. ALL PROPERTY CONNECTIONS SHALL BE SETOUT & CONSTRUCTED IN ACORDANCE WITH THE WATER CORPORATION STANDARDS.
11. THE CONTRACTOR SHALL REINSTATE ALL FOOTPATHS AND KERBING TO MATCH EXISTING TO REQUIREMENTS OF THE LOCAL AUTHORITY.
12. THE CONTRACTOR SHALL UNDERTAKE THE REQUIRED TRAFFIC MANAGEMENT AND ROAD REINSTALLATION WORKS TO THE REQUIREMENTS OF THE LOCAL AUTHORITY.
13. LIAISE WITH WESTERN POWER TO SUPPORT POWER POLES AS REQUIRED BY WESTERN POWER AT CONTRACTORS EXPENSE.
14. EASEMENTS TO WATER CORPORATION AS PER FIGURE 4.1 IN THE WASTEWATER MANUAL VOLUME 1 AT NO COST TO THE WATER CORPORATION.
15. THE CONTRACTOR SHALL ALLOW FOR ALL AS CONSTRUCTED INFORMATION (INCLUDING SURVEY) TO BE PLOTTED IN ACCORDANCE WITH THE CORPORATIONS CURRENT PRACTICE AND DELIVERED TO THE ENGINEER FOR SIGNING AND PRESENTATION TO THE WATER CORPORATION.
16. IT IS DEEMED THAT THE AS CONSTRUCTED DOCUMENTS FORM PART OF THE WORKS. PRACTICAL COMPLETION CAN NOT BE AWARDED IF ACCEPTABLE AS CONSTRUCTED DOCUMENTS HAVE NOT BEEN PROVIDED TO THE ENGINEER.
17. CHAMBER DEPTHS ARE APPROXIMATE ONLY. CONTRACTOR SHALL CALCULATE DEPTHS AND ORDER MATERIALS ACCORDINGLY.

NOTE
CONTRACTOR TO CHECK ALL EXISTING SEWER LEVELS PRIOR TO COMMENCEMENT OF WORKS. ANY DISCREPANCIES TO BE REPORTED TO THE ENGINEER.

NOTE
CONTRACTOR TO ORGANISE WATER CORPORATION TO CONNECT TO EXISTING SEWER. WATER CORPORATION FEES. ALLOWED IN PROVISIONAL SUM

LEGEND

- EXISTING GROUND CONTOUR
- PROPOSED GROUND CONTOUR
- EXISTING GROUND LEVELS
- PROPOSED EARTHWORK LEVELS
- PROPOSED SEWERS AND MANHOLES
- EXISTING SEWERS AND MANHOLES
- RETICULATION AREA BOUNDARY
- EXISTING GAS LINE
- EXISTING SEWER PIPE
- EXISTING TELSTRA CABLE
- EXISTING WATER MAIN
- EXISTING POWER LINE
- EXISTING DRAINAGE LINE
- EXISTING SEWER PRESSURE MAIN
- REINFORCED CONCRETE ACCESS CHAMBER
- GATIC ACCESS CHAMBER
- MINIMUM FILL LEVEL
- EXISTING SURFACE LEVEL
- INVERT LEVEL UP STREAM / PIPE DIAMETER / GRADE / LENGTH / INVERT LEVEL DOWN STREAM
- DUPLEX LOT
- GROUP HOUSING
- PILE AND KEEL
- LOT NOT FOR RELEASE
- TIGHT CONNECTION
- IS SEWER WITH RISING SHAFT NOT AS PROPERTY CONNECTION POINT
- ISC IS SEWER WITH RISING SHAFT AS PROPERTY CONNECTION POINT

1:250 Half Size 1:500 - SCALE (m) 0 2.5 5 10 15

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WAPC No. 151517

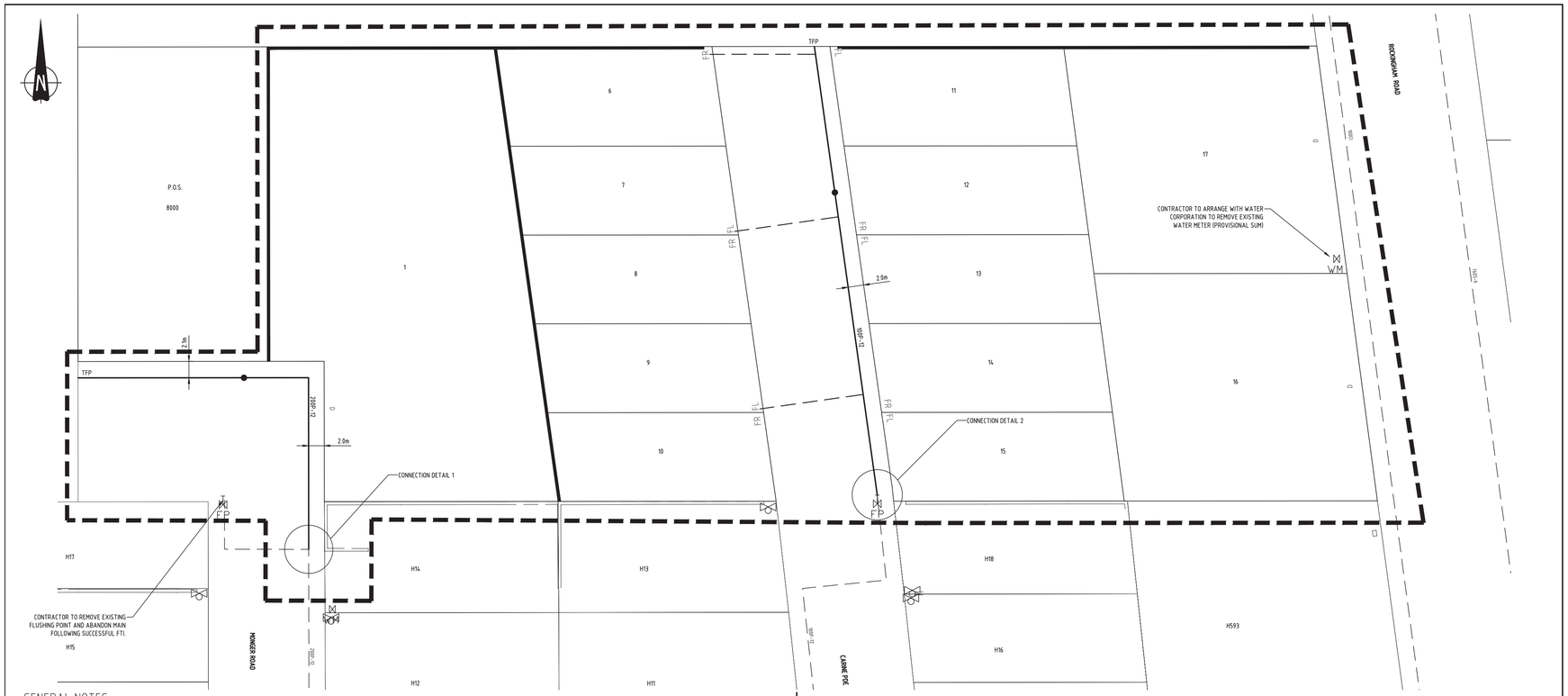
THIS PLAN IS ACCEPTED AS COMPLYING WITH OVERALL SCHEME PLANNING.

COMPLIANCE WITH RELEVANT MANUALS REMAINS THE RESPONSIBILITY OF THE CONSULTING ENGINEER.

NO WORKS ARE TO COMMENCE ON SITE UNTIL STARTUP ARRANGEMENTS HAVE BEEN MADE WITH THE RELEVANT WORKS INSPECTOR. SEE DEVELOPER'S MANUAL FOR CONTACT DETAILS.

..... FOR MANAGER LAND SERVICING

MC36-203-001-01A



GENERAL NOTES

1. ALL WORKS SHALL BE CONSTRUCTED IN ACCORDANCE WITH WATER CORPORATION STANDARDS.
2. ALL PIPES TO BE INSTALLED TO WITHIN 3.5m OF EXISTING MAIN. CONNECTION TO EXISTING BY WATER CORPORATION TO BE ORGANISED BY CONTRACTOR.
3. UNLESS OTHERWISE DIRECTED BY THE ENGINEER, COVER REQUIREMENTS SHALL COMPLY WITH THE WATER CORPORATION STANDARDS.
4. MINIMUM CLEARANCE TO GAS = 300mm, MINIMUM CLEARANCE TO OTHER SERVICES = 150mm.
5. ALL WORKS SHALL BE IN DRY GROUND. GROUND WATER SHALL NOT BE PERMITTED TO ENTER PIPES.
6. UNLESS OTHERWISE SHOWN ON THIS DRAWING OR VARIED BY THE ENGINEER ALL PIPES AND FITTINGS SHALL BE LAID ON AN ALIGNMENT OF 2.1m FROM THE CENTRE OF THE PIPE TO THE ROAD RESERVE BOUNDARY.
7. FLUSHING POINTS SHALL BE INSTALLED ON ALL MAINS AT CONNECTION POINTS TO EXISTING MAINS OR WHERE SPECIFIED.
8. CONTRACTOR SHALL INSTALL FLUSHING POINTS AT ALL DEAD ENDS.
9. UNLESS OTHERWISE SHOWN ALL DIMENSIONS ARE IN METRES.
10. UNLESS DIMENSIONED OTHERWISE MAINS SHALL EXTEND AT LEAST 8m ALONG THE FRONT OF LAST LOT SERVED.
11. ALL VALVES ARE OPPOSITE BOUNDARY PEGS UNLESS DIMENSIONED OTHERWISE. ALL HYDRANTS ARE IN MIDDLE OF LOTS OR OPPOSITE BOUNDARY PEGS AS SHOWN.
12. THIS DRAWING TO BE READ IN CONJUNCTION WITH THE PROJECT SPECIFICATION.
13. SERVICE CROSSINGS TO BE LOCATED AT RIGHT ANGLES TO BOUNDARY AND INSTALLED IN ACCORDANCE WITH THE REQUIREMENTS OF THE WATER CORPORATION.
14. **SERVICES, SUCH AS SEWER, WATER, GAS, TELEPHONE, ELECTRICITY, AND DRAINAGE MAY BE ENCOUNTERED DURING CONSTRUCTION OF THE WORKS. SERVICES INFORMATION SHOWN ON DRAWINGS IS INDICATIVE ONLY AND MAY NOT BE COMPLETE. BEFORE EXCAVATION COMMENCES THE LOCATION OF ALL SUCH SERVICES SHALL BE OBTAINED FROM THE RELEVANT AUTHORITIES.**
15. **CO-ORDINATE THE LOCATION OF ALL EXISTING AND PROPOSED SERVICES PRIOR TO COMMENCEMENT OF WORK. ANY CONFLICTS ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.**
16. THE CONTRACTOR SHALL ALLOW FOR ALL AS CONSTRUCTED INFORMATION (INCLUDING SURVEY) TO BE PLOTTED IN ACCORDANCE WITH THE WATER CORPORATIONS CURRENT PRACTICE AND DELIVERED TO THE ENGINEER FOR SIGNING AND PRESENTATION TO THE WATER CORPORATION.
17. IT IS DEEMED THAT THE AS CONSTRUCTED DOCUMENTS FORM PART OF THE WORKS. PRACTICAL COMPLETION CAN NOT BE AWARDED IF ACCEPTABLE AS CONSTRUCTED DOCUMENTS HAVE NOT BEEN PROVIDED TO THE ENGINEER.

P.E. NOTES

1. P.E. PIPES SHALL WHERE NECESSARY BE DEFLECTED DOWN FROM MAIN TAPPING TO ACHIEVE CORRECT DEPTH.
2. TAPPING BAND NOT TO BE CLOSER THAN 150mm TO JOINT ON LARGE PIPE.
3. WHERE A P.E. MAIN IS CONNECTED TO A PVC MAIN THE TAPPING BAND SHALL BE MANUFACTURED FROM GUN METAL AND BE OF THE SPLIT BAND TYPE AND HAVE AN INTERNAL DIAMETER CORRESPONDING TO THE PIPE OUTSIDE DIAMETER.
4. ALL SLUICE VALVES ON P.E. MAIN TO BE 50mm DIAMETER GATE VALVES WITH CAST IRON HANDLES.
5. POLYETHYLENE PIPE TO BE M.D.P.E.
6. IN CUL-DE-SACS WHERE P.E. MAINS ARE DEFLECTED TO SUIT CADASTRAL BOUNDARY CHANGES IN DIRECTION, THE ALIGNMENT OF MAINS SHALL BE 2.1m +/- 0.3m. THIS TOLERANCE SHALL ONLY APPLY IN THE VICINITY OF TRUNCATION POINTS AT ALL OTHER LOCATIONS THE MAINS SHALL BE LAID ON THE 2.1m ALIGNMENT.
7. FLUSHING POINTS TO BE PROVIDED AT THE END OF ALL P.E. MAINS.

PIPE MATERIAL DESIGNATION

D.I. - DUCTILE IRON

P - U.P.V.C

R.C. - REINFORCED CONCRETE

A.C. - ASBESTOS CEMENT

MDPE - MEDIUM DENSITY POLYETHYLENE

CI - CAST IRON

S - STEEL

NUMBER OF SERVICES

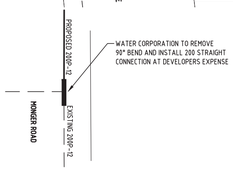
PRELAID SHORT SINGLE	- 1
PRELAID SHORT DUAL	- 1
PRELAID LONG SINGLE	- 1
PRELAID LONG DUAL	- 7
DEFERRED SERVICES	- 3
TOTAL CONNECTION	- 10
TOTAL LOTS SERVED	- 13

EXTENSION

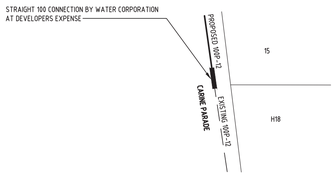
CONTRACTOR TO LAY 58.1m OF 100 P-12
516m OF 200 P-12

CONNECTION

CONNECTIONS(2)TO BE MADE BY WATER CORPORATION



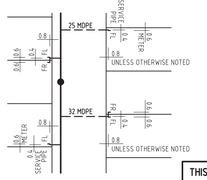
CONNECTION DETAIL 1
NTS



CONNECTION DETAIL 2
NTS

LEGEND

- EXISTING WATER MAIN AND HYDRANT
- EXISTING WATER MAIN AND SLUICE VALVE
- 150 CI — PROPOSED WATER MAIN, PIPE SIZE AND MATERIAL DESIGNATION
- PROPOSED PIPE AND SLUICE VALVE
- PROPOSED PIPE AND HYDRANT
- PROPOSED PIPE WITH CHANGE IN DIAMETER
- "FL" OR "FR" — DENOTES SIDE OF LOT TO BE SERVICED (VIEWED FROM THE ROAD)
- "D" — DEFERRED CONNECTION
- FP — FLUSHING POINT
- TFP — TEMPORARY FLUSHING POINT
- WATER RETICULATION BOUNDARY
- PROPOSED RETAINING WALLS



TYPICAL LONG AND SHORT PRELAID SERVICE DETAIL

NOT TO SCALE

0 2.5 5 10 15
1:250

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WATER RETICULATION DETAILS

WAPC No	: 151517
SUB FILE	: JT1 2015 04.861 V01
MAIN EXT FILE	: JT1 2015 10371 V01
PLAN	: MC36-103-001-01A

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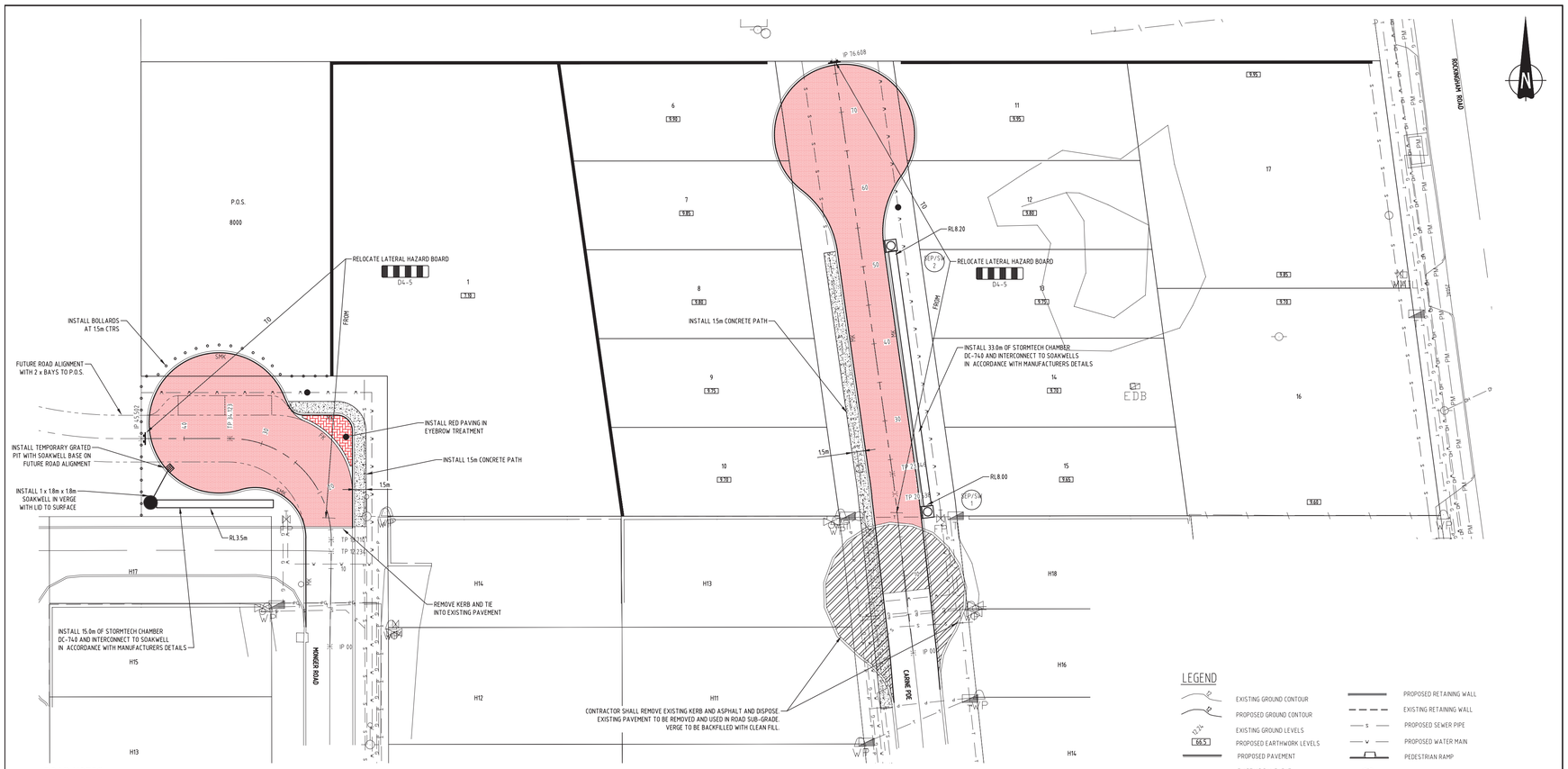
..... FOR MANAGER LAND SERVICING



ROAD NOTES

1. VERTICAL DATUM : AUSTRALIAN HEIGHT DATUM.
   HORIZONTAL DATUM : PERTH COASTAL GRID 1994 (PCG94)
2. **CO-ORDINATE THE LOCATION OF ALL EXISTING AND PROPOSED SERVICES PRIOR TO COMMENCEMENT OF WORK. ANY CONFLICTS ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.**
3. LOCATE ALL LEVELS FROM EXISTING SURVEY MARKS.
4. ALL SURVEY MARKS ARE TO BE PROTECTED.
5. ALL EDGE KERBING TO BE MOUNTABLE, ALL ISLAND KERBING TO BE SEMI MOUNTABLE. UNLESS OTHERWISE NOTED.
6. **SERVICES, SUCH AS SEWER, WATER, GAS, TELEPHONE, ELECTRICITY, AND DRAINAGE MAY BE ENCOUNTERED DURING CONSTRUCTION OF THE WORKS. SERVICES INFORMATION SHOWN ON DRAWINGS IS INDICATIVE ONLY AND MAY NOT BE COMPLETE. BEFORE EXCAVATION COMMENCES THE LOCATION OF ALL SUCH SERVICES SHALL BE OBTAINED FROM THE RELEVANT AUTHORITIES.**
7. SIGN POSTS AND STREET NAME PLATES TO BE SUPPLIED AND INSTALLED TO LOCAL AUTHORITY REQUIREMENTS.
8. THE CONTRACTOR SHALL SPOT OUT THE LINE MARKING. THE CONTRACTOR SHALL ADVISE MAIN ROADS WHEN THE SITE IS READY FOR LINEMARKING AND SIGNAGE INSTALLATION. LINE MARKING AND SIGNING TO BE UNDERTAKEN BY MAIN ROADS.
9. PROVIDE ALL SIGNING, LIGHTING AND FLAGMEN NECESSARY TO ENSURE SAFETY OF THE PUBLIC AND OF THE WORKS.
10. EXISTING VERGES SHALL NOT BE DISTURBED BEYOND THE EXTENT OF WORK.
11. CONSTRUCT PEDESTRIAN RAMPS AS SHOWN TO LOCAL AUTHORITY REQUIREMENTS.
12. ALL WORKS TO BE CONSTRUCTED IN ACCORDANCE WITH THE PROJECT SPECIFICATION, BUT WHERE NO DETAIL PROVIDED, TO THE REQUIREMENTS OF THE LOCAL AUTHORITY.
13. TIE IN OF NEW SURFACE TO FINISH FLUSH WITH EXISTING SURFACE.
14. ALL FILL SHALL BE CLEAN NON PLASTIC MATERIAL FREE FROM VEGETATION AND OTHER DELETERIOUS MATERIAL AND CERTIFIED AS SUITABLE FOR INDUSTRIAL LANDUSE.
15. ALL FILL SHALL BE PLACED IN UNIFORM LAYERS NOT EXCEEDING 300mm THICKNESS AND COMPACTED TO A DENSITY NOT LESS THAN 95% MAXIMUM DRY DENSITY.
16. THE CONTRACTOR SHALL PREPARE AS-CONSTRUCTED ROADS DRAWINGS (INCLUDING SURVEY) TO THE SATISFACTION OF THE LOCAL AUTHORITY. AS CONSTRUCTED PLANS TO BE ISSUED TO THE ENGINEER FOR SIGNING AND PRESENTATION TO THE LOCAL AUTHORITY.
17. IT IS DEEMED THAT THE AS CONSTRUCTED DOCUMENTS FORM PART OF THE WORKS. PRACTICAL COMPLETION CAN NOT BE AWARDED IF ACCEPTABLE AS CONSTRUCTED DOCUMENTS HAVE NOT BEEN PROVIDED TO THE ENGINEER.

NOTE

ROAD AND DRAINAGE AS CONSTRUCTED DETAILS TO BE PROVIDED IN 'R' AND 'D' SPEC FORMAT AS PER CITY OF COCKBURN REQUIREMENTS

DRAINAGE NOTES

1. PILE AND KEEL SHALL BE PROVIDED IN SOFT GROUND AND WHERE DRAINS CROSS EXISTING SEWERS.
2. EXCAVATION SHALL BE KEPT TO A MINIMUM AND TRENCHES SUPPORTED.
3. PIPES SHALL BE LAID ON THE PREPARED BASE OF THE TRENCH, TO A UNIFORM GRADE AT DESIGN LEVELS.
4. FILLING SHALL BE PLACED IN HORIZONTAL LAYERS NOT EXCEEDING 150mm IN THICKNESS AND COMPACTED TO ACHIEVE A DENSITY NOT LESS THAN 95% MAXIMUM DRY DENSITY.
5. FILLING SHALL BE CLEAN NONPLASTIC MATERIAL FREE FROM STONES OR CLAY LUMPS. EXCAVATED MATERIAL SHOULD BE USED WHERE POSSIBLE.
6. ALL PIPES SHALL BE CLASS (2) UNLESS OTHERWISE NOTED. NOTIFY THE ENGINEER WHERE MIN. COVER CAN NOT BE ACHEVED.
7. PIPES SHALL BE LAID OBVERT TO OBVERT TAKEN FROM THE CENTRE OF THE PITS.
8. ALL WORKS SHALL BE TO THE PROJECT SPECIFICATION, BUT WHERE NO DETAIL IS PROVIDED, TO THE REQUIREMENTS OF THE LOCAL AUTHORITY.
9. MINIMUM COVER ON DRAINAGE TO BE 900mm UNDER ROAD AND 600mm IN VERGE.
10. CHECK INVERT LEVELS OF ALL EXISTING STORMWATER PRIOR TO COMMENCEMENT OF WORK.
11. DRAINAGE PIPE LENGTHS ARE INDICATIVE ONLY. MANHOLES & GULLIES TO BE LOCATED AS SHOWN AND SETOUT IN ACCORDANCE WITH THE STANDARD DETAILS.
12. DRAINAGE PIPES ON LONGITUDINAL SECTION SHOWN FOR ILLUSTRATIVE PURPOSES ONLY.
13. THE CONTRACTOR SHALL PREPARE AS-CONSTRUCTED DRAINAGE DRAWINGS (INCLUDING SURVEY) TO THE SATISFACTION OF THE LOCAL AUTHORITY. AS CONSTRUCTED PLANS TO BE ISSUED TO THE ENGINEER FOR SIGNING AND PRESENTATION TO THE LOCAL AUTHORITY.
14. IT IS DEEMED THAT THE AS-CONSTRUCTED DOCUMENTS FORM PART OF THE WORKS. PRACTICAL COMPLETION CAN NOT BE AWARDED IF ACCEPTABLE AS-CONSTRUCTED DOCUMENTS HAVE NOT BEEN PROVIDED TO THE ENGINEER.

PATH NOTES

1. ALL FOOTPATHS SHALL BE CONSTRUCTED TO LOCAL AUTHORITY STANDARD.
2. ALL MATERIAL USED SHALL BE IN ACCORDANCE WITH LOCAL AUTHORITY STANDARD SPECIFICATION.
3. CONTRACTOR SHALL PROTECT ALL EXISTING WORKS, AND SUPPLY AND MAINTAIN ALL SAFETY DEVICES TO PROTECT VEHICLES, PEDESTRIANS AND THE WORKS.
4. ALL CONCRETE WORK SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 32 MPa AT 28 DAYS.
5. PRIOR TO PLACING CONCRETE THE BASE SHALL BE FREE FROM DELTERIOUS MATERIAL, UNIFORMLY COMPACTED TO 95% MAXIMUM DRY DENSITY AND LIGHTLY DAMPENED.
6. WHEN CONCRETE IS FINISHED TO CORRECT LEVEL THE FINAL SURFACE SHALL BE BROOM FINISHED AND ALL EDGES AND JOINTS TOOL FINISHED.
7. CONTRACTION JOINTS SHALL BE CONSTRUCTED EVERY 1.5 METRES IN FORM OF PLAIN DUMMY JOINT. EXPANSION JOINTS SHALL BE CONSTRUCTED EVERY 3rd CONTRACTION JOINT AND SHALL BE FULL DEPTH JOINTS 15mm WIDE, FILLED WITH BITUMEN IMPREGNATED CANEITE OR SIMILAR. CONTRACTION AND EXPANSION JOINTS SHALL BE FORMED TO THE LOCAL AUTHORITY STANDARDS AND WHEN NOT AVAILABLE, TO IPWEA STANDARDS.
8. PROTECT THE FINISHED WORK FOR 24 HOURS AFTER THE CONCRETE HAS BEEN LAID, ANY DAMAGE SHALL BE MADE GOOD AT THE CONTRACTORS EXPENSE.
9. ALL FOOTPATHS TO BE 1.5m WIDE .

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LEGEND

- EXISTING GROUND CONTOUR
- PROPOSED GROUND CONTOUR
- EXISTING GROUND LEVELS
- PROPOSED EARTHWORK LEVELS
- PROPOSED PAVEMENT
- EXISTING PAVEMENT
- EXISTING PATH
- PROPOSED 1.8m X 1.8m SIDE ENTRY SOAKWELL SYSTEM
- CONCRETE FOOTPATH
- EXISTING GAS LINE
- EXISTING SEWER PIPE
- EXISTING TELSTRA CABLE
- EXISTING WATER MAIN
- EXISTING POWER LINE
- EXISTING DRAINAGE LINE
- EXISTING ASPHALT TO BE REMOVED
- RED ASPHALT
- BRICK PAVING
- PROPOSED RETAINING WALL
- EXISTING RETAINING WALL
- PROPOSED SEWER PIPE
- PROPOSED WATER MAIN
- PEDESTRIAN RAMP
- DENOTES SIDE ENTRY PIT NUMBER
- DENOTES DRAINAGE JUNCTION PIT NUMBER
- INVERT LEVEL UP STREAM / PIPE DIAMETER / GRADE / LENGTH / INVERT LEVEL DOWN STREAM
- PROPOSED STREET SIGN
- FK DENOTES FLUSH KERBING
- MK DENOTES MOUNTABLE KERBING
- SMK DENOTES SEMI MOUNTABLE KERBING
- BK DENOTES BARRIER KERBING
- SEP SIDE ENTRY PIT
- GP GRATED PIT
- AC ACCESS CHAMBER

1:250 0 2.5 5 10 15

WARC: 151517

CONTRACTOR NOTES:

1. VERIFY ALL MATERIAL QUANTITIES AGAINST SITE CONDITIONS PRIOR TO QUOTATION AND ADVISE ELECTRICAL CONSULTANTS OF ANY VARIATIONS.
2. ORGANISE ON SITE MEETING WITH WP PRIOR TO COMMENCEMENT OF WORK.
3. LAY CABLES IN ACCORDANCE WITH WP REQUIREMENTS.
4. MAKE ALLOWANCE FOR TERRACING OF CABLES WHERE REQUIRED.
5. BEDDING SAND TO BE IMPORTED WHERE ROCK IS ENCOUNTERED.
6. PLAN CABLE RUNS TO LIMIT THE NUMBER OF STRAIGHT JOINTS.
7. COMMENCE LAYING CABLES FROM THE TRANSFORMER, SWITCHGEAR OR UNIVERSAL PILLAR.
8. ALL CABLES LAID NEXT TO RETAINING WALLS TO BE IN CONDUIT.
9. INSTALL HEATSHRINK "END CAP" AT ALL CABLE ENDS.
10. INSTALL HEATSHRINK GLOVES ON ALL LV CABLE TERMINATION ENDS.
11. STREETLIGHT POLES MUST NOT BE INSTALLED IN FOOTPATHS.CONTACT 3E IF ANY CONFLICTS ARE FOUND ON SITE PRIOR TO INSTALLATION.
12. SCREENING AROUND SUBSTATION SITES MUST CONSIST OF NON METALLIC MATERIALS OR EARTHED IN ACCORDANCE WITH WP'S SUBSTATION MANUAL.
13. BORE UNDER EXISTING ROADS.
14. CABLES MAY BE INSTALLED IN LANEWAYS WITHOUT CONDUIT PROVIDED 300mm OF CLEAN SAND IS INSTALLED BELOW CABLES & CLEAN SAND IS INSTALLED ABOVE CABLES ALL THE WAY UP TO THE ROAD BASE WITH A MINIMUM OF ONE SPARE DUCT.
15. ALL ABOVE GROUND ASSETS INCLUDING SERVICE PILLARS,STREETLIGHTS AND LOW VOLTAGE (LV) FRAMES ARE TO BE LOCATED ON GROUND LEVEL 300mm ABOVE 100 YEAR FLOOD LEVEL AND NOT IN A PRECARIOUS POSITION.HIGH VOLTAGE EQUIPMENT AND SUBSTATIONS TO BE LOCATED ONE METRE ABOVE THE 100 YEAR FLOOD LEVEL.
16. CONTRACTOR TO LEAVE SUFFICIENT CABLE COILED AT ALL INTERFACE POINTS (INCLUDING JOINTS, PILLAR TERMINATIONS & POLE TERMINATIONS) TO ALLOW WP TO COMPLETE INTERFACE WORKS.INSTALL END CAPS TO PROTECT CABLE.
17. HV FEEDER CABLES TO BE INSTALLED AT MINIMUM COVER OF 1120mm
18. CONTRACTOR TO INSTALL STREETLIGHT ON THE 2.55m ALIGHMENT TO AVOID THE FOOTPATH
19. CONTRACTOR TO INSTALL UNI PILLARS OUTSIDE OF SEWER EASEMENT.240LV CABLES TO BE INSTALLED IN 100 HD DUCT

WESTERN POWER SCOPE OF WORKS

(A) WP TO COST AND CARRY OUT TERMINATION OF NEW 240LV CABLE TO EXISTING Tx LOCATED ON LOT 211. WP TO SUPPLY TERMINATION AND CARRY OUT ALL ASSOCIATED WORKS

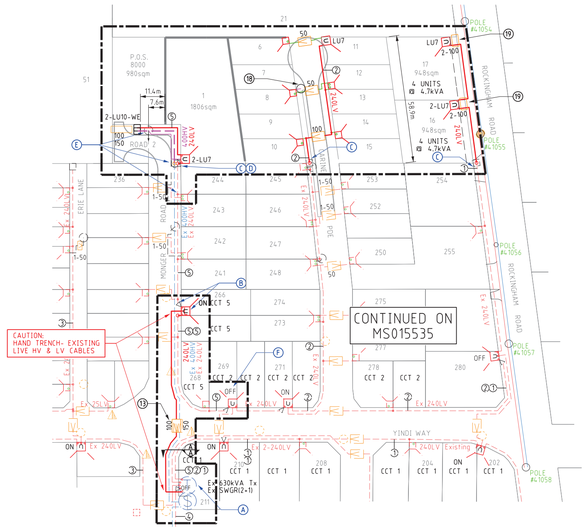
(B) WP TO COST AND CARRY OUT;
- REMOVAL OF EXISTING MINI PILLAR ON LOT 266
- INSTALLATION OF NEW UNI PILLAR
- CUT & SWING OF EXISTING 240LV CABLE INTO NEW UNI PILLAR AND CONFIGURE AS SHOWN
- JOINT EXTEND AND TERMINATE EX 240LV TO NEW UNI PILLAR AS SHOWN.
- TERMINATION OF NEW 240LV CABLE INTO NEW UNI PILLAR AS SHOWN
- TERMINATION OF EXISTING 25LV CABLE INTO NEW UNI PILLAR.
WP TO SUPPLY ALL MATERIALS AS REQUIRED AND CARRY OUT ALL ASSOCIATED WORKS

(C) WP TO COST TO CARRY OUT REMOVAL OF EXISTING WORKING END AND STRAIGHT JOINT NEW 240LV CABLE TO EXISTING 240LV CABLE WP TO SUPPLY JOINTS AND CARRY OUT ALL ASSOCIATED WORKS.

(D) WP TO COST TO CARRY OUT REMOVAL OF EXISTING WORKING END AND STRAIGHT JOINT NEW 400HV CABLE TO EXISTING 400HV CABLE WP TO SUPPLY JOINTS AND CARRY OUT ALL ASSOCIATED WORKS.

(E) WP TO COST AND CARRY OUT;
- RELOCATION OF EXISTING LIGHT POLE AT LOT 244 TO POS 8000 AS SHOWN.
- DISCONNECT AND ABANDON EXISTING STREETLIGHT CABLE FROM EXISTING PILLAR ON LOT 243
- TERMINATE NEW STREETLIGHT CABLE TO RELOCATED EXISTING LIGHT POLE.
WP TO SUPPLY ALL MATERIALS AND CARRY OUT ALL ASSOCIATED WORKS

(F) WP TO COST AND CARRY OUT REMOVAL OF LINK IN UNI PILLAR LOT 269 TO CONFIGURE AS SHOWN. WP TO CARRY OUT ALL ASSOCIATED WORKS



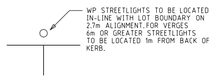


WP ETSA 6.5m SINGLE OUTREACH POLE
NOT TO SCALE

NOTE:
WESTERN POWERS StreetVision DECORATIVE LIGHTING IN THIS SUBDIVISION.

6.5m ETSA SINGLE OUTREACH WITH BOURKE HILL 42W CF LUMINAIRES. COLOUR TO BE BLACK SATIN.

ALL STREETLIGHT CABLE TO BE IN CONDUITS IF OUTSIDE WP ALIGNMENT.



STREETLIGHT POLE LOCATION

ARROW DENOTES DIRECTION TO PEG WITH WHICH DUCTS ARE TO BE ALIGNED

DUCTS TO BE LAID TO WP SPECIFICATION AS OUTLINED IN UNDERGROUND DISTRIBUTION SCHEMES MANUAL - POLICY AND INSTALLATION OPTIONS

DENOTES PREVIOUSLY REQUESTED DUCTS

Dimensions and scales to be checked prior to measuring cable lengths

1:1000 — 20 10 0 20 40 60 80

LEGEND

SCHEME BDY:
RETAINING WALL
RETAINING WALL EXTRA FOOTING

HV CABLES
- CNS3 - 400mm2 (3X1c)
- CN49 - 240mm2 (3X1c)
- CN48 - 185mm2 (3X1c)
- CNS2 - 95mm2 (3X1c)
- CNS1 - 50mm2 (3X1c)
- CNS3 - 50mm2 (1c)
- CN46 - 35mm2 (3X1c)
- CN47 - 35mm2 (1c)
- EXISTING HV CABLES (SIZE AND TYPE INDICATED)

LV-SL CABLES
- CN45 - 240mm2 (1x3c)
- CN44 - 185mm2 (1x3c)
- CN43 - 120mm2 (1x3c)
- CN42 - 25mm2 (1x3c)
- CN41 - 16mm2 SL (1c)
- 40 C PILOT
- EXISTING LV CABLES (SIZE AND TYPE INDICATED)

STREET LIGHTS — EXISTING
- 42w CFL
- 80w MV
- 125w MV
- 70w HPS
- 150w HPS
- 250w HPS
- 70/75w MH
- 150w MH
- 250w MH

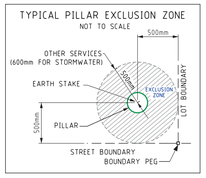
LEGEND DEFINES TYPE & WATTAGE - NOT COLOUR

PILLARS / PITS / ETC
- MINI (WORKING ENDS)
- UNIVERSAL
- MINI
- LINK
- CABLE MARKER U/G
- MPI
- UTILITIES PIT
- 100/200AMP CUTOUT
- CONDUIT / POLY PIPE

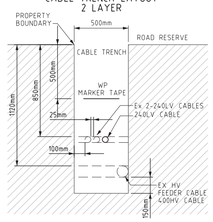
TRANSFORMERS (T) — SWITCHGEAR (S)

AERIAL CONDUCTORS AND POLES
- NEW POLE (ANY TYPE AS INDICATED)
- EXISTING POLE (ANY TYPE AS INDICATED)
- HV / LV — EXISTING AERIAL CONDUCTORS (SIZE AND TYPE INDICATED)

TYPICAL PILLAR EXCLUSION ZONE
NOT TO SCALE

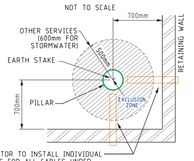


CABLE TRENCH LAYOUT 2 LAYER



SECTION A-A
NOT TO SCALE

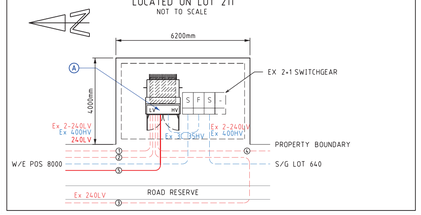
TYPICAL PILLAR EXCLUSION ZONE WITH RETAINING WALL
NOT TO SCALE



CONTRACTOR TO INSTALL INDIVIDUAL CONDUITS FOR ALL CABLES UNDER RETAINING WALLS & STAIR CASES
50mm CONDUIT FOR MINI-PILLAR
50mm CONDUIT FOR CONSUMER MAINS

CENTRE OF PILLAR TO BE 700mm FROM RETAINING WALL. WHERE RETAINING WALL IS ONE SIDED,CENTRE OF PILLAR TO BE 500mm FROM THE NON-RETAINED LOT BOUNDARY AND 700mm FROM RETAINING WALL

EXISTING 22kV/630kVA SUBSTATION DETAIL WITH MPS TRANSFORMER & HV 2+1 SWITCHGEAR LOCATED ON LOT 211
NOT TO SCALE

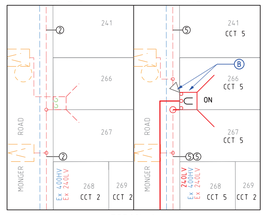


*ASTERIX DENOTES INCREASED LOAD ON AN EXISTING CIRCUIT

TRANSFORMER SPECIFICATIONS AND LOCATION	FUSEWAY NO.	CIRCUIT NO.	FUSE AMPS	CABLE mm²	CIRCUIT NAME	VOLT DROP	AMPS	TOTAL AMPS
EXISTING 630kVA Tx LOT 211 22kV (827A)	1	1*	315	240	UNI LOT 210 TO W/E LOT 17	7.37V	215A	
	2	2*	315	240	LOT 280 UNI (OFF) & UNI LOT 11	8.52V	215A	
	3	3	315	240	LOT 213 TO W/E LOT 230	5.28V	196A	695A
ADMD=4.7kVA OR 3.9kVA	4	4	315	240	(OFF) INTERCONNECTION	0V	0A	
	5	5*	315	240	UNI LOTS 266 & 1, W/E LOT 51	4.14V	145A	

NOTE:ALL UNMETERED SUPPLIES (Including CUSTOMER AND WESTERN POWER STREETLIGHTING ASSETS)					
TYPE OF EQUIPMENT	NO of UNITS	UNIT WATTAGE	TOTAL WATTAGE	DAILY HRS OPERATION	WP Asset Yes / No
6.5m WP ETSA POLE + 42W CF BOURKEHILL LUMINAIRE	1	42W	42W	DUSK/DAWN	YES
NOTE: ALL UNMETERED SUPPLIES and STREETLIGHTS MUST BE INCLUDED IN DESIGN DRAWING					

BEFORE — AFTER



DETAIL A
LOT 266 UNI PILLAR UPGRADE
NOT TO SCALE

EXISTING OVERHEAD SERVICES — WORKSAFE - REGULATION 3.64

IF WORKING IN THE VICINITY OF EXISTING OVERHEAD DISTRIBUTION OR TRANSMISSION LINES.

REFER TO "WORKSAFE" REGULATION 3.64

FOR CONSTRUCTION

DIAL BEFORE YOU DIG 1100 www.1100.com.au

THE LOCATION OF EXISTING SERVICES IS APPROXIMATE ONLY. NO GUARANTEE IS GIVEN THAT ALL EXISTING SERVICES ARE SHOWN.ALWAYS REFER TO CURRENT DBYD DRAWINGS.CONFIRM ASSET LOCATIONS ON SITE BEFORE COMMENCEMENT OF WORK.

REFER TO 'WORKSAFE'REGULATION 3.21

CONSULTING
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Scale 1:1000 @ A1 Original Paper Size

LOT 20 ROCKINGHAM