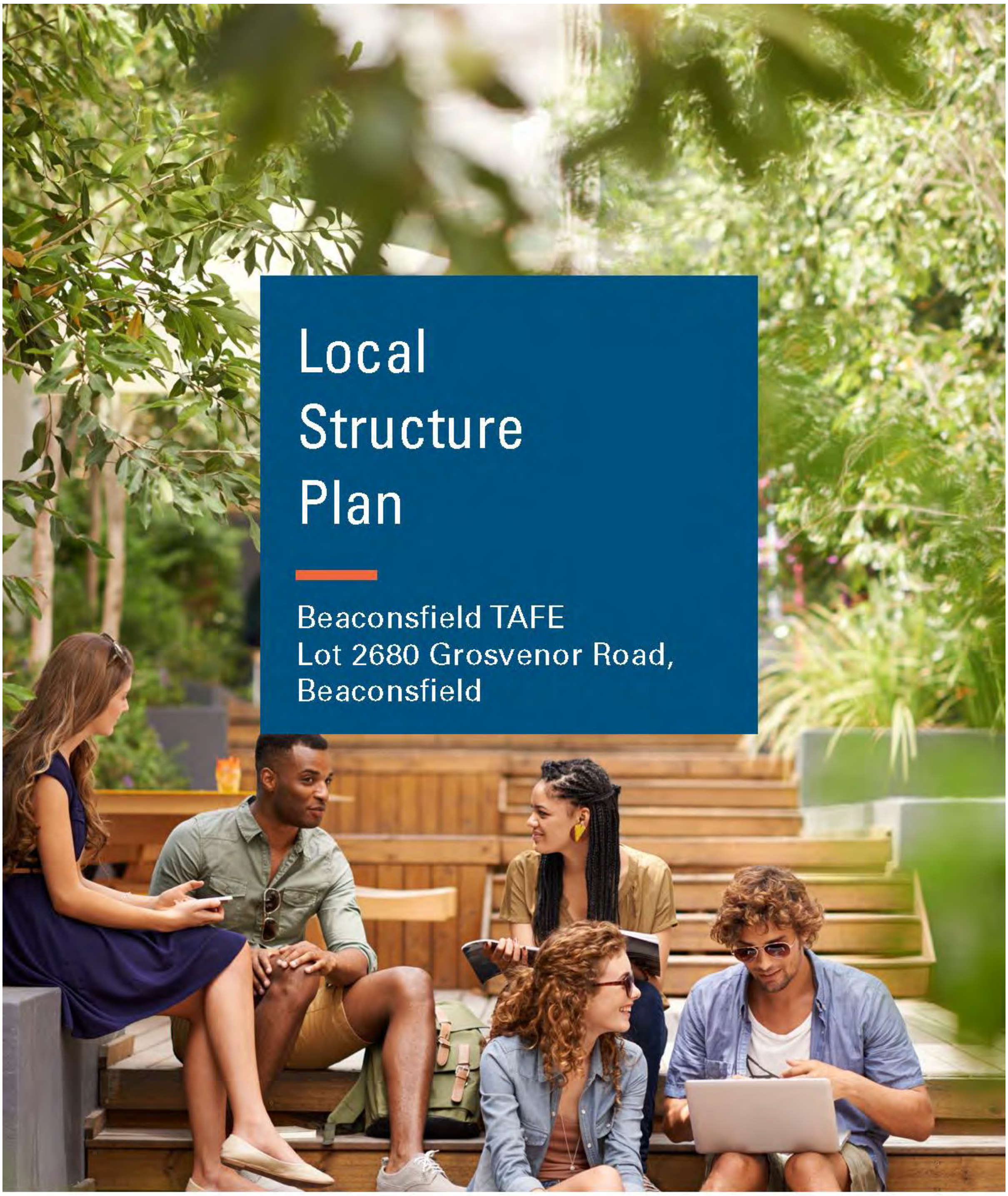

Local Structure Plan

Beaconsfield TAFE
Lot 2680 Grosvenor Road, Beaconsfield

Prepared for DevelopmentWA
Prepared by Taylor Burrell Barnett
August 2023

Document Information

Local Planning Structure

Beaconfield TAFE
Lot 2680 Grosvenor Street
Beaconsfield

DevelopmentWA

22/036

Prepared By: Taylor Burrell Barnett

Level 7, 160 St Georges Terrace
PERTH WA 6000

PO Box 7130
Cloisters Square
PERTH WA 6850

Phone: 9226 4276
Email: admin@tbbplanning.com.au

Doc ID: 22~036 Beaconsfield TAFE Lot 2680 Local Structure Plan FINAL 1.4

Revision	Status	Author	Approved by	Date Issue
1.1	Draft	J McCallum	L Barnett	24/05/2023
1.2	Draft	J McCallum	L Barnett	16/06/2023
1.3	Draft	J McCallum	L Barnett	29/06/2023
1.4	Final	J McCallum	L Barnett	14/08/2023

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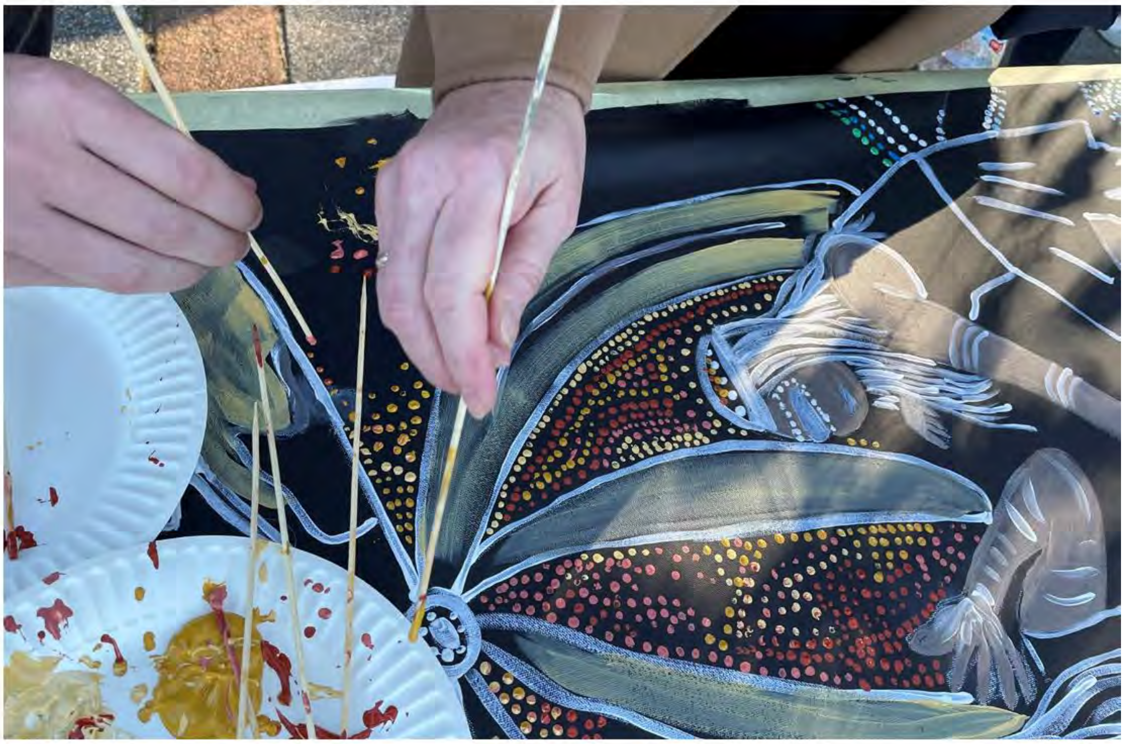
Acknowledgement of country

"We respectfully acknowledge the Whadjuk Nyoongar people, who have been the Traditional Owners of the land where we work for at least 45,000 years.

We pay our respects to the Elders past, present and future for they hold the memories, the traditions, the culture and hopes that, through meaningful connection, we aim to apply to the design and planning of better communities in the future."



Endorsement

This Structure Plan is prepared under the provisions of the City of Fremantle Local Planning Scheme No. 4

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

Date

Signed for and on behalf of the Western Australian Planning Commission

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

Witness

Date

Date of Expiry

Table of Amendments

Amendment No.	Summary of the Amendment	Amendment Type	Date Approved by WAPC

Table of Density Plan

Density Plan No.	Area of Density Plan Application	Date Endorsed by WAPC	Date Approved by WAPC

The Structure Plan is prepared in a manner and form approved by the Western Australian Planning Commission (WAPC) and is comprised of a Part One and Part Two, as follows:

- Part One – Implementation, including the Structure Plan; and
- Part Two – Explanatory Section, including technical appendices.

Technical reports and studies have been prepared and are appended to the Structure Plan:

- Landscape Report – REALMstudios
- Servicing Report – Pritchard Francis
- Local Water Management Strategy - Urbaqua
- Transport Impact Assessment – Phil Jones Associates

The following **Table 1** is a summary of the key statistics and information as it applies to the structure plan area.

Table 1: Structure Plan Summary Table

Item	Data	Structure Plan reference (section no.)
Total area covered by the Structure Plan	3.819ha	Plan 1
Approximate area of each land use proposed:	R40 - 0.2376ha R60 - 1.4123ha R100 - 0.2016ha R160 - 0.4459ha	Plan 1
Estimated Lot Yield	84 (incl. 2 grouped/multiple dwelling sites)	Part 2
Estimated number of dwellings	155	Part 2 'Yield Analysis'
Estimated residential site density	49 dwellings per hectare	Part 2 'Yield Analysis'
Estimated population	372 people (at 2.4 people per household)	Part 2 'Yield Analysis'
Estimated area and percentage of public open space	0.614ha (incl drainage)	Plan 1

Executive Summary

This Structure Plan is prepared over Lot 2680 Grosvenor Street, Beaconsfield which was previously the Beaconsfield TAFE site.

The Beaconsfield TAFE Local Structure Plan (BTLSP) has been prepared to facilitate the proposed redevelopment of the Beaconsfield TAFE site (BTS), as depicted on **Figure 1**.

The BTLSP site is bounded by Grosvenor Street to the north, Caesar Street to the east, Lefroy Road to south and Badham Close to the west. The site is currently vacant. The TAFE buildings have recently been demolished following the discontinuation of tertiary education, with curriculum now being delivered at other TAFE campuses throughout the metropolitan area.

This presents an excellent opportunity to redevelop the site, optimising its regional advantages while respecting and celebrating its unique history. The proposed development will allow for the revitalisation of the BTS by providing additional opportunities for high quality residential infill to facilitate population growth, provide diverse housing and increasing local variety in Beaconsfield. The increase in residents will be supported by high quality public realm that responds to site context, retains existing trees wherever possible, and improving the amenity of current and future residents.

Key components of the BTLSP include:

- A range of residential densities promoting a variety of housing typologies;
- Quality public open space that responds to the site topography as well as providing opportunities for the retention and protection of existing mature trees on site, wherever possible;
- Retention of and reuse of materials found within the BTS and surrounding region, such as existing limestone; and
- Commitment to best practice water and energy management practices, climate responsive design and innovative construction methodologies.

The BTLSP will guide the detailed planning and design of the BTS in accordance with relevant State planning policy and local strategic objectives.

Part 1.0

Implementation

1.0 Beaconsfield TAFE Local Structure Plan

1.1 Structure Plan Area and Operation

The Beaconsfield TAFE Local Structure Plan shall apply to the land contained within the inner edge of the line denoting the structure plan boundary as shown on **Figure 1**.

1.2 Purpose

The BTLSP shall come into operation on the day it is endorsed by the Western Australian Planning Commission.

1.3 Objectives

- Redevelopment of the BTS will respond to local cultural and natural sense of place, through the reuse of naturally occuring materials, interpretation of the historical use of the BTS and incorporation of dwelling design responsive to surrounding typologies.
- The BTLSP will contribute to greater housing choice in the locality, facilitating the achievement of additional urban infill by redeveloping underutilised land and incorporating a range of dwelling types. Variation in dwelling typologies will promote greater housing diversity and improve local housing affordability.
- Development will be sympathetically located and oriented to minimise amenity impacts on the surrounding locality, responding to site characteristics and existing population.
- Redevelopment will seek to retain existing trees, wherever possible, within the public open space and promote greater urban canopy throughout the BTS. Landscaping of the public open space will prioritise the planting of locally endemic species and promotion of water sensitive urban design outcomes.
- Street design will encourage slow vehicle movement through the BTS, prioritising pedestrian/cyclist movement where ever possible, facilitating on-street parking and integrating with adjacent landscaped areas wherever practical.

Figure 1: Beaconsfield TAFE Site Local Structure Plan

LEGEND

ZONES

Residential

RESERVES

Public Open Space

OTHER

Structure Plan Area Boundary

R Codes

Local Street Link (Indicative Location)

Indicative Road Reserve Boundary

1.4 Subdivision and Development Requirements

An amendment to the Metropolitan Redevelopment Scheme proposes to rezone the 'Public Purpose' reservation over the BTS to 'Urban', facilitating orderly and proper development of the BTS. A concurrent amendment to the City of Fremantle's Local Planning Scheme No. 4 (LPS4) pursuant to section 126 of the *Planning and Development Act 2005* is also proposed to be undertaken to zone the land 'Development', requiring the adoption of a Local Structure Plan to guide and facilitate redevelopment.

As illustrated in **Figure 1**, only a residential zone is proposed with a range of densities from R40 to R160. Public Open Space reserves are proposed with priority road reserves shown indcatively, the extent of reserves will be confirmed at subdivision stage.

1.4.1 Zones and Reserves

1.4.1.1 Zones/Precincts

Land use and development within the BTS is to be consistent with prescribed zones and reservations as detailed on the Structure Plan Map (**Figure 1**). Land use permissibility is to be in accordance with the relevant zone, and land use permissibility of the Zoning Table of LPS4.

Subdivision and development of land will be in accordance with the relevant density coding allocation on **Figure 1**.

1.4.1.2 Road Reserves

Two Local Street Links are included on **Figure 1**, showing the approximate location of these connections and confirming that a high level of permeability will be provided through the BTS.

The first Local Street Link enters the site from Badham Close, travelling east through the BTS before heading north connecting with Grosvenor Street, providing connectivity through the site.

The second Local Street Link commences at Grosvenor Street and bisects the BTS, linking with the first Local Street Link.

1.4.1.3 Public Open Space

The BTLSP will be comprised of two distinct public open space reserves, as shown on **Figure 1**.

Green Link

The green link Public Open Space is located in the western extent of the BTS and will incorporate a range of tree species including a number of retained trees, wherever possible. The North-West and South-West components of the green link will provide pedestrian and cyclist connectivity, a range of passive recreation options, opportunities for heritage interpretation, drainage and traffic calming of the east-west local road. The South-West portion is also identified as a potential location for a Community Bore.

The indicative design of the Green Link is set out in **Part 2**.

Lefroy Road Public Open Space

This area of Public Open Space is located in the eastern extent of the BTS. This POS will provide opportunities for gathering and relaxation, as well as facilities intended to support pedestrian amenity, such as drinking fountains. The South-East POS will also incorporate tree planting along the Lefroy Road street edge and the southern edge of adjacent R60 lots.

1.4.2 Density and Development

1.4.2.1 Density and R-Codes

The BTLSP includes a range of density types, from R40 to R160, delivering a range of housing options. Built form outcomes will be in accordance with the relevant R-Code and controls set out in State Planning Policy 7.3 Volume 1 and 2 (R-Codes).

1.4.2.2 Locational Criteria

The BTLSP is surrounded by R20 low density single residential development to the west, Bruce Lee Oval to the north and the Davis Park Local Structure Plan area to the east, as well as by an existing secondary school to the south. To the south east is the Lefroy Quarry Local Structure Plan area and an extension of the proposed green link. Development intensity and scale are positioned to minimise conflict and provide a sympathetic interface with existing development

1.4.2.3 Development Layout and Rationale

The BTLSP layout responds to the contours of the BTS at the point of redevelopment, with the lowest Natural Ground Level (NGL) located along Lefroy Road with depressions in the south-west and sout-east corners. The NGL then rises to the middle of the BTS, maintaining a consistent grade thereafter through to Grosvenor Street.

The BTLSP is arranged to ensure that existing trees are retained on site, wherever possible, provide public open space at existing low points, align residential cells to facilitate overland stormwater flow to the low points on site and to orient development to optimise access to northern light.

Single residential lots are considered to be most appropriately located on the expanse of land which is predominantly the same grade, generally along Grosvenor Street. It is proposed that sites of greater density are situated where a transition in the natural ground level occurs, adjacent to Lefroy Road and at the intersection of Badham Close and Street 1, enabling the change in grade to be accommodated within built form.

1.4.2.4 Local Development Plan

For lots coded R100 and R160 development shall be compliant with State Planning Policy 7.3 Volume 2 - Apartment Codes, unless otherwise varied by a LDP. For lots coded R40 and R60 development shall be compliant with State Planning Policy 7.3 Volume 1, unless modifications are required to address detailed design as a condition of subdivision approval.

Local Development Plans may address the following matters, in consultation with the City of Fremantle:

- Interface with Lefroy Road and surrounding development context (including adjoining public open space and community facilities).
- Access and servicing considerations.
- Built form controls including, building height, setbacks, finished floor levels flush with adjacent public realm and any other building design feature considered relevant.
- Approach to waste management including bin placement, vehicle access and management.

A Local Development Plan for R100 and R160 may also vary the maximum height limit set out in State Planning Policy 7.3 Volume 2 - Apartment Codes up to the maximum range identified in The Heart of Beaconsfield Master Plan, being 5 storeys for the R100 site and 8 storeys for the R160 site. The approval of a Local Development Plan by the City of Fremantle is required prior to the lodgement of a Development Application.

A proposal to vary the maximum height limit shall demonstrate the provision of appropriate community benefits, commensurate with the discretion sought, to the satisfaction of the City of Fremantle. Potential community benefits include:

- Provision of 30% social or affordable housing, delivered in perpetuity
- Provision of additional deep soil area and trees which exceed the requirements of the R-Codes
- Achievement of a certified 5 Star Green Star Rating
- Other community benefit agreed with the City of Fremantle.

1.4.2.5 Heritage

The BTLSP will incorporate stories from traditional owners, reflecting the role of the BTS before it became a TAFE. Additionally stories related to the operation of the TAFE will also be interpreted. Interpretation will form a component of the design of the public realm.

1.4.3 Other Requirements

1.4.3.1 Protection or management of environmental or landscape features

Existing mature trees should be retained, where possible, with priority given to natural species and trees with significant tree canopy, in accordance with the Landscape Report prepared by REALMstudios. Refer to **Appendix B** – Landscape Report.

1.4.3.2 Urban water management

Drainage is intended to be located in the two primary areas of public open space within existing drainage sumps. Street design will exemplify WSUD principles, road side swales will be used for the transition of water at surface and permeable paving will be incorporated to enable the reinfiltration of water at key points, generally in accordance with the Local Water Management Strategy prepared by Urbaqua. Refer to **Appendix C** – Local Water Management Strategy.

1.4.3.3 Infrastructure and Servicing

The BTS is generally flat with a grade fall at Lefroy Road and two existing depressions in the south-west and south-east of the site. The BTLSP will be gas free. Upgrades to services will be undertaken generally in accordance with the Servicing Report prepared by Pritchard Francis. Refer to **Appendix E** – Servicing Report.

1.5 Additional Detail

Table 2: Additional Detail Required

Additional Information/Purpose	Approval Stage	Responsible Agency (Consultation Required)
Urban Water Management Strategy	Condition of subdivision approval	City of Fremantle
Local Development Plan	Condition of subdivision approval	City of Fremantle
Landscape Plan	Condition of subdivision approval	City of Fremantle
Traffic Impact Statement or Traffic Impact Assessment	As required	City of Fremantle
Arboricultural Report and Tree Management Plan	Condition of subdivision approval	City of Fremantle
Environmentally Sustainable Design Report	R100 and R160 development, Condition of development approval	City of Fremantle

1.6 Staging and Implementation

As indicated on **Figure 2**, staging for the BTLSP is proposed to be broadly carried out in two stages.

Stage 1

Will deliver the majority of the envisioned redevelopment including road reserves, public open space, servicing infrastructure and single residential lots.

Stage 2

Will deliver the remaining elements of the BTLSP being primarily the grouped dwelling and multiple dwelling sites.

Figure 2: Beaconsfield TAFE Local Structure Plan - Staging

Part

2.0

Explanatory Section

1.0
Planning Background

1.0 Planning Background

1.1 Introduction and Purpose

Part 2 of the BTLSP provides an explanation of how the structure plan was developed in consideration of the site's defining characteristics, the planning framework and a vision for redevelopment. It also provides guidance on how the structure plan should be interpreted and implemented.

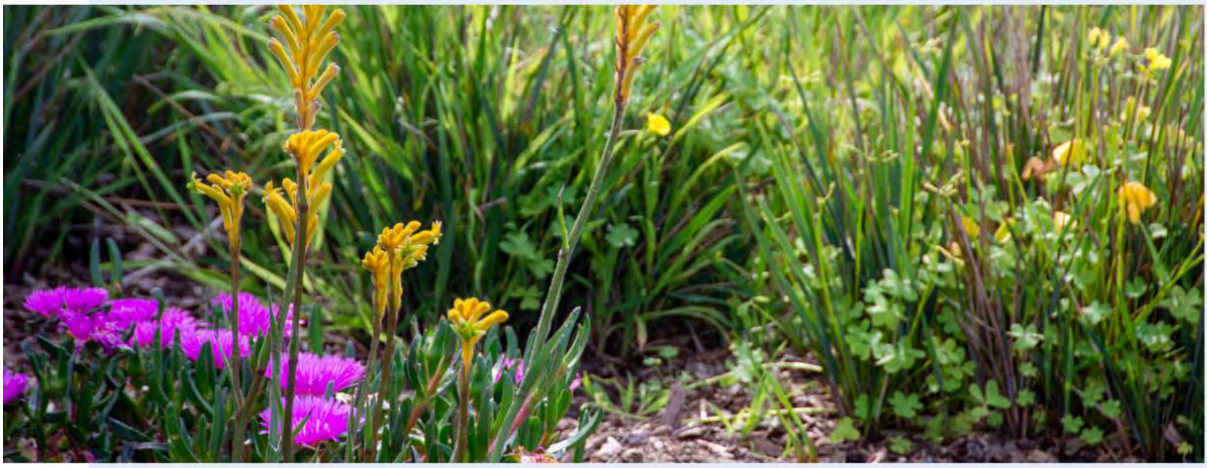
The purpose of the BTLSP is to facilitate comprehensive redevelopment for residential infill, delivery of a range of dwelling typologies and densities, and public open space. In this regard the BTLSP will guide future subdivision and development within the BTS.

This document provides all necessary information and addresses the reporting requirements of the City of Fremantle (City) Local Planning Scheme No. 4 (LPS4) and the requirements of the Planning and Development (Local Planning Scheme) Regulations 2015, including the Western Australian Planning Commissions's Structure Plan Framework.

Beaconsfield TAFE Local Structure Plan Objectives

- The redevelopment of the BTS will respond to local cultural and natural sense of place through the reuse of naturally occurring materials, reinterpretation of the historical use of the land and incorporation of dwelling design which reflects surrounding typologies.
- The BTLSP will contribute to greater housing choice in the locality, facilitating the achievement of additional urban infill by redeveloping underutilised land and incorporating a range of dwelling types. Variation in dwelling design will promote greater housing diversity and improve local housing affordability.
- Development will be sympathetically located and oriented to minimise amenity impacts on the surrounding locality, responding to site characteristics, context and existing residents.
- Redevelopment will seek to retain existing trees within the public open space and promote greater urban canopy overall. Landscaping of the public open space will prioritise the planting of locally endemic species, enhance the relationship with place and promote water sensitive urban design outcomes.
- Street design will encourage the slow movement of vehicles, prioritising pedestrian/cyclist movement where ever possible, facilitating on-street parking and promoting integration with landscaped areas.

2.0
Land Description



2.0 Land Description

2.1 Location

The BTS is located within the locality of Beaconsfield, in the local government area of the City of Fremantle, approximately 15km south-west of the Perth Central Business District and 2km south-east of the Fremantle City Centre.

The BTS is bounded by Badham Close to the west, Grosvenor Street to the north, Caesar Street to the east, and Lefroy Road to the south. Bruce Lee Oval is located opposite the the site to the north, providing opportunities for passive and active recreation. Fremantle College is located immediately to the south.

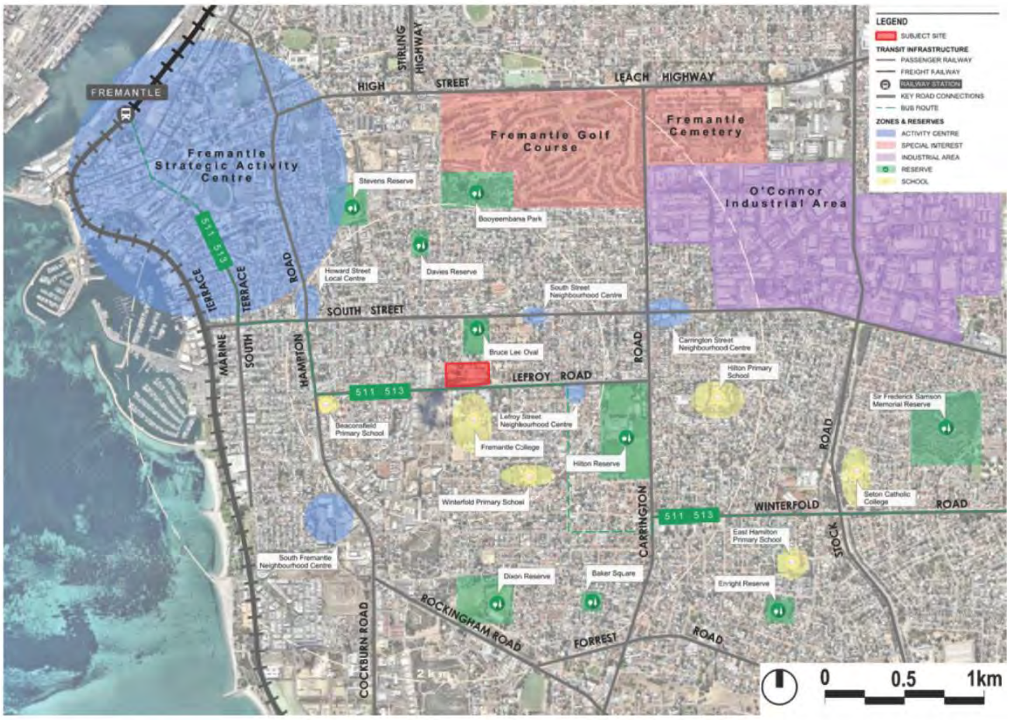


Figure 3: Local Context

Legal Description and Ownership

The BTS is comprised of a single landholding; the title details are set out in **Table 3**. A copy of the Certificate of Title is contained in **Appendix A** .

The site is approximately 3.819ha in area, with a frontage of 265m along Lefroy Road to the south, 118m along Badham Close to the west, 264m along Grosvenor Street to the north and 120m along Caesar Street to the east.

Table 3: Land Description

Lot No.	Landowner	Folio	Volume	Deposited Plan
2680	Western Australian Land Authority	4017	277	33642

Figure 4: Lot Cadastre

2.1.1 Regional Context

The BTS is well positioned with a range of employment options for residents, and a high level of accessible amenities and education opportunities in close proximity. It is located 2km south-east of the Fremantle City Centre (refer **Figure 5**) which offers a wide range of commercial and retail services, recreation, employment, educational and cultural services.

The site is also serviced by a range of District Centres and Industrial Areas, within a 5km radius, providing a variety of services and employment options.

The BTS is connected to the regional movement network providing excellent regional movement capabilities via private vehicle and transit, particularly along South Street. Public transport is readily available by several bus routes which provide high frequency connectivity to the Fremantle and Mandurah Train lines, as well as the Murdoch Specialised Centre.

The area is also supported by a variety of regionally significant recreational facilities. It is within 2.5km of the coast, the Fremantle Boar Harbour, South Fremantle foreshore, Fremantle Public Golf Course, as well as a range local passive and active recreation spaces.

Figure 5: Regional Context

2.1.2 Land Use

The BTS is generally surrounded by residential land uses, predominantly to the west and east (Refer **Figure 6**). The eastern residential area, situated between Caesar Street, South Street, Fifth Avenue and Lefroy Road, is included in the Davis Park Local Structure Plan.

Fremantle College is located to the south and is a key land use in the locality. Bruce Lee Oval is located to the north and provides a large expanse of active recreational space.

2.1.3 History

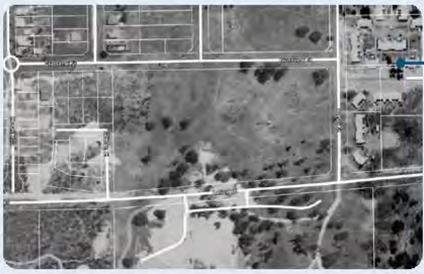
The BTS has been used for educational purposes, housing the Challenger TAFE campus for over 50 years, being progressively developed to accommodate teaching space for a range of trades and vocations. The tertiary education function ceased in 2021 with its services being absorbed into other TAFE's located within the Perth metropolitan area.

Since the discontinuation of the TAFE operation all buildings on site have been demolished and the land is undergoing remediation to facilitate redevelopment, with significant trees retained and protected. A Heritage Assessment was prepared by Griffiths Architects prior to demolition commencing and is discussed in **Section 4.1.3**

Figure 6: Surrounding land uses

Aerial photos

The Challenger TAFE campus for over 50 years



1953

1974

1985

2002

2021

2022

2.1.4 Demographic Summary

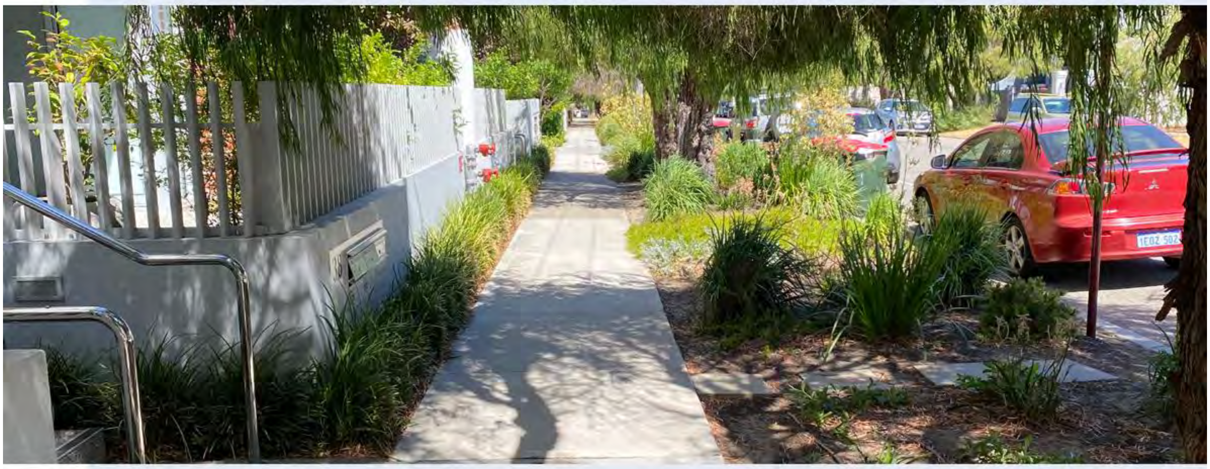
A demographic summary outlining the key demographic markers of the Beaconsfield locality and their relationship to the Perth Metropolitan average is provided in **Table 4.** In comparison to the Perth Metropolitan average the existing population of Beaconsfield is generally older with smaller households. The amount of medium and high density housing is lower than the Perth Metropolitan average, suggesting an existing lack of dwelling diversity.

Table 4: Demographic summary

		Beaconsfield	Perth Metropolitan
AGE	Median Age	42	37
INCOME	Median weekly household income	$1,837	$1,865
HOUSEHOLD	Couples/Families	68%	73%
	Single/Group	32%	27%
	Household Size	2.4	2.6
DWELLING TYPE	Flat or Apartment	3.5%	29%
COST OF HOUSING	Household (with mortgage/without mortgage)	70%	70%
	Median weekly rent	$350	$350
	Household renting	25%	26%
LANGUAGE	English speaking	83%	78%
	Other language	17%	22%
TERTIARY EDUCATION	Bachelor or higher	52%	41%
	Vocational	37%	46%

"Shaping places that are truly exceptional"

3.0
Planning Framework



3.0 Planning Framework

3.1 Zoning and Reservations

3.1.1 Metropolitan Region Scheme

The Metropolitan Region Scheme (MRS) divides land in the metropolitan region into zones and reservations, coordinating how land may be used. The MRS encompasses the entire metropolitan region, from Rockingham in the south to Yanchep in the north.

The BTLSP area is currently zoned 'Public Purpose – Technical School' reserve under the MRS, consistent with its historical use as a TAFE campus (**Figure 7**). The surrounding area is predominantly zoned 'Urban', with Fremantle College located to the south being zoned 'Public Purpose Reserve – Secondary School'.

3.1.2 MRS Amendment 13/57 – Minor Amendment (Concurrent)

An amendment to the MRS has been initiated by the Western Australian Planning Commission (WAPC) to rezone the, now vacant, 'Community Purpose – Technical School' reserve to the 'Urban' zone to allow redevelopment to commence in accordance with the proposed BTLSP (**Figure 7**).

The MRS amendment also proposes that the City's LPS4 be concurrently amended, pursuant to section 126 of the Planning and Development Act 2005, from the 'Public Purposes – Technical School' zone to the 'Development' zone.

Figure 7: MRS current and amended

3.1.3 City of Fremantle Local Planning Scheme No. 4

LPS4 was adopted in March 2007, undergoing a number of amendments, most recently in July 2022 (Amendment 82). Amendment 82 was undertaken primarily with the purpose of aligning LPS4 with the land use definitions set out in the Planning and Development Act 2005 Regulations.

The BTS area is currently zoned as 'Public Purposes - Technical School' reserve (Refer **Figure 8**), consistent with the current MRS zoning. In the event that the MRS zoning is amended, the existing reserve classification will be automatically extinguished, and it is necessary that the Local Planning Scheme also be amended to maintain consistency between the two schemes. As mentioned in the preceding section, it is proposed that the BTS will be concurrently rezoned to 'Development' zone.

The objective of the 'Development' zone is:

To provide for future residential, industrial, commercial or other uses in accordance with a comprehensive structure plan or Local Development Plan prepared in accordance with the provisions of the Scheme.

Given the range of residential densities identified within the proposed BTLSP, the extent of bespoke landscape areas, creation of road reserves and development proposed in accordance with the R-Codes, it is considered that a Standard Local Structure Plan is the appropriate planning mechanism to guide the development of the BTS.

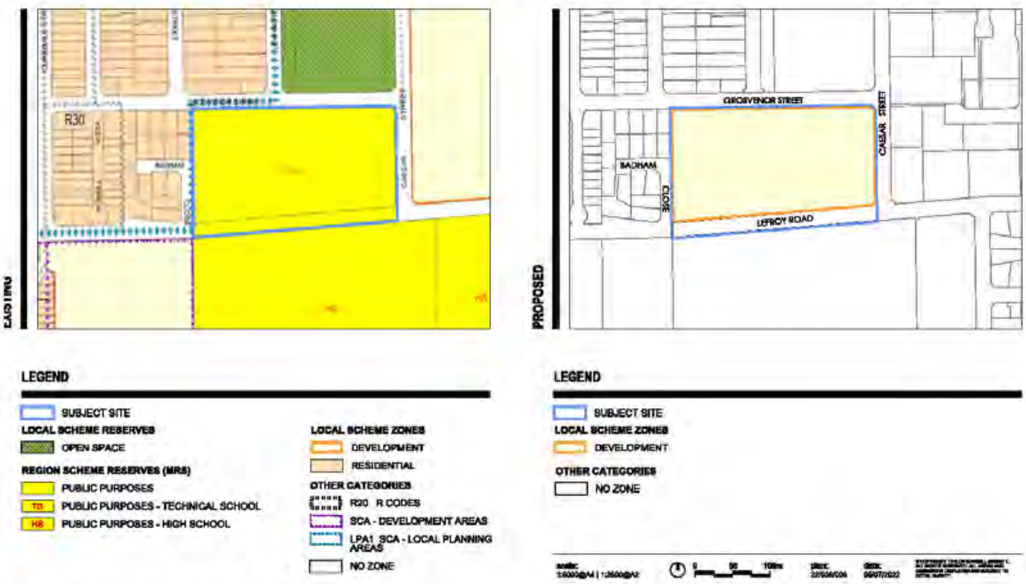


Figure 8: LPS4 current and amended

3.1.4 State Planning Framework

State Planning Strategies

State Planning Strategy 2050

The State Planning Strategy (SPS) is the lead strategic planning document within the State government, providing a strategic basis for the integration and coordination of land-use planning and development across state, regional and local jurisdictions. The SPS guides, shapes and informs the hierarchy of State, regional and local planning tools, instruments and decisions within the Western Australian planning system.

The SPS proposes that diversity, liveability, connectedness and collaboration are central to achieving the vision of sustained growth and prosperity, and establishes principles, strategic goals and directions to ensure the development of the State progresses towards this vision.

In planning for the future of the BTS the vision of the SPS, including the established principles of diversity and liveability have been applied to the development of the concept. In particular, the development of a range of dwelling typologies which support increased choice and access for a wider section of the community. Another key component of the BTLSP is the facilitation of redevelopment while simultaneously protecting and conserving existing significant natural assets, improving local amenity and enhancing overall liveability.

Perth and Peel @3.5 Million and the Central Metropolitan Sub-Regional Planning Framework

The Perth and Peel @ 3.5 million land use planning and infrastructure framework sets out an overarching approach for the development of Perth and Peel with a population of 3.5 million people by 2050. The Perth and Peel @ 3.5 million strategic suite of documents includes four planning and infrastructure frameworks for the Central, North-West, North-East and South Metropolitan Peel subregions which provide more detailed guidance relevant to the sub-region on sustainable development for the same time period.

The Perth and Peel @ 3.5 million spatial plan set out in the Central Sub-Regional Planning Framework (Framework) identifies the BTLSP area as 'Public Purposes', reflective of the fact that the BTS was still operating as a TAFE facility when the Framework was adopted. As the TAFE has since closed and the BTS is no longer required for a Public Purpose, the classification under the Framework is no longer appropriate; in considering an alternative use of the land, it is fitting to consider its alignment with the surrounding context, which in this case, is predominantly residential.

Notwithstanding its inconsistency with the use classification under Framework, the BTLSP is consistent with the objectives of the Perth and Peel @ 3.5 million in that it will maximise the use of an underutilised parcel of inner urban land, promoting greater infill and facilitating the provision of greater housing diversity in the area.

State Planning Policies

State Planning Policy 3 – Urban Growth and Settlement

State Planning Policy 3.0 – Urban Growth and Settlement (SPP 3.0) sets out the principles and considerations that guide the development of new urban growth areas and settlements. Its objectives include promoting the growth and development of urban areas in response to the social and economic needs of communities, enhancing the quality of life in those communities, and creating an identifiable sense of place.

It is considered that the BTLSP meets the key requirements of creating sustainable communities set out in SPP 3.0 by facilitating the efficient use of land for a range of dwelling typologies, supporting a higher density of development in an area already well serviced by public transport, with access to local amenities such as retail and schools.

State Planning Policy 7.0 – Design of the Built Environment

State Planning Policy 7.0 – Design of the Built Environment (SPP 7.0) provides the broad framework for the design of the built environment across Western Australia and applies to all levels of the planning hierarchy. A number of State Planning Policies have been adopted as a 7 series policy, known as the DesignWA suite.

Relevantly, the BTLSP has been developed in accordance with the 10 design principles of SPP 7.0 with a particular focus on context and character, landscape quality, sustainability and amenity.

Context and Character

The BTLSP proposes to transition the existing character of the Beaconsfield locality with the aspirational, high density vision established in The Heart of Beaconsfield Master Plan. This is achieved by providing a range of low to medium density offerings to the west, north and east adjacent to existing low density development. Higher density is proposed to be located along the southern boundary which is able to respond more sympathetically to existing residential development and ensure that overshadowing generated by scale does not adversely impact private land.

A key element of character that will define the design of the public realm, and within the built form of individual developments, is the reuse of the limestone vein which runs north-south through the broader Fremantle region, and exists within the eastern section of the BTS. The reconstitution of this extant material contributes to the expression of local context and also enhancing local sense of place.

Landscape Quality

A strong and defined landscape connection is located on the western extent of the BTS, bisecting the BTS in a north – south orientation, improving pedestrian amenity, non-vehicular connectivity through the BTS and facilitating the retention of significant trees.

The public realm landscape master plan prepared for the BTS articulates a design vision which responds to the existing grade change in a sensitive manner, contributing to an interesting and engaging public realm.

The public open space will also incorporate bbq's, play equipment and amenities to support scooter and bike usage, further enhancing landscape quality.

Sustainability

Aside from the retention of significant mature trees preserving overall canopy cover and cooling in the local area, the drainage strategy for the public realm will invert the collection method, expressing water from small events (1:5) and detaining water from larger events (1:20). This method of controlling water and using it as a feature in the public realm creates a visual connection between the design of the landscape and the broader sustainability objectives of the BTLSP.

In addition to specific sustainability initiatives being considered for the inclusion in the BTLSP, including alignment with the One Planet Living Framework, other sustainability objectives, include energy efficiency, water efficiency/reuse, incorporation of a community bore for on lot irrigation, optimal lot design and orientation. No gas connections will be provided.

Amenity

The proposed retention of mature trees, connection between areas of public open space via a connected swale system and the high quality shared space movement network all contribute to deliver an enhanced amenity outcome for the BTLSP.

The BTS is also well supported by public transport to regional networks, large areas of public open space, accessible local centres to the east and a number of primary and secondary school options in the locality, showing that the site is well positioned to cater for increased residential density.

Medium Density Code and Apartment Code

State Planning Policy 7.3 Volume 1 (Medium Density Code) was released by the Western Australian Government in March 2023 and has the role of informing built form for single dwellings for areas coded R30 – R80. As the majority of the BTLSP is within this coding range the Medium Density Code applies. R100 and R160 coded areas are subject to compliance with State Planning Policy 7.3 Volume 2 (Apartment Code).

Development of the BTLSP has been informed by the Medium Density Code, with the Concept Plan (**Figure 14**) being guided by optimised lot orientation that maximises access to northern sunlight, a road network which prioritises consistent and uninterrupted dwelling frontages, and lot sizes that enable delivery of a high quality product, consistent with the Objectives and Acceptable Outcomes of the Medium Density Code.

The proposed higher density sites that are subject to compliance with the Apartment Code propose maximum building heights of 4 storeys (15m) for R100 and 5 storeys (18m) for R160. Testing of the two areas was undertaken during the development of the Concept Plan to confirm that both areas were capable of delivering a medium/high density outcome, with key considerations including optimised access to northern natural light, positive relationship with the streetscape, minimised overshadowing of neighbouring properties and appropriate location of car parking areas which mitigate the visual impact on the public realm.

The R100 and R160 coded areas may be subject to further control by a Local Development Plan to ensure development reflects the broader BTLSP objectives in particular integration with the public realm, servicing and access.

Draft Structure Plan Guidelines (2022)

The preparation of a structure plan is required by virtue of the proposed concurrent zone to 'Development Area' in the City of Fremantle's LPS 4.

The draft Structure Plan Guidelines (Guidelines) apply to the preparation, assessment and use of structure plans, that is standard structure plans as well as precinct structure plans. The Guidelines reference clause 14 of the Planning and Development Act 2005 Local Planning Scheme Regulations (Regulations) and define the two types of structure plans as:

1. *"Standard Structure Plan is a plan depicting the intended zoning and subdivision pattern for an area of land. A standard structure plan does not determine built form; however, it may identify a site or precinct which requires development guidance*
2. *Precinct Structure Plan is a plan depicting the intended zoning or land use and subdivision pattern for an area of land and in addition, provides development guidance for built-form and the public realm."*

The Guidelines also refer to Schedule 2, cl.16(1)(a) and (b) of the Regulations to guide the manner and form of a structure plan.

The BTLSP (classified as a Standard Structure Plan) guides the development of residential land through the allocation of R-Codes, road reserves, public open space and drainage. Built form will be primarily controlled through the provisions of the relevant R-Code in **Figure 1** .

Operational Policy 2.4 – Planning for School Sites

Operational Policy 2.4 – Planning for School Sites (OP 2.4) establishes general requirements for school sites to meet existing and future community needs, ensuring that the State provides sufficient capacity and includes requirements for the design and location of schools.

OP 2.4 identifies that a primary school should be provided for every 1,500 dwellings delivered in a greenfields or infill context. It is proposed that the BTLSP will yield approximately 155 dwellings, well below the threshold of 1,500 dwellings identified in OP 2.4. Notwithstanding it is understood that the combination of the BTLSP, the recently approved Davis Park Local Structure Plan (591 - 779 dwellings estimated), and the high density proposal of the balance of The Heart of Beaconsfield Master Plan area is likely to place pressure in the locality for an additional primary school in the future – particularly if The Heart of Beaconsfield Master Plan vision of high density is achieved.

This future demand may be met by the future provision of an additional primary school, or potentially the expansion of nearby Winterfold Primary (Public) or Christ the King School (Private). Given that the possible future need for additional primary school capacity is generated by the cumulative effects of a number of discrete development areas, and is still yet to be clearly identified, it is suggested that the planning for additional school sites may be examined more thoroughly through the City's Local Planning Strategy.

Liveable Neighbourhoods

Liveable Neighbourhoods is the WAPC's current operational policy guiding the design and approval of structure plans and subdivision. The objective of Liveable Neighbourhoods is the delivery of new developments that provide high quality living environments for working and recreation, as well as contributing to the successful implementation of the State Planning Strategy.

The BTLSP has been developed giving regard to the principles of Liveable Neighbourhoods, in particular the:

- creation of a sense of community, enhanced sense of place and connection to the local environment;
- provision of a range of lot sizes and dwelling types to provide choice in housing and contribute to greater local diversity. Densities have been chosen based upon the quality and extent of local amenities, including public open space, local centres and schools; and
- extensive public realm which directly interfaces with dwellings and is expressed within all road reserves contributing to a unified landscape aesthetic.

3.1.5 Local Planning Framework

City of Fremantle Local Planning Strategy

The City of Fremantle Local Planning Strategy (Strategy) was adopted by the City of Fremantle in April 2001, with a purpose to:

"provide the strategic direction of future population and employment; the broad strategies for housing, employment, shopping and business activities; and proposals for transport, parks, regional open space and other public uses"

The Strategy establishes a number of Local Planning Areas within the City, each Local Planning Area with specific objectives, strategies and development control mechanisms tailored to individual areas in order to maintain cohesive and identifiable neighbourhoods. Local Planning Area 5 (LPA5) applies to the Beaconsfield locality, including the BTS. The BTS is not specifically addressed within the Strategy, as the TAFE was operational when the Strategy was drafted. Notwithstanding, it is considered that the BTLSP is broadly consistent with the objectives of LPA5 as:

- The BTLSP proposes a range of medium and high density residential development enhancing the variation in dwelling typologies in the locality.
- Additional residential land uses not envisaged by the Strategy will contribute to the retail strength of the South Street local centre and Lefroy Road shops.
- Redevelopment of the BTS facilitates environmental remediation and ensures that underutilised land is developed in a timely manner.

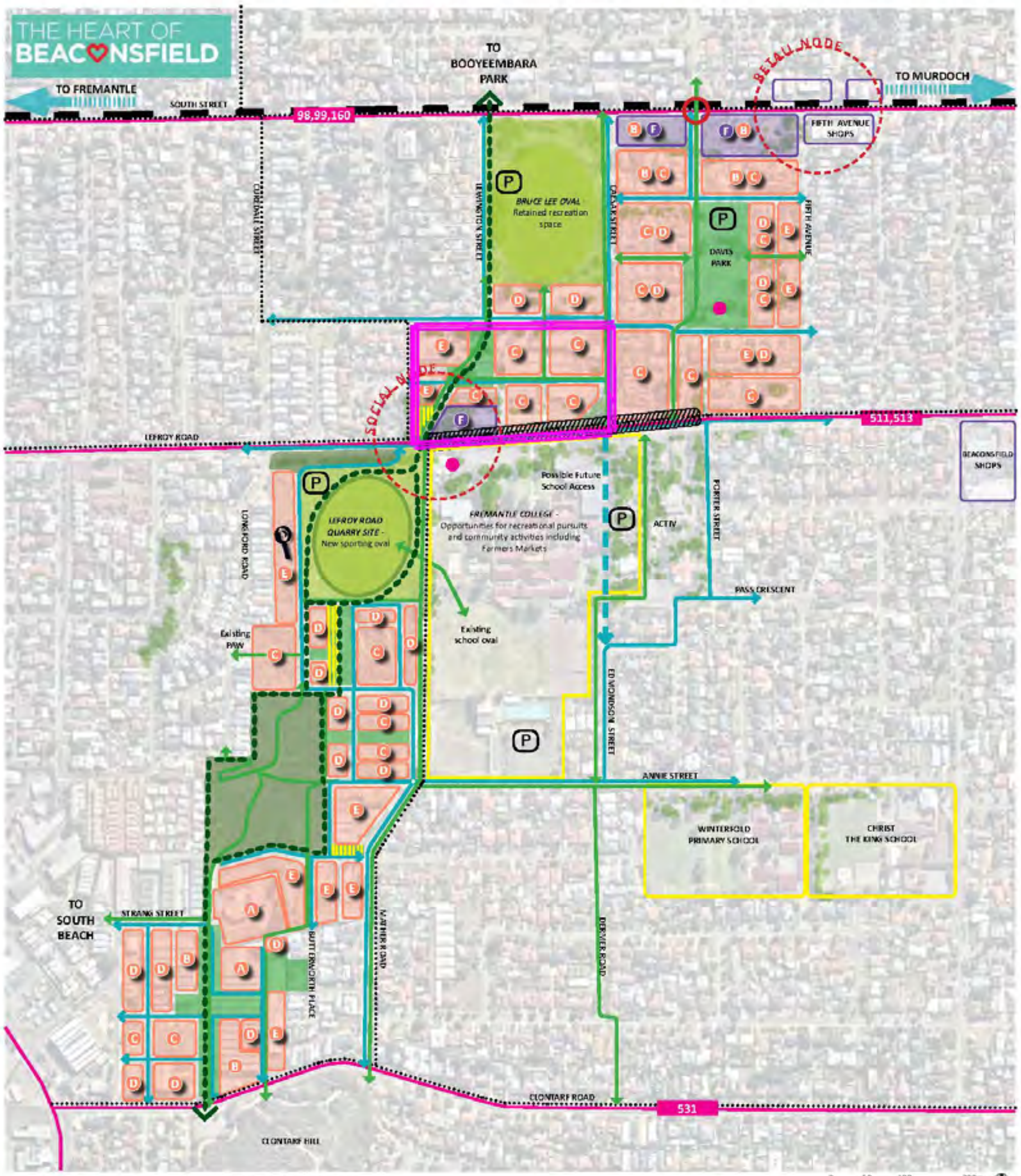
In response to the review that was undertaken by the City with regard to the ongoing suitability of LPS4 in 2020, the WAPC advised that, due to a number of factors, a new Local Planning Strategy should be prepared and approved to allow gazettal of a new Local Planning Scheme. It is understood that a draft Local Planning Strategy has been provided to WAPC for its comment

3.1.6 The Heart of Beaconsfield Master Plan

In April 2021 the City of Fremantle approved the Heart of Beaconsfield Master Plan (THOB) following several years of community consultation. THOB sets out a long-term vision for the broader Beaconsfield locality and will guide future detailed planning for the various redevelopment areas within Beaconsfield. In particular three key themes were established which underpin THOB, these are:

- Tree retention and open space provision
- Housing choice and diversity of population
- Sense of place and community facilities

THOB identifies the BTS for redevelopment into a range of low and medium density development cells, including a green north/south pedestrian link which connects Lefroy Road and Grosvenor Street, and a vehicle connection between Badham Close and Caesar Street. In addition to the regional planning undertaken at a metropolitan level, THOB provides the basis for the BTLSP, demonstrating that the redevelopment is consistent with the approved vision of the locality.



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MASTERPLAN CONCEPT

This masterplan provides an indication of how multiple sites in the 'Heart of Beaconsfield' might develop over time to capitalise on the suburb's great attributes, and to facilitate further improvements along the way. It was formulated in consultation with key landowners and the community, providing a vision for how various community objectives might be met over time.

The plan includes improved connections throughout the area (particularly for cyclists and pedestrians), a greater range of housing types, retention of existing parks and community focal points as well as the creation of new ones (including a new sporting oval), and protection of trees where possible. Delivery of the plan would occur in stages as different landowners redevelop, and details may change through further design and approval processes, however the Masterplan seeks to provide an overarching concept of how different elements can work together.

LEGEND

- A High rise apartments up to 8-12 storeys
- B Medium rise apartments 5-8 storeys
- C Low rise apartments 3-5 storeys
- D Townhouses and maisonettes 2-3 storeys
- E Family houses 1-2 storeys
- F Mixed use/community facility
- Schools
- Existing Childcare Centre
- Traffic calming and school drop-off
- Nodes - social / retail
- Existing trees
- Development subject to further site investigations

Public open space

- Natural open space
- Recreation/ passive open space
- Active open space/ Sports
- Drainage/passive open space & integrated urban water management
- Green link
- Pedestrian link
- Vehicle access (including footpath)
- Transit corridor link
- Cycle network (Bike Plan 2019-24)
- Bus routes
- Possible future traffic signals subject to approval from MRWA
- P Additional parking opportunities

THE HEART OF BEACONSFIELD IS A CITY OF FREMANTLE PROJECT IN PARTNERSHIP WITH

Available in alternative formats on request.

Figure 9: The Heart of Beaconsfield Master Plan

Local Planning Policies

A range of Local Planning Policies are considered applicable to the development of the BTLSP. The following summarises the Local Planning Policies which affect the implementation of the BTLSP:

Local Planning Policy 2.9 – Residential Streetscape Policy

The provisions of this policy apply to all residential development and addresses items including setbacks, building orientation, building height and scale.

Streetscape typologies within the BTS have been influenced by SPP 7.3, and the particular landscape outcomes sought for streets within the BTLSP. Setbacks, building orientation, height and scale for built form are proposed to be consistent with the relevant volume of the R-Codes, unless varied by an approved LDP.

Local Planning Policy 2.10 – Landscaping of Development and Existing Vegetation on Development Sites

The objective of this policy is to provide guidance on the requirement and assessment of landscape plans and where requirements of the LPP 2.10 and LPS4 can be varied in relation to planning applications whose curtilage contain tree(s) and vegetation considered worthy of conservation.

The BTLSP meets the objectives of LPP 2.10 by retaining a significant number of trees on site, within public open space. Importantly the two primary groupings of mature trees, being the south-west corner and the central west copse, are retained and celebrated as the two core nodes connecting the central green link.

Local Planning Policy 2.13 – Sustainable Buildings Design Requirements

This policy requires that all mixed use and multiple dwelling developments which are in excess of 1,000m2 Gross Leasable Area total are required to be designed to achieve a rating of not less than 4 Star Green Star Rating using the relevant Green Building Council of Australia rating tool.

A series of workshops have been undertaken at a project level to determine other potential sustainability initiatives, noting the existing approach to water efficiency/expression and tree retention. Three key opportunities at a whole of site level were identified and would be explored for implementation at detailed design stage:

- De-risk low-carbon technologies, through demonstration and research, and target operational Net Zero across the development.
- Deliver accessible, inclusive, integrated and diverse housing solutions.
- Through collaboration and research seek to:
  - Maximise net zero opportunities.
  - Maximise community liveability, health and wellbeing.

It is noted that ultimate consideration of a sustainable built form, consistent with the requirements of LPP 2.13, will be undertaken at the development application stage.

Green Plan 2020

The City's Green Plan 2020 was adopted by the City to maintain and enhance green spaces, increase the quality and distribution of green spaces, increase biodiversity and water efficiency and encourage greening of private property.

The Green Plan states that there is a gap in public open space within a 400m walkable catchment in Beaconsfield, which should be addressed as part of structure planning.

The BTLSP retains the majority of trees on site, informed by a report prepared by Arbor Centre prior to the demolition of the existing Beaconsfield TAFE structures.

Approximately 16% of the site area is identified in the BTLSP for public open space, and the Landscape Plan identifies a 30% canopy target throughout the BTS. Furthermore, the landscape master plan investigates opportunities for the evolution of landscape ecology, particularly the growth of native species.

Bike Plan 2019 - 2024

The plan sets out the existing cycling environment and identifies the facilities that the City has for cyclists, as well as key areas for improvement. Lefroy Road is identified as a secondary cycle route with a local cycle route identified along the western edge of the BTS.

The BTLSP supports the objectives of the Bike Plan by implementing a north-south cycle link situated on the western extent of the BTS conceptually shown to run through the central green link connecting Lefroy Road and Grosvenor Street.

One Planet Living Action Plan 2020 – 25

The City has used the One Planet Living framework since 2014 to set the sustainability agenda at a local level, enshrined in the City's One Planet Living Action Plan 2020 - 25. One Planet Living outlines 10 principles covering social, environmental and economic considerations with the end goal of achieving a more sustainable future.

The BTLSP supports the objectives of One Planet Living, and by extension the City's Action Plan 2020 – 25, by:

- Retaining significant trees on site and the implementation of extensive public open space, optimising tree provision and cooling in co-ordination with the City's green Plan 2020.
- Prioritise water sensitive urban design techniques in the public realm through the extensive use of swales supporting passive infiltration and promoting site self-sufficiency.
- Formalise bike and pedestrian connections through the site, in accordance with the intent of the Bike Plan 2019 – 2024, enhancing amenity and prioritising non-vehicular modes of transportation.

Surrounding Local Structure Plans

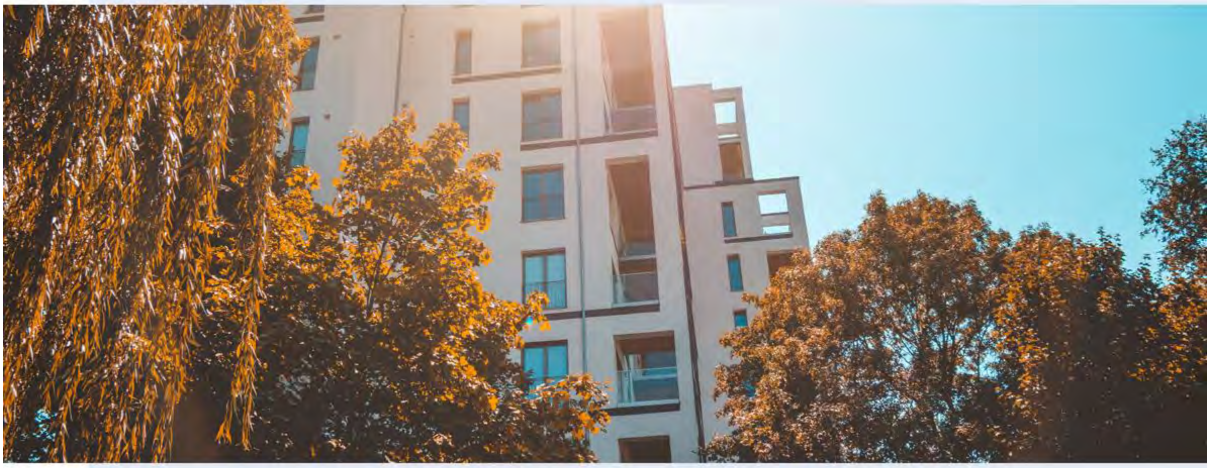
Davis Park Precinct Structure Plan

The Davis Park Precinct Structure Plan applies to 10.18 hectares of land bounded by South Street, Lefroy Road, Caesar Street and Fifth Avenue.

The Davis Park Precinct Structure Plan provides for the realisation of the vision for the Davis Park Precinct:

"The redevelopment of Davis Park Precinct will support high quality residential and commercial development in a vibrant and sustainable urban setting, consolidating the South Street local centre as a transport-oriented development node on the South Street corridor whilst maintaining scale and character complementry to its context."

4.0
Site Conditions and Constraints



4.0 Site Conditions and Constraints

4.1.1 Biodiversity and Natural Area Assets

A Stage 1 Arboricultural Dilapidation Report has been prepared by the Arbor Centre Consultancy who surveyed and mapped all of the existing trees on site in 2020 and 2021 prior to the commencement of demolition. The 2021 survey found that a good proportion of trees on site were in an acceptable to good condition.

REALMstudios undertook an initial assessment of the BTS to assist in the development of an initial concept, based on the Stage 1 Arboricultural Dilapidation Report. The assessment undertaken by REALMstudios determined that the most significant trees on site are the Ficus microcarpa (Hills Weeping Fig), Araucaria heterophylla (Norfolk Island Pine), Melaleuca lanceolata (Rottnest Island Tea Tree) and the Casuarina equisetifolia (Horsetail She-oak) whose canopies register at the neighbourhood and local level. They provide immediate benefits to site amenity and a basis for structuring the layout of the BTLSP, including:

- Neighbourhood skyline value.
- Definition of historical courtyards and built form.
- Bird habitat and movement.
- Shade and shelter from summer sun and wind.
- Immediate views from upper building levels.
- Cross-site screening and mitigation of internal views.
- Screening to built form.
- Site navigation and wayfinding.
- Referencing to the Fremantle coastal and suburban vernacular.
- Landform and Soils.

The topography of the site is generally flat with a level of approximately 19m AHD. There is a significant embankment along the south eastern edge, where the level drops from 19m AHD to 14m AHD at the Lefroy Road frontage. There is also a steep depression in the south west corner of the site reducing to 12m AHD at its lowest point. Both areas were historically used for drainage.

The generally flat nature of the site is a symptom of the development of the TAFE, with the majority of the BTS levelled in the past from a limestone ridge.

4.1.2 Infrastructure and Servicing

Preliminary investigations undertaken prior to the demolition of the Beaconsfield TAFE established that existing infrastructure would require upgrading to allow for redevelopment at the nominated density. Notwithstanding, the operation of the Beaconsfield TAFE campus and the intensity of the visiting population associated with that use, confirms that the site is capable of supporting a population density commensurate with the intensity proposed within the proposed BTLSP, albeit with a focus on education as opposed to residential land uses.

4.1.3 Heritage

The BTS is included on the City of Fremantle's Municipal Heritage Inventory (MHI) and Scheme Heritage List as a Level 3 Place. It is included in the MHI for its social value as a tertiary education place. There are no values attached to the fabric of the place. **Figure 10** shows early plans of the Fremantle TAFE.

The Heritage Assessment, undertaken prior to demolition of the Beaconsfield TAFE, determined that, whilst the physical form of the place has little merit, that it does have social value as a location. The Heritage Assessment stated that, with regard to the architecture it "is utilitarian drawing on design elements of the post World War 2 International style and has no particular architectural merit".

The Heritage Assessment recommended that, acknowledging the negligible physical significance of the built form, the social significance of the place be represented in some other way, such as through mature trees, site planning and interpretation.

Noting the recommendations of the Heritage Assessment, the proposed public open space will retain a significant number of the existing mature trees in public open space. Additionally, site planning formalises the informal north-south pedestrian connection through the BTS, historically located on the western border and now forming the core green connection through the BTS.

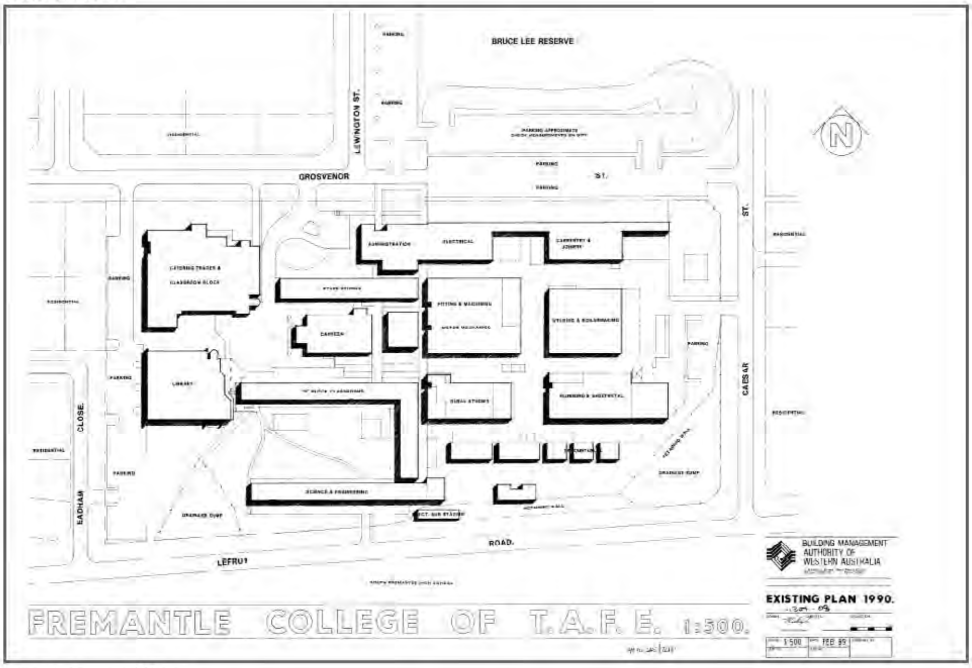


Figure 10: Fremantle TAFE plan

4.1.4 Opportunities and Constraints Summary

A desktop opportunities and constraints assessment has been undertaken to develop an understanding of design elements which would then inform the preparation of the BTLSP. Opportunities and constraints have been categorised based on their relationship to one another, as follows:

Built Form and Land Use (**Figure 11**)

1. Predominantly flat site provides optimal development platform for laneway lots.
2. Boundary interface with existing residences, consider mitigation or potential amenity impacts.
3. High amenity outlook, north facing to enhanced Grosvenor Street.
4. Consider integration of batter area into development sites with built form absorbing the level differences.
5. Dwellings along Lefroy Road need to mitigate noise and optimise solar access into living spaces whilst presenting an appealing face to the public realm.
6. Potential to consider integration of grouped housing site with public open space retained trees.w

Figure 11: Built form and land use

Movement Network (**Figure 12**)

1. Possible street connection opportunity.
2. Consider merits of using existing crossover location for vehicle access into a development site.
3. Paths of natural movement and key desire lines for retention. Provide safe, legible, secure and direct links for pedestrians and cyclists.
4. Integrate natural & built features with movement network to enhance amenity and slow traffic.
5. Foster passive surveillance from pedestrian, cyclist and vehicle traffic along public realm edges.
6. Ensure new vehicle junctions are located and operate safely, avoid impact on existing trees.

Figure 12: Movement network

Public Realm (**Figure 13**)

1. Enhancement of drainage sumps as landscape features.
2. Special Grosvenor Street 'parkways' with retained & planted trees, special planting and street design.
3. Consider options for the integration of existing trees in a link between Bruce Lee Oval and Lefroy Road/Quarry site.
4. Retention of both lines of trees as an 'arbor-walk'.
5. High and low points of the site.

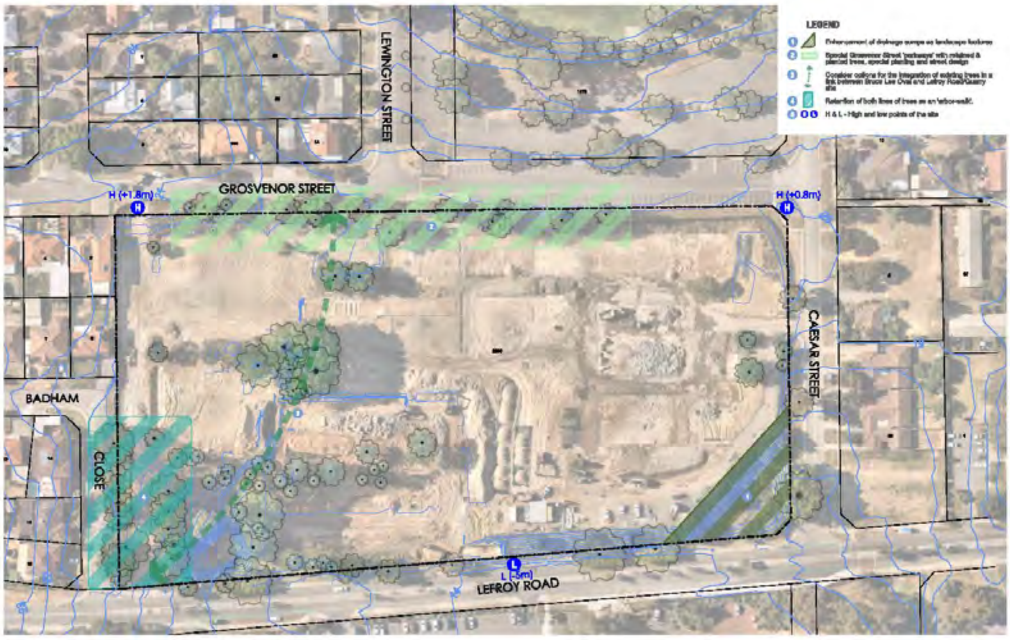


Figure 13: Public realm

5.0
The Structure Plan

5.0 The Structure Plan

5.1 The Vision and Objectives

The Vision

> The redevelopment of the Beaconsfield TAFE site will embody the principles of sustainable infill development by being responsive to context, reflecting local natural ecology, designing for people over vehicles and informed by the responsible use of energy and water.
>
> Redevelopment will be guided by the implementation of high quality public open space, followed by the coordinated delivery of lower density development and completed by higher density development.

Beaconsfield TAFE Site Local Structure Plan Objectives

- The redevelopment of the BTS will respond to local cultural and natural sense of place through the reuse of naturally occurring materials, reinterpretation of the historical use of the BTS, incorporating dwelling densities which reflects existing typologies.
- The BTLSP will contribute to greater housing choice in the locality, facilitating the achievement of additional urban infill by redeveloping underutilised land and incorporating a range of dwelling types. Variation in densities will promote greater housing diversity and improve local housing affordability.
- Development will be sympathetically located and oriented to minimise amenity impacts on the surrounding locality, responding to site characteristics, context and existing residents.
- Redevelopment will seek to retain existing trees within the public open space and promote greater urban canopy overall. Landscaping of the public open space will prioritise the planting of locally endemic species, enhance the relationship with place and promote water sensitive urban design outcomes.
- Street design will encourage the slow movement of vehicles, prioritising pedestrian/cyclist movement where ever possible, facilitating on-street parking and promoting integration with landscaped areas.

5.2 Concept Plan

5.2.1 The Beaconsfield TAFE Local Structure Plan Concept Plan

The achievement of the vision and objectives is balanced with the planning undertaken by the City which has preceded the development of the BTLSP, in particular THOB, has informed the preparation of a Concept Plan identifying how the BTS may developed.

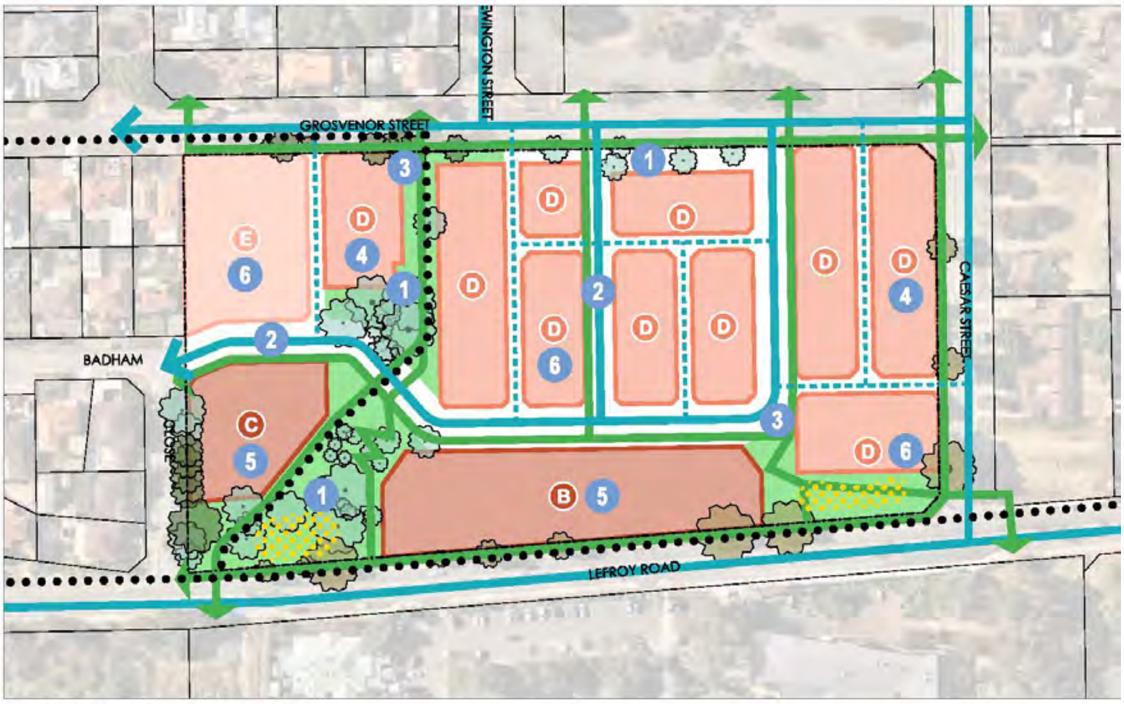


Figure 14: The Concept Plan

Concept Plan Notes

1. Retention of existing trees to be optimised in the public realm through the location and configuration of parks and the widening of road reserves.
2. Internal streets to be aligned and designed as low-traffic, slow-speed environments.
3. Well-connected pedestrian and cycle links to be provided through the site, with good wayfinding qualities and integration with the neighbourhood path network.
4. Streets and laneways aligned to optimise the best passive-solar lot orientation and provide a good interface between future dwellings and existing residences.
5. Apartment development, with appropriate height setbacks from existing residences, to be located to overlook public realm and positioned where the built form can absorb the level difference between Lefroy Road and the interior of the site.
6. A mix of lot types and sizes to be provided through the site, to accommodate a variety of house types, sizes and affordability levels.

Legend

Housing Types

Higher Density

- B Medium rise apartments 5 storeys
- C Low rise apartments 4 storeys

Medium Density

- D Townhouses and maisonettes 2-3 storeys

Lower Density

- E Family houses 1-2 storeys

Public Open Space

- Recreation / Passive Open Space
- Drainage / Passive Open Space

Connectivity

- Pedestrian Link
- Vehicle Access
- Cycle Network
- Laneway Access

Existing Trees to be investigated for possible retention

- Native Species
- Exotic Species
- Other Verge Trees

5.2.2 Pre-lodgement Consultation

In acknowledgement of the engagement previously undertaken by the City in the lead up to the adoption of THOB Master Plan, targeted consultation occurred with regard to the BTS. **Table 5** summarises the groups consulted in the preparation of the BTLSP

Table 5: Summary of consultation

Date	Event	Purpose
01/05/2022	City of Fremantle	Forward planning for the BTS
22/08/2022	City of Fremantle and Department of Planning, Lands and Heritage	To confirm process with regard to MRS Amendment and LSP
10/10/2022 - 28/10/2023	Community Consultation	Seek feedback to shape the concept design
09/02/2023	City of Fremantle	Update on progress of planning for the BTS
22/02/2023	Western Australian Planning Commission	Initiation of amendment to the MRS
March 2023	Community Consultation	Release of draft Concept Plan and consultation summary
31/03/2023 and 27/04/2023	Site walk with local whadjuk elders	Implementation of Aboriginal cultural heritage
20/04/023	City of Fremantle	Technical consideration with City of Fremantle staff
16/06/2023	Department of Planning, Lands and Heritage	To confirm process
Recurring	Communications and Engagement Group Development WA City of Fremantle Department of Planning, Lands and Heritage Department of Communities Department of Education WA Police	To coordinate the delivery and engagement activities related to the Beaconsfield Redevelopment Project.


"Shaping places that are truly exceptional"

5.3 Design Themes

Principle 1:

Make a place that is easy and understandable to walk through, with shaded paths and universal access.

Create Comfortable and Beautiful Streets and Green-links

Image 1: Public realm environment that is easily accessible and pleasant for pedestrians to experience (North Coogee)

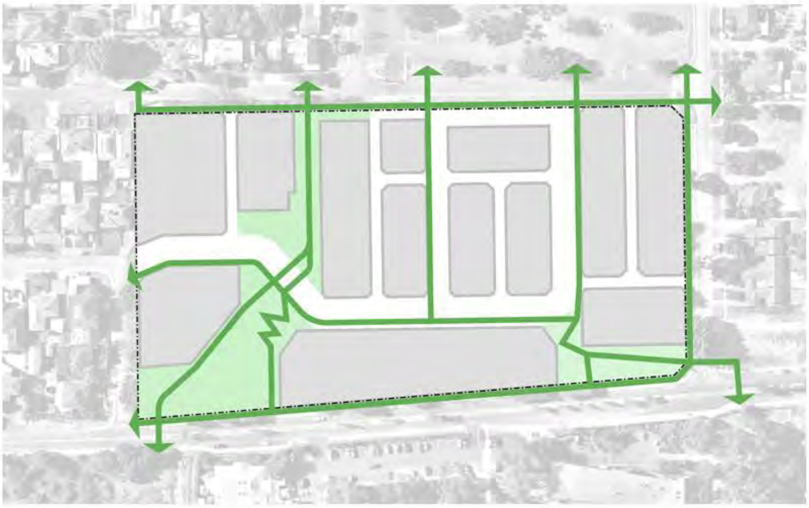


Figure 15: Principle 1

Principle 2:

Use the landscaping of front gardens, swales, verges and park edges to bring visual delight to the public realm experience.

Image 2: Native themed, cohesive landscaping in a private garden and wide verges providing an appealing pedestrian experience (White Gum Valley)

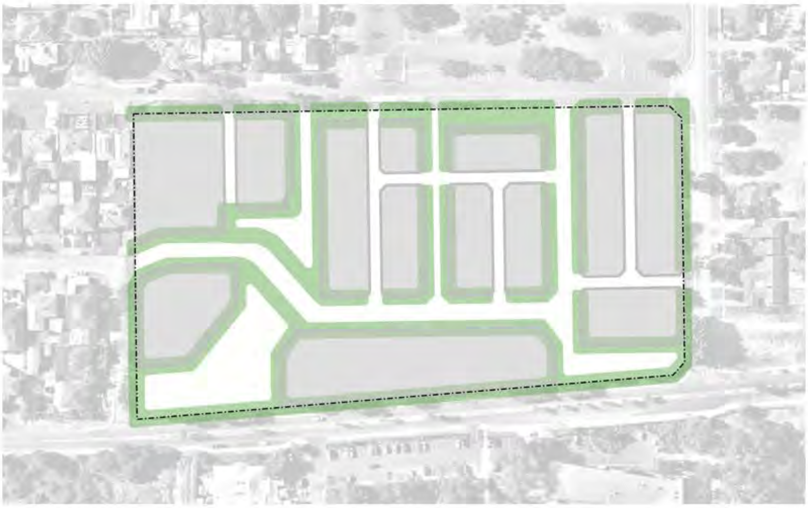


Figure 16: Principle 2

Principle 3:

Provide laneways to accommodate services and reduce constraints for tree planting and tree retention, helping to create 30% tree canopy cover and an attractive urban greenscape.

Image 3: A laneway with landscaping in the public realm and rear garden/balcony spaces that create a pleasant environment (Subiaco)

Figure 17: Principle 3

Principle 4:

Create slow-speed streets where cars have to pause, give way and stop.

Maximise Safety and Minimise Conflict for Pedestrians

Image 4: A narrow street with two-way carriageway (6m-wide) that narrows at single-lane points to enable on-street parking and slow-moving traffic to pass (Fremantle)

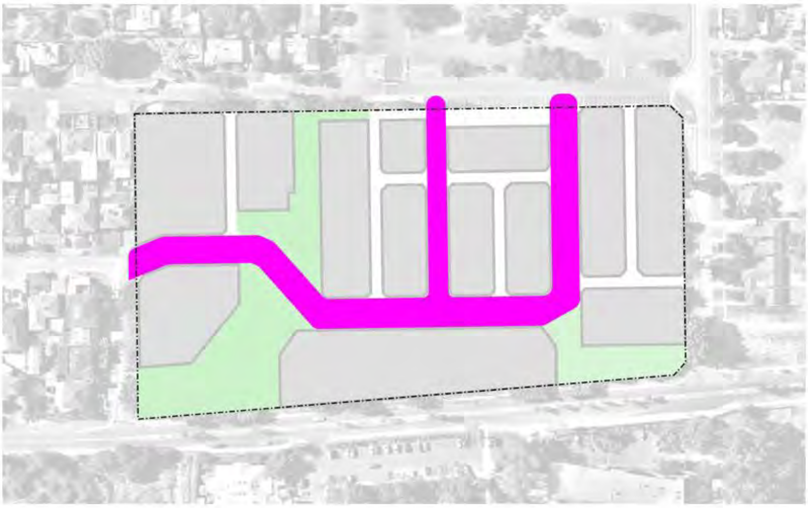


Figure 18: Principle 4

Principle 5:

Provide laneways to avoid or limit crossovers in the street.

Image 5: A street with a footpath uninterrupted by crossovers, creating more landscaping space and better safety for pedestrians (San Mateo, California)

Figure 19: Principle 5

Principle 6:

Provide numerous narrow and step-free pedestrian street-crossing points.

Image 6: A standard-wdth intersection modified to be raised, achieving continuous footpaths with no level change for pedestrians (South Fremantle)

Figure 20: Principle 6

5.3.1 Land Use and Urban Form

As illustrated on **Figure 1**, all development within the BTLSP is proposed to be residential. Various density allocations have been determined to maximise dwelling diversity while remaining respectful of the existing character of the locality and embodying the future urban form envisaged by the THOB.

Yield Analysis

Figure 14 illustrates how the BTLSP envisages that development will be designed and delivered. The proposed yields are summarised in **Table 6.**

Estimated Population

Based on an average household of 2.4 persons, the BTLSP has the potential to cater for a population of approximately 372 people.

Table 6: Concept Plan Yields

Reserve Type	Area
POS 1	0.483ha
POS 2	0.132ha
Road Reserve	0.909ha
PAW	
Sub-Total	1.524ha

Density Type	Area	# Lots	Yield
R40	0.237ha	8	8
R60	1.412ha	74	74
R100	0.201ha	1	26
R160	0.445ha	1	47
Sub-Total	2.295ha	84	155
Grand Total	3.819ha	84	155

5.3.2 Urban Form

Height

Building heights within the BTLSP are proposed in accordance with the relevant R-Code. R40 lots are located adjacent to existing residential development along Grosvenor Street and Badham Close and will encourage sympathetic built form that responds to existing topography within the BTS.

Sites identified for R100 and R160 are located adjacent to existing roads and landscape to minimise the visual impact of bulk and scale.

Setbacks

Setbacks to lots will be in accordance with the relevant R-Code, unless varied by an LDP in the case of the R100 or R160 sites.

Figure 21: Section Location

Topography

The natural topography of the BTS is predominantly flat with depressions along the southern extent adjacent to Lefroy Road. Two areas of POS are proposed adjacent to Lefroy Road to allow the difference in levels to be transitioned through landscaping while continuing to be functional. The R160 site is proposed adjacent to Lefroy Road and, in addition to mitigating the appearance of scale, also allows the level difference to transition through built form via a stepped ground floor.

The R60 sites identified to the north of POS 2 will also incorporate a stepped ground floor to accommodate the change in level.

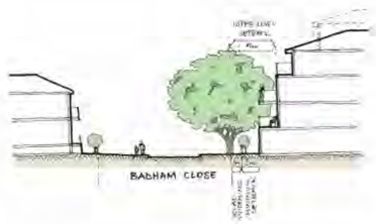


Figure 22: Section A

Interface

Sectional illustrations have been prepared to articulate the interface of important sites within the BTS, these being:

- **Section A** - The relationship between proposed R100 development, with built form compliant with the R-Codes, and the existing two storey dwelling on Badham Close. The retained tree is shown, located within a widened road reserve. A four storey height is identified with a potential fifth storey shown indicatively, subject to section 1.4.2.4 of the BTLSP.
- **Section B** - Illustrates the level difference between Lefroy Road and the central 15m-16m road reserve.
- **Section C** - Illustrates the level difference between south-east POS and the adjacent R60 residential cell, articulating the need for a sub-level to transition natural ground level and interfacing with both areas of the public realm.

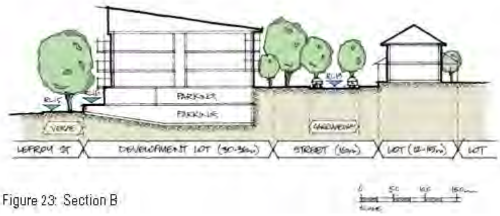


Figure 23: Section B

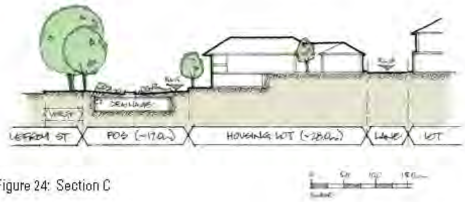


Figure 24: Section C

5.3.3 Built Form Character

The BTLSP will facilitate a range of built form outcomes and support a range of residential typologies, improving local diversity in dwelling stock and increasing access to affordable living options.

Residential R40

Areas zoned R40 will include lots with an areas that range between 310m² and 420m². These lots are a minimum of 30m x 10.5m and are able to accomodate separate detached homes, engendering a built form which is consistent with adjacent residential development in terms of scale and intensity.

Residential R60

A range of lot typologies are proposed within the R60 coded area, encouraging a diversity in dwelling product. Lot sizes range from 165m² to 305m². Lot depths range from 10.5m to 28m, with lot widths ranging from 7.5m to 10m.

Lot configuration has been progressed with an appreciation of the need for efficient house design, promoting livability, improving the availability for greenery and an enhanced sustainability outcome. All R60 lots are proposed to be rear-loaded. Dwellings will be oriented towards the public open space or higher order roads, with garaging to the rear, improving amenity and opportunities for passive surveillance of the key movement corridors.

Residential R100

A site has been identified at the south-east corner of the intersection of Badham Close and Street 1 for development to an R100 standard. The unique location, which can be viewed in the round, requires a bespoke approach to dwelling design that positively interfaces with all external elevations.

It is considered that a site specific response to development design will be required, in addition to the guidance provided in the R-Codes. Accordingly a Local Development Plan may be required to appropriately respond to contextual factors, such as relationship to the public realm, servicing, access and screening.

Residential R160

The site positioned between the two primary areas of POS and Street 1, is also subject to the most significant ground level change found within the BTS. These contextual factors provide an excellent opportunity for the design of distinctive built form which includes a split-level ground floor that responds to Lefroy Road and Street 1.

An opportunity to provide direct vehicle access to Lefroy Road exists where it can be appropriately supported by technical information and the delivery of a ground floor which maintains a high degree of activation for residential development.

The east-west orientation of the R160 site facilitates the achievement of a high proportion of northern aspect dwellings, maximising access to natural light. Similar to the R100 site it is considered that a site specific response to development will be required. Accordingly a Local Development may be required to appropriately respond to contextual factors, such as access to Lefroy Road, relationship with the public realm and servicing.

5.3.4 Public Open Space

A Public Realm Master Plan has been prepared for the BTS by REALMstudios (refer **Appendix B** and **Figure 23** below). Key outcomes of the report are discussed below:

Location and Distribution

The BTS incorporates two key areas of Public Open Space (POS), the primary area of POS is separated into two distinct components, North-West and South-West, which are bisected by Street 1. This area of POS is approximately 4772m², providing pedestrian and cyclist connectivity through the western edge of the BTS and a range of pedestrian amenities.

The secondary area of POS is located at the south-eastern corner of the BTS and is approximately 1327m2 in area. This area will provide opportunities for passive recreation and contemplation, while also providing a green interface between Fremantle College and the BTS. Both southern areas of POS also serve a drainage function and respond to the existing difference in ground levels between Lefroy Road and the BTS.

Figure 25: Public Realm Master Plan

Form and Function

The defining theme which permeates throughout the public realm design is the cohabitation of context, through the reuse of naturally forming limestone, and the movement of water, which can be seen in the proliferation of swales throughout the public realm and the prevalence of surface water. Stormwater will be gathered by overland swales which connect with the southern extent of the BTS which houses the two primary areas of drainage. The BTS is underlain with limestone bedrock, found predominantly in the eastern half of the site. While the retention of the limestone in-situ is not feasible, the limestone will be reconstituted and reused throughout the public realm, providing a secondary visual connection with place and linking the site with the limestone scarp found running north-south to the east of Fremantle.

POS 1 – North-West POS

POS 1 (Refer **Figure 26**) approximately 1,646m², provides day to day recreation for the immediate residential population.

The elevated location together with retention of mature Ficus trees creates an instant cool, shady and appealing place. The hardscaped courtyard of the former TAFE featured circular raised planters wrapping the trees. To aid in the health of the retained trees new raised planter walls will be constructed, potentially from reused limestone.

A plaza forms a node in association with the main east-west street as it bends through the development. It also is the northern component of the green link, connecting future dwellings up to Grosvenor Street across to Bruce Lee Oval.

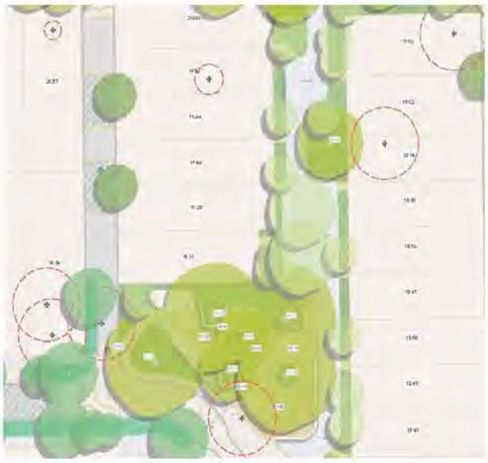


Figure 26: POS 1 - North-West POS

POS 2 – South-West POS

POS 2 (Refer **Figure 27**) serves as the recreational and social focus of the BTS, providing the most significant area of public open space. POS 2 also navigates the level difference between Lefroy Road up to the central east-west road and the grade of the remainder of the BTS.

The existing sump will be rereplaced by a below ground storage and infiltration gallery. A partially turfed and planted shallow basin above the storage will then be available for green open space. This basin will capture and infiltrate rainfall events while also retaining water at the surface where practical.

POS 2 also incorporates at-grade pedestrian and cyclist paths along the north-western corner of the open space and a number of opportunities for passive recreation.

Figure 27: POS 2 - South-West POS

POS 3 – South-East POS

POS 3 (Refer **Figure 28**) features a large expanse of lawn, interfacing with tree canopy for shading and a series of retaining and seating walls, confirming POS 3 as an area predominantly for rest, respite and relaxation.

Similar to POS 2, POS 3 navigates the significant level difference between Lefroy Road and the main east-west road. This small open space provides a path connection which traverses the level change, relying on switchbacks to achieve a grade which is unversally accessible. POS 3 also serves a drainage function, with a stormwater storage tank located below ground.

Due to the level difference the lots fronting POS 3 to the north incorporate a split level to suitably address the POS and obtaining vehicle access from the rear lane. Lots will have direct access to the public open space, facilitating good passive surveillance of the public realm.

Figure 28: POS 3 - South-East POS

5.3.5 Landscape Design

Streetscapes

The streets within the BTS comprise three distinct categorised based on their role, widths and design, as follows:

Street 1 (15m - 16m)

Street 1 is a continuation of Badham Close from the west, extending east through the BTS then turning northward and connecting with Grosvenor Street. The form and function of this route is consistent with Access Street D as defined by Liveable Neighbourhoods.

Street 1 is varies between 15m and 16m in width, with the 16m width (Refer **Figure 29**) located opposite the R160 zone to allow for on-street and embayed parking, 1.5m pedestrian paths and swale/tree planting, in addition to a nominal 6m/5.6m carriageway (Refer **Figure 30**). On-street and embayed parking will be line-marked to encourage a slower traffic environment enhancing pedestrian amenity and safety.

Additionally, to facilitate an improved pedestrian experience adjacent to the green link the adjacent carriageway width will be throttled and include material treaments which combine to reinforce pedestrian priority.

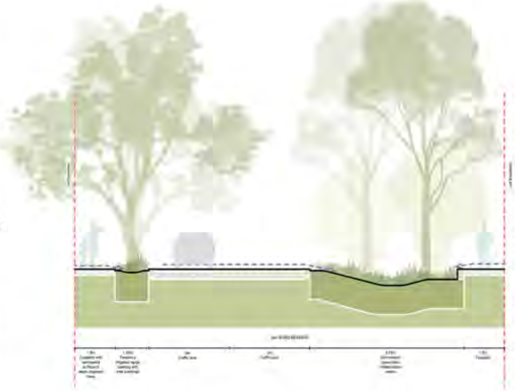


Figure 29: 16m road reserve - typical

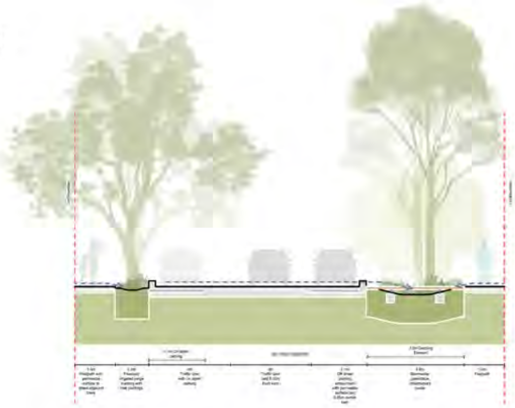


Figure 30: 16m road reserve - on street parking

Street 2 (11m)

Street 2 is oriented north/south and connects Grosvenor Street east of Lewington Street to Street 1. The form and function of this route is consistent with Access Street D as defined by Liveable Neighbourhoods.

The Street 2 road reserve incorporates two 3m lanes, a 1.5m wide footpath adjacent to 1m of verge planting and a 2.5m swale which also includes pedestrian connection to dwellings (Refer **Figure 31**). Similar to Street 1, on-street parking is proposed to be included intermittently along Street 2 to encourage a slower speed environment (Refer **Figure 32**).

No subterranean services are proposed to be located within the Street 2 road reserve significantly reducing potential conflict with tree root zones, optimising growth and vitality of vegetation.

Laneways (6m)

All other internal streets are proposed as 6m road reserve widths, consistent with laneways as defined by Liveable Neighbourhoods. As all single lots are envisaged to be rear-loaded, the laneways provide vehicle access to all single lots.

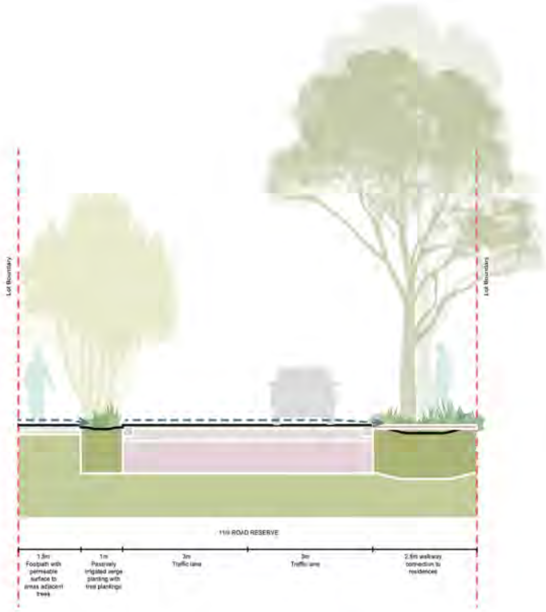


Figure 31: 11m road reserve - typical

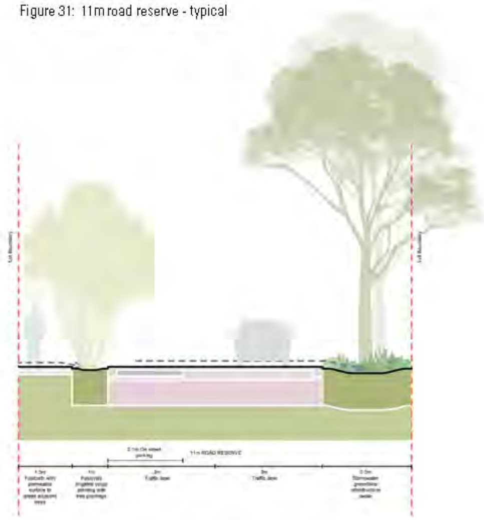


Figure 32: 11m road reserve - on street parking

5.3.6 Movement and Traffic

A Transport Impact Assessment has been prepared (**Appendix C**) in respect of the transport function of the BTS. Key outcomes of the report are discussed below:

Regional Road Network

The BTLSP site is surrounded by existing roads, described below:

South Street

South Street is a Primary Distributor Road (Main Roads WA Road Hierarchy) which provides connectivity from the now deleted Fremantle Eastern Bypass through to the Kwinana Freeway and beyond to the east. South Street has a single lane in each direction, with unprotected on street cycle lanes within a 20m road reserve. It is subject to a 60km/hr speed limit.

Lefroy Road

Lefroy Road is a Local Distributor (Main Roads WA Road Hierarchy). It is a two-way single carriageway road which connects to Hampton Road in the west and Carrington Street in the east. It is subject to the built-up area 50km/h speed limit and this drops to 40km/h near the LSP site due to a School Zone. There is unprotected on-road cycle lanes and sits within a 20m road reserve.

Badham Close

Badham Close is an Access Road (Main Roads WA Road Hierarchy). It is a two-way single carriageway cul-de-sac with access via Lefroy Road. It is subject to the built-up area 50km/h speed limit and sits within a 15m road reserve with a 6m wide road pavement.

Grosvenor Street

Grosvenor Street is an Access Road (Main Roads WA Road Hierarchy). It is a two-way single carriageway road which intersects with Lewington Street and Caesar Street. It is subject to the built-up area 50km/h speed limit and sits within a 20m road reserve with a 6m wide road pavement.

Caesar Street

Caesar Street is an Access Road (Main Roads WA Road Hierarchy). It is a two-way single carriageway road which intersects with South Street to the north and Lefroy Road in the south. It is subject to the built-up area 50km/h speed limit and sits within a 20m road reserve with a 6m wide road pavement.

Lewington Street

Lewington Street is an Access Road (Main Roads WA Road Hierarchy). It is a two-way single carriageway road which intersects with Grosvenor Street in the south and South Street in the north. It is subject to the built-up area 50km/h speed limit and sits within a 20m road reserve with a 6m wide road pavement.

Transport Impact Assessment

The Transport Impact Assessment notes that at full development of the BTLSP it is anticipated to generate 930 vehicle movements per day and 95 vehicle movements each way on the peak, which is less than the 1,750 attributed to the operation of the TAFE. The modelling undertaken confirms that the external and internal road capacity is sufficient to accommodate the anticipated volume of movements.

The potential for direct access to Lefroy Road from the proposed grouped dwelling/multiple dwelling site on Lefroy Road was also modelled and was found to operate satisfactorily, with minimal disruption to Lefroy Road traffic flows.

Street Types and Connections

Three road typologies are proposed within the BTLSP including, one primary east-west route (15m – 16m road reserve), a secondary north-south route (11m road reserve) and six tertiary laneways (6m) providing a supporting function and connecting to the primary and/ or secondary route.

Street typologies are shown in **Figure 32.**

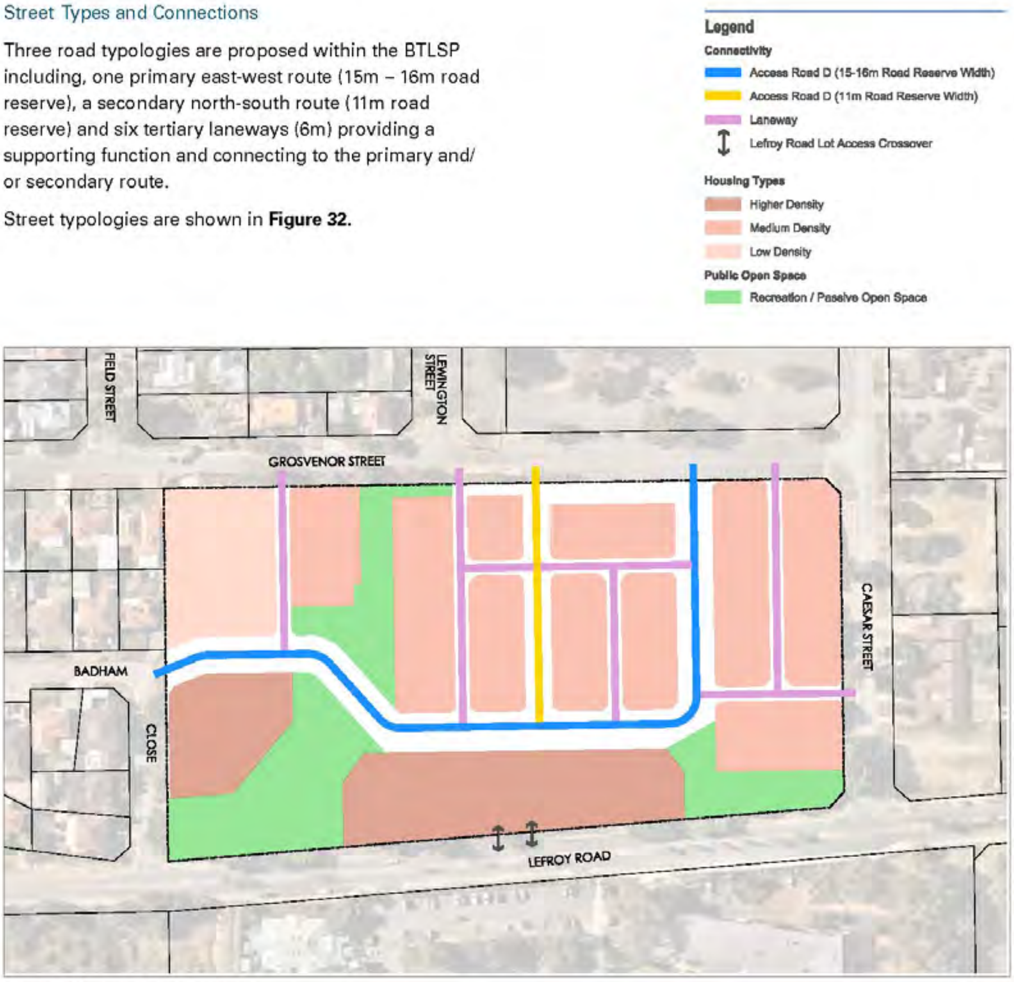


Figure 33: Movement - Vehicle Connections

Pedestrian Movements and Cycle Network

The BTS is situated amongst a number of key pedestrian and cycle routes, providing connections to schools, public open space as well as future and existing local centres. Historically, pedestrians benefitted from an informal connection through the western extent of the BTS connecting Lefroy Road to Grosvenor Street. The BTS is also identified in the City's Bike Plan 2019 - 2024 as a key future north-south connection for cyclists, tieing into the existing cycle network.

The BTS includes provision for both pedestrians and cyclists to move in a north-south direction through a formalised connection within the green link, improving pedestrian and cyclist amenity overall.

Legend

Connections
- Shared Path
- Pedestrain Path
- Laneway - Informal shared street

Housing Types
- Higher Density
- Medium Density
- Low Density

Public Open Space
- Recreation / Passive Open Space

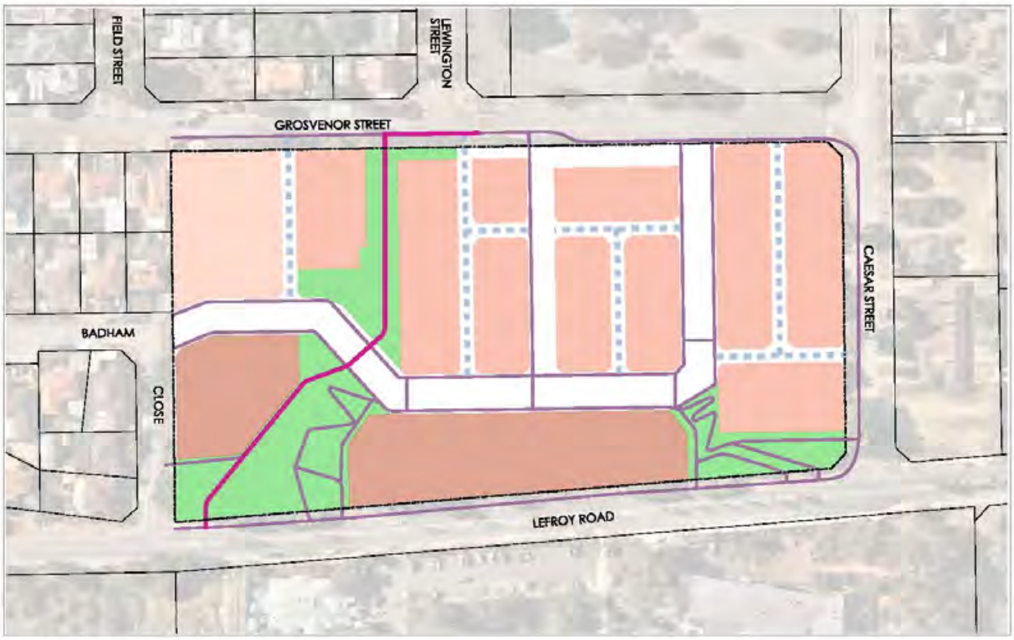


Figure 34: Pedestrian and Cyclist Connections

Public Transport

The BTS is located within immediate proximity of existing bus routes along Lefroy Road (511, 512 and 513) as well as being within walking distance of bus routes along South Street (160, 998 and 999) which operate at high frequency during peak hours, providing connectivity to the wider public transport network via Fremantle Station or Murdoch Station.

No additional public transport links are proposed.

5.3.7 Water Management

A Local Water Management Strategy has been prepared (**Appendix D**) in respect of the water management of the BTS. Key outcomes of the report are discussed below:

Water Sustainability

The key water sustainability outcome is proposed to be implementation of a community bore for the irrigation of private gardens located within single residential and grouped housing lots. Groundwater is proposed to be used for the irrigation of public open space. There is allocation available in the Perth superficial aquifer and a groundwater allocation has been applied for for a volume of 13, 598 KL/annum for public open space and the community bore.

Additionally, the retention of existing trees are proposed wherever possible within areas of public open space and water efficiency measures are proposed for domestic house management.

Wastewater will be disposed of by the reticulated sewerage network and potable water provided by scheme water.

Stormwater Management

Pre-development the BTS incorporated two existing sumps located to the south-west and south-east which accounted for drainage coming from the TAFE and two external road catchments.

Key post-development management will include:

- Soakwells will be required for all dwellings to capture and infiltrate stormwater.
- Permeable paving will be used in portions of the road reserves to infiltrate stormwater close to source.
- Stormwater from first flush events will be treated in roadside swales.
- Road drainage will be conveyed to roadside swales and/or infiltration cells via the road reserve or pipe/pits.
- Swales discharge to two main infiltration areas; the eastern and western infiltration areas.
- The western infiltration area will have underground cells within the old sump area, with an infiltration basin over the top of cells and will accommodate 1% AEP event on site.
- The eastern infiltration area will have underground cells within the old sump area and will also accommodate up to the 1% AEP event on site.
- Swales will be vegetated with locally native, drought tolerant species but will be provided with irrigation to ensure healthy plant growth. Trees will be retained were possible with public open space, with additional planting to provide shade and to assist in maintaining good infiltration rates.
- Stormwater drainage design ensures detailed immobile stormwater is full infiltrated within a time period exceeding 96 hours per storm event.

Groundwater Management

Due to proposed changes to the existing landform for development purposes, some sand fill will be required to re-contour site. The sand will also be mixed with limestone rubble to ensure uniform infiltration.

All WSUD infrastructure has a minimum separation of 11m to ground water and finished lot levels are approximately 2.7m from the top water level in the basins, exceeding the minimum clearance requirement of 0.3m.

5.3.8 Servicing and Infrastructure

An Engineering Servicing Report has been prepared (**Appendix E**) in respect of the servicing of the BTS. Key outcomes of the report as discussed below:

Existing Topography and Geology

Broad demolition of the Challenger TAFE structures have occurred, with key contour features being:

- The site is broadly characterised with an RL 21.17 AHD at the north-western entry off Grosvenor Street, falling to RL 19.32 AHD in the south-western corner at Lefroy Street.
- There is an existing basin in the south-western portion of the site, approximately 536m2, at RL 17.80 AHD around the edges, to RL 11.72 AHD at the centre of the basin.
- RL 19.32 AHD in the south-western portion, to RL 19.13 AHD along Lefroy Street to the south-eastern corner. Before the corner of the site batters down to another basin with a base RL of 12.50 AHD, over 294m2. This batter extends 170m around the corner of the site, totalling an area of 1,989m2.

An updated feature survey of the now demolished site will be undertaken to establish the internal site levels.

The site is typified of the following soil condition:

- North-eastern quarter of the site is underlain by solid limestone to a depth of at least 5m.
- South-eastern quarter of the site is comprised of mainly limestone fill.
- South-western corner of the site is comprised of bright orange sand with a thin layer of stone in some locations, and large limestone boulders.
- North-western corner of the site consists of sand fill for approximately 1m, overlying sand with boulders.

A geotechnical investigation of the BTS was undertaken, and based on the field investigation results, subsurface conditions can be generalised as follows:

- Sand/Silty Sand/Gravelly Sand: including site-derived fill. Typically sand with variable amounts of limestone as gravel and cobbles, with non-plastic fines. Thickness is variable;
- Inferred Limestone: based on test refusal depths.

It is suggested that the BTS is classified as 'Class A' in accordance with AS 2870-2011 provided that normal site preparation is undertaken prior to construction.

Bulk Earthworks

The bulk earthworks design strategy will take into consideration the existing levels, tree retention and use of built form to tie into the existing environment. Key design elements include:

- Implementation of a split lot level into the southern grouped dwelling/multiple dwelling site, allowing at least one storey level difference between Lefroy Road at approximately RL 15.20 AHD and the internal network at approximately RL 18.40 AHD.
- Implementation of a split lot level concept for the block of single residential lots (lot 12 to 16) on the corner of Lefroy Road and Caesar Street, where the 2m difference van be absorbed through built form and also allowing the lots to be accessed from the south-eastern Public Open Space.
- Lot levels will be designed to minimise retaining walls where possible.
- Given the presence of solid limestone within the north-eastern portion of the site a minimum Class "A" site is expected to be achieved. The affected area may have to be over-excavated by 1m to remove limestone, and 1m of inert sand fill balanced by cut/fill.

Power

Based on the Western Power maximum demand (DADMD) calculator, it is anticipated that the maximum demand per green title dwelling will be 3.1 kVA, and the maximum demand per multi-residential lot will be 4.7 kVA.

The Western Power Network Capacity Mapping Tool indicates that the land development area is fed by the Edmund Street Amherst substation. The remaining capacity on the network is between 15 – 20 MVA.

The Beaconsfield TAFE had power provision for 2 x 500 MVA. The proposed development will require less than the demand of the site when it was previously operating as a TAFE. Therefore, there is adequate power provision for the site.

It is likely that two substations will be required to service the development, with the aspiration of undergrounding the existing overhead power network along Lefroy Road.

Sewer

The Water Corporation Esinet data indicates that the development area is located adjacent to a number of sewer reticulation mains. It is anticipated that an extension of the existing network through the BTS will be required to facilitate the ultimate lot design, factoring in existing topography and depressions, particularly to the south of the BTS.

Water

The Water Corporation Esinet data indicates that the development area is located in proximity to a number of water reticulation mains. An extension and upgrade to of the existing Grosvenor Street main and the Caeser Street main is anticipated, servicing the development from the north and eventually connecting with the existing Badham Close main. The upgrade to the existing service is recommended to ensure sufficient provision of fire services capacity.

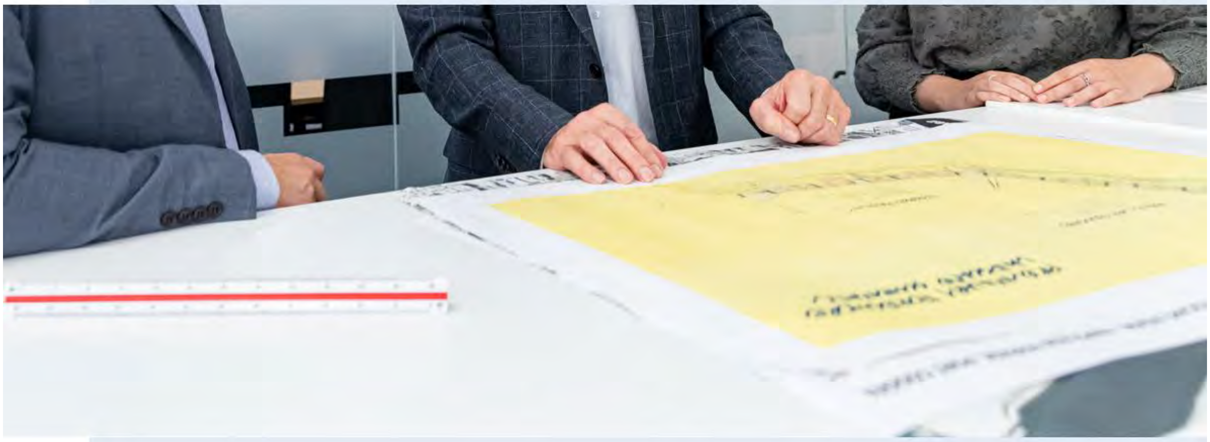
Gas

As discussed in preceding sections it is proposed that BTS site will not incorporate a reticulated gas connection.

Telecommunications

A Dial Before You Dig investigation indicates that there is sufficient existing communications infrastructure surrounding the site to service the development.

6.0
Staging and Implementation



6.0 Staging

As indicated on **Figure 35** , staging for the BTS redevelopment is proposed to be broadly carried out in two stages.

Stage 1

Will deliver the majority of the envisaged redevelopment including road reserves, public open space, servicing infrastructure and single residential lots.

Stage 2

Will deliver the remaining elements of the BTLSP, primarily the grouped dwelling and multiple dwelling sites.

Figure 35: Beaconsfield TAFE Local Structure Plan - Staging

Appendix A

Certificate of Title

REGISTER NUMBER	
2680/D33642	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	N/A

WESTERN AUSTRALIA

VOLUME	FOLIO
4017	277

RECORD OF CERTIFICATE OF TITLE

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.

BGRoberts
REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 2680 ON DIAGRAM 33642

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

WESTERN AUSTRALIAN LAND AUTHORITY OF LEVEL 2, 40 THE ESPLANADE PERTH WA 6000
(TF P063095) REGISTERED 3/3/2022

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

1. *P063096 CAVEAT BY STATE OF WESTERN AUSTRALIA LODGED 3/3/2022.

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:	LR3054-106 (2680/D33642)
PREVIOUS TITLE:	LR3054-106
PROPERTY STREET ADDRESS:	11-15 GROSVENOR ST, BEACONSFIELD.
LOCAL GOVERNMENT AUTHORITY:	CITY OF FREMANTLE
RESPONSIBLE AGENCY:	WESTERN AUSTRALIAN LAND AUTHORITY

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING P063095

Appendix B

Landscape Report- REALMstudios

Beaconsfield TAFE

Landscape Report

REALM studios

REALMstudios ...

would like to acknowledge that the site included in this report is on the traditional lands of Whadjuk Noongar. We offer our respect to the elders both past, present and future and through them, all Aboriginal and Torres Strait Islander People.

We are all on Country.

We respect its original owners, their knowledge, these places - with them, we work to create regenerative systems, places and solutions for the future.

We would like to also acknowledge the broader community, stakeholders and Council staff that have contributed to the process and outcome of this Guideline Document.

Project: 22456 Beaconsfield TAFE

Authors: Damien Pericles, Brett Schreurs, Michael Mirmeo, Jessica Gannaway, Ali Doody Burras

Client: DevelopmentWA

Date: May 2023

Revision: Final

Prepared by: REALMstudios

Table of Contents

draft

REALM studios

Map of Fremantle Harbour 1887

Introduction

draft

The former Beaconsfield TAFE site was developed in the late 1960's as an education campus for various trades including building and construction, carpentry, business, hospitality, marine science, and visual arts. Prior to this the site was remnant coastal bushland over an undulating dunal landform.

The Whadjuk Noongar peoples have a deep history of connection to the area as well as recent links to the TAFE facility, in particular through the visual arts course.

The demolition now gives way to development of the site primarily for medium density residential purposes of which social and affordable housing is anticipated.

The landscape strategy is couched in social and ecological sustainability. The vision is to create a new residential community grounded in place and respectful of Noongar ways of being.

Reflective of lost ecologies associated with coastal dunes and the limestone ridge upon which the site is located.

It will connect beyond site to strengthen and link with the recreational and open space network outlined in the 'Heart of Beaconsfield Master Plan', and it will provide the infrastructure to support a healthy community.

Despite most being exotic species, the design retains valuable existing trees to create instant tree canopy and cool shade in key open spaces. Additional street tree planting will, in time, deliver ecologically responsive canopy together with an integrated water management and movement network that supports walking and cycling.

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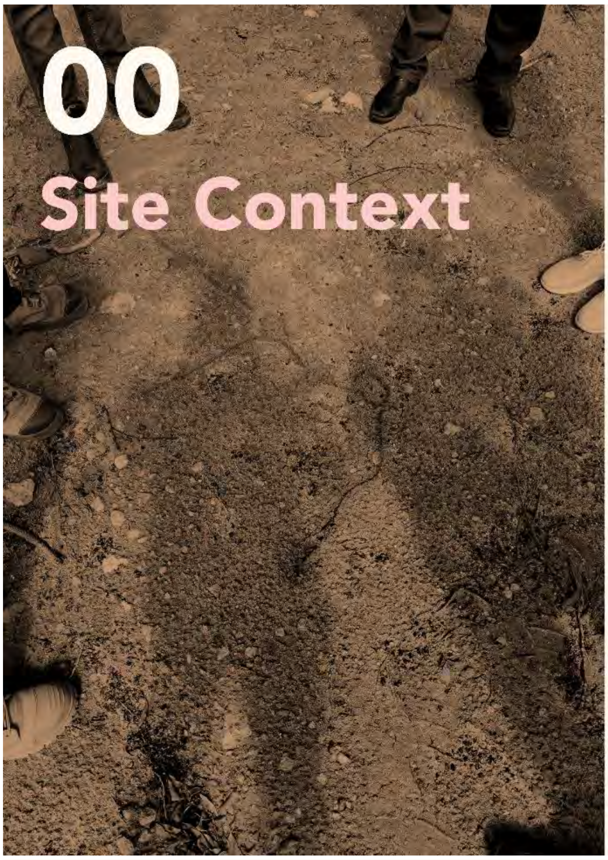
Site Context



draft

Walk on Country with Noongar Elders

A walk on country occurred with the design team and Whadjuk Noongar Traditional Elders including Glenys Yarran, Brendan Moore, Greg Ugle and Diana Ponton.

The discussion was fruitful and initially revolved around the recent history of the TAFE campus where numerous Noongar students were enrolled in the Visual Arts course taught by local artist Lindsay Powell during the late 1990's. Glenys and Diana talked fondly about a creative period in which a large amount of work was produced, some of which is unaccounted for. There is an opportunity to capture this 'lived experience' in the landscape design.

We learnt that this area was Midgegooroo country or Beeliar, which stretched from the ocean through to the Canning River south of the Swan River. Midgegooroo was the father of Yagan and like his son was well known for his resistance to colonial settlement. It is highly likely that Midgegooroo would have been one of those who observed the first British explorations in 1827 and the subsequent establishment in June 1829 of the port of Fremantle. He was captured and then later executed on 22nd May 1833 following multiple violent exchanges with colonialists.

As part of the interactions between settlers and Noongar there was description that the area around the TAFE site would have been used for transient tracks and escape routes as well as high points where observation of colonial movements were afforded. Given the sandy, limestone soils and elevated exposed condition the area was not inhabited as much as the resource rich coast and necklace of wetlands further inland. Regardless the low points adjacent the site would have been seasonal wetlands that may have provided a food source. These have since been filled in and developed. When camping in the area Mia Mias would have been built to protect from the winds.

A story was shared regarding Seven Brothers, expressed through seven hills that are spread over the Fremantle area. These included Monument Hill, Cantonment Hill, Clontarf Hill and Buckland Hill.

Mythological stories relate to the limestone ridge as being created by the Waugal, the sacred rainbow serpent. The nearby Clontarf hill holds the story of a mother and her two sons who are the protectors of Derbal Nara (Cockburn Sound), and who protect Derbal Nara from the Booyl-a-gatak, or sorcery coming from the north-west. A Nyitting story explains that the Derbal Nara or Cockburn Sound was formed through a fight between the Waugal and the Spirit Crocodile from the north.

The underlying geology was talked about – caste limestone and the traditional use of limestone when crushed into powder form for use in painting. The use of site-sourced limestone was supported with suggestions to use in gabion walling.

Local plants and animals that were discussed include:
Melaleuca lanceolata (Rottnest Island Tea Tree) or Moonah and
Eucalyptus gomphocephala (Tuart) or Tuart

The group recommended Aboriginal organisations be contracted to provide construction and maintenance services as part of the delivery of the precinct and to source local seed for propagation and use in future planting on site. There was a desire to see Noongar employment opportunities.

Drawing in sand by Brendan Moore of the South Fremantle coastline and associated points of attraction for Noongar peoples.

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Precinct Planning Context

draft

Heart of Beaconsfield Master Plan

A regional master plan was developed and is now adopted by the City of Fremantle together with Department of Communities and the local community. The TAFE site is located central to the plan.

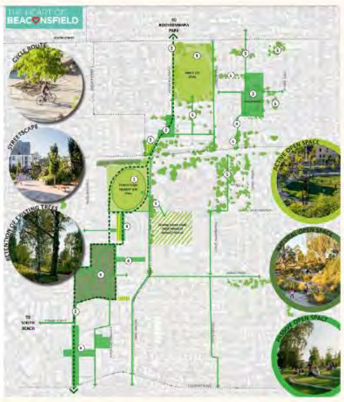
It identified a north/south open space network and future development areas with the following key and relevant strategies:

- To provide pedestrian and cycle links between open space, community facilities and recreation areas
- Provide a range of housing types for various income levels
- Retention of significant trees to maintain a sense of place
- Provide for a north-south green link that enhances tree canopy and connects key areas of open space.
- Retain and provide additional active, natural and passive open space.

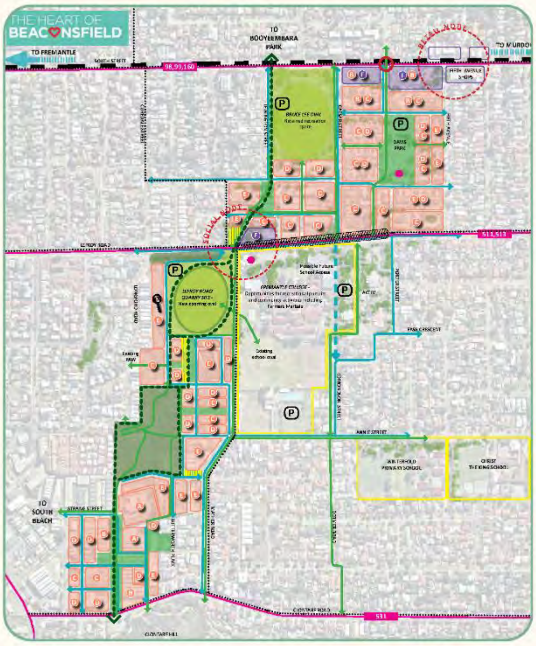
On the TAFE site specific and relevant points from the master plan include:

- Retain Trees and provide a N/S green link through the site.
- Provide for activity appropriate for a social node
- Create a retail and social node to the SW corner of site
- Provide some high density apartment living.

Most importantly, the master plan shows how the TAFE site needs to provide a strong connection through site in order to forge a strong pedestrian and cycle link along the length of the broader Heart of Beaconsfield Master Plan.



The Heart of Beaconsfield Master Plan



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Precinct Ecological Corridor

The former TAFE site is located within a loosely connected series of remnant and potentially regenerated open spaces and bushland areas, that form a north south connection in line with a limestone ridge and parallel to the coast. Conceptually there is an ecological link that stretches from the Beeliar Regional Park to Booyeembara Park integrating both hilltop and lower damp-land ecologies. This chain of spaces has been identified in the Heart of Beaconsfield Master Plan.

Key remnant bushland sites such as Clontarf Hill, Manning Park and Beeliar Regional Park provide a good indication of the former ecological context and plant communities that would have inhabited the former TAFE site. These sites feature very high ecological & cultural values with rare and endangered species & communities such as limestone heath and Tuart Woodlands.

The reserves provide roosting and forage habitat for the endangered Carnaby Cockatoos and feature the protected Parrot Bush (Banksia sessilis) which occurs over much of the ridge. There are also potential sites for the threatened Graceful Sun Moth (priority 4 endangered species) and a recorded site for the Lined Skink (priority 3 endangered species).

The lower chain of wetlands located between two dune systems that feature in the Beeliar Regional Park would have been a former coastline.

The proximity to the coast means strong and semi-saline winds are a feature that also inform ecological communities and their habits.

The key tree species in these reserves include:

- Eucalyptus gomphocephala (White Gum) or Tuart in Noongar
- Melaleuca lanceolata (Rottnest Island Tea Tree) or Moorah
- Melaleuca rhaphiophylla (Swamp Paperbark) or Bibool and
- Eucalyptus decipiens (Red Heart Gum) or Moit

draft

1 BEELIAR REGIONAL PARK

2 MANNING PARK

https://fremantleshippingnews.com.au

3 CLONTARF HILL

4 LEFROY ROAD QUARRY SITE

5 BEACONSFIELD TAFE SITE

6 BRUCE LEE OVAL

7 BOOYEEMBARA PARK

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Precinct Ecological Narrative

draft

1953 Aerial of Beaconsfield (Landgate)

1953

1965

1979

The dominance of limestone outcrops and underlying geology creates a specific soil condition but also defines a rustic character of the area.

The Cottesloe soil complex is described as a low hilly landscape with shallow brown sands over limestone with much exposed limestone. The site would have had a dynamic topography with dunal high points and seasonally wet depressions. The TAFE development has flattened much of the site through cut and fill.

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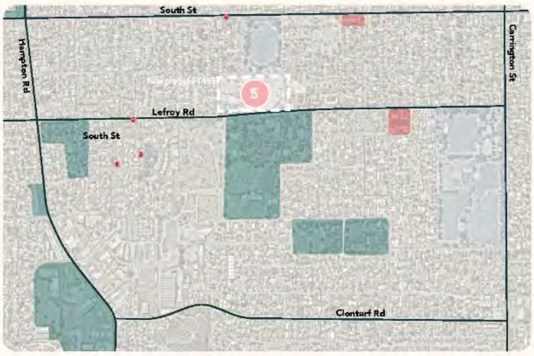
Beaconsfield Urban Character

A study tour of the surrounding area reveals the underlying kast limestone geology and how this materiality informs a unique character of the area.

Streets are often cut through the soft rock to reveal sectional elevations of the bed rock that in some locations require structural support with either concrete or brick infill.

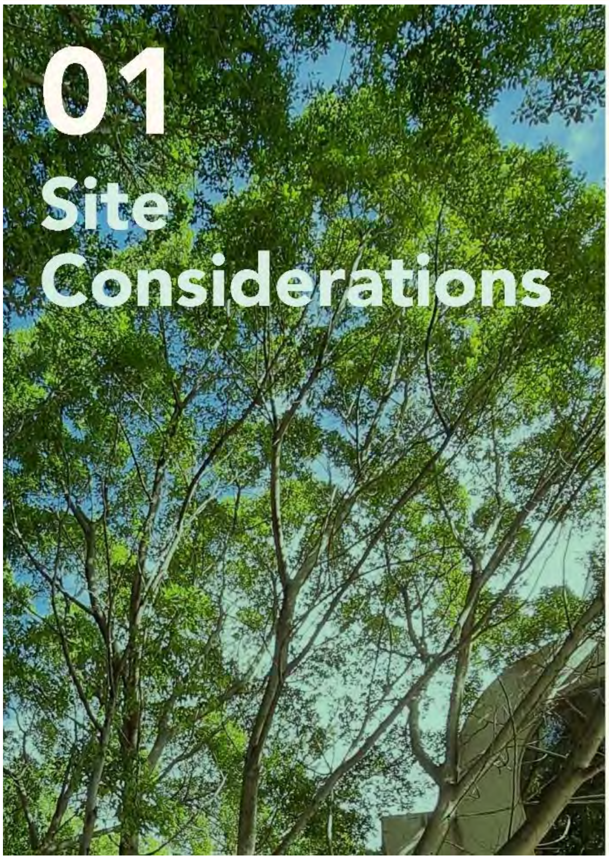


Corner South and Field Street, Beaconsfield

Solomon Street, Beaconsfield.

Expression of kast limestone ridge found throughout the suburb of Beaconsfield.

A patchwork of limestone forms, finishes and construction over time.



Landscape Analysis

The context and existing site features:

- Bruce Lee Oval - former seasonal soak
- Council Carpark to north and potential development site
- Various fully mature existing trees - some forming a link across the site (refer detailed assessment)
- PSP to south landing on Lefroy Road
- High School & Primary School opposite to south
- Low point on Lefroy Road to south
- Two constructed sumps / low points
- Generally good views to south

Existing Tree Assessment

draft

Existing trees have been assessed to identify an overall landscape retention strategy. The assessment includes trees on lot as well as verge trees.

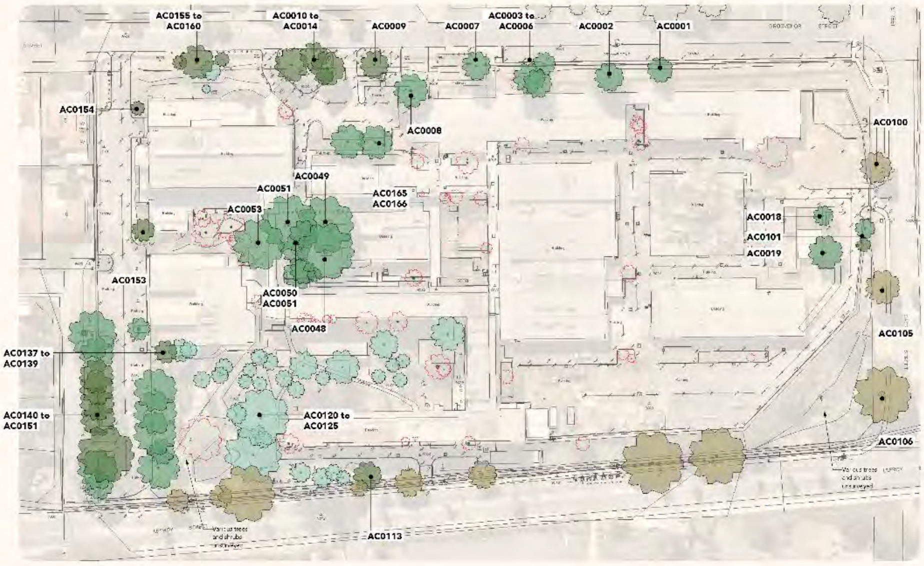
This has been conducted using arboricultural reporting from Arbor Centre titled: 'Beaconsfield TAFE - Arboricultural Dilapidation Report - Arbor Centre - April 2020' which has provided (among other things) species, size, age and health of trees.

It was found that very few native tree species within the lot were worthy of retention.

There were however a number of good quality exotic trees worthy of retention.

Trees nominated for retention have informed lot layout, road alignment and site levels. Levels are informed by proximity to major roots.

We note that some trees were not surveyed.



Legend - Existing Trees

Exotic Species - Retain

Non-Surveyed - TBC

Trees To Be Removed

Other Verge Trees - Retain

NOTE

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Existing Trees and Character

Existing trees identified to be retained on site form the building blocks for an ecological corridor and instant urban canopy at a precinct scale.

The demolishing of existing buildings allow for a visual connectivity between POS areas and green pockets throughout the proposed development.

The existing tree canopies provide opportunity for a shaded route through the development.

Retained trees - looking north (230320)

draft

1 SOUTH-WEST CORNER SOAK

Araucaria heterophylla (Norfolk Island Pine) AC0121 to AC0128 in 'Good Condition' to be retained.

Ficus microcarpa var. hillii (Hills Weeping Fig) AC123 to be retained.

2 EXISTING CARPARK

3 FICUS COURTYARD

Ficus microparpa var hillii (Hills Weeping Fig) AC048 to AC053 to be retained.

4 FICUS COURTYARD

5 GROSVENOR ST. EDGE - WEST

Melaleuca lanceolata (Rottnest Island Tea Tree) AC0163 and Casuarina equisetifolia (Hosetail She-oak) AC0158to be retained

6 GROSVENOR ST. EDGE - EAST

Melaleuca lanceolata (Rottnest Island Tea Tree) AC0011 to AC0014 and Casuarina equisetifolia (Hosetail She-oak) AC0009 to be retained

7 SOUTH-EAST CORNER SOAK

Tree codes from the below report:
'Beaconsfield TAFE - Arboricultural Dilapidation Report - Arbor Centre - April 2020'

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Topography & Drainage

The original topography would have featured a dunal hilltop to the NE corner of site. This has been levelled with the top of the hill pushed southward to create a level pad for the former TAFE building.

To the south-west corner TAFE buildings negotiated a single floor level change to a low lying zone where a fenced sump for drainage is located.

Another fenced sump is located to the south-east corner of the site. A significant level change is experienced in this location, where the site meets Lefroy Road.

Typically the majority of former building pads were at a level of RL 19.20. This level now features significant bed rock just below the surface. Former drainage and service corridors were excavated from the bed rock to achieve required depths.

Grosvenor Street acts as an east-west ridge line with water draining to the north at this point.

Given the nature of karst limestone the large flat surface actually drains fairly well (as evidenced in a site visit immediately after rain). Some local pooling was evident however less then expected.

LEGEND

- Existing open drainage sump
- Existing site drainage pits
- Overland Flow Direction

1 SOUTH-WEST CORNER SOAK

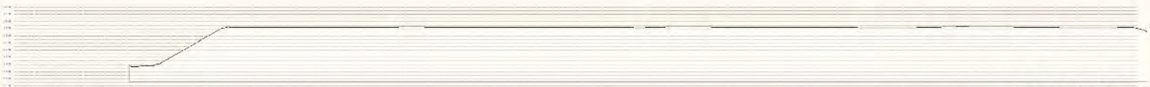
2 SOUTH-WEST CORNER SOAK

3 INTERNAL LEVELS

4 INTERNAL LEVELS

5 LEFROY ST. LEVEL CHANGE

6 SOUTH-EAST CORNER SOAK



Section through existing conditions

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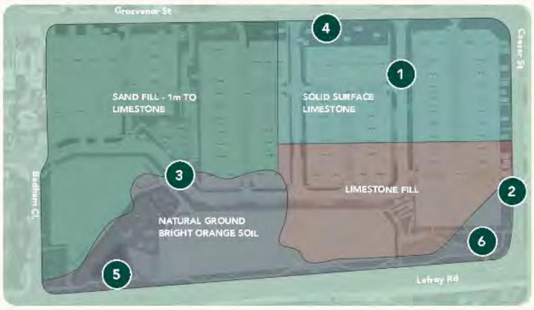
Site Geomorphology



The demolition contractor provided important input on existing conditions immediately following demolition in particular with regards soil conditions.

As per the diagram, a good quarter of the site was identified as being limestone bed rock. Image 1 is an aerial photo showing the bucket scrapings into the rock. This has cost and engineering implications for the development.

It also represents an opportunity for the limestone to be quarried and used as a material resource within the project.

Throughout the site large 'floaters' are evident and would equally be suitable for reuse as feature elements in the landscape.

Within the south-western sump karst limestone is clearly evident in the steep battered wall of the depression.

1 SURFACE LIMESTONE

2

3

4 SURFACE LIMESTONE

5

6

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02 Masterplan Layers

Masterplan Principles

draft

A series of principles are outlined over-leaf to guide design development including:

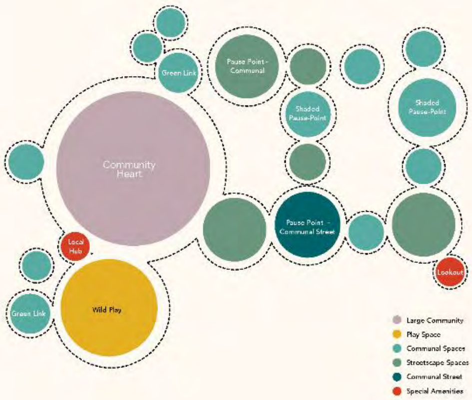
- Tree Retention
- Climate Responsive Design
- Water-wise Design
- Coastal Ecologies
- Sense of Community and Place
- Sustainability and Low Carbon Materiality

The Masterplan is then organised into separable layers or strategies for:

- Uses / Zones / Amenity Programme
- POS Typologies
- Water Management (WSUD)
- Movement and Connectivity
- Lighting & Art
- Proposed Trees

Each of these layers comes together to create the physical foundation to achieve the Masterplan's vision and guiding principles.

Below is an abstracted programme diagram that reveals connectivity between different proposed uses within an approximation of the spatial hierarchy.



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Beaconsfield TAFE will be...

draft

Tree Retention
"Existing Tree Retention to inform urban structure"

Retention and protection of existing trees to maintain as much of the sites existing character and physical properties as possible. Future tree plantings will look to increase the ecological diversity of the site through endemic tree specie selection.

Climate Responsive Design
"Integrate resilience and adaptiveness into the design"

The Beaconsfield TAFE site will integrate climate resilient design into the public and communal spaces of the precinct.

Coastal Ecologies
"Reinstate Coastal Ecologies and connect to place"

Buildings and public spaces will respond to the natural landscape and historic ecological classes of the precinct. The landscape selections will be informed by the sites ecological class.

Sense of Community and Place - Granular Ecologies
"Create a fine grain with moments of delight"

Best practice street design will make sure that safe arrival, movement and connection is prioritised for all. The visibility of cultural narratives and artistic flair will highlight the pride and character of the Beaconsfield community. Spaces will be designed for flexibility in the future as the community evolves.

Sustainability and Low Carbon Materiality
"Deliver Low Carbon Materiality & Life Cycle Cost"

The Beaconsfield TAFE site will use and be an exemplar project for integration of sustainable and low carbon materiality. Full life cycle cost will be a key consideration for material specification and selection. Best practice standards for sustainability will underpin the built form, public realm and ongoing operations of the precinct. The development will target net zero operational and carbon reduction, ensuring positive benefits and a minimal impact on the environment.

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Uses / Zones / Amenity

draft

LEGEND

The Masterplan proposes the following features and amenities:

- Passive recreation areas
- Community Hub
- Community Shelter (BBQ / tables)
- Art Interpretation
- WSUD Infrastructure
- Drink Fountains
- Community Bore
- Wayfinding
- Seating Opportunities
- Gathering Opportunities
- Loco Hub
- Community Foraging
- POS 1 - North West POS
- POS 2 - South-West POS
- POS 2 - South-West POS - Terrace & DUP
- POS 3 - South East POS
- Northern & Eastern Verge
- Southern & Western Verge
- Street type A - 16m
- Street type B - 11m
- Street type C - Laneway 6m

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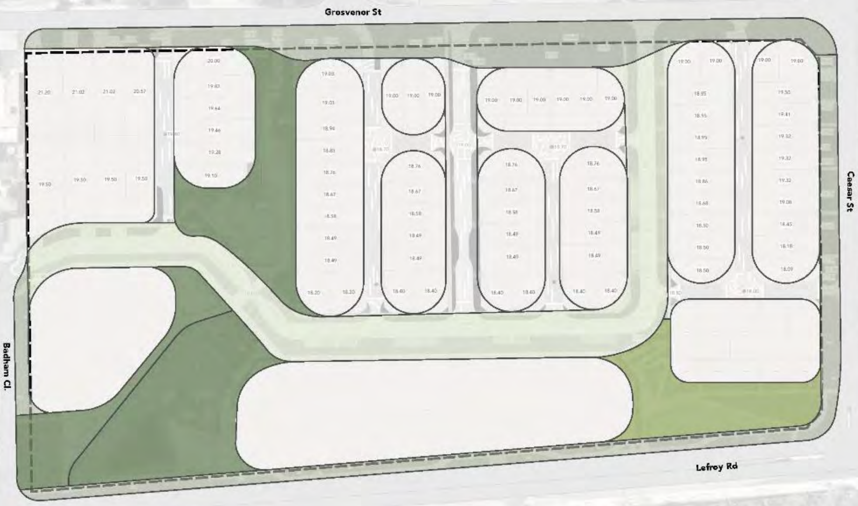
POS Typologies



draft

LEGEND

LOCAL PARKS & GREEN LINKS

- POS 1 - North West POS
- POS 2 - South West POS

POCKET PARK

- POS 3 - South-East POS

MICRO PARK

- All Large Verge Spaces

GREEN STREETS

- Main Street

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Water Management (WSUD)

draft

LEGEND

Potential WSUD Landscape Features:

- Flush kerb - Wet
- Flush kerb - dry
- WSUD swale
- Surface Infiltration
- Sub-Surface Infiltration corridors
- Drainage Falls / Flow Direction
- Pit & Pipe Connection

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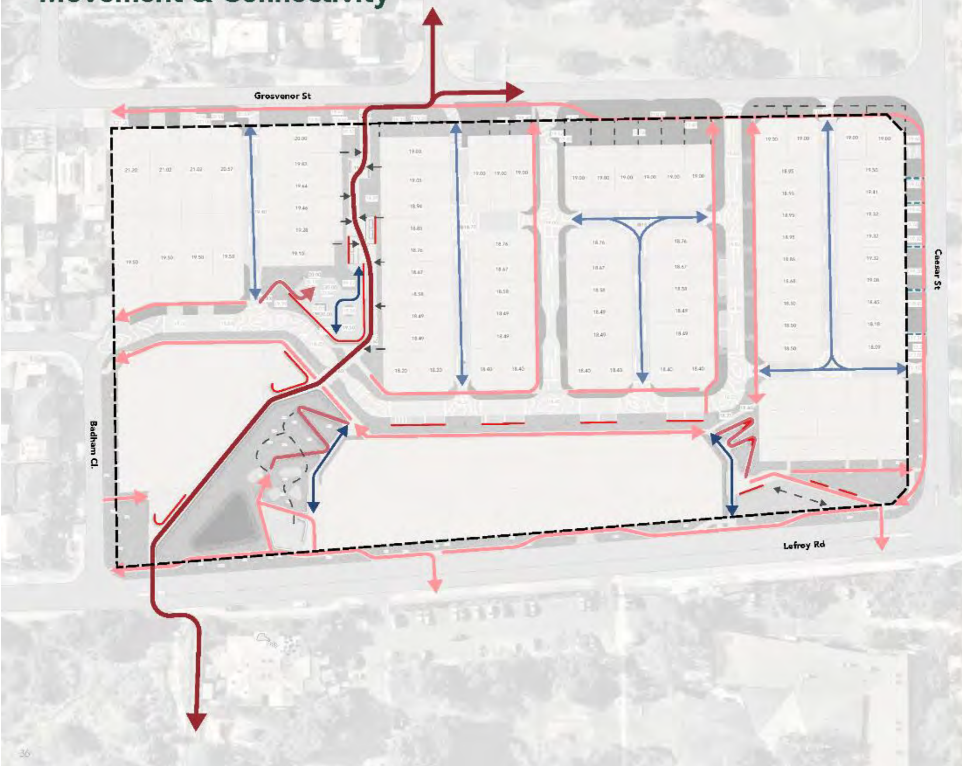
Movement & Connectivity



draft

LEGEND

Potential Connectivity Landscape Features:

- On grade bike path
- DDA - On grade pedestrian
- Laneway - Informal shared street
- Pedestrian connection to verge
- Stair Connection
- Rest / Pause points
- Informal Paths / Connection

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Lighting & Art

draft

LEGEND

Potential Lighting & Art Landscape Features:

- Pole Tops
- Integrated Lighting with existing trees
- Retaining wall with integrated art
- Boardwalk & play space with integrated art
- Paving with integrated art or feature artwork opportunities to be developed

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Proposed Trees

draft

LEGEND

- Existing trees to be retained.
- Existing trees to be removed.
- Feature Street Tree A
- Feature Street Tree B
- Feature Street Tree C
- Feature Street Tree D

CANOPY COVER TARGETS

Pre Development Canopy Cover **19%**

11% Current Canopy Cover

Canopy Cover Target To meet City of Fremantle Urban Forestry Policy: Southern Precinct of 26% **30%**

Note: 30% is the minimum desired Canopy Coverage total.

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Introduction

The landscape and open space master plan for the Beaconsfield TAFE development site addresses three key spatial considerations;

1. destination parks including mini plazas
2. green linkages and
3. variously scaled streetscapes.

The master plan integrates the various layers and strategies outlined previously, together with a design aesthetic & sense of both a local narrative and materiality to create a vision for a new inclusive and sustainable community that has grown out of this specific place.

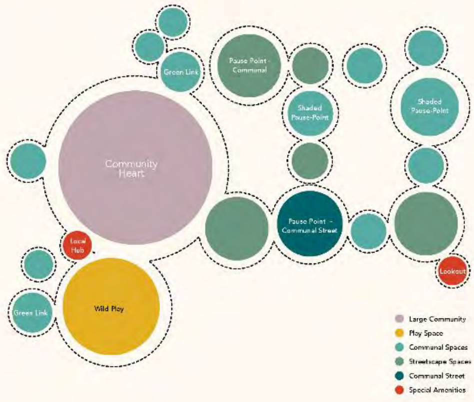
The public open space network has been curated to provide a range of experiences and recreation opportunities for the local community within a shaded and cool urban context. The Figs and Norfolks will create an instant sense of place and enjoyable place to hang out with friends.

The scheme works hard to connect seamlessly with neighbouring and future open space networks to deliver upon the vision of the 'Heart of Beaconsfield MP'.

It integrates best-practice water management to enhance liveability through high-quality tree canopy and increased soil moisture. The mostly native plant palette will strengthen local bio-diversity and in time evolve what is currently a de-natured site into an ecologically responsive and regenerative neighbourhood.

Other sustainability measures will include recycling of site sourced materials to both minimise carbon load but also resonate with a local sense of place. We will also look to engage Aboriginal organisations in the construction and delivery of public art.

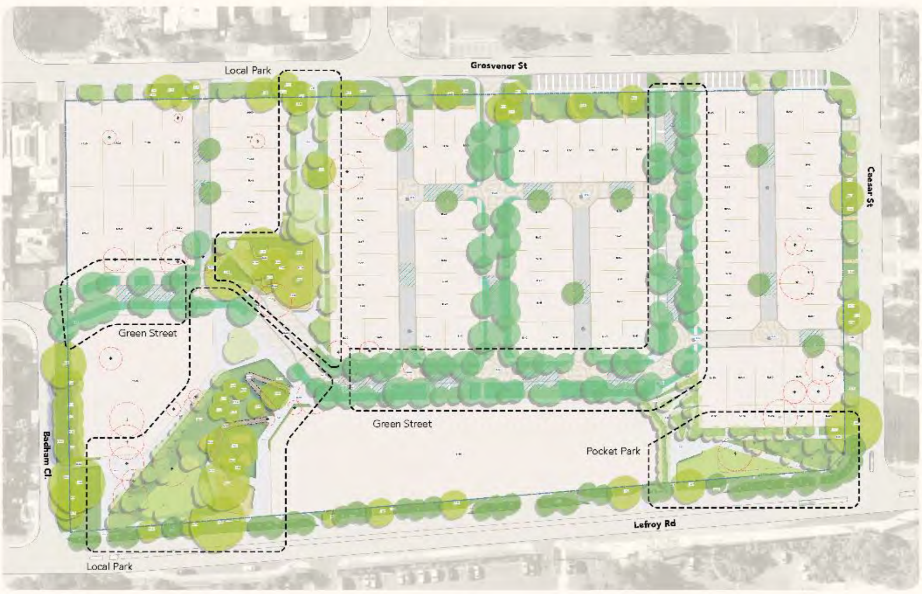
Lastly the design carefully manages level change to create moments of drama and surprise whilst also maintaining smooth and DAIP compliant on-grade connections where required.



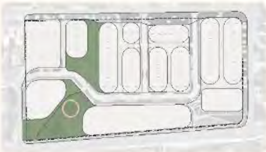
OVERALL MASTERPLAN

LEGEND

- Lot Boundary
- Paving A
- Paving B
- Paving C
- Paving D
- Paving Permeable & Structural Soils
- Garden Bed A
- Garden Bed B
- Garden Bed C
- Walkway
- Wall
- Staircase & Handrails
- Existing Tree Retained
- Proposed Tree Type A
- Proposed Tree Type B
- Proposed Tree Type C
- Existing Tree to be Removed



Local Parks & Green Links



POS 2 - South-West POS + Terrace & DUP

Key User Groups: Residents

Size Guide: 1ha - 5ha

Length of Stay: 1 -3 hours

Broad Purpose:
Local public open space serves as the recreational and social focus of a community, with a user catchment of approximately 800m. Residents are able to use their local parks to access a range of amenities that service the broader community as well as local needs.

Vision: **Playing in the Pines**

Located within the social node of the broader 'Heart of Beaconsfield Masterplan' this local park provides an active recreation node. It will become a place of play and connection, overlooked by adjacent ground and multi-level apartments and open to Lefroy Road to the south.

Responding to the existing natural assets of large mature pine trees and significant level change this open space will be vertical and dramatic.

The existing PSP crosses Lefroy Road to the south west and strikes a grade up at approx 18.40. This level wraps around the space to forge an on-grade cycle and pedestrian link. The path will also assist in providing passive surveillance of the sunken play space below.

The existing sump will be retrofitted into a below ground storage and infiltration gallery. A partially turfed and planted shallow basin above the storage will then be available for green open space (with all fencing removed). This basin will capture and infiltrate small but high frequency rainfall events in order to retain soil moisture where it is needed most - at the surface. This approach distinguishes itself from the WGV basin which directs low flow events directly into the underground storage area leaving the above landscape dry.

Site salvaged trees & limestone to be re-purposed into place based play elements.

Utilise Dry Drainage Infrastructure

Celebrate Existing Trees

LEGEND

- Lot Boundary
- Paving A
- Paving B
- Paving C
- Paving D
- Paving Permeable & Structural Soils
- Garden Bed A
- Garden Bed B
- Garden Bed C
- Walkway
- Wall
- Staircase & Handrails
- Staircase & Handrails
- Existing Tree Retained
- Proposed Tree Type A
- Proposed Tree Type B
- Proposed Tree Type C
- Existing Tree to be Removed

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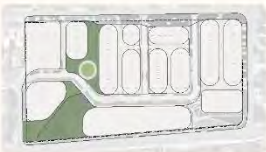
Local Parks & Green Links



POS 1 - North-West POS

Key User Groups: Residents

Size: 0.4ha - 1ha

Length of Stay: 1 -2 hours

Broad Purpose:
A small space that provides day to day recreation opportunities for the immediate residential population. The space may incorporate areas of natural vegetation to provide both ecological function and the enjoyment of the community.

Vision: **Meet me under the Figs**

The elevated location together with retention of mature Ficus trees creates an instant cool, shady and appealing place. This hard-scaped courtyard of the former TAFE featured circular raised planters wrapping the trees. To aid in the health of the retained trees new raised planter walls will be constructed - likely from site sourced limestone.

This plaza forms a node in association with the main street as it bends through the development. It also forges a green link between future single lot residential houses up to Grosvenor Street where a broad landscape set back facilitates retention of existing trees and a link to Bruce Lee Oval.

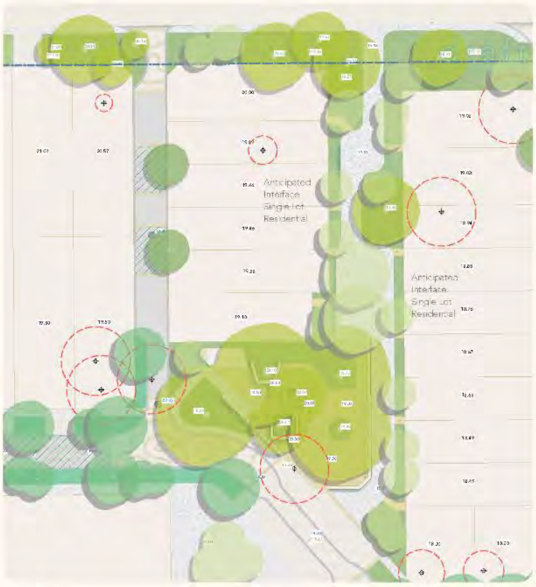
Interface to residents - Provide Direct Access

Existing site conditions

Coastal Vegetation & Level Change

Shaded Pause Points & Passive Surveillance

Shared Movement Zone – PSP link



LEGEND

- Lot Boundary
- Paving A
- Paving B
- Paving C
- Paving D
- Paving Permeable & Structural Soils
- Garden Bed A
- Garden Bed B
- Garden Bed C
- Walkway
- Wall
- Staircase & Handrails
- Staircase & Handrails
- Existing Tree Retained
- Proposed Tree Type A
- Proposed Tree Type B
- Proposed Tree Type C
- Existing Tree to be Removed

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Pocket Park

POS 3 - South-East

Vision: **Hang Out After School**

Featuring a rolling lawn, shady trees and a series of integrated retaining and seating walls this park will be a good place to sit and reconnect with nature or take the dog for a walk.

The small open space works hard to provide a DDA compliant path connection across significant level change as well as provide a below ground storage tank for stormwater management.

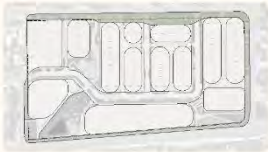
Due to split level dwellings fronting the north side, direct access to the park from these lots will be afforded. This will also assist with passive surveillance of the park.

Graded turf with passive surveillance

Terracing with pause points, textural planting & lighting

Coastal Vegetation & Level Change

Verge Parks (Micro Parks)



Key User Groups: Residents

Size: <0.4ha

Length of Stay: 30 mins

Broad Purpose:
A public 'backyard'/respite point, designed to function as a small green pocket that allows for green relief; residential size passive spaces (i.e. grass for kids to play, path for children to ride, dog walking) and respite points (i.e a spot to eat lunch, check your phone).

Vision: **Activated Verge Areas**

A well designed and maintained verge has the potential to hence the biodiversity, ecosystem function and human amenity of a place. The identified verges in the former Beaconsfield Tafe site will be utilised as additional open space with connections to the larger open space network. the verges will feature coastal endemic planting, and be embedded with water sensitive urban design. they will provide a comfortable and shaded pedestrian network, connecting the site both internally and externally.

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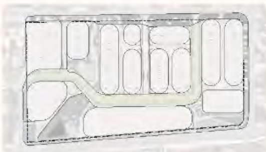
Green Streets



Key User Groups: Residents

Size: NA

Length of Stay: NA

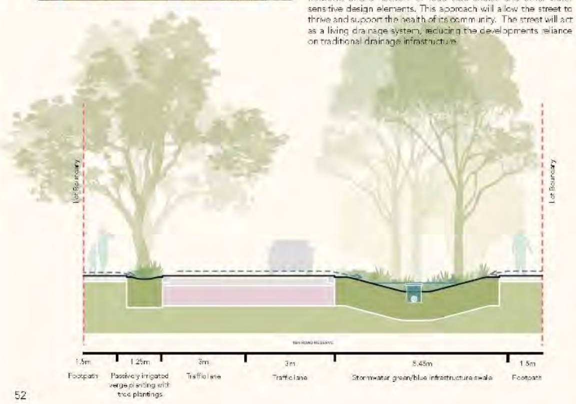
Broad Purpose:
Utilising the available space within the street thoroughfare to increase the environmental and social value of a street. Embedded with the principles of water Sensitive Urban Design these streets will function as micro ecosystems, forming part of the larger green and blue networks of the site.

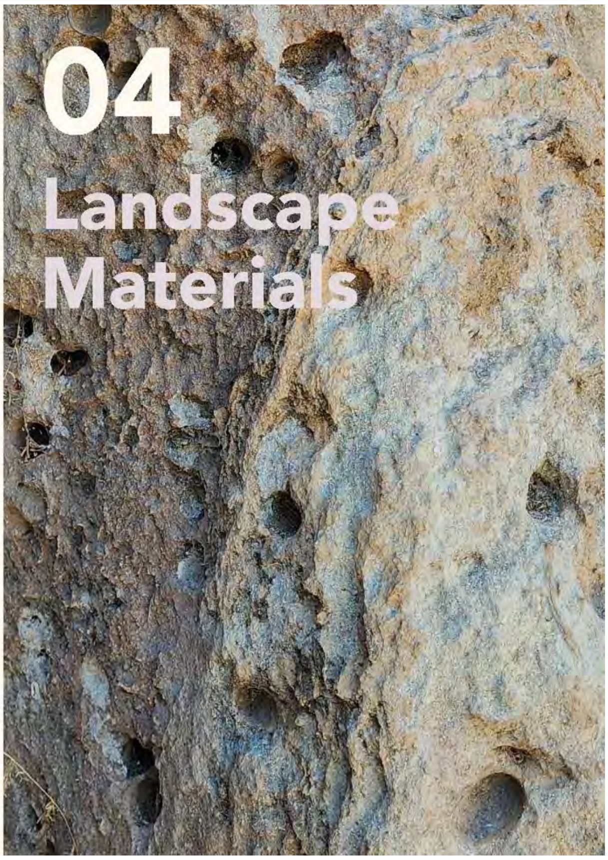
Green Streets in the Old TAFE Site:

Main Street

The main street of the former Beaconsfield Tafe will act as a movement corridor for both people and water. its design recognises the potential of a street as an open space that is capable of providing recreational and passive enjoyment as well as maximising the environmental value of what has typically been a vehicle dominated landscape.

The main street will be a people first street, in which the car will be required to prioritise alternative modes of transport (i.e. walking, cycling). A narrowing of the carriageway allows for significantly wider verges, providing critical space to incorporate wide path networks and a network of road side swales and other water sensitive design elements. This approach will allow the street to thrive and support the health of its community. The street will act as a living drainage system, reducing the developments reliance on traditional drainage infrastructure.





04 Landscape Materials

Suggested Materials Palette

Minimal palette with interest provided through texture & moments of community exchange

Permeable surfaces in low traffic areas and edge conditions

BORAL ENVISIA*

BORAL INNOVO*

Feature boulders, spalls, gravel & fines

SITE SOURCED LIMESTONE

Textural Walls

Terraces

SITE SOURCED TIMBER

Hugelkulture

Informal features

Temporary activation seating

Play elements

Furniture & Fixings

*Or Similar Approved

REALM studios

Suggested Planting Palette

Endemic Tree Canopy - Tuart (Eucalyptus Gomphocephala)

Drought Tolerant Coastal Natives

Reflective of Local Character

Agonis Flexuosa

Acacia pulchella

Eucalyptus decipiens

Eucalyptus gomphocephala

REALM studios

Suggested Planting Palette


Acacia cyclops


Acacia pulchella


Hakea prostrata


Dianella revoluta


Grevillea crithmifolia


Hakea prostrata


Kenedia prostrata


Melaleuca huegelii


Melaleuca systena


Olearia axillaris


Phyllanthus calycinus


Spyridium globulosum


Templetonia retusa


Xanthorrhoea preissii

REALM studios

city making + liveability

REALMstudios Pty Ltd
ABN 391 65483330

enquiries@realmstudios.com

www.**REALM**studios.com

Melbourne
Ground Floor, 79-81 Coppin Street
Richmond, Melbourne, VIC 3121
T +61 3 9070 1157
jon.shinkfield@realmstudios.com
M +61 411 551 512

Perth
L2, Commonwealth Bank Building
242 Murray Street, Perth WA 6000
T +61 8 9227 7222
damien.pericles@realmstudios.com
M +61 456 714 655

Sydney
Level 4, 68 Wentworth Avenue,
Surry Hills, 2010
tom.ward@realmstudios.com
M +61 414 369 262

Hobart
89 Macquarie Street,
Hobart, Tas 7000
alan.chetwell@realmstudios
M +61 431 454 492

Appendix C

Transport Impact Assessment - PJA

Pritchard Francis for DevelopmentWA

Challenger TAFE Redevelopment LSP

Transport Impact Assessment

April 2023

Project Code: 07061

PJA
Level 27
St Martins Tower
44 St Georges Terrace
Perth
WA 6000
Australia
pja.com.au

Version Control and Approval

Version	Date	Main Contributor	Issued by	Approved by
A – Draft	17 March 2023	Rodney Ding	Rodney Ding	Tim Judd
B – Final	31 March 2023	Rodney Ding	Rodney Ding	Tim Judd
C – Final	5 April 2023	Rodney Ding	Rodney Ding	Tim Judd
D – Final	6 April 2023	Rodney Ding	Rodney Ding	Tim Judd

Prepared for

Andrew Tucker
Principal - Urban Renewal
Pritchard Francis for DevelopmentWA
Pritchard Francis
430 Roberts Road
SUBIACO WA 6008

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Appendices

1 Introduction / Background

1.1.1 This Transport Impact Assessment (TIA) has been prepared by PJA on behalf of Pritchard Francis for Development WA in relation to a proposed local structure plan (LSP) on land at the old Challenger TAFE site, within the City of Fremantle.

1.1.2 The proposed LSP covers Lot 2680 Grosvenor Street, whilst the development will comprise 82 single residential lots and two larger grouped dwelling/mixed use lots providing up to 110 dwellings. The site location is shown in Figure 1-1.

Figure 1-1: Site Location

Source: MetroMap

1.1.3 Lot 2680 is included within The Heart of Beaconsfield Masterplan area for residential development. An extensive consultation period was involved with the final masterplan adopted by the City of Fremantle in 2021.

1.1.4 The LSP benefits from being well located for access to high-frequency bus routes on South Street, as well as a large number of master planned cycle and pedestrian routes, which will encourage the use of non-car modes and minimise the road impact of the LSP.

1.2 Purpose of this report

1.2.1 The *Western Australia Planning Commission Transport Assessment Guidelines* (WAPC Guidelines) sets out what level of assessment is necessary, based on the expected traffic impact of a proposed development. This specifies that where a development is forecast to generate more than 100 trips per hour in the peak operational hours, a Transport Impact Assessment (TIA) is required. Where this is not the case a Transport Impact Statement (TIS) would suffice. A TIA has a greater focus on the external traffic impact resulting from the development than a TIS.

1.2.2 Based on the proposed scale of development, it can be expected that more than 100 trips per hour would be generated, and therefore the impact would be 'high' and a TIA is required.

1.3 Transport Assessment objectives

1.3.1 In line with the WAPC Guidelines, this TIA seeks to demonstrate that the proposed LSP will:

- *"provide safe and efficient access for all modes;*
- *be well integrated with the surrounding land uses;*
- *not adversely impact the surrounding areas; and*
- *not adversely impact the surrounding transport networks or the users of those networks."*

1.3.2 This TIA considers all transport modes, including public transport, walking and cycling, as well as private motor vehicles and freight.

1.4 Layout of this report

1.4.1 The remaining chapters of this TIA cover the following:

- **Chapter 2** sets out details of the proposed LSP.
- **Chapter 3** provides details of the existing situation.
- **Chapter 4** establishes the proposals for the internal transport networks.
- **Chapter 5** sets out changes proposed to external transport networks.
- **Chapter 6** demonstrates how the LSP will integrate with the surrounding area.
- **Chapter 7** analyses the internal transport networks.
- **Chapter 8** analyses the external transport networks.
- **Chapter 9** includes a review of safety issues.
- **Chapter 10** concludes the TIA.

2 LSP Proposal

2.1 Regional Context

2.1.1 The Challenger TAFE Redevelopment LSP is located in the area covered by The Heart of Beaconsfield Masterplan.

2.1.2 Lot 2680 is bounded by Bruce Lee Oval to the north, residential development to the west a high school to the south and a proposed redevelopment area covering current community housing to the east.

2.1.3 A number of transport documents were prepared in GHD and GTA Consultants (now Stantec) for the Davis Park Structure Plan, lying immediately east of Lot 2680, including a traffic assessment and supplementary technical note assessment.

2.1.4 Once complete, The Heart of Beaconsfield masterplan area will comprise circa 600 dwellings, with the aim for it to be a walkable, transit-orientated development.

2.2 Proposed Land Uses

2.2.1 The proposed LSP for the redevelopment of the Challenger TAFE will include 82 single residential lots and two grouped dwellings/mixed use lots providing up to approximately 110 unit dwellings. No other land uses are proposed. The proposed layout is provided as Appendix **A**.

2.3 Proposed Connectivity

2.3.1 The LSP will be accessed direct from Grosvenor Street, Badham Close and Caesar Street, via new local internal streets. No direct connections are proposed onto Lefroy Road but the option of a direct access from the LSP to Lefroy Road has not been precluded at this stage.

2.4 Specific Issues

2.4.1 There are no specific transport issues that have been identified in relation to the proposed LSP.

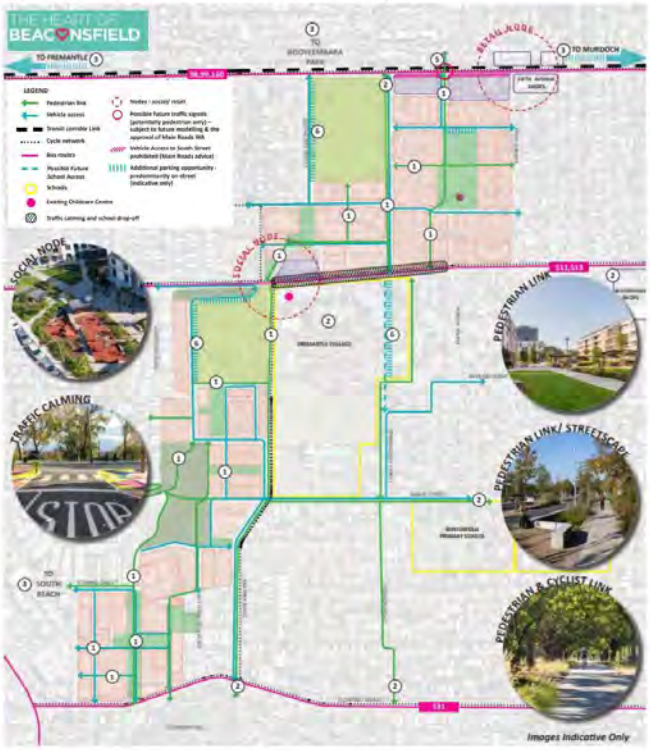
3 Existing Situation

3.1 Existing (2023) Land Uses

3.1.1 Lot 2680 currently has recently been cleared of the remnant buildings of the previous Challenger TAFE that has used this site for many years. As mentioned previously, the site is bounded by Bruce Lee Oval to the north, residential development to the west a high school to the south and a proposed redevelopment area covering current community housing to the east.

3.1.2 This lot is within the area zoned for Residential R25-40 development within The Heart of Beaconsfield Masterplan, as shown in Figure 3-1. It currently has vacant buildings on the site.

Figure 3-1: The Heart of Beaconsfield Masterplan



Source: City of Fremantle

3.2 Existing (2023) Road Network

3.2.1 The road network within the LSP has not yet been constructed but there are existing roads bordering the site.

3.2.2 The LSP will be accessed direct from Grosvenor Street, Badham Close and Caesar Street, via new local internal streets. Grosvenor Street links to Lewington Street and Caesar Street, beyond which South Street can be accessed and Lefroy Road, via Caesar Street. South Street and Lefroy Road subsequently link to Hampton Road and Carrington Street, whilst South Street also connects to the Kwinana Freeway further to the east. Badham Close intersects with Lefroy Road at the south western corner of the LSP site.

South Street

3.2.3 South Street is a Primary Distributor Road (Main Roads WA Road Hierarchy) which provides connectivity from the now deleted Fremantle Eastern Bypass through to the Kwinana Freeway and beyond to the east. South Street has a single lane in each direction, with unprotected on street cycle lanes within a 20m road reserve. It is subject to a 60km/hr speed limit.

Lefroy Road

3.2.4 Lefroy Road is a Local Distributor (Main Roads WA Road Hierarchy). It is a two-way single carriageway road which connects to Hampton Road in the west and Carrington Street in the east. It is subject to the built-up area 50km/h speed limit and this drops to 40km/h near the LSP site due to a School Zone. There is unprotected on-road cycle lanes and sits within a 20m road reserve.

Grosvenor Street

3.2.5 Grosvenor Street is an Access Road (Main Roads WA Road Hierarchy). It is a two-way single carriageway road which intersects with Lewington Street and Caesar Street. It is subject to the built-up area 50km/h speed limit and sits within a 20m road reserve with a 6m wide road pavement.

Caesar Street

3.2.6 Caesar Street is an Access Road (Main Roads WA Road Hierarchy). It is a two-way single carriageway road which intersects with South Street to the north and Lefroy Road in the south. It is subject to the built-up area 50km/h speed limit and sits within a 20m road reserve with a 6m wide road pavement.

Lewington Street

3.2.7 Lewington Street is an Access Road (Main Roads WA Road Hierarchy). It is a two-way single carriageway road which intersects with Grosvenor Street in the south and South Street in the north. It is subject to the built-up area 50km/h speed limit and sits within a 20m road reserve with a 6m wide road pavement.

Badham Close

3.2.8 Badham Close is an Access Road (Main Roads WA Road Hierarchy). It is a two-way single carriageway cul-de-sac with access via Lefroy Road. It is subject to the built-up area 50km/h speed limit and sits within a 15m road reserve with a 6m wide road pavement.

3.3 Existing Traffic Flows

Traffic count data has been obtained from Main Roads WA Traffic Map and from recent traffic surveys in March 2023, where available. This is shown in Table 3-1.

Table 3-1: Traffic Data

	Average Monday to Friday two-way	AM Peak		PM Peak	
		Eastbound/ Northbound	Westbound/ Southbound	Eastbound/ Northbound	Westbound/ Southbound
South Street – west of Carrington Street from Traffic Map 2020/21	20,385	635	955	780	750
Lefroy Road – derived from SCATS 2022	7,235	480	320	495	225
Lewington Street – south of South Street from survey	260	9	10	13	15
Caesar Street – north of Grosvenor Street from survey	1,110	68	51	43	59
Grosvenor Street – west of Caesar Street from survey	400	17	14	27	14

3.3.1 Whilst no traffic count data is available for the roads in the immediate vicinity of the LSP, these are local roads and it can therefore be expected that the flows are generally lower than 3,000vpd and in keeping with their function and form.

3.4 Existing Pedestrian and Cycle Provision

3.4.1 There are previous pedestrian routes within the site, which is currently unused, and these allowed a north to south route from Lefroy Road and Grosvenor Street along the western edge of the site.

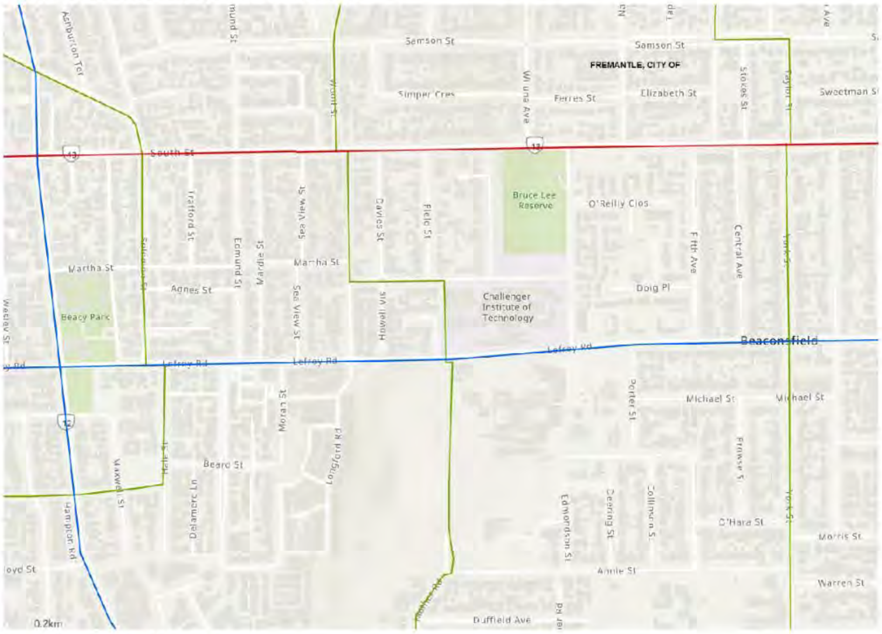
3.4.2 The roads within the vicinity of the site have some footpath provision, with a footpath located on at least one side of each street. These provide an interconnecting pedestrian route through Beaconsfield.

3.4.3 Cycle provision in the vicinity of the site is extensive, with unprotected cycle lanes along most of the main roads.. There are unprotected cycle lanes on both South Street (Primary Route as part of the Perth Long Term Cycle Network (LTCN)) and Lefroy Road (Secondary Route as part of the Perth LTCN), with connections to other routes within the Beaconsfield area.

3.4.4 To the west of the site, a local route on the LTCN is proposed connect with South Street near Wood Street.

3.4.5 Details of these routes are shown below in Figure 3-2.

Figure 3-2: Long Term Cycle Network Map



Source: Department of Transport

3.5 Existing Public Transport Provision

3.5.1 The LSP is located on Lefroy Road with bus stops in immediate proximity. South Street has bus stops that can be accessed within 250-300m of the redevelopment and to the north side of Bruce Lee Reserve. The bus routes on these roads connect with Fremantle Station and Murdoch Station, whilst the Circle Bus Routes (998 and 999) on South Street provide access to locations beyond these train stations.

3.5.2 Buse routes 511, 512 and 513 use Lefroy Road whilst routes 160, 998 and 999 use South Street. A summary of these services is provided in Table 3-2. The net effect of the frequency and number of these routes and services is that the stops on both South Street and Lefroy Road offer a bus service every 3-4 minutes in peak periods, within easy access of the LSP site.

Table 3-2: Bus Services

Bus No.	Route	Days of Operation	Times of Operation (weekday)	Peak frequency
	South Street			
160	Fremantle Station to East Perth	Monday – Sunday	5:25am – 9:02pm	Every 30 minutes
998	Circle Route	Monday – Sunday	5:49am – 8:08pm	Every 15 minutes
999	Circle Route	Monday – Sunday	5:29am – 8:55pm	Every 15 minutes
	Lefroy Road			
511	Fremantle Station to Murdoch Station	Monday – Sunday	5:25am – 9:02pm	Every 20 minutes
512	Fremantle Station to Murdoch Station	Monday – Sunday	5:49am – 8:08pm	Every 20 minutes
513	Fremantle Station to Murdoch Station	Monday – Sunday	5:29am – 8:55pm	Every 20 minutes

4 Proposed Internal Transport Networks

4.1 Proposed Road Network

4.1.1 The proposed road network within the LSP can be seen on the plan included as **Appendix** A, with a summary of the proposed roads set out in Table 4-1.

Table 4-1: Proposed Roads

Road	Road Reserve	Location Description	Liveable Streets Road Type
Street 1 (NW)	15-16m Road Reserve	Continuation of Badham Close to the east through the site then turns to north to intersect with Grosvenor Street west of Caesar Street	Based on Access Street D
Street 2 (NS)	11m Road Reserve	Runs NS from Grosvenor Street east of Lewington Street to Street 1	Based on Access Street D
Laneway 1	6m Road Reserve	Runs NS from Grosvenor Street west of Lewington Street to Street 1	Laneway
Laneway 2	6m Road Reserve	Runs NS from Grosvenor Street at Lewington Street to Street 1	Laneway
Laneway 3	6m Road Reserve	Runs NS from Lane 5 between Street 1 and Street 2 to Street 1	Laneway
Laneway 4	6m Road Reserve	Runs NS from Grosvenor Street between Street 1 and Caesar Street to Laneway 6	Laneway
Laneway 5	6m Road Reserve	Runs EW from Street 1 to Laneway 2	Laneway
Laneway 6	6m Road Reserve	Runs EW from Caesar Street to Street 1	Laneway

4.1.2 The road types have been reviewed based on the WA Liveable Neighbourhoods Update 02, dated January 2009. This specifies the following for Access Streets and Laneways:

Table 4-2: Liveable Streets Road Specifications

Street Type	Max Design Speed / Target Operating Speed (km/hr)	Indicative Volume (vehicles per day)	Indicative Street Reserve Width (m)	Indicative Road Pavement Width (m)
Access Street D – Narrow Yield or Give Way Street	50/30	1000	14.2	5.5-6
Laneway / Rear Lane	15	300	6-6.4	6 typical (3 - 6.4 range)

4.1.3 The Access Street D roads (Narrow Yield or Give Way Streets) will have a 6m wide carriageway, as well as at least one footpath of 1.8m width. In the few locations where the Road Reserve width is widened to 16m, embayed parking is proposed to be provided near grouped dwelling lots for Street 1. This road type has an indicative upper volume of 1,000 vehicles per day and is effective in constraining vehicle speeds. Street 2 is proposed to have an 11m wide road reserve as there is proposed to be little servicing required from this street. This width will allow a 6m wide carriageway and 2.5m wide verges each side.

4.1.4 The cross-section for a typical Access Street D is demonstrated in Figure 4-1.

Figure 4-1: Cross-Section for 15m Street 1

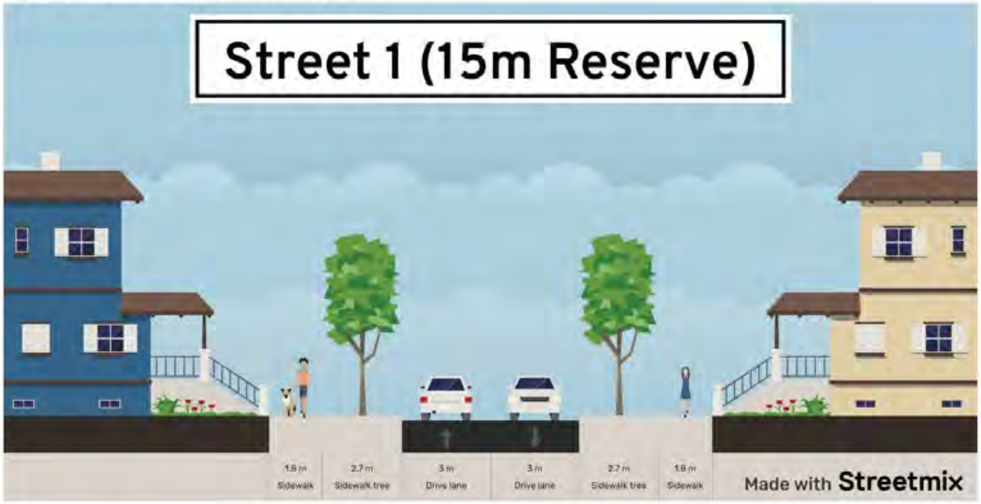


Figure 4-2: Cross-Section for 16m Street 1

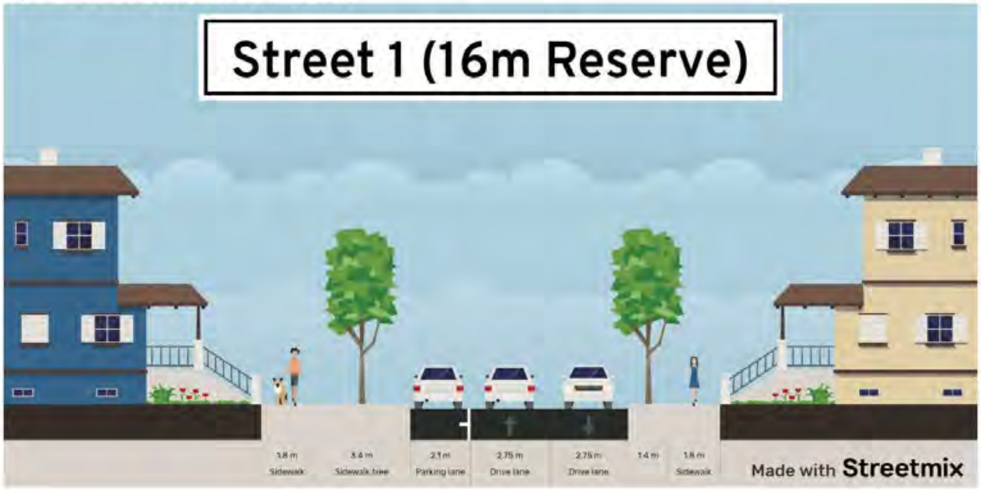


Figure 4-3: Cross-Section for 11m Street 2

Figure 4-4: Cross-Section for 6m Laneways

4.1.5 Not shown on the above cross sections are proposed "throttle points" internally, particularly on Street 1, to promote lower vehicular speeds both internally and when driving to and from Lefroy Road via Badham Close. This will also allow Healthy Streets principles to be applied for the redevelopment area. These principles are based on the idea that streets should be designed to encourage physical activity, promote social interaction, and improve air quality. Some of the key principles include reducing traffic volume and speed, creating dedicated space for pedestrians and cyclists, increasing access to public transportation, and prioritizing green space and trees. By implementing Healthy Street principles, communities can create more liveable and sustainable urban environments that promote health, safety, and overall quality of life.

4.1.6 The laneways are suitable for carrying up to 300 vehicles per day. They will have a 6m wide two-way carriageways, with no parking and no footpath.

4.2 Intersection Controls

4.2.1 Due to the low volume and low speed residential nature of the LSP, all intersections within the LSP are intended to be constructed as priority-controlled T-intersections. The only exception is the four-way intersection formed by the intersection of Street 2 and Lane 5. Due to low traffic flows (expected well below 2,000vpd through the intersection), this format is considered acceptable. This intersection will then require signage on the Lane 5 approaches to Street 2.

4.2.2 The intersection of Street 1 and Badham Close will require the creation of a modified priority junction, with the east-west leg of Badham Close becoming the minor leg and the Badham Close north-south leg and Street 1 becoming the priority legs.

4.3 Pedestrian and Cycle Network

4.3.1 1.8m wide footpaths will be provided alongside the Access Street D roads, in accordance with the Liveable Neighbourhoods Guidelines. These paths will connect to the existing pedestrian network in the vicinity. Dropped kerb crossings will be provided as appropriate, including at junctions.

4.3.2 Cyclists can either use the footpaths, or cycle on the quiet streets within the LSP.

4.3.3 Also proposed is a "green link" to be provided to maintain connectivity between Bruce Lee Reserve north of the LSP to the continuation of this philosophy through the remainder of The Heart of Beaconsfield to the south though proposed parklands and paths. This connectivity will be maintained as there is presently a traffic island (with ramps and tactile pavers) on Lefroy Road east of Badham Close to facilitate the safe two-stage pedestrian crossing of Lefroy Road as the wider pedestrian linkages are developed as The Heart of Beaconsfield is further progressed.

4.4 Public Transport Routes

4.4.1 No public transport routes or stops will be provided within the LSP.

5 Changes to External Transport Networks

5.1.1 No changes to the external transport networks are proposed as a result of the LSP.

5.1.2 The roads in the vicinity of the site have been constructed for some time and not likely to be modified, whilst there is also existing provision for pedestrians and cyclists, and access to public transport services.

5.1.3 There may be modifications to external street networks as other local structure plans are developed, for example the Davis Park Structure Plan to the east. This project proposes a new signalised 4-way intersection at the current 3-way intersection of South Street and Nannine Avenue. In addition to this there is also possible movement bans at the intersection of South Street and Caesar Street.

6 Integration with Surrounding Area

6.1 Surrounding Attractors / Generators

6.1.1 The area in the vicinity of the site is mostly mature residential development to the west and north but the area to the east and further to the south is being redeveloped for residential use with some commercial offering near the intersection of South Street and Nannine Avenue, in line with The Heart of Beaconsfield masterplan.

6.1.2 Fremantle College is located opposite the development site on Lefroy Road. White Gum Valley Primary School is located north of South Street approximately 1km from the development site whilst Winterfold Primary School is located approximately 800m to the south of the site, south of Lefroy Road.

6.1.3 Further, the proposed shopping precinct to be delivered as part of the Davis Park Structure Plan near the intersection of South Street and Nannine Avenue is approximately 400m from the site (walk time approximately 5 minutes). Within the shopping centre there is proposed to be a supermarket and a number of complementary offerings.

6.1.4 There are additionally a number of parks and play areas in the vicinity of the site, including Bruce Lee Reserve to the immediate north of the site and a proposed parkland south of Lefroy Road, to be delivered as part of The Heart of Beaconsfield masterplan.

6.2 Travel Desire Lines

Pedestrian / Cycling

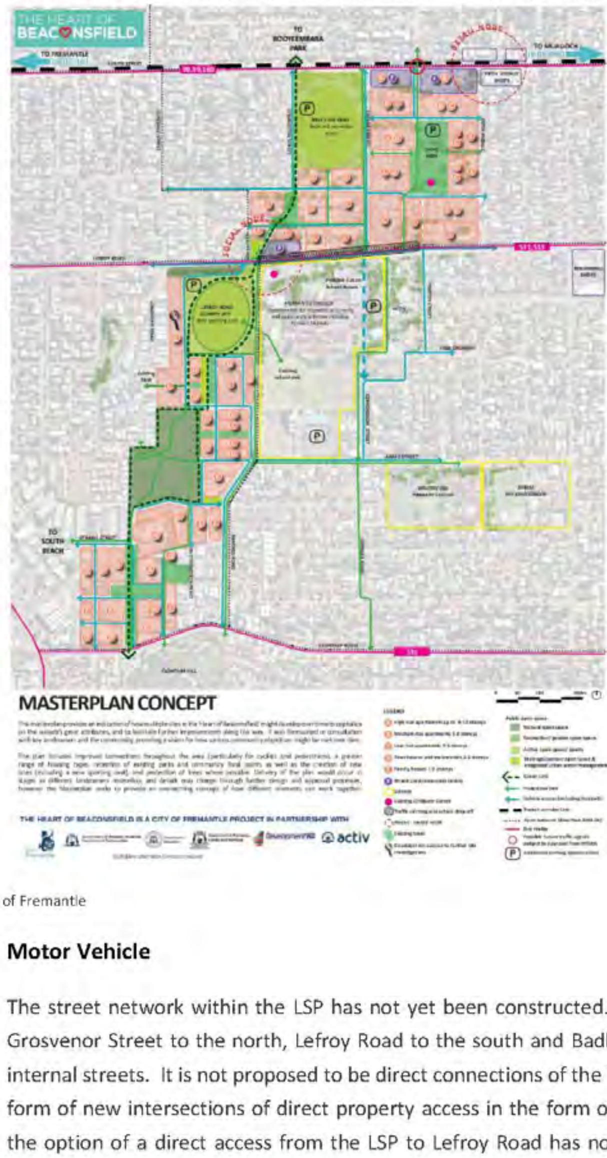
6.2.1 The travel desire lines between the LSP and the major attractors (schools, parks and shopping areas) will mainly be via the paths that connect back to the proposed redevelopment.

6.2.2 As mentioned in Section 4.2, footpaths will be provided alongside the Access Streets within the site. These paths will connect to the existing pedestrian network in the vicinity and comprises a network of footpaths with dropped kerb tactile paving crossings. Cyclists can either use the footpaths, or cycle on the quiet streets within the LSP.

6.2.3 The existing pedestrian and cycle provision requires no remedial measures as a result of this redevelopment. There are traffic islands/medians in South Street and Lefroy Road to allow two-staged crossings of these streets. Other local streets can be crossed in a single movement as these streets are narrower (typically 6m pavement) and carry significantly less traffic than South Street and Lefroy Road. This is the case in crossing Grosvenor Street to access Bruce Lee Reserve and in the future to cross Caesar Street to access to the commercial development proposed within.

6.2.4 Desire lines in the wider The Heart of Beaconsfield Masterplan have been identified as part of that project. These are shown below in Figure 6-1.

Figure 6-1: Pedestrian & Cycling Desire Lines from The Heart Masterplan



Source: City of Fremantle

Motor Vehicle

6.2.5 The street network within the LSP has not yet been constructed. The LSP will be accessed from Grosvenor Street to the north, Lefroy Road to the south and Badham Close to the west, via new internal streets. It is not proposed to be direct connections of the LSP to Lefroy Road, either in the form of new intersections of direct property access in the form of driveway/crossovers although the option of a direct access from the LSP to Lefroy Road has not been precluded at this stage.

These multiple connection points will distribute traffic amongst these streets and further afield and not overload the traffic carrying capacity for the street network.

6.2.6 The existing surrounding street network is deemed to be acceptable, and no remedial measures are needed.

Public Transport

6.2.7 There are currently no future public transport services being planned within the LSP.

6.2.8 As mentioned previously in Section 3.5, the LSP has good access to existing public transport services, with services on South Street and Lefroy Road offering high frequency access to buses on both streets.

6.2.9 The existing public transport provision requires no remedial measures as a result of this LSP.

7 Analysis of Internal Transport Networks

7.1.1 The LSP is currently undeveloped and does not generate traffic onto the existing road network.

7.1.2 Prior to the LSP, the site was used by Challenger TAFE. Although no traffic counts are available for the time the site was used by the TAFE, based on the approximate 17,500m² floor area of the buildings on the site and generation rates for a university (ITE Land Use Code 550), the site is likely to have been generating approximately 1,750 vehicle trips per day prior to its closure.

7.2 Redevelopment Traffic Generation

7.2.1 The predicted vehicle trips to be generated by the proposed LSP have been determined based on the rates outlined in Table 7-1 (based on WAPC Guidelines). The generation rate for the unit type of dwelling in the grouped dwelling sites, is less than the rates for the single residential dwelling sites, due to smaller size of these dwellings and the limited parking likely to be proposed for these dwellings (likely 1 vehicle versus the 2-3 with the single residential dwelling allowing for some on-street parking.

Table 7-1: Typical Land Use Vehicle Trip Rates (WAPC Guidelines Volume 2)

Land Use	Unit	AM peak hour trip rate			PM peak hour trip rate		
		In	Out	Total	In	Out	Total
Single Residential	Dwellings	0.15	0.45	0.6	0.375	0.225	0.6
Units	Dwellings	0.1	0.3	0.4	0.25	0.15	0.4

7.2.2 There are proposed to be 82 single residential dwellings plus up to another 110 unit type dwellings in the two grouped dwelling (although around 90 dwellings are planned, the 110 is the maximum yield possible) lots in total proposed in the LSP.

7.2.3 From the vehicle trip rates in Table 7-1, the AM peak hour vehicle trips predicted to be generated by the LSP are 23 inbound and 70 outbound respectively and the PM peak hour vehicle trips in and out are 58 and 35 respectively. This equates to 93 two-way vehicle movements in each peak. This equates to approximately 930 trips per day, which is considerably less, almost half, than the assessed traffic generation of the previous TAFE use of approximately 1,750 trips per day.

7.2.4 Given the scale of the LSP and that it is only residential, it is expected that all of these vehicle trips would be externally distributed onto the adjacent street network.

Table 7-2: Trip Generation Summary

	AM peak hour trips			PM peak hour trips		
	In	Out	Total	In	Out	Total
Single Residential	12	37	49	31	18	49
Units	11	33	44	28	16	44
Total	**23**	**70**	**93**	**58**	**35**	**93**

7.3 Trip Distribution

7.3.1 For the purposes of estimating vehicle movements, the directional distributions shown in Table 7-3 have been assumed for the proposed LSP. The proportions have been taken from the *Beaconsfield Masterplan: Traffic Impact Assessment (GHD, Feb 2019)* and it is considered that these assumptions are still reasonable for the proposed LSP site, being immediately adjacent to Davis Park. The internal 16% of trips from this previous assessment has been apportioned to the other external destinations.

Table 7-3: Trip Distribution (derived from Beaconsfield Masterplan/Davis Park)

External Route to/from	Percentage Distribution
Fremantle	25%
Perth and Eastern Destinations	25%
Cockburn	20%
Rockingham and Southern Destinations	20%
Northern Destinations	10%
Internal	0%

7.3.2 Applying these distribution proportions with the trip generation in Table 7-2 results in the following anticipated traffic flows onto the surrounding external roads.

Table 7-4: Resulting Trips Distributed

External Roads	AM peak hour trips		PM peak hour trips	
	In	Out	In	Out
South Street (West)	6	18	15	9
South Street (East)	8	24	20	12
Lefroy Road (East)	0	0	0	0
Lefroy Road (West)	9	28	23	14

7.4 Through Traffic

7.4.1 It is anticipated that through traffic within the LSP would be limited, as the LSP is not located on any through routes through the site and does not provide a route between any key destinations.

7.5 Roads and Intersections

7.5.1 Two-way, two-lane roads are proposed within the LSP to accommodate the anticipated traffic flows, as detailed previously in section 4.1.

7.5.2 Adequate sight distance is provided at each intersection.

7.5.3 As detailed in Section 4.1, all intersections will take the form of priority junctions to accommodate the anticipated traffic flows. Any delays to vehicles at these junctions would be minimal given the low vehicular traffic volumes forecast.

7.5.4 As the maximum anticipated two-way trips within site is 50 vehicles in the peak hours, and through traffic is forecast to be negligible, roads within the LSP would not carry more than 500 vehicles per day. Therefore, it is acceptable that properties fronting roads are accessed directly from the roads.

7.6 Pedestrian/Cycle Networks

7.6.1 As the internal roads within the LSP are anticipated to have low volumes of traffic, with up to 50 two-way vehicle trips within the AM peak hour, it is considered that none of the proposed roads within the LSP would be difficult for pedestrians and cyclists to cross.

7.6.2 This is in line with Table 4 of the *WA Transport Impact Assessment Guidelines Volume 2*, which has been reproduced below. This states that for a two-lane undivided road, which is what is proposed for the internal road network within the redevelopment, the ability of most pedestrians to cross would only be affected if there are more than 1,100 vehicles per hour.

Table 7-5: Traffic Volumes Affecting Pedestrian Crossing Amenity

Road cross-section	Traffic volume affecting ability of pedestrians to cross (vehicles per hour – two-way)
2 lane undivided	1,100 vph
2 land divided (or with pedestrian refuse islands)	2,800 vph
4 lane undivided (without pedestrian refuge islands)	700 vph
4 lane divided (or with pedestrian refuge islands)	1,600 vph

7.7 Safe Walk/Cycle to School Assessment

7.7.1 As discussed previously, Fremantle College is located opposite the LSP site on Lefroy Road. White Gum Valley Primary School is located north of South Street approximately 1km from the LSP site whilst Winterfold Primary School is located approximately 800m to the south of the LSP, south of Lefroy Road.

7.7.2 The likely routes that residents may take from the LSP site to access the schools are as follows:

7.7.3 White Gum Valley Primary School

- Onto the footpath on the south side of Grosvenor Street
- Cross Grosvenor Street onto Lewington Street path on western side
- Cross Lewington Street south of South Street
- Walk along footpath on south side of South Street
- Cross South Street west of Wiluna Avenue

7.7.4 Fremantle College

- Onto the footpath on the western side of Caesar Street or the north side of Lefroy Road
- Cross Caesar Street north of Lefroy Road
- Cross Lefroy Road east of Caesar Street to access the college

7.7.5 Winterfold Primary School

- Onto the footpath on the western side of Caesar Street or the north side of Lefroy Road
- Cross Caesar Street north of Lefroy Road
- Cross Lefroy Road east of Caesar Street
- Walk to Porter Street and then head south to the school

7.7.6 Each road mentioned has been assessed in terms of where any potential crossing difficulties are likely, this is presented in Table 7-6.

Table 7-6: Walk/Cycle to School Crossing Assessment

Road	Crossing Assessment
Grosvenor Street	Grosvenor Street is anticipated to have low traffic volumes, as it only currently serves a limited number of dwellings, therefore it is not anticipated that this road would be hard to cross for some people.
Lewington Street	Lewington Street is anticipated to have low traffic volumes, as it only currently serves a limited number of dwellings, therefore it is not anticipated that this road would be hard to cross for some people.
Caesar Street	Caesar Street is provided with uncontrolled dropped kerb crossings with tactile paving at junctions with block paving. At the junction with Lefroy Road, Caesar Street is provided with a central refuge to aid pedestrians crossing.
South Street	South Street experiences higher traffic volumes, but this section of South Street has a traffic island with refuge crossing South Street in two stages.
Lefroy Road	Lefroy Road experiences higher traffic volumes, but this section of Lefroy Road has a traffic island with refuge crossing Lefroy Road in two stages under the control of a warden controlled school crossing and a School Zone.

7.7.7 It is concluded from this assessment, that the likely routes that will be taken by residents of the LSP to access the nearby schools are suitable, as continuous footpaths are provided along all of the sections with some crossing facilities provided, either due to low traffic nature of the surrounding area and with appropriate two stage crossings on higher volume roads.

7.8 Pedestrian Permeability and Efficiency

7.8.1 Beaconsfield as a suburb has a Walk Score[1] of 60. This indicates that Beaconsfield is somewhat walkable which implies that some errands can be accomplished on foot in Beaconsfield. The development of Davis Park to the immediate east of this LSP may improve this as local shops will come within easy walking distance of the LSP area.

7.8.2 In the case of Beaconsfield, Western Australia, the pedestrian permeability of the area is generally quite high. The suburb is located close to Fremantle, a major urban centre, and is well-connected to public transport, including buses. Additionally, there are numerous footpaths throughout the area, allowing pedestrians to move around and access key destinations.

7.8.3 In terms of pedestrian efficiency, the surrounding area is also relatively well-designed. The suburb has a grid-like street network to navigate, with a mix of residential and commercial areas that are well-connected to each other. There are also numerous pedestrian crossings throughout the area, which help to ensure safe and efficient pedestrian movement.

7.8.4 The proposed LSP is located immediately adjacent to Davis Park and within 400m walkable catchment of existing and proposed commercial development either side of South Street near Fifth Avenue.

7.8.5 Overall, it is considered that the LSP is located within an accessible location, as the majority is within at least a 20-minute walk of key amenities, schools and public transport services.

[1] https://www.walkscore.com/AU-WA/Perth/Beaconsfield

8 Analysis of External Transport Networks

8.1 Scope of Assessment

8.1.1 Traffic surveys were undertaken at the following intersections in March 2023 and these form the basis of this traffic impact assessment:

- Lewington Street / South Street;
- Caesar Street / South Street;
- Caesar Street / Lefroy Road;

8.1.2 The LSP is estimated to be fully settled by approximately 2028. This brings the 10 years post build out scenario to 2038 and to accord with strategic road network forecast scenarios, the traffic impact assessment analyses have been based on a 2041 timeframe to align with a Main Roads WA ROM24 year:

- Scenario 1: 2041 Base case (i.e. "without development") operation of the intersections in SIDRA Intersection (SIDRA) for the anticipated year of development opening and nominal 18-year design horizon; and
- Scenario 2: 2041 Future case (i.e. "with development") operation of the subject intersections in SIDRA for equivalent design horizons for the purposes of comparison.

8.2 SIDRA Analysis

8.2.1 The operation of each intersection has been analysed using SIDRA Intersection (Version 9.1). The key outputs of SIDRA are summarised below:

- **Degree of Saturation (DOS)** is the ratio of the volume of traffic observed making a particular movement compared to the maximum capacity for that movement.
- The **95th Percentile (95th %ile) Queue** represents the maximum queue length that can be expected in 95% of observed queue lengths in the peak hour.
- **Average Delay** is the delay time that can be expected over all vehicles making a particular movement in the peak hour.

8.2.2 The WAPC Guidelines indicate an average delay for each vehicle passing through an intersection to be less than 55 seconds for a signalised intersection and 35 seconds for a priority intersection.

8.2.3 The SIDRA results for the intersections for the estimated future volumes is presented in the tables Table 8-1 to Table 8-3 .

8.2.4 For the assessments it has been assumed that the current geometry of the intersections will remain unchanged.

8.2.5 For the 2041 assessment with the LSP, the intersection of South Street and Lewington Street has included additional bunching of traffic on the eastern approach of the intersection. The reason for this is the proposed signalised intersection to be created at the intersection of South Street and Nannine Avenue with the development of Davis Park creating gaps and platooning of traffic on South Street. This signalised intersection will be required due to the amount of traffic attracted to the commercial development component of Davis Park because the intersection of South Street and Caesar Street will fail due to the Davis Park development alone.

8.2.6 The assessment of the intersection of South Street and Caesar Street in Table 8-2 for 2041 with the LSP, included the combined effect of both the Davis Park redevelopment and this site LSP. The assessment is shown to confirm that the intersection of South Street and Caesar Street will not function appropriately in its current form in 2041 with the LSP in this part of The Heart of Beaconsfield. It is expected that Caesar Street will become a cul-de-sac at South Street or be limited in movements so that the right turn from Caesar Street onto South Street is not permitted, as this movement is the problematic movement in 2041.

8.2.7 The assessment of the intersection of Lefroy Road and Caesar Street in Table 8-3 for 2041 with the LSP, included the combined effect of both the Davis Park redevelopment and this site LSP. The assessment is shown to confirm that the intersection of Lefroy Road and Caesar Street will continue to function at an acceptable level. Overall, there are presently acceptable delays and queuing at this intersection in peak periods. The addition of the proposed LSP traffic over and above the Davis Park redevelopment traffic is expected to have minimal impacts and also be acceptable. No special treatment is required for this intersection. Also, with minimal changes to this intersection, there is expected to be minimal to no impacts on Lefroy Road between Badham Close and Caesar Street, thus not impacting on the operation of this section of roadway and affecting the traffic flow to and from Fremantle College.

8.2.8 The assessment of the intersection of Lefroy Road and Badham Close was not modelled as the above intersection, carrying much more traffic was found to be expected to operate satisfactorily in 2041 with background traffic growth and the LSP traffic. The intersection of Lefroy Road and Badham Close is expected to operate in a slightly better level than the intersection of Lefroy Road and Caesar Street.

8.2.9 The adjacent Davis Park redevelopment on the east side of Caesar Street is expected to have a much higher generation of traffic than the LSP, and this effect has been included in the future 2041 base and with LSP modelling in the tables below.

8.2.10 An assessment was also undertaken to examine if a direct connection of the LSP to Lefroy Road could be contemplated on an operational viewpoint. This was assessed for the 2041 scenario only with result shown in Table 8-4. This has shown that such a connection, if contemplated, could function adequately in the AM and PM peak periods with minimal delays and queues. This direct connection could also have the benefit of less traffic travelling to and from South Street, and thus the performance of the intersection of South Street and Lewington Street could be slightly better compared to the scenario with no direct connection to Lefroy Road.

Table 8-1: South Street / Lewington Street – SIDRA Results

Lane	AM Peak				PM Peak			
	Degree of Saturation	Average Delay (s)	Level of Service	95th %ile Q (m)	Degree of Saturation	Average Delay (s)	Level of Service	95th %ile Q (m)
Current								
Lewington St S LT	0.01			0.4	0.01			0.1
Lewington St S RT	0.05			1	0.03			0.6
South St E LT/Thr	0.45			0	0.30			0
South St W Thr	0.30			0	0.41			0
South St W RT	0.01			0.1	0.01			0.2
Intersection (based on minor leg appr)	**0.05**	**21**	**C**	**1**	**0.03**	**15**	**C**	**0.6**
2041 Base								
Lewington St S LT	0.03			0.6	0.01			0.2
Lewington St S RT	0.12			2	0.06			1
South St E LT/Thr	0.57			0	0.38			0
South St W Thr	0.38			0	0.52			0
South St W RT	0.01			0	0.01			0.3
Intersection (based on minor leg appr)	**0.12**	**44**	**E**	**2**	**0.06**	**29**	**D**	**1**
2041 w Dev								
Lewington St S LT	0.04			1	0.01			0.3
Lewington St S RT	0.25			5	0.13			3
South St E LT/Thr	0.58			0	0.39			0
South St W Thr	0.38			0	0.52			0
South St W RT	0.01			0	0.02			0.6
Intersection (based on minor leg appr)	**0.25**	**38**	**E**	**5**	**0.13**	**28**	**D**	**3**

Table 8-2: South Street / Caesar Street – SIDRA Results

Lane	AM Peak				PM Peak			
	Degree of Saturation	Average Delay (s)	Level of Service	95th %ile Q (m)	Degree of Saturation	Average Delay (s)	Level of Service	95th %ile Q (m)
Current								
Caesar St S LT	**0.15**			4	**0.03**			1
Caesar St S RT	**0.07**			1	**0.07**			2
South St E LT/Thr	0.56			0	0.34			0
South St W Thr	0.32			0	0.43			0
South St W RT	0.09			2	0.06			2
Intersection (based on minor leg appr)	**0.15**	**15**	**C**	**4**	**0.07**	**13**	**B**	**2**
2041 Base								
Caesar St S LT	**0.34**			7	**0.04**			1
Caesar St S RT	**0.22**			4	**0.16**			3
South St E LT/Thr	0.70			0	0.42			0
South St W Thr	0.41			0	0.55			0
South St W RT	0.20			4	0.08			2
Intersection (based on minor leg appr)	**0.34**	**36**	**E**	**7**	**0.16**	**21**	**C**	**3**
2041 w Dev								
Caesar St S LT	**0.40**			9	**0.16**			4
Caesar St S RT	**0.91**			16	**1.20**			56
South St E LT/Thr	0.71			0	0.45			0
South St W Thr	0.41			0	0.55			0
South St W RT	0.23			5	0.23			6
Intersection (based on minor leg appr)	**0.91**	**80**	**F**	**16**	**1.20**	**112**	**F**	**56**

Table 8-3: Lefroy Road / Caesar Street – SIDRA Results

Lane	AM Peak				PM Peak			
	Degree of Saturation	Average Delay (s)	Level of Service	95th %ile Q (m)	Degree of Saturation	Average Delay (s)	Level of Service	95th %ile Q (m)
Current								
Lefroy Rd E Thr	0.26			0	0.12			0
Lefroy Rd E RT	0.05			1	0.04			1
Caesar St N LT	**0.04**			**1**	**0.06**			**2**
Caesar St N RT	**0.05**			**1**	**0.01**			**0.2**
Lefroy Rd W LT/Thr	0.21			0	0.13			0
Intersection (based on minor leg appr)	**0.05**	**8**	**A**	**1**	**0.06**	**6**	**A**	**2**
2041 Base								
Lefroy Rd E Thr	0.33			0	0.15			0
Lefroy Rd E RT	0.05			2	0.05			1
Caesar St N LT	**0.04**			**1**	**0.06**			**2**
Caesar St N RT	**0.07**			**2**	**0.01**			**0.3**
Lefroy Rd W LT/Thr	0.26			0	0.17			0
Intersection (based on minor leg appr)	**0.07**	**10**	**A**	**2**	**0.06**	**6**	**A**	**2**
2041 w Dev								
Lefroy Rd E Thr	0.33			0	0.15			0
Lefroy Rd E RT	0.05			2	0.07			2
Caesar St N LT	**0.04**			**1**	**0.08**			**2**
Caesar St N RT	**0.13**			**3**	**0.03**			**1**
Lefroy Rd W LT/Thr	0.26			0	0.20			0
Intersection (based on minor leg appr)	**0.13**	**11**	**B**	**3**	**0.08**	**6**	**A**	**2**

Table 8-4: Lefroy Road / Possible Direct Access – SIDRA Results

Lane	AM Peak				PM Peak			
	Degree of Saturation	Average Delay (s)	Level of Service	95th %ile Q (m)	Degree of Saturation	Average Delay (s)	Level of Service	95th %ile Q (m)
2041 w Dev								
Lefroy Rd E Thr	0.36			0	0.16			0
Lefroy Rd E RT	0.004			0.1	0.01			0.3
LSP Access N LT	**0.06**			**2**	**0.02**			**0.5**
LSP Access N RT	**0.06**			**2**	**0.02**			**0.5**
Lefroy Rd W LT/Thr	0.27			0	0.22			0
Intersection (based on minor leg appr)	**0.06**	**0.3**	**A**	**2**	**0.02**	**0.3**	**A**	**0.5**

8.3 Pedestrian / Cycle Networks

8.3.1 The local pedestrian and cycle networks will be able to accommodate the likely level of pedestrian and cycle trips generated by the proposed redevelopment.

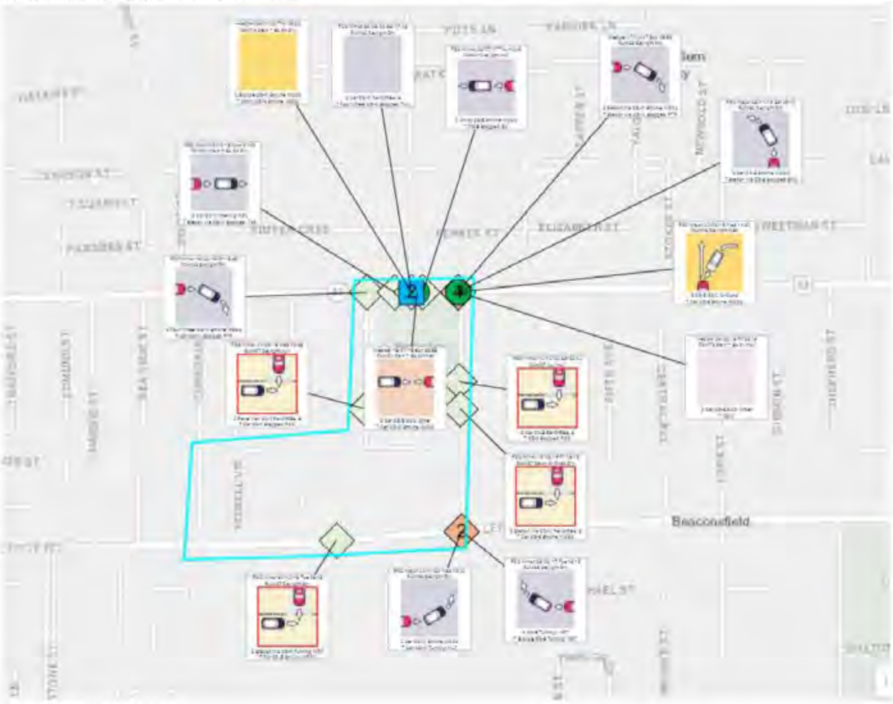
9 Safety Issues

9.1.1 The level of internal trips will be low given the nature of the LSP. Further, the internal roads will have a 6m carriageway widths or narrower, to encourage slower vehicle speeds. These characteristics will inherently improve the safety of the LSP.

9.1.2 In the vicinity of the site, there is pedestrian and cycle infrastructure provision. This includes the provision of dropped kerb crossings with tactile paving on the minor arm of priority junctions. There is also street lighting.

9.1.3 Crash history for the most recent five-year period (2017 to 2021) has been reviewed from the Main Roads WA Crash Information map on streets in the vicinity of the LSP site. Crashes in the vicinity of the site were identified and the locations of which are shown in Figure 9-1.

Figure 9-1: Location of Collisions



Source: MRWA Crash Map

9.1.4 The collisions located within the identified study area can be summarised as follows:

- Lewington Street:
  - There was a single crash resulting in minor damage as a car exited a driveway.
- Caesar Street:
  - There were two crashes, both resulting in minor damage as cars exited driveways.
- Lefroy Road:
  - There was a single crash resulting in minor damage as a car exited a driveway.
- Grosvenor Road:
  - No crashes
- Badham Close:
  - No Crashes
- South Street:
  - There have been five crashes between Lewington Street and Caesar Street, with one of those requiring hospitalisation (car versus bike at night) and another requiring medical attention (a head on crash in the west at night). The other three crashes resulted in property damage.
- Intersection of South Street and Lewington Street
  - The has been a single minor property damage crash at this intersection involving a car colliding with another stopped to turn right from South Street in Lewington Street
- Intersection of South Street and Caesar Street
  - There have been four crashes at this intersection. Two of these were rear ends, with one requiring medical attention, involving a car colliding with the rear of another stopped to turn right from South Street into Cesar Street.
- Intersection of Lefroy Road and Caesar Street
  - There have been two crashes at this intersection both resulting in major property damage and both were rear end crashes, one from the east and the other from the west both on Lefroy Road turning into Caesar Street.

9.1.5 With the cluster of crashes at the intersection of South Street and Caesar Street, the proposed intersection modification as a result of the Davis Park Structure Plan could address this problem. This may limit movements or be a partial close of this intersection. Access from north to south could then be replaced by the proposed future traffic signals at the intersection of South Street and Nannine Avenue. There is also a cluster of crashes on South Street near Wiluna Avenue, but these are almost entirely only involving vehicles, and this area is expected to have a high crossing demand for pedestrians as a result of the LSP.

10 Conclusion

10.1.1 This TIA has been prepared by PJA on behalf of Development WA in relation to a proposed LSP on land in Beaconsfield on the old Challenger TAFE site, within the City of Fremantle. The site is included within The Heart of Beaconsfield Master Plan area for residential development.

10.1.2 The LSP would generate approximately 95 two-way vehicle trips in each peak period. These trips would quickly dissipate across the local street network and are not forecast to have a significant impact in any location.

10.1.3 The only exception is the intersection of South Street and Caesar Street, which is proposed to be modified (by others) as a result of the adjacent Davis Park redevelopment. Also, the intersection of South Street and Lewington Street may be impacted, but proposed signalisation of the intersection of South Street and Nannine Avenue will create more gaps and platooning in traffic and generally maintain the performance of this intersection at acceptable levels.

10.1.4 The addition of a possible direct property access to the proposed apartment site on Lefroy Road has been found to be able to operate satisfactory, with minimal disruption to Lefroy Road traffic flows and could be allowed, if so desired.

10.1.5 Within the LSP site, traffic is expected to be limited to site generated trips, with minimal through traffic. Thus, the internal road network would comprise two-way streets with dropped kerb tactile paving pedestrian crossings. Footpaths will be provided alongside the roads, which will link to existing provision. Cyclists can utilise the network of cycle paths and lanes in the area, with potential for longer distance cycling via the proposed LTCN.

10.1.6 The LSP benefits from being within walking distance of nearby schools and within walking distance of the proposed commercial shopping precinct in Davis Park. There are frequent bus services on South Street and Lefroy Road providing access to both Fremantle and Murdoch train stations.

Appendix A Proposed Layout

LEGEND

ZONES

Residential

RESERVES

Public Open Space

OTHER

Scheme Area Boundary

R Codes

Local Street Link (Indicative location)

Structure Plan Map

0 20 40m

scale:
1:2000@A4

plan:
22/038/021

date:
28/02/2023

Taylor Burrell Barnett Town Planning & Design
Level 7, 160 St Georges Terrace, Perth WA 6000
e: admin@tbbplanning.com.au
p: (08) 9226 4276

Taylor
Burrell
Barnett

Appendix B WAPC Guideline - TIA for Structure Pans Checklist

Item	Provided	Comments/Proposals
Summary		
Introduction / Background		
name of applicant and consultant	Y	
structure plan location and context	Y	
brief description of structure plan	Y	
key issues	Y	No key issues identified, key opportunities set out
background information	Y	
Structure Plan Proposal		
regional context	Y	
proposed land uses	Y	
table of land uses and quantities	Y	
major attractors/generators	Y	Site to be fully residential
any specific issues	Y	
Existing Situation		
existing land uses within structure plan	Y	
existing land uses surrounding the structure plan	Y	
existing road network within structure plan	N/A	No road network within LSP at present
existing road network surrounding the structure plan	Y	
traffic flows on roads within structure plan (AM and PM peak hours)	N/A	No road network within LSP at present
traffic flows on roads surrounding the structure plan (AM and PM peak hours)	Y	
existing pedestrian/cycle networks within the structure plan	N/A	No pedestrian / cycle network within LSP at present
existing pedestrian/cycle networks surrounding the structure plan	Y	
existing public transport services within the structure plan	N/A	No public transport services within LSP at present
existing public transport services surrounding the structure plan	Y	
Proposed Internal Transport Networks		
changes/additions to existing road network	Y	
road reservation widths	Y	
road cross-sections & speed limits	Y	
intersection controls	Y	
pedestrian/cycle networks and crossing facilities	Y	
public transport routes	Y	

Changes to external transport networks		
road network	N/A	No changes to the external transport networks are proposed, except as proposed by the Davis Park development
intersection controls	N/A	No changes to the external transport networks are proposed, except as proposed by the Davis Park development
pedestrian/cycle networks and crossing facilities	N/A	No changes to the external transport networks are proposed
public transport services	N/A	No changes to the external transport networks are proposed
Integration with surrounding area		
surrounding attractors/generators	Y	
proposed changes to surrounding land uses	Y	
travel desire lines from structure plan to these attractors/generators	Y	
adequacy of existing transport networks	Y	
deficiencies in existing transport networks	N/A	No deficiencies identified
remedial measures to address deficiencies	N/A	No remedial measures needed
Analysis of internal transport networks		
assessment years and time periods	N/A	Peak periods assessed, assessment year not relevant as very limited through traffic
structure plan generated traffic	Y	
extraneous (through) traffic	Y	
design traffic flows	Y	Details provided in Chapter 4
road cross-sections	Y	Details provided in Chapter 4
intersection sight distances	Y	
intersection operation and method of control	Y	Details provided in Chapter 4
frontage access strategy	Y	
pedestrian/cycle networks	Y	
safe walk/cycle to school assessment (residential structure plans only)	Y	
pedestrian permeability & efficiency	Y	
access to public transport	N/A	No public transport provision proposed within the structure plan
Analysis of external transport networks		
base flows for assessment years	Y	
total traffic flows	Y	
road cross-sections	N/A	No changes to external road networks proposed
intersection operation	N/A	Low traffic volumes forecast to be generated
pedestrian/cycle networks	Y	

Safety issues		
identify issues	Y	
remedial measures	N/A	remedial measures to be provided through intersection changes proposed due to Davis Park development
Conclusions	Y	

Appendix D

Local Water Management Strategy - Urbaqua

Local Water Management Strategy

Beaconsfield TAFE

Prepared for DevelopmentWA

By Urbaqua

May 2023

urbaqua
land and water solutions

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Executive Summary

Table 1: Design elements and compliance

Design Objective	Design compliance with objectives
Site Characteristics	• The site topography ranges from 21 mAHD in the north-west corner to two low points in the south-west (15 mAHD) and south-east 14 (mAHD) corners of the site. • Regional geology mapping indicates the entire site is underlain by sand (S7). • Preliminary geotechnical information indicates there are areas of sand, limestone rubble and limestone capping • There is no known risk of Acid Sulfate Soil (ASS) disturbance within 3 m of the surface. • There are no registered contaminated sites located within or adjacent to site boundaries. • The site is underlain by the Superficial Swan aquifer, followed by the Leederville and Yarragadee aquifers. • Regional groundwater contours indicate maximum groundwater levels are approximately 1 mAHD across the site, which equates to 14 - 19 m below ground level. • The *Perth Groundwater Map* indicates the site is suitable for garden bore use and is classed as low risk for iron staining. • No wetlands, surface water bodies or waterways within or adjacent to the site. • There are various mature trees growing across the site, with most of the high ecological value trees located in the west and southwest portions. Tree retention is proposed. • A search of the EPBC Act Protected Matters Search Tool identified two listed Threatened Ecological Communities (TECs) that are likely to occur within the site area. • A search of the Aboriginal Heritage Inquiry System (AHIS) indicates no Aboriginal or European heritage places are located within or adjacent to the site.
Water sustainability	• Wastewater will be disposed of by the reticulated sewerage network. • Potable water will be provided by scheme water. • Groundwater is proposed for irrigation supply for the POS areas. • A community bore system is proposed for the irrigation of single residential and grouped housing lots. • The site water balance is relatively unchanged between pre and post development due to the 'urban' nature of the TAFE site pre-development. Some more groundwater abstraction is expected due to the increase in vegetated areas proposed post development. • Preliminary options analysis has been undertaken for the community bore. • There is allocation available in the Perth superficial aquifer and a groundwater allocation has been applied for the volume of 13,598 kL/annum for POS irrigation and community bore requirements.

Design Objective	Design compliance with objectives
	• The landscaping strategy includes retention of trees where possible. • Water efficiency measures are proposed for in house management.
Stormwater management	• Predevelopment the site had two existing sumps with drainage coming from the internal TAFE site and two external City of Fremantle road catchments. • Predevelopment modelling indicates that the sumps did not quite accommodate the full 1% AEP event in the sumps. • Post development design and modelling has ensured that the full 1 % AEP is managed on site (including the existing City external catchments). Post development management will include: • Soakwells will be required for all dwellings (single and grouped housing) to capture and infiltrate stormwater on site. • Permeable paving will be used in portions of the road reserves to infiltrate stormwater close to source. • Stormwater from the first flush events will be treated in roadside swales. • Road drainage will be conveyed either via the road reserve (flush kerbing) or pipe/pits to roadside swales and/ or infiltration cells. • Swales will discharge to two main infiltration areas; the eastern and western infiltration areas. • The western infiltration area will have underground cells within the old sump area, with an infiltration basin over the top of the cells. • The western cells and basins accommodate up to the 1% AEP event on site. • The eastern infiltration area will have underground cells within the old sump area, and will accommodate up to the 1% AEP event on site. • Swales will be vegetated with locally native, drought tolerant species but will be provided with irrigation to ensure healthy plant growth. Trees will be retained with the additional planting to provide shade and to assist in maintaining good infiltration rates. • Stormwater drainage design ensures detained immobile stormwater is fully infiltrated within a time period not exceeding 96 hours per storm event (maximum of 19.2 hours).
Groundwater management	• Due to proposed changes to the existing landform for development purposes, some sand fill will be required to re-contour the site. The sand will also be mixed with the limestone rubble to ensure uniform infiltration. • Preliminary earthwork levels equate to a separation distance of approximately 16.7 – 20.0m between lot levels and groundwater and 18m below the grouped housing levels. This exceeds the 1.2m separation required under the BUWM guidelines. • All WSUD infrastructure has a minimum separation to groundwater of 11m to groundwater which exceeds the 0.3m requirement. • No subsoil drainage is proposed.
Flood management	• Finished floor levels are approximately 2.7m the top water level in the basin. This exceeds the 0.3m clearance requirement.

Design Objective	Design compliance with objectives
Monitoring	• Monitoring has not been undertaken pre-development due to the large separation distance to groundwater. • A monitoring program will be designed for the community bore requirements.
Implementation	• Further actions required for detailed subdivision design (including the community bore design) have been detailed.

CONTENTS

Figures

Tables

1 INTRODUCTION

1.1 Background

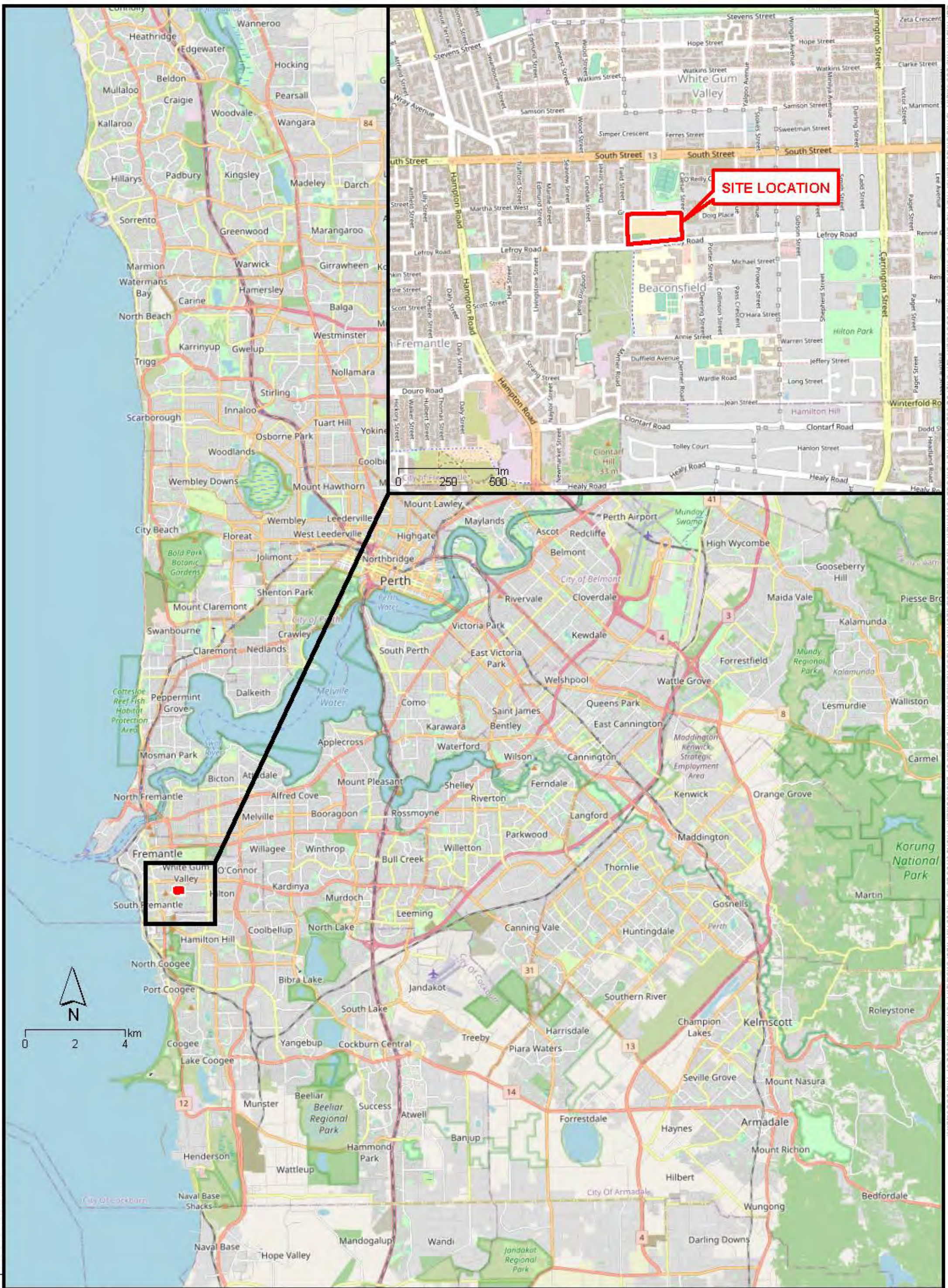
This Local Water Management Strategy (LWMS) has been prepared to support the Local Structure Plan for the Beaconsfield TAFE site (hereafter referred to as the site) in the City of Fremantle (Figure 1).

The site is located approximately 20 km south-west of the Perth CBD and 2km south-east of Fremantle. The site is approximately 3.8 hectares in size and is bound by:

- Lefroy street to the south;
- Grosvenor Street to the north;
- Caesar Street to the east;
- Badham Close to the west.

This LWMS has been prepared consistent with *Better Urban Water Management* (WAPC, 2008) and the Draft *State Planning Policy 2.9 Planning for Water* and its' guidelines. A checklist for the LWMS requirements is included in Appendix 1 and outlines the compliance with the documents listed above.

The LWMS provides a summary of the design objectives (determined by guiding documents and City of Fremantle requirements), site characteristics (following a review of regional datasets and field investigations), water management measures and steps to implement the UWMP.



Job: J000946 Doc: 001 Date: 8/05/2023 Ph: (08) 9328 4663 Fax: (08) 6316 1431 E: info@urbaqua.org.au	Department of Education LOCAL WATER MANAGEMENT STRATEGY LOT 2680 GROSVENOR STREET, BEACONSFIELD **SITE LOCATION**	**Figure 1**

1.2 Planning Background and Context

The site is zoned 'Public purposes (Technical school)' under the Metropolitan Region Scheme (MRS). A regional masterplan was prepared for the 'Heart of Beaconsfield' which included this site. The project was led by the City of Fremantle in cooperation with the Department of Communities and other partners. The masterplan provided a general guide to how the redevelopment of various sites within the suburb might redevelop, particularly around the Davis Park precinct, Lefroy Road Quarry and this site. It covered a 48 hectare area and a key feature included a new green link connecting South Street to Lefroy Road and Clontarf Road, of which this site is an integral part of. The green link had the objectives of;

- Providing pedestrian and cycle links between open space, community facilities and recreation areas;
- Provide for a north-south green link that enhances tree canopy and connects key areas of open space;
- Retention of significant trees to maintain a sense of place;
- Retain and provide additional active, natural and passive open space. On the TAFE site specific and relevant points from the master plan include.

The masterplan accommodated the Department of Communities proposal for redevelopment of this TAFE site and the final masterplan concept was adopted by council in April 2021, following and extensive community engagement and development process.

1.3 Proposed Development

The proposed development will be a mix of residential lots (2.30 ha), with associated POS (0.61 ha) and road infrastructure (0.91 ha) including:

- 2 higher density multi-residential lots (GD/MD).
- 82 individual residential lots ranging in size from 120 m^2 to 440 m^2 in size (average lot size 201 m^2).
- Three POS and drainage areas (one eastern POS/drainage area, one western POS/drainage area, and once central POS).
- Roads, laneways and road reserves.

These features are presented on the site concept plan on Figure 2.

LOT SUMMARY

LOT YIELD			LOT AREA	
Size	No.	%	Average	% of Total Area
120m² - 159m²	6	7.32%	138m²	5.02%
160m² - 179m²	35	42.68%	168m²	35.79%
180m² - 234m²	25	30.49%	195m²	29.57%
235m² - 319m²	14	17.07%	290m²	24.82%
320m² - 440m²	2	2.44%	404m²	4.89%
Number of Lots	82			
Minimum Lot Size 133m² Maximum Lot Size 422m²			Average Lot Size 201m² Total Lot Area 16618m²	
GD/MD Lot	2			
Total Number of Lots	84			

Legend

Total Application Area (3.8192ha)
Tree to be considered for retention in public realm
Other existing tree

Land Use Summary

Residential Lots	2.2998ha (60%)
Road Reserve	0.9090ha (24%)
POS and Drainage	0.6104ha (16%)

Source: Taylor Burrell Barnett, 23.01.2023

urbaqua

Job: J000946
Doc: 002
Date: 08.05.23
Ph: (08) 9328 4663
Fax: (08) 6316 1431
E: info@urbaqua.org.au

Department of Education
LOCAL WATER MANAGEMENT STRATEGY
LOT 2680 GROSVENOR STREET, BEACONSFIELD

CONCEPT PLAN

Figure 2

1.4 LWMS Policy and Guidelines

The LWMS has been prepared in accordance with the *Better Urban Water Management* (BUWM) guidelines (WAPC, 2008) and *Interim: Developing a Local Water Management Strategy* (DoW, 2008). Additional guidance is provided in:

- Liveable Neighbourhoods (WAPC, 2009)
- Local Government Guidelines for Subdivisional Development (WAPC, 2017)
- Decision Process for Stormwater Management in Western Australia (DWER, 2017)
- Stormwater Management Manual for Western Australia (DoW, 2004-2007)
- WA State Water Strategy ((Department and Premier of the Cabinet, 2004)
- WA State Water Plan (Department of the Premier and Cabinet, 2007)
- State Planning Policy 2.9 Water Resources (WAPC, 2006) (an update to *SPP 2.9 Planning for Water* is currently in draft)
- City of Fremantle Water Conservation Strategy (CoF, 2013)
- City of Fremantle Engineering Technical Guidance (2018)
- The regional master plan; *Heart of Beaconsfield Master Plan*

1.5 LWMS Design Objectives

Table 2 summarises the key design criteria for the Structure Plan with consideration of the *Decision process for stormwater management* (DWER, 2017). These criteria have been considered in developing the LWMS for the site which is outlined in Section 3 through 6 below. A LWMS checklist is provided in Appendix 1.

Table 2: Objectives

Design Element	Criteria
Water sustainability	• Maximise local infiltration to replenish surface groundwater aquifers; • Reach a target for domestic scheme water use of 100kL/year per person; and • Provide alternative water sources for domestic irrigation (gardens).
Surface water management	• Design for the small, then minor, then major rainfall events and aim to replicate how water moves in the natural landscape. • The lot runoff to be retained and infiltrated within all lots through soakwell systems. • The first 15mm of rainfall is to be managed and treated through water sensitive urban design (WSUD). • Minor event runoff from events larger than 15 mm total depth are to be managed to provide serviceability, amenity and road safety requirements. • Major event runoff is to be managed to ensure flood protection. • Water quality treatment systems and stormwater management structures should be designed in accordance with the Stormwater Management Manual for Western Australia (DoW, 2004-2007) and Australian Runoff Quality: A guide to water sensitive urban design (Engineers Australia, 2006). • Improve water quality throughout the development.

Design Element	Criteria
Groundwater management	• Provide an appropriate separation distance between finished lot levels and groundwater to maintain the expected level of amenity with all soakwell devices designed with a minimum of 0.3 m separation from the maximum groundwater level.
Flood management	• Roads and public open spaces are to be designed to cater for the surface overflow for more severe storm events with habitable floors at least 0.3 m above the 1% AEP flood or storage level at any location;
Management of disease vectors and nuisance insects	• Limit the creation of new sites for breeding of nuisance insects; • Prevent standing water in drainage infrastructure (infiltration within 96hrs); and
Implementation	• Provide a framework to implement water management strategies outlined in the LWMS;

2 SITE CHARACTERISTICS

2.1 Location and Land Use

The site is located within the suburb of Beaconsfield in the City of Fremantle. It is predominantly surrounded by residential lots, public open space (POS) to the north (Bruce Lee Reserve), and education services (Fremantle College) to the south.

According to Landgate aerial photography, the site has been used for education services (TAFE) since 1970, before which the land was undeveloped. The TAFE buildings and associated services have now been demolished to make way for the proposed development.

2.2 Climate and Rainfall

The site is located in the south-west of Western Australia and experiences a temperate climate characterised by cool, wet winters and warm, dry summers. The closest Bureau of Meteorology (BOM) weather station with rainfall data is the Fremantle weather station (number 9192), which has recorded an annual average rainfall of 702.4 mm. Most of the year's rainfall is typically received during May to September, as shown in Plate 1 below. The closest BOM weather station with temperature data is the Jandakot Aero weather station (number 9172), with temperature data also summarised in Plate 1 below.

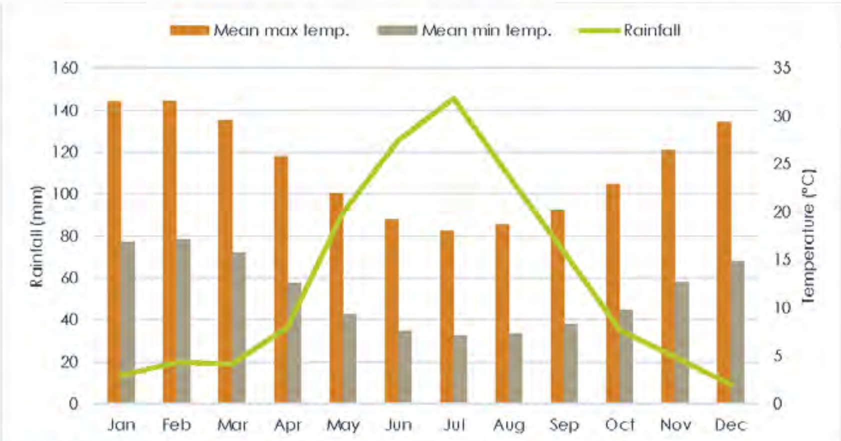


Plate 1: Mean Temperature and Rainfall Statistics from BOM Weather Stations
Source: (BOM, 2023 a) (BOM, 2023 b)

2.3 Landform and Topography

The site topography ranges from 21 mAHD in the north-west corner to two low points in the south-west (15 mAHD) and south-east 14 (mAHD) corners of the site. These low points are associated with the existing drainage sumps. The slope of the site is gradual down towards Lefroy Road until reaching each of the sumps, which are steep sided.

2.4 Geology and Soils

2.4.1 Regional Data

Regional geology mapping indicates the entire site is underlain by sand (S7) described as (DMIRS, 2022)

> *S7: SAND - pale yellowish brown, medium to coarse-grained sub-angular quartz, trace of feldspar, moderately sorted, of residual origin.*

It is adjacent to areas of *LS1: LIMESTONE* to the west of the site. Regional geology mapping is presented on Figure 3 below.

2.4.2 Geotechnical Information

During demolition works, geomorphological information was presented that triggered the requirement for further geotechnical assessment of the site. The demolition works found areas of limestone capping/ less permeable areas. This information is presented in Figure 4.

A geotechnical investigation is currently being undertaken. Some preliminary results have been provided to Urbaqua to assist with the drainage modelling assumptions however the geotechnical information is not yet finalised. This has been discussed with the City, and they were comfortable with progressing with the finalisation of the modelling and LWMS (Appendix 2) based on the risks, possible contingency options and given the LWMS modelling can be refined further at detailed design.

A summary of the preliminary advice provided by Galt Geotechnics is provided below and further discussion of the earthworks management for the site is provided in Section 4.2.

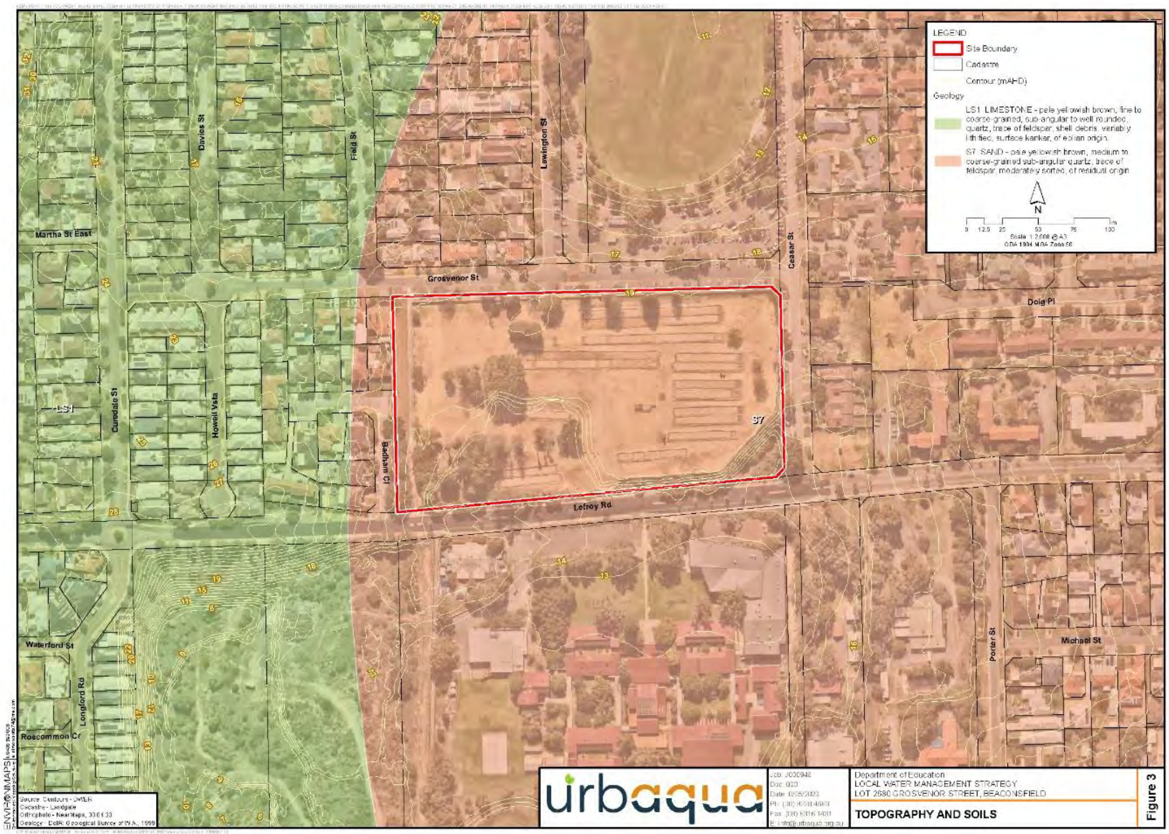
- The upper northern half of the site has predominantly shallow limestone, within ~1 m of ground surface. Typically, massive but can be discontinuous with sand pockets.
- The southern half of the site has thicker "sand". The "sand" is both natural sand (which usually includes some limestone gravel and cobbles) or mixed sand/limestone rubble fill in the top ~1 m to 2 m.
- The "sand" thickness increases to 3+ m further south but would overlie limestone at depth.
- The low-lying area in the south centre of the site is ~5 m lower than elsewhere and has shallow limestone.

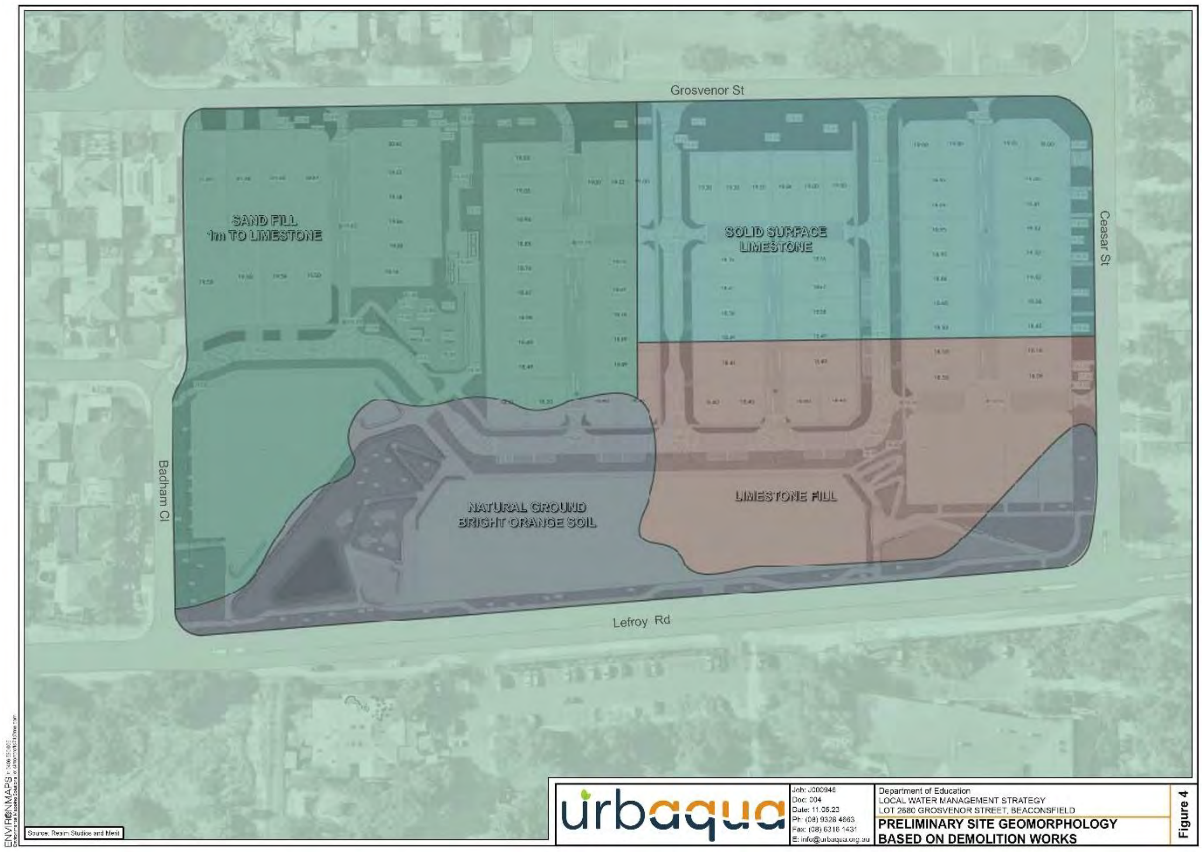
Regarding preliminary infiltration results, Galt Geotechnics advised;

- The "limestone" is frequently better than expected (up to k = 7 m/day), however one test had k = 0.5 m/day in the far north-west corner of the site.
- The "sand" and rubble fill mostly have good infiltration (k = 4 to 11 m/day) with one local result of k = 1.5 m/day.

2.4.3 Acid Sulphate Soils

Regional acid sulfate soil risk mapping indicates that there is no known risk of Acid Sulfate Soil (ASS) disturbance within 3 m of the surface.


LEGEND
Site Boundary
Cadastre
Contour (mAHD)
Geology
LS1 LIMESTONE - 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.
S7 SAND - pale yellowish brown, medium to coarse-grained sub-angular quartz, trace of feldspar, moderately sorted, of residual origin
N
0 12.5 25 50 75 100 m
Scale 1:2,000 @ A3
GDA 1994 MGA Zone 50
Grosvenor St
Lefroy Rd
Badham Cl
Ceasar St
Doig Pl
Martha St East
Davies St
Field St
Lewington St
Curedale St
Howell Vsta
Waterford St
Longford Rd
Roscommon Cr
Porter St
Michael St
LS1
S7
Source: Contours - DWER
Cadastre - Landgate
Orthophoto - NearMaps, 30.04.23
Geology - DoIR: Geological Survey of W.A., 1999
Job: J000946
Doc: 003
Date: 10/05/2023
Ph: (08) 9328 4663
Fax: (08) 6316 1431
E: info@urbaqua.org.au
Department of Education
LOCAL WATER MANAGEMENT STRATEGY
LOT 2680 GROSVENOR STREET, BEACONSFIELD
TOPOGRAPHY AND SOILS
Figure 3


Grosvenor St
SAND FILL
1m TO LIMESTONE
SOLID SURFACE
LIMESTONE
Ceasar St
Badham Cl
NATURAL GROUND
BRIGHT ORANGE SOIL
LIMESTONE FILL
Lefroy Rd
Source: Realm Studios and Meld
Job: J000946
Doc: 004
Date: 11.05.23
Ph: (08) 9328 4663
Fax: (08) 6316 1431
E: info@urbaqua.org.au
Department of Education
LOCAL WATER MANAGEMENT STRATEGY
LOT 2680 GROSVENOR STREET, BEACONSFIELD
PRELIMINARY SITE GEOMORPHOLOGY
BASED ON DEMOLITION WORKS
Figure 4

2.5 Contamination

There are no registered contaminated sites located within or adjacent to site boundaries. One contaminated site is located approximately 260 m along Lefroy Road to the west (8 Waterford Street site number 20332), classified as remediated for restricted use. This classification has been given to the site due to chloride contamination in the groundwater, and the site was previously used as a landfill for construction and demolition waste. Groundwater is not suitable for domestic garden watering but can be used for public open space irrigation at that contaminated site.

The impact of this in relation to the proposed community bore is discussed in more detail in Section 3.3.2.

2.6 Groundwater

2.6.1 Aquifers

The site is underlain by the Superficial Swan aquifer, followed by the Leederville and Yarragadee aquifers. It is located within the Perth groundwater area, and the City of Fremantle South groundwater management subarea, which is proclaimed under the *Rights in Water and Irrigation Act 1914* (RIWI Act).

It is not located in a groundwater Public Drinking Water Source Area (PDWSA).

There are no active groundwater licences in place across the site, however allocation is available in the Superficial Swan aquifer for this management subarea. All current allocations within this management area are currently held by the City of Fremantle (as of May 2023). (DWER, 2023 a).

2.6.2 Groundwater Levels

Regional groundwater contours indicate maximum groundwater levels are approximately 1 mAHD across the site, which equates to 14 - 19 m below ground level. Groundwater flow is generally to the west towards the ocean, with a relatively flat hydraulic gradient (DWER, 2023 b) as shown in Figure 5.

A search of the Water Information Reporting bore network indicates one bore (site reference 61406382) is located within site boundaries, however the bore has no usable groundwater level information available. A bore located within the Bruce Lee Reserve 100 m the north of the site (reference number 6140711) has level data available, and indicates the shallow aquifer maximum level is 1.027 mAHD (recorded in September 2022), which is in line with the regional maximum contour.

No predevelopment groundwater monitoring has been undertaken due to the significant depth to groundwater across the site (Section 7.1).

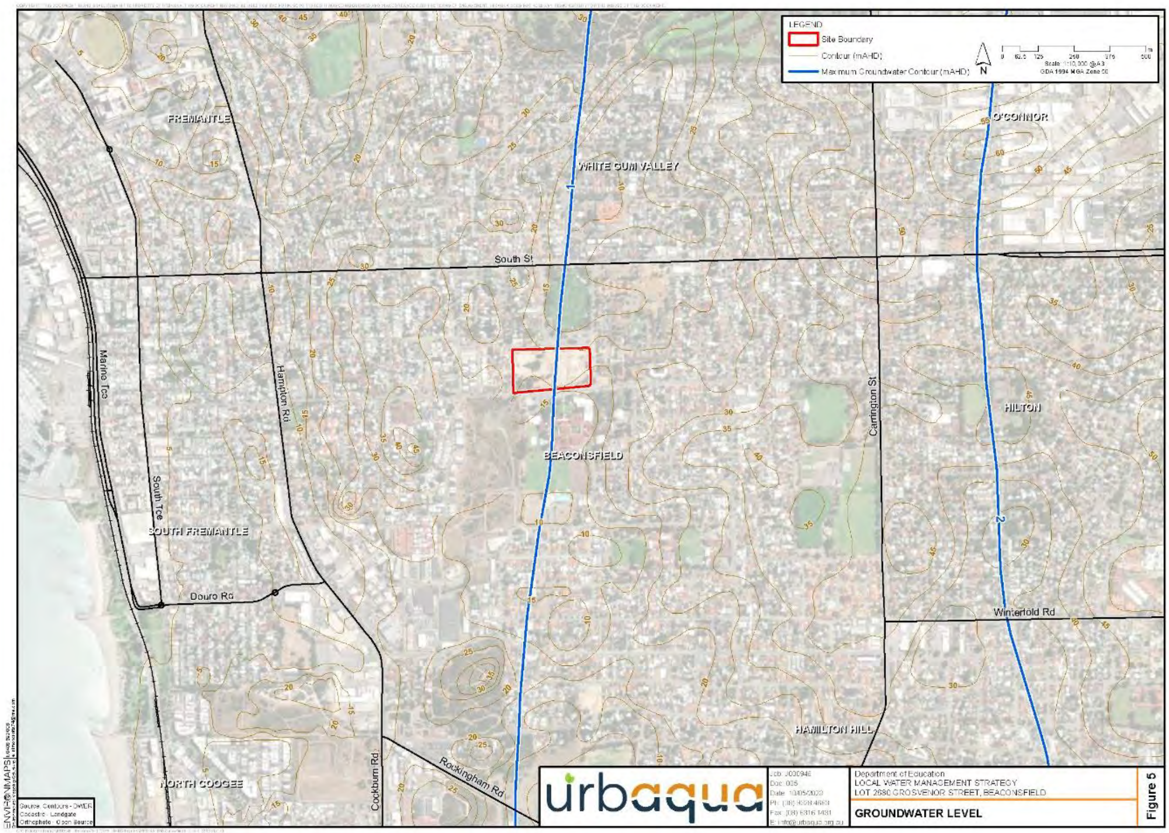
2.6.3 Groundwater Quality

The *Perth Groundwater Map* indicates the site is suitable for garden bore use and is classed as low risk for iron staining. Water quality information from nearby sites at Bruce Lee Reserve and Salentina Ridge substantiate this regional information with iron readings of <0.05mg/l (in 2022) and 0.03mg/l (in 2014) respectively.

Groundwater salinity is estimated to be 500-1000 mg/L (DWER, 2023 b).

Groundwater contamination has been recorded slightly down-gradient of the site, as discussed in more detail in Section 2.5. As the hydraulic gradient is relatively shallow, this should still be considered when assessing groundwater suitability for abstraction and irrigation, and this is discussed more in Section 3.3.2.

Groundwater quality data at bore 61407111 (within Bruce Lee Reserve) was taken in February 2019, for inorganics, nutrients, metals, and physical parameters. This data has been presented in Appendix 3.


LEGEND
Site Boundary
Contour (mAHD)
Maximum Groundwater Contour (mAHD)
N
0 62.5 125 250 375 500 m
Scale 1:10,000 @A3
GDA 1994 MGA Zone 50
FREMANTLE
WHITE GUM VALLEY
O'CONNOR
South St
Marine Tce
Hamilton Rd
BEACONSFIELD
Carrington St
HILTON
South Tce
SOUTH FREMANTLE
Douro Rd
Winterfold Rd
HAMILTON HILL
Cockburn Rd
Rockingham Rd
NORTH COOGEE
urbaqua
Job: J000946
Doc: 005
Date: 10/05/2023
Ph: (08) 9328 4663
Fax: (08) 6316 1431
E: info@urbaqua.org.au
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LOCAL WATER MANAGEMENT STRATEGY
LOT 2680 GROSVENOR STREET, BEACONSFIELD
GROUNDWATER LEVEL
Figure 5

2.7 Surface Water

No wetlands, surface water bodies or waterways within or adjacent to the site.

Surface water drainage within the site was previously directed to two sumps located in the south-western and south-eastern corners, which also capture some stormwater runoff from road areas outside of the site boundary. Predevelopment stormwater management is further discussed in Section 4.

2.8 Vegetation

There are various mature trees growing across the site, with most of the high ecological value trees located in the west and southwest portions.

The site is located within a chain of open spaces and bushland areas that stretch from Booyeembara Park to Beeliar Regional Park, in line with the limestone ridge that runs parallel to the coast (identified in the *Heart of Beaconsfield Master Plan*). Other reserves within this chain provide an indication of the ecological context and plant communities of the former TAFE site. The chain features very high ecological and cultural values with rare and endangered species and communities (REALMstudios, 2023).

Key tree species located within these reserves include:

- *Eucalyptus gomphocephala* (White Gum) or Tuart in Noongar
- *Melaleuca lanceolata* (Rottnest Island Tea Tree) or Moonah
- *Melaleuca rhaphiophylla* (Swamp Paperbark) or Bibool and
- *Eucalyptus decipiens* (Red Heart Gum) or Moit.

Tree retention is a key aspect of the proposed redevelopment, with a target to reach 30% canopy cover at the site to meet the City of Fremantle's *Urban Forestry Policy: Southern Precinct* target of 26%. Existing trees across the site have been assessed by ArborCentre, including on-lot and verge trees. Tree retention has informed the lot layout of the site, road alignment, site levels and drainage locations. The tree retention plan is shown in Figure 6, with further information provided in REALMstudio's Landscape Report (Appendix 4).

2.8.1 Conservation, ESAs and Bush Forever

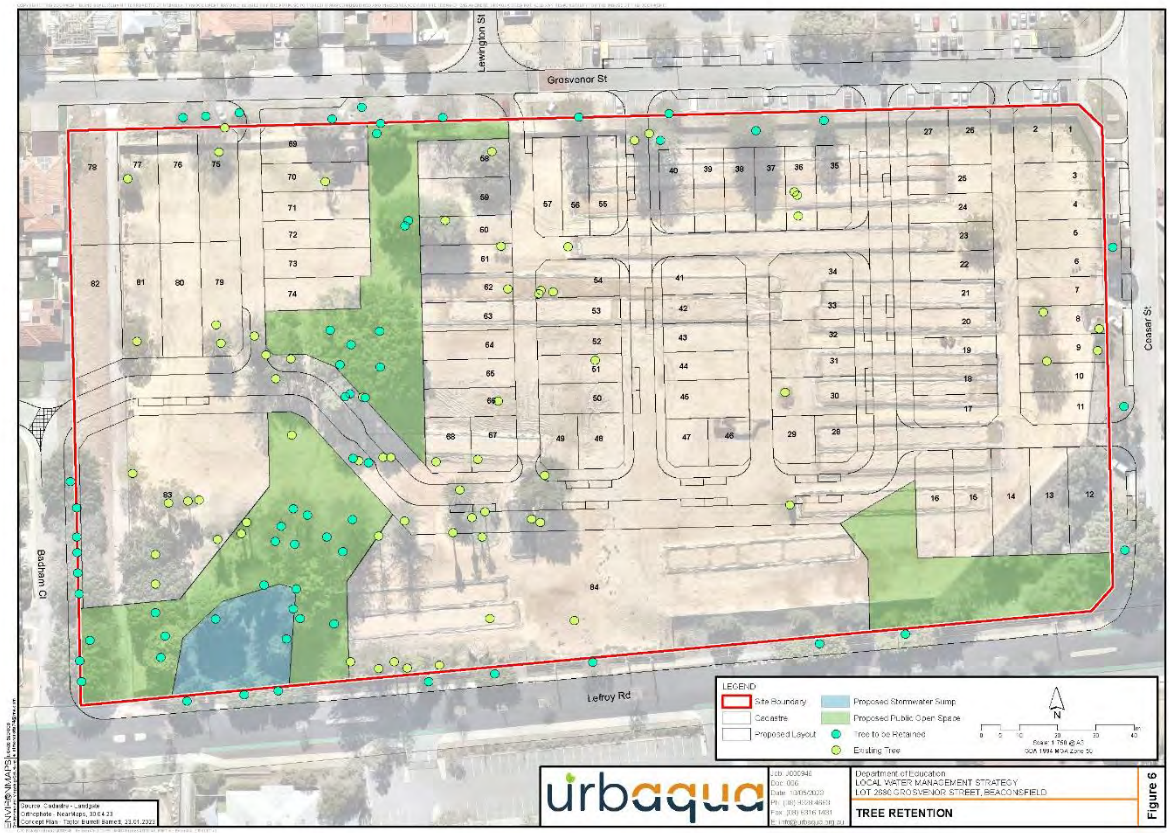
A search of the EPBC Act Protected Matters Search Tool (Department of Climate Change, Energy, the Environment and Water, 2023) identified two listed Threatened Ecological Communities (TECs) that are likely to occur within the site area, including:

- *Banksia* Woodlands (endangered)
- Tuart Eucalyptus (*Eucalyptus gomphocephala*) (critically endangered)

The search also identified 19 listed threatened flora species that may be present within the site. The site is not mapped as an Environmentally Sensitive Area (ESA) and contains no Bush Forever sites.

2.9 Heritage

A search of the Aboriginal Heritage Inquiry System (AHIS) indicates no Aboriginal or European heritage places are located within or adjacent to the site.



Grosvenor St
Lewington St
Caesar St
Badham Ct
Lefroy Rd
LEGEND
Site Boundary
Cadastre
Proposed Layout
Proposed Stormwater Sump
Proposed Public Open Space
Tree to be Retained
Existing Tree
N
Scale: 1:750 @ A3
GDA 1994 MGA Zone 50
Source: Cadastre - Landgate
Orthophoto - NearMaps, 30.04.23
Concept Plan - Taylor Burrell Barnett, 23.01.2023
ENVIRONMAPS
urbaqua
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Date: 10/05/2023
Ph: (08) 9328 4663
Fax: (08) 6316 1431
E: info@urbaqua.org.au
Department of Education
LOCAL WATER MANAGEMENT STRATEGY
LOT 2680 GROSVENOR STREET, BEACONSFIELD
TREE RETENTION
Figure 6

3 WATER BALANCE AND USAGE STRATEGY

3.1 Wastewater Disposal

The site will be connected to the Water Corporation sewer reticulation network for wastewater disposal. The Water Corporation Esinet data indicates that the development area is located adjacent to the following sewer reticulation mains:

- Ø150mm existing asbestos cement (AC) sewer gravity pipe located 1m inside the western boundary of Lot 2680 from Grosvenor Street to Badham Close, approximately 2m to 5m deep. Note that an easement will be present over this asset, located 5.0m centrally over the asset. This easement will extend 3.5m into Lot 2680. This gravity pipe connects to a manhole each on Grosvenor Street and Badham Close, and the remaining sewer network extending west, away from the site.
- Ø150mm existing asbestos cement (AC) sewer gravity pipe located in the western verge of Badham Close.
- Ø50mm unplasticized polyvinyl chloride (PVC-U) private sewer pressure main located in the southern verge of Lefroy Road, servicing the Lefroy Road Child Care Centre.
- Ø510mm existing reinforced concrete (RC) sewer pressure main, the Mt Pleasant line, located in the western verge of Caesar Street.
- Ø610mm existing reinforced concrete (RC) sewer pressure main, the Mt Pleasant Duplication, located in the western verge of Caesar Street.
- Ø230mm existing vitrified clay (VC) private pressure main located in the western verge of Caesar Street servicing the South Fremantle High School.
- Ø230mm existing vitrified clay (VC) sewer gravity pipe located in the eastern verge of Caesar Street.

Pritchard Francis anticipate an extension off the existing Ø150mm AC gravity pipe will be required to service the first block of single residential lots facing Grosvenor Street to the west. The southern side of this block, lots 79 - 82, group housing sites lot 83, and the internal block between Grosvenor Street and the Public Open Space, lots 69 to 74, will be serviced by an extension off the existing Ø150mm AC sewer in Badham Close. A Ø150mm extension west into Grosvenor Street off the existing Ø230mm VC reticulation main in Caesar Street will service the remaining lots across the development from the internal roads, including lots 1, 2, 26 and 27 fronting Caesar Street, to be serviced off Caesar Street. The two eastern blocks adjacent Caesar Street will be serviced at the rear from the internal laneway, lots 3 to 11 and 17 to 25.

Due to the split-level arrangement proposed for lot 84, the lower-level fronting Lefroy Road will be serviced by a wastewater pump station. The split-level arrangement required for lots 12 to 16 to tie these lots to the internal road level, and the Public Open Space level fronting Lefroy Road, the lower split portion of the lots cannot be serviced by sewer. The preliminary sewer connection plan is provided in Appendix 5.

3.2 Potable Water Supply

The site will be connected to the Water Corporation scheme water network for potable water supply. The Water Corporation Esinet data indicates that the development area is located in proximity to the following water reticulation mains:

- Ø150mm reinforced concrete (RC) main located in the eastern verge of Caesar Street.
- Ø100mm reinforced concrete (RC) main located in the northern verge of Lefroy Road.
- Ø50mm copper (CU) main located in the western verge of Badham Close.

- Ø100mm cast iron (CI) main located in the northern verge of Grosvenor Street.

Pritchard Francis anticipate that the site will be serviced from the existing Ø100mm CI main in Grosvenor Street, the Ø150mm RC main in Caesar Street, and the Ø50mm CU main in Badham Close. An extension and upgrade of the Ø100mm main in Grosvenor Street to a Ø 150mm main will connect to the Ø150mm main in Caesar, this extension will service the development from the north, and eventually connecting into the Ø50mm CU main in Badham Close. The upgrade of the service to a Ø150mm main is recommended by Pritchard Francis and the Water Corporation to ensure the provision of fire services capacity for the development. Micro tunnelling of the water main from the western end of Grosvenor Street will also be required to avoid existing above ground services and to protect trees. The preliminary sewer connection plan is provided in Appendix 5.

3.3 Irrigation Supply

Groundwater is proposed for irrigation of the site, both of the three POS areas and the household/apartment private gardens. A community bore/ third pipe system is proposed for the private lots and this is discussed further in Section 3.3.2.

The site does not currently have a groundwater licence however there is availability within the Perth-Superficial Swan aquifer, Subarea City of Fremantle South, Level 1. Preliminary liaison with DWER confirmed that there was sufficient allocation available for the volumes required for this site and that the proponent can submit a licence application for the POS irrigation and the proposed community bore system, despite still being subject to further approvals and design (*pers. comm.* Glenn Simmons, April 2023). A licence application for 13,598 kL/annum has been submitted to DWER in May 2023 and is awaiting approval.

A breakdown of the irrigation volume requirement is provided in Table 3 below.

Table 3: Irrigation Volume Requirements

Use	Realm	Approx. % of realm area for irrigation	Area requiring irrigation (sqm)	Irrigation Volume Demand (kL/annum)
Public use	Public Open Space	28%	10,563	7,922
	Verges	-	1,268	951
Community bore	Single dwelling lots	16%	5,000	3,750
	Grouped housing lots	16%	1,300	975
	TOTAL (private)		**6,300**	**4,725**
	TOTAL		**18,131**	**13,598**

3.3.1 Public Open Space

The site has three POS areas, totalling 1.056 ha (28% of total site area). At an irrigation rate of 7500 kL/ha/year, this will require an approximate irrigation supply of 7,922 kL/year. The landscape concept plan is provided in Figure 9 and the full landscape report is presented in Appendix 4.

The landscape design has been strongly influenced by the character of the area, in particular retaining the existing trees and landform.

The following will be implemented to improve water efficiency within POS.

- Selection of drought tolerant, native plant species where appropriate.
- Soil conditioning and mulching to improve moisture and nutrient retention.
- Controlled water application rates to suit the water requirement of plants, climate and rainfall patterns.
- Water efficient sprinkler systems.

3.3.2 Community Bore

There is an opportunity to reduce the potable water consumption and using fit-for-purpose use on this site by implementing a community bore system to supply households and the apartments with groundwater for irrigation. Initial liaison has been undertaken with the City of Fremantle to determine whether they would be amenable to a community bore system, acknowledging that they would be the ultimate service provider of the community bore. The City noted that a precedent had been set with Development WA's project "The White Project" in White Gum Valley, and so they are therefore comfortable with managing a community bore system and would be amendable to the proposal provided the relevant approvals have been gained.

A community bore is a "bore or multiple bores supplying groundwater via a reticulated network to a number of properties in urban developments for non-drinking uses including private garden watering and/or for irrigation of communal green spaces within the development" (DWER, 2018).

The groundwater proposed in this community bore scheme is a non-drinking water supply and therefore requires its' own pipe network, separate from scheme water. The groundwater would be delivered via a third pipe (or purple pipe) network and is closely monitored to ensure optimal delivery.

Community bores can provide a centralised, well-managed, fit-for-purpose alternative water supply for both public and private irrigation, if implemented in an appropriate site with available groundwater, and as part of a suite of integrated urban water management options and water efficiency measures.

Before a community bore can be implemented, there needs to be an understanding of the amount of groundwater available, whether the draw on this supply is sustainable in the long term and whether there will be enough stormwater infiltration back into the system to create a healthy localised water balance. This has been addressed in Section 3.4

The benefits of installing a community bore may include:

- Potential to provide a well-managed, fit-for-purpose alternative water supply for both public and private irrigation.
- Maintain or increase urban greening and improve local amenity.
- Reduced reliance on scheme water consumption and deferred capital expenditure on centralised infrastructure.
- Substantially reduce the total demand for potable water at the development (up to 40% reduction).
- Maximised water efficiency for developments if metering is in place, consumption limits are enforced and if implemented alongside WSUD principles.
- Maximised water efficiency at the household scale if implemented alongside water efficient landscape design and effective irrigation systems. Provision of information to residents from local council or via development 'Design Guidelines' can assist with this.

- Installation of a third pipe system/'purple-pipe' infrastructure can be used for climate independent recycled water should there be insufficient groundwater supplies in the future.
- Benefit residents through reduced water rates and certainty of supply (i.e. in the event of additional restrictions on external use of potable water).

The process outlined in the *Guideline for the Approval of Non-Drinking Water Systems in Western Australia* (Department of Water, 2013c) has been followed when evaluating the proposed community bore system. This guideline includes the following four stages of assessment:

- Stage 1: Planning - Option evaluation and concept design - Identify source options.
- Stage 2: Preliminary design - secure source and identify supply system.
- Stage 3: Detailed design and approvals - provide for infrastructure requirements and apply for approvals to use (and supply) a non-drinking water source.
- Stage 4: Implementation – obtain approvals to construct (and operate).

The options evaluation and concept design (Stage 1) is presented in this report in Appendix 6. The preliminary design (Stage 2) is being initiated currently and Stage 3 will be completed as part of the detailed design. Stage 2 and 3 design works will be presented in the UWMP. Stage 4 approvals to construct and operate will be obtained prior to construction.

3.3.2.1 Concept Design

The options evaluation and concept design (Stage 1) is presented in Appendix 6. A 'purple pipe' system will be provided throughout the development within the road reserve for which private properties to connect. The proposed location of the purple pipe system and typical detail of connection point will be determined at detailed design and presented in the UWMP.

The pipe network will be fed by a community bore located within a private lot in POS Area 2 (Figure 10). The community bore and purple pipe irrigation network. The system will include stations to subdivide the site into separate irrigation sub-areas if required. Each area will be irrigated two times a week in line with current Water Corporation guidelines.

Potential yield and detailed water quality analysis will be investigated during Stage 2 and detailed design to confirm suitability, and identify if any treatment is required (i.e., iron filters). However, some preliminary background information is available which suggests that yield and quality will be acceptable.

Groundwater Yield

The TAFE site previously had a production bore installed in 1996. The TAFE bore log in provided in Appendix 7. This bore is still viable and able to operate, however given the age of the infrastructure, a new bore is likely to be required (*pers. comm.* Daniel Rose, Pinion Advisory, May 2023). This is currently being assessed by the Irrigation subcontractor, Pinion Advisory. A CAW licence application has been submitted to DWER in May 2023 in the event a new bore is required.

Preliminary estimations by Pinion Advisory estimated the full site would require approx. 5L/sec to provide sufficient irrigation to operate within the generally accepted irrigation window of 40hr/week.

The test results for the existing TAFE bore (Appendix 7) show that even at 15L/sec the drawdown stabilises at approx. 16.9m BGL from 1.5 - 6 hours (i.e. the water level in the bore stabilises relatively quickly following commencement of pumping, indicating that the inflow of water into the bore is sufficient to sustain the production flow rate out) (Pinion, 2023).

This indicates that the aquifer onsite is capable of sustaining the higher flow of 15L/sec. While water levels may have changed marginally over the 30 years, the actual transmissivity of the aquifer will not have changed (Pinion, 2023), so the site should be able to rely on the same replenishment, albeit at a potentially lower pumping level overall.

The site should therefore be able to achieve the necessary production flow rates required for the new development with some ease, and without the requirement for additional storage tanks on site to store water to supply peak volumes during irrigation periods. This will be confirmed during detailed design.

Irrigation Quality

It is acknowledged that further site-specific groundwater quality testing will be required as part of detailed design. However, preliminary water quality information obtained from other sources suggests;

- The groundwater is fresh and suitable for irrigation (500-1000 mg/L (DWER, 2023 b)). The nearby DWER WIN bore (in 2019) and the onsite TAFE bore (in 1996) both identified an Electrical conductivity (EC) of ~1,000uS/cm (relatively fresh).

- Existing data (refer to Section 2.6.3, Appendix 3 and Appendix 7) suggests the local groundwater has low iron concentrations. Iron filters are therefore unlikely to be required.

- Chloride has been identified as a potential groundwater contaminant of concern in the locality (Section 2.5). DWER water quality data from the local Bruce Lee reserve shows a Cl level of 147,000 ug/l (or 147mg/l) which is considered 'good' (Appendix 3). The ANZECC (2000) guidelines for Recreational Water Quality which allow human contact have a trigger value of 400mg/l which is above the concentrations observed at Bruce Lee Reserve. The ANZECC (2000) Drinking Water guidelines have a trigger value of 250mg/l which is also above the concentrations observed at Bruce Lee Reserve.

- In 1996, the results from the TAFE bore indicated that the free carbon dioxide content was low and the alkalinity was high so there should be little to no corrosion in the pumping system (Agro-nutritional research laboratory, 1996).

3.4 Water Balance

A conceptual water balance model has been developed to investigate the change in incoming and outgoing water, and any possible effect from the proposed change in land use at the site. The water balance model used in this study is based on the following equations (1) and (2). These equations calculate the water entering the soil profile and ultimately recharging the groundwater and superficial aquifer both pre and post development.

	INCOMING WATER		OUTGOING WATER	
Pre-Development Water Balance =	**(P + IGW)**	**–**	**(EX + ET + CL)**	**(1)**
Post Development Water Balance =	**(P + IGW)**	**–**	**(EX + ET + CL)**	**(2)**

Where:

P = Precipitation

IGW = Irrigation with Groundwater

EX = Extraction from groundwater (for irrigation)

ET = Evapotranspiration

CL = Catchment losses

Table 4 summarises the key parameters and calculations used in the model pre and post development.

Table 4: Key Water Balance Assumptions

Element	Pre-Development	Post Development
Precipitation (P)	Historical monthly rainfall (BOM: Fremantle Station). Rainfall assumed to remain unchanged between scenarios.	
Irrigation with Groundwater (IGW)	Based on irrigating the vegetated portion of the site predevelopment Approximately 25% of the site based on aerial assessment of predevelopment. At a rate of 10mm irrigation depth, 2 days/week, 9 months/year.	Based on irrigating the vegetated portion of the site post development. Based on 82 lots with an average size of 201sqm and a garden size of 16% of lot area. Based on the DWER groundwater allocation rate of 7,500kL/annum/ ha, this equates to 3,750 kL/annum which has been applied for from DWER. (This equates to an irrigation rate of approx. 12mm irrigation depth, 3 days/week, 9 months/year). Based on 2 apartment lots with an average size of 2574sqm and a garden size of 14% of lot area. Based on the DWER groundwater allocation rate of 7,500kL/annum/ ha, this equates to 975 kL/annum which has been applied for from DWER. (This equates to an irrigation rate of approx. 12mm irrigation depth, 3 days/week, 9 months/year). Based on 10,563sqm of POS and 1,268 sqm of roadside verges. Based on the DWER groundwater allocation rate of 7,500kL/annum/ ha, this equates to 8,873 kL/annum for public space which has been applied for from DWER. (This equates to an irrigation rate of approx. 10mm irrigation depth, 2 days/week, 9 months/year).
Extraction (EX)	Total extraction for irrigation (based on above) – 7,684 kL/annum.	Total extraction for irrigation (based on above) – 13,598 kL/annum (GWL applied for).
Evapotranspiration (ET)	Historical monthly potential evapotranspiration data (Applied to approx. 25% of total site area based on aerial review of proportion of vegetation pre development)	Historical monthly potential evapotranspiration data (Applied to areas of POS, verges and household gardens)

Element	Pre-Development	Post Development
Catchment losses (CL)	Runoff at the site would occur if rate of rainfall exceeds the rate of infiltration. Runoff rates are higher in urban environments due to increased impermeable surfaces and the introduction of a stormwater drainage system (and initial and continuous losses). Catchment losses in this balance are based on 2mm initial loss from the impervious areas (estimated to be 75% of total area).	Runoff at the site would occur if rate of rainfall exceeds the rate of infiltration. Runoff rates are higher in urban environments due to increased impermeable surfaces and the introduction of a stormwater drainage system (and initial and continuous losses). Catchment losses in this balance are based on 2mm initial loss from the impervious areas (total site area less the POS areas).
Potable water	Based on 800 people on site each day using 47 l/pp/day (sinks and toilets - Water Corporation domestic water use study). 500 staff at approx. 50% attendance rate = 250ppl/day 2000 students at approx. 25% attendance = 550ppl/day	Based on 82 houses with PE of 2.7ppl per house, 2 apartments with 54 ppl/apartment. Based on 147 l/pp/day for in house use (Water Corporation domestic water use study)
Losses from households/ building	Potable water 'removed from the site' (e.g., through leaks, evaporative cooling, other which equates to 39 l/day/FTE.	Potable water 'removed from the site' (e.g., through leaks, car washing, evaporative cooling, other which equates to 41 l/day/FTE.
Wastewater	Based on the potable water consumption less the losses from buildings (as above).	Based on the potable water consumption less the losses from buildings (as above).

3.4.1 Water Balance Results

Diagrammatic representation of the conceptual water balance for the site pre-development and post development is provided in Plate 2 and 3 below. The diagrams illustrate that there in minimal difference in the key factors/ water source types of the water balance between Pre and Post development land uses scenarios given the relatively 'urban' nature of the TAFE site predevelopment.

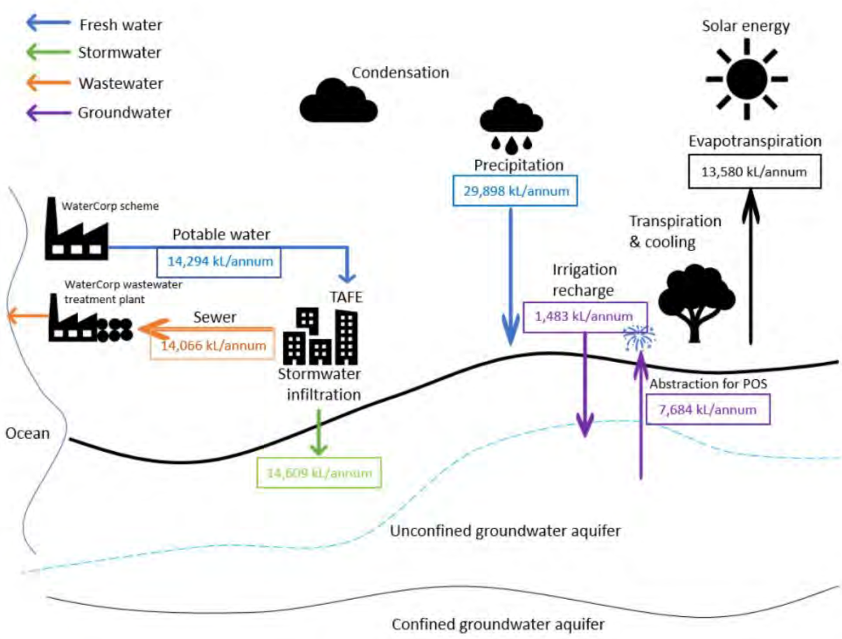


Plate 2: Predevelopment Conceptual Water Balance Diagram

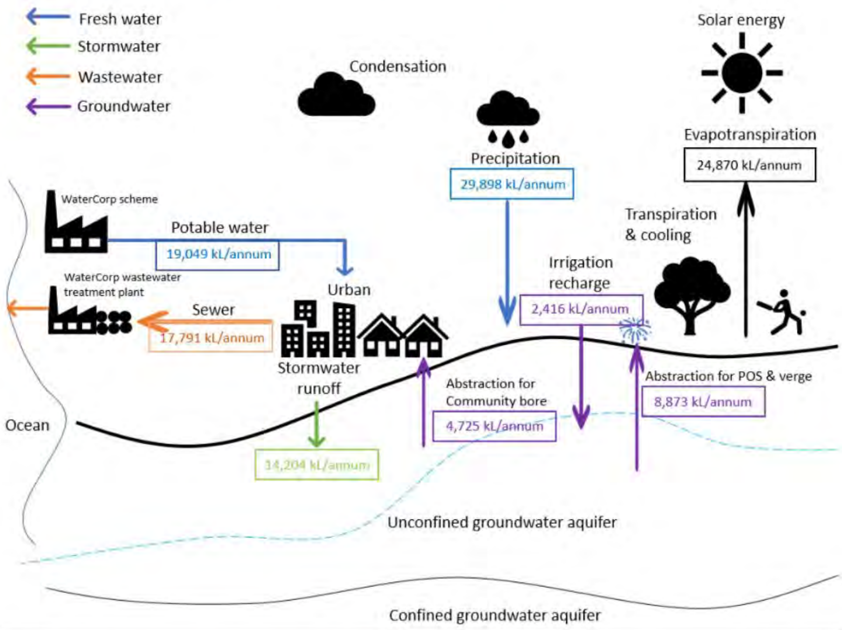


Plate 3: Post development Conceptual Water Balance Diagram

Comparisons of pre and post development volumes are demonstrated in Plates 4 and 5 below. The site water balance for this site is relatively unchanged between pre and post development scenarios due to;

- There are the same sources of water and wastewater disposal both pre and post development (i.e., potable water from Water Corporation scheme for inhouse/building use, wastewater disposal to Water Corporation scheme, and groundwater for all irrigation in both scenarios including households, which is more typically scheme water for new developments).
- There is a similar area of vegetated spaces being retained post development (minimal clearing).
- A stormwater management regime that infiltrates stormwater and mimics the predevelopment regimes (refer to Section 4.3).

The main differences are derived from the increased evapotranspiration rate due to the increased vegetated areas (with public spaces and household gardens post development) which results in increased abstraction for irrigation and some increased groundwater allocation requirements.

Potable water and wastewater disposal volumes have increased slightly post development due to the increase in population equivalent numbers and the full-time nature of the residences in comparison to the pre-development TAFE students.

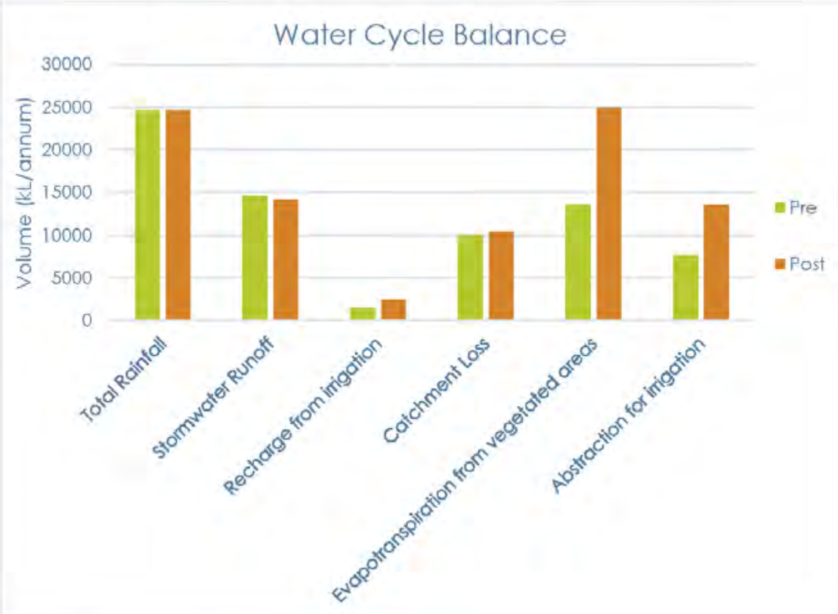


Plate 4: Water Balance Comparison

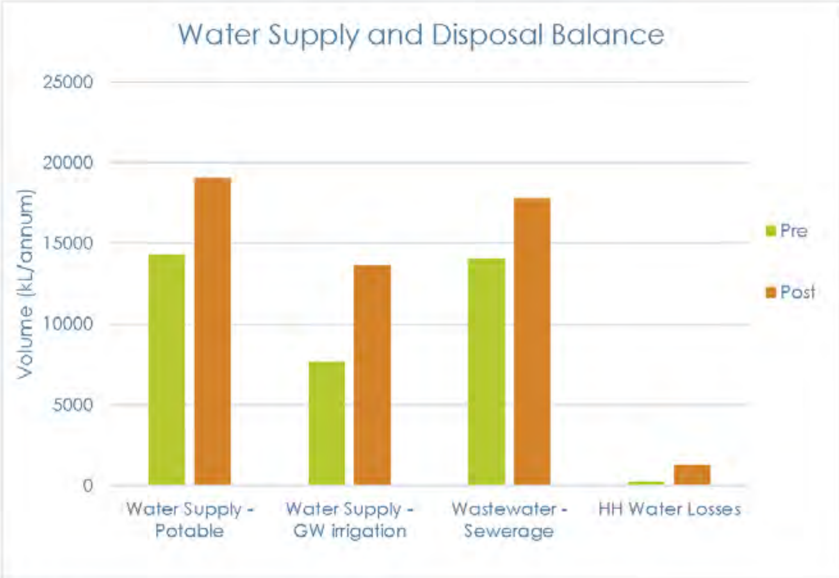


Plate 5: Water Supply and Disposal Comparison

3.5 Water Conservation and Efficiency

3.5.1 Household Management

In addition to the community bore system reducing the scheme water for ex-house use for garden irrigation, newly constructed houses will be recommended to meet the Water Corporation's Waterwise homes and gardens criteria. That is:

- All showerheads installed will be better than the minimum WELS 3 Star rating;
- All taps installed will be better than the minimum WELS 4 Star rating;
- All toilets will be duel flush and exceed the minimum WELS 4 Star rating; and
- All water using appliances installed are rated WELS 4 Star or above.

4 STORMWATER MANAGEMENT

4.1 Principles and Objectives

Stormwater management across the site has been developed in accordance with the following WSUD principles and objectives:

- Protect life and property from flooding of the 1% Annual Exceedance Probability (AEP) event.
- Manage runoff from small rainfall events on-site or as close to the source as possible.
- Protect and enhance sensitive receiving environments (groundwater) by managing the water cycle, water quality, habitat diversity and biodiversity.
- Control stormwater quality through implementation of appropriate non-structural source controls and structural controls.
- Achieve good urban amenity by integrating stormwater management systems within the design of road reserves.
- Reduce runoff volumes, peak flow rates, and improve water quality, biodiversity and aesthetics by managing stormwater through the retention and planting of vegetation.

4.2 Earthworks and Soil Remediation Management

As discussed in Section 2.4.2, preliminary advice from Galt Geotechnics on the soil remediation works and therefore the likely infiltration rates for stormwater infiltration post development are presented below;

- For general drainage in limestone areas, Galt Geotechnics suggest trimming off of fill and then ripping of the limestone to approximately 0.6 m depth, then re-compacting and replacing fill. This is to help interconnect defects and voids in the limestone and therefore allow stormwater to infiltrate.

- For soakwell/underground infiltration cell areas, Galt Geotechnics suggest over-excavating by a minimum of 1 m below the base of the soakwell/underground infiltration cells, and 1 m in plan, and then replace with clean sand during the backfilling (fines <5%, k>5 m/day when compacted to 95% MMDD).

- In sand/rubble fill areas, Galt Geotechnics do not recommend any additional measures, and to design on k = 4 m/day (or k = 5 m/day with interconnected soakwells).

- In the ripped limestone/over-excavated cell areas, design on k = 3 m/day (noting that the conductivity of the clean sand will be much higher than the surrounding limestone).

Preliminary drainage modelling assumed an infiltration rate of 5m/day across the site to account for the likely infiltration rate following the proposed remediation works identified above. This strategy was discussed with the City (Appendix 2) and it was agreed that should further amendments to the modelling assumptions be required, that this could be determined at subdivision stage and detailed design. If the modelled infiltration rate could not be achieved, then the detailed modelling design at UWMP could investigate other solutions that do not require more area requirements or changes to the Structure Plan design. Possible options could investigate (but not be limited to);

- Altering sub catchments or pipe networks to move water away from low permeability areas and take larger volumes of water to areas with a higher infiltration rate.

- Excavate deeper and add more infiltration cells given there is significant depth to groundwater. The current design is based on filling the current sump holes with cells to minimise excavation. However, if more storage was required, further excavation could occur. This would be unlikely to affect the tree retention or POS areas as it accommodates the same footprint.

4.3 Stormwater Management Summary

4.3.1 Pre-Development Stormwater Management Overview

As the site contains two existing drainage sumps located in the south-west and south-east corners. Predevelopment modelling was undertaken to determine the likely contribution of stormwater runoff to the sumps from existing City of Fremantle external catchments and the pre development TAFE site. The predevelopment catchment plan is provided in Figure 7 below.

The predevelopment model results indicated that both sumps' capacities did not quite accommodate the entire 1% AEP event.

Table 5: Pre-development Modelling Results

	Capacity (m^3)	1% AEP Pre-development Peak Volume (m^3)
Western sump	949	1,089
Eastern sump	848	965

Liaison with the City of Fremantle identified that post development management should maintain or improve the stormwater management on the site, namely, to accommodate the full 1% AEP peak volume requirements on site. The post development management has achieved this, and this is detailed further in the sections below.

The predevelopment modelling results and assumptions, including the derivation of the existing catchment delineation, are presented in more detail in Appendix 8.

4.3.2 Post Development Stormwater Management Overview

Post development stormwater management will be managed through the following Water Sensitive Urban Design (WSUD) features;

- Permeable paving in some portions of the roads
- Roadside swales
- Underground infiltration cells (in the old sump locations)
- An overground infiltration basin (over one of the cells)

Internal catchments

Conceptual earthworks levels for the post development site indicate that there will be two internal catchments draining to the western infiltration area and the eastern infiltration area (in the predevelopment sump locations), therefore mimicking the predevelopment flow regime.

The modelled post development catchments consist of 19 individual sub catchments to consider the permeable paving areas. These modelled sub catchments are shown in Figure 8 and the permeable paving is shown in Figure 9.

The sub catchment plans for the overall management of the minor and major events for the internal site are shown in Figure 10 and Figure 11 respectively.

External catchments

As per pre-development, the two external catchments (from Lefroy Road and parts of the residential areas to the north of the Lefroy Road and surrounding the site) (Figure 8) from the City roads will continue to drain to the western and eastern infiltration areas post development. The modelling detail, including parametrisation, is provided in the modelling report in Appendix 8.

Conveyance

The post-development drainage network consists of permeable paving intermittently spread throughout the development laneways and roads, along with the roadside swales where space permits, with limited piped drainage. This infiltrates stormwater as close to source as possible, mimicking pre-development conditions.

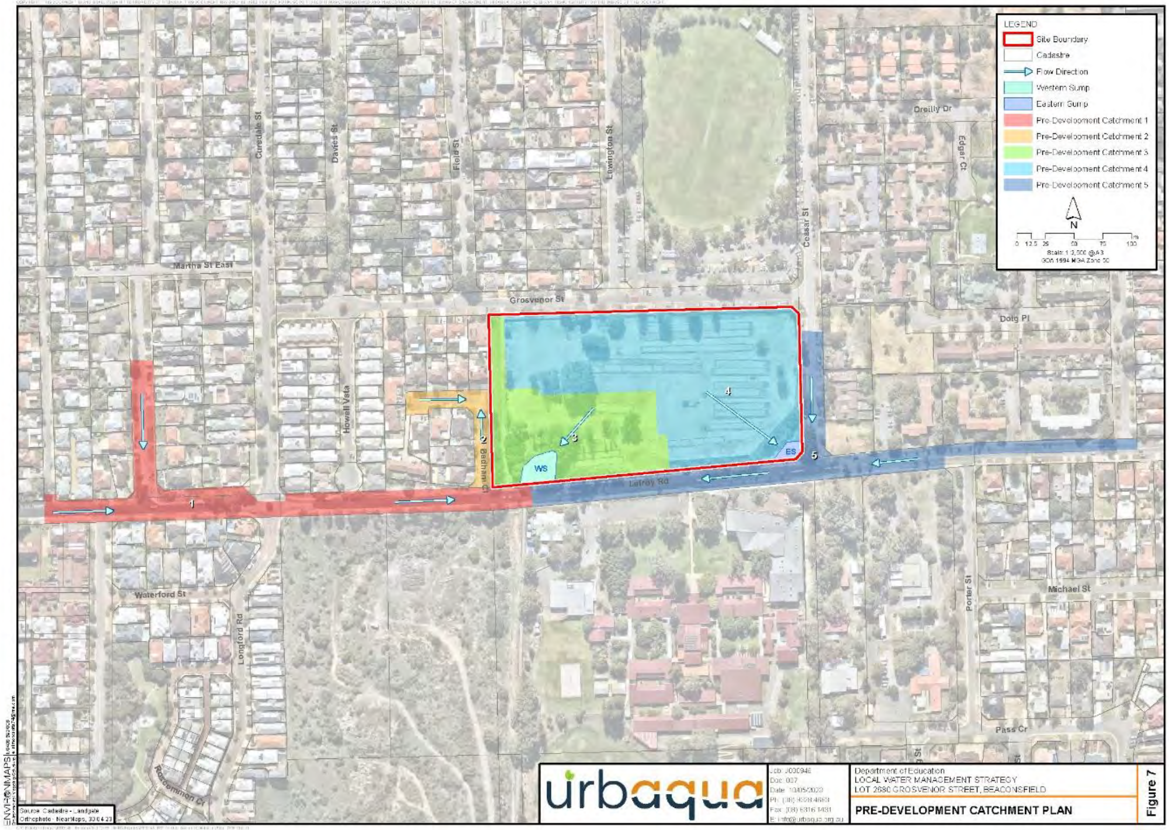
The roads and swales will convey stormwater via overland flow to each subsequent swale until reaching the low point in each catchment. Stormwater is then conveyed from the swale end points to underground drainage cells for infiltration in each catchment.

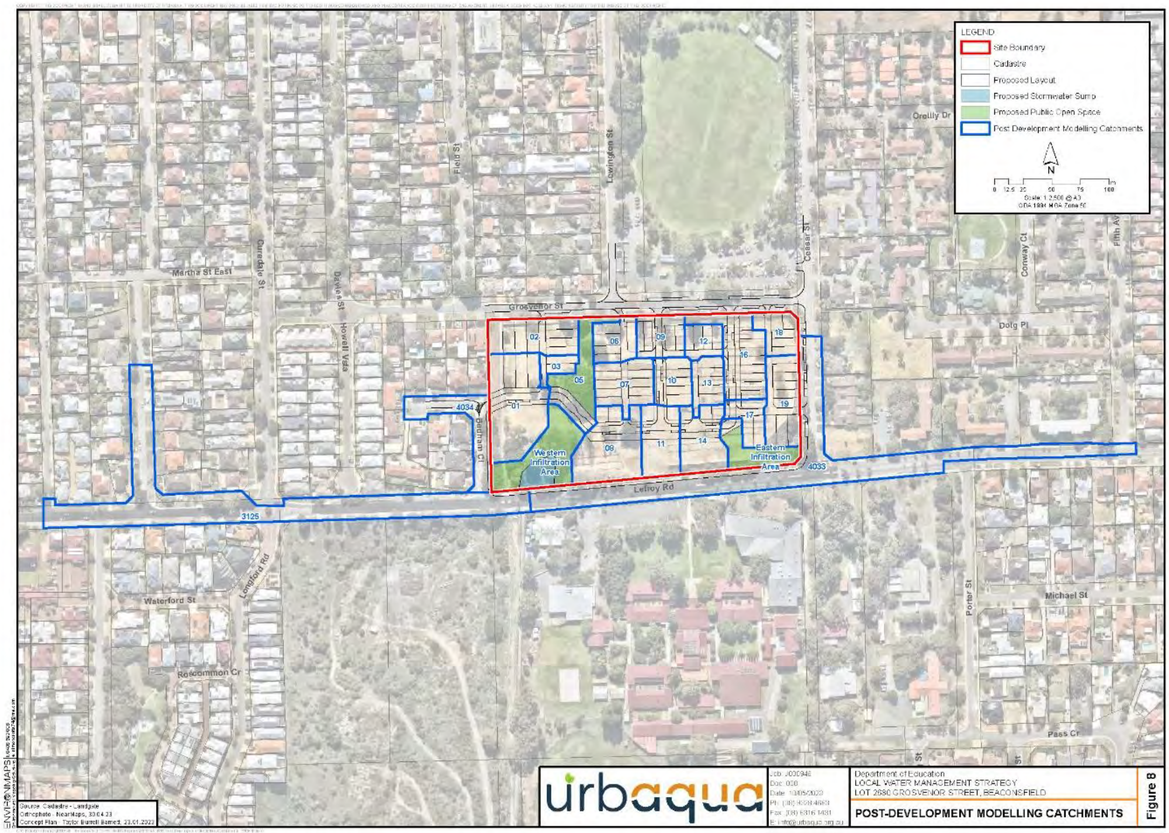
Terminal Points

The old sump in the western catchment will be filled with underground infiltration cells for infiltration of minor events after pre-treatment. A shallow infiltration basin will overlay the infiltration cells for the major storm events. The basin will be incorporated into POS Area 2.

Due to the site elevations and desired connections (pedestrian) to Lefroy Road, the old sump area in the eastern catchment will be filled with underground infiltration cells for infiltration of both minor and major storm events. There will be no overground infiltration basin in this case as instead there will be a walkway connection for pedestrian access to Lefroy Road.

Details of the sizing and design for the post-development stormwater management for 1 Exceedance per Year (EY), 20% Annual Exceedance Probability (AEP) and 1% AEP events are discussed in more detail in the sections below.


LEGEND
Site Boundary
Cadastre
Flow Direction
Western Sump
Eastern Sump
Pre-Development Catchment 1
Pre-Development Catchment 2
Pre-Development Catchment 3
Pre-Development Catchment 4
Pre-Development Catchment 5
N
Scale: 1:2,500 @ A3
GDA 1994 MGA Zone 50
Grosvenor St
Martha St East
Lefroy Rd
Cessal St
Edgar Ct
Doig Pl
Michael St
Porter St
Waterford St
Longford Rd
Pass Cr
Howell Vsta
Lowington St
WS
ES
1
2
3
4
5
Source: Cadastre - Landgate
Orthophoto - NearMaps, 23.04.23
Job: J000946
Doc: 007
Date: 10/05/2023
Ph: (08) 9328 4663
Fax: (08) 6316 1431
E: info@urbaqua.org.au
Department of Education
LOCAL WATER MANAGEMENT STRATEGY
LOT 2680 GROSVENOR STREET, BEACONSFIELD
PRE-DEVELOPMENT CATCHMENT PLAN
Figure 7


LEGEND
Site Boundary
Cadastre
Proposed Layout
Proposed Stormwater Sump
Proposed Public Open Space
Post Development Modelling Catchments
N
Scale: 1:2,500 @ A3
GDA 1994 MGA Zone 50
Grosvenor St
Martha St East
Lefroy Rd
Doig Pl
Michael St
Porter St
Waterford St
Longford Rd
Roscommon Cr
Pass Cr
Western Infiltration Area
Eastern Infiltration Area
3125
4033
4034
Source: Cadastre - Landgate
Orthophoto - NearMaps, 23.04.23
Job: J000946
Doc: 008
Date: 10/05/2023
Ph: (08) 9328 4663
Fax: (08) 6316 1431
E: info@urbaqua.org.au
Department of Education
LOCAL WATER MANAGEMENT STRATEGY
LOT 2680 GROSVENOR STREET, BEACONSFIELD
POST-DEVELOPMENT MODELLING CATCHMENTS
Figure 8

4.4 Lot and Grouped Housing Drainage Management

Single residential and grouped housing lots will contain soakwells to infiltrate minor events. Modelling assumptions accounted for two soakwells installed on all single residential lots, 8 soakwells for the eastern apartment site, and 17 soakwells for the central apartment site. At this stage, soakwells have not been sized to cater for specific rainfall events, as this will be refined at subdivision stage (UWMP).

During major storm events, lot infiltration infrastructure capacity will be exceeded, and runoff will be directed towards the roads for both the single-residential lots and multi-residential lots. This has been accounted for in the modelling and model parametrisation and assumptions have been detailed in Appendix 8.

4.5 Road Drainage Management

4.5.1 Small Event Management

Small events are managed via various at-source infiltration measures throughout the development to reduce the volume of water reaching the end of catchment infiltration points. This includes permeable paving, and roadside swales.

Permeable paving has been located at laneway intersections and along central roads to spread stormwater infiltration out throughout the development, with locations shown on Figure 9. Placement has been strategically chosen to provide additional traffic management benefits, as the corrugated nature of the paving also acts as a "road calming" measure. Permeable paving areas have not been sized to infiltrate particular rainfall events or volumes, due to economic factors which have instead determined the total area permeable paving available.

Swales have been provided throughout both east and west catchments where tree retention, walkways and infrastructure allow, to convey road runoff to drainage storage areas and provide infiltration and water quality treatment.

The swales have not been sized to contain a particular rainfall event or volume, but have been provided where space allows and where green connections were desired. They provide first flush treatment through the development to treat stormwater runoff. Water quality treatment is discussed further in Section 4.6 below.

Preliminary swale design has provided a maximum depth of 0.5 m and 1:4 side slopes, with long lengths of swales maintained by providing bridging elements across swales where required. Where appropriate, flush kerbing will be installed adjacent to swales to provide direct runoff into swales from road surfaces.

Although the swales and permeable paving act to reduce the amount of runoff received by each ultimate infiltration area, the 1EY event cannot be fully accounted for via these management structures. A such, the western and eastern underground storage areas (drainage cells) still receive some runoff in a 1EY event. This is summarised in Table 6 below, along with infiltration area details.

4.5.2 Minor Event Management

Road runoff up to the 20% AEP will be conveyed through a combination of piped drainage and swales (Figure 10) into the ultimate infiltration areas within each catchment. Both the eastern and western infiltration cells contain rainfall events up to and including the critical 20% AEP event. Sizing details of the infrastructure is provided in Section 4.5.3.

The minor event management plan is presented on Figure 10. This demonstrates the six sub catchments for minor events flow paths, which ultimately discharge to the two end points (western and eastern infiltration areas).

- Sub catchments 1 and 2 ultimately end up in the western infiltration area, via swale 1 and swale 2.
- Sub catchments 3 (a, b, c) and 4 ultimately end up in the eastern infiltration area via swale 3a, swale 3c and swale 3. Sub catchment 4 drains to a trapped low point where a piped network will convey stormwater to swale 3.

4.5.3 Major Event Management

Major flood runoff (1% AEP) is conveyed via overland flow down roads and swales. From the end point in each ultimate swale (swale 2 and swale 3 Figure 11) stormwater will be piped to the underground cells in the western and eastern infiltration areas. The underground cells and western basin have been modelled and sized in a 1-D Infoworks ICM model, as detailed in Appendix 8 with results presented in Table 6 below.

- The underground cells have been sized to accommodate the 1% AEP event.
- The western underground storage can only contain up to and including the 20% AEP event, and events greater than this up to and including the 1% AEP are contained within an above-ground basin. Water will passively flow from the cells into the basin as water levels rise in larger events.

Table 6: 1EY, 20% AEP and 1% AEP Modelling Results

Detail	Western Infiltration Area		Eastern Infiltration Area
	Underground	Above ground	Underground
Type	Drainage cells	Basin	Drainage cells
Invert level (mAHD)	12	15	12.5
Top of Bank (mAHD)	14 (2 m deep)	15.5	14 (1.5 m deep)
Base Area	500	396	500
Top Area	500	486	500
Total Volume	1000	221	750
1EY event (3 hr critical duration)			
Peak volume (m³)	166	-	85
Top water level (m AHD)	12.4	-	12.7
20% AEP event (3 hr critical duration)			
Peak volume (m³)	343	-	214
Top water level (m AHD)	12.7	-	12.9
1% AEP event (6 hr critical duration)			
Peak volume (m³)	1000	177	749
Top water level (m AHD)	14	15.4	14

4.6 Water Quality Treatment

4.6.1 Structural Controls

Stormwater quality will primarily be managed through vegetated swales. The vegetated areas will filter sediment and pollutants (heavy metals etc) and provide nutrient removal. All stormwater will pass through vegetated swales for treatment (and some infiltration) before entering the underground infiltration cells. The swale areas will typically comprise of the following profile (see **Plate 4** below):

- Vegetation: An appropriate mix of high nutrient stripping plant species will be selected from those identified in *Vegetation Guidelines for Stormwater Biofilters in the South-West of Western Australia* (Monash University, 2014). Remainder to be local, native, ephemeral plants. Typically, 8-12 plants per m^2.
- Stone mulch: 100% stone, 4-13mm in size. 50mm thick. No fines. No wood mulch as it will float under flood conditions.
- Filter media: 300mm amended soil layer. PRI > 10. Saturated K 100-300mm/hr.
- Transition and Drainage: underlying in situ sandy soils.

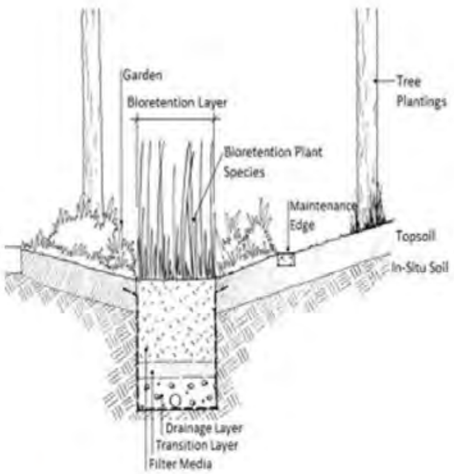


Plate 6: Typical Roadside Swale

4.6.2 Non-Structural Controls

In addition to the stormwater management as described above, the following non-structural controls will be employed at the site:

- Ongoing litter management such as street sweeping, and manual litter collections will be included in routine maintenance programs.
- Appropriately spaced and managed litter bins in open spaces.
- Litter control measures in the drainage system where required (traps prior to cells).
- Restrict the use of fertiliser on POS areas to limit the potential addition or leaching of nutrients to stormwater runoff.

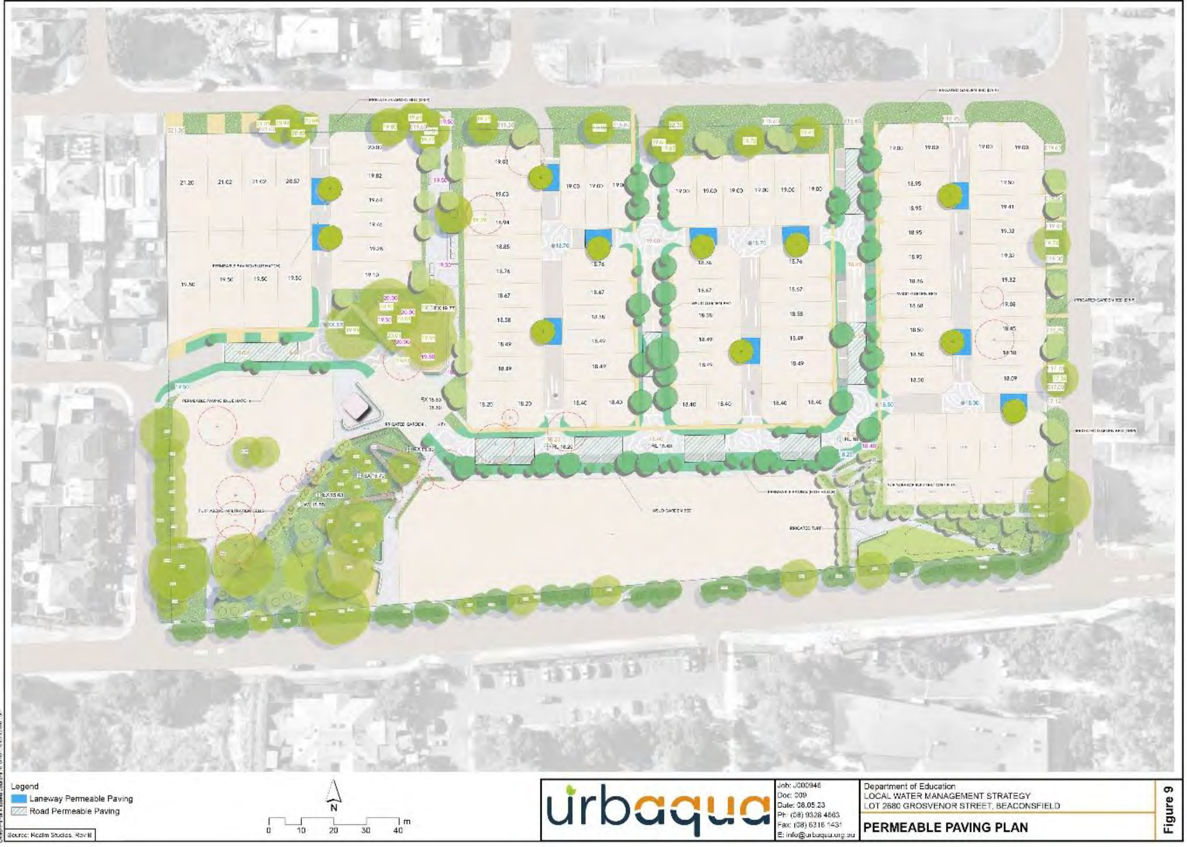
- Local residents will be informed of the need for stormwater quality management and how they can contribute via measures such as community signage and/or information packs included in lot purchase documentation.
- Construction practices such as drainage, erosion, sediment, housekeeping, and dust controls will be employed during earthworks, construction and major landscaping.

4.6.3 Management of Disease Vectors and Nuisance Insects

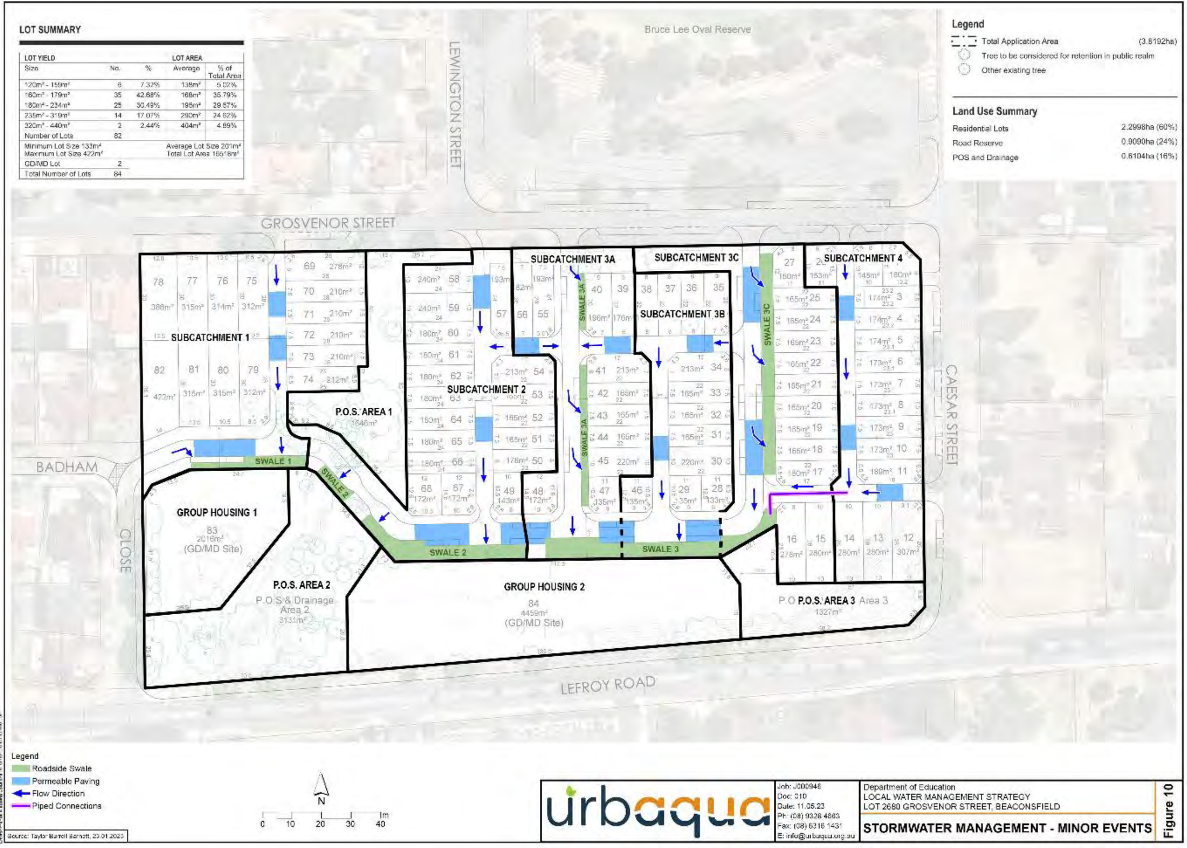
To minimise the risk of nuisance insects or disease vectors, water must move from open treatment systems within 96 hours. The estimated emptying times for the 1% AEP events in the western and eastern infiltration areas are presented below (based on 5m/day);

- Western infiltration cells: 19.2 hours
- Western basin: 3.8 hours
- Eastern infiltration cells: 14.4 hours

Emptying times are all below 96 hours.

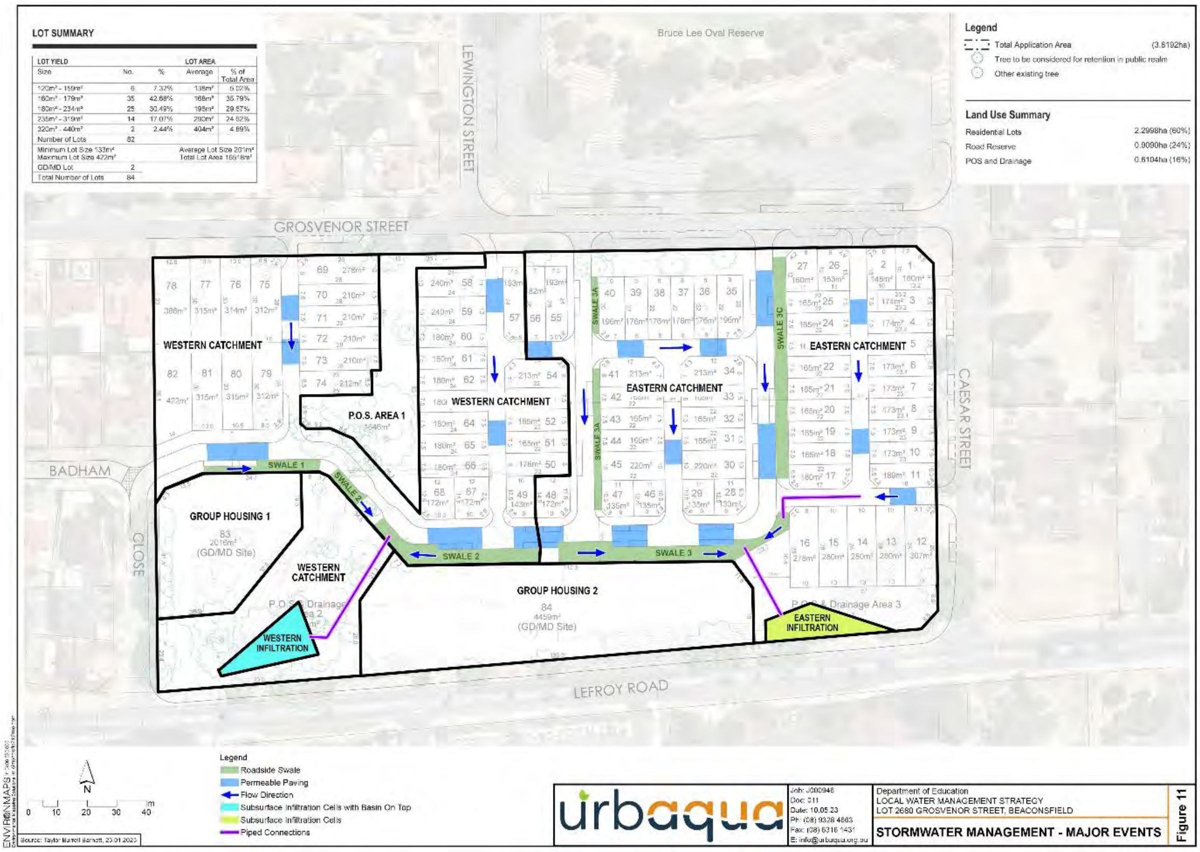


urbaqua	Job: J000946 Doc: 009 Date: 08.05.23 Ph: (08) 9328 4663 Fax: (08) 6316 1431 E: info@urbaqua.org.au	Department of Education LOCAL WATER MANAGEMENT STRATEGY LOT 2680 GROSVENOR STREET, BEACONSFIELD **PERMEABLE PAVING PLAN**	Figure 9



LOT YIELD			LOT AREA	
Size	No.	%	Average	% of Total Area
120m² - 159m²	6	7.32%	138m²	5.02%
160m² - 179m²	35	42.68%	168m²	35.79%
180m² - 234m²	25	30.49%	195m²	29.57%
235m² - 319m²	14	17.07%	290m²	24.62%
320m² - 440m²	2	2.44%	404m²	4.89%
Number of Lots	82			
Minimum Lot Size 133m² Maximum Lot Size 422m²			Average Lot Size 201m² Total Lot Area 16618m²	
GD/MD Lot	2			
Total Number of Lots	84			

urbaqua	Job: J000946 Doc: 010 Date: 11.05.23 Ph: (08) 9328 4663 Fax: (08) 6316 1431 E: info@urbaqua.org.au	Department of Education LOCAL WATER MANAGEMENT STRATEGY LOT 2680 GROSVENOR STREET, BEACONSFIELD **STORMWATER MANAGEMENT - MINOR EVENTS**	Figure 10


LOT SUMMARY
LOT YIELD
LOT AREA
Size | No. | % | Average | % of Total Area
120m² - 159m² | 6 | 7.32% | 138m² | 5.02%
160m² - 179m² | 35 | 42.68% | 168m² | 35.79%
180m² - 234m² | 25 | 30.49% | 195m² | 29.57%
235m² - 319m² | 14 | 17.07% | 290m² | 24.62%
320m² - 440m² | 2 | 2.44% | 404m² | 4.99%
Number of Lots | 82
Minimum Lot Size 133m²
Maximum Lot Size 422m²
Average Lot Size 201m²
Total Lot Area 16618m²
GD/MD Lot | 2
Total Number of Lots | 84
Legend
Total Application Area (3.8192ha)
Tree to be considered for retention in public realm
Other existing tree
Land Use Summary
Residential Lots 2.2998ha (60%)
Road Reserve 0.9090ha (24%)
POS and Drainage 0.6104ha (16%)
Bruce Lee Oval Reserve
LEWINGTON STREET
GROSVENOR STREET
CAESAR STREET
BADHAM CLOSE
LEFROY ROAD
WESTERN CATCHMENT
EASTERN CATCHMENT
P.O.S. AREA 1
SWALE 1
SWALE 2
SWALE 3
SWALE 3A
SWALE 3C
GROUP HOUSING 1
83
2016m²
(GD/MD Site)
GROUP HOUSING 2
84
4459m²
(GD/MD Site)
WESTERN INFILTRATION
EASTERN INFILTRATION
P.O.S. & Drainage Area 3
Legend
Roadside Swale
Permeable Paving
Flow Direction
Subsurface Infiltration Cells with Basin On Top
Subsurface Infiltration Cells
Piped Connections
N
0 10 20 30 40 m
Source: Taylor Burrell Barnett, 20.01.2023
urbaqua
Job: J000948
Doc: 011
Date: 10.05.23
Ph: (08) 9328 4663
Fax: (08) 6316 1431
E: info@urbaqua.org.au
Department of Education
LOCAL WATER MANAGEMENT STRATEGY
LOT 2680 GROSVENOR STREET, BEACONSFIELD
STORMWATER MANAGEMENT - MAJOR EVENTS
Figure 11

5 GROUNDWATER MANAGEMENT

Key objectives for groundwater management in general are:

- Protecting infrastructure and assets from flooding and inundation by high seasonal groundwater levels, perching and/or soil moisture;
- Protecting groundwater dependent ecosystems from the impacts of urban runoff; and,
- Managing and minimising changes in groundwater levels and groundwater quality following redevelopment.

Due to the existing site characteristics, the significant depth to groundwater, and the absence of groundwater dependant ecosystems, groundwater management at this site is considered low risk. The following planning measures are adopted to achieve the relevant objectives above:

- Ensure infiltration of stormwater runoff, consistent with existing conditions; and,
- Use of treatment areas within swales to improve groundwater quality compared with the existing conditions.

5.1 Fill Management

Due to proposed changes to the existing landform for development purposes, some sand fill will be required to re-contour the site. The sand will also be mixed with the limestone rubble to ensure uniform infiltration across the site as discussed in Section 4.2. Preliminary geotechnical results and advice indicate the presence of caprock and limestone across some areas of the site and that earthworks will require the following soil management measures which are detailed in Section 4.2.

Indicative levels and separation distances to groundwater are provided in the sections below. The preliminary lot earthwork levels are provided in Figure 12 and are sufficient to meet the separation distances to groundwater required under the BUWM guidelines (WAPC, 2008).

Where imported fill is to be used, clean sand which is free of organic matter or other deleterious material will be used. The fines content will be less than 5% to promote drainage as per the engineering guidelines for subdivisional development (IPWEA, 2011).

5.1.1 Lot Levels

Finished Floor Levels (FFL) are shown on Figure 12. FFLs in the lots are all set at range from 17.7 to 21.2 mAHD, and at 19.0mAHD for the grouped housing sites.

These levels equate to a separation distance of approximately 16.7 – 20.0m below lot levels and 18m below the grouped housing levels. This exceeds the 1.2 m separation required under the BUWM guidelines.

5.1.2 Swale and Basin Clearances

DWERs *Urban Water Management Plans, Guidelines for Preparing Plans and for Complying with Subdivision Conditions* (DoW, 2008) states:

> *The invert of storage areas or swales should be set at least 0.3 metres above the MGL or approved controlled groundwater level*

Table 7 below shows a summary of the basin, underground cells and swale invert clearances to groundwater. The minimum separation to groundwater is 11mbgl which exceeds 0.3m.

Table 7: Clearances to Groundwater

WSUD Name (Figure 10)	Approximate Invert Level (mAHD)	Max. Groundwater Level (mAHD)	Clearance (m)
Swale 1	18.5	1	17.5
Swale 2	17.7	1	16.7
Swale 3	17.8	1	16.8
Swale 3a	18.5	1	17.5
Swale 3c	18.0	1	17.0
Western basin	15.0	1	14.0
Western cells	12.0	1	11.0
Eastern cells	12.5	1	11.5

The grouped housing will have underground soakwells. The base of onsite soakwells is a likely to be approximately 17 mAHD (2 mbgl to accommodate soakwell height). This achieves 16m separation from groundwater which is above the 0.3m separation requirement.

5.2 Subsoil Drainage

Shallow groundwater has not been observed across the site, and as such subsoil drainage is not proposed.

5.3 Groundwater Quality

Groundwater quality will be maintained with the treatment of the first flush stormwater events through the onsite swales prior to infiltration to groundwater. This is discussed further in Section 4.6.

LOT SUMMARY

LOT YIELD			LOT AREA	
Size	No.	%	Average	% of Total Area
$120m^2$ - $159m^2$	6	7.32%	$138m^2$	5.02%
$160m^2$ - $179m^2$	35	42.68%	$168m^2$	35.79%
$180m^2$ - $234m^2$	25	30.49%	$196m^2$	29.67%
$235m^2$ - $319m^2$	14	17.07%	$290m^2$	24.62%
$320m^2$ - $440m^2$	2	2.44%	$404m^2$	4.89%
Number of Lots	82			
Minimum Lot Size $133m^2$ Maximum Lot Size $422m^2$			Average Lot Size $201m^2$ Total Lot Area $16518m^2$	
GD/MD Lot	2			
Total Number of Lots	84			

Legend

Total Application Area (3.8192ha)

Tree to be considered for retention in public realm

Other existing tree

Land Use Summary

Residential Lots	2.2998ha (60%)
Road Reserve	0.9090ha (24%)
POS and Drainage	0.6104ha (16%)

Source: Pritchard Francis, 2023 & Taylor Burrell Barnett, 23.01.2023

urbaqua

Job: J000946
Doc: 012
Date: 11.05.23
Ph: (08) 9328 4663
Fax: (08) 6316 1431
E: info@urbaqua.org.au

Department of Education
LOCAL WATER MANAGEMENT STRATEGY
LOT 2680 GROSVENOR STREET, BEACONSFIELD

PRELIMINARY LOT LEVEL CONCEPT PLAN

Figure 12

6 FLOOD MANAGEMENT STRATEGY

6.1 Drainage 1% AEP Clearances to Lot Levels

The City of Fremantle *Engineering Technical Guidance Notes* (2018) identifies that:

> *The Free Board level required is 300mm, this is the level between a flooded road reserve and the floor level of commercial/residential properties or carparks*

DWER's Decision Process for Stormwater Management in WA (DoW, 2017) states:

> *Protect people and property from flooding by constructing residential, commercial, and industrial building habitable floor levels with the following minimum clearances above the 1 per cent annual exceedance probability (AEP) flood level:*
>
> - road drainage systems: 0.3 m
> - terminal retention or detention areas with no overflow relief: 0.5 m
> - major drainage system and waterways: 0.5 m

This is an urban road drainage system with overflow relief, therefore a separation distance of 0.3m is required between the TWLs of basins/swales and finished floor levels. Detailed design will ensure that a minimum of 0.3m will be provided between the top of swales/ basin and the habitable floor levels.

It is recognised that the eastern basin is not located directly adjacent to any lots (it is set back within the tiered POS area) and that the western cells will be underground and therefore not strictly a flood risk to houses. However, for the purposes of reporting and to provide some context to the levels on site the clearances for the basin and cells (based on the preliminary strategy modelling) have been summarised in Table 8 below.

Table 8: Finished Floor Level Clearances to Top of Basin/ Cells

Basin/Swale Name	Top of basin/ cells (mAHD)	Closest Min. Adjacent Lot Level (mAHD)	Clearance (m)
Western basin	15.5	18.2	2.7
Eastern underground cells	14.5	17.6	3.1

The minimum clearance requirements are therefore easily achievable between the western basin/ eastern cells and indicative finished floor levels.

7 MONITORING

7.1 Pre-development Monitoring

DWER generally advise that in areas with greater than 5m to groundwater, monitoring is not required for urban water reporting. Due to the significant clearance to groundwater at this site (14-19m below ground level), no predevelopment monitoring was considered necessary.

7.2 Post Development Monitoring

Similarly owing to the depth to groundwater pre- and post-development, groundwater monitoring following development is not considered necessary for urban water reporting requirements.

However, due to the proposed community bore system for irrigation, water quality monitoring from the production bore will be undertaken post development. The extent of monitoring required will be detailed in the community bore feasibility study and detailed design in the UWMP.

8 IMPLEMENTATION FRAMEWORK

The success of the water management strategies outlined in this document depends on their implementation through further planning, detailed design, construction and maintenance.

8.1 Further Work

Urban Water Management Plans (UWMPs) are the final water management documents within the state government planning framework outlined in Section 1. These documents are prepared as a condition of the subdivision (in support of local development plans) to demonstrate that designs achieve the objectives, strategies and design criteria outlined in this LWMS.

The UWMP will be prepared in consultation with the City of Fremantle and be based on local site investigations appropriate to the proposal and level of risk to water resources. The UWMP should be consistent with the requirements of the DWER's *Urban water management plans: Guidelines for preparing plans and for complying with subdivision conditions* (DoW, 2008b).

Specifically, the UWMP should include detailed engineering and landscaping designs and design of swale systems and non-structural control measures to manage impacts from construction

8.2 Summary of Roles and Responsibilities

Key tasks, roles and responsibilities relating to delivery of urban water management objectives are outlined in Table 9.

Table 9: Summary of roles and responsibilities

Task	Responsibility	Planning stage
Preparation of the UWMP	Development WA	Subdivision (UWMP)
Assessment / Approval of the UWMP	City of Fremantle / DWER	Subdivision (UWMP)
Detailed design of community bore irrigation and third pipe system	Development WA	Subdivision (UWMP)
Potable water supply planning and connection to main distribution network	Development WA/ Water Corporation	Subdivision (UWMP)
Design of water distribution networks	Development WA	Subdivision (UWMP)
Water and wastewater planning and connection to main distribution networks	Development WA/ Water Corporation	Subdivision (UWMP)
Design of wastewater reticulation networks	Development WA	Subdivision (UWMP)
Design of drainage networks including design of water quality treatment areas	Development WA	Subdivision (UWMP)
Development of detailed Landscaping plan incorporating stormwater management strategies	Development WA	Subdivision (UWMP)

Task	Responsibility	Planning stage
Confirmation of ongoing management and maintenance requirements and agreement with the City for handover of responsibilities	Development WA / City of Fremantle	Subdivision (UWMP)
Water quality monitoring program for the community bore network	Development WA	Subdivision (UWMP)

9 REFERENCES

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Appendix 1 LWMS Checklist

Local water management strategy item	Deliverable	☑	Comments
Executive summary			
Summary of the development design strategy, outlining how the design objectives are proposed to be met	Table 1: Design elements & requirements for BMPs and critical control points	☑	Exec summary table
Introduction			
Total water cycle management – principles & objectives Planning background Previous studies		☑	Section 1
Proposed development			
Structure plan, zoning and land use. Key landscape features Previous land use	Site context plan Structure plan	☑ ☑	Section 1
Landscape – proposed POS areas, POS credits, water source, bore(s), lake details (if applicable)	Landscape Plan	☑	Section 3
Design criteria			
Agreed design objectives		☑	Section 1.5
Pre-development environment			
Existing information and more detailed assessments (monitoring). How do the site characteristics affect the design?		☑	Section 2
Site Conditions – existing topography/ contours, aerial photo underlay, major physical features	Site condition plan	☑	Section 2.3
Geotechnical – topography, soils including acid sulphate soils and infiltration capacity, test pit locations	Geotechnical plan	☑	Section 2.4
Environmental – areas of significant vegetation, wetlands and buffers, waterways and buffers, contaminated sites	Environmental Plan plus supporting data where appropriate	☑	Section 2.8
Surface Water – topography, 100 year floodways and flood fringe areas, water quality of flows entering and leaving (if applicable)	Surface Water Plan	☑	Section 2.7
Groundwater – topography, pre development groundwater levels and water quality, test bore locations	Groundwater Plan plus details of groundwater monitoring and testing	☑	Section 2.6
Water sustainability initiatives			
Water supply & efficiency measures – private and public open spaces		☑	Section 3.4
Fit-for-purpose strategy and agreed actions. If non-potable supply, support with water balance		☑	Section 3.1
Wastewater management		☑	Section 3.2
Stormwater management strategy			
Flood protection – peak flow rates, volumes and top water levels at control points,100 year flow paths and100 year detentions storage areas	major event Plan Long section of critical points	☑	Section 4
Manage serviceability – storage and retention required for the critical 5 year ARI storm events Minor roads should be passable in the 5 year ARI event	minor event Plan	☑	Section 4.5
Protect ecology – detention areas for the 1 yr 1 hr ARI event, areas for water quality treatment and types of (including indicative locations for) agreed structural and non-structural best management practices and treatment trains. Protection of waterways, wetlands (and their buffers), remnant vegetation and ecological linkages	small event Plan Typical cross sections	☑	Section 4.5

Local water management strategy item	Deliverable	☑	Comments
Groundwater management strategy			
Post development groundwater levels and fill requirements (including existing and likely final surface levels), outlet controls, and any subsoils	Groundwater/subsoil Plan	☑	Section 5
Actions to address acid sulfate soils or contamination		☑	n/a
The next stage – subdivision and urban water management plans			
Content and coverage of future urban water management plans to be completed at subdivision. Include areas where further investigations are required prior to detailed design.		☑	Section 8
Monitoring			
Recommended future monitoring plan including timing, frequency, locations and parameters, together with arrangements for ongoing actions		☑	Section 7
Implementation			
Developer commitments		☑	Section 8
Roles, responsibilities, funding for implementation		☑	Section 8
Review		☑	Section 8

Appendix 2 Correspondence

From:	Sharn Bruere
To:	Rebecca Epworth; James McCallum
Cc:	Naomi Lawrance; Linda Pham; andrew.t@pfeng.com.au; Brett Schreurs; Damien Pericles (damien.pericles@realmstudios.com); Jim Polinelli; Morgan Gillham
Subject:	RE: LWMS - Lot 2680 Grosvenor Street, Beaconsfield - Local Structure Plan
Date:	Tuesday, 2 May 2023 6:09:22 PM
Attachments:	image002.png image003.png image004.png image005.png image006.png image007.png image008.png image010.png

Thanks @Rebecca Epworth and @James McCallum,

This all sounds low risk and you have sufficiently alleviated any concerns my end, thank you. On that basis, yes we would be comfortable for the LSP to be lodged with the worst case scenario LWMS while further work is being undertaken and amendments made if required once this further work is complete, though it sounds like it will be ready in time anyway.

Ultimately, the City would like to work with Development WA on the best outcomes for the site. We are interested in (as well as many other things) the impact of any 'drainage sump' (not that we particularly like that term being used in modern developments) on the overall POS areas and retained trees. We also hope that using more permeable surfaces in the design of roads and paths will improve the surface area and infiltration of the site.

Lastly, lodging the LSP with the City does not have to be the end of the conversation with the City officers. We are happy to receive and share information as needed.

Thank you all kindly and I look forward to seeing the finalised LSP for this site.

Best wishes,
Sharn

CITY OF Fremantle

Sharn Bruere
TEAM LEADER STRATEGIC PLANNING

T 9432 9775 | E sharnb@fremantle.wa.gov.au
Walyalup Civic Centre | 151 High Street | Fremantle
PO BOX 807 | Fremantle WA 6959

The City of Fremantle acknowledges the Whadjuk people as the Traditional Owners of the Fremantle/Walyalup area and we recognise their cultural and heritage beliefs are still important today.

From: Rebecca Epworth <Rebecca@urbaqua.org.au>
Sent: Tuesday, 2 May 2023 4:40 PM
To: Sharn Bruere <sharnb@fremantle.wa.gov.au>
Cc: James McCallum <James@tbbplanning.com.au>; Naomi Lawrance <Naomi.Lawrance@developmentwa.com.au>; Linda Pham <Linda.Pham@developmentwa.com.au>; andrew.t@pfeng.com.au; Brett Schreurs <Brett.Schreurs@realmstudios.com>; Damien Pericles (damien.pericles@realmstudios.com) <damien.pericles@realmstudios.com>
Subject: RE: LWMS - Lot 2680 Grosvenor Street, Beaconsfield - Local Structure Plan

Hi Sharn,

Thanks, responses below in green.

Bec

Rebecca Epworth
BSc (Hons), MSc, MSc (Eng)
Director

urbaqua

Suite 4/226 Carr Place, Leederville WA 6007
P: 08 9328 4663
M: 0437 707 472
www.urbaqua.org.au

From: Sharn Bruere <sharnb@fremantle.wa.gov.au>
Sent: Tuesday, 2 May 2023 12:48 PM
To: Rebecca Epworth <Rebecca@urbaqua.org.au>
Subject: RE: LWMS - Lot 2680 Grosvenor Street, Beaconsfield - Local Structure Plan

Thank you Rebecca,
Much appreciated. It appears you are confirming that with the potential engineering solutions, your team are confident the worst case scenario (infiltration rate of 5m/day) approach can be reasonably planned for.

Two questions:

1. When do you think the LWMS will be completed? It's being completed in the next couple of weeks and then goes to internal review, and will be submitted with the LSP docs on 9th June as you discussed with James I believe.
2. With the engineering solution(s) provided below aside, would a worst worst case scenario (I think this means less than 5m/day across the site) require anything else (provisions, space etc) that would affect the POS, existing trees and road layout/design?

   As we have some prelim Geotech results now, we have more confidence that a 'worst case scenario' isn't as likely. As the initial permeability is reinforcing our assumptions on infiltration rates ie 5m/day is possible in the main infiltration areas and across a lot of the site.

   In the event that we could not rectify with an rock breaking engineering solution, the detailed modelling design could look at other solutions that do not require more space or changes to the design. Possible options could look at (but not be limited to);

   a. Altering sub catchments or pipe networks to move water away from low permeability areas and take larger volumes of water to areas with a higher infiltration rate (eg. areas with more than 5m/day).
   b. Or we could go deeper with the infiltration cells (there is significant depth to groundwater). The current design is based on filling the current sump holes with cells to minimise excavation. But if more storage was required, we could excavate down in the existing sump locations (which we know infiltrates). This is unlikely to affect the tree retention or POS area as it would be the same footprint just deeper.
3. On the converse would a better case scenario allow for something that is restricted by the worst case scenario?

   No I don't believe so. Given we have some prelim Geotech results already that support the assumptions we have made in the modelling, I believe it to be a fairly accurate representation of reality.

   a. If the infiltration rate was a lot higher (and therefore we are required to reduce the drainage volumes managed on site), we would still propose street swales to create the cool, green corridors. The change would more likely result in either shallower swales or reducing the capacity of the underground cells. Neither of these changes would change the road layout or the POS areas. So in that respect, the drainage design has some flexibility to adapt to changes in permeability at delayed design (I think this is what you mean? If not, let me know and I can address again).

I hope those questions make sense.

Thanks & kind regards,
Sharn

Sharn Bruere
TEAM LEADER STRATEGIC PLANNING

T 9432 9775 | E sharnb@fremantle.wa.gov.au
Walyalup Civic Centre | 151 High Street | Fremantle
PO BOX 807 | Fremantle WA 6959

The City of Fremantle acknowledges the Whadjuk people as the Traditional Owners of the Fremantle/Walyalup area and we recognise their cultural and heritage beliefs are still important today.

From: Rebecca Epworth <Rebecca@urbaqua.org.au>
Sent: Tuesday, 2 May 2023 10:30 AM
To: Sharn Bruere <sharnb@fremantle.wa.gov.au>
Cc: Naomi Lawrance <Naomi.Lawrance@developmentwa.com.au>; Linda Pham <Linda.Pham@developmentwa.com.au>; Brianna Newnham <brianna.newnham@pfeng.com.au>; Brett Schreurs <Brett.Schreurs@realmstudios.com>; Ben De Marchi <Ben@tbbplanning.com.au>; James McCallum <James@tbbplanning.com.au>; andrew.t@pfeng.com.au; Damien Pericles <damien.pericles@realmstudios.com>
Subject: RE: LWMS - Lot 2680 Grosvenor Street, Beaconsfield - Local Structure Plan

Hi Sharn,

Thank you for the chat this morning. Further to that, please find below some summary points about the drainage modelling assumptions and its' implications on the Structure Plan design.

- Modelling assumed an infiltration rate of 5m/day across the whole site.
  - 5m/day is relatively low for sand infiltration rates.
  - Limestone capping has the potential for lower infiltration rates however (eg. 0.5 - 5m/day).
- Geotechnical investigations are currently being undertaken, some prelim results show:
  - That infiltration rates close to the two main stormwater infiltration areas (eastern underground cells and western underground cells with basin over the top) are at about 5m/day so we are comfortable that the modelling reflects the onsite conditions in those two main infiltration areas.
  - In other areas of the site there will still be infiltration proposed through soakwells, permeable paving and roadside swales. So far, results show that across the rest of the site the infiltration rates vary from 0.5m/day (limestone) to 11m/day, but with most of the site at 5+m/day (although as I mentioned, geotech works are still in progress).
- Although it is recognised that there are some areas with lower in-situ permeability, the engineering works are proposing to address that;
  - In areas with limestone capping, the rock will be broken up and mixed with the sand fill proposed for the earthworks on site. The site will then be re-contoured/earthworked with the broken rock/sand mixture. Given this, the team are still confident that the other areas on site will be able to achieve an infiltration rate of 5m/day.

The LWMS stormwater modelling has shown that with these assumptions, stormwater from the existing catchments (outside the site) and the proposed development can be managed in the current POS areas and road layout design. Further information will be provided in the LWMS and any further refinement of the drainage design/ modelling can also be addressed at subdivision stage.

If you have any queries, please do not hesitate to contact me.

Thanks, Bec

Rebecca Epworth
BSc (Hons), MSc, MSc (Eng)
Director

urbaqua

Suite 4/226 Carr Place, Leederville WA 6007
P: 08 9328 4663
M: 0437 707 472
www.urbaqua.org.au

Appendix 3 WIN Bore Groundwater Quality Data (DWER, 2023 c)

			Acidity to pH 8.3 (CaCO3)		Al (sol) (ug/L)		Alkalinity (CO3-CaCO3)		Alkalinity (HCO3-CaCO3)		Alkalinity (OH-CaCO3)		Alkalinity (tot) (CaCO3)		Anions (sum sol) (meq/L)		As (sol) (ug/L)		Ca (sol) (ug/L)	
Site Ref	Collect Time	Collect Date	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality
61407111	10:45:00	25/02/2019																		
61407111	10:50:01	25/02/2019																		
61407111	10:50:03	25/02/2019	15000	Good	<10	Good	<1	Good	228	Good	<1	Good	228000	Good	9.62	Good	<1	Good	105000	Good

			Cations (sum sol)		Cd (sol) (ug/L)		Cl (sol) (ug/L)		Cond @ 25 deg C (uS/cm)		Cu (sol) (ug/L)		D18O (VSMOW) {delta		D2H (VSMOW) {delta 2H}		F (sol) (ug/L)		Fe (sol) (ug/L)	
Site Ref	Collect Time	Collect Date	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality
61407111	10:45:00	25/02/2019							1013	Good										
61407111	10:50:01	25/02/2019											-3.7	Good	-15.3	Good				
61407111	10:50:03	25/02/2019	10.4	Good	<0.1	Good	147000	Good	974	Good	<1	Good					100	Good	<50	Good

			Ion balance (%)		K (sol) (ug/L)		Mg (sol) (ug/L)		Mn (sol) (ug/L)		N (sum sol ox) {NOx-N.		N (tot kjel) {TKN} (ug/L)		N (tot) {TN, pTN} (ug/L)		Na (sol) (ug/L)		NH3-N/NH4-N (sol) (ug/L)	
Site Ref	Collect Time	Collect Date	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality
61407111	10:45:00	25/02/2019																		
61407111	10:50:01	25/02/2019																		
61407111	10:50:03	25/02/2019	3.81	Good	8000	Good	14000	Good	<1	Good	6660	Good	700	Good	7400	Good	87000	Good	40	Good

			Ni (sol) (ug/L)		NO2-N (sol) (ug/L)		NO3-N (sol) (ug/L)		O2-{DO %sat} (%)		O2-{DO conc} (mg/L)		ORP uncomp (in situ)		P (tot) {TP, pTP} (ug/L)		pH (no units)		SO4 (sol) (ug/L)	
Site Ref	Collect Time	Collect Date	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality
61407111	10:45:00	25/02/2019							79	Good	6.85	Good	89.1	Good			7.05	Good		
61407111	10:50:01	25/02/2019																		
61407111	10:50:03	25/02/2019	<1	Good	<10	Good	6660	Good							<50	Good	7.93	Good	44000	Good

			Suspended Solids		TDSolids (evap @180øC)		Temperature (deg C)		Turbidity (NTU) (NTU)		Zn (sol) (ug/L)	
Site Ref	Collect Time	Collect Date	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality	Reading Value	Quality
61407111	10:45:00	25/02/2019					22.3	Good				
61407111	10:50:01	25/02/2019										
61407111	10:50:03	25/02/2019	12	Good	572	Good			3.3	Good	<5	Good

Appendix 4 Landscape Report (REALMstudios, 2023)

Beaconsfield TAFE

Landscape Report

REALM studios

REALMstudios ...

would like to acknowledge that the site included in this report is on the traditional lands of Whadjuk Noongar. We offer our respect to the elders both past, present and future and through them, all Aboriginal and Torres Strait Islander People.

We are all on Country.

We respect its original owners, their knowledge, these places - with them, we work to create regenerative systems, places and solutions for the future.

We would like to also acknowledge the broader community, stakeholders and Council staff that have contributed to the process and outcome of this Guideline Document.

Project: 22456 Beaconsfield TAFE
Authors: Damien Pericles, Brett Schreurs, Michael Mennea, Jessica Gannaway, Ali Doody Burras
Client: DevelopmentWA
Date: May 2023
Revision: Final
Prepared by: REALMstudios

Table of Contents

draft

REALMstudios

Map of Fremantle Harbour 1887

Introduction

draft

The former Beaconsfield TAFE site was developed in the late 1960's as an education campus for various trades including building and construction, carpentry, business, hospitality, marine science, and visual arts. Prior to this the site was remnant coastal bushland over an undulating dunal landform.

The Whadjuk Noongar peoples have a deep history of connection to the area as well as recent links to the TAFE facility, in particular through the visual arts course.

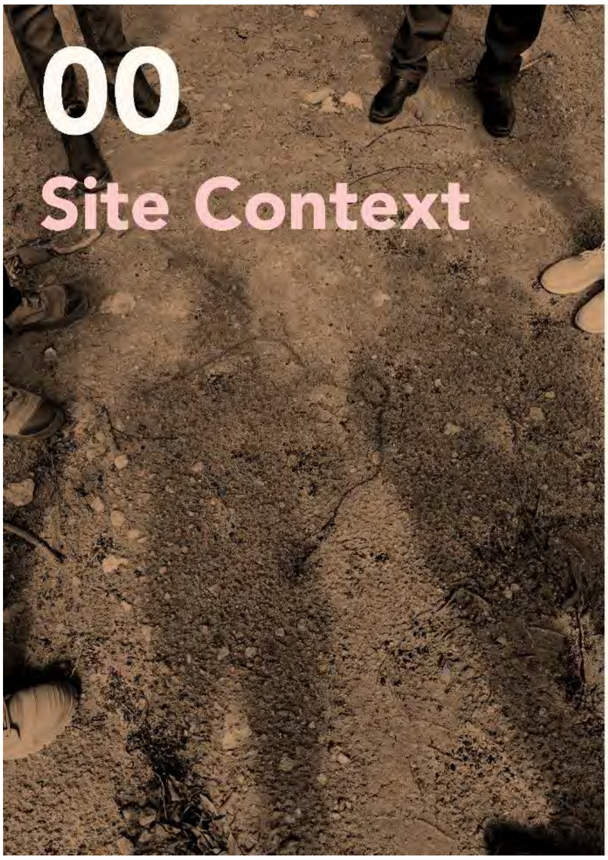
The demolition now gives way to development of the site primarily for medium density residential purposes of which social and affordable housing is anticipated.

The landscape strategy is couched in social and ecological sustainability. The vision is to create a new residential community grounded in place and respectful of Noongar ways of being.

Reflective of lost ecologies associated with coastal dunes and the limestone ridge upon which the site is located.

It will connect beyond site to strengthen and link with the recreational and open space network outlined in the 'Heart of Beaconsfield Master Plan', and it will provide the infrastructure to support a healthy community.

Despite most being exotic species, the design retains valuable existing trees to create instant tree canopy and cool shade in key open spaces. Additional street tree planting will, in time, deliver ecologically responsive canopy together with an integrated water management and movement network that supports walking and cycling.



draft

Walk on Country with Noongar Elders

A walk on country occurred with the design team and Whadjuk Noongar Traditional Elders including Glenys Yarran, Brendan Moore, Greg Ugle and Diana Ponton.

The discussion was fruitful and initially revolved around the recent history of the TAFE campus where numerous Noongar students were enrolled in the Visual Arts course taught by local artist Lindsay Powell during the late 1990's. Glenys and Diana talked fondly about a creative period in which a large amount of work was produced, some of which is unaccounted for. There is an opportunity to capture this 'lived experience' in the landscape design.

We learnt that this area was Midgegooroo country or Beeliar, which stretched from the ocean through to the Canning River south of the Swan River. Midgegooroo was the father of Yagan and like his son was well known for his resistance to colonial settlement. It is highly likely that Midgegooroo would have been one of those who observed the first British explorations in 1827 and the subsequent establishment in June 1829 of the port of Fremantle. He was captured and then later executed on 22nd May 1833 following multiple violent exchanges with colonialists.

As part of the interactions between settlers and Noongar there was description that the area around the TAFE site would have been used for transient tracks and escape routes as well as high points where observation of colonial movements were afforded. Given the sandy, limestone soils and elevated exposed condition the area was not inhabited as much as the resource rich coast and necklace of wetlands further inland. Regardless the low points adjacent the site would have been seasonal wetlands that may have provided a food source. These have since been filled in and developed. When camping in the area Mia Mias would have been built to protect from the winds.

A story was shared regarding Seven Brothers, expressed through seven hills that are spread over the Fremantle area. These included Monument Hill, Cantonment Hill, Clontarf Hill and Buckland Hill.

Mythological stories relate to the limestone ridge as being created by the Waugal, the sacred rainbow serpent. The nearby Clontarf hill holds the story of a mother and her two sons who are the protectors of Derbal Nara (Cockburn Sound), and who protect Derbal Nara from the Booyl-a-gatak, or sorcery coming from the north-west. A Nyitting story explains that the Derbal Nara or Cockburn Sound was formed through a fight between the Waugal and the Spirit Crocodile from the north.

The underlying geology was talked about – caste limestone and the traditional use of limestone when crushed into powder form for use in painting. The use of site-sourced limestone was supported with suggestions to use in gabion walling.

Local plants and animals that were discussed include:

Melaleuca lanceolata (Rottnest Island Tea Tree) or Moonah and

Eucalyptus gomphocephala (Tuart) or Tuart

The group recommended Aboriginal organisations be contracted to provide construction and maintenance services as part of the delivery of the precinct and to source local seed for propagation and use in future planting on site. There was a desire to see Noongar employment opportunities.

Drawing in sand by Brendan Moore of the South Fremantle coastline and associated points of attraction for Noongar peoples

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Precinct Planning Context

draft

Heart of Beaconsfield Master Plan

A regional master plan was developed and is now adopted by the City of Fremantle together with Department of Communities and the local community. The TAFE site is located central to the plan.

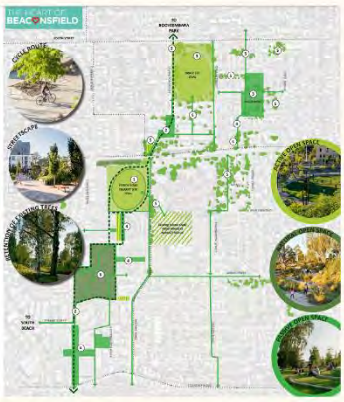
It identified a north/south open space network and future development areas with the following key and relevant strategies:

- To provide pedestrian and cycle links between open space, community facilities and recreation areas
- Provide a range of housing types for various income levels
- Retention of significant trees to maintain a sense of place
- Provide for a north-south green link that enhances tree canopy and connects key areas of open space.
- Retain and provide additional active, natural and passive open space.

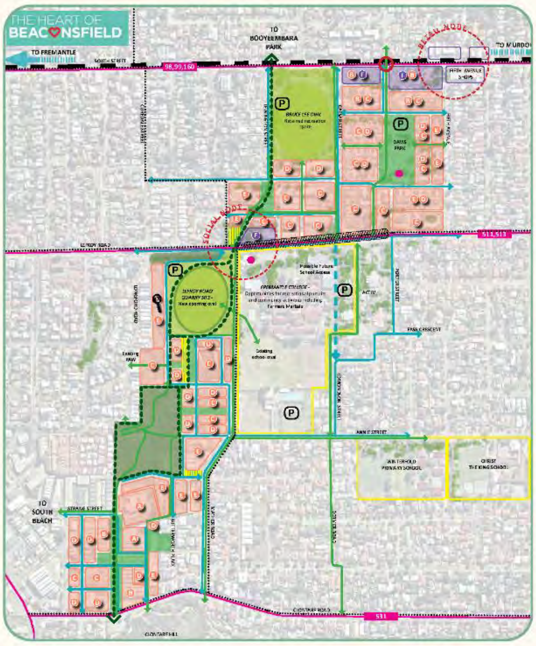
On the TAFE site specific and relevant points from the master plan include:

- Retain Trees and provide a N/S green link through the site.
- Provide for activity appropriate for a social node
- Create a retail and social node to the SW corner of site
- Provide some high density apartment living.

Most importantly, the master plan shows how the TAFE site needs to provide a strong connection through site in order to forge a strong pedestrian and cycle link along the length of the broader Heart of Beaconsfield Master Plan.



The Heart of Beaconsfield Master Plan



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Precinct Ecological Corridor

The former TAFE site is located within a loosely connected series of remnant and potentially regenerated open spaces and bushland areas, that form a north south connection in line with a limestone ridge and parallel to the coast. Conceptually there is an ecological link that stretches from the Beeliar Regional Park to Booyeembara Park integrating both hilltop and lower camp-land ecologies. This chain of spaces has been identified in the Heart of Beaconsfield Master Plan.

Key remnant bushland sites such as Clontarf Hill, Manning Park and Beeliar Regional Park provide a good indication of the former ecological context and plant communities that would have inhabited the former TAFE site. These sites feature very high ecological & cultural values with rare and endangered species & communities such as limestone heath and Tuart Woodlands.

The reserves provide roosting and forage habitat for the endangered Carnaby Cockatoos and feature the protected Parrot Bush (Banksia sessilis) which occurs over much of the ridge. There are also potential sites for the threatened Graceful Sun Moth (priority 4 endangered species) and a recorded site for the Lined Skink (priority 3 endangered species).

The lower chain of wetlands located between two dune systems that feature in the Beeler Regional Park would have been a former coastline.

The proximity to the coast means strong and semi-saline winds are a feature that also inform ecological communities and their habits.

The key tree species in these reserves include:

- Eucalyptus gomphocephala (White Gum) or Tuart in Noongar
- Melaleuca lanceolata (Rottnest Island Tea Tree) or Moorah
- Melaleuca rhaphiophylla (Swamp Paperbark) or Bibool and
- Eucalyptus decipiens (Red Heart Gum) or Moit

draft

1 BEELIAR REGIONAL PARK

2 MANNING PARK

https://fremantleshippingnews.com.au

3 CLONTARF HILL

4 LEFROY ROAD QUARRY SITE

5 BEACONSFIELD TAFE SITE

6 BRUCE LEE OVAL

7 BOOYEEMBARA PARK

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Precinct Ecological Narrative

draft

1953 Aerial of Beaconsfield (Landgate)

1953

1965

1979

The dominance of limestone outcrops and underlying geology creates a specific soil condition but also defines a rustic character of the area.

The Cottesloe soil complex is described as a low hilly landscape with shallow brown sands over limestone with much exposed limestone. The site would have had a dynamic topography with dunal high points and seasonally wet depressions. The TAFE development has flattened much of the site through cut and fill.

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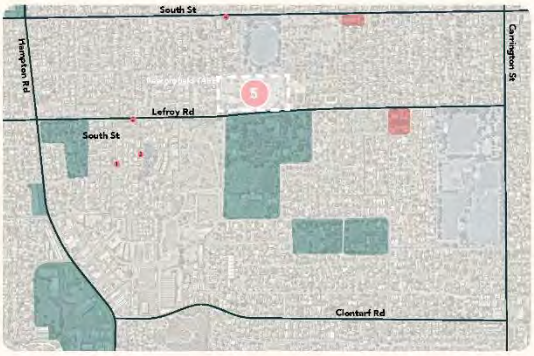
Beaconsfield Urban Character

A study tour of the surrounding area reveals the underlying kast limestone geology and how this materiality informs a unique character of the area.

Streets are often cut through the soft rock to reveal sectional elevations of the bed rock that in some locations require structural support with either concrete or brick infill.



Corner South and Field Street, Beaconsfield

Solomon Street, Beaconsfield.

Expression of kast limestone ridge found throughout the suburb of Beaconsfield.

A patchwork of limestone forms, finishes and construction over time.

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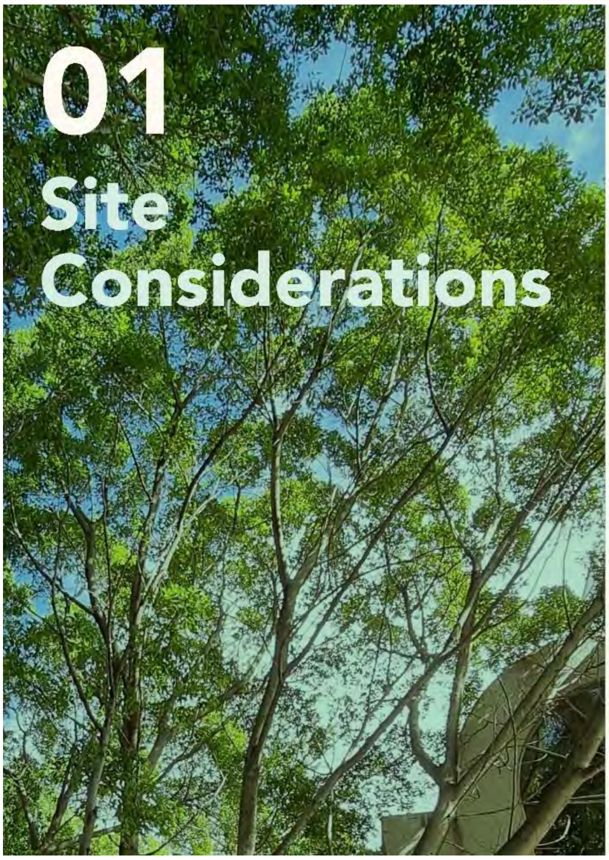

01 Site Considerations

Landscape Analysis

The context and existing site features:

- Bruce Lee Oval - former seasonal soak
- Council Carpark to north and potential development site
- Various fully mature existing trees - some forming a link across the site (refer detailed assessment)
- PSP to south landing on Lefroy Road
- High School & Primary School opposite to south
- Low point on Lefroy Road to south
- Two constructed sumps / low points
- Generally good views to south

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Existing Tree Assessment

draft

Existing trees have been assessed to identify an overall landscape retention strategy. The assessment includes trees on lot as well as verge trees.

This has been conducted using arboricultural reporting from Arbor Centre titled: 'Beaconsfield TAFE - Arboricultural Dilapidation Report - Arbor Centre - April 2020' which has provided (among other things) species, size, age and health of trees.

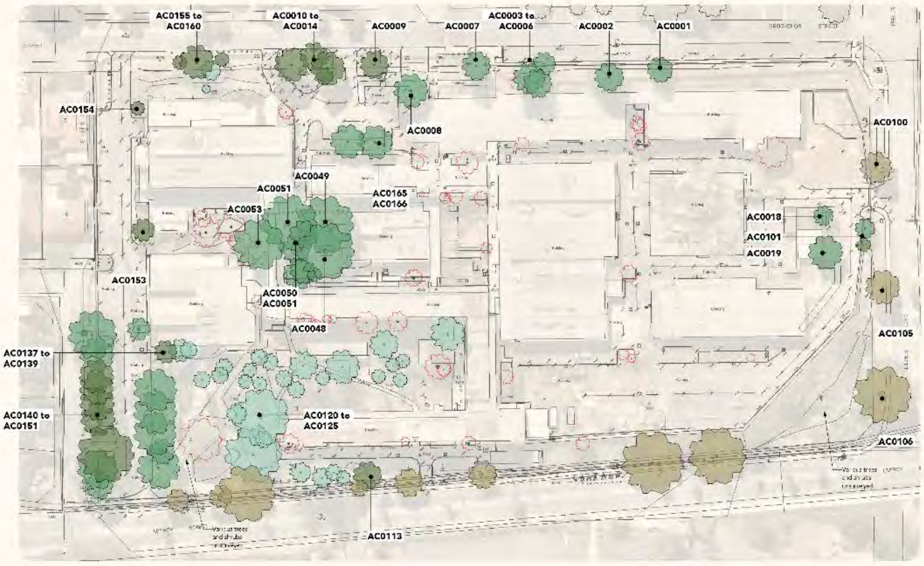
It was found that very few native tree species within the lot were worthy of retention.

There were however a number of good quality exotic trees worthy of retention.

Trees nominated for retention have informed lot layout, road alignment and site levels. Levels are informed by proximity to major roots.

We note that some trees were not surveyed.

Legend - Existing Trees



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Existing Trees and Character

draft

Existing trees identified to be retained on site form the building blocks for an ecological corridor and instant urban canopy at a precinct scale.

The demolishing of existing buildings allow for a visual connectivity between POS areas and green pockets throughout the proposed development.

The existing tree canopies provide opportunity for a shaded route through the development.

Retained trees - looking north (230320)

1 SOUTH-WEST CORNER SOAK

Araucaria heterophylla (Norfolk Island Pine) AC0121 to AC0128 in 'Good Condition' to be retained.

Ficus microcarpa var. hillii (Hills Weeping Fig) AC123 to be retained.

2 EXISTING CARPARK

3 FICUS COURTYARD

Ficus microparpa var. hillii (Hills Weeping Fig) AC048 to AC053 to be retained.

4 FICUS COURTYARD

5 GROSVENOR ST. EDGE - WEST

Melaleuca lanceolata (Rottnest Island Tea Tree) AC0163 and Casuarina equisetifolia (Hosetail She-oak) AC0158to be retained.

6 GROSVENOR ST. EDGE - EAST

Melaleuca lanceolata (Rottnest Island Tea Tree) AC0011 to AC0014 and Casuarina equisetifolia (Hosetail She-oak) AC0009 to be retained.

7 SOUTH-EAST CORNER SOAK

Tree codes from the below report:
'Beaconsfield TAFE - Arboricultural Dilapidation Report - Arbor Centre - April 2020'

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Topography & Drainage

The original topography would have featured a dunal hilltop to the NE corner of site. This has been levelled with the top of the hill pushed southward to create a level pad for the former TAFE building.

To the south-west corner TAFE buildings negotiated a single floor level change to a low lying zone where a fenced sump for drainage is located.

Another fenced sump is located to the south-east corner of the site. A significant level change is experienced in this location, where the site meets Lefroy Road.

Typically the majority of former building pads were at a level of RL 19.20. This level now features significant bed rock just below the surface. Former drainage and service corridors were excavated from the bed rock to achieve required depths.

Grosvenor Street acts as an east-west ridge line with water draining to the north at this point.

Given the nature of karst limestone the large flat surface actually drains fairly well (as evidenced in a site visit immediately after rain). Some local pooling was evident however less then expected.

LEGEND

- Existing open drainage sump
- Existing site drainage pits
- Overland Flow Direction

1 SOUTH-WEST CORNER SOAK

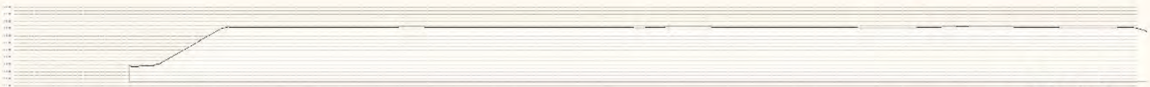
2 SOUTH-WEST CORNER SOAK

3 INTERNAL LEVELS

4 INTERNAL LEVELS

5 LEFROY ST. LEVEL CHANGE

6 SOUTH-EAST CORNER SOAK



Section through existing conditions

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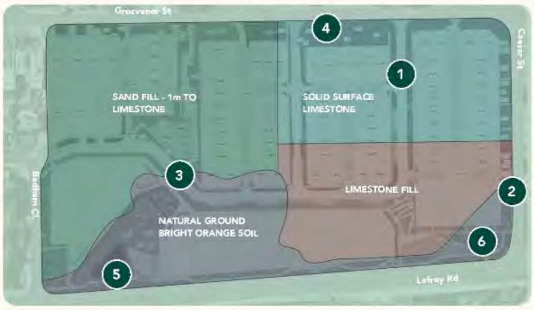
Site Geomorphology



The demolition contractor provided important input on existing conditions immediately following demolition in particular with regards soil conditions.

As per the diagram, a good quarter of the site was identified as being limestone bed rock. Image 1 is an aerial photo showing the bucket scrapings into the rock. This has cost and engineering implications for the development.

It also represents an opportunity for the limestone to be quarried and used as a material resource within the project.

Throughout the site large 'floaters' are evident and would equally be suitable for reuse as feature elements in the landscape.

Within the south-western sump karst limestone is clearly evident in the steep battered wall of the depression.

1 SURFACE LIMESTONE

2

3

4 SURFACE LIMESTONE

5

6

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02 Masterplan Layers

Masterplan Principles

draft

A series of principles are outlined over-leaf to guide design development including:

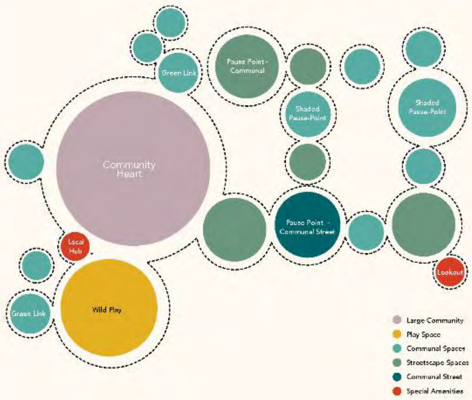
- Tree Retention
- Climate Responsive Design
- Water-wise Design
- Coastal Ecologies
- Sense of Community and Place
- Sustainability and Low Carbon Materiality

The Masterplan is then organised into separable layers or strategies for:

- Uses / Zones / Amenity Programme
- POS Typologies
- Water Management (WSUD)
- Movement and Connectivity
- Lighting & Art
- Proposed Trees

Each of these layers comes together to create the physical foundation to achieve the Masterplan's vision and guiding principles.

Below is an abstracted programme diagram that reveals connectivity between different proposed uses within an approximation of the spatial hierarchy.



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Beaconsfield TAFE will be...

draft

Tree Retention
"Existing Tree Retention to inform urban structure"

Retention and protection of existing trees to maintain as much of the sites existing character and physical properties as possible. Future tree plantings will look to increase the ecological diversity of the site through endemic tree specie selection.

Climate Responsive Design
"Integrate resilience and adaptiveness into the design"

The Beaconsfield TAFE site will integrate climate resilient design into the public and communal spaces of the precinct.

Coastal Ecologies
"Reinstate Coastal Ecologies and connect to place"

Buildings and public spaces will respond to the natural landscape and historic ecological classes of the precinct. The landscape selections will be informed by the sites ecological class.

Sense of Community and Place - Granular Ecologies
"Create a fine grain with moments of delight"

Best practice street design will make sure that safe arrival, movement and connection is prioritised for all. The visibility of cultural narratives and artistic flair will highlight the pride and character of the Beaconsfield community. Spaces will be designed for flexibility in the future as the community evolves.

Sustainability and Low Carbon Materiality
"Deliver Low Carbon Materiality & Life Cycle Cost"

The Beaconsfield TAFE site will use and be an exemplar project for integration of sustainable and low carbon materiality. Full life cycle cost will be a key consideration for material specification and selection. Best practice standards for sustainability will underpin the built form, public realm and ongoing operations of the precinct. The development will target net zero operational and carbon reduction, ensuring positive benefits and a minimal impact on the environment.

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Uses / Zones / Amenity

draft

LEGEND

The Masterplan proposes the following features and amenities:

- Shared pedestrian orientated streets
- Universal accessibility paths
- Passive recreation areas
- Community Hub
- Community Shelter (BBQ / tables)
- Existing Trees / Shade / Ecological corridors
- Art Interpretation
- Cultural Heritage Opportunities
- Parkland & CPTED Lighting
- WSUD Infrastructure
- Drink Fountains
- Community Bore
- Wayfinding
- Seating Opportunities
- Gathering Opportunities
- Local Hub

- POS 1 - North-West POS
- POS 2 - South-West POS
- POS 2 - South-West POS - Terrace & DUP
- POS 3 - South East POS
- Northern & Eastern Verge
- Southern & Western Verge
- Street type A - 16m
- Street type B - 11m
- Street type C - Laneway 6m

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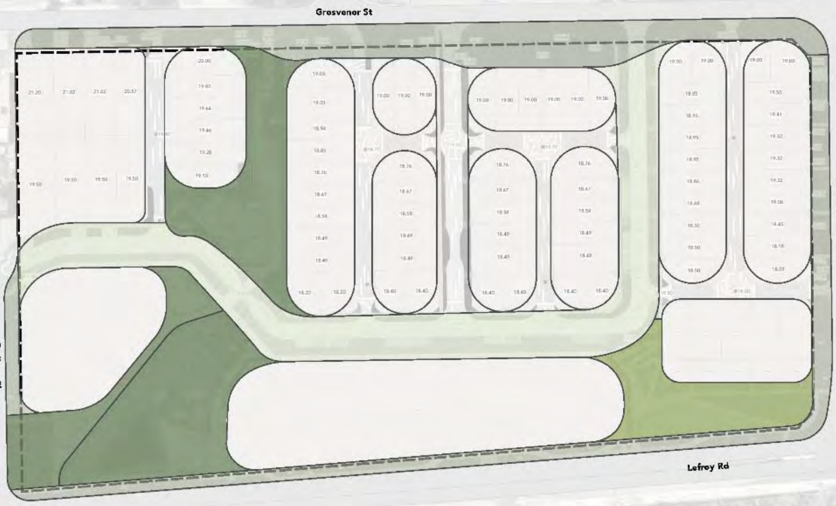
POS Typologies



draft

LEGEND

LOCAL PARKS & GREEN LINKS

- POS 1 - North West POS
- POS 2 - South West POS

POCKET PARK

- POS 3 - South-East POS

MICRO PARK

- All Large Verge Spaces

GREEN STREETS

- Main Street

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Water Management (WSUD)

draft

LEGEND

Potential WSUD Landscape Features:

- Flush kerb - Wet
- Flush kerb - dry
- WSUD swale
- Permeable Paving
- Surface Infiltration
- Sub-Surface Infiltration corridors
- Drainage Falls / Flow Direction
- Pit & Pipe Connection

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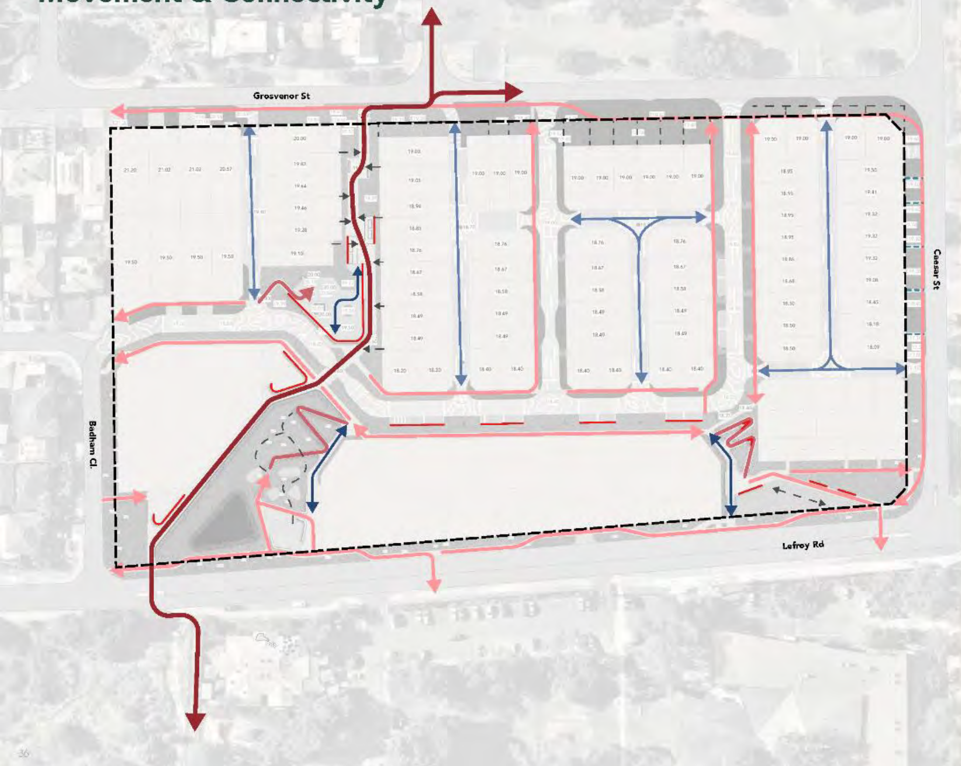
Movement & Connectivity



draft

LEGEND

Potential Connectivity Landscape Features:

- On grade bike path
- DDA - On grade pedestrian
- Laneway - Informal shared street
- Pedestrian connection to verge
- Stair Connection
- Rest / Pause points
- Informal Paths / Connection

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Lighting & Art

draft

LEGEND

Potential Lighting & Art Landscape Features:

- Pole Tops
- Integrated Lighting with existing trees
- Retaining wall with integrated art
- Boardwalk & play space with integrated art
- Paving with integrated art or feature artwork opportunities to be developed

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Proposed Trees

draft

LEGEND

- Existing trees to be retained.
- Existing trees to be removed.
- Feature Street Tree A
- Feature Street Tree B
- Feature Street Tree C
- Feature Street Tree D

CANOPY COVER TARGETS

Pre Development Canopy Cover **19%**

11% Current Canopy Cover

Canopy Cover Target To meet City of Fremantle Urban Forestry Policy: Southern Precinct of 26% **30%**

Note: 30% is the minimum desired Canopy Coverage total.

REALM studios

03 The Landscape Masterplan

Introduction

draft

The landscape and open space master plan for the Beaconsfield TAFE development site addresses three key spatial considerations;

1. destination parks including mini plazas
2. green linkages and
3. variously scaled streetscapes.

The master plan integrates the various layers and strategies outlined previously, together with a design aesthetic & sense of both a local narrative and materiality to create a vision for a new inclusive and sustainable community that has grown out of this specific place.

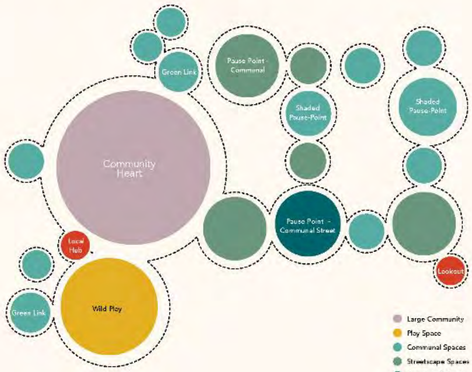
The public open space network has been curated to provide a range of experiences and recreation opportunities for the local community within a shaded and cool urban context. The Figs and Norfolks will create an instant sense of place and enjoyable place to hang out with friends.

The scheme works hard to connect seamlessly with neighbouring and future open space networks to deliver upon the vision of the 'Heart of Beaconsfield MP'.

It integrates best-practice water management to enhance liveability through high-quality tree canopy and increased soil moisture. The mostly native plant palette will strengthen local bio-diversity and in time evolve what is currently a de-natured site into an ecologically responsive and regenerative neighbourhood.

Other sustainability measures will include recycling of site sourced materials to both minimise carbon load but also resonate with a local sense of place. We will also look to engage Aboriginal organisations in the construction and delivery of public art.

Lastly the design carefully manages level change to create moments of drama and surprise whilst also maintaining smooth and DAIP compliant on-grade connections where required.



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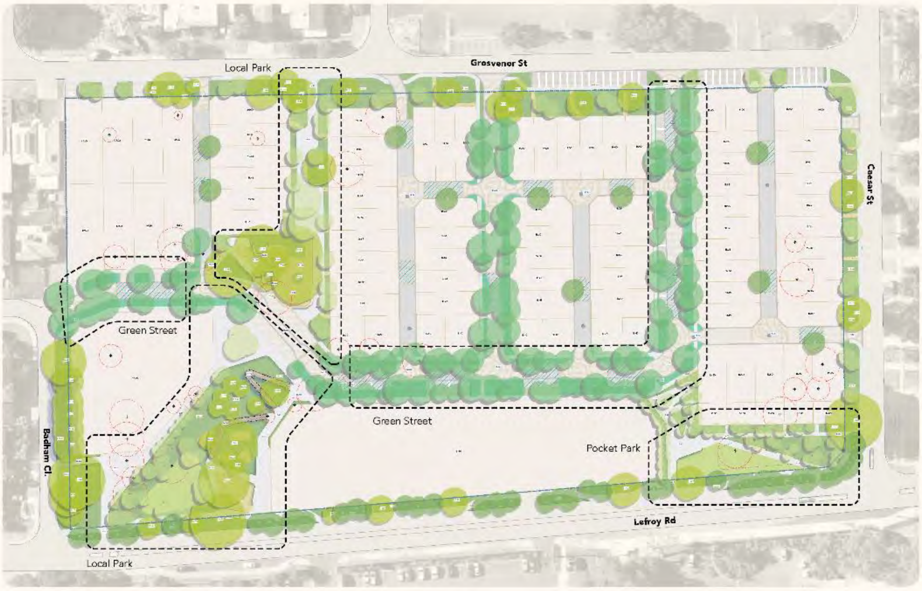
OVERALL MASTERPLAN

draft

LEGEND

- Lot Boundary
- Paving A
- Paving B
- Paving C
- Paving D
- Paving Permeable & Structural Soils
- Garden Bed A
- Garden Bed B
- Garden Bed C
- Walkway
- Wall
- Staircase & Handrails
- Existing Tree Retained
- Proposed Tree Type A
- Proposed Tree Type B
- Proposed Tree Type C
- Existing Tree to be Removed



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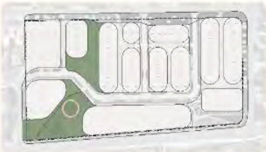
Local Parks & Green Links



POS 2 - South-West POS + Terrace & DUP

Key User Groups: Residents

Size Guide: 1ha - 5ha

Length of Stay: 1 -3 hours

Broad Purpose:
Local public open space serves as the recreational and social focus of a community, with a user catchment of approximately 800m. Residents are able to use their local parks to access a range of amenities that service the broader community as well as local needs.

Vision: **Playing in the Pines**

Located within the social node of the broader 'Heart of Beaconsfield Masterplan' this local park provides an active recreation node. It will become a place of play and connection, overlooked by adjacent ground and multi-level apartments and open to Lefroy Road to the south.

Responding to the existing natural assets of large mature pine trees and significant level change this open space will be vertical and dramatic.

The existing PSP crosses Lefroy Road to the south west and strikes a grade up at approx 18.40. This level wraps around the space to forge an on-grade cycle and pedestrian link. The path will also assist in providing passive surveillance of the sunken play space below.

The existing sump will be retrofitted into a below ground storage and infiltration gallery. A partially turfed and planted shallow basin above the storage will then be available for green open space (with all fencing removed). This basin will capture and infiltrate small but high frequency rainfall events in order to retain soil moisture where it is needed most - at the surface. This approach distinguishes itself from the WGV basin which directs low flow events directly into the underground storage area leaving the above landscape dry.

Site salvaged trees & limestone to be re-purposed into place based play elements.

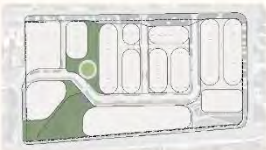
Utilise Dry Drainage Infrastructure

Celebrate Existing Trees

LEGEND

- Lot Boundary
- Paving A
- Paving B
- Paving C
- Paving D
- Paving Permeable & Structural Soils
- Garden Bed A
- Garden Bed B
- Garden Bed C
- Walkway
- Wall
- Staircase & Handrails
- Staircase & Handrails
- Existing Tree Retained
- Proposed Tree Type A
- Proposed Tree Type B
- Proposed Tree Type C
- Existing Tree to be Removed

Local Parks & Green Links



POS 1 - North-West POS

Key User Groups: Residents

Size: 0.4ha - 1ha

Length of Stay: 1 -2 hours

Broad Purpose:
A small space that provides day to day recreation opportunities for the immediate residential population. The space may incorporate areas of natural vegetation to provide both ecological function and the enjoyment of the community.

Vision: **Meet me under the Figs**

The elevated location together with retention of mature Ficus trees creates an instant cool, shady and appealing place. This hard-scaped courtyard of the former TAFE featured circular raised planters wrapping the trees. To aid in the health of the retained trees new raised planter walls will be constructed - likely from site sourced limestone.

This plaza forms a node in association with the main street as it bends through the development. It also forges a green link between future single lot residential houses up to Grosvenor Street where a broad landscape set back facilitates retention of existing trees and a link to Jackie Chan

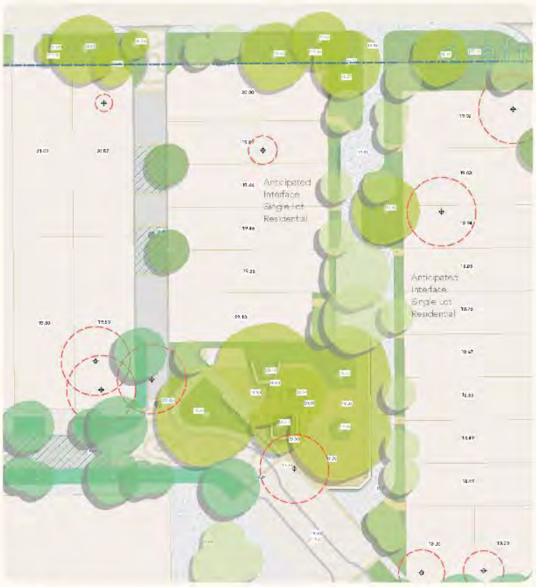
Interface to residents - Provide Direct Access

Existing site conditions

Coastal Vegetation & Level Change

Shaded Pause Points & Passive Surveillance

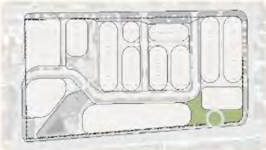
Shared Movement Zone – PSP link



LEGEND

- Lot Boundary
- Paving A
- Paving B
- Paving C
- Paving D
- Paving Permeable & Structural Soils
- Garden Bed A
- Garden Bed B
- Garden Bed C
- Walkway
- Wall
- Staircase & Handrails
- Staircase & Handrails
- Existing Tree Retained
- Proposed Tree Type A
- Proposed Tree Type B
- Proposed Tree Type C
- Existing Tree to be Removed

Pocket Park



POS 3 - South-East

Graded turf with passive surveillance

Terracing with pause points, textural planting & lighting

Coastal Vegetation & Level Change

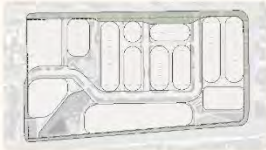
Vision: **Hang Out After School**

Featuring a rolling lawn, shady trees and a series of integrated retaining and seating walls this park will be a good place to sit and reconnect with nature or take the dog for a walk.

The small open space works hard to provide a DDA compliant path connection across significant level change as well as provide a below ground storage tank for stormwater management.

Due to split level dwellings fronting the north side, direct access to the park from these lots will be afforded. This will also assist with passive surveillance of the park.

Verge Parks (Micro Parks)



Key User Groups: Residents

Size: <0.4ha

Length of Stay: 30 mins

Broad Purpose:
A public 'backyard'/respite point, designed to function as a small green pocket that allows for green relief; residential size passive spaces (i.e. grass for kids to play, path for children to ride, dog walking) and respite points (i.e a spot to eat lunch, check your phone).

Vision: **Activated Verge Areas**

A well designed and maintained verge has the potential to hence the biodiversity, ecosystem function and human amenity of a place. The identified verges in the former Beaconsfield Tafe site will be utilised as additional open space with connections to the larger open space network. the verges will feature coastal endemic planting, and be embedded with water sensitive urban design. they will provide a comfortable and shaded pedestrian network, connecting the site both internally and externally.

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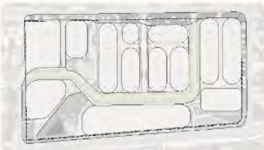
Green Streets



Key User Groups: Residents

Size: NA

Length of Stay: NA

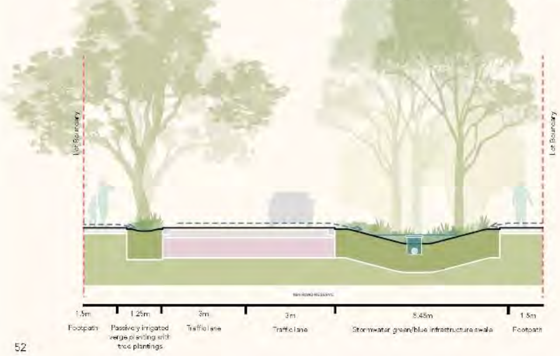
Broad Purpose:
Utilising the available space within the street thoroughfare to increase the environmental and social value of a street. Embedded with the principles of water Sensitive Urban Design these streets will function as micro ecosystems, forming part of the larger green and blue networks of the site.

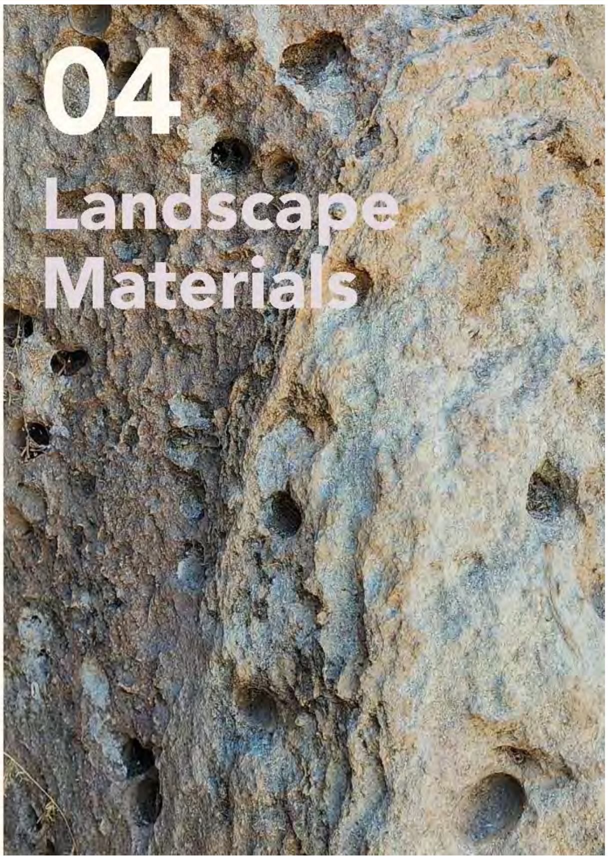
Green Streets in the Old TAFE Site:

Main Street

The main street of the former Beaconsfield Tafe will act as a movement corridor for both people and water. its design recognises the potential of a street as an open space that is capable of providing recreational and passive enjoyment as well as maximising the environmental value of what has typically been a vehicle dominated landscape.

The main street will be a people first street, in which the car will be required to prioritise alternative modes of transport (i.e. walking, cycling). A narrowing of the carriageway allows for significantly wider verges, providing critical space to incorporate wide path networks and a network of road side swales and other water sensitive design elements. This approach will allow the street to thrive and support the health of its community. The street will act as a living drainage system, reducing the developments reliance on traditional drainage infrastructure.





04 Landscape Materials

Suggested Materials Palette


Minimal palette with interest provided through texture & moments of community exchange


Permeable surfaces in low traffic areas and edge conditions


BORAL ENVISIA*

BORAL INNOVO*

Feature boulders, spalls, gravel & fines

SITE SOURCED LIMESTONE


Textural Walls

Terraces

SITE SOURCED TIMBER

Hugelkulture

Informal features

Play elements

Furniture & Fixings

Temporary activation seating

*Or Similar Approved

Suggested Planting Palette

Endemic Tree Canopy - Tuart (Eucalyptus Gomphocephala)

Reflective of Local Character

Drought Tolerant Coastal Natives

Agonis Flexuosa

Acacia pulchella

Eucalyptus decipiens

Eucalyptus gomphocephala

Suggested Planting Palette


Acacia cyclops


Acacia pulchella


Hakea prostrata


Dianella revoluta


Grevillea crithmifolia


Hakea prostrata


Kenedia prostrata


Melaleuca huegelii


Melaleuca systena


Olearia axillaris


Phyllanthus calycinus


Spyridium globulosum


Templetonia retusa


Xanthorrhoea preissii

REALM studios

city making + liveability

REALMstudios Pty Ltd
ABN 391 65483330

enquiries@realmstudios.com

www.**REALM**studios.com

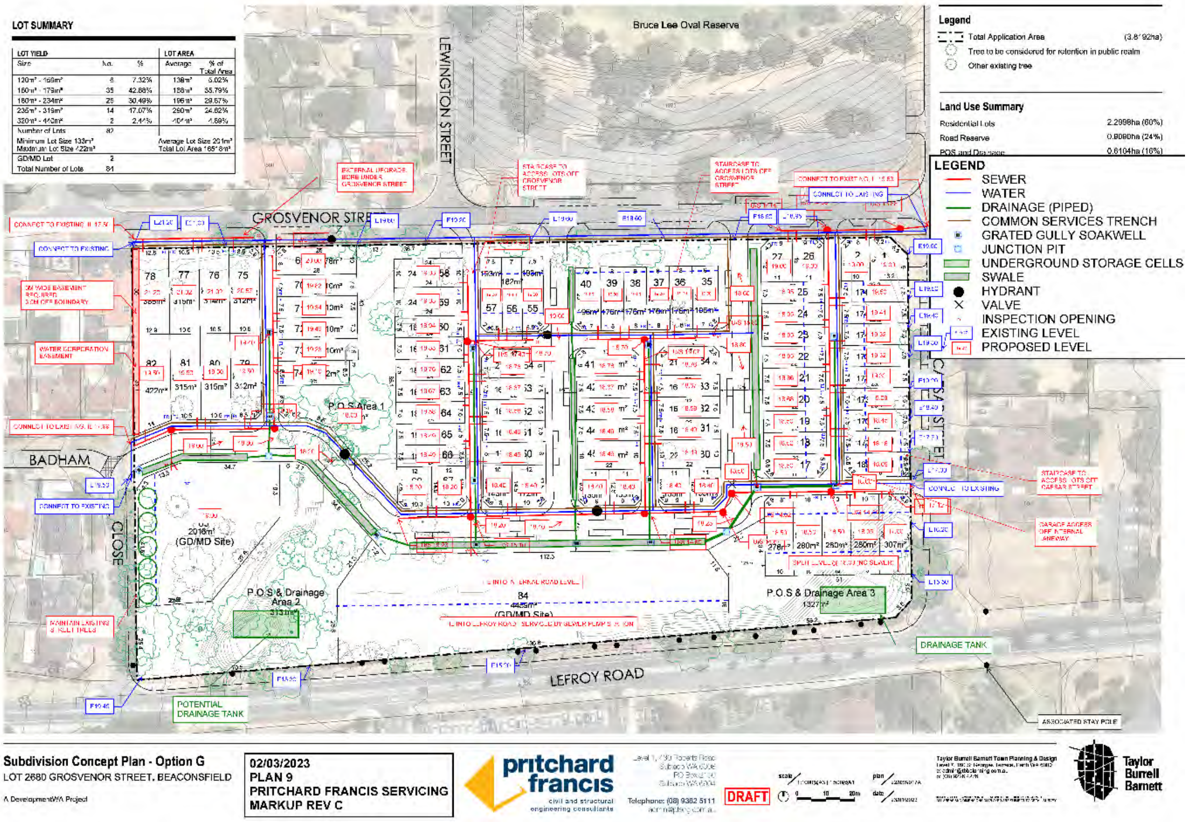
Ground Floor, 79-81 Coppin Street
Richmond, Melbourne, VIC 3121
T +61 3 9070 1157
jon.shinkfield@realmstudios.com
M +61 411 551 512

L2, Commonwealth Bank Building
242 Murray Street, Perth WA 6000
T +61 8 9227 7222
damien.pericles@realmstudios.com
M +61 456 714 655

Level 4, 68 Wentworth Avenue,
Surry Hills, 2010
tom.rivard@realmstudios.com
M +61 414 369 262

89 Macquarie Street,
Hobart, Tas 7000
alan.chellewell@realmstudios
M +61 431 454 492

Appendix 5 Sewer and potable water connection plan (Pritchard Francis, 2023)



LOT SUMMARY

LOT YIELD			LOT AREA	
Size	No.	%	Average	% of Total Area
120m² - 159m²	6	7.32%	138m²	5.02%
160m² - 179m²	35	42.68%	168m²	35.79%
180m² - 234m²	25	30.49%	196m²	29.57%
235m² - 319m²	14	17.07%	290m²	24.62%
320m² - 440m²	2	2.44%	404m²	4.89%
Number of Lots	82			
Minimum Lot Size 133m² Maximum Lot Size 422m²			Average Lot Size 201m² Total Lot Area 165?8m²	
GD/MD Lot	2			
Total Number of Lots	84			

Appendix 6 Community Bore - Options Evaluation and Concept Plan

Table A1: **Community Bore - Option Evaluation and Concept Design Summary**

Element	Requirement	Response
Task 1: Identify the options for non-drinking water source(s)		
Site characteristics and possible constraints	Is the site in a public drinking water source area?	No
	Are conservation wetland or odour buffers required?	No
	Does the site have contaminated soil or is it registered with Department of Environment Regulation as contaminated?	No registered sites
	Are there any other site-specific constraints or considerations that may affect the proposed system; e.g. subject to flooding?	No
Land planning considerations	Consider relevant state and local planning policy and include the preliminary concept in any required planning documents	Land planning considerations have been accounted for during the structure planning of the site.
	Take into account the form and function (i.e. level of irrigation) of proposed areas of public open space	The concept plan has been included in this LWMS.
	Identify land requirements including opportunities to integrate infrastructure into multiple-use corridors	Preliminary assessment suggests that the pump rates from the aquifer (Appendix 7) are sufficient to supply irrigation to households without additional storage tank requirements. The production bore is proposed within the multi-use corridor of POS 2.
Intended end uses and estimated demand	Identify the proposed non-drinking uses of the water supply including proposed source of irrigation for public open space and consider supply for domestic garden irrigation, toilet flushing etc.	The community bore will be used for irrigation of residential lot and grouped housing lot gardens.
	With the end uses identified, estimate demand, based on assumptions of consumption rates. The Water Corporation's online H2Options provide additional information and a water balance calculation tool	Water demand for the community bore irrigation is estimated to be as 4,725 kL/yr (Table 2 of this LWMS).
Assessment of possible non-drinking water sources	Assess source options for identified end uses and consider contingencies where necessary, having regard for the estimated demand	Contingency source options are potable water (scheme), rainwater (tanks), domestic garden bores. Domestic garden bores are considered unsuitable in development due to the relatively small lot sizes. Rainwater tanks are not generally suitable for garden irrigation due to the lack of rainfall over summer when irrigation is required, and therefore large storage requirements. Potable water will be available as an alternative (business as usual) option if required.
	Consider the quality of the water supply and whether it is fit for the purpose. If unknown, identify the water quality variables to be determined based on its intended use.	Full water quality testing and analysis will be undertaken in Stage 2 works and presented in the UWMP. Preliminary water quality testing has indicated water is relatively fresh, low in iron and normal for chloride.
	For groundwater (or surface water) in a proclaimed area and where groundwater is a contingency source, obtain advice from the Department of Water regional office on water availability and licensing or permit requirements	Allocation is currently available in the superficial aquifer and an allocation licence application has been submitted.
Assessment of possible options for treatment, storage and distribution	Define likely requirements for treatment of the identified source(s) for proposed end use(s) and location	Preliminary assessment suggests treatment will not be required. Section 3.4.2.1. of this LWMS.
	Decide if storage is required and likely options to provide it	Preliminary assessment suggests storage will not be required. Section 3.4.2.1. of this LWMS.
	Assess possible options for distribution of non-drinking water to end users	Pipe network in road reserve.
Evaluation of options and identification of preliminary preferred option(s)	Make a preliminary evaluation of options for source(s) and supply to identify the preferred non-drinking water system(s)	Potable or community bore.
Task 2: Develop concept design of preliminary option(s)		
Identify infrastructure and land requirements:	Identify infrastructure needs and how much land is required for the protection of the water source, treatment, storage and/or distribution needs.	Bore will be contained within POS 2 – size is unlikely to be significant (similar to the exiting TAFE bore on site) and flexible (subject to detailed design).
	Identify any existing and planned water infrastructure for the site and how it may affect the proposed non-drinking water system – contact the existing water service provider	Existing water infrastructure has been removed as part of demolition works. Planned infrastructure will consider the addition of a third pipe system.

Element	Requirement	Response
	Address relevant standards, codes and guidelines (e.g. plumbing)	Water use will be external use only.
Preliminary review of health risks	Identify Department of Health requirements – discuss requirements for treatment and management of exposure risk based on source water and intended end-uses and the receiving environment as per the *Guidelines for the non-potable uses of recycled water in Western Australia* (DoH 2011) and/or the *draft alternate water supply guidelines – stormwater and rainwater* (DoH 2009).	DoH is not the regulator for groundwater. Previous advice from DoH has indicated that an external irrigation system with no taps would be considered lower risk (Clemencia Rodriguez, *pers. comm.*). Monitoring and auditing is likely to be required.
	Understand the requirements of the *Australian guidelines for water recycling* (Phase 1 and relevant Phase 2 modules, NRMMC-EPHC-NHMRC 2006-09) and the above mentioned Department of Health guidelines to determine ability to manage public health risks.	Not applicable - source of community bore is groundwater (not greywater or treated wastewater).
Preliminary review of environmental risks	Identify Department of Environment Regulation requirements for an environmental works approval and licence if proposing source water from a prescribed activity listed in schedule 1 of the *Environmental Protection Regulations 1987*; e.g. from a sewerage waste water treatment plant	Not applicable - source of community bore is groundwater (not a prescribed site).
	For treated wastewater proposed from prescribed premises, the Department of Environment Regulation will require details of anticipated water quality, how the system will be managed, and the intended uses of the water.	
	For managed aquifer recharge proposals consider the Department of Water's requirements as per *Operational policy 1.01 – Managed aquifer recharge in Western Australia* (DoW 2011a), including hydrogeological assessment and environmental risk assessment requirements. Department of Water recommends a desktop site feasibility assessment and a preliminary meeting with the department at this	Not applicable – no aquifer recharge.

Element	Requirement	Response
	stage	
	Obtain advice from the Office of the Environmental Protection Authority for proposals with a potential to cause significant environmental impacts (e.g. location in sensitive environments) regarding the need to refer the proposal for assessment. Any EPA assessment will occur outside the non-drinking water approval process.	No significant environmental impacts anticipated as the proposed extraction volume is small and there are no significant groundwater dependant ecosystems surrounding the site.
Institutional arrangements	Consider who will own and manage the non-drinking water system in the immediate and long term	It is envisaged that Development WA will own and operate the infrastructure for the system until handover to council (2 years post construction). Preliminary liaison has occurred with the City of Fremantle. Further information in Section 3.4 of this LWMS.
	Consult with the current or future asset manager for POS irrigation (e.g. local government) on the preferred non-drinking water option	Preliminary consultation has occurred and further consultation will be undertaken in Stage 2.
	Identify the preferred water service provider where applicable: - Contact the Department of Water or visit its website for initial advice whether the proposed service would qualify for a water services licensing exemption and on the process for obtaining an exemption. - Where applicable, review requirements to become a licensed water service provider outlined in the Economic Regulation Authority's publication *Electricity, gas and water licences: application guideline and forms* (Economic Regulation Authority 2011).	Water service provider licence may be required, however proponent will apply for an exemption during detailed design stage. Further work will be undertaken at detailed design.
Preliminary costs and financial viability	Develop a broad understanding of likely costs for the system (cost-benefit analysis) including the preferred source, required treatment, storage and distribution infrastructure as well as future operating and capital costs, revenue sources and financial viability	Based on the community bore volume prediction per household (Table 2 in this LWMS / 84 houses), estimated ex-house use per lot is 45 kL/yr. The Water Corporation currently charges \$1.905/kL, equating to an annual total saving of \$86 per household irrigation. However, the overall reduction in potable demand in households would likely drop each household into a lower tier payment schedule with Water

Element	Requirement	Response
		Corporation. Link: **Understanding your water use charges - Water Corporation** Further cost analysis for the community bore will undertaken during detailed design stage.
Preliminary project risk assessment	Proponents are encouraged to meet with the approving agencies to undertake a preliminary evaluation of risks	Preliminary consultation has been undertaken with the City of Fremantle and DWER (licencing branch). In the next stages, further, more detailed liaison will be undertaken with the City and DWER. The Department of Health will be contacted, and the community if required.
Community acceptance	Identify the benefit to customers and whether the community would be likely to accept and use the non-drinking water supply	In addition to environmental benefit, there are specific benefits for customers including potential cost saving. Information about these benefits will be provided at the point of sale.
Overall environmental footprint	Identify impacts on ecological biodiversity, energy efficiency, water efficiency, and any other site-specific considerations.	The community bore will improve water efficiency at the site. The TAFE site has historically been irrigated via an existing groundwater production bore 15m deep (so in the superficial aquifer) – so no negative environmental impacts envisaged.

Appendix 7 TAFE Production Bore Log (1996)

WESTERN IRRIGATION

LEADERS IN WATER MANAGEMENT FOR OVER 25 YEARS

June 28, 1996

Transfield Maintenance Pty Ltd
GPO Box 2047
PALMYRA WA 6157

Our Ref: D27 : AOL4895.DOC

Attention: **Faults Co-ordinator**

Dear Sir,

J/N 154872A - FREMANTLE TAFE BORE

As part of the works involved in completing the above job, Western Irrigation has undertaken the construction of a replacement bore and pump installation at the above site. We enclose details of the replacement facility, including the bore log, test results and water analysis.

We recommend these records be maintained in an appropriate place, as they will be valuable for use during maintenance of the facility in the future.

If there are any queries regarding this information, please contact this office.

Yours faithfully,

WESTERN IRRIGATION PTY LTD

Andrew Ogden
Managing Director

Enclosure

WESTERN IRRIGATION PTY LTD ACN 065 952 230
19 Shields Crescent Booragoon WA 6154
Ph: (09) 330 1144 Fax: (09) 330 5630

WESTERN IRRIGATION

LEADERS IN WATER MANAGEMENT FOR OVER 25 YEARS

DRILLING REPORT

Driller	S. Chitty			**Commenced**	29/4/96
Assistant		**Bore No**	2	**Completed**	5/5/96
Driller's License		**Rig** Ruston			
Property Owner	Fremantle TAFE		**Location**	Grosvenor Street, Fremantle	

Depth of Stratas	**Metres**	**Description of Strata**	**Casing Inserted**		
Surface To	3	Orange sand		**Diameter of Bore**	155mm
	10	Soft limestone		**Static Water Level**	15.11m
	11	Very hard stone		**Pumping Level**	18.43m
	16	Soft limestone		**Supply L/s**	22.2
	17	Hard grey limestone		**Water Analysis**	
	25.5	Soft limestone		**pH**	7.2
	26	Hard limestone		**T.D.S**	700
	28	Soft limestone with hard layers.		**Na C1**	
				Fe. (Iron)	Nil
				Developing Hours	20
				Screen Length	6.0m
				Diameter	8" tele
				Aperture	0.5mm
				Testing Hours	10
				Depth of Packer	N/A
				Total Depth	28m
Remarks:				**Fittings etc:**	
Slotted casing Gravel Pack Chemicals, etc:					
Hours to Complete Boring:			**Signature:**		

WESTERN IRRIGATION PTY LTD ACN 065 952 230

19 Shields Crescent Booragoon WA 6154

Ph: (09) 330 1144 Fax: (09) 330 5630

WESTERN IRRIGATION
LEADERS IN WATER MANAGEMENT FOR OVER 25 YEARS

TEST PUMPING - BORE

Location:	Fremantle TAFE		
Date:	7/5/96	Work Docket No:	18998
Operator:	Jeff Scanlin		
SWL (m)	15.11	Total Depth (m)	
Packer (m)		I.D. (mm)	

Times (minutes)	Litres per second	Pumping Level (m)	Time (minutes)	Litres per second	Pumping Level
1	5.0	15.35	105		
2		15.35	120		
3		15.35	135		
4		15.36	150		
5		15.35	165		
6		15.36	180		
7		15.36	210		
8		15.36	240		
9		15.35	270		
10		15.35	300		
11		15.35	330		
12		15.36	360		
13		15.35	390		
14		15.35	420		
15		15.35	450		
30		15.36	480		
45		15.36	510		
60		15.36	540		
75			570		
90			600		

Comments:

Stage 1 of 5

WESTERN IRRIGATION

LEADERS IN WATER MANAGEMENT FOR OVER 25 YEARS

TEST PUMPING - BORE

Location:	Fremantle TAFE		
Date:	7/5/96	Work Docket No:	18998
Operator:	Jeff Scanlin		
SWL (m)	15.11	Total Depth (m)	
Packer (m)		I.D. (mm)	

Times (minutes)	Litres per second	Pumping Level (m)	Time (minutes)	Litres per second	Pumping Level
1	10.0	15.77	105	10	15.80
2		15.77	120		15.80
3		15.77	135		
4		15.77	150		
5		15.78	165		
6		15.77	180		
7		15.78	210		
8		15.78	240		
9		17.78	270		
10		15.78	300		
11		15.78	330		
12		15.78	360		
13		15.78	390		
14		15.78	420		
15		15.78	450		
30		15.80	480		
45		15.80	510		
60		15.80	540		
75		15.79	570		
90		15.80	600		

Comments: Stage 2 of 5

WESTERN IRRIGATION PTY LTD ACN 008 952 230
19 Shields Crescent Booragoon WA 6154
Ph: (09) 330 1144 Fax: (09) 330 5630

TEST PUMPING - BORE

Location:	Fremantle TAFE		
Date:	7/5/96	Work Docket No:	18998
Operator:	Jeff Scanlin		
SWL (m)	15.11	Total Depth (m)	
Packer (m)		I.D. (mm)	

Times (minutes)	Litres per second	Pumping Level (m)	Time (minutes)	Litres per second	Pumping Level
1	15.0	16.78	105	15.0	16.87
2		16.81	120		16.87
3		16.81	135		16.86
4		16.81	150		16.87
5		16.81	165		16.87
6		16.81	180		16.87
7		16.80	210		16.88
8		16.81	240		16.88
9		16.80	270		16.89
10		16.81	300		16.89
11		16.81	330		16.87
12		16.80	360		16.86
13		16.81	390		
14		16.81	420		
15		16.81	450		
30		16.81	480		
45		16.83	510		
60		16.84	540		
75		16.86	570		
90		16.87	600		

Comments:

Stage 3 of 5

WESTERN IRRIGATION PTY LTD ACN 008 952 230
19 Shields Crescent Booragoon WA 6154
Ph: (09) 330 1144 Fax: (09) 330 5630

WESTERN IRRIGATION
LEADERS IN WATER MANAGEMENT FOR OVER 25 YEARS

TEST PUMPING - BORE

Location:	Fremantle TAFE		
Date:	7/5/96	Work Docket No:	18998
Operator:	Jeff Scanlin		
SWL (m)	15.11	Total Depth (m)	
Packer (m)		I.D. (mm)	

Times (minutes)	Litres per second	Pumping Level (m)	Time (minutes)	Litres per second	Pumping Level
1	22.2	18.28	105		
2		18.29	120		
3		18.32	135		
4		18.35	150		
5		18.37	165		
6		18.38	180		
7		18.44	210		
8		18.46	240		
9		18.50	270		
10		18.46	300		
11		18.43	330		
12		18.42	360		
13		18.43	390		
14		18.43	420		
15		18.42	450		
30		18.44	480		
45			510		
60			540		
75			570		
90			600		

Comments:

Stage 4 of 5

WESTERN IRRIGATION PTY LTD ACN 065 952 230
19 Shields Crescent Booragoon WA 6154
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WESTERN IRRIGATION
LEADERS IN WATER MANAGEMENT FOR OVER 25 YEARS

TEST PUMPING - BORE

Location:	Fremantle TAFE		
Date:	7/5/96	Work Docket No:	18998
Operator:	Jeff Scanlin		
SWL (m)	15.11	Total Depth (m)	
Packer (m)		I.D. (mm)	

Times (minutes)	Litres per second	Pumping Level (m)	Time (minutes)	Litres per second	Pumping Level
1	0	15.17	105		
2		15.15	120		
3		15.15	135		
4		15.16	150		
5		15.14	165		
6		15.15	180		
7		15.15	210		
8		15.15	240		
9		15.14	270		
10		15.15	300		
11		15.15	330		
12		15.15	360		
13		15.15	390		
14		15.15	420		
15		15.14	450		
30		15.15	480		
45			510		
60			540		
75			570		
90			600		

Comments: Recovery

Stage 5 of 5

agro-nutritional research laboratory

Technical and Advisory Services
for Agriculture, Horticulture and
the Environment.

20 Baden Street, Osborne Park W.A. 6017
Phone / Fax: (09) 444 6247

Livestock Controls Pty. Ltd.
A.C.N. 008 744 250

RECEIVED 15 MAY 1996

THA:AC

14 May 1996

Western Irrigation
19 Shields Crescent
BOORAGOON WA 6154

Attn: Andrew Ogden

Dear Andrew,

Enclosed are the results of the analysis of the bore water sample from Fremantle Tafe which we received on the 13th May.

This water was colourless and odourless when we received it.

Also I should comment that the water was very warm when we received it. Thus obviously it had been sitting in the back of a warm or hot delivery van for some time.

The pH data shows the water is slightly alkaline in reaction. The electrical conductivity and the total salt data show the water has a moderate salinity. The bicarbonate, potential alkalinity and hardness are high. Thus this water will definitely have an alkaline effect on soils to which it's applied. The iron content is negligible. Thus there shouldn't be any iron stains problem. However the precipitation of carbonate salts is likely to occur where this water is allowed to evaporate. The free carbon dioxide content is low. This along with the alkalinity of the water indicate there should be little or no corrosion in the pumping system.

Yours sincerely,

Dr. T.H. Arkley

AGRO-NUTRITIONAL RESEARCH LABORATORY

20 Baden Street, Osborne Park WA 6017 Phone: 444 6247

Client WESTERN IRRIGATION

WATER ANALYSIS REPORT

Date 14.5.96 Lab No. WI 544

ORDER NO. 54011

Sample	FREMANTLE TAFE		
Colour and Odour	Colourless Odourless		
pH (acidity or alkalinity)	7.2		
Electrical conductivity ms/cm	1.15		
Total Dissolved Salts	700		
Sodium			
Potassium			
Calcium			
Magnesium			
Carbonate			
Bicarbonate	285		
Chloride			
Sulphate			
Nitrate			
Phosphate			
Boron			
Total Iron	nil		
Manganese			
Fluoride			
Hardness (as $CaCO_3$)	360		
Alkalinity (as $CaCO_3$)	235		
Dissolved Carbon Dioxide	29		
Sodium Absorption Ratio			

Concentrations reported as ppm (mg/L) unless otherwise stated.

WESTERN IRRIGATION

LEADERS IN WATER MANAGEMENT FOR OVER 25 YEARS

WD: 18998

INV: 45994

PUMP PERFORMANCE TEST

CLIENT:	Fremantle TAFE	PUMP SITE:	Western Irrigation Test Tank

PUMP DETAILS:		MOTOR DETAILS:	
Type:	Submersible	Type:	Submersible
Manufacturer:	Lowara	Manufacturer:	Franklin
Model:	630/9	Rated current (A):	24
No. stages:	9 S.T.G	Rated voltage (V):	380/415
Construction:	S/S	Construction:	S/S
Serial No.:		Serial No.:	
Nominal diameter:	6"	Nominal diameter:	6"
Checkvalve (Y/N):	Yes	Rated power (kW):	11kW

TEST RESULTS

Pressure (kPa)	Flow (L/s)	Current: (A)	Voltage: (V)	Comments:
100	11.80	21	430	
200	11.00	21		
300	10.25	21		
400	9.90	21		
500	9.46	21		
600	8.55	21		
700	7.54	21		
800	6.61	20		
1300	0	16		
PG7	T.T.0.1. 3"	Board 1	Board 1	<— TEST EQUIPMENT ID #:

Comments:

Tested By:	Glen Heffer	Signed:		Dated:	1/05/96

Reviewed by:	Jeff Sanders	Signed:		Dated:	1/05/96

WESTERN IRRIGATION
LEADERS IN WATER MANAGEMENT FOR OVER 25 YEARS

BORE AND PUMP TEST

Client:	Transfield Maintenance		
Location:	SMC Fremantle TAFE		
Bore Number:		Date:	9/5/96
Tested By:	Stephen Carey	Test Method:	Orifice
Pump Details:	Lowara G30/9 / Franklin 11kW		
Sand Produced:	None in 2 minutes at open flow		
Static Water Level (m):	14.95	High Pressure Setting (kPa):	700 - working 5 seconds delay
Low Pressure Setting (kPa)	50 - working 5 minutes delay	Low Level Cutout (m):	20 - working
Invoice No:	45994	Work Docket:	18998

Time	Pressure (kPa)	Flow (L/sec)	Pumping Level (m)	Drawdown (m)	Current (Amps)
Minutes					
Started					
5	0	11.40	15.34	0.39	20.00
7	100	10.85	15.31	0.36	20.00
9	200	10.35	15.29	0.34	20.00
11	300	9.68	15.26	0.31	20.25
13	400	8.93	15.21	0.26	20.00
15	500	8.20	15.17	0.22	20.00
17	600	7.23	15.13	0.18	19.75
19	700	5.91	15.08	0.13	18.25
21	800	4.54	15.03	0.08	17.50
23	900		15.00	0.05	16.50
24	1100	0			15.50

Comments:

WESTERN IRRIGATION PTY LTD ACN 055 962 230
19 Shields Crescent Booragoon WA 6154
Ph: (09) 330 1144 Fax: (09) 330 5630

Quality Endorsed Company

Appendix 8 Stormwater Modelling Report (Urbaqua, 2023)

APPENDIX 1 – HYDROLOGICAL MODELLING

This Appendix summarises the hydrologic and hydraulic model construction and parameterisation utilised for this study.

1.1 Predevelopment model construction and parameterisation

A 1-dimensional InfoWorks ICM model was constructed for the study area and adjacent contributing drainage catchments. This includes Badham Close, which drains to soakwells located on the western boundary of the site, and two Lefroy Road catchments. One of these (west of Fifth Avenue, including part of Caesar Street) drains to soakwells located on the southern boundary of the site whilst the other (east of Sea View Street, including part of Curedale Street) drains to the western sump within the study area.

1.1.1 Drainage network and subcatchment delineation

Prior to demolition, building roofs, carparks and other hardstand areas within the study area were connected to an onsite drainage system incorporating numerous soakwells and forming two large catchments, each draining to one of the two sumps located on site. For pre-development modelling purposes, two subcatchments have been defined within the study area discharging directly to the two sumps. Figure 1 shows the predevelopment model layout and modelled details of the two sumps are provided in Table 1, Figure 2, and Figure 3. Infiltration from the sumps is modelled as 5m/day.

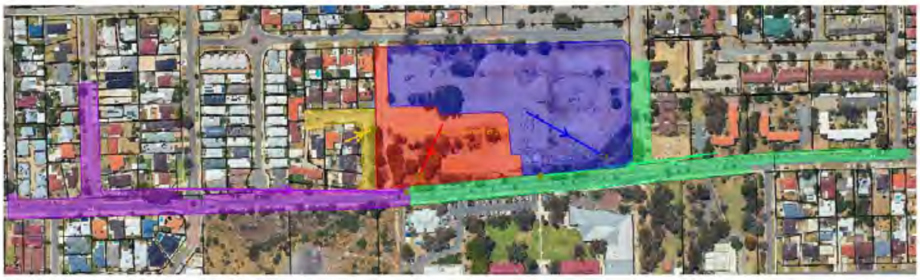

Figure 1: Predevelopment model layout

Table 1: Predevelopment sump modelled details

Location	Invert level (m AHD)	Top of bank level (m AHD)	Base area (m^2)	Top area (m^2)	Total volume (m^3)
Western sump	12	15.5	86	486	949
Eastern sump	12.5	14.5	174	705	848

1.1.2 Rainfall

Rainfall for design events were developed using *Australian Rainfall and Runoff* (ARR2019) and BoM (2016) IFD ensemble methodology resulting in an ensemble of 10 rainfall simulation events for each design storm. Ensembles were generated for 1EY, 20% and 1% AEP events of 10min, 20min, 30min, 1hr, 3hr, 6hr, 12hr, and 24hr durations.

	Level (m AD)	Area (m2)	Perimeter (m)
1	12.000	86.00	37.000
2	12.500	154.00	50.000
3	13.000	199.00	57.000
4	13.500	241.00	62.000
5	14.000	288.00	67.000
6	14.500	340.00	73.000
7	15.000	396.00	79.000
8	16.000	575.00	94.000
*			

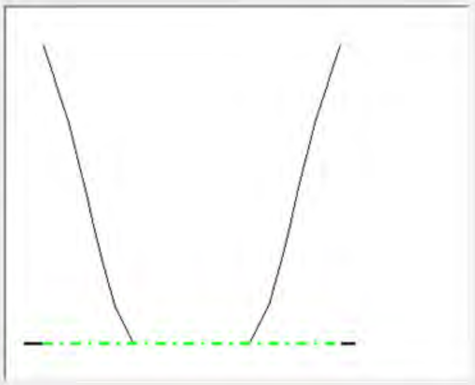

Figure 2: Western sump – modelled storage array

	Level (m AD)	Area (m2)	Perimeter (m)
1	12.500	174.00	75.000
2	13.000	310.00	77.000
3	13.500	419.00	91.000
4	14.000	540.00	105.000
5	15.000	870.00	130.000
*			

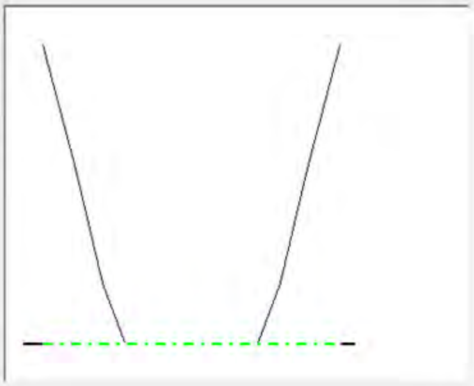

Figure 3: Eastern sump – modelled storage array

1.1.3 Runoff parameterisation

ARR2019 provides spatially distributed recommendations for initial and continuing loss rates for application in pervious areas of rural catchments. For this site, the recommended rates are:

- Initial loss – 37 mm
- Continuing loss – 2.9 mm/hr

ARR2019 also recommends that indirectly connected urban areas are allocated initial and continuing losses of 60-80% of rural rates and effective impervious areas are allocated initial losses of 1-2mm and zero continuing loss.

Effective impervious areas (EIA) account for roads, areas of standing surface water and roofs and hardstand areas of lots that are directly connected to a drainage system. Pervious areas of developed lots and road reserves and impervious areas connected to soakwells or otherwise disconnected from the drainage system are assigned as indirectly connected areas (ICA).

Subcatchments within the study area have been parameterised applying these rates and the study area is modelled as 100% ICA in the predevelopment model. A full summary of parameters applied in this study is presented in Table 2.

Table 2: Summary of model parameters

Parameter	Unit	
Catchment roughness (Manning's N)		
Rural pervious areas	-	0.040
Indirectly connected areas (ICA)	-	0.035
Effective impervious areas (EIA)	-	0.025
Hydraulic roughness (Manning's N)		
Vegetated open swales/drains	-	0.040
Culverts and piped drainage	-	0.015
Initial Loss		
Indirectly connected areas (ICA)	mm	28
Effective impervious areas (EIA)	mm	2
Continuing loss		
Indirectly connected areas (ICA)	mm/hr	2.9
Effective impervious areas (EIA)	mm/hr	0
Infiltration rate	m/day	5

1.2 Predevelopment model results

Following construction of the predevelopment model a full set of ensemble rainfall events were analysed for the 1EY, 20% AEP and 1%AEP to determine the event resulting in the median peak storage volume for each duration and the maximum of these was selected as the critical event for this study.

Table 3 presents peak volumes and top water levels for critical events at each on-site sump.

Table 3: Predevelopment model results

Location	1EY		20% AEP		1% AEP	
	Peak volume (m^3)	Top water level (m AHD)	Peak volume (m^3)	Top water level (m AHD)	Peak volume (m^3)	Top water level (m AHD)
Western Sump						
	150.9	13.0	243.8	13.5	1089	15.7
Eastern Sump						
	98.4	12.9	179.1	13.2	965.6	14.7
Critical duration						
	3 hour		*3 hour*		*6 hour*	

1.3 Post-development model construction and parameterisation

The model was updated to include proposed post-development land uses using InfoWorks ICM based on the proposed concept plan.

1.3.1 Drainage network and subcatchment delineation.

The post-development drainage network consists of roadside swales where space permits and a limited extent of piped drainage. The study area continues to form two catchments draining to storage provided at each of the previous sump locations as shown in Figure 4. These catchments consist of 19 individual subcatchments as shown in Figure 5 which also shows the locations of roadside swales and permeable paving.

Figure 4: Post development model layout

Figure 5: Post development study area layout

The two former sumps are proposed to be redeveloped as underground storage systems. The eastern storage contains rainfall events up to and including the critical 1% ARP event underground. The western storage contains rainfall events up to and including the critical 20% AEP event underground, with additional above-ground storage provided for major events.

Table 4, Figure 6, and Figure 7 provides design information for the two modelled storage systems. Infiltration from roadside swales and storage areas is modelled as 5m/day.

Table 4: Post-development storage system modelled details

Location	Invert level (m AHD)	Top of bank level (m AHD)	Base area (m^2)	Top area (m^2)	Total volume (m^3)
Western storage					
Underground	12	(2m deep)	500	500	1000
Above ground	15	15.5	396	486	221
Eastern storage					
Underground	12.5	(1.5m deep)	500	500	750

1.3.2 Runoff parameterisation

Post-development areas are parameterised consistent with the predevelopment model including urban lots with soakwells (100% ICA), road reserves (70% EIA, 30% ICA), permeable paving (100% ICA) and public open space (100% ICA).

	Level (m AD)	Area (m2)	Perimeter (m)
1	12.000	500.00	90.000
2	12.500	500.00	90.000
3	13.000	500.00	90.000
4	13.500	500.00	90.000
5	13.999	500.00	90.000
6	14.000	1.50	4.000
7	14.999	1.50	4.000
8	15.000	396.00	79.000
9	16.000	575.00	94.000
*			

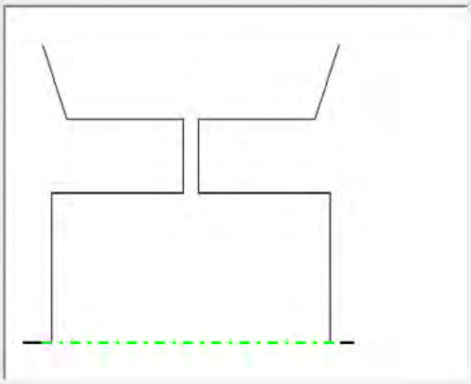

Figure 6: Western storage – modelled storage array

	Level (m AD)	Area (m2)	Perimeter (m)
1	12.500	500.00	120.000
2	13.000	500.00	120.000
3	13.500	500.00	120.000
4	14.000	500.00	120.000
5	14.100	1.50	4.000
6	14.500	1.50	4.000
7	15.000	870.00	130.000
*			

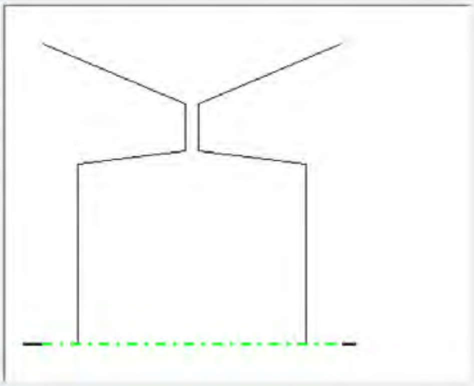

Figure 7: Eastern storage – modelled storage array

1.4 Model results

Table 5 provides a summary peak volumes and top water levels for critical events at each post-development storage system. Additional online storage has been included in this modelling to address minor flooding in the 1% AEP event, predicted at both sumps in predevelopment modelling.

All rainfall events are fully contained underground within the eastern storage. There is a small amount of storage contained above ground in the western storage to a maximum depth of 0.5m.

Table 5: Post-development model results

Location	1EY		20% AEP		1% AEP	
	Peak volume (m^3)	Top water level (m AHD)	Peak volume (m^3)	Top water level (m AHD)	Peak volume (m^3)	Top water level (m AHD)
Western Storage						
Underground	166	12.4	343	12.7	1000	14
Above ground	-	-	-	-	177	15.4
Eastern Storage						
Underground	85	12.7	214	12.9	749	14
Critical duration						
	3 hour		*3 hour*		*6 hour*	

urbaqua
land and water solutions

Client: Development WA

Report	Version	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
Preliminary draft	V1	RMu/REp	REp	Electronic	May 2023

Urbaqua
land & water solutions
Suite 4/226 Carr Place
p: 08 9328 4663 | f: 08 6316 1431
e: info@urbaqua.org.au
www.urbaqua.org.au

Appendix E

Servicing Report - Pritchard Francis

Beaconsfield TAFE

Lot 2680 Grosvenor Street, Beaconsfield

Engineering Servicing Report

Project No: 22-347

Table of Contents

Appendix One:	Concept Plan by Taylor Burrell Barnett
Appendix Two:	Galt Geotechnics Final Geotechnical Report
Appendix Three:	Feature Survey
Appendix Four:	Contamination Risk Review
Appendix Five:	Water Corporation Sewer Infrastructure
Appendix Six:	Water Corporation Water Infrastructure
Appendix Seven:	Existing Stormwater Infrastructure
Appendix Eight:	City of Fremantle Stormwater Requirements
Appendix Nine:	3E Western Power DIP Scope Plan
Appendix Ten:	Western Power Infrastructure
Appendix Eleven:	Communications Infrastructure
Appendix Twelve:	Pritchard Francis Civil Servicing Concept Plan
Appendix Thirteen:	PJA Traffic Impact Assessment

Revision	Description	Author	Date
A	Issued for Local Structure Plan	Brianna Newnham	6 April 2023
B	Revised with Preliminary Geotechnical Advice	Brianna Newnham	12 May 2023
C	Revised with Final Geotechnical Advice	Brianna Newnham	26 May 2023

1 Introduction

1.1 General

Pritchard Francis has been engaged by DevelopmentWA to prepare this engineering services report to supplement the Local Structure Plan (planning) submission. The purpose of this report is to identify existing site conditions, existing services and potential upgrades required to facilitate the proposed subdivision for single and multi-residential sites on Lot 2680 Grosvenor Street, Beaconsfield.

The development area is located within the City of Fremantle and is bordered by Grosvenor Street on the northern boundary, Caesar Street on the eastern boundary, Lefroy Road on the southern boundary and Badham Close to the west. Figure 1 below depicts an aerial photograph of the area. The concept plan by Taylor Burrell Barnett has been included in Appendix One.

Figure 1 – Aerial Photograph of Proposed Development Site (January 2023)

This report outlines the capacity of existing utilities to service the residential development. The services under assessment are:

- Water and Sewer Reticulation (Water Corporation WA)
- Drainage (City of Fremantle)
- Power (Western Power)
- Communications (Telstra, NBN, Optus)

In addition to a utility service capacity assessment, the report also covers geology and preliminary earthworks advice for the redevelopment. Note that gas is not proposed to be utilised by this development.

1.2 Report Qualifications

In line with this report, Pritchard Francis make the following qualifications:

- This report was prepared exclusively for DevelopmentWA. Unless otherwise stated, the use of this report by third parties is not permitted.
- The information provided in this report may be considered valid for three (3) months from the date of the report.
- The information provided in this report is based upon the information and documentation provided by the client / architect / developer. Pritchard Francis have relied on such information and documents being true. Where we are uninformed of developments outside of this report, Pritchard Francis cannot be held responsible or liable for any problems or issues that may arise as a consequence.
- Assumptions have been made which, if incorrect, have the potential to impact the recommendations of this report. Major development implications existing through avenues which cannot be assured at the time of this report, including the upgrading and provision of utility services, WAPC Conditions, DA Conditions, Local Authority Scheme Requirements, timing of adjacent developments, etc.
- Unless otherwise stated, the capacities of existing services have not been verified via calculations. Where required, specialty consultants may need to be engaged to provide accurate assessments of existing and future servicing capacities.
- The civil designs presented in this report are conceptual in nature, and by no means depict the ultimate design solution. Detail design and documentation will be necessary to validate all design levels and gradients to ensure compliant with the client brief, Australian Standards, Austroads and relevant authority guidelines.
- Where design is carried out by third parties using information provided by Pritchard Francis, it is recommended that Pritchard Francis be engaged or involved in the design process.
- The geotechnical investigation is an interpretive report of the geotechnical site conditions and will be limited by the extents and quantity of the test pits, hand augers, and CPTs completed across the site. The geotechnical report provides a site assessment only at those points where and when samples were taken. The data derived by sampling and subsequent laboratory testing was interpreted by engineers and scientists to provide an opinion about the overall site conditions, their impact on the proposed development, and recommended remedial actions. The actual site conditions may differ to those inferred as abrupt changes in the site conditions can occur.

2 Information Sources

The table below outlines the background information provided to Pritchard Francis at the time of the report.

Description of Data	Obtained From	Date
Contamination Risk Review	Emerge Associates	20 June 2019
Heritage Assessment	Griffiths Architects	March 2020
Stage 1 Arboriculture Dilapidation Report	The Arbor Centre Consultancy	April 2020
Feature Survey	McMullen Nolan Group Pty Ltd	24 May 2022
Existing Tree Analysis	Realm Studios	24 May 2022
Stormwater Drainage As Cons	City of Fremantle	30 May 2022
Dial Before You Dig	Before You Dig Australia	29 June 2022
Water Corporation Data	Water Corporation	14 July 2022
Aerial Image	Metro Maps	14 July 2022
1:50,000 Geology Mapping Series	Department of Mines, Industry Regulation & Safety	14 July 2022
Groundwater Data	Department of Water & Environmental Regulation	18 July 2022
Bushfire Prone Areas Mapping	Department of Fire and Emergency Services	18 July 2022
Floodplain Mapping	Department of Water and Environmental Regulation	18 July 2022
Concept Plan	Taylor Burrell Barnett	13 February 2023
Traffic Impact Assessment	PJA	24 March 2023
Preliminary Geotechnical Site Findings	Merit	24 March 2023
Preliminary Geotechnical Report	Galt Geotechnics	12 May 2023
Final Geotechnical Report	Galt Geotechnics	26 May 2023

3 Site Conditions

The former Challenger TAFE campus of 54 years has been demolished as part of a forward works package and will be redeveloped. The site is bound by roads on all boundaries except the interface against existing houses in the north-western corner and contains two drainage sumps and significant level changes in the order of 4m across the site.

3.1 Geotechnical Investigation

A geotechnical investigation of the site has been completed by Galt Geotechnics, and results have been published in their report WAG220004-01 003 R Rev1, dated 26 May 2023 which has been attached within Appendix Two.

Based on the field investigation results, subsurface conditions across the site can be generalised as follows:

- SAND/Silty SAND/Gravelly SAND: including site-derived fill. Typically sand with variable amounts of limestone as gravel and cobbles, with non-plastic fines. Thickness is variable; overlying
- TAMALA LIMESTONE: fine to coarse grained, pale yellow, some typically sub horizontal or up to about 30° bedding, some vugs, defects are typically partings and some seams at about 20 mm to 200 mm spacing, Limestone is inferred from refusal at test pit and CPT locations.

These results are in accordance with geological mapping published in the 1:50,000 scale Environmental Geology Series Map for Fremantle. The sand is typically medium-dense to dense. The CPTs indicate that loose sand is present in some locations to around 1 m depth. The key geotechnical issues at this site are:

<u>Variable Sand/Limestone Conditions</u>

The surface of any limestone layer is likely to be highly variable over short spatial extents, varying between sand and limestone. This will have influences on:

- Drainage (well cemented limestone areas may not drain well)
- Excavatability (well cemented limestone will be difficult to excavate)
- General constructability (due to variation in materials)
- Foundation variability below buildings (hard and soft foundation areas leading to irregular settlements).

<u>Sand with High Gravel and Fines</u>

The sandy soils at the site have high gravel (typically >15%) and high fines contents (>5%), which means that:

- Compaction control of these materials should be done using an NDG. A PSP will not be suitable for compaction control. Method specifications may be developed if appropriate.
- Once compacted, pockets of the material with high fines may form a tight matrix that has a reduced permeability when compared to the surrounding material.

Infiltration testing was conducted, and results varied across the site based on the subsurface conditions uncovered. Galt recommend the below design infiltration rates (k) and site preparation for various stormwater drainage methods:

- Large drainage areas such as drainage cells and interconnected soakwells:
  - k = 5m/day
  - Over-excavate/rip limestone (as required) to achieve a minimum of 0.6 m of soil or ripped limestone (sand/gravel i.e., no solid limestone) below the base of any proposed drainage infrastructure.
- Single drainage items such as single soakwells:
  - k = 3m/day
  - Over-excavated/rip limestone (as required) to achieve a minimum 0.6 m of soil (sand/gravel i.e., no solid limestone) below the base of any proposed soakwell.
- Finished surfaces requiring good drainage:
  - Rip the limestone to ~1 m below finished surface levels (we anticipate that at least ~0.4 m of soil will be replaced above, therefore this is likely to require ripping to ~0.6 m below the exposed limestone surface).

Galt Geotechnics suggests the site classification of 'Class A' in accordance with AS 2870–2011 provided that normal site preparation is undertaken prior to construction.

Excavations in areas where limestone is present will require ripping equipment, large excavators with toothed rock buckets, a rock pick or a hydraulic rock breaker, or a combination of techniques. This methodology will be required in excavating the sewer trench in the north-eastern corner of the development, where the sewer run is proposed at several metres deep.

The design parameters recommended in the geotechnical report will be implemented in the design of the foundations.

The geotechnical investigation is an interpretative report of the geotechnical site conditions and will be limited by the extents and quantity of the test pits, hand augers and CPTs completed across the site. The geotechnical report provides a site assessment only at those points where and when samples were taken. The data derived by sampling and subsequent laboratory testing was interpreted by engineers and scientists to provide an opinion about the overall site conditions, their impact on the proposed development and recommended remedial actions. The actual site conditions may differ to those inferred as abrupt changes in the site conditions can occur.

3.2 Topography and Feature Survey

Pritchard Francis have utilised the feature survey data undertaken by MNG Survey, undertaken prior to the site's demolition. A copy of this survey can be found in Appendix Three.

The site originally hosting 13 existing buildings totalling 12,660m² over a site area of 38,188m² has been demolished. The majority of the remaining site area was asphalt pavement, forming carparks and driveways, and isolated patches of sand and dirt with many mature trees and shrubs.

The existing contour levels are in the order of:

- RL 21.17 AHD at the north-western entry off Grosvenor Street, falling to RL 19.32 AHD in the southwestern corner at Lefroy Street.
- There is an existing basin in the south-western portion of the site, approximately 563m², at RL 17.80 AHD around the edges, to RL 11.72 AHD at the centre of the basin. The base of the basin is approximately 130m², the sides batter down over 8m to 12m around the extents.
- RL 19.32 AHD in the south-western portion, to RL 19.13 AHD along Lefroy Street to the south-eastern corner. Before the corner of the site batters down to another basin with a base RL of 12.50 AHD, over 294m². This batter extends 170m around the corner of the site, totalling an area of 1,989m².
- RL 15.00 AHD at the corner of Caesar Street and Lefroy Street increasing to RL 19.61 AHD at the corner of Caesar Street and Grosvenor Street.
- RL 19.61 AHD increasing to RL 21.11 AHD on the northern boundary along Grosvenor Street.
- Spot levels around majority of the site range from RL 19.10 AHD to RL 19.79 AHD, excluding the path area inside the U-shaped building block in the south-western portion of the site, where levels are in the order of RL 15.24 AHD.

An updated feature survey of the now demolished site will be undertaken to establish the internal site levels.

3.3 Acid Sulphate Conditions

Acid Sulphate Soils (ASS) are naturally occurring soils that contain iron sulphide minerals and are benign in undisturbed states below the water table. When the soils are excavated or exposed to air, the sulphides react with oxygen to form sulphuric acid. Care and treatment must be undertaken when carrying out construction in areas with ASS.

The Department of Water and Environment Regulation's (DWER) mapping series indicates that the entire site is in an area of low to no risk of actual ASS and potential ASS occurring at depths greater than 3m of the soil profile.

Acid Sulphate Soils are not a risk to the development.

3.4 Groundwater

The Department of Water and Environment Regulation (DWER) indicate that groundwater is likely to be encountered at RL 1.00 AHD within the development site, well below the existing natural surface level of RL 15.00-20.00m AHD.

Groundwater levels are not a risk to the development.

3.5 Environmental Impacts of Historical Use

Emerge Associates completed a Contamination Risk Review of the development site prior to the building demolition stage, this review has been included in Appendix Four. The main findings from the review state:

- Emerge recommend that a more detailed soil investigation is undertaken following the demolition of buildings to obtain a more detailed understanding of residual pesticide concentrations.
- Impacts to groundwater are not considered to be an issue at present from the reported pesticide residues in soil given that they are present in soil beneath the building footprints and are not exposed to rainfall and leaching mechanisms.

The remnant impact of organochlorine pesticides (OCP's), that were applied legally in the past is being managed by DevelopmentWA. The DWER process will ensure the site is validated and no notification will be left on the development titles as the material would be remediated, allowing unrestricted use.

3.6 Bushfire Risk

The Department of Fire and Emergency Services (DFES) bushfire risk mapping indicates that no sites within the development area are located within a bushfire prone area.

4 Infrastructure

4.1 Sewer

The Water Corporation Esinet data indicates that the development area is located adjacent to the following sewer reticulation mains:

- Ø150mm existing asbestos cement (AC) sewer gravity pipe located 1m inside the western boundary of Lot 2680 from Grosvenor Street to Badham Close, approximately 2m to 5m deep. Note that an easement will be present over this asset, located 5.0m centrally over the asset. This easement will extend 3.5m into Lot 2680. This gravity pipe connects to a manhole each on Grosvenor Street and Badham Close, and the remaining sewer network extending west, away from the site.
- Ø150mm existing asbestos cement (AC) sewer gravity pipe located in the western verge of Badham Close.
- Ø50mm unplasticized polyvinyl chloride (PVC-U) private sewer pressure main located in the southern verge of Lefroy Road, servicing the Lefroy Road Child Care Centre.
- Ø510mm existing reinforced concrete (RC) sewer pressure main, the Mt Pleasant line, located in the western verge of Caesar Street.
- Ø610mm existing reinforced concrete (RC) sewer pressure main, the Mt Pleasant Duplication, located in the western verge of Caesar Street.
- Ø230mm existing vitrified clay (VC) private pressure main located in the western verge of Caesar Street servicing the South Fremantle High School.
- Ø230mm existing vitrified clay (VC) sewer gravity pipe located in the eastern verge of Caesar Street.

It is anticipated an extension off the existing Ø150mm AC gravity pipe will be required to service the first block of single residential lots facing Grosvenor Street to the west. The southern side of this block, lots 79 - 82, group housing sites lot 83, and the internal block between Grosvenor Street and the Public Open Space, lots 69 to 74, will be serviced by an extension off the existing Ø150mm AC sewer in Badham Close. A Ø150mm extension west into Grosvenor Street off the existing Ø230mm VC reticulation main in Caesar Street will service the remaining lots across the development from the internal roads, including lots 1, 2, 26 and 27 fronting Caesar Street, to be serviced off Caesar Street. The two eastern blocks adjacent Caesar Street will be serviced at the rear from the internal laneway, lots 3 to 11 and 17 to 25.

Due to the split-level arrangement proposed for lot 84, the lower-level fronting Lefroy Road will be serviced by a wastewater pump station. The split-level arrangement required for lots 12 to 16 to tie these lots to the internal road level, and the Public Open Space level fronting Lefroy Road, the lower split portion of the lots cannot be serviced by sewer.

Refer to Appendix Five which contains a plan of the existing sewer infrastructure.

4.2 Water

The Water Corporation Esinet data indicates that the development area is located in proximity to the following water reticulation mains:

- Ø150mm reinforced concrete (RC) main located in the eastern verge of Caesar Street.
- Ø100mm reinforced concrete (RC) main located in the northern verge of Lefroy Road.
- Ø50mm copper (CU) main located in the western verge of Badham Close.
- Ø100mm cast iron (CI) main located in the northern verge of Grosvenor Street.

Pritchard Francis anticipate that the site will be serviced from the existing Ø100mm CI main in Grosvenor Street, the Ø150mm RC main in Caesar Street, and the Ø50mm CU main in Badham Close. An extension and upgrade of the Ø100mm main in Grosvenor Street to a Ø 150mm main will connect to the Ø150mm main in Caesar, this extension will service the development from the north, and eventually connecting into the Ø50mm CU main in Badham Close. The upgrade of the service to a Ø150mm main is recommended by Pritchard Francis and the Water Corporation to ensure the provision of fire services capacity for the development. Micro tunnelling of the water main from the western end of Grosvenor Street will also be required to avoid existing above ground services and to protect trees.

Refer to Appendix Six which contains a plan of the existing water infrastructure.

4.3 Wet Fire Services

As detailed in 4.2 Water Reticulation, Pritchard Francis has allowed provision in the local network to future proof where Fire Services can come directly off the upgraded Ø150mm Water Corporation main in Grosvenor Street. Fire Services would need to be installed in accordance with NCC 2022, and hydrants and valves spaced in accordance with Water Corporation standards. Hydraulics consultant TJ Peach & Associates has completed additional pressure testing of the neighbouring network to assist in providing for performance-based solutions to future purchasers and builders.

4.4 Stormwater Drainage

4.4.1 City of Fremantle Drainage Infrastructure

The City of Fremantle stormwater drainage data indicates that the residential development area is located in proximity to the following stormwater assets:

- 420m² drainage sump in the south-eastern corner of the development site.
- 565m² drainage sump in the south-western corner of the development site.
- Two Council stormwater pipes of unknown size from the southern verge of Lefroy Road discharging into the 565m² drainage sump.
- Various Council stormwater pipes surrounding the development site of unknown size, material, and invert levels.

Pritchard Francis anticipate that drainage swales running alongside most internal roads (i.e., not laneways), connected to a pit and pipe network, and underground detention devices will be required to cater for the residential development. Overland flow paths catering for rainfall events larger than the City of Fremantle minimum requirements will be provided, discharging west towards the existing drainage sump within the Public Open Space. Also flowing east towards the second Public Open Space, where it is proposed to upgrade the existing drainage sump with underground detention devices to maximise the storage and infiltration potential. This is also an option for the existing drainage sump in the eastern Public Open Space.

Refer to Appendix Seven which contains a plan of the existing stormwater infrastructure.

4.4.2 City of Fremantle Drainage Requirements

A drainage swale (treatment train) running much of the length of the internal road network will attenuate overland flow off the roads and allow infiltration to occur. Pritchard Francis also expect storage under roads via soakwells or GRAF cells will be required to capture all discharge from the road reserve. The existing drainage sumps in the south-western and south-eastern corners of the site will remain functional and serve as overflow points for the road discharge, and external catchments these sumps already serve. Pritchard Francis propose these sumps to be augmented for better functionality and integrated into the Public Open Space arrangements.

Pritchard Francis anticipates that stormwater drainage for this site will be retained on site and infiltrated via localised soakwells within the boundaries of each residential development as per the City of Fremantle stormwater requirements (see Appendix Eight).

4.5 Power

A Dial Before You Dig investigation indicates there is existing power infrastructure within the vicinity of the proposed development as below:

- High Voltage main (overhead) located within the eastern verge of Caesar Street.
- High Voltage main (overhead) located within the northern verge of Lefroy Road.
- Low Voltage main (overhead) located within the eastern verge of Caesar Street.
- Low Voltage main (overhead) located within the northern verge of Lefroy Road.
- Low Voltage main (overhead) located within the northern verge of Grosvenor Road.
- Low Voltage main (overhead) located within the western verge of Badham Close.
- High Voltage main (underground) located within the northern verge of Lefroy Road.
- Low Voltage main (underground) located within the northern verge of Lefroy Road.
- Streetlighting located within the Lefroy Road, Caesar Street and Grosvenor Street road reserves.

Based on the Western Power maximum demand (DADMD) calculator, it is anticipated that the maximum demand per green title dwelling will be 3.1 kVA, and the maximum demand per multi-residential lot will be 4.7kVa.

The Western Power Network Capacity Mapping Tool indicates that the land development area is fed by the Edmund Street Amherst substation. The remaining capacity on the network is between 15-20 MVA.

The Beaconsfield TAFE site had power provision for 2 x 500 MVA, the proposed development will require less than the demand of the site when it was operating previously as the Challenger TAFE facility. Therefore, there is adequate power provision for the site.

3E Consulting Engineers have provided a preliminary power scope for the development outlining the existing infrastructure, the following is to be investigated further:

- Extent of overhead power removal, termination pole and anchor wire locations to the surrounds of the development,
- Substation locations,
- Dual HV networks and physical locations along Lefroy Road
- Finalised total yield,
- Group housing site servicing strategy, either:
  - Western Power minimum for WAPC clearance to sell sites, or
  - Likely site physical connection ratings, or
  - Likely site physical connection ratings plus an electric vehicle charging allowance.

It is likely that two substations will be required to service the development, with the aspiration of undergrounding the existing overhead power network along Lefroy Road.

The 3E power DIP scope plan has been provided within Appendix Nine. The existing power infrastructure data has been provided within Appendix Ten.

4.6 Communications

A Dial Before You Dig investigation indicates that there is existing communications infrastructure within the vicinity of the proposed development as below:

- P50mm NBN conduit running north-south down the western boundary of Lot 2680 connecting a pit on Grosvenor Street with Badham Close.
- P35mm NBN conduit and associated pits forming a lot connection from Grosvenor Street.
- Various type 2, B and C NBN pits located within Lot 2680.
- P35mm NBN conduit in the eastern verge of Caesar Street.
- Various Telstra communications cable and pit network which serviced the original TAFE buildings. There are optic fibre cables present within this network.

There is sufficient communications infrastructure surrounding the site to service the development. The communications infrastructure data has been provided within Appendix Eleven.

5 Site Levels and Retaining / Bulk Earthworks Methodology

The design strategy for this development will take into consideration the existing levels, tree retention and use of built form to tie into the existing environment.

Pritchard Francis intend to implement a split lot level into the group housing sites, allowing the lot to accommodate at least a storey (i.e., 3m) level difference between Lefroy Road at approximately RL 15.20m AHD and the internal network at approximately RL 18.40m AHD. This will allow the 3m difference to be absorbed by the structure in built form, reducing the need for significant import of fill and heavy use of retaining walls, while thereby minimising the effect on the adjacent neighbours as much as possible. The Public Open Spaces will also absorb any level differences, and the existing south-western and south-eastern drainage sumps will be retained and blended into the landscaping.

A split lot level concept may also be adopted for the block of single residential lots (lots 12 to 16) on the corner of Lefroy Road and Caesar Street, where the 2m level difference can be absorbed through built form, allowing the lots to be accessed from the south-eastern Public Open Space as well. Additionally, the south-eastern portion of the block of lots fronting Caesar Street, lots 8 to 11, and the centrally located lots facing Grosvenor Street, lots 35 to 40 and 55 to 57, will require staircases to access the lots from the road reserve to tie into internal road levels, where garage access is provided internally.

Lot levels will be designed to minimise retaining walls where possible. Adjacent lots will be stepped in one or two brick courses, to reduce costs of retaining, and limestone mass retaining walls will only be implemented where necessary.

Given the presence of solid limestone within the north-eastern portion of the development site, Pritchard Francis expect to achieve a minimum Class "A" site, the affected area may have to be over-excavated by 1m to remove limestone, and 1m of inert sand fill balanced by cut/fill or imported. The necessary treatment will be confirmed within the detailed geotechnical investigation.

The Civil Servicing Concept produced by Pritchard Francis is included in Appendix Twelve.

6 Traffic Impact Assessment

A Traffic Impact Assessment was undertaken by PJA to determine the extents of traffic generated pre and post development, and whether any alterations to the existing surrounding road network to cater for changes in trips generated are required.

PJA determined that the expected vehicle trips generated by the proposed development yield of 82 single residential dwellings and 90 unit type dwellings (maximum 110 unit type dwellings is possible between the two group housing sites), is approximately 930 trips per day, which is significantly less than the assessed traffic generation of the previous TAFE use of the site, at approximately 1,750 trips per day.

PJA has assessed that the maximum anticipated two-way trips within the site is 50 vehicles in the peak hours and given that the internal roads in the development would not carry more than 500 vehicles per day, it is acceptable that the properties fronting existing roads are accessed directly from the roads. Furthermore, it is considered these low levels of traffic would not make it difficult for pedestrians ands cyclists to cross the internal roads throughout the development.

PJA have concluded the Beaconsfield TAFE development will not trigger the need for any upgrades to external roads or intersections. PJA found the addition of a possible direct property access to the proposed apartment site on Lefroy Road can operate satisfactory, with minimum disruption to the Lefroy Road traffic flows, and could be allowed if so desired.

See Appendix Thirteen for PJA's Traffic Impact Assessment.

7 Conclusion

This report outlines the geotechnical conditions, existing road reserves, and services supporting the proposed Beaconsfield TAFE development at Lot 2680 Grosvenor Street, Beaconsfield. After preliminary geological mapping investigations, the site is founded on sand and limestone, and is therefore geotechnically suitable for development. A geotechnical investigation will be required to determine the site remediation and preparation required to achieve a Class A site classification.

Pritchard Francis confirm that based on the Dial Before You Dig data and as constructed information provided by utility providers, the site is accessible and can be serviced with water, sewer, stormwater drainage, electrical and communications infrastructure, and that additional service support will be required when demand increases as a result of the proposed development and to support the development layout. A Traffic Impact Assessment conducted by PJA confirms that the demand of the proposed redevelopment will be absorbed into the existing road network without any upgrades.

Appendices

Appendix One:	Concept Plan by Taylor Burrell Barnett
Appendix Two:	Galt Geotechnics Final Geotechnical Report
Appendix Three:	Feature Survey
Appendix Four:	Contamination Risk Review
Appendix Five:	Water Corporation Sewer Infrastructure
Appendix Six:	Water Corporation Water Infrastructure
Appendix Seven:	Existing Stormwater Infrastructure
Appendix Eight:	City of Fremantle Stormwater Requirements
Appendix Nine:	3E Western Power DIP Scope Plan
Appendix Ten:	Western Power Infrastructure
Appendix Eleven:	Communications Infrastructure
Appendix Twelve:	Pritchard Francis Civil Servicing Concept Plan
Appendix Thirteen:	PJA Traffic Impact Assessment

Appendix One: Concept Plan by Taylor Burrell Barnett

LOT SUMMARY

LOT YIELD			LOT AREA	
Size	No.	%	Average	% of Total Area
120m² - 159m²	6	7.32%	138m²	5.02%
160m² - 179m²	35	42.68%	168m²	35.79%
180m² - 234m²	25	30.49%	196m²	29.67%
235m² - 319m²	14	17.07%	290m²	24.62%
320m² - 440m²	2	2.44%	404m²	4.89%
Number of Lots	82			
Minimum Lot Size 133m² Maximum Lot Size 422m²			Average Lot Size 201m² Total Lot Area 16519m²	
GD/MD Lot	2			
Total Number of Lots	84			

Legend

- Total Application Area (3.8192ha)
- Tree to be considered for retention in public realm
- Other existing tree

Land Use Summary

Residential Lots	2.2998ha (60%)
Road Reserve	0.9090ha (24%)
POS and Drainage	0.6104ha (16%)

Subdivision Concept Plan - Option G

LOT 2680 GROSVENOR STREET, BEACONSFIELD

A DevelopmentWA Project

DRAFT

scale 1:1000@A3 | 1:500@A1

0 10 20m

plan 22/036/017A

date 23/01/2023

Taylor Burrell Barnett Town Planning & Design
Level 7, 160 St Georges Terrace, Perth WA 6000
e: admin@tbbplanning.com.au
p: (08) 9226 4276

Taylor Burrell Barnett

Appendix Two: Galt Geotechnics Final Geotechnical Report

Report on

GEOTECHNICAL STUDY
PROPOSED SUBDIVISION
15 GROSVENOR STREET, BEACONSFIELD

Submitted to:
Pritchard Francis
Level 1, 430 Roberts Street
SUBIACO WA 6008

www.galtgeo.com.au
50 Edward Street
OSBORNE PARK WA 6017
T: +61 (8) 6272-0200

WAG220004-01 003 R Rev1

26 May 2023

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FIGURES

APPENDICES

1. INTRODUCTION

This revised report presents the outcomes of Galt Geotechnics Pty Ltd's (Galt's) geotechnical study for the proposed development at 15 Grosvenor Street, Beaconsfield ("the site"). The location of the site relative to the surrounding area is shown on Figure 1, Site and Location Plan.

This revision incorporates the results of borehole drilling undertaken at the site.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

Based on the supplied information, the site is approximately 3.8 ha in plan area and rectangular in shape. Publicly available contour mapping shows the site surface level varies from around RL 10 m to RL 24 m AHD.

The site was previously occupied by a TAFE that has since been demolished. The site is clearly a former hill that was levelled (primarily in the north/northeast of the site) to produce level areas for construction of the former TAFE buildings. As such, there are higher and lower areas across the site. The fill areas (predominantly in the south of the site) appear to comprise site-derived sand/limestone rubble mix.

Details of the proposed development are limited, however we understand that the immediate work will be to undertake earthworks and civil works to prepare the site for future developments (likely to be mixed use and residential developments, with single residential, group housing and possibly including low-rise buildings).

Preliminary supplied drawings for the proposed development are presented in Appendix A.

3. PROJECT OBJECTIVES

The objectives of the study were to provide:

- Guidance on preparation of soil under pavements, roads and car parking areas, including design CBR.
- Design parameters for retaining structures and batter slopes.
- Design parameters for shallow foundations (strip and pad footings) including allowable bearing pressures and settlement estimates
- Site classification to AS 2870 (and recommendations for those two super-lots 3-4 storey)
- Earthquake site soil class to AS 1170.4.
- Subsurface soil condition, soil properties, and comment on optimum finished ground level and how it may influence the design and construction of foundations.
- Guidance for on site storm water disposal by infiltration including design permeability rates (based on areas of absolute limestone)
- Site preparation/compaction/reuse of in situ soil
- Possible presence of rock/limestone (in certain areas)
- Specify remediation work required to ensure that the site will have a site classification of A.
- Assess the suitability of excavated material for reuse as fill.
- Recommend the required site preparation and specifications for filling the site including the building pads, roads and car parks.
- Any other information deemed necessary for design of given structure.

4. FIELDWORK

4.1 Details

Fieldwork was carried out on 27 April 2023 and 15 May 2023 by a geotechnical engineer from Galt. Photographs of the site taken during the fieldwork are presented in Appendix B. The testing carried out during the fieldwork is summarised below:

Table 1: Fieldwork Summary

Test Type	Number	Locations	Depth Range (m)	Details/Results
Cone Penetration Tests (CPTs)	12	CPT01-CPT12	0.8-5.5	Appendix C
Test Pits	10	TP01-TP10	0.4-3.0	Appendix D
Perth Sand Penetrometer (PSP) Tests	10	TP01-TP10	0.45-1.05	Appendix E
Infiltration Tests	8	IT01-IT08	0.2-0.8	Section 4.2
Machine boreholes (HQ3 Diamond coring)	3	BH01 – BH03	5.0	Appendix F

The locations of the tests are shown on Figure 1, Site and Location Plan. The borehole locations BH01 to BH03 as shown on the plan are planned test locations and have not been completed at the time of this report.

4.2 Infiltration Test Results

Infiltration testing was carried out in boreholes using the method described by Cocks[1]. The results of the infiltration testing are presented below.

Table 2: Summary of Tests

Test Location	Description	Pipe Embedment (m)	Minimum Unsaturated Conductivity, k (m/day)
IT01	SAND/Rubble	0.8	>10
IT02	SAND/Rubble	0.6	4.8
IT03	SAND/Rubble (0.5 m) over LIMESTONE	0.2	0.5
IT04	SAND/Rubble (0.4 m) over LIMESTONE	0.4	5.0
IT05	SAND/Rubble (0.6 m) over LIMESTONE	0.3	1.0
IT06	SAND/Rubble	0.6	>10
IT07	SAND/Rubble	0.6	5.0
IT08	SAND/Rubble (0.5 m) over LIMESTONE	0.8	6.8

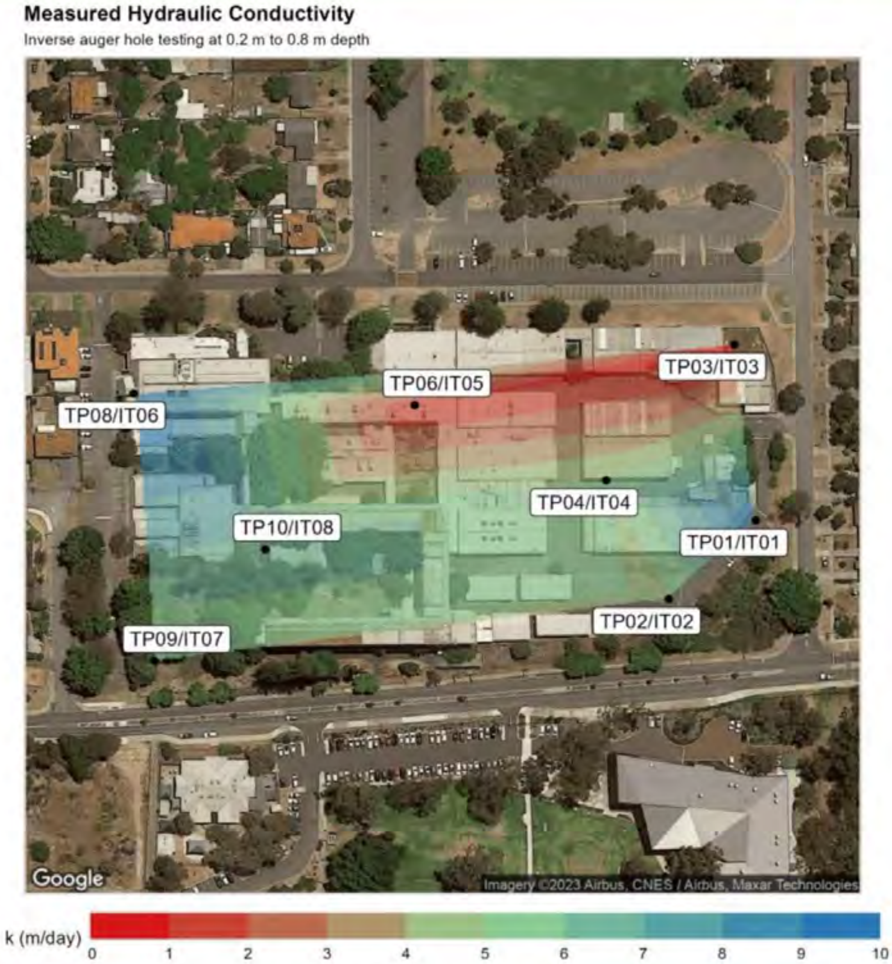
Notes: 1. The minimum unsaturated conductivities are typically recorded towards the end of the test, with head varying between about 0 m (dry) and 0.2 m

2. Conductivities greater than 10 m/day not reported due to inaccuracies of the test in highly permeable soils.

3. "Rubble" refers to a mixture of natural sand, sand fill and limestone gravels/cobbles.

The measured hydraulic conductivity values and their test locations are summarised in the inline image overleaf. The contour shading is for visualisation purposes and should not be taken as definitive.

1 Cocks, G (2007), "Disposal of Stormwater Runoff by Soakage in Perth Western Australia", Journal and News of the Australian Geomechanics Society, Volume 42 No. 3, pp 101-114



5. LABORATORY TESTING

Laboratory test certificates are presented in Appendix G and results are summarised below.

Table 3: Summary Soil Laboratory Test Results

Test Location	Sample Depth (m)	% Gravel	% Sand	% Fines	% Organics
TP01	0.5-1.0	25	66	9	
TP03	0.0-0.5	11	81	8	1.0
TP05	0.0-0.5	19	72	9	4.9
TP07	0.0-0.3				1.7

Table 4: Summary Rock Laboratory Test Results

Test Location	Sample Depth (m)	Point Load Index - $I_{s(50)}$ (MPa)	Unconfined Compressive Strength (MPa)	Rock Strength (AS1726-2017)
BH01	1.75 - 1.90	0.08		Very Low [1]
	1.80 – 2.00		1.42	Very Low
	2.05 - 2.10	0.35		Medium [1]
	4.50 - 4.63	0.22		Low [1]
	3.00 - 3.15	0.16		Low [1]
	3.50 – 3.70		0.54	Soil Strength
	4.83 - 5.00	0.89		Medium [1]
BH02	0.85 - 0.93	0.39		Medium [1]
	1.50 - 1.61	0.40		Medium [1]
	1.65 - 1.70	0.61		Medium [1]
	1.70 – 1.90		1.91	Very Low
	3.50 - 3.57	0.48		Medium [1]
	4.30 - 4.38	0.24		Low [1]
	4.70 - 4.80	0.32		Medium [1]
BH03	1.73 - 1.83	0.44		Medium [1]
	2.75 - 2.82	0.56		Medium [1]
	4.05 – 4.23		5.25	Low
	4.50 - 4.60	0.63		Medium [1]

Note: [1] Strength inferred from point load testing is as set out in Table 19 of AS1726, and is an indication of rock strength only. Correlations between UCS and point load index are known to vary considerably for different materials.

6. SITE CONDITIONS

6.1 Geology

The Fremantle sheet of the 1:50,000 scale Environmental Geology series map indicates that the area is underlain by sand derived from the weathering of Tamala limestone.

The findings of our investigation are in accordance with geological mapping, with a variable thickness of sand overlying limestone. Some fill materials (likely site derived sand/limestone mixtures) are also present in some areas.

6.2 Subsurface Conditions

The subsurface conditions at the site can broadly be summarised as:

> **SAND/Silty SAND/Gravelly SAND –** including site-derived fill. Typically sand with variable amounts of limestone as gravel and cobbles, with non-plastic fines. Thickness is variable; overlying
> **TAMALA LIMESTONE** – fine to coarse grained, pale yellow, some typically sub horizontal or up to about 30° bedding, some vugs, defects are typically partings and some seams at about 20 mm to 200 mm spacing, Limestone is inferred from refusal at test pit and CPT locations.

The sand is typically medium-dense to dense. The CPTs indicate that loose sand is present in some locations to around 1 m depth.

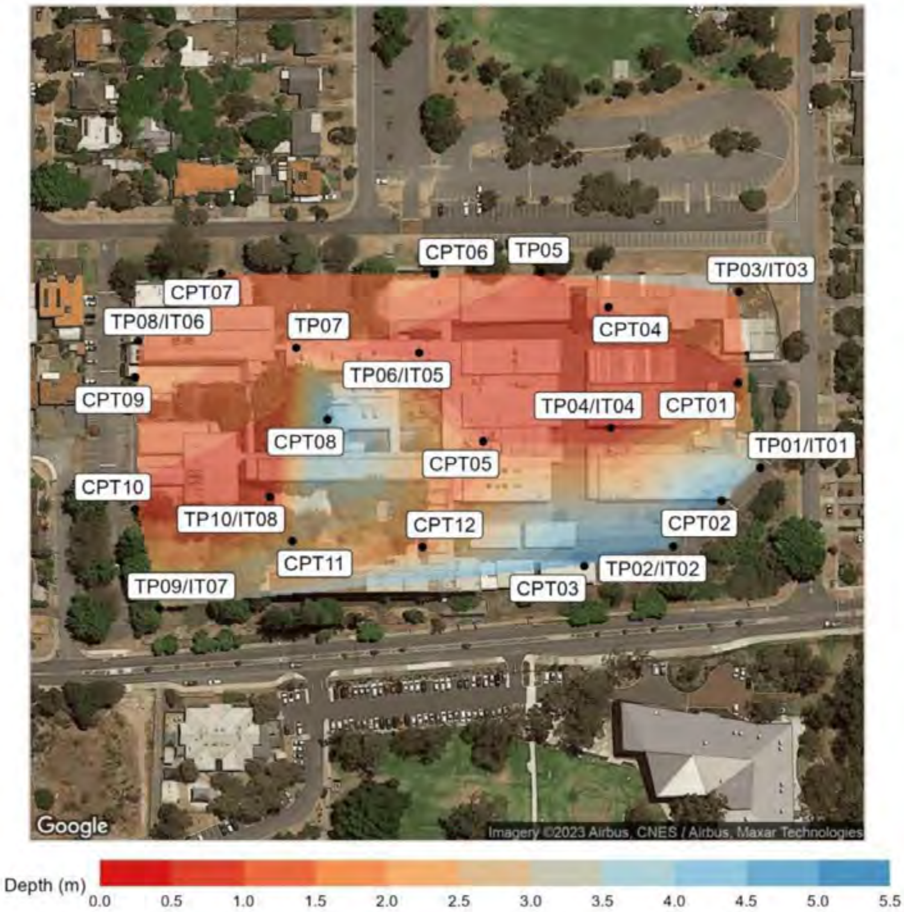
The inline images overleaf show:

Encountered thickness of sand and sand/rubble mixtures overlying inferred limestone; and
Estimated limestone elevation based on refusal depths.

We highlight that the contouring on the images is based only on the test locations carried out and may show shadings that are not reflective of site conditions at locations between tests.

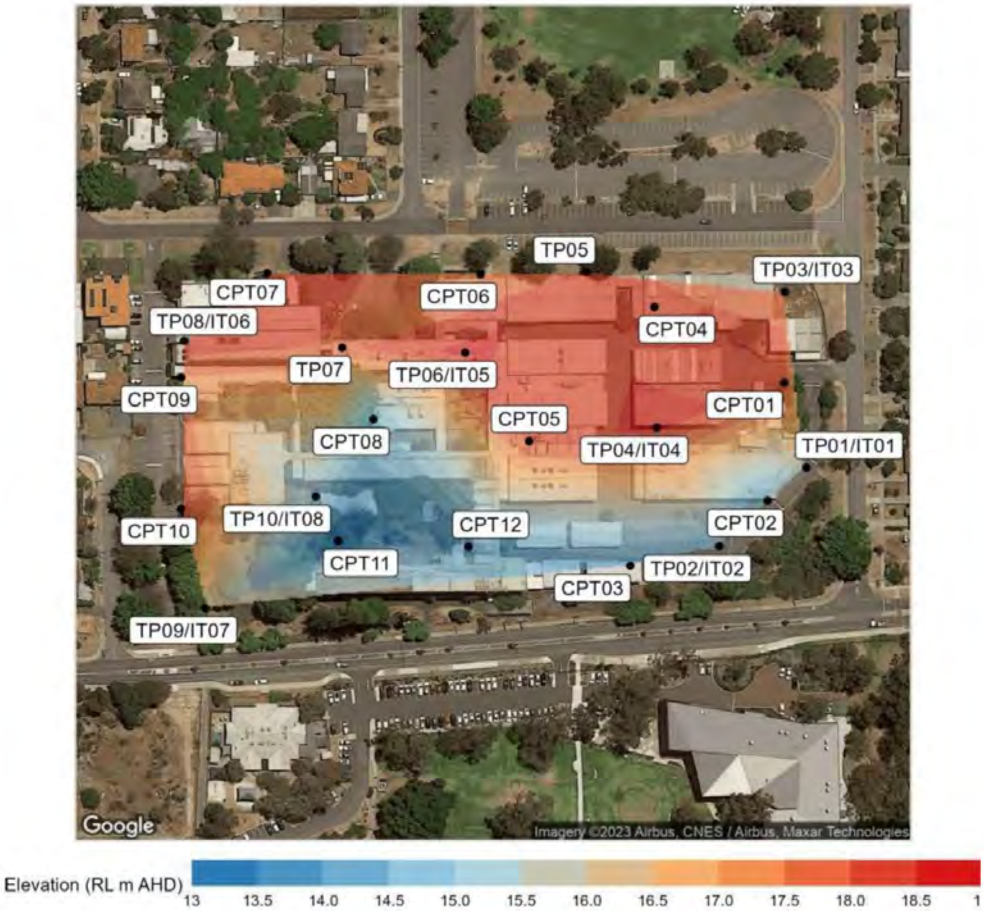
Encountered Sand Thickness over Inferred Limestone

Based on test refusal depths



Estimated Encountered Limestone Elevation

Based on feature survey and test refusal depths



A supplied photograph from Pritchard Francis at an excavation at the northeast corner of the site is shown inline.

Inline Image 1: Supplied Photograph Showing Excavation of Northeast Corner

The photograph shows the exposed surface after excavation/stripping down to the top of the limestone surface at this part of the site. The photograph shows that limestone surface is very uneven with sandy pockets (limestone is white, sandy pockets in orange-brown).

6.3 Groundwater

The Perth Groundwater Atlas (1997) shows the maximum groundwater level to be around RL 1 m AHD. This is within about 10 m of the current ground surface at the lowest point.

Groundwater should not adversely impact the proposed development.

7. GEOTECHNICAL ASSESSMENT

7.1 Key Geotechnical Issues

The key geotechnical issues at this site are:

Variable Sand/Limestone Conditions

The surface of any limestone layer is likely to be highly variable over short spatial extents, varying between sand and limestone. This will have influences on:

- Drainage (well cemented limestone areas may not drain well)
- excavatability (well cemented limestone will be difficult to excavate)
- general constructability (due to variation in materials)

- foundation variability below buildings (hard and soft foundation areas leading to irregular settlements).

Sand with High Gravel and Fines

The sandy soils at the site have high gravel (typically >15%) and high fines contents (>5%), which means that:

- Compaction control of these materials should be done using an NDG. A PSP will not be suitable for compaction control. Method specifications may be developed if appropriate.
- Once compacted, pockets of the material with high fines may form a tight matrix that has a reduced permeability when compared to the surrounding material.

7.2 Site Classification

We consider that the site is geotechnically capable of supporting the proposed development.

We have assessed the site in accordance with AS 2870-2011 "Residential Slabs and Footings". We consider that a site classification of "Class A" is appropriate provided the site preparation measures as described in Section 7.4 are followed during development.

Note: AS2870 is limited to single and double storey residential buildings and is not strictly applicable for the proposed development. This must be taken into account by the structural engineers.

7.3 Site Subsoil Class

We have assessed the site subsoil class in accordance with AS1170.4-2007, "Earthquake Design Actions – Australia". We consider that a site subsoil class of 'Ce' is appropriate for the site.

7.4 Site Preparation

The site preparation measures outlined below are aimed at bulk earthworks design, and are intended to prepare the site for subdivision.

The following measures must be followed:

- Strip any uncontrolled fill from the site (where encountered) and, if suitable, stockpile it for potential re-use as non-structural fill. If contaminated, dispose off-site. We did not encounter uncontrolled fill during the investigation.
- Strip and stockpile topsoil from unpaved areas of the site for potential re-use in non-structural applications or for possible processing and blending with clean sand. The topsoil strip is only necessary to remove roots and we recommend a 50 mm topsoil strip or as otherwise necessary to remove all roots from the soil. All tree roots must be removed, this may result in significant excavation in places.
- Excavate to the required level. Stockpile suitable excavated material for potential re-use as fill (see Section 7.6) and remove unsuitable or excess material off-site.
- In areas where drainage is a concern (soakwell zones, general lot areas that need to be permeable for drainage, etc), we recommend specific treatment to ensure that either granular fill or ripped limestone is present to at least ~1.2 m below the finished site surface (locally deeper where deep soakage elements are required). Recommendations in regard to over-excavation and ripping are contained in Section 7.11. Practically, this may be required over large areas of the site.

Excavations should be battered to a temporary slope as given in Section 7.9 where applicable and not in close proximity to adjacent structures etc. If required, construct temporary/permanent retaining walls where batters cannot be accommodated.

Moisture condition and compact the exposed ground to achieve the level of compaction specified in Section 7.5. Proof compaction of limestone is not required.

Any areas of loose sand or unsuitable material must be removed and replaced with approved fill as outlined in Section 7.6.

Where fill is required to build up levels, use approved fill (see Section 7.6), placed and compacted in layers of no greater than 300 mm loose thickness.

7.5 Compaction

The density and testing requirements are summarised below:

Table 5: Summary of Compaction Requirements

Soil Description	Soil Particle Limits	Where Present	Density Requirement (DDR)	QA/QC Test Method
Import Sand	<5% fines <5% gravel	Fill	95% MMDD	PSP
Import Gravel	<5% fines	Fill	95% MMDD	NDG
In situ sand/rubble	<12% fines >5% gravel <5% greater than 19 mm	Site surface to top of limestone	95% MMDD	NDG Method Specification
Limestone/Sand Mixtures	<12% fines >5% gravel >5% greater than 19 mm 0% greater than 300 mm	Bulk cut-fill	95% MMDD	Method Specification

Notes: 1. Fines – Material passing the 0.075 mm sieve. Gravel – Material retained on the 2.36 mm sieve.
2. DDR – Dry Density Ratio
3. MMDD – Modified maximum dry density SMDD – Standard maximum dry density
4. PSP – Perth Sand Penetrometer NDG – Nuclear Density Gauge

Density Requirements

The MMDD must be determined in accordance with AS1289.5.2.1. Compaction of all soils must be carried out using suitable compaction equipment when the soil is at a moisture content of within 2% of the optimum moisture content.

Nuclear Density Gauge Testing

If a PSP cannot be used because the soil is unsuitable (>5% fines or >5% gravel), or there are issues with PSP testing, then compaction control must be done using a nuclear density gauge (NDG) in accordance with AS1289.5.8.1. NDG tests must be done to a depth of 0.3 m.

An NDG should be used on all in situ soils given the high variability of the natural sandy soils with high fines and gravel contents.

Method Specification

Given that we do not recommend the use of a PSP for the testing of the in situ soils, we understand that the required NDG testing frequency may be quite high. We consider that the existing surface may be prepared using a method specification, provided that:

The method specification is developed with a geotechnical engineer present on site.

NDG testing is done during the trial:
- Every 2 passes
- Minimum 4 locations

Method specification compliance is maintained for all prepared areas on a minimum 20 m grid, with compliance to include:
- Roller used (weight, style, vibration)
- Water application rate (per lift)
- Layer thickness placed
- Number of passes with roller

A preliminary method specification for sand/limestone mixes is:

- Remove boulders greater than 300 mm in size;
- Moisture condition to OMC, estimated to be around 15-20%, roughly 10 litres of water per m2 per 100 mm thickness of fill, i.e. around 40 L/m2 for a 400 mm thick layer;
- Place in loose layers not greater than 400 mm loose thickness;
- Compact with a minimum 10 passes of a pad foot roller (minimum 16 tonne) in full vibratory mode.

Perth Sand Penetrometer Testing

Where clean sand is used (<5% fines and <5% gravel), a Perth sand penetrometer (PSP) may be used for compaction control in accordance with AS1289.6.3.3. A PSP must not be used as the primary means of verifying the compaction of the in situ soils. A PSP may be used to assess if any loose zones exist between limestone/gravel particles.

The following minimum blow counts may be assumed to correlate to a DDR of 95% MMDD for any imported sand fill:

Depth range 0 m to 0.15 m:	SET
Depth range 0.15 m to 0.45 m:	8 blows
Depth range 0.45 m to 0.75 m:	10 blows
Depth range 0.75 m to 1.05 m:	12 blows (or 6 blows for depth range 0.75 m to 0.9 m)

If difficulties are experienced recording the required blow counts, a site-specific PSP correlation should be carried out to determine the PSP blow count correlating to a DDR of 95% MMDD. In addition, a particle size distribution (PSD) test should be done to verify that the use of a PSP is suitable for the sands being tested. A site-specific PSP correlation must:

- be done on site;
- use the nuclear density gauge (NDG) to determine density at a minimum of 5 points with varying density to a depth of 300 mm below surface;
- include at least 1 point where the dry density ratio is in excess of 95% MMDD;
- use a calibrated PSP to determine the PSP blow count from 150 mm to 450 mm at each of the NDG test points; and
- be plotted on a chart of PSP blow count vs DDR.

Testing Frequency

After compaction, verify that the required level of compaction has been achieved by testing at the base of excavation and through the full depth of any fill, and to a minimum depth of 0.9 m (or 0.3 m if an NDG is used). The frequency of testing should be as follows:

- on each lift of fill at the rate of 1 test per 500 m^3 or at least 2 tests per layer (4 tests per layer below the building footprint), whichever is greater;
- At each spread footing location;

- at 5 m centres along gravity retaining wall footings and strip footings (where present); and
- at 10 m centres below on-ground slabs and pavements.

The above testing does not apply for the in situ soils where a method specification is used.

General

Over-excavation and replacement of loose material must be done where the minimum DDR cannot be achieved.

Fill must be placed in horizontal layers of not greater than 300 mm loose thickness (other than where a sand/limestone method specification is used). Each layer must be compacted by suitable compaction equipment, and carefully controlled to ensure even compaction over the full area and depth of each layer.

Care will need to be taken if compacting in the vicinity of existing structures, such as the adjacent properties. This is particularly important if vibratory compaction is being carried out. Tynan (1973)[2] provides guidance on the selection of compaction equipment for use adjacent to structures.

Large compaction equipment (self-propelled vibrating rollers, etc.) must not be used within 2 m behind retaining walls. Hand compaction plant (e.g., plate compactors) must be used.

7.6 Approved Fill

Imported granular fill must comply with the material requirements as stated in AS 3798-2007, "Guidelines on Earthworks for Commercial and Residential Developments".

Generally, the sandy soils at the site are considered suitable for re-use as structural fill, but we highlight that the materials may be highly variable in fines and gravel content.

Any other structural fill must meet the following requirements:

- Must not contain any putrescible deleterious inclusions or rubbish.
- Organic content must be less than 2% by weight.
- Must not contain any particles greater than 300 mm in size.
- Fines content of less than 12%.
- Minimum required saturated hydraulic conductivity (k) when compacted to 100% MMDD (if stormwater disposal is proposed, i.e., k=5 m/day if used in design).

Some of the upper soils have a high organic and root content. These must be screened (where required to remove oversize organics) prior to re-use. Blending may be required due to elevated organic content (i.e., TP05 topsoil has 4.9% organic content from our laboratory testing). On site assessment by a geotechnical engineer should be carried out to provide re-use requirements.

Where doubt exists, a geotechnical engineer must be engaged to inspect and approve the use of potential fill materials.

7.7 Shallow Footings

We consider that the proposed building may be founded on shallow spread footings founded within the in situ sandy soils encountered across the site, provided the site preparation recommendations outlined in Section 7.4 are followed.

[2] Tynan (1973) Ground Vibration and Damage Effects on Buildings, Australia Road Research Board, Special Report No. 11

Footings for any structure should not be founded on a combination of sandy soils and solid limestone, as this can lead to differential settlements between footings. Footings should be founded on either:

- Minimum 300 mm of soil (sand/gravelly sand etc.) over limestone; or
- Solid limestone or lean mix concrete placed above over-excavated limestone.

Table 5 and Table 6 give allowable bearing pressures and estimated settlements for pad footings and strip footings at embedment depths of 0.5 m and 1.0 m below ground surface. These values assume that the site preparation procedures in Section 7.4are followed.

Table 6: Pad Footing Allowable Bearing Pressures and Estimated Settlements

Minimum Footing Embedment (m)	Minimum Footing Dimension (m)	Allowable Bearing Pressure (kPa)	Estimated Settlement (mm)
0.5	0.5	150	<5
	1.0	200	5-10
	1.5	250	5-10
	2.0	250	10-15
	2.5	250	10-15
1.0	1.0	250	5-10
	2.0	250	10-15
	3.0	250	15-20

Table 7: Strip Footing Allowable Bearing Pressures and Estimated Settlements

Minimum Footing Embedment (m)	Minimum Footing Dimension (m)	Allowable Bearing Pressure (kPa)	Estimated Settlement (mm)
0.5	0.5	150	5-10
	1.0	200	10-15
	1.5	200	10-15
	2.0	200	15-20
1.0	1.0	200	10-15
	2.0	200	15-20

Allowable bearing pressures for footings of intermediate plan dimensions to those tabulated can be interpolated. Footings that have a plan dimension either smaller or larger than those covered by tables above will need to be considered individually along with other embedment depths. Footings carrying significant eccentric loading, such as below retaining walls, must be assessed separately.

Allowable working bearing pressure of 250 kPa (pad footings) and 200 kPa (strip footings) are considered to be an upper limit for footings to limit total and differential settlements as well as the risk of long-term creep settlement which may occur under high bearing pressures.

The settlement of the proposed structure will depend upon a number of factors including the applied pressures, footings size and base preparation. The estimates of settlement provided above assume that the site preparation measures in Section 7.4 have been completed. The estimated settlements are for the working bearing pressure values shown. Differential settlements of up to half of the total estimated settlement values are likely between footings of similar sizes, loads and elevations. About 70% of the settlement is expected to occur during construction.

The estimated settlements indicated in the above tables do not include interaction effects from footings founded near other footings (i.e. groups of footings). Interaction effects will need to be considered if the spacing between adjacent footings is smaller than the dimension of the footings (i.e. the centre-to-centre spacing between footings is less than twice the width of the footings). This could act to double the nominated settlements, dependent on the footing configuration. Where an assessment of footing groups is required, a more detailed numerical analysis would need to be undertaken (we can complete this, if required).

All foundation excavations must be assessed by a competent person prior to blinding.

7.8 Earth Retaining Structures

Retaining structures may be designed in accordance with AS 4678 (2002) "Earth Retaining Structures". We recommend that all retaining walls at the site be backfilled with free-draining fill, e.g. sand (imported free draining sand fill with less than 5% fines). We still generally consider that the soils at the site (with high gravel and fines) are suitable for backfill behind retaining walls.

For the design of retaining structures, the parameters in Table 8 are considered appropriate for compacted sand backfill behind retaining walls.

Table 8: Retaining Wall Geotechnical Design Parameters

Soil Type	Bulk Density (kN/m^3)	Angle of Internal Friction (deg.)	Wall Friction = 0°		Wall Friction = 0.5Φ	
			Coefficient of Active Earth Pressure, K_a	Coefficient of Passive Earth Pressure, K_p	Coefficient of Active Earth Pressure, K_a	Coefficient of Passive Earth Pressure, K_p
Compacted in situ sand or sand fill	18	34	0.28	3.5	0.25	5.7
Limestone	18	36	0.26	3.9	0.22	6.5

Notes:
1. Earth pressure coefficients are provided in this table for conditions of zero friction between the wall and the soil and with wall friction of 0.5Φ'.
2. A horizontal ground surface behind the wall has been assumed.
3. The retaining wall designer should make an independent assessment of the parameters appropriate to the construction method to be used, including alternative values of wall friction.

Compaction plant can augment the lateral earth pressure acting on retaining walls. Hand operated compaction equipment is recommended within 2 m of any retaining walls to minimise compaction pressures.

It is important to note that some ground movement will occur behind any soil retaining system, including gravity retaining walls.

Retaining walls can move and rotate under imposed soil loading resulting in settlement behind the wall. This must be considered in the design and during construction of the retaining walls in order that adjacent properties are not adversely affected. Particular care should be exercised when forming excavations so as not to affect neighbouring properties. Account must be taken of the effect of both temporary and permanent works on neighbouring properties. Anchoring or strutting of retaining walls may be required.

Detailed design of retaining structures should be undertaken using methods appropriate to the proposed retention system.

7.9 Excavations

Based on the soil profile encountered, we consider that excavations at the site can be readily achieved to the top of the limestone using conventional earthmoving equipment (i.e. 5 tonne excavator or greater in size).

Caprock (very well cemented, high strength rock) was not noted in the boreholes. The limestone strength was generally measured as very low to medium strength. The limestone was continuous where sampled (i.e. without prevalent sand/uncemented zones) but included a number of defects and small uncemented zones which should help ease excavatability compared to well cemented limestone.

Based on the conditions observed in the boreholes, and Pettifer and Fookes (1994)[4], ripping is likely to be required for excavations in limestone. Given this, a large excavator (>30 tonnes) combined with a toothed rock bucket is likely to be needed for excavation. A rock pick or hydraulic breaker is likely to be needed, at least locally if not prevalently, to loosen rock prior to excavation. Consideration could be given to a rock cutting wheel or similar to create excavations in the limestone, although this may not be possible to the depth required (up to ~4 m for sewers). A combination of techniques may be needed.

The possible presence of obstructions such as buried services, cemented layers, high strength core stones, old footings and slabs must be taken into account when selecting excavation equipment. Tamala limestone is known for highly variable strength and cementation over short plan and vertical distances and the presence of well-cemented, high strength material cannot be discounted (but was not encountered at the test locations).

Excavations in sand are particularly prone to instability unless support is provided. Care must be exercised in such excavations and appropriate safety measures adopted where necessary, particularly in the vicinity of existing buildings, structures and infrastructure.

Excavations in sand must be battered at slopes no steeper than 1V:2H for temporary slopes and 1V:3H for permanent slopes where no external restraint is provided to the slope (suitable for slope heights up to 2 m with no surcharge at the crest of the slope). Even at these slope angles erosion and rilling may occur. Where steeper slopes are required, temporary or permanent slope retention must be employed.

Temporary slopes of 1V:2H require the following:

- No surcharge (machinery, stockpiles, etc.) is present in the vicinity of the crest of the slope.
- The maximum slope height is 2 m without specific advice and slope stability analysis.

Temporary excavations in moderately or well cemented limestone may be battered at up to 2V:1H. Permanent excavations may be up to 1V:1H.

Surcharges (such as structures, plant and soil stockpiles) must not be placed at or close to the crest of unsupported excavations.

A geotechnical engineer must be consulted where there is any doubt regarding the stability or safety of unsupported excavations.

Note: Where the above batters cannot be accommodated in the vicinity of existing footings, roads and services, temporary lateral support will be required.

Based on the proposed development, we do not consider that a retention system will be required, but we can provide further advice if required.

[4] G. S. Pettifer & P. G. Fookes (1994), 'A revision of the graphical method for assessing the excavatability of rock' Q J Eng Geol 27: 145 – 164.

7.10 Pavement Thickness Design

Where design of flexible pavements is undertaken, a subgrade California bearing ratio (CBR) of 12% may be assumed for pavement thickness design. This CBR assumes that the site preparation requirements outlined in Section 7.4 have been carried out in pavement subgrade areas.

Care should be taken to ensure pavements are not founded on combinations of limestone/sand. The subgrade should be consistent, preferably with a minimum 300 mm thickness of sandy/gravelly soil over limestone.

Adequate drainage must be provided to all pavement subgrades to prevent ponding of water and weakening of the subgrade.

7.11 Stormwater Disposal

We understand that the stormwater disposal at the site is proposed to be handled by:

- Large drainage cells in the proposed public-open-spaces for street and commercial drainage;
- Soak wells in the residential properties, with overflow drainage onto the street or overflow drains (for capture into the drainage cells).

On this basis, we recommend the following:

Large Drainage Areas – Drainage Cells, Interconnected Soakwells

- Over-excavate/rip limestone (as required) to achieve a minimum of 0.6 m of soil or ripped limestone (sand/gravel i.e., no solid limestone) below the base of any proposed drainage infrastructure.
- The soil should extend to a plan extent of 1 m outside the edge of the drainage area.
- Where possible, avoid over-compaction of this 0.6 m thick layer of soil and the backfill around the sides of the drainage cell.
- Carry out design of structures using a design value of hydraulic conductivity (k) of 5 m/day.

Single Drainage Items – Single Soakwells

- Over-excavated/rip limestone (as required) to achieve a minimum 0.6 m of soil (sand/gravel i.e., no solid limestone) below the base of any proposed soakwell.
- The soil should extend to a plan extent of 0.5 m around the outside of any proposed soakwell.
- Where possible, avoid over-compaction of this 0.6 m layer of soil and the backfill around the sides of the soakwells.
- Carry out design of structures using a design value of hydraulic conductivity (k) of 3 m/day.

Finished Surfaces Requiring Good Drainage

To ensure that areas of the site do not have shallow limestone which may hinder surface drainage, we recommend:

- Trim off any soil and limestone rubble to expose the underlying limestone
- Rip the limestone to ~1 m below finished surface levels (we anticipate that at least ~0.4 m of soil will be replaced above, therefore this is likely to require ripping to ~0.6 m below the exposed limestone surface).
- Moisture condition and re-compact the limestone with 6 passes of a vibrating roller (min. static weight: 10 tonnes)
- Replace the soil up to the design finished level in accordance with Section 7.4.

Soakwell Placement

Soak wells should be placed outside a line of 1V:2H extending below the edge of the nearest footing, subject to local council regulations. Discharge from soak wells has been known to promote densification of loose sandy soils, leading to settlements of footings and slabs. Soak wells should be carefully wrapped with geotextile to prevent migration of sand and fines into the soak well.

8. FURTHER INVESTIGATION

Additional work may be required if further refinement of the site conditions is required, i.e., to refine:

- Depth to limestone/thickness of sand; or
- Hydraulic conductivity of onsite materials.

As discussed in the report text, assessment of stripped topsoil may be required to determine re-use requirements. Particularly around the existing trees at the site.

9. CLOSURE

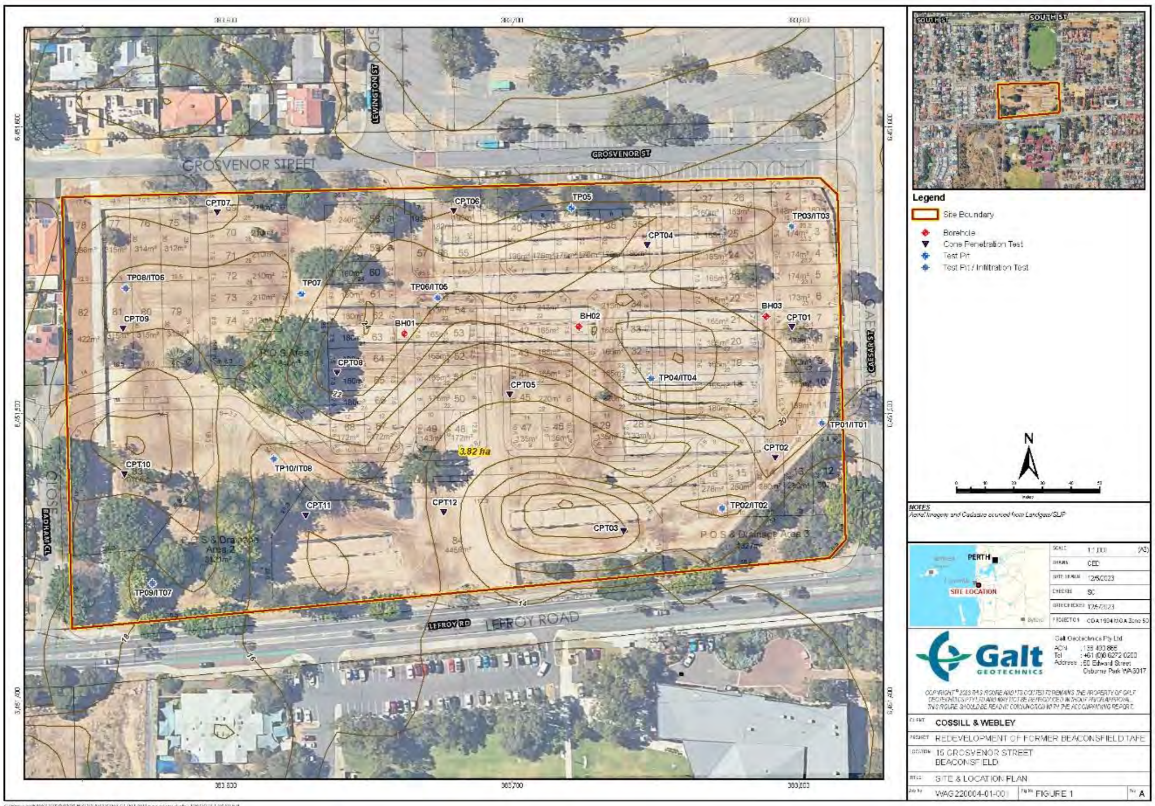
We draw your attention to Appendix H of this report, "Understanding your Report". The information provided within is intended to inform you as to what your realistic expectations of this report should be. Guidance is also provided on how to minimize risks associated with groundworks for this project. This information is provided not to reduce the level of responsibility accepted by Galt, but to ensure that all parties who rely on this report are aware of the responsibilities each assumes in so doing.

GALT GEOTECHNICS PTY LTD

Owen Woodland CPEng
Geotechnical Engineer

https://galtgeo.sharepoint.com/sites/WAG220004/Shared Documents/01 Cosweb SI/03 Correspondence/WAG220004-01 003 R Rev1.docx

Figures


GROSVENOR STREET
GROSVENOR ST
LEWINGTON ST
LEFROY ROAD
LEFROY RD
CPT01
CPT02
CPT03
CPT04
CPT05
CPT06
CPT07
CPT08
CPT09
CPT10
CPT11
CPT12
BH01
BH02
BH03
TP01/IT01
TP02/IT02
TP03/IT03
TP04/IT04
TP05
TP06/IT05
TP07
TP08/IT06
TP09/IT07
TP10/IT08
3.82 ha
SOUTH ST
Legend
Site Boundary
Borehole
Cone Penetration Test
Test Pit
Test Pit / Infiltration Test
N
NOTES
Aerial Imagery and Cadastre sourced from Landgate/SLIP
PERTH
SITE LOCATION
SCALE 1:1,000 (A3)
DRAWN CED
DATE DRAWN 12/5/2023
CHECKED SC
DATE CHECKED 12/5/2023
PROJECTION GDA1994 MGA Zone 50
Galt
GEOTECHNICS
Galt Geotechnics Pty Ltd
ACN : 138 430 865
Tel : +61 (0)8 6272 0200
Address : 50 Edward Street
Osborne Park WA 6017
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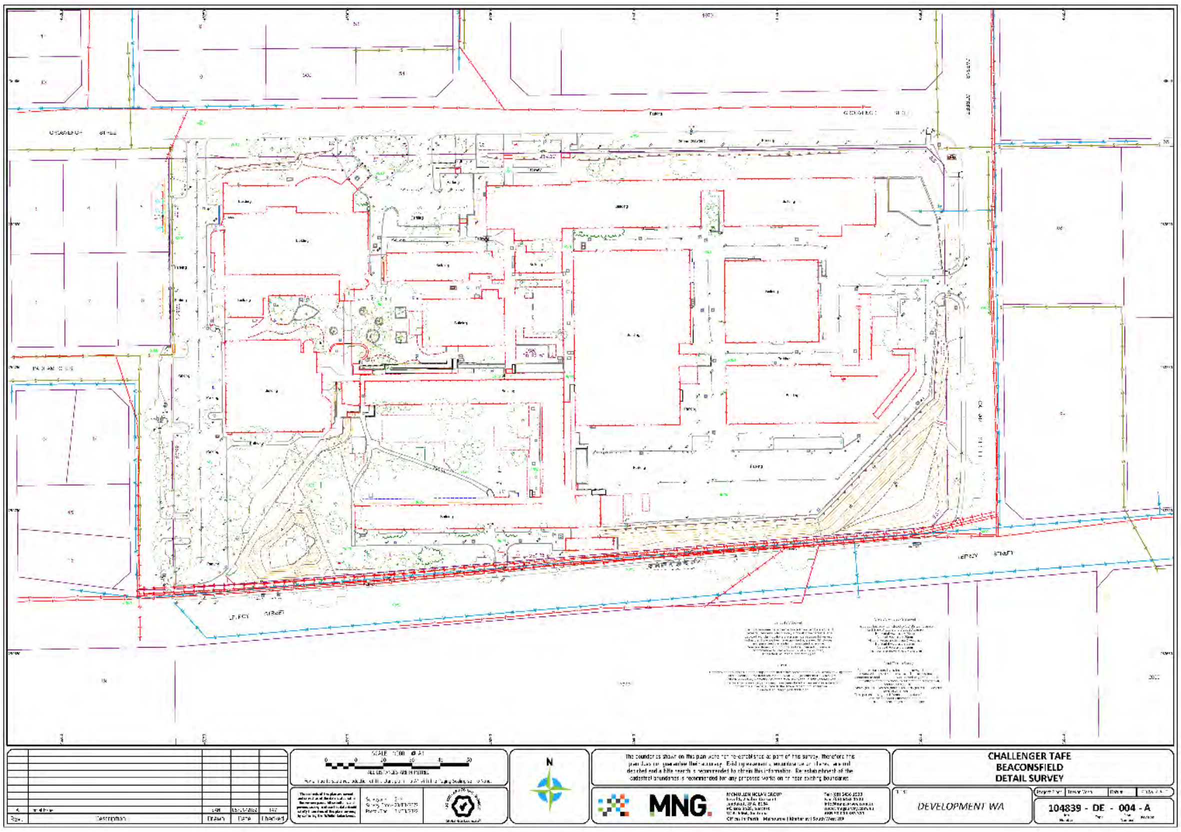
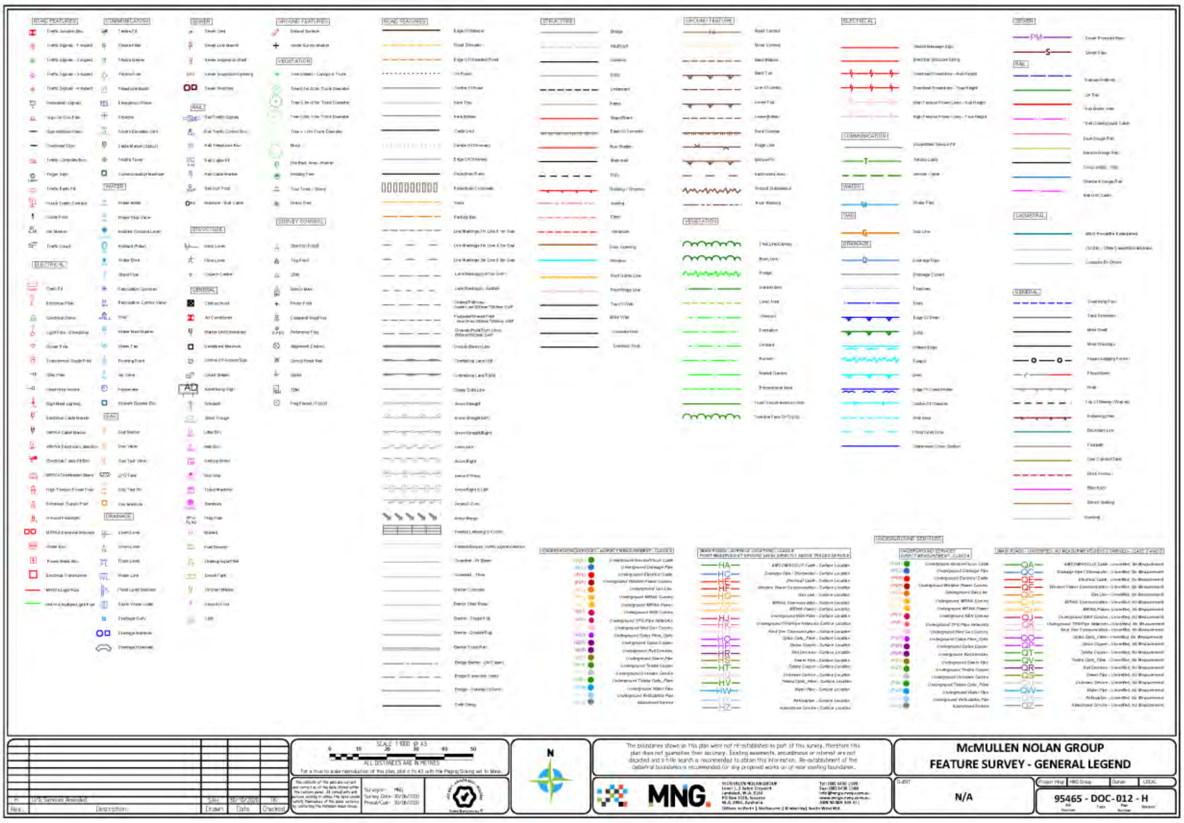
CLIENT COSSILL & WEBLEY
PROJECT REDEVELOPMENT OF FORMER BEACONSFIELD TAFE
LOCATION 15 GROSVENOR STREET
BEACONSFIELD
TITLE SITE & LOCATION PLAN
Job No WAG 220004-01-001
Fig No FIGURE 1
Rev A

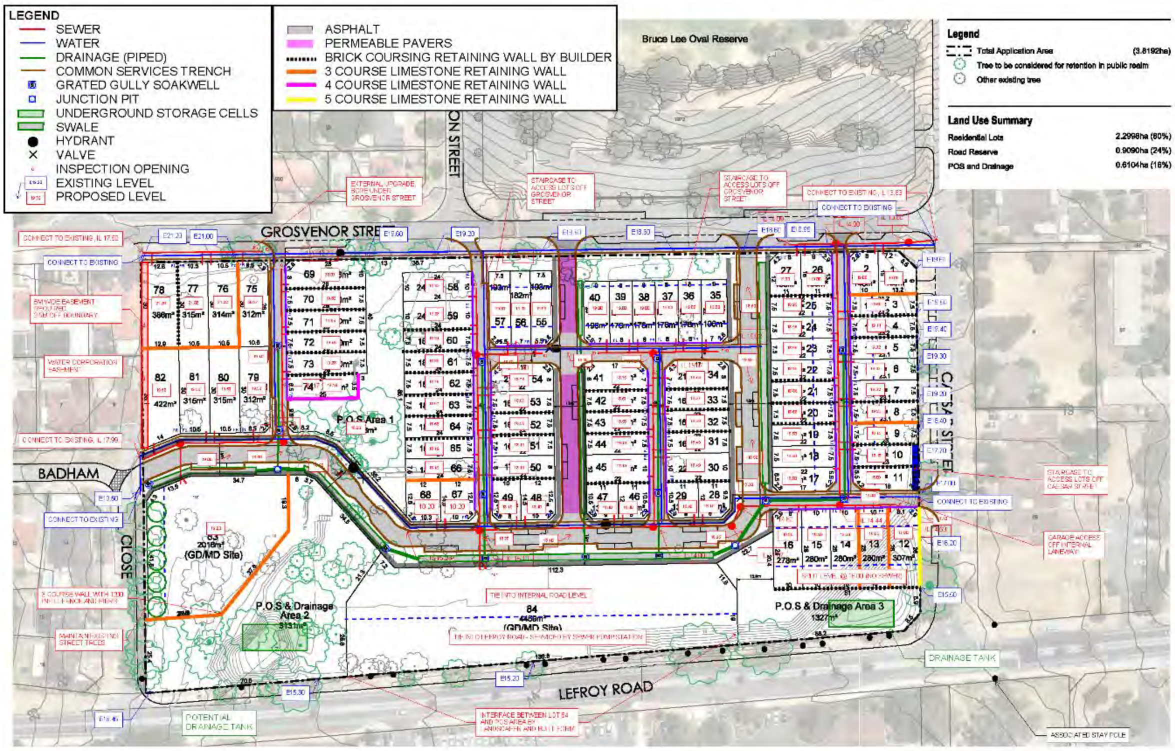
Appendix A: Supplied Drawings



CHALLENGER TAFE
BEACONSFIELD
DETAIL SURVEY
DEVELOPMENT WA
104839 - DE - 004 - A
MNG.



The boundaries shown on this plan were not re-established as part of this survey, therefore this plan does not guarantee their accuracy. Existing easements, encumbrances or interest are not depicted and a title search is recommended to obtain this information. Re-establishment of the cadastral boundaries is recommended for any proposed works on or near existing boundaries.
McMULLEN NOLAN GROUP
FEATURE SURVEY - GENERAL LEGEND
N/A
95465 - DOC - 012 - H
MNG.



Subdivision Concept Plan - Option G
LOT 2680 GROSVENOR STREET, BEACONSFIELD

A DevelopmentWA Project

24/03/2023
PLAN 9
PRITCHARD FRANCIS SERVICING
MARKUP REV C

pritchard francis
civil and structural engineering consultants
Telephone: (08) 9382 5111

DRAFT

Taylor Burrell Barnett Town Planning & Design
Taylor Burrell Barnett

LOT SUMMARY

LOT YIELD			LOT AREA	
Size	No.	%	Average	% of Total Area
120m² - 159m²	6	7.32%	138m²	5.02%
160m² - 179m²	35	42.68%	168m²	35.79%
180m² - 234m²	25	30.49%	196m²	29.67%
235m² - 319m²	14	17.07%	290m²	24.62%
320m² - 440m²	2	2.44%	404m²	4.89%
Number of Lots	82			
Minimum Lot Size 133m² Maximum Lot Size 422m²			Average Lot Size 201m² Total Lot Area 16518m²	
GD/MD Lot	2			
Total Number of Lots	84			

Subdivision Concept Plan - Option G
LOT 2680 GROSVENOR STREET, BEACONSFIELD

A DevelopmentWA Project

DRAFT

Taylor Burrell Barnett Town Planning & Design
Taylor Burrell Barnett

Appendix B: Site Photographs

Photograph 1: Looking west across the site

Photograph 2: Looking northeast across the site (demolished building footprints shown)

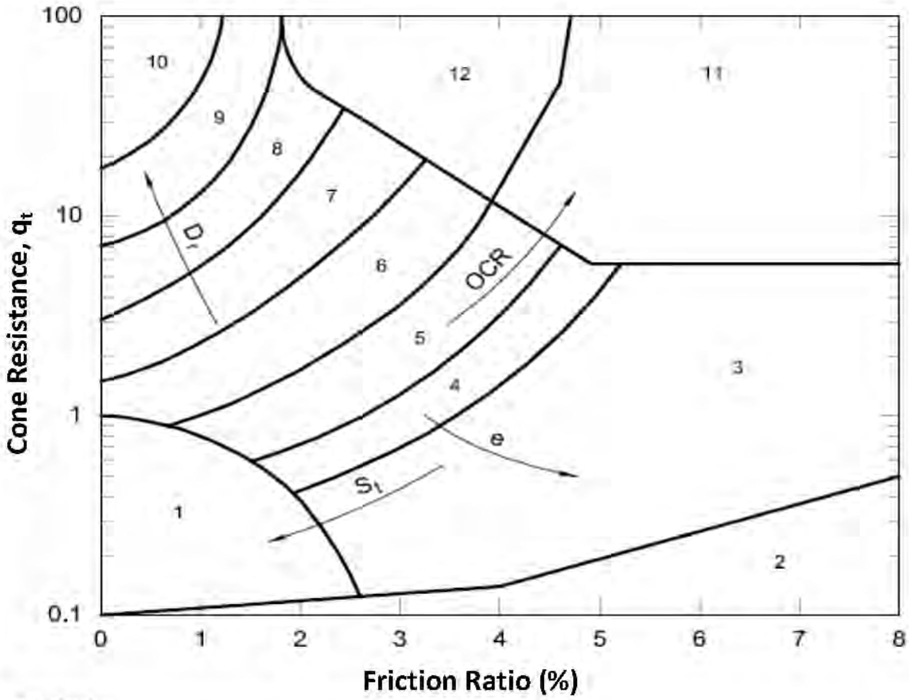
Photograph 3: Looking north at existing drainage area at the south of the site

Photograph 4: Looking at existing batter near the south of the site

Photograph 5: Looking at existing trees at the southwest of the site

Photograph 6: looking northwest at existing batter area at the south of the site

Appendix C: Cone Penetration Test Results



DEFINITIONS

q_t : Cone tip resistance corrected for pore water pressure
S_t : Sensitivity
e : Void ratio
D_r : Relative density
OCR : Overconsolidation ratio
OC : Overconsolidated

SOIL BEHAVIOUR TYPE ZONES

1. Sensitive fine grained
2. Organic material
3. Clay
4. Silty clay to clay
5. Clayey silt to silty clay
6. Sandy silt to clayey silt
7. Silty sand to sandy silt
8. Sand to silty sand
9. Sand
10. Gravelly sand to sand
11. Very stiff fine grained material (OC/cemented)
12. Sand to clayey sand (OC/cemented)

NOTES

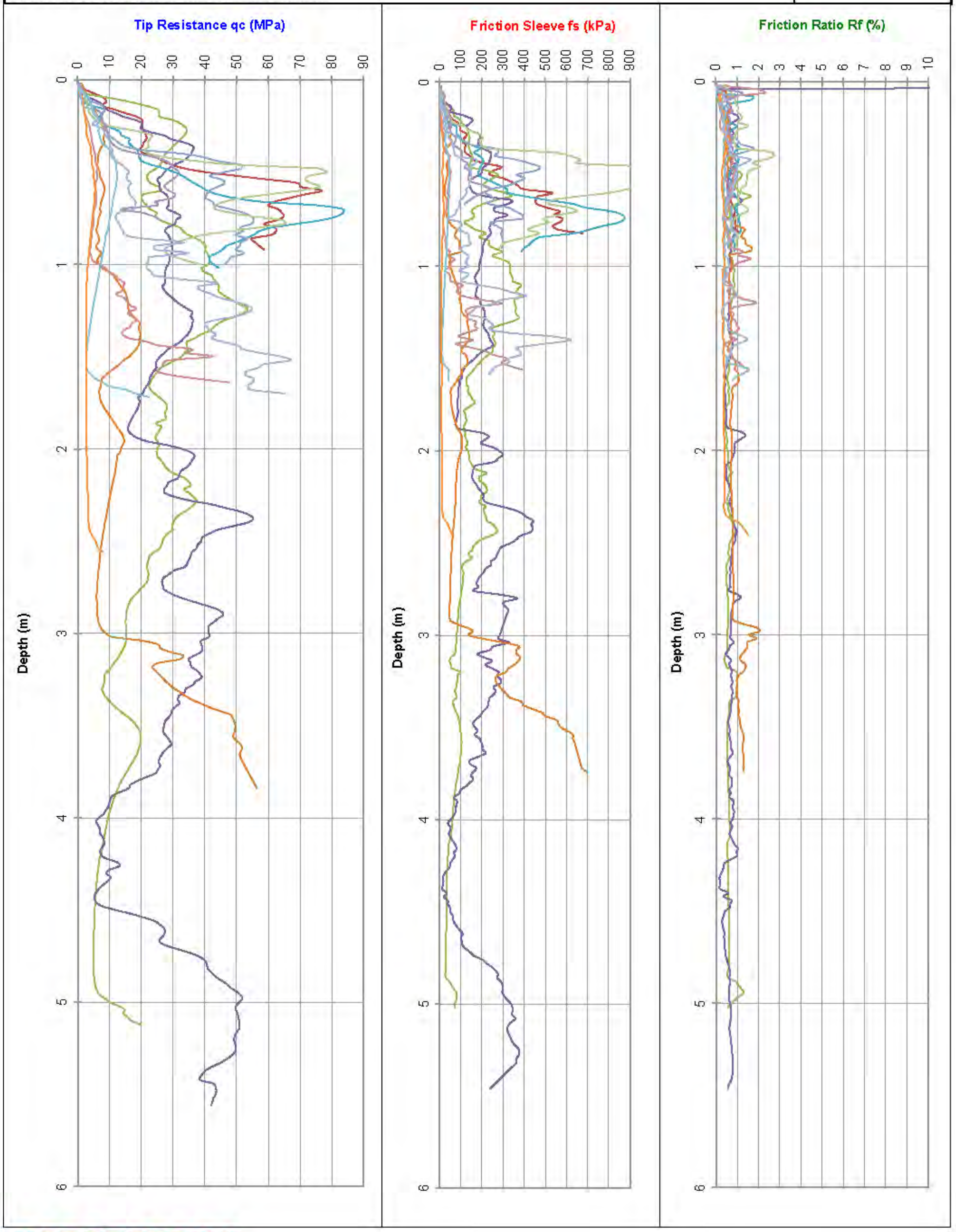
A. Some overlap in type zones is expected
B. Local correlations are preferred and may indicate soil type boundaries that are different from those shown above

Reference: Robertson, P.K., Campanella, R.G., Gillespie, D. and Grieg, J. (1986) "Use of Piezometer Cone Data". Proceedings of the ASCE Speciality Conference In Situ '86: Use of In Situ Tests in Geotechnical Engineering, Blacksburg, pp 1263-80, American Society of Civil Engineers (ASCE)

Galt GEOTECHNICS

CONE PENETRATION TESTING (CPT) SOIL TYPE INTERPRETATION

ELECTRIC FRICTION-CONE PENETROMETER		ALL DATA
CLIENT: Pritchard Francis	Job No.: WAG220004-02	
PROJECT: Beaconsfield Residential Sub-Division	Date/s: 28-Apr-2023	
LOCATION: Grosvenor Street, Beaconsfield		



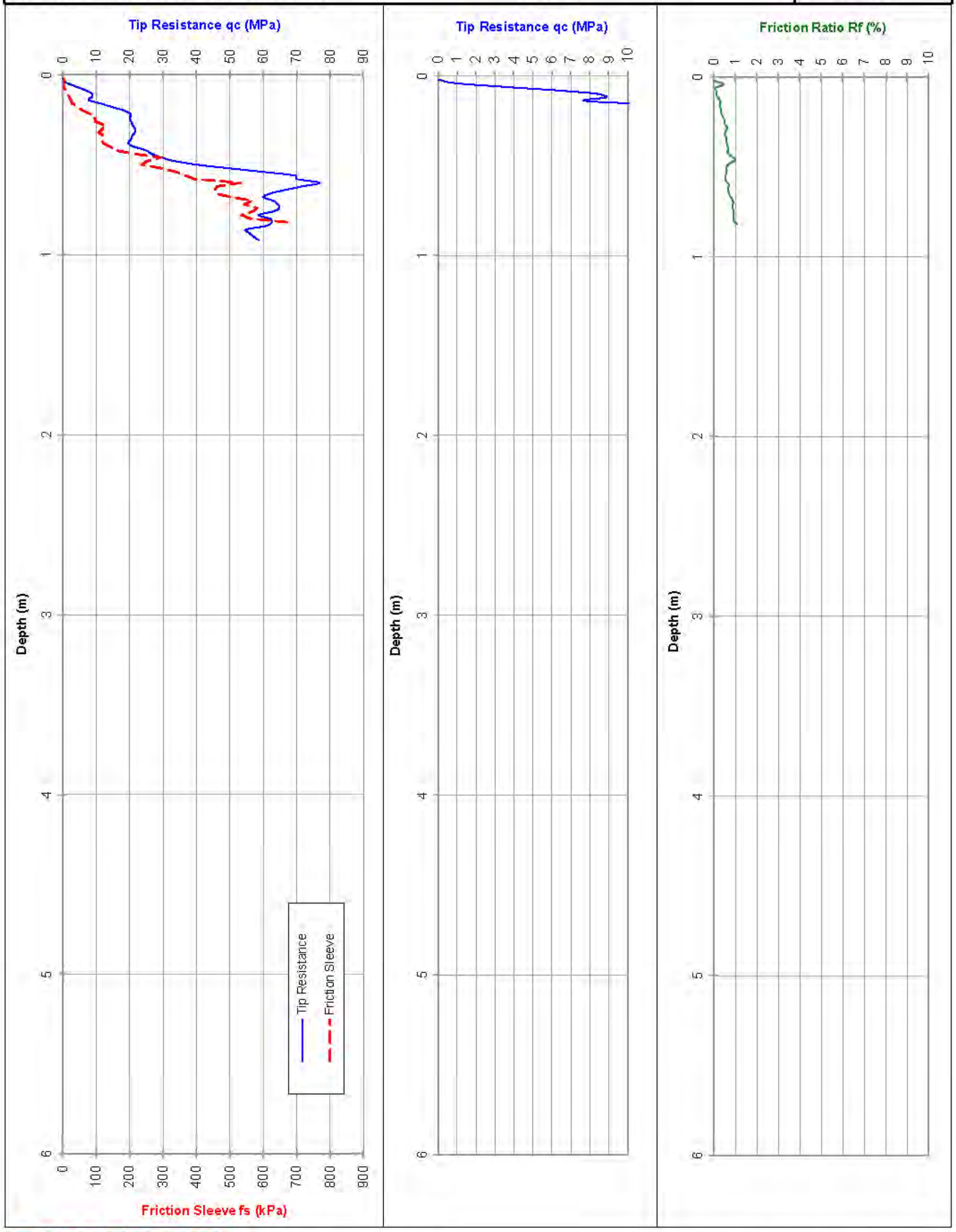
PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Rig Type: 11t track (M2)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT:	Pritchard Francis	Job No.: WAG220004-02	Probe I.D
PROJECT:	Beaconsfield Residential Sub-Division	RL (m):	CPT 01
LOCATION:	Grosvenor Street, Beaconsfield	Co-ords:	28-Apr-23



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 0.8

Dummy probe to (m):

Refusal: Rod Friction

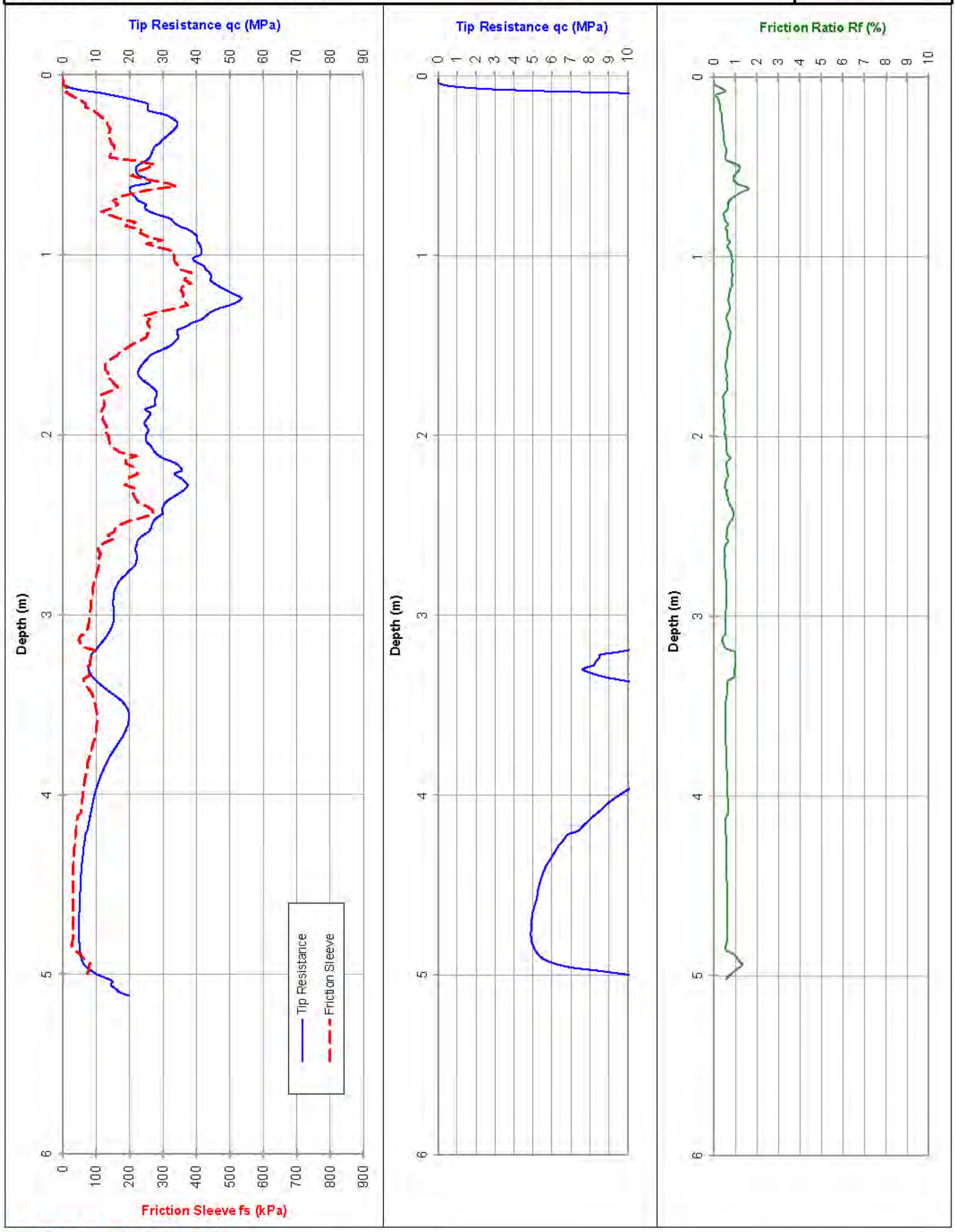
Cone I.D.: EC27

File: GL1120M2

Rig Type: 11t track (M2)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Pritchard Francis	Job No.: WAG220004-02	Probe I.D
PROJECT: Beaconsfield Residential Sub-Division	RL (m):	CPT 02
LOCATION: Grosvenor Street, Beaconsfield	Co-ords:	28-Apr-23



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 4.0

Dummy probe to (m):

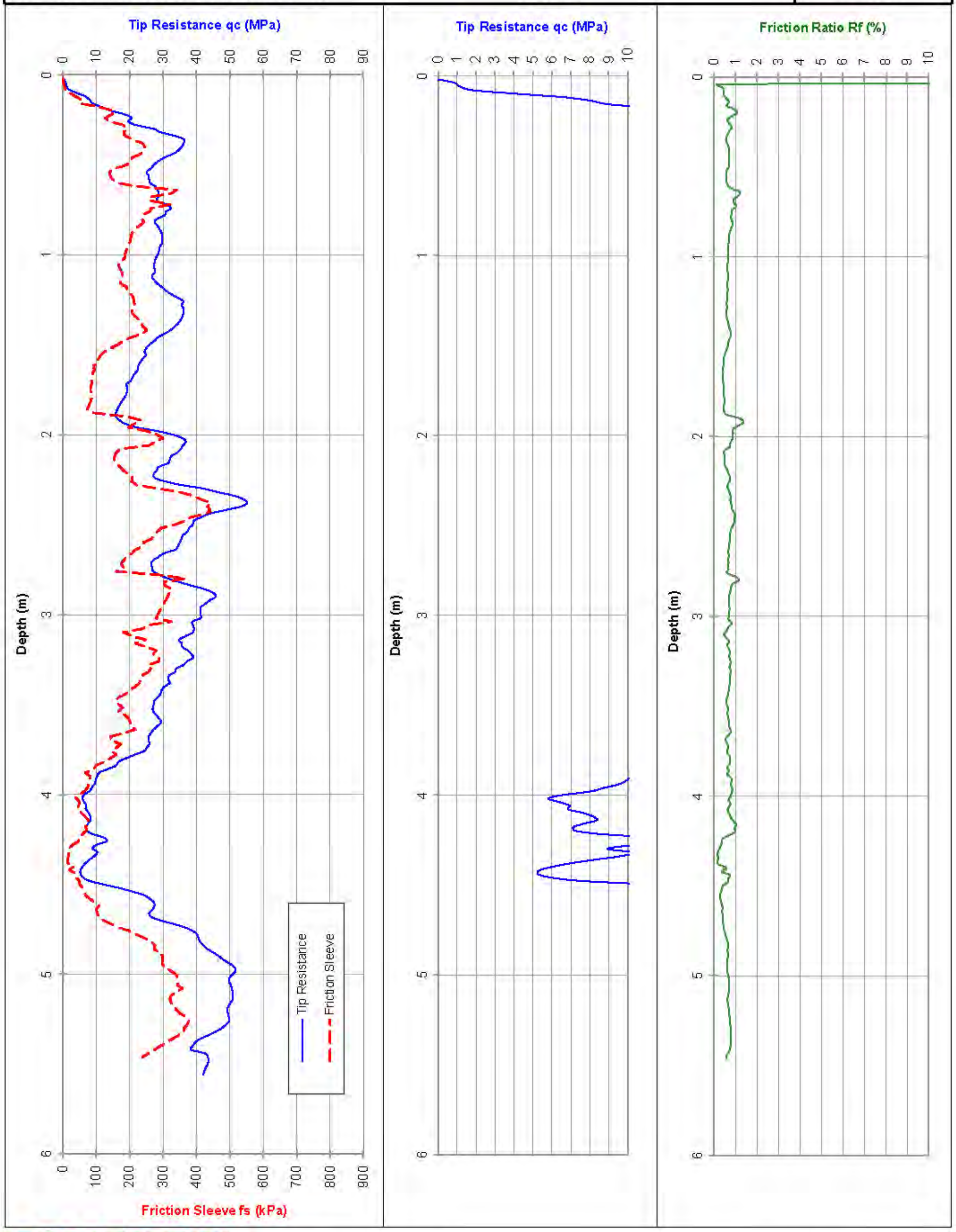
Refusal: Inclination

Cone I.D.: EC27

File: GL1121M2

Rig Type: 11t track (M2)

ELECTRIC FRICTION-CONE PENETROMETER		Probe I.D
CLIENT: Pritchard Francis	Job No.: WAG220004-02	CPT 03
PROJECT: Beaconsfield Residential Sub-Division	RL (m):	
LOCATION: Grosvenor Street, Beaconsfield	Co-ords:	28-Apr-23



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 4.3

Dummy probe to (m):

Refusal: Rod Friction

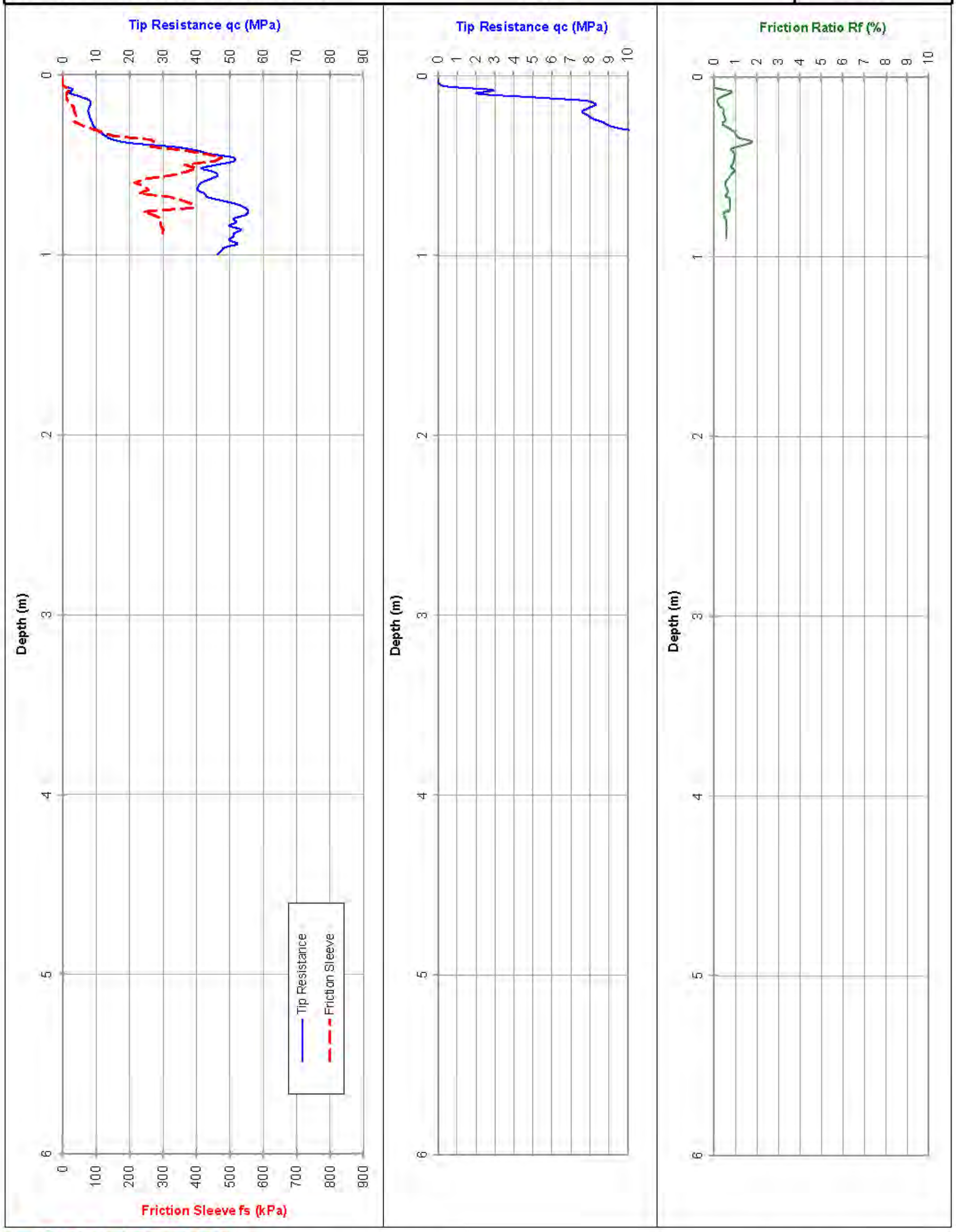
Cone I.D.: EC27

File: GL1122M2

Rig Type: 11t track (M2)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT:	Pritchard Francis	Job No.: WAG220004-02	Probe I.D
PROJECT:	Beaconsfield Residential Sub-Division	RL (m):	CPT 04
LOCATION:	Grosvenor Street, Beaconsfield	Co-ords:	28-Apr-23



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 0.8

Dummy probe to (m):

Refusal: Rod Friction

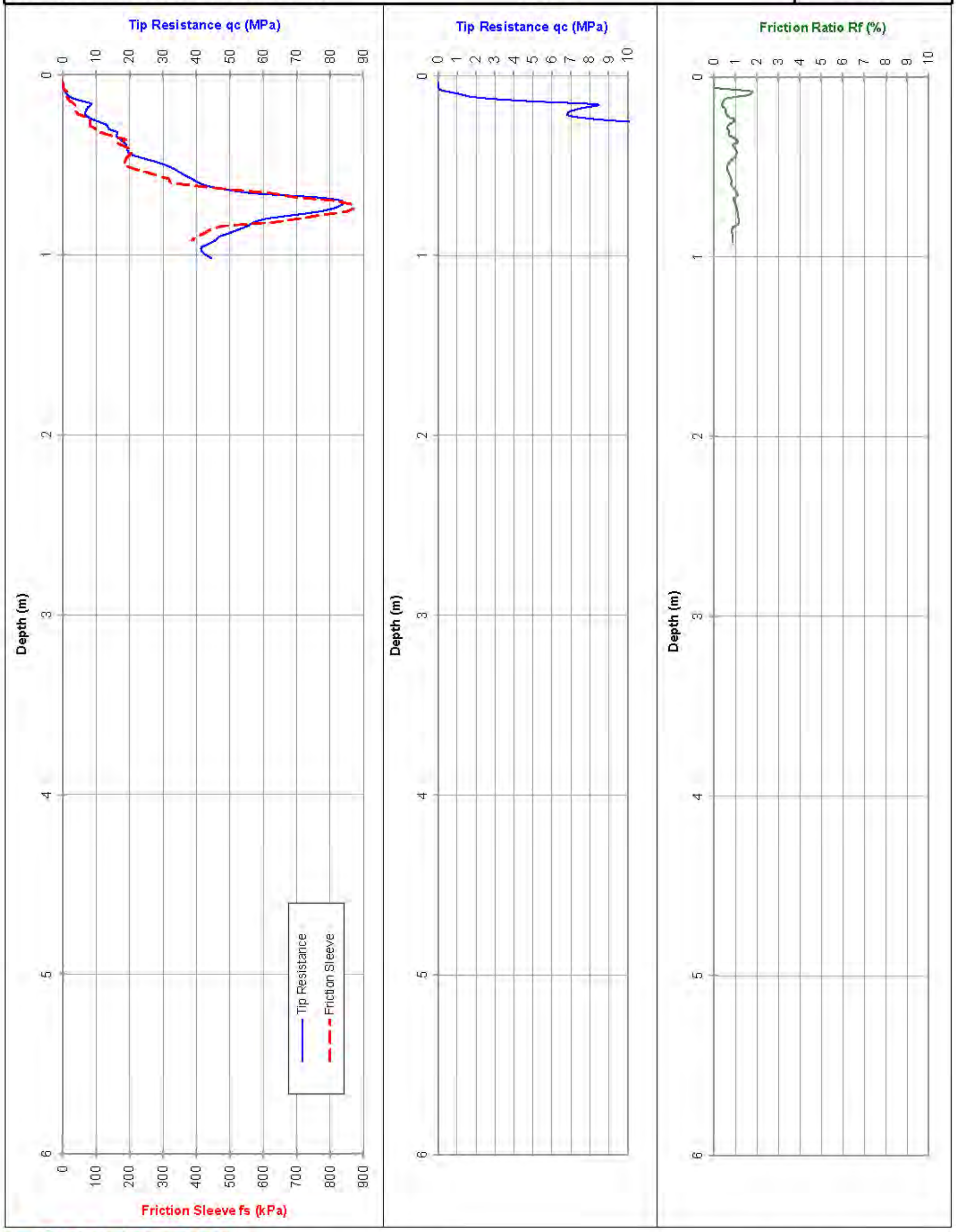
Cone I.D.: EC27

File: GL1125M2

Rig Type: 11t track (M2)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Pritchard Francis	Job No.: WAG220004-02	Probe I.D	CPT 05
PROJECT: Beaconsfield Residential Sub-Division	RL (m):		
LOCATION: Grosvenor Street, Beaconsfield	Co-ords:		28-Apr-23



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 1.0

Dummy probe to (m):

Refusal: Rod Friction

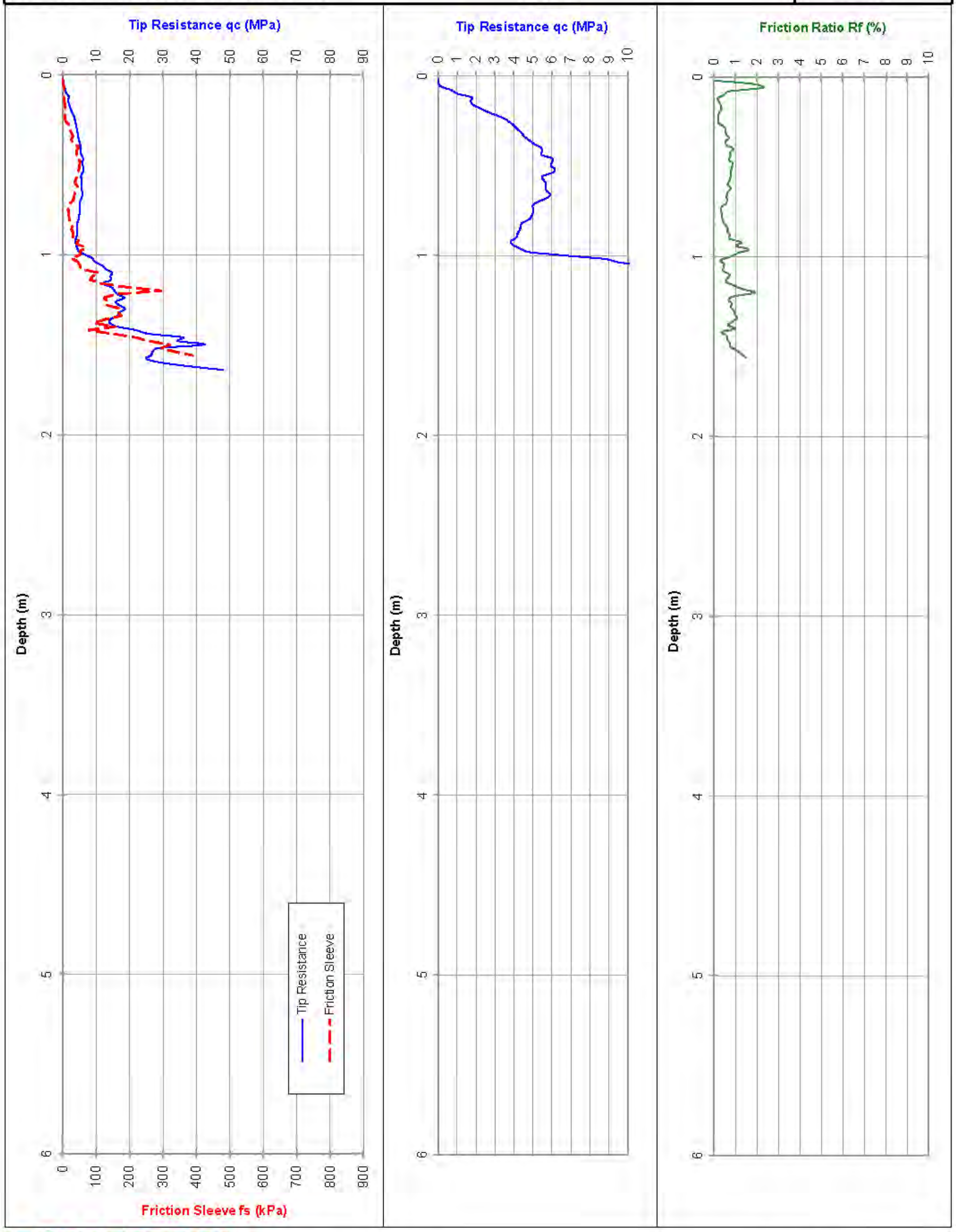
Cone I.D.: EC27

File: GL1123M2

Rig Type: 11t track (M2)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Pritchard Francis	Job No.: WAG220004-02	Probe I.D
PROJECT: Beaconsfield Residential Sub-Division	RL (m):	CPT 06
LOCATION: Grosvenor Street, Beaconsfield	Co-ords:	28-Apr-23



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 1.2

Dummy probe to (m):

Refusal: Inclination

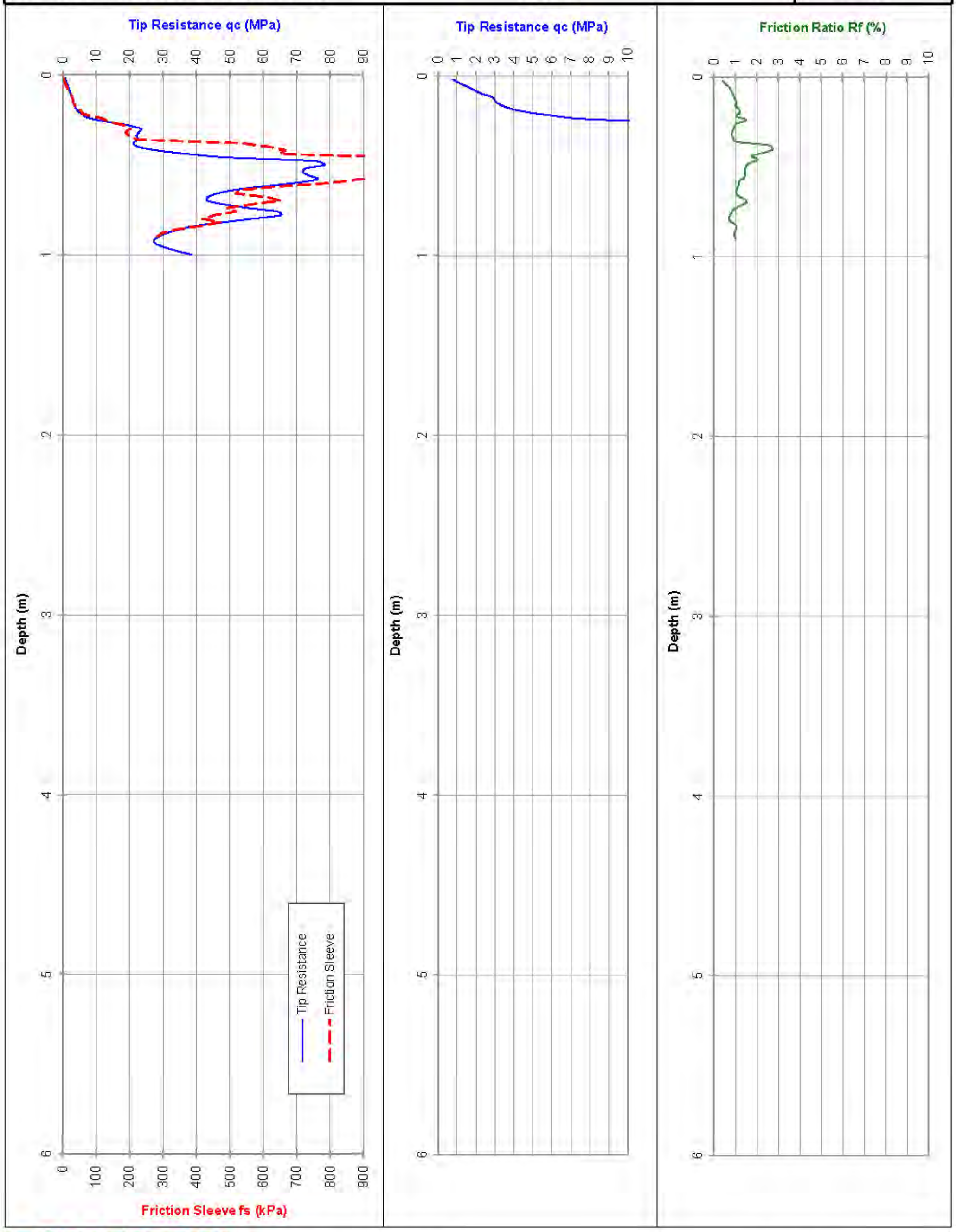
Cone I.D.: EC27

File: GL1126M2

Rig Type: 11t track (M2)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT:	Pritchard Francis	Job No.: WAG220004-02	Probe I.D
PROJECT:	Beaconsfield Residential Sub-Division	RL (m):	CPT 07
LOCATION:	Grosvenor Street, Beaconsfield	Co-ords:	28-Apr-23



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 0.7

Dummy probe to (m):

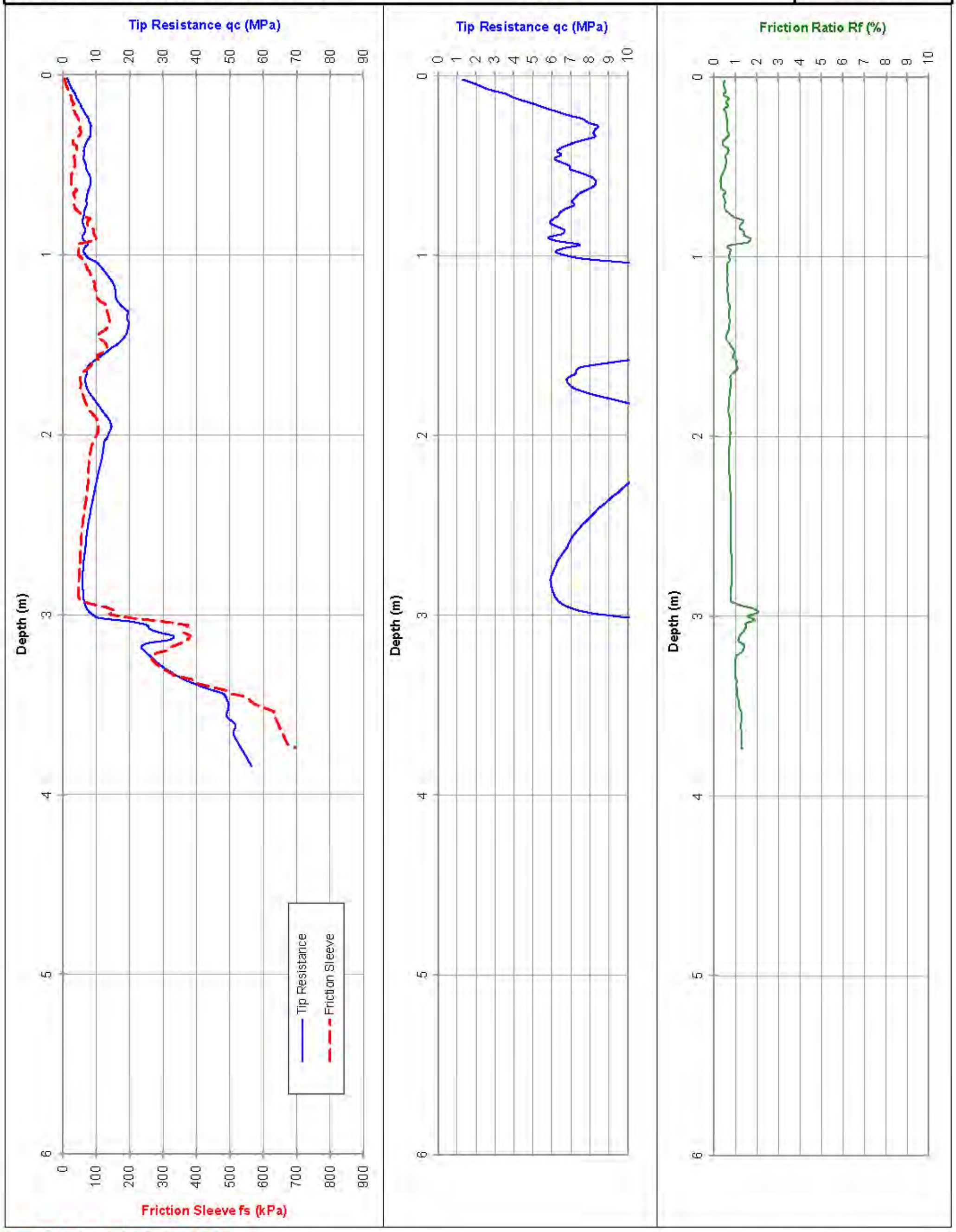
Refusal: Rod Friction

Cone I.D.: EC27

File: GL1127M2

Rig Type: 11t track (M2)

ELECTRIC FRICTION-CONE PENETROMETER		Probe I.D
CLIENT: Pritchard Francis	Job No.: WAG220004-02	CPT 08
PROJECT: Beaconsfield Residential Sub-Division	RL (m):	
LOCATION: Grosvenor Street, Beaconsfield	Co-ords:	28-Apr-23



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 3.0

Dummy probe to (m):

Refusal: Rod Friction

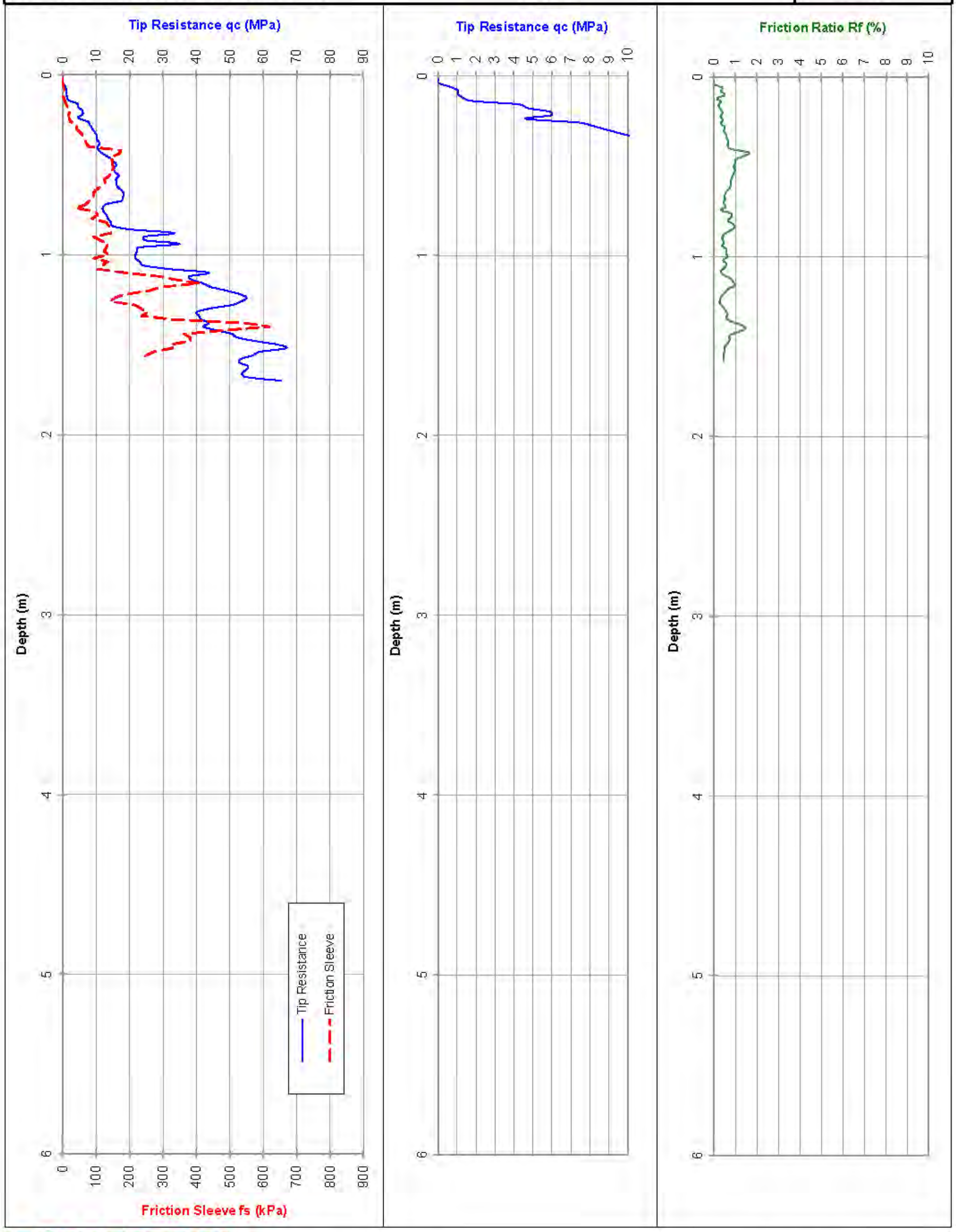
Cone I.D.: EC27

File: GL1124M2

Rig Type: 11t track (M2)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Pritchard Francis	Job No.: WAG220004-02	Probe I.D
PROJECT: Beaconsfield Residential Sub-Division	RL (m):	CPT 09
LOCATION: Grosvenor Street, Beaconsfield	Co-ords:	28-Apr-23



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 1.2

Dummy probe to (m):

Refusal: Rod Friction

Cone I.D.: EC27

File: GL1131M2

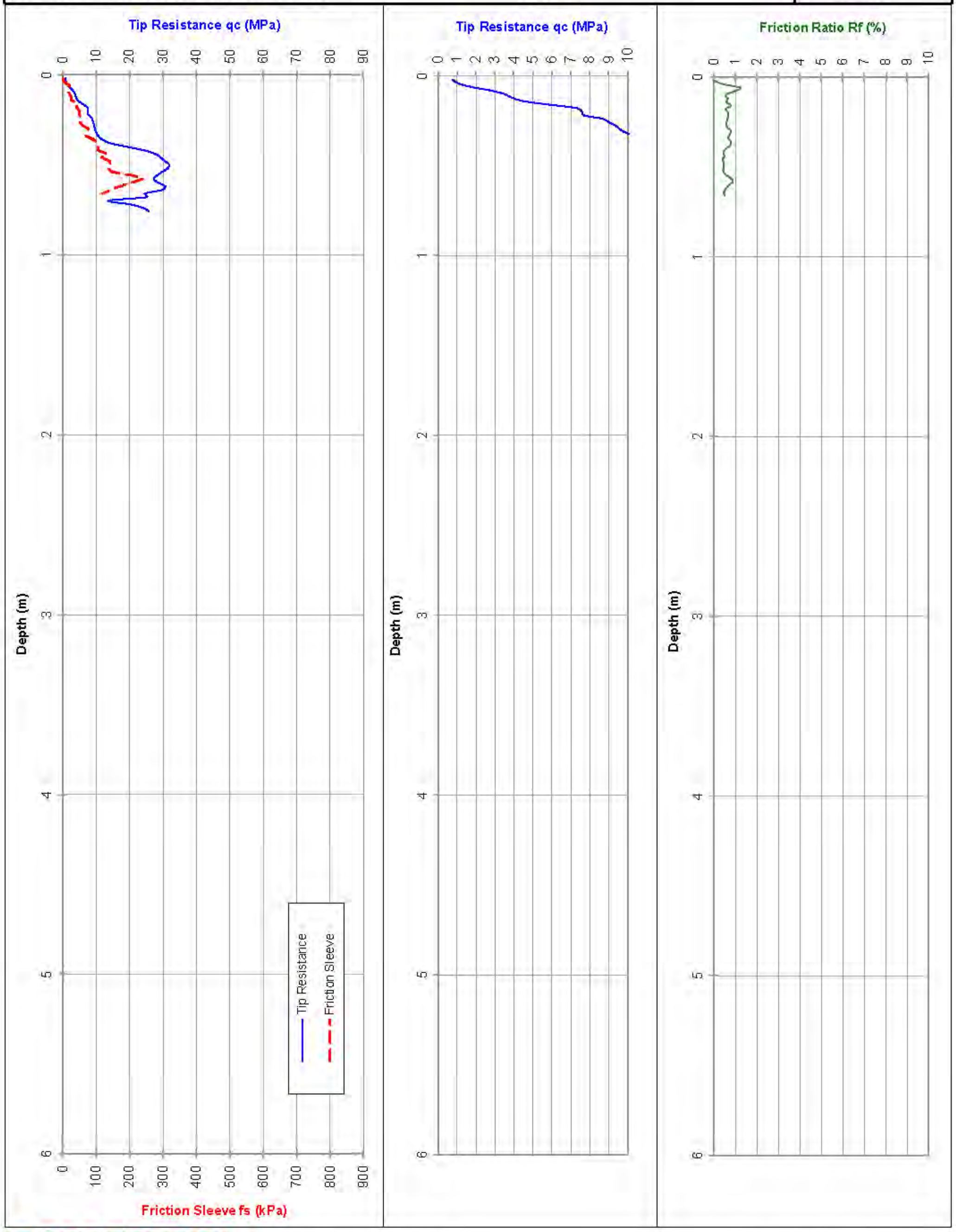
Rig Type: 11t track (M2)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Pritchard Francis
PROJECT: Beaconsfield Residential Sub-Division
LOCATION: Grosvenor Street, Beaconsfield

Job No.: WAG220004-02
RL (m):
Co-ords:

Probe I.D
CPT 10
28-Apr-23



PROBEDRILL GEOTECHNICAL SURVEY

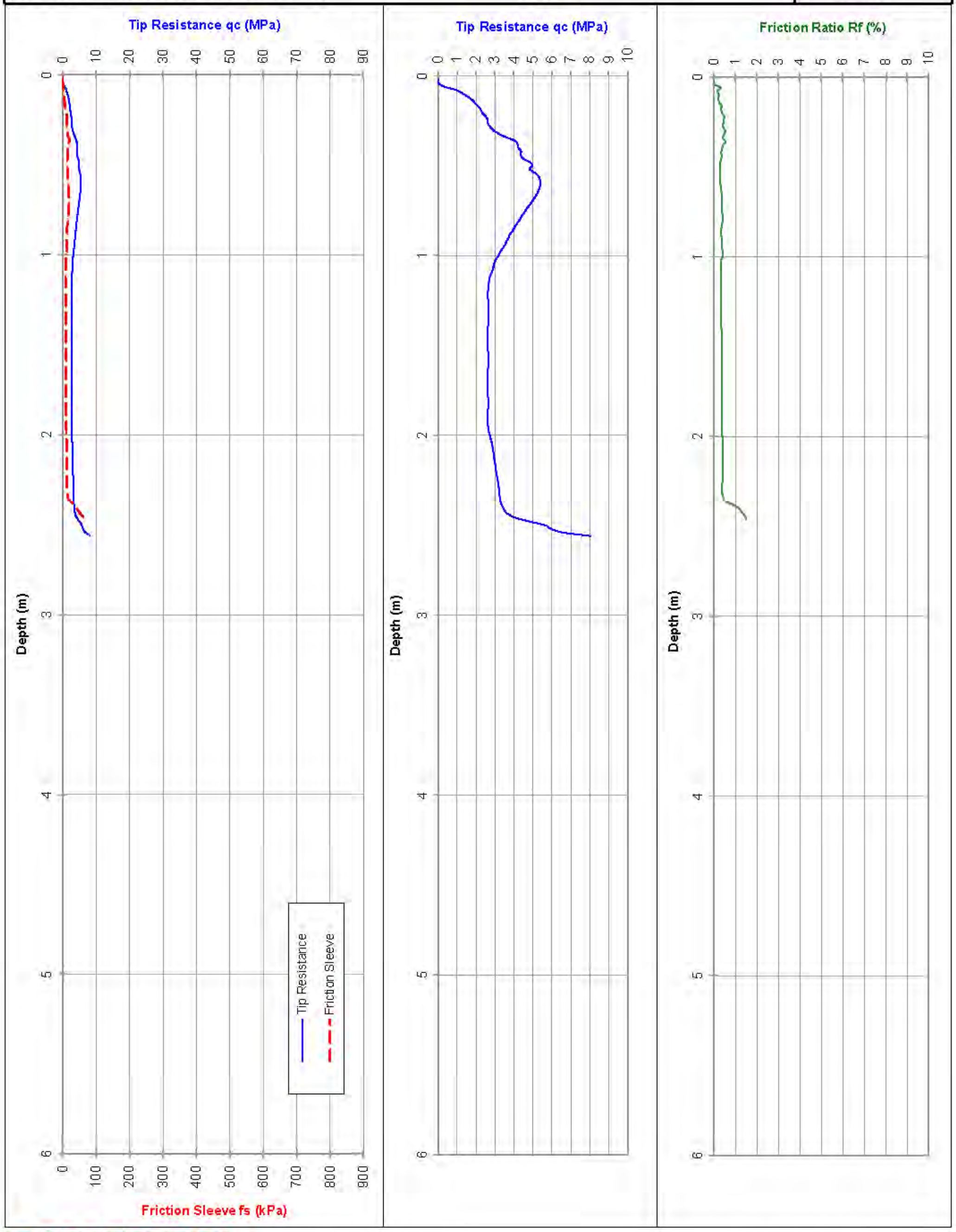
Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 0.5
Dummy probe to (m):
Refusal: Inclination

Cone I.D.: EC27
File: GL1128M2
Rig Type: 11t track (M2)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT:	Pritchard Francis	Job No.: WAG220004-02	Probe I.D
PROJECT:	Beaconsfield Residential Sub-Division	RL (m):	CPT 11
LOCATION:	Grosvenor Street, Beaconsfield	Co-ords:	28-Apr-23



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 2.3

Dummy probe to (m):

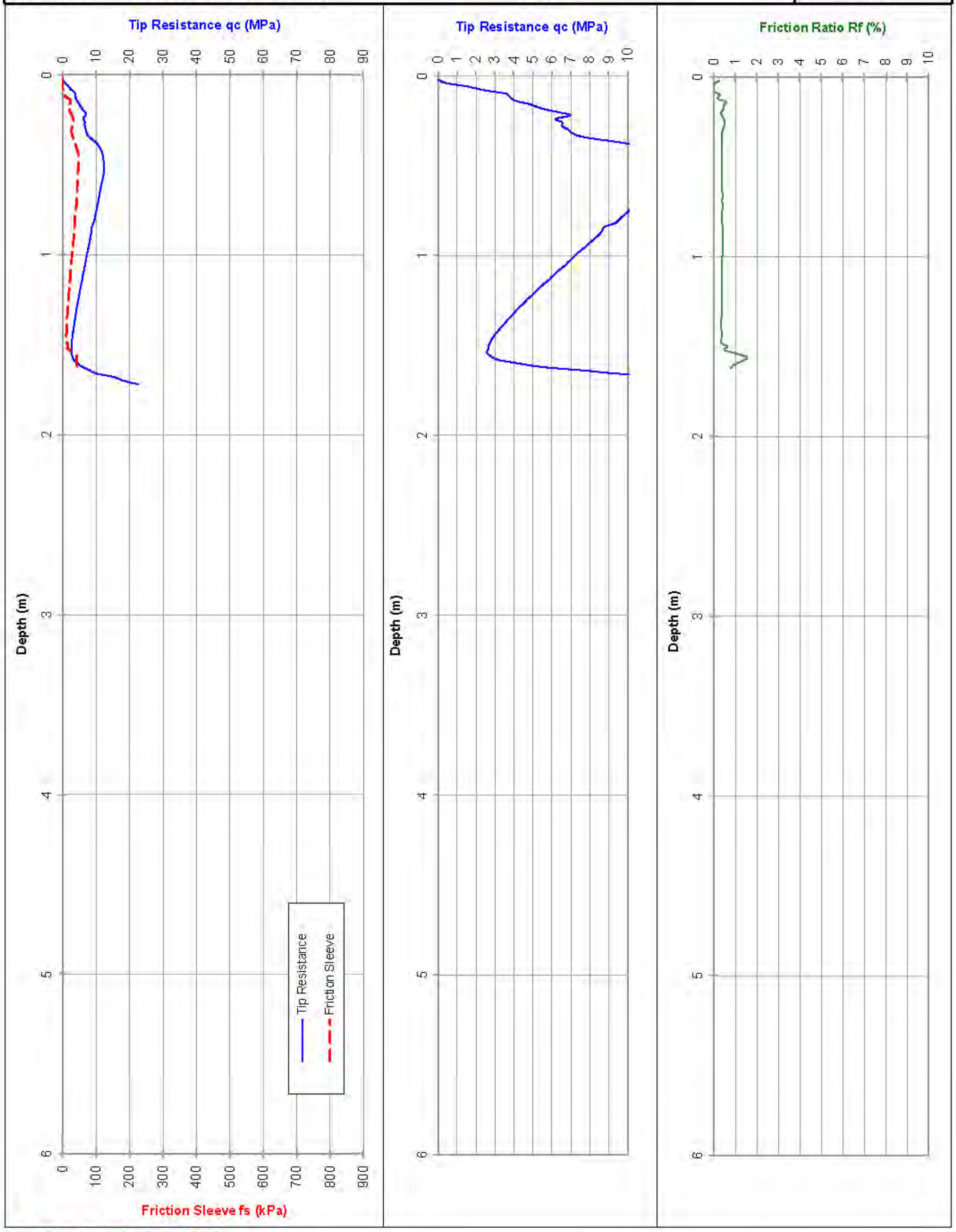
Refusal: Inclination

Cone I.D.: EC27

File: GL1130M2

Rig Type: 11t track (M2)

ELECTRIC FRICTION-CONE PENETROMETER		Probe I.D
CLIENT: Pritchard Francis	Job No.: WAG220004-02	CPT 12
PROJECT: Beaconsfield Residential Sub-Division	RL (m):	
LOCATION: Grosvenor Street, Beaconsfield	Co-ords:	28-Apr-23



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 1.2

Dummy probe to (m):

Refusal: Inclination

Cone I.D.: EC27

File: GL1129M2

Rig Type: 11t track (M2)

Appendix D: Test Pit Reports

METHOD OF SOIL DESCRIPTION
BOREHOLE AND TEST PIT REPORTS

GRAPHIC LOG & SOIL CLASSIFICATION SYMBOLS

Graphic	USCS	Soil Name	Graphic	USCS	Soil Name
		FILL (various types)		SM	Silty SAND
		COBBLES / BOULDERS		ML	SILT (low liquid limit)
	GP	GRAVEL (poorly graded)		MH	SILT (high liquid limit)
	GW	GRAVEL (well graded)		CL	CLAY (low plasticity)
	GC	Clayey GRAVEL		CI	CLAY (medium plasticity)
	GM	Silty GRAVEL		CH	CLAY (high plasticity)
	SP	SAND (poorly graded)		OL	Organic SILT (low liquid limit)
	SW	SAND (well graded)		OH	Organic SILT (high liquid limit)
	SC	Clayey SAND		Pt	PEAT

NOTE: Dual classification given for soils with a fines content between 5% and 12%.

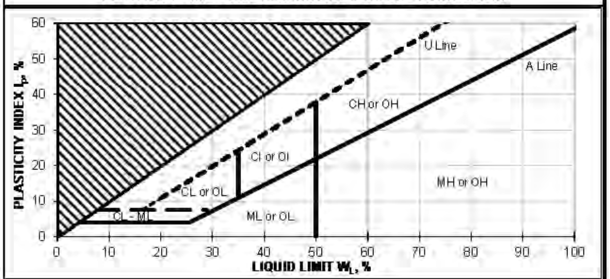
SOIL CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil descriptions are based on AS1726-2017. Material properties are assessed in the field by visual/tactile methods in combination with field and laboratory testing techniques (where used).

NOTE: AS 1726-2017 defines a fine grained soil where the total dry mass of fine fractions (<0.075 mm particle size) exceeds 35%.

PARTICLE SIZE		
Soil Name		Particle Size (mm)
BOULDERS		>200
COBBLES		63 to 200
GRAVEL	Coarse	19 to 63
	Medium	6.7 to 19
	Fine	2.3 to 6.7
SAND	Coarse	0.6 to 2.36
	Medium	0.21 to 0.6
	Fine	0.075 to 0.21
FINES	SILT	0.002 to 0.075
	CLAY	<0.002

PLASTICITY - MODIFIED CASAGRANDE CHART - AS1726-2017



RESISTANCE TO EXCAVATION		
Symbol	Term	Description
VE	Very easy	All resistances are relative to the selected method of excavation
E	Easy	
F	Firm	
H	Hard	
VH	Very hard	

MOISTURE CONDITION	
Symbol	Term
D	Dry
M	Moist
W	Wet

CEMENTATION	
Cementation	Description
Weakly cemented	Soil may be easily disaggregated by hand in air or water
Moderately cemented	Effort is required to disaggregate the soil by hand in air or water

CONSISTENCY		
Symbol	Term	Undrained Shear Strength (kPa)
VS	Very Soft	0 to 12
S	Soft	12 to 25
F	Firm	25 to 50
St	Stiff	50 to 100
VSt	Very Stiff	100 to 200
H	Hard	>200

ORGANIC SOILS	
Material	Organic Content % of dry mass
Inorganic soil	<2%
Organic soil	2% to 25%
Peat	>25%

DENSITY		
Symbol	Term	Density Index (%)
VL	Very Loose	<15
L	Loose	15 to 35
MD	Medium Dense	35 to 65
D	Dense	65 to 85
VD	Very Dense	>85

EXPLANATORY NOTES TO BE READ WITH BOREHOLE AND TEST PIT REPORTS

Galt

METHOD OF DRILLING OR EXCAVATION

AC	Air Core	E	Excavator	PQ3	PQ3 Core Barrel
AD/T	Auger Drilling with TC-Bit	EH	Excavator with Hammer	PT	Push Tube
AD/V	Auger Drilling with V-Bit	HA	Hand Auger	R	Ripper
AT	Air Track	HMLC	HMLC Core Barrel	RR	Rock Roller
B	Bulldozer Blade	HQ3	HQ3 Core Barrel	SON	Sonic Rig
BH	Backhoe Bucket	N	Natural Exposure	SPT	Driven SPT
CT	Cable Tool	NMLC	NMLC Core Barrel	WB	Washbore
DT	Diatube	PP	Push Probe	X	Existing Excavation

SUPPORT

T	Timbering

PENETRATION EFFORT (RELATIVE TO THE EQUIPMENT USED)

VE	Very Easy	E	Easy	F	Firm
H	Hard	VH	Very Hard		

WATER

►	Water Inflow	▼	Water Level
◄	Water Loss (complete)		
◁	Water Loss (partial)		

SAMPLING AND TESTING

B	Bulk Disturbed Sample	P	Piston Sample
BLK	Block Sample	PBT	Plate Bearing Test
C	Core Sample	U	Undisturbed Push-in Sample
CBR	CBR Mould Sample		U50: 50 mm diameter
D	Small Disturbed Sample	SPT	Standard Penetration Test
ES	Environmental Soil Sample		Example: 3, 4, 5 N=9
EW	Environmental Water Sample		3,4,5: Blows per 150 mm
G	Gas Sample		N=9: Blows per 300 mm after
HP	Hand Penetrometer		150 mm seating interval
LB	Large Bulk Disturbed Sample	VS	Vane Shear; P = Peak
M	Mazier Type Sample		R = Remoulded (kPa)
MC	Moisture Content Sample	W	Water Sample

ROCK CORE RECOVERY

TCR = Total Core Recovery (%) $= \frac{CRL}{TCL} \times 100$

RQD = Rock Quality Designation (%) $= \frac{ALC>100}{TCL} \times 100$

TCL	Length of Core Run
CRL	Length of Core Recovered
ALC>100	Total Length of Axial Lengths of Core Greater than 100 mm Long

TEST PIT: TP01

Sheet 1 OF 1

Job Number: WAG220004-01		**Contractor:** ANH Contracting		**Date:**	27/04/2023
Client: Pritchard Francis		**Machine:** JCB 3CX		**Logged:**	PF
Project: Geotechnical Study		**Operator:** Neil		**Checked Date:**	11/05/2023
Location: Grosvenor Street, Beaconsfield		**Bucket:** 3 m toothed		**Checked By:**	SC

METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	E-F		0.0 – 1.5					SP-SM	FILL: Silty SAND, fine to coarse grained, sub-rounded to sub-angular, pale yellow/brown, 5-10% non-plastic fines, trace cobbles, trace gravel, trace organics	M	D	
E	F-E		1.5 – 3.0					SP	FILL: Gravelly SAND: fine to medium grained, sub-angular to sub-rounded, orange/brown with depth, limestone gravel, fine to coarse grained, sub-angular to sub-rounded gravel (20-30%), trace cobbles, trace fines Thin layer of brown sand (from 2.5 m)	D - M		
			3.0						Hole terminated at 3.00 m Target depth Groundwater not encountered			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

TEST PIT: TP02

Sheet 1 OF 1

Job Number:	WAG220004-01	**Contractor:**	ANH Contracting	**Date:**	27/04/2023
Client:	Pritchard Francis	**Machine:**	JCB 3CX	**Logged:**	PF
Project:	Geotechnical Study	**Operator:**	Neil	**Checked Date:**	11/05/2023
Location:	Grosvenor Street, Beaconsfield	**Bucket:**	3 m toothed	**Checked By:**	SC

Excavation					Sampling	Field Material Description						
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	F		0.0 – 2.3					SP-SM	FILL: Silty SAND, fine to coarse grained, sub-rounded to sub-angular, pale brown, 5-10% non-plastic fines, trace cobbles, trace gravel, trace organics	D - M	VD (0.0–0.75); D (0.75–3.0)	
	E		2.3 – 3.0					SP	FILL: Gravelly SAND, fine to medium grained, sub-angular to sub-rounded, orange to brown sand, limestone gravel, fine to coarse grained, sub-angular to sub-rounded, trace cobbles, trace fines			
			3.0						Hole terminated at 3.00 m Target depth Groundwater not encountered			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

Galt GEOTECHNICS

TEST PIT: TP03

Job Number: WAG220004-01
Client: Pritchard Francis
Project: Geotechnical Study
Location: Grosvenor Street, Beaconsfield

Contractor: ANH Contracting
Machine: JCB 3CX
Operator: Neil
Bucket: 3 m toothed

Date: 27/04/2023
Logged: PF
Checked Date: 11/05/2023
Checked By: SC

METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	E		0.0		B(TP03-1)			SP-SM	Silty SAND: fine to coarse grained, sub-rounded to sub-angular, pale brown, 5-10% non-plastic fines, trace cobbles, trace gravel, trace organics	D - M	VD	
	F		0.5					SP-GP	SAND/LIMESTONE mix: SAND, fine to medium grained, sub-angular to sub-rounded, yellow, trace fines LIMESTONE (70%), fine to medium grained, white, weakly to well cemented, low to medium strength, highly to moderately weathered, excavated as Sandy Gravelly COBBLES with boulders, sub-angular to sub-rounded, white limestone and yellow sand, fine to coarse grained, sub-angular to sub-rounded gravel (30%), fine to medium grained, sub-angular to sub-rounded sand (20-30%), with sub-angular boulders, trace fines			
	F-H		1.5						LIMESTONE: fine to medium grained, white, weakly to well cemented, low to medium strength, moderately to well cemented, recovered as gravel, cobbles and boulders in a sandy matrix			
			2.0						Hole terminated at 2.00 m Target depth Groundwater not encountered			
			2.5									
			3.0									

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

TEST PIT: TP04

Sheet 1 OF 1

Job Number:	WAG220004-01	**Contractor:**	ANH Contracting	**Date:**	27/04/2023
Client:	Pritchard Francis	**Machine:**	JCB 3CX	**Logged:**	PF
Project:	Geotechnical Study	**Operator:**	Neil	**Checked Date:**	11/05/2023
Location:	Grosvenor Street, Beaconsfield	**Bucket:**	3 m toothed	**Checked By:**	SC

Excavation					Sampling	Field Material Description						
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	E		0.0					GP	FILL: Sandy GRAVEL, fine to coarse grained, sub-rounded to rounded lateritic and limestone gravel, fine to coarse grained, sub-angular to sub-rounded sand (20-30%), trace fines	M	VD	
	F-H		0.5 – 1.0						LIMESTONE: fine to medium grained, sub-angular to sub-rounded, yellow/white, moderately to well cemented, moderately to slightly weathered, low to hard strength, recovered as gravels and cobbles in a sandy matrix	D - M		
			1.5 – 3.0						Hole terminated at 1.10 m Refusal on limestone Groundwater not encountered			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

TEST PIT: TP05

Sheet 1 OF 1

Job Number: WAG220004-01	**Contractor:** ANH Contracting	**Date:** 27/04/2023	
Client: Pritchard Francis	**Machine:** JCB 3CX	**Logged:** PF	
Project: Geotechnical Study	**Operator:** Neil	**Checked Date:** 11/05/2023	
Location: Grosvenor Street, Beaconsfield	**Bucket:** 3 m toothed	**Checked By:** SC	

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	E		0.0		B(TP05-1)			SP-SM	Gravelly SAND with organics, fine to coarse grained, sub-angular to sub-rounded, pale brown, fine to coarse grained, sub-rounded to rounded gravel, with organics, with fines		D	Adjacent to big palmtrees, lots of roots at topsoil
	F-H		0.5					SP-GP	SAND to LIMESTONE mix: SAND (30%), fine to medium grained, sub-angular to sub-rounded, yellow, trace fines LIMESTONE (70%), fine to medium grained, white, low to medium strength, moderately to well cemented, slightly weathered Excavated as Sandy Gravelly COBBLES: sub-angular to sub-rounded, white limestone and yellow sand, fine to coarse grained, sub-angular to sub-rounded gravel (30%), fine to medium grained, sub-angular to sub-rounded sand (20-30%), with sub-angular boulders, trace fines	M	VD	
	H		1.0						LIMESTONE: fine to medium grained, white, moderately to well cemented, slightly weathered, medium to high strength, recovered as gravels and cobbles in a sandy matrix			
			1.5						Hole terminated at 1.20 m Refusal on limestone Groundwater not encountered			
			2.0									
			2.5									
			3.0									

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

TEST PIT: TP06

Sheet 1 OF 1

Job Number:	WAG220004-01	**Contractor:**	ANH Contracting	**Date:**	27/04/2023
Client:	Pritchard Francis	**Machine:**	JCB 3CX	**Logged:**	PF
Project:	Geotechnical Study	**Operator:**	Neil	**Checked Date:**	11/05/2023
Location:	Grosvenor Street, Beaconsfield	**Bucket:**	3 m toothed	**Checked By:**	SC

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	F-H		0.0					SP-SM	FILL: Gravelly SAND/Sandy GRAVEL: fine to medium grained, sub-angular to sub-rounded, pale brown, fine to coarse grained, sub-angular to sub-rounded gravel (40-60%), with fines	M	VD	
	H		0.5						LIMESTONE: fine to medium grained, sub-angular to sub-rounded, white, weakly to well cemented, moderate to slightly weathered, low to medium strength, excavated as Sandy GRAVEL with cobbles, fine to coarse grained, sub-angular to sub-rounded, white, fine to medium grained, sub-angular to sub-rounded cobbles	D - M		
			1.0									
			1.5									
			2.0									
			2.5									
			3.0						Hole terminated at 3.00 m Refusal on limestone Groundwater not encountered			

Sketch & Other Observations


Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

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TEST PIT: TP07

Sheet 1 OF 1

Job Number: WAG220004-01	**Contractor:** ANH Contracting	**Date:** 27/04/2023
Client: Pritchard Francis	**Machine:** JCB 3CX	**Logged:** PF
Project: Geotechnical Study	**Operator:** Neil	**Checked Date:** 11/05/2023
Location: Grosvenor Street, Beaconsfield	**Bucket:** 3 m toothed	**Checked By:** SC

Excavation					Sampling	Field Material Description						
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	E		0.0		B(TP07-1)			SP	Gravelly SAND, fine to medium grained, sub-angular to sub-rounded, brown, fine to coarse grained, sub-rounded gravel (30%), trace fines, trace organics	M	VD	
	F-H		0.5 – 1.0					GP-SP	SAND(60%), LIMESTONE MIX (40%) SAND, fine to medium grained, sub-angular to sub-rounded, orange, trace fines LIMESTONE: fine to medium grained, sub-angular to sub--rounded, white, moderately to well cemented, moderately to slightly weathered, low to high strength Excavated as Gravelly SAND with COBBLES: fine to medium grained, sub-angular to sub-rounded, yellow orange, fine to coarse grained, sub-angular to sub-rounded white limestone, with sub-angular cobbles, trace fines	D - M		
			1.5 – 3.0						Hole terminated at 1.30 m Refusal on limestone Groundwater not encountered			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

GALT LIB 1.01.GLB Log GG_EXCAVATION WAG220004-01.GPJ <<DrawingFile>> 12/05/2023 15:08 10.02.00.04 Datgel DGD, CPT, Photo, Monitoring Tools | Lib: GALT 1.01 2013-02-21 Prj: GALT 1.01 2013-02-21

TEST PIT: TP08

Job Number:	WAG220004-01	**Contractor:**	ANH Contracting	**Date:**	27/04/2023
Client:	Pritchard Francis	**Machine:**	JCB 3CX	**Logged:**	PF
Project:	Geotechnical Study	**Operator:**	Neil	**Checked Date:**	11/05/2023
Location:	Grosvenor Street, Beaconsfield	**Bucket:**	3 m toothed	**Checked By:**	SC

Excavation					Sampling	Field Material Description						
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	E-F		0.0		B(TP08-1)			GP	FILL: Sandy GRAVEL, fine to coarse grained, sub-angular to sub-rounded, pale brown/white, fine to medium grained, sub-angular to sub-rounded sand (30%), trace fines	M	VD	Plastic observed, gravel size concrete and blue metal, plastic pvc pipe
	F-H		0.5					SP-GP	SAND: (50%)/LIMESTONE (50%) MIX: SAND, fine to medium grained, sub-angular to sub-rounded, pale brown, trace fines LIMESTONE: fine to medium grained, white, weakly to well cemented, highly to slightly weathered, low to medium strength Excavated as Sandy GRAVEL with cobbles: fine to coarse grained, sub-rounded, pale brown/white, fine to medium grained, sub-angular to sub-rounded sand (30-40%), with sub-angular gravel, trace boulders, trace fines	D - M		
	H		1.0									
			1.5						Hole terminated at 1.30 m Refusal on limestone Groundwater not encountered			
			2.0									
			2.5									
			3.0									

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

GALT LIB 1.01.GLB Log GG_EXCAVATION WAG220004-01.GPJ <<DrawingFile>> 12/05/2023 15:08 10.02.00.04 Datgel DGD, CPT, Photo, Monitoring Tools | Lib: GALT 1.01 2013-02-21 Prj: GALT 1.01 2013-02-21

TEST PIT: TP09

Sheet 1 OF 1

Job Number:	WAG220004-01	**Contractor:** ANH Contracting		**Date:**	27/04/2023
Client:	Pritchard Francis	**Machine:** JCB 3CX		**Logged:**	PF
Project:	Geotechnical Study	**Operator:** Neil		**Checked Date:**	11/05/2023
Location:	Grosvenor Street, Beaconsfield	**Bucket:** 3 m toothed		**Checked By:**	SC

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	E		0.0					SP	FILL: Gravelly SAND, fine to medium grained, sub-angular to sub-rounded, pale brown, fine to coarse grained, sub-angular to sub-rounded gravel (20-30%), trace fines, trace organics	M	VD	Large roots (30 mm) in upper 200 mm
	F		0.5					GP	FILL: Sandy GRAVEL, fine to coarse grained, sub-rounded to rounded, pale brown/white, fine to medium grained, sub-angular to sub-rounded sand (30-40%), trace fines	D - M		
	E-F		1.0 / 1.5					SP	SAND: fine to medium grained, sub-angular to sub-rounded, yellow, trace fines, trace gravel, weakly to moderately cemented sand			Possible old topsoil layer
	F		2.0 / 2.5									
			3.0						Hole terminated at 3.00 m Target depth Groundwater not encountered			

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

TEST PIT: TP10

Sheet 1 OF 1

Job Number:	WAG220004-01	**Contractor:**	ANH Contracting	**Date:**	27/04/2023
Client:	Pritchard Francis	**Machine:**	JCB 3CX	**Logged:**	PF
Project:	Geotechnical Study	**Operator:**	Neil	**Checked Date:**	11/05/2023
Location:	Grosvenor Street, Beaconsfield	**Bucket:**	3 m toothed	**Checked By:**	SC

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	SOIL CLASS	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
E	E-F		0.0					SP-SM	FILL: Gravelly SAND, fine to medium grained, sub-angular to sub-rounded, brown, fine to coarse grained, sub-rounded gravel (30%), with fines, trace cobbles, trace boulder	M		300-400 mm boulder
	H		0.5						LIMESTONE: fine to medium grained, white, moderately to well cemented, moderately to slightly weathered, low to high strength, recovered as boulders, cobbles and gravel in a sandy matrix	D - M		
			1.0						Hole terminated at 0.90 m Refusal on limestone Groundwater not encountered			
			1.5									
			2.0									
			2.5									
			3.0									

Sketch & Other Observations

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

Appendix E: Perth Sand Penetrometer Test Results

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50 Edward Street OSBORNE PARK WA 6017

ABN: 64 625 054 729

PERTH SAND PENETROMETER FIELD TEST DATA
(AS 1289.6.3.3)

Client: Pritchard Francis
Project: Grosevnor Street
Location: Beaconsfield
Job No: WAG220004-01
Date: 27-Apr-23
Engineer: PF

Test No:	PSP1	PSP2	PSP3	PSP4	PSP5	PSP6	PSP7	PSP8
Location:	TP01	TP02	TP03	TP04	TP05	TP06	TP07	TP08
Depth (mm)	**Nº of Penetrometer Blows per 150 mm Depth Interval**							
0-150	SET	SET	SET	SET	SET	SET	SET	SET
150-300	7	15+	10	15	3	12	9	11
300-450	7	14	10	15+	6	15+	12	10
450-600	7	11	15+		11		15	15+
600-750	5	7			7		15+	
750-900	4	6			15+			
900-1050	10	6						
1050-1200								
1200-1350								
1350-1500								
1500-1650								
1650-1800								

Test No:	PSP9	PSP10						
Location:	TP09	TP10						
Depth (mm)	**Nº of Penetrometer Blows per 150 mm Depth Interval**							
0-150	SET	SET						
150-300	5	4						
300-450	15	8HB						
450-600	15+							
600-750								
750-900								
900-1050								
1050-1200								
1200-1350								
1350-1500								
1500-1650								
1650-1800								

Perth Sand Penetrometer tests done in accordance with AS 1289.6.3.3 (except blow counts are reported per 150 mm, rather than 300 mm)
HB: Hammer bounce (refusal)
0= Penetration due to hammer weight only
R: Refusal

Appendix F: Borehole Logs

ROCK STRENGTH, WEATHERING AND DEFECTS

STRENGTH

SYMBOL	TERM	UNIAXIAL COMPRESSIVE STRENGTH MPa	POINT LOAD STRENGTH INDEX $I_{s(50)}$ MPa	FIELD ASSESSMENT
VL	Very Low	0.6 to 2	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; too hard to cut a triaxial sample by hand. Pieces up to 30 mm thick can be broken by finger pressure.
L	Low	2 to 6	0.1 to 0.3	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
M	Medium	6 to 20	0.3 to 1	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.
H	High	20 to 60	1 to 3	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken by a pick with a single blow; rock rings under hammer.
VH	Very High	60 to 200	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
EH	Extremely High	more than 200	more than 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

NOTE: The strength of rock is based on the uniaxial compressive strength (UCS). Where adequate UCS test data is not available, classification of strength may be made on the basis of the point load strength index ($I_{s(50)}$).

WEATHERING

SYMBOL	TERM	DEFINITION
RS	Residual Soil	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
XW	Extremely Weathered	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
HW	Highly Weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
MW	Moderately Weathered	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable, but shows little or no change of strength from fresh rock.
SW	Slightly Weathered	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fr	Fresh	Rock shows no sign of decomposition of individual minerals or colour changes.

NOTE: The term 'Distinctly Weathered' may be used where it is not practicable to distinguish between 'Highly Weathered' and 'Moderately Weathered' rock. 'Distinctly Weathered' is defined as follows: 'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores'. There is some change in rock strength.

DEFECTS

ROCK DEFECTS

P	Parting
J	Joint
SSu	Sheared Surface
SZ	Sheared Zone
SS	Sheared Seam
CS	Crushed Seam
IS	Infilled Seam
WS	Extremely Weathered Seam
DI	Drilling induced break/fracture

TEXTURE / FABRIC

B	Bedding
La	Lamination
F	Foliation
Cl	Cleavage
Fl	Flow Banding
V	Vein

COATING / INFILLING

Cn	Clean
St	Stained
Vn	Veneer
Ct	Coating

SURFACE ROUGHNESS

VR	Very rough
Ro	Rough
Sm	Smooth
Po	Polished
Sl	Slickensided

SURFACE SHAPE

Pl	Planar
Cr	Curved
Un	Undulating
St	Stepped
Ir	Irregular

CORE DRILLING DETAILS

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
TCR	Total Core Recovery	TOR	Top of Run
RQD	Rock Quality Designation	BOR	Bottom of Run

BOREHOLE: BH01

Sheet 1 OF 1

Job Number: WAG220004-01	**Contractor:** SM	**Date:** 15/05/2023	
Client: Pritchard Francis	**Drill Rig:** Hanjin D8	**Logged:** AM	
Project: Proposed Sub-Division	**Inclination:** -90°	**Checked Date:** 25/05/2023	
Location: Grosvenor Street, Beaconsfield		**Checked By:** TM	

DRILLING | MATERIAL | FRACTURES

Drilling & Casing	Water	Core Run Details	Samples & Field Tests	Depth (m)	Soil Class	Description: ROCK TYPE : Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, etc as applicable) START CORING AT 0.00m	Additional Data (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
HQ3 (0.0–5.0)		TCR=60% SCR=60% RQD=8%; 1.50		0.00–0.60	SP-SM	Inferred FILL: SAND, fine to medium grained, sub-angular to sub-rounded, pale yellow, with gravel, with low plasticity fines	Moisture and insitu density not measured Core Loss 0.00-06.00
				0.60m–1.10		LIMESTONE: fine to coarse grained, pale yellow recovered as GRAVEL, with non-plastic fines	
		TCR=100% SCR=100% RQD=45%; 1.50		1.10m–3.50		LIMESTONE: fine to coarse grained, pale yellow, some bedding at about 0 to 30 degrees, some vugs	1.10-5.00: Defects at about 20 mm to 200 mm centers, and are typically seams and partings at about 0 to 30 degrees, 1 mm to 50 mm thick, rough, undular, clean or infilled with sand and / or gravel
		TCR=100% SCR=100% RQD=17%; 1.50		3.50m–5.00m		Medium strength	
				5.00		Hole terminated at 5.00 m Target depth Groundwater not measured due to drill mud	

Weathering | Estimated Strength Is(50) ○ - Axial □ - Diametral △ - Irregular: EL VL L M H VH EH | Natural Fracture (mm): 20 60 200 600 2000 | Visual

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

PointID : BH01 Depth Range: 0.00 - 5.00 m - smart

	TITLE		
Galt GEOTECHNICS	Pritchard Francis Grosvenor Street, Beaconsfield Proposed Sub-Division Core Photo - BH01	DRAWN	DATE 19/05/2023
		CHECKED	DATE 19/05/2023
		SCALE Not To Scale	A4
		PROJECT No WAG220004-01	FIGURE No 1/1

BOREHOLE: BH02

Sheet 1 OF 1

Job Number:	WAG220004-01	**Contractor:**	SM	**Date:**	15/05/2023
Client:	Pritchard Francis	**Drill Rig:**	Hanjin D8	**Logged:**	AM
Project:	Proposed Sub-Division	**Inclination:**	-90°	**Checked Date:**	25/05/2023
Location:	Grosvenor Street, Beaconsfield			**Checked By:**	

DRILLING: PROGRESS (DRILLING & CASING, WATER), CORE RUN DETAILS, SAMPLES & FIELD TESTS, DEPTH (m)

MATERIAL: GRAPHIC LOG, SOIL CLASS, DESCRIPTION — ROCK TYPE: Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, etc as applicable) START CORING AT 0.00m; Weathering; ESTIMATED STRENGTH Is(50) (○ - Axial, □ - Diametral, △ - Irregular) EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH

FRACTURES: NATURAL FRACTURE (mm) 20 100 300 1000 3000; VISUAL; ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other

Depth (m)	Drilling & Casing	Core Run Details	Description	Additional Data
0.00	HQ3	TCR=100% SCR=99% RQD=93%	Concrete Hardstand	
0.40m			LIMESTONE: fine to coarse grained, pale yellow, some typically sub horizontal bedding, some vugs	0.40-3.00: Defects at about 20 mm to 200 mm centres, and are typically partings and some seams, sub horizontal, 1 mm to 50 mm thick, undulat, clean or infilled with sand and / or gravel
1.50		1.50 / TCR=100% SCR=100% RQD=95%		
3.00		1.50 / TCR=100% SCR=100% RQD=40%		3.00-5.00: Defects as described above with spacing typically about 30 mm to 100 mm centres
4.50		1.50		
5.00m			Hole terminated at 5.00 m Target depth Groundwater not measured due to drill mud	

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

PointID : BH02 Depth Range: 0.00 - 5.00 m - smart

	TITLE		
Galt GEOTECHNICS	Pritchard Francis Grosvenor Street, Beaconsfield Proposed Sub-Division Core Photo - BH02	DRAWN	DATE 19/05/2023
		CHECKED	DATE 19/05/2023
		SCALE Not To Scale	A4
		PROJECT No WAG220004-01	FIGURE No 1/1

BOREHOLE: BH03

Galt Geotechnics

Sheet 1 OF 1

Job Number: WAG220004-01	**Contractor:** SM	**Date:** 15/05/2023	
Client: Pritchard Francis	**Drill Rig:** Hanjin D8	**Logged:** AM	
Project: Proposed Sub-Division	**Inclination:** -90°	**Checked Date:** 25/05/2023	
Location: Grosvenor Street, Beaconsfield		**Checked By:**	

DRILLING: Progress – Drilling & Casing	Water	Core Run Details	Samples & Field Tests	Depth (m)	Graphic Log	Soil Class	MATERIAL: DESCRIPTION – ROCK TYPE: Colour, Grain size, Structure (texture, fabric, mineral composition, hardness alteration, cementation, etc as applicable). START CORING AT 0.00m	Weathering	Estimated Strength Is(50) (○ - Axial, □ - Diametral, △ - Irregular) EL VL L M H VH EH	NATURAL FRACTURE (mm) 20 60 100 300 1000	Visual	ADDITIONAL DATA (joints, partings, seams, zones, etc) Description, orientation, infilling or coating, shape, roughness, thickness, other
HQ3 (0.0–5.0 m)		TCR=100% SCR=73% RQD=60%		0.0 – 0.40m		SP-SM	SAND: fine to coarse grained, sub-angular to sub-rounded, brown, approximately 15-20% gravel, with non-plastic fines					
				0.40m – 5.00m			LIMESTONE: fine to coarse grained, pale yellow, some typically sub horizontal bedding, some vugs					0.40-3.00: Defects at about 20 mm to 200 centers, and are typically partings and some seams; sub horizontal, 1 mm to 50 mm thick, rough, undular, clean or infilled with sand and / or gravel
		1.60 / TCR=93% SCR=93% RQD=80%		1.5								1.60-1.70: Core Loss: 1.6-1.7 m
		1.40 / TCR=100% SCR=100% RQD=93%		3.0								3.00-5.00: Defects as described above, with spacing typically about 30 mm to 100 mm centres
		1.60		4.5								
				5.00m			Hole terminated at 5.00 m Target depth Groundwater not measured due to drill mud					

Comments:

See Explanatory Notes and Method of Soil Description sheets for details of abbreviations and basis of descriptions

PointID : BH03 Depth Range: 0.00 - 5.00 m - smart

	TITLE	DRAWN	DATE 19/05/2023
Galt GEOTECHNICS	Pritchard Francis Grosvenor Street, Beaconsfield Proposed Sub-Division Core Photo - BH03	CHECKED	DATE 19/05/2023
		SCALE Not To Scale	A4
		PROJECT No WAG220004-01	FIGURE No 1/1

Appendix G: Laboratory Test Results

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

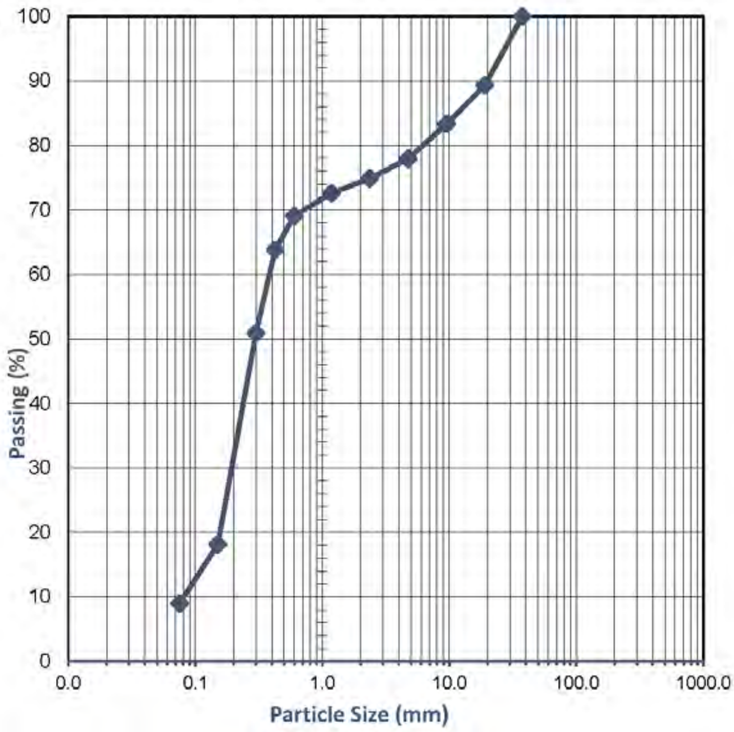
TEST REPORT - AS 1289.3.6.1, *AS 1289.1.1

Client:	Pritchard Francis	*Ticket No.*	S9681
Client Address:	-	*Report No.*	WG23.7537_1_PSD
Project:	Beaconsfield Residential Subdivision	*Sample No.*	WG23.7537
Location:	Grosvenor Street Beaconsfield	*Date Sampled:*	Not Specified
Sample Identification:	TP01 0.5-1	*Date Tested:*	3/5 - 4/5/23

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
150.0	
100.0	
75.0	
37.5	100
19.0	89
9.5	83
4.75	78
2.36	75
1.18	73
0.600	69
0.425	64
0.300	51
0.150	18
0.075	9



*Comments: *AS 1289.1.1- Deviation from standard: Insufficient sample according to test method requirements. NATA accreditation does not cover the performance of this service.*

Approved Signatory:

Name: Matthew Lichon

Date: 04/May/2023

NATA Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

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WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

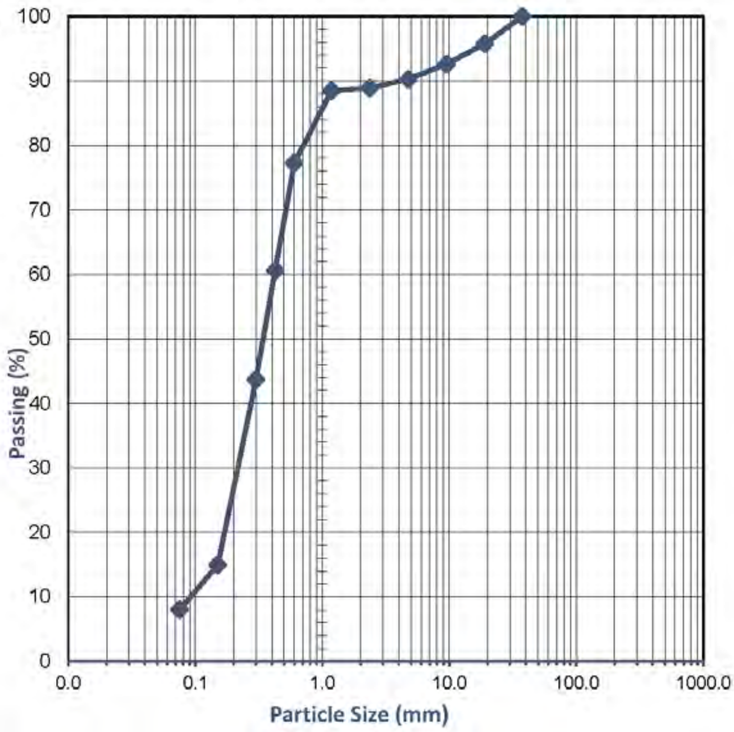
TEST REPORT - AS 1289.3.6.1

Client:	Pritchard Francis	*Ticket No.*	S9681
Client Address:	-	*Report No.*	WG23.7538_1_PSD
Project:	Beaconsfield Residential Subdivision	*Sample No.*	WG23.7538
Location:	Grosvenor Street Beaconsfield	*Date Sampled:*	Not Specified
Sample Identification:	TP03 0-0.5	*Date Tested:*	03/05 - 04/05/2023

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
150.0	
100.0	
75.0	
37.5	100
19.0	96
9.5	93
4.75	90
2.36	89
1.18	89
0.600	77
0.425	61
0.300	44
0.150	15
0.075	8



Comments:

Approved Signatory:

Name: Matthew Lichon

Date: 04/May/2023

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WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

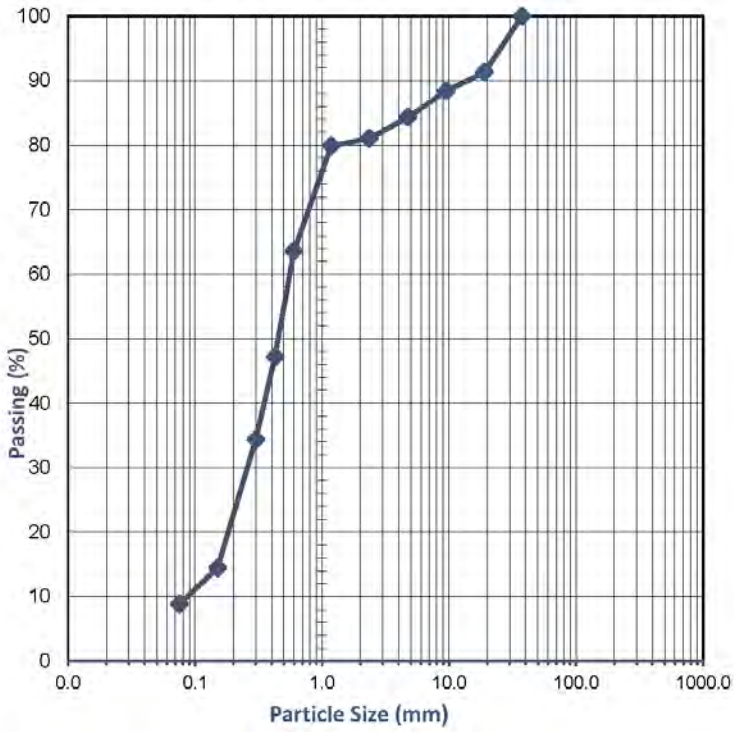
TEST REPORT - AS 1289.3.6.1

Client:	Pritchard Francis	*Ticket No.*	S9681
Client Address:	-	*Report No.*	WG23.7539_1_PSD
Project:	Beaconsfield Residential Subdivision	*Sample No.*	WG23.7539
Location:	Grosvenor Street Beaconsfield	*Date Sampled:*	Not Specified
Sample Identification:	TP05 0-0.5	*Date Tested:*	03/05 - 04/05/2023

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
150.0	
100.0	
75.0	
37.5	100
19.0	91
9.5	88
4.75	84
2.36	81
1.18	80
0.600	64
0.425	47
0.300	34
0.150	14
0.075	9



Comments:

Approved Signatory:

Name: Matthew Lichon

Date: 04/May/2023

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WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - ASTM D2974-14 (Test Method C)

Client:	Pritchard Francis	*Ticket No.*	S9681
Client Address:	-	*Report No.*	WG23.7537-7540_1_ORG
Project:	Beaconsfield Residential Subdivision	*Sample No.*	WG23.7537-7540
Location:	Grosvenor Street Beaconsfield	*Date Sampled:*	Not Specified
Sample Identification:	See Below	*Date Tested:*	3/05/2023

TEST RESULTS - Organic Content

Sampling Method: Sampled by Client, Tested as Received

Testing Completed By: WGLS - LC

Furnace Temperature (^{o}C): 440

Sample Number	Sample Identification	Ash Content (%)	Organic Content (%)
WG23.7538	TP03 0-0.5	99.0	1.0
WG23.7539	TP05 0-0.5	95.1	4.9
WG23.7540	TP07 0-0.3	98.3	1.7

Comments:

Approved Signatory: Coneill

Name: Cody O'Neill

Date: 03/May/2023

NATA Accreditation No. 20599
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GALT GEOTECHNICS PTY LTD
POINT LOAD INDEX CALCULATION SHEET

Job: Proposed Subdivision
Location: Beaconsfield
Job Number: WAG220004-01
Date: 16/05/2023

Drill Method: HQ3 Coring

Borehole	Depth of Test (m)	Type of Test (A, D or I)	Plate Separation, D (mm)	Width, W (axial and irregular tests only) (mm)	Failure Load, P (kN)	A (mm^2)	D_e	I_s (MPa)	$I_{s(50)}$ (MPa)	Rock Strength (AS1726-2017)
BH01	1.75 - 1.90	D	55		0.23		55.00	0.08	**0.08**	Very Low
BH01	2.05 - 2.10	D	56		1.04		56.00	0.33	**0.35**	Medium
BH01	4.5 - 4.63	D	54		0.61		54.00	0.21	**0.22**	Low
BH01	3.0 - 3.15	D	56		0.47		56.00	0.15	**0.16**	Low
BH01	4.83 - 5.0	D	56		2.64		56.00	0.84	**0.89**	Medium
BH02	0.85 - 0.93	D	55		1.13		55.00	0.37	**0.39**	Medium
BH02	1.50 - 1.61	D	57		1.21		57.00	0.37	**0.40**	Medium
BH02	1.65 - 1.75	D	58		1.91		58.00	0.57	**0.61**	Medium
BH02	3.50 - 3.57	D	53		1.32		53.00	0.47	**0.48**	Medium
BH02	4.3 - 4.38	D	54		0.67		54.00	0.23	**0.24**	Low
BH02	4.7 - 4.8	D	55		0.94		55.00	0.31	**0.32**	Medium
BH03	1.73 - 1.83	D	55		1.28		55.00	0.42	**0.44**	Medium
BH03	2.75 - 2.82	D	55		1.63		55.00	0.54	**0.56**	Medium
BH03	4.5 - 4.6	D	58		1.98		58.00	0.59	**0.63**	Medium

AGGREGATE | ROCK | CONCRETE

TEST REPORT - AS 4133.4.2.2

Client:	Pritchard Francis	*Ticket No.*	50028
Client Address:	430 Roberts Road, Subiaco WA 6008	*Report No.*	ARC-R23.347_1_UCSR
Project:	Proposed Subdivision, Grosevnor St Beaconsfield	*Sample No.*	ARC-R23.347
Location:	Beconsfield, WA 6162	*Date Sampled:*	Not Specified
Sample Identification:	BH01 - 1.8 - 2.0m	*Date Tested:*	17/05/2023

TEST RESULTS - Determination of Uniaxial Compressive Strength - Rock Strength less than 50 MPa

Specimen Condition	As Received	Wet Bulk Density (t/m^3)	1.68
Average Diameter (mm)	61.6	Moisture Content (%)	29.1
Average Height (mm)	156.6	Loading Rate (mm/min)	0.03
Length/Diameter Ratio	2.5	Time to Failure (min)	2.4
Lithological Description	Sedimentary	Description of Failure	Shear Along Single Plain

Uniaxial Compressive Strength (MPa) **1.42**

Photo Pre Test:	Photo Post Test:
	

Comments: Job Reference - WAG220004-01

Approved Signatory:

Name: Beau Griffiths

Date: 21/05/2023

Accreditation No. 21169

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AGGREGATE | ROCK | CONCRETE

TEST REPORT - AS 4133.4.2.2

Client:	Pritchard Francis	*Ticket No.*	50028
Client Address:	430 Roberts Road, Subiaco WA 6008	*Report No.*	ARC-R23.348_1_UCSR
Project:	Proposed Subdivision, Grosevnor St Beaconsfield	*Sample No.*	ARC-R23.348
Location:	Beconsfield, WA 6162	*Date Sampled:*	Not Specified
Sample Identification:	BH01 - 3.5 - 3.7m	*Date Tested:*	17/05/2023

TEST RESULTS - Determination of Uniaxial Compressive Strength - Rock Strength less than 50 MPa

Specimen Condition	As Received	Wet Bulk Density (t/m^3)	1.56
Average Diameter (mm)	61.2	Moisture Content (%)	33.2
Average Height (mm)	137.9	Loading Rate (mm/min)	0.03
Length/Diameter Ratio	2.3	Time to Failure (min)	3.2
Lithological Description	Sedimentary	Description of Failure	Shear Along Single Plain

Uniaxial Compressive Strength (MPa) **0.54**

Photo Pre Test:	Photo Post Test:
	

Comments: Job Reference - WAG220004-01

Approved Signatory:
Name: Beau Griffiths
Date: 21/05/2023

NATA Accreditation No. 21169
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TEST REPORT - AS 4133.4.2.2

Client:	Pritchard Francis	*Ticket No.*	50028
Client Address:	430 Roberts Road, Subiaco WA 6008	*Report No.*	ARC-R23.349_1_UCSR
Project:	Proposed Subdivision, Grosevnor St Beaconsfield	*Sample No.*	ARC-R23.349
Location:	Beconsfield, WA 6162	*Date Sampled:*	Not Specified
Sample Identification:	BH02 - 1.7 - 1.9m	*Date Tested:*	17/05/2023

TEST RESULTS - Determination of Uniaxial Compressive Strength - Rock Strength less than 50 MPa

Specimen Condition	As Received	Wet Bulk Density (t/m^3)	1.76
Average Diameter (mm)	60.8	Moisture Content (%)	31.5
Average Height (mm)	142.1	Loading Rate (mm/min)	0.03
Length/Diameter Ratio	2.3	Time to Failure (min)	1.2
Lithological Description	Sedimentary	Description of Failure	Shear Along Single Plain

Uniaxial Compressive Strength (MPa) **1.91**

Photo Pre Test:	Photo Post Test:
	

Comments: Job Reference - WAG220004-01

Approved Signatory:

Name: Beau Griffiths

Date: 21/05/2023

NATA

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AGGREGATE | ROCK | CONCRETE

TEST REPORT - AS 4133.4.2.2

Client:	Pritchard Francis	*Ticket No.*	50028
Client Address:	430 Roberts Road, Subiaco WA 6008	*Report No.*	ARC-R23.350_1_UCSR
Project:	Proposed Subdivision, Grosevnor St Beaconsfield	*Sample No.*	ARC-R23.350
Location:	Beconsfield, WA 6162	*Date Sampled:*	Not Specified
Sample Identification:	BH03 - 4.05 - 4.23m	*Date Tested:*	17/05/2023

TEST RESULTS - Determination of Uniaxial Compressive Strength - Rock Strength less than 50 MPa

Specimen Condition	As Received	Wet Bulk Density (t/m^3)	2.02
Average Diameter (mm)	61.7	Moisture Content (%)	12.8
Average Height (mm)	144.6	Loading Rate (mm/min)	0.03
Length/Diameter Ratio	2.3	Time to Failure (min)	2.2
Lithological Description	Sedimentary	Description of Failure	Shear Along Single Plain

Uniaxial Compressive Strength (MPa) **5.25**

Photo Pre Test:	Photo Post Test:
	

Comments: Job Reference - WAG220004-01

Approved Signatory:
Name: Beau Griffiths
Date: 21/05/2023

NATA
Accreditation No. 21169
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Appendix H: Understanding Your Report

www.galtgeo.com.au
50 Edward Street OSBORNE PARK WA 6017

ABN: 64 625 054 729

UNDERSTANDING YOUR REPORT

GALT FORM PMP11 Rev4

1. EXPECTATIONS OF THE REPORT

This document has been prepared to clarify what is and is not provided in your report. It is intended to inform you of what your realistic expectations of this report should be and how to manage your risks associated with the conditions on site.

Geotechnical engineering and environmental science are less exact than other engineering and scientific disciplines. We include this information to help you understand where our responsibilities begin and end. You should read and understand this information. Please contact us if you do not understand the report or this explanation. We have extensive experience in a wide variety of projects and we can help you to manage your risk.

2. THIS REPORT RELATES TO PROJECT-SPECIFIC CONDITIONS

This report was developed for a unique set of project-specific conditions to meet the needs of the nominated client. It took into account the following:

- the project objectives as we understood them and as described in this report;
- the specific site mentioned in this report; and
- the current and proposed development at the site.

It should not be used for any purpose other than that indicated in the report. You should not rely on this report if any of the following conditions apply:

- the report was not written for you;
- the report was not written for the site specific to your development;
- the report was not written for your project (including a development at the correct site but other than that listed in the report); or
- the report was written before significant changes occurred at the site (such as a development or a change in ground conditions).

You should always inform us of changes in the proposed project (including minor changes) and request an assessment of their impact.

Where we are not informed of developments relevant to your report, we cannot be held responsible or liable for problems that may arise as a consequence.

Where design is to be carried out by others using information provided by us, we recommend that we be involved in the design process by being engaged for consultation with other members of the project team. Furthermore, we recommend that we be able to review work produced by other members of the project team that relies on information provided in our report.

3. DATA PROVIDED BY THIRD PARTIES

Where data is provided by third parties, it will be identified as such in our reports. We necessarily rely on the completeness and accuracy of data provided by third parties in order to draw conclusions presented in our reports. We are not responsible for omissions, incomplete or inaccurate data associated with third party data, including where we have been requested to provide advice in relation to field investigation data provided by third parties.

4. SOIL LOGS

Our reports often include logs of intrusive and non-intrusive investigation techniques prepared by Galt. These logs are based on our interpretation of field data and laboratory results. The logs should only be read in conjunction with the report they were issued with and should not be re-drawn for inclusion in other documents not prepared by us.

5. THIRD PARTY RELIANCE

We have prepared this report for use by the client. This report must be regarded as confidential to the client and the client's professional advisors. We do not accept any responsibility for contents of this document from any party other than the nominated client. We take no responsibility for any damages suffered by a third party because of any decisions or actions they may make based on this report. Any reliance or decisions made by a third party based on this report are the responsibility of the third party and not of us.

6. CHANGE IN SUBSURFACE CONDITIONS

The recommendations in this report are based on the ground conditions that existed at the time when the study was undertaken. Changes in ground conditions can occur in numerous ways including anthropogenic events (such as construction or contaminating activities on or adjacent to the site) or natural events (such as floods, groundwater fluctuations or earthquakes). We should be consulted prior to use of this report so that we can comment on its reliability. It is important to note that where ground conditions have changed, additional sampling, testing or analysis may be required to fully assess the changed conditions.

7. SUBSURFACE CONDITIONS DURING CONSTRUCTION

Practical constraints mean that we cannot know every minute detail about the subsurface conditions at a particular site. We use professional judgement to form an opinion about the subsurface conditions at the site. Some variation to our evaluated conditions is likely and significant variation is possible. Accordingly, our report should not be considered as final as it is developed from professional judgement and opinion.

The most effective means of dealing with unanticipated ground conditions is to engage us for construction support. We can only finalise our recommendations by observing actual subsurface conditions encountered during construction. We cannot accept liability for a report's recommendations if we cannot observe construction.

8. ENVIRONMENTAL AND GEOTECHNICAL ISSUES

Unless specifically mentioned otherwise in our report, environmental considerations are not addressed in geotechnical reports. Similarly, geotechnical issues are not addressed in environmental reports. The investigation techniques used for geotechnical investigations can differ from those used for environmental investigations. It is the client's responsibility to satisfy themselves that geotechnical and environmental considerations have been taken into account for the site.

Geotechnical advice presented in a Galt Environmental report has been provided by Galt Geotechnics under a sub-contract agreement. Similarly, environmental advice presented in a Galt Geotechnics report has been provided by Galt Environmental under a sub-contract agreement.

Unless specifically noted otherwise, no parties shall draw any inferences about the applicability of the Western Australian state government landfill levy from the contents of this document.

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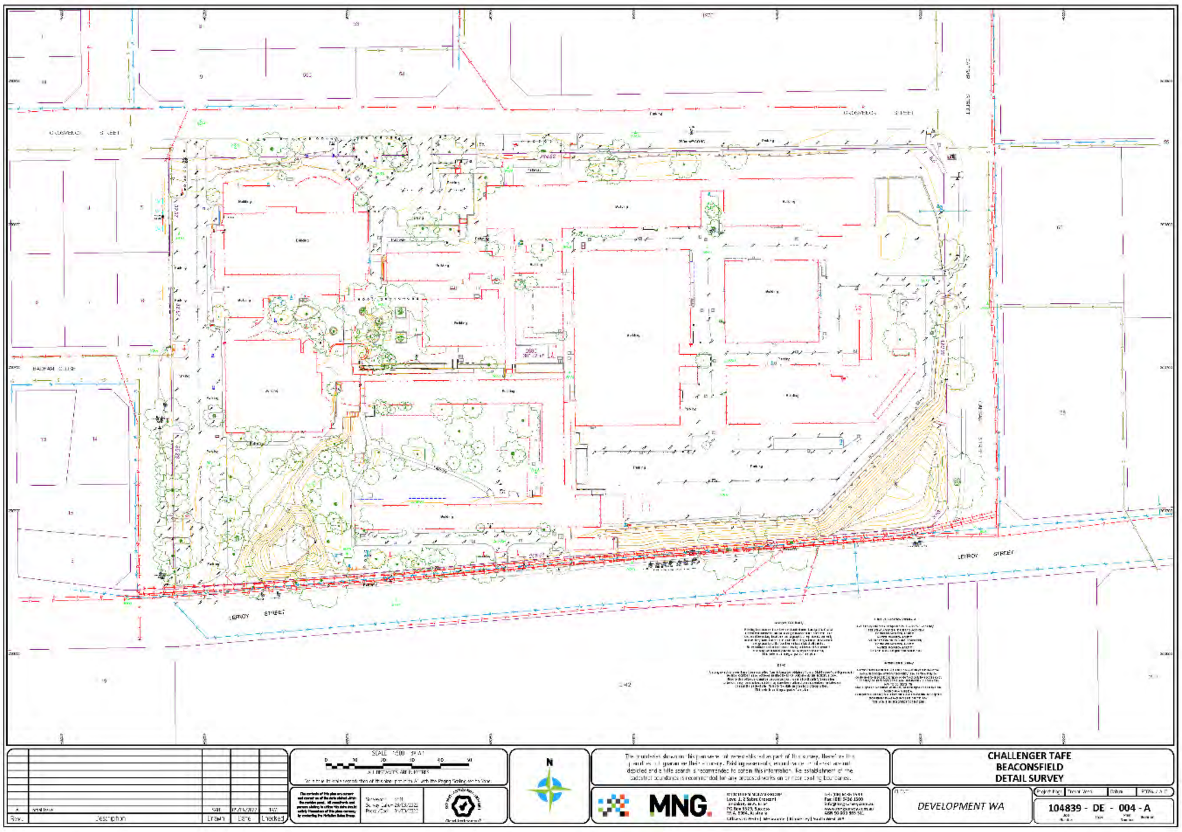
Appendix Three: Feature Survey


LEFROY STREET
CHALLENGER TAFE
BEACONSFIELD
DETAIL SURVEY
DEVELOPMENT WA
104839 - DE - 004 - A
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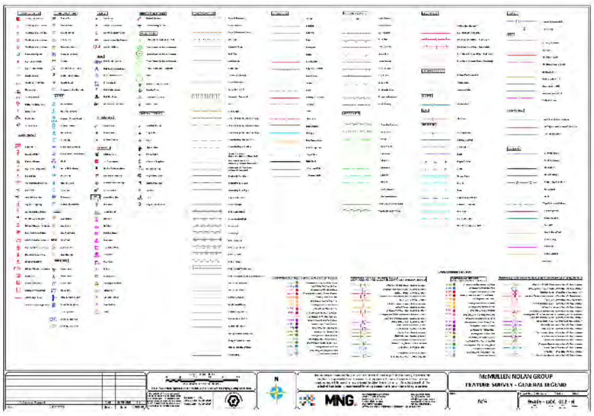
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FEATURE SURVEY - GENERAL LEGEND
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Appendix Four: Contamination Risk Review

PERTH OFFICE
Suite 4, 26 Railway Road
Subiaco
Western Australia 6008

P +61 8 9380 4988
F +61 8 9380 9636
emergeassociates.com.au

Document Reference: EP19-058(01)--002 DWP

Emerge contact: Simon Gregg

20 June 2019

Attention: Garrick Smith
Development Manager
Complex Projects | Housing
Department of Communities
Level 4, 169 Hay Street
East Perth WA 6004

Delivered via email: Garrick.Smith@communities.wa.gov.au

Dear Garrick

FORMER BEACONSFIELD TAFE SITE PRELIMINARY CONTAMINATION RISK REVIEW

1 INTRODUCTION

Emerge Environmental Services Pty Ltd (trading as Emerge Associates) was engaged by the Department of Communities (the Department) to undertake a preliminary contamination risk review of the former Beaconsfield TAFE site located at 15 Grosvenor Street Beaconsfield, subsequently referred to as the 'site'. The site is shown on **Figure 1**.

2 BACKGROUND

It is understood that the Department is acquiring the site to facilitate future redevelopment, presumably for residential purposes. The intent of the review is to identify the presence of any significant sources of contamination that could pose a significant remediation/ cost risk, or otherwise limit the development options for the site.

The site is the location of the former Beaconsfield TAFE which is currently disused, and demolition works are intended to commence following site acquisition. The site contains a range of buildings utilised for educational purposes, with potential areas of interest for contamination expected to be limited to manual arts/ automotive workshop areas and dangerous goods storage. The presence of asbestos containing materials (ACM) is likely given the original development of the site occurred circa 1974, however this does not fall within the scope of the review as this would be considered a demolition issue.

The objective of the preliminary contamination review is to visually assess the site for evidence of potentially contaminating activities and infrastructure and complete a targeted assessment of the soil beneath the main buildings to ascertain the presence of residual pesticide concentrations. This information will provide an understanding of any potential constraints or management requirements that may be necessary for future development of the site.

3 SCOPE OF WORK

The scope of work completed for the assessment comprised the following:

- A review of historical aerial photographs to identify and document the historical land use and notable changes in the site buildings.
- Review of the Contaminated Sites Database and the current certificate of title (CT) for the site to ascertain the contamination status of the site under the *Contaminated Sites Act 2003.*
- An inspection of the site for evidence of potentially contaminating land uses and infrastructure and for evidence of construction and demolition (C&D) waste.
- Advancement of 10 soil bores beneath selected buildings to identify the presence/ absence of contaminants associated with subterranean termite treatments, and advancement of three soil bores adjacent to triple interceptor trap (TIT) infrastructure to identify potential contamination from this infrastructure. The investigation associated with the 13 soil bores comprised:
  - Using a ground penetrating radar to clear all 13 coring locations for the presence of underground services.
  - Coring through the concrete slab at 10 locations within buildings and coring through the asphalt at three locations adjacent to the TITs to access the subsurface soils.
  - Completion of a soil bore using a hand auger at all 10 soil bore locations in building to depths between 0.2 metres below ground level (mBGL) and 1.0 mBGL.
  - Collection of soil samples from immediately below the concrete slab, and at subsequent depths of 0.3 m, 0.5 m and 1.0 mBGL, or until refusal was encountered.
  - Submission of 28 primary samples to a National Association of Testing Authorities (NATA) accredited laboratory for analysis for organochlorine pesticides (OCPs) and organophosphorus pesticides (OPPs), and 10 primary samples for analysis for metals (arsenic [As], cadmium [Cd], chromium [Cr], copper [Cu], lead [Pb], mercury [Hg], nickel [Ni] and zinc [Zn]).
  - Submission of two quality control samples (one field duplicate sample and one field triplicate sample) to a NATA accredited laboratory for analysis for metals, OCPs and OPPs.
  - Completion of one soil bore using a hand auger adjacent to each of the three TITs to a maximum depth ranging between 1.1 mBGL and 1.8 mBGL to target the base of each TIT.
  - Collection of soil samples from a depth equivalent to, or slightly deeper than the maximum depth of the TIT infrastructure.
  - Submission of three primary samples to a NATA accredited laboratory for analysis of metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn), total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene and xylene (BTEX), polycyclic aromatic hydrocarbons (PAH), volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs).

4 SITE CONDITIONS

4.1 Site details

The site comprises an approximate area of 3.81 hectares (ha) being Lot 2680 on Diagram 33642. The site details are provided in **Table 1** and the site boundary is shown on **Figure 1**.

Table 1: Site identification details

Item	Description
Site name	Former Beaconsfield TAFE
Site address	11 – 15 Grosvenor Street Beaconsfield, WA, 6162
Certificate of title	Volume LR3054; Folio 106 Lot 2680 on Diagram 33642
Current site owner	Department of Training and Workforce Development
Current site use	Disused TAFE education campus
Current site zoning	Public Purposes Reserve (Technical school) pursuant to the *Metropolitan Region Scheme (WAPC 2017)*.
Local government area	City of Fremantle
Pertinent notifications	None

The current CT obtained for the site, provided in **Attachment 1**, does not contain any memorials related to contamination. A review of the Contaminated Sites Database was completed on 12 June 2019. The site is not present on the Contaminated Sites Database, which in combination with review of the current CT, indicates that the site has not been classified as a suspected contaminated site pursuant to the *Contaminated Sites Act 2003*.

5 SITE HISTORY

Historical aerial photographs from 1953 and 1965 indicate a minor amount of vegetation clearance had occurred in these years associated with informal tracks. The 1974 historical aerial photograph shows the majority of the current buildings were present in the same general orientation as they currently are. Several small buildings were constructed in the west portion of the site by 1981 which were subsequently demolished and a large building constructed circa 1983. One u-shaped building present in the north-west portion of the site was demolished and a large building constructed in its place circa 1985. Up to seven demountable classroom buildings were located in the south-east portion of the site from about 1981 to the present day.

The site is understood to have been used as an education facility since it was constructed in the early 1970s and no other activities are known to have occurred on the site. Portions of the site used for activities with potential for contamination include the manual arts buildings and dangerous goods storage. In addition, given the potential presence of ACM in the buildings due to the period of construction, the buildings observed to have been demolished in the north-west and west portions of the site in early/ mid 1980s have the potential for ACM impacts to the soil that could have resulted from inappropriate demolition. At present the footprints of the former buildings remain beneath the current buildings which replaced them, therefore the presence of ACM at those locations is a consideration.

6 CONTAMINANTS OF POTENTIAL CONCERN

The contaminants of potential concern (CoPCs) relevant to this investigation included metals, OCPs and OPPs as primary CoPC for the on-site buildings, and metals, TRH, BTEX, PAH, VOCs and SVOCs for the TIT infrastructure.

7 ASSESSMENT CRITERIA

The adopted human health assessment criteria for assessment of soil samples were:

- Health Investigation Levels (HIL A) for residential land uses.
- Health Screening Levels A (HSL A) for residential land uses.
- HSL A for direct contact and HSL for intrusive maintenance workers.

8 FIELDWORK

The fieldwork for the site inspection and soil bore installations was undertaken on 7 and 10 June 2019.

8.1 Site inspection

The site inspection identified the following infrastructure which have been identified as potential sources for contamination:

- One TIT situated outside the east wall of Building J, the depth of the base of the TIT was observed to be 1.8 mBGL as shown in **Plate 1**. No staining or sheen was observed on the walls of the TIT or the water surface within the TIT. The TIT retained water at the time of inspection.
- One TIT situated adjacent to a possible wash bay located outside the south-east corner of Building J as shown in **Plate 2**. The depth of the base of the TIT was observed to be 1.5 mBGL. No staining or sheen was observed on the walls of the TIT or the water surface within the TIT.
- One small TIT situated outside the south wall of Building J as shown in **Plate 3**. Dark coloured soil was observed to a depth of approximately 0.1 m within the TIT although no oily sheen was observed.
- One 205 litre (L) drum used for fat and oil storage situated outside the north wall of Building F (used as a canteen) as shown in **Plate 4**. Black staining from spilt cooking fats and oils from the drum was noted on the concrete adjacent to the drum which was observed to be flowing to a nearby stormwater drain.
- A concrete pad was situated immediately east of Building M upon which an open tank was historically located used for washing of engines. The tank was removed approximately 20 years ago. No staining was evident on the concrete ground surface.
- Several storage sheds were observed containing chemicals and paints:
    - Paint shed located outside the east wall of Building J. No staining was noted on the concrete ground surface beneath.
    - Storage shed with gas bottles and cleaning products within Building K. The storage shed had a concrete base and no staining was evident.
- Buried LPG lines were observed to extend between Buildings P, K, M and J. The lines were noted to be cut at the ground level adjacent to each building. The LPG main is located in the south-west corner of the site adjacent to Lefroy Road although it is confirmed to be disconnected.
- No ACM or C&D waste was observed on the visible exposed soil surface across the site, particularly in the west and north-west portions of the site where former buildings were located.
- ACM present as fibre cement material (FCM) was observed in locations mostly associated with building damage sustained via recent vandalism. This included:
    - Broken FCM pieces laying on the ground in several rooms within Buildings B, J, M and P. For example FCM pieces within Building M are shown in **Plate 5**.

  - Broken FCM ceiling pieces laying on the ground in a walkway between Building D and F.
  - An intact ACM vent pipe situated at ground level immediately west of Building K.
- A large amount of furniture, education-related items (paper, filing cabinets, stationary and equipment related to respective trades) and general rubbish was observed in each building.

Plate 1: Internal portion of the TIT situated adjacent to the east wall of Building J.

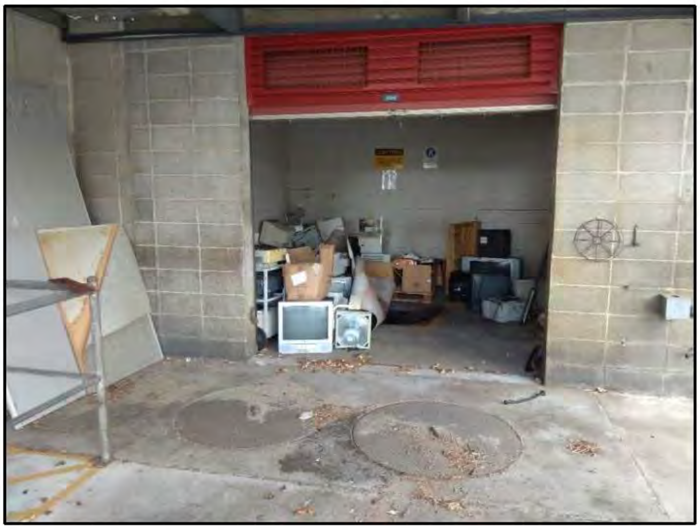

Plate 2: TIT present outside a possible wash bay on the east side of Building J with a drain visible within the centre of the room.

Plate 3: Internal portion of a small TIT situated adjacent to the south wall of Building J.

Plate 4: Fat and cooking oil storage drum, spilt fats and cooking oils on the ground surface toward a stormwater drain to the north of Building F.

Plate 5: Broken FCM pieces lying on the ground within Building M.

The location of each soil bore and site infrastructure is shown in **Figure 1**.

8.2 Soil bore installation

The soil bores were installed using a hand auger. The hand auger was decontaminated between sampling locations. The process for the advancement of soil bores comprised:

- Coring of the concrete slab or asphalt to a depth sufficient to intersect the underlying soil.
- Logging of each soil bore noting lithology and the presence of staining, odours, C&D waste material and any FCM.
- Collection of soil samples at depths:
  - Immediately below the concrete/ asphalt, and at subsequent depths of 0.3 m, 0.5 m and 1.0 mBGL or until refusal for locations within buildings. A sample depth of 0.1 m indicates the soil immediately beneath the concrete/ asphalt.
  - Equivalent to, or slightly below, the maximum depth of the TIT infrastructure.
- Backfilling each soil bore in the order of removal.

The coordinates of each soil bore are provided in **Table 2** and the location of each soil bore is shown in **Figure 1**.

Table 2: Soil bore details

Test pit ID	Coordinates	Target infrastructure	Year of construction
SB01	Easting: 383626; Northing: 6451537	Building D – administration building	Circa 1974
SB02	Easting: 383712; Northing: 6451558	Building E – electrical trades	Circa 1974
SB03	Easting: 383756; Northing: 6451558	Building B – carpentry trades	Circa 1974
SB04	Easting: 383748; Northing: 6451528	Building M – automotive trades	Circa 1974
SB05	Easting: 383727; Northing: 6451527	Building J – TIT#1	Circa 1974
SB06	Easting: 383755; Northing: 6451491	Building P – plumbing and gas trades	Circa 1974
SB07	Easting: 383725; Northing: 6451500	Building J – TIT#2	Circa 1974

Table 2: Soil bore details (continued)

Test pit ID	Coordinates	Target infrastructure	Year of construction
SB08	Easting: 383688; Northing: 6451481	Building J – TIT#3	Circa 1974
SB09	Easting: 383601; Northing: 6451543	Building C – hospitality and restaurant	Circa 1985
SB10	Easting: 383694; Northing: 6451530	Building J – civil/ mechanical engineering	Circa 1974
SB11	Easting: 383639; Northing: 6451494	Building U north – classrooms	Circa 1974
SB12	Easting: 383644; Northing: 6451454	Building U south – classrooms	Circa 1974
SB13	Easting: 383582; Northing: 6451497	Building L – library	Circa 1983

The total depth and a general description of the lithology encountered in each soil bore is provided in **Table 3**.

Table 3: General description of each soil bore

Test pit ID	Total depth (mBGL)	General description of lithology
SB01	1.0	Yellow-orange sand, coarse grained, dry, no deleterious materials.
SB02	1.0	Yellow sand, medium-coarse grained, dry, no deleterious materials.
SB03	0.5	Yellow-beige sand, medium-coarse grained, dry, no deleterious materials. Refusal encountered on cemented limestone at 0.5 mBGL.
SB04	0.8	Yellow-beige sand, medium-coarse grained, dry, no deleterious materials. Refusal encountered on cemented limestone at 0.8 mBGL.
SB05	1.8	Yellow-brown sand, medium-coarse grained, dry, no deleterious materials.
SB06	0.7	Yellow sand, coarse grained, dry, no deleterious materials. Refusal encountered on cemented limestone at 0.7 mBGL.
SB07	1.5	Yellow-beige sand, coarse grained, dry, no deleterious materials.
SB08	1.1	Yellow-beige sand, coarse grained, dry, no deleterious materials.
SB09	1.0	Yellow sand, coarse grained, dry, no deleterious materials.
SB10	0.6	Yellow-beige sand, coarse grained, dry, no deleterious materials. Refusal encountered on cemented limestone at 0.6 mBGL.
SB11	0.7	Yellow-beige sand, coarse grained, dry, no deleterious materials. Refusal encountered on cemented limestone at 0.6 mBGL.
SB12	0.2	Yellow sand, coarse grained, dry, no deleterious materials. Refusal encountered on cemented limestone at 0.2 mBGL.
SB13	0.8	Yellow sand, coarse grained, dry, no deleterious materials. Refusal encountered on cemented limestone at 0.8 mBGL.

The observations provided in **Table 3** indicate that:

- No odours, visual evidence of contamination (staining), ACM or deleterious materials was observed during advancement of the soil bores.
- The soil lithology comprised medium to coarse grained sands which are likely to be reworked natural soils from the site.

9 QUALITY ASSURANCE/ QUALITY CONTROL

A description of the QA/ QC processes and results are provided below.

9.1 Field QA/ QC

Field quality control protocols implemented during the soil investigation comprised:

- Collection of quality control samples to demonstrate data precision and reliability.
- Appropriate labelling of samples.
- Decontamination of reusable equipment (hand auger) between sampling locations using Decon-90 and rinsing with potable water.

Field QA/ QC samples were collected at the rate of at least 5% in order to assess the likelihood and extent of bias from either cross contamination, sampling technique or unacceptable laboratory precision. Two QA/ QC samples were collected during the soil investigation which comprised one field duplicate sample and one field triplicate sample. The QA/ QC sample identification for samples collected during the soil sampling is provided in **Table 4**.

Table 4: QA/ QC sample identification

Sample ID	Sample type	Laboratory
SB03_0.15	Primary sample	ARL Perth
SQA01	Field duplicate sample	ARL Perth
SQA02	Field triplicate sample	ALS Perth

The QA/ QC samples were analysed for the same analytical suite as the primary samples, specifically OCPs, OPPs and metals.

Rinsate and trip blank samples were not collected given that the purpose of the soil investigation was to provide a preliminary indication of the presence of contamination at the site, and is not intended to be used for any site reclassification or validation purposes. Therefore collection of duplicate and triplicate samples only is considered to be sufficient for the purposes of the investigation.

Laboratory results for the duplicate and triplicate samples were assessed using a determination of the relative percent difference (RPD). Where a primary sample and a QC sample are compared, the RPD provides an indication of the reproducibility of the results. In accordance with *Australian Standard AS 4482.1-2005 Guide to the Sampling and Investigation of Potentially Contaminated Soil. Part I: Non-volatile and semi volatile compounds* AS 4482.1-2005 (Standards Australia 2005). Emerge adopts an RPD acceptance criterion up to 30%.

Following a review of the field QA/ QC results the following observations/ conclusions are made:

- Field QA/ QC sample collection was undertaken a rate consistent with the *Australian and New Zealand Standards AS/NZS 5667.1:1998* (SA/SNZ 1998).
- A review of the RPDs calculated for the duplicate and triplicate samples was undertaken and identified two non-conformances in relation to the reported concentration of aldrin and dieldrin:
    - Aldrin was reported in primary sample SB03_0.15 (2.7 mg/ kg), duplicate sample SQA01 (3.0 mg/ kg) and triplicate sample (9.38 mg/ kg) with a maximum reported RPD of 110%.
    - Dieldrin was reported in primary sample SB03_0.15 (3.5 mg/ kg), duplicate sample SQA01 (4.0 mg/ kg) and triplicate sample (7.85 mg/ kg) with a maximum reported RPD of 76%.

The RPD exceedances are considered to result from the heterogeneity of the soil matrix and the variation in presence of residual pesticides within the soil matrix due to the sample collection method. The triplicate sample result has been adopted for interpretation for this sample.

The large majority of RPD values were below the 30% target criterion for the duplicate and triplicate samples indicate a suitably accurate and precise data set. As such, the RPD exceedances identified are not considered to have materially impacted on conclusions or recommendations provided in this report and the analytical data is considered to have sufficient accuracy and precision on which to base conclusions relating to chemical concentrations in relation to the potential human health risk.

9.2 Laboratory QA/ QC

A review of the laboratory QA/ QC data for the soil sampling has been undertaken and is provided in **Table 5**. The review did not identify any issues.

Table 5: Laboratory QA/ QC compliance summary

Laboratory work order	Sample date	Laboratory QA/ QC requirement achieved								
		NATA accreditation	CoC completed and returned	Sample received within holding time	Analysis undertaken within holding time	Laboratory internal duplicate analysis	Method blank analysis	Laboratory control Spike analysis	Matrix spike recovery analysis	Surrogate sample analysis
19-08948	10/06/2019	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
EP1905622	10/06/2019	Yes	Yes	Yes	Yes	3NC	Yes	Yes	1NC	Yes
19-09191	13/06/2019	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The non-conformances identified in **Table 5** for lab report EP1905622 relate to the triplicate sample SQA02. Laboratory duplicate RPDs were reported to exceed the specified limit for aldrin and dieldrin which relates to degree of contamination contained within this sample and the matrix heterogeneity. The frequency of quality control samples for the triplicate sample was less than expected for matrix spike analysis which is not considered to affect the conclusions drawn from the investigation given that matrix spike analysis was completed to an acceptable degree within the primary set of samples.

9.3 QA/ QC summary

A review of field and laboratory QA/ QC procedures and data indicates that there were no non-conformances in laboratory QA/ QC requirements, and therefore the reliability and accuracy of the results are considered suitable upon which to make risk based decisions.

10 ANALYTICAL RESULTS

10.1 Building sub-slab soils

Soil samples from soil bores SB01 to SB04 and SB06 were submitted to NATA certified laboratories on 11 June 2018, and samples from soil bores SB09 to SB13 were submitted to a NATA certified laboratory on 13 June 2018 under standard chain of custody procedures (CoC).

The analytical results provided by the laboratory were assessed against the adopted assessment levels which revealed the following:

- There was only one exceedance of the residential land use (HIL A) criteria for arsenic in Building U (south). This is likely to be an isolated exceedance given the remaining samples reported arsenic concentrations close to, or below the laboratory limit of reporting (LoR). The remaining metals did not exceed the criteria for all samples analysed.
- The assessment criteria for residential land uses (HIL A) for Aldrin+Dieldrin (6.0 mg/kg) was exceeded at the following locations:
    - Building B (carpentry):
        - 17.2 mg/ kg at a depth of 0.15 m (triplicate sample result adopted).
        - 7.1 mg/ kg at a depth of 0.5 m.

  - Building D (administration):
    - 19.4 mg/ kg at a depth of 0.3 m.
    - 6.3 mg/ kg at a depth of 0.5 m.
  - Building M (automotive):
    - 363 mg/ kg at a depth of 0.1 m.
    - 74.4 mg/ kg at a depth of 0.3 m.
    - 23.0 mg/ kg at a depth of 0.5 m.
  - Building P (gas and plumbing):
    - 93 mg/ kg at a depth of 0.15 m.
    - 44 mg/ kg at a depth of 0.3 m.
  - Building J (civil/ mechanical trades):
    - 7.2 mg/ kg at a depth of 0.1 m.
    - 9.7 mg/ kg at a depth of 0.3 m.
  - Building U north (classrooms):
    - 39 mg/ kg at a depth of 0.1 m.
    - 62 mg/ kg at a depth of 0.3 m.
  - Building U south (classrooms): 22 mg/ kg at a depth of 0.1 m.
- The remaining suite of OCPs and OPPs apart from aldrin and dieldrin reported concentrations below the residential land use (HIL A) assessment criteria for samples collected in Buildings B, D, M, P, J and U (north and south).
- The assessment criteria for OCPs and OPPs were not exceeded for samples collected beneath Building C (hospitality), Building E/ Y (electrical trades) and Building L (library).

Buildings constructed in the 1970s (Buildings A, B, D, M, P, J and U) are noted to contain the highest concentrations of residual pesticides with seven of eight sampled locations from these buildings exceeding the assessment criteria for residential land use. Three buildings (Building M, P and U north) reported concentrations exceeding the assessment criteria for all land uses including commercial-industrial. The concentrations exceed the residential land use criteria to a depth of at least 0.5 mBGL. The two buildings sampled that were constructed in the 1980s (Building C and L) reported detectable concentrations of residual pesticides but at concentrations below the assessment criteria.

Copies of the laboratory analytical certificates are provided in **Attachment 2**.

10.2 Triple interceptor trap infrastructure

Soil samples from soil bores SB05, SB07 and SB08 were submitted to a NATA certified laboratory on 11 June 2018 under standard CoC procedures.

The analytical results provided by the laboratory were assessed against the adopted assessment levels which reported no exceedances for the HIL A, HSL A or HSL A for direct contact for TRH, BTEX, PAH, VOCs, SVOCs or metals. All concentrations of hydrocarbons analysed were reported below the laboratory LoR.

Copies of the laboratory analytical certificates are provided in **Attachment 2**.

11 ISSUES REQUIRING CONSIDERATION

Some degree of management is considered to be required for the soil beneath the original building footprints for at least the 1970s era buildings following demolition given the presence of concentrations of residual pesticides exceeding the assessment level for a residential land use in seven of the 10 buildings sampled. The concentrations exceeded the assessment level for commercial-industrial land uses in three of the 10 buildings sampled. Soil impacts exceeding residential land use criteria were reported to depths of at least 0.5 mBGL in most locations. Buildings constructed in the 1970s are observed to contain the highest concentrations of residual pesticides. Management options may include excavation with disposal to a suitable off-site facility, or management on-site within a suitably designed area that will mitigate any potential risk to human health or ecological receptors such as beneath a building footprint, beneath roads or within a public open space area.

The concentrations identified during the review represent only a single location from within each footprint, and some variability may be expected in the concentrations present beneath the footprint of each building. Therefore is it recommended that a detailed soil investigation is undertaken following demolition of the buildings to obtain more detailed understanding of concentrations of residual pesticides at the site. This may be undertaken prior to demolition, however due to the hardness of the concrete this is a very slow process for each sample. A more expedited and easier method to establish the lateral and vertical distribution of pesticide residues is sampling of the building footprint after demolition of the buildings. The additional information could show the elevated concentration of residual pesticides are restricted, however, the frequency of the exceedances at seven of the 10 locations suggests this is unlikely.

The present of staining adjacent to a fats and cooking oils storage drum is not considered to be a contamination issue, but rather a potential hygiene issue. Although not observed during the soil investigation due to the limited number of intrusive locations in each building, the potential presence of ACM in soils beneath buildings in the west and north-west portion of the site should also be considered during future demolition and development works.

12 SUMMARY AND CONCLUSIONS

The sand materials present beneath the majority of buildings on-site constructed in the 1970s are impacted by residual pesticides at least to a depth of 0.5 mBGL. Some variability may be expected in the concentrations present beneath each building given the limited sampling regime, however the results indicate that residual pesticides are present in the majority of buildings sampled exceeding the assessment criteria for a residential land use.

A degree of management is expected to be required following demolition to address the risks posed by the residual pesticides in soil to facilitate redevelopment of the site. However, it is recommended that the Department undertake a more detailed soil investigation following demolition of the buildings to obtain more detailed understanding of residual pesticide concentrations.

Impacts to groundwater are not considered to be an issue at present from the reported pesticide residues in soil given that they are present in soil beneath the building footprints and are not exposed to rainfall and leaching mechanisms.

It is noted that in their current state, the residual pesticides do not pose a risk to human health given the presence beneath building footprints and current land use. In addition, at present there is no proposal for site redevelopment that may trigger reporting of the site to the Department of Water and Environmental Regulation (DWER) as a suspected contaminated site. Based on the reported concentration exceedances for pesticides, reporting of the site to the DWER as *'Potentially contaminated – investigation required'* may be necessary following the demolition.

13 CLOSING

Any queries relating to this report should be direct to David Pond or Simon Gregg on 9380 4988.

Yours sincerely
Emerge Associates

David Pond
LEAD ENVIRONMENTAL CONSULTANT – CONTAMINATED LAND AND ACID SULFATE SOILS

cc: None
Encl: Figure 1: Site Features
Attachment 1: Current Certificate of Title
Attachment 2: Laboratory Certificates

Standards Australia/Standards New Zealand (SA/SNZ) 1998, *Australian/New Zealand Standard AS/NZS 5667.1:1998 Water Quality - Sampling. Part 1: Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples*, Standards Australia, Homebush and Standards New Zealand, Wellington.

Standards Australia 2005, *AS 4482.1-2005 Guide to the Sampling and Investigation of Potentially Contaminated Soil. Part I: Non-volatile and semivolatile compounds*, Standards Australia, Sydney.

Western Australian Planning Commission (WAPC) 2017, *Metropolitan Region Scheme*, Perth.

Figure 1: **Site Features**

Project: Preliminary Contamination Review
Former TAFE Beaconsfield

Client: Department of Communities

Plan Number:
EP19-058(01)--F01
Drawn: KNM
Date: 14/06/2019
Checked: DWP
Approved: SPG
Date: 20/06/2019

N

0 20 40
Metres
Scale: 1:1,250@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used

REGISTER NUMBER	
2680/D33642	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	N/A

WESTERN AUSTRALIA

VOLUME LR3054 FOLIO 106

RECORD OF QUALIFIED CERTIFICATE OF CROWN LAND TITLE

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

NO DUPLICATE CREATED

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

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 2680 ON DIAGRAM 33642

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: RESERVE UNDER MANAGEMENT ORDER

PRIMARY INTEREST HOLDER: VET (WA) MINISTERIAL CORPORATION OF CARE OF DEPARTMENT OF TRAINING AND WORKFORCE DEVELOPMENT, LOCKED BAG 16, OSBORNE PARK DC

(XE L916860) REGISTERED 23/4/2012

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

1. G419580 RESERVE 37822 FOR THE PURPOSE OF TECHNICAL SCHOOL SITE REGISTERED 13/3/1997.
   L916859 CHANGE OF RESERVE PURPOSE. PURPOSE CHANGED TO FOR THE PURPOSES OF THE VOCATIONAL EDUCATION AND TRAINING ACT 1996. REGISTERED 23/4/2012.
   L916860 MANAGEMENT ORDER. CONTAINS CONDITIONS TO BE OBSERVED. WITH POWER TO LEASE FOR ANY TERM. REGISTERED 23/4/2012.

Warning:
(1) A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.
(2) The land and interests etc. shown hereon may be affected by interests etc. that can be, but are not, shown on the register.
(3) The interests etc. shown hereon may have a different priority than shown.

--END OF CERTIFICATE OF CROWN LAND TITLE--

STATEMENTS:

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

SKETCH OF LAND: LR3054-106 (2680/D33642)
PREVIOUS TITLE: LR3054-106

END OF PAGE 1 - CONTINUED OVER

ORIGINAL CERTIFICATE OF CROWN LAND TITLE
QUALIFIED

PROPERTY STREET ADDRESS:	11-15 GROSVENOR ST, BEACONSFIELD.
LOCAL GOVERNMENT AUTHORITY:	CITY OF FREMANTLE
RESPONSIBLE AGENCY:	DEPARTMENT OF TRAINING AND WORKFORCE DEVELOPMENT

NOTE 1:	A000001A	LAND PARCEL IDENTIFIER OF COCKBURN SOUND LOCATION 2680 ON SUPERSEDED PAPER CERTIFICATE OF CROWN LAND TITLE CHANGED TO LOT 2680 ON FREEHOLD TITLE DIAGRAM 33642 ON 22-AUG-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.
NOTE 2:		THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE.
NOTE 3:	L916858	CORRESPONDENCE FILE 01790-1982-02RO

NOT TO BE REMOVED FROM DEPARTMENT OF LAND ADMINISTRATION LT 158

Sundry Document G419580

Corr. 1790/1982

NO DUPLICATE ISSUED

REGISTER VOL. 3054 BOOK FOL. 106

WESTERN AUSTRALIA

Crown Land Record

The undermentioned land shown on the sketch in the First Schedule hereto is land of the Crown subject to the interests, easements, encumbrances and notices shown in the Second Schedule hereto.

3054 VOL. 106 FOL.

Dated 13th March, 1997

CHIEF EXECUTIVE OFFICER

LAND REFERRED TO

Cockburn Sound Location 2680 on Office of Titles Diagram 33642

FIRST SCHEDULE

Page 1 (of 2 pages)

FOR ENCUMBRANCES AND OTHER MATTERS AFFECTING THE LAND SEE SECOND SCHEDULE

PERSONS ARE CAUTIONED AGAINST ALTERING OR ADDING TO THIS RECORD OR ANY NOTIFICATION HEREON

SECOND SCHEDULE NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

PARTICULARS	INSTRUMENT NATURE	INSTRUMENT NUMBER	REGISTERED	TIME	SEAL	CERT. OFFICER
Reserve No 37822 for the purpose of "Technical School Site".	Sundry	G419580				
Vested in Minister for Training. In Gov. Gaz. 4.2.97.	Sundry	G419580		15.30		

VOL. 3054 FOL. 106

URGENT

CHAIN OF CUSTODY

emerge ASSOCIATES

CLIENT: Emerge Associates	POSTAL ADDRESS: Suite 4, 6 Centro Avenue, Subiaco WA 6008	Page 1 of 3
PROJECT MANAGER: David Pond	CONTACT PHONE: 0451 154 505	~~ALS LABORATORY: Perth~~ ARL PERTH
PROJECT ID.: EP19-058(01)	PROJECT NAME: TAFE Beaconsfield	TURNAROUND REQUIREMENTS
SAMPLER(S): David Pond	SAMPLERS PHONE: 0451 154 505	☐ Standard (5-7 days) ☒ Non-standard (3 DAY TAT)
QUOTE NO.: EN/222/18 ORDER NO.:		Email reports to: ~~simon.gregg@emergeassociates.com.au~~ david.pond@emergeassociates.com.au
Laboratory Batch No:	Comments/special handling/storage or disposal	Email invoice to: accounts@emergeassociates.com.au

11°c

Laboratory Use	Yes	No	N/a
Custody seal intact:	☐	☐	☐
Free ice/frozen ice bricks present:	☒	☐	☐
Random sample temp on receipt:		11.4 °C	

ANALYSIS REQUIRED

Lab ID	Sample ID	Matrix	Date	Type & Preservative	Total No.	S-12 (OCP/OPPs)	S-2 (8 metals)	HOLD	Additional information (likely contaminants, dilutions or specific QC analysis)
19-08948-1	SB01_0.1	SOIL	10/6/19	1 x GLASS	1	X	X		
-2	SB01_0.3	↓	↓	↓	1			X	
-3	SB01_0.5				1			X	
-4	SB01_1.0				1			X	
-5	SB02_0.1				1	X	X		
-6	SB02_0.3				1			X	
-7	SB02_0.5				1			X	
-8	SB02_1.0				1			X	
-9	SB03_0.15				1	X	X		
-10	SB03_0.3				1			X	
-11	SB03_0.5				1			X	
-12	SB04_0.1				1	X	X		
TOTAL									

RELINQUISHED BY:		RECEIVED BY		CoC emailed to ALS?
NAME: D. Pond	DATE: 11/6/19	NAME: Ryan Seater	DATE: 11/06/19	☐ Yes ☐ No
OF: Emerge Associates	TIME: 0830	OF: ARL	TIME: 10:30	
NAME:	DATE:	NAME:	DATE:	
OF:	TIME:	OF:	TIME:	

Water Container Codes: **P** = Unpreserved Plastic; **N** = Nitric Preserved Plastic; **ORC** = Nitric Preserved ORC; **SH** = Sodium Hydroxide/Cd Preserved; **S** = Sodium Hydroxide Preserved Plastic; **AG** = Amber Glass Unpreserved; **AP** = Airfreight Unpreserved Plastic; **V** = VOA Vial HCl Preserved; **VB** = VOA Vial Sodium Bisulphate Preserved; **VS** = VOA Vial Sulfuric Preserved; **AV** = Airfreight Unpreserved Vial; **SG** = Sulfuric Preserved Amber Glass; **H** = HCl preserved Plastic; **HS** = HCl Preserved Speciation bottle; **SP** = Sulfuric Preserved Plastic; **F** = Formaldehyde Preserved Glass; **Z** = Zinc Acetate Preserved Bottle; **E** = EDTA Preserved Bottles; **ST** = Sterile Bottle; **LI** = Lugols Iodine Preserved Bottles; **STT** = Sterile Sodium Thiosulfate Preserved Bottles. **Soil Container Codes**: **J** = Jar; **ASS** = Plastic Bag for Acid Sulfate Soils; **B** = Unpreserved Bag.

URGENT

CHAIN OF CUSTODY

emerge ASSOCIATES

CLIENT: Emerge Associates	POSTAL ADDRESS: Suite 4, 6 Centro Avenue, Subiaco WA 6008	Page 2 of 3
PROJECT MANAGER: David Pond	CONTACT PHONE: 0451 154 505	~~ALS LABORATORY: Perth~~ ARL PERTH
PROJECT ID.: EP19-058(01)	PROJECT NAME: TAFE Beaconsfield	TURNAROUND REQUIREMENTS
SAMPLER(S): David Pond	SAMPLERS PHONE: 0451 154 505	☐ Standard (5-7 days) ☒ Non-standard (3 DAY TAT)
QUOTE NO.: EN/222/18 ORDER NO.:		Email reports to: ~~simon.gregg@emergeassociates.com.au~~ david.pond@emergeassociates.com.au
Laboratory Batch No:	Comments/special handling/storage or disposal	Email invoice to: accounts@emergeassociates.com.au

Laboratory Use	Yes	No	N/a
Custody seal intact:	☐	☐	☐
Free ice/frozen ice bricks present:	☐	☐	☐
Random sample temp on receipt:		°C	

ANALYSIS REQUIRED

Lab ID	Sample ID	Matrix	Date	Type & Preservative	Total No.	S-12 (OCP/OPPs)	S-2 (8 metals)	TRH, BTEX, PAH	HOLD	Additional information (likely contaminants, dilutions or specific QC analysis)
19-08948-13	SB04_0.3	SOIL	10/6/19	1 x GLASS	1				X	
-14	SB04_0.5	↓	↓	↓	1				X	
-15	SB05_1.8				1		X	X		
-16	SB06_0.15				1	X	X			
-17	SB06_0.3				1				X	
-18	SB06_0.5				1				X	
-19	SB07_1.5				1		X	X		
-20	SB08_1.1				1		X	X		
-21	SB09_0.1				1	X	X			
-22	SB09_0.3				1				X	
-23	SB09_0.5				1				X	
-24	SB09_1.0				1				X	
TOTAL										

RELINQUISHED BY:		RECEIVED BY		CoC emailed to ALS?
NAME: D. Pond	DATE: 11/6/19	NAME: Ryan Seater	DATE: 11/06/19	☐ Yes ☐ No
OF: Emerge Associates	TIME: 0830	OF: ARL	TIME: 10:30	
NAME:	DATE:	NAME:	DATE:	
OF:	TIME:	OF:	TIME:	

Water Container Codes: **P** = Unpreserved Plastic; **N** = Nitric Preserved Plastic; **ORC** = Nitric Preserved ORC; **SH** = Sodium Hydroxide/Cd Preserved; **S** = Sodium Hydroxide Preserved Plastic; **AG** = Amber Glass Unpreserved; **AP** = Airfreight Unpreserved Plastic; **V** = VOA Vial HCl Preserved; **VB** = VOA Vial Sodium Bisulphate Preserved; **VS** = VOA Vial Sulfuric Preserved; **AV** = Airfreight Unpreserved Vial; **SG** = Sulfuric Preserved Amber Glass; **H** = HCl preserved Plastic; **HS** = HCl Preserved Speciation bottle; **SP** = Sulfuric Preserved Plastic; **F** = Formaldehyde Preserved Glass; **Z** = Zinc Acetate Preserved Bottle; **E** = EDTA Preserved Bottles; **ST** = Sterile Bottle; **LI** = Lugols Iodine Preserved Bottles; **STT** = Sterile Sodium Thiosulfate Preserved Bottles. **Soil Container Codes**: **J** = Jar; **ASS** = Plastic Bag for Acid Sulfate Soils; **B** = Unpreserved Bag.

URGENT

CHAIN OF COUSTODY

emerge ASSOCIATES

CLIENT: Emerge Associates	POSTAL ADDRESS: Suite 4, 6 Centro Avenue, Subiaco WA 6008	Page 3 of 3
PROJECT MANAGER: David Pond	CONTACT PHONE: 0451 154 505	~~ALS LABORATORY: Perth~~ ARC PERTH
PROJECT ID.: EP19-058(01)	PROJECT NAME: TAFE Beaconsfield	TURNAROUND REQUIREMENTS
SAMPLER(S): David Pond	SAMPLERS PHONE: 0451 154 505	☐ Standard (5-7 days) ☒ Non-standard (3 DAY TAT)
QUOTE NO.: EN/222/18 ORDER NO.:		Email reports to: ~~simon.gregg@emergeassociates.com.au~~ david.pond@emergeassociates.com.au
Laboratory Batch No:	Comments/special handling/storage or disposal	Email invoice to: accounts@emergeassociates.com.au

Laboratory Use	Yes	No	N/a
Custody seal intact:	☐	☐	☐
Free ice/frozen ice bricks present:	☐	☐	☐
Random sample temp on receipt:			°C

ANALYSIS REQUIRED

SAMPLE DETAILS				CONTAINER INFORMATION		ANALYSIS REQUIRED											
Lab ID	Sample ID	Matrix	Date	Type & Preservative	Total No.	S-12 (OCP/OPPs)	S-2 (8 metals)										Additional information (likely contaminants, dilutions or specific QC analysis)
19-019498-15	SQA01	SOIL	10/6/19	1x GLASS	1	X	X										
			TOTAL														

RELINQUISHED BY:		RECEIVED BY		CoC emailed to ALS?
NAME : D. POND	DATE: 11/6/19	NAME : Ryan Jeatin	DATE: 11/06/19	☐ Yes ☐ No
OF: Emerge Associates	TIME: 0830	OF: ARL	TIME: 10:30	
NAME :	DATE:	NAME :	DATE:	
OF:	TIME:	OF:	TIME:	

Water Container Codes: **P** = Unpreserved Plastic; **N** = Nitric Preserved Plastic; **ORC** = Nitric Preserved ORC; **SH** = Sodium Hydroxide/Cd Preserved; **S** = Sodium Hydroxide Preserved Plastic; **AG** = Amber Glass Unpreserved; **AP** = Airfreight Unpreserved Plastic; **V** = VOA Vial HCl Preserved; **VB** = VOA Vial Sodium Bisulphate Preserved; **VS** = VOA Vial Sulfuric Preserved; **AV** = Airfreight Unpreserved Vial; **SG** = Sulfuric Preserved Amber Glass; **H** = HCl preserved Plastic; **HS** = HCl Preserved Speciation bottle; **SP** = Sulfuric Preserved Plastic; **F** = Formaldehyde Preserved Glass; **Z** = Zinc Acetate Preserved Bottle; **E** = EDTA Preserved Bottles; **ST** = Sterile Bottle; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles. **Soil Container Codes**: **J** = Jar; **ASS** = Plastic Bag for Acid Sulfate Soils; **B** = Unpreserved Bag;

Paul Nottle

From:	Doug Todd
Sent:	Monday, 17 June 2019 13:29
To:	ARL Samples
Cc:	Paul Nottle
Subject:	FW: ARL 19-08948

Can we please put these on 48hr TA?

Regards

Doug

Douglas Todd | Laboratory Manager
Phone. +61 8 6253 4444 | Fax: +61 8 6253 4440
Email. dougtodd@arlgroup.com.au
Website. http://www.arlgroup.com.au
Address. 46-48 Banksia Road, WELSHPOOL, WA, 6106

ProMicro Pty Ltd
Science with Ethics

Follow us on LinkedIn

ARL
Analytical Reference Laboratory

From: David Pond <David.Pond@emergeassociates.com.au>
Sent: Monday, 17 June 2019 13:18
To: Doug Todd <dougtodd@arlgroup.com.au>
Subject: RE: ARL 19-08948

Hi Doug,

Please proceed with OC/OPs on 48hr TAT on these samples:

Job 19-08948 - Px
SB01_0.3-2
SB01_0.5-3
SB02_0.3-6
SB02_0.5-7
SB03_0.3-10
SB03_0.5-11

SB04_0.3-13
SB04_0.5-14
SB06_0.3-17
SB06_0.5-18.
SB09_0.3-22
SB09_0.5-23

Job 19-09191 - A
SB10_0.3-2
SB10_0.5-3
SB11_0.3-5
SB11_0.5-6.
SB13_0.3-9
SB13_0.5-10.

Thanks
David

David Pond
Lead Environmental Consultant - Contaminated Land & Acid Sulfate Soils
e David.Pond@emergeassociates.com.au
Suite 4, 26 Railway Road, Subiaco WA 6008
w emergeassociates.com.au // t 0893804988

From: Doug Todd [mailto:dougtodd@arlgroup.com.au]
Sent: Monday, 17 June 2019 10:18 AM
To: David Pond <David.Pond@emergeassociates.com.au>
Subject: RE: ARL 19-08948

Hi David

ARL Group
Proudly Western Australian

ARL

ProMicro

SAMPLE RECEIPT NOTICE

Job Number: 19-08948
Expected Due Date: 14 June 2019

Customer Information

Attention:	David Pond
Customer:	Emerge Associates
Address:	4/26 Railway Road Subiaco WA 6008
Phone Number:	9380 4988
Fax Number:	9380 9636
Report To:	David Pond
Report email:	david.pond@emergeassociates.com.au

Job Information

Project Reference:	EP19-058(01) - TAFE Beaconsfield
Purchase Order:	
ARL Quote Number:	

Receival Information

Date/Time Received:	11/06/2019	**Delivery Mode:**	Courier
Temperature of Samples °C:	11.4	**Relinquished by:**	David Pond
Security Seal:	N/A		

Contact Details

Registered by: Ryan Seaton samples@arlgroup.com.au
For any queries relating to sample condition (i.e. breakages/missing samples), registered analyses or sample labelling.

Laboratory Contact: Douglas Todd dougtodd@arlgroup.com.au
For any queries relating to analytical capability, status of testing or explanation of results.

Registration Comments

Disposal of non-microbiological samples will occur after the following time, from the date of issue of Final Report:

Aqueous Sample (non-micro) – 3 months   Solid Samples (non-micro) – 6 months

Disposal of microbiological samples will occur after the following time, from the date of Testing:

Aqueous Sample (micro) – 2 weeks   Solid Samples (micro) – 2 weeks

SAMPLE RECEIPT NOTICE

Emerge Associates — *Job No: 19-08948* — *Expected Due Date: 14 June 2019*

ANALYSIS ASSIGNED

The following table outlines the procedures assigned to each sample, as taken from the client-supplied Chain of Custody.
Details of the individual tests assigned to each procedure can be requested from the laboratory at any time.
If any of the information in this document is incorrect, please contact the laboratory as soon as possible.

Sample Number	Sample Description	OCOP in Soil	TRH (NEPM) in Soil	PAH in Soil	8 Heavy Metals in Soil	Soil Parameters
19-08948-1	SB01_0.1	✓			✓	✓
19-08948-2	SB01_0.3					
19-08948-3	SB01_0.5					
19-08948-4	SB01_1.0					
19-08948-5	SB02_0.1	✓			✓	✓
19-08948-6	SB02_0.3					
19-08948-7	SB02_0.5					
19-08948-8	SB02_1.0					
19-08948-9	SB03_0.15	✓			✓	✓
19-08948-10	SB03_0.3					
19-08948-11	SB03_0.5					
19-08948-12	SB04_0.1	✓			✓	✓
19-08948-13	SB04_0.3					
19-08948-14	SB04_0.5					
19-08948-15	SB05_1.8		✓	✓	✓	✓
19-08948-16	SB06_0.15	✓			✓	✓
19-08948-17	SB06_0.3					
19-08948-18	SB06_0.5					
19-08948-19	SB07_1.5		✓	✓	✓	✓
19-08948-20	SB08_1.1		✓	✓	✓	✓
19-08948-21	SB09_0.1	✓			✓	✓
19-08948-22	SB09_0.3					
19-08948-23	SB09_0.5					

SAMPLE RECEIPT NOTICE

Emerge Associates — *Job No: 19-08948* — *Expected Due Date: 14 June 2019*

Sample Number	Sample Description	OCOP in Soil	TRH (NEPM) in Soil	PAH in Soil	8 Heavy Metals in Soil	Soil Parameters
19-08948-24	SB09_1.0					
19-08948-25	SQA01	✓			✓	✓

ARL Group
Proudly Western Australian

ARL   ProMicro

LABORATORY REPORT

Job Number:	19-08948
Revision:	00
Date:	14 June 2019

ADDRESS: **Emerge Associates**
4/26 Railway Road
Subiaco WA 6008

ATTENTION: David Pond

DATE RECEIVED: 11 June 2019

YOUR REFERENCE: EP19-058(01) - TAFE Beaconsfield

PURCHASE ORDER:

APPROVALS:

Paul Nottle
Organics Manager

Sam Becker
Inorganics Manager

REPORT COMMENTS:

This report is issued by Analytical Reference Laboratory (WA) Pty Ltd
Samples are analysed on an as received basis unless otherwise noted.
Metals in soils analysis was conducted on a dry weight basis.

METHOD REFERENCES:

Methods prefixed with "ARL" are covered under NATA Accreditation Number: 2377
Methods prefixed with "PM" are covered under NATA Accreditation Number: 2561

ARL No. 070	Semi Volatile Organic Compounds by GC-ITDS
ARL No. 133	Purgeable Volatile Organic Compounds in Soil by GCMS
ARL No. 003	OCOP and PCB in Soil
ARL No. 192	Total Recoverable Hydrocarbons (C_6-C_{10}) in Soil
ARL No. 193	Total Recoverable Hydrocarbons (>C_{10}-C_{40}) in Soil
ARL No. 006	Polycyclic Aromatic Hydrocarbons in Soil
ARL No. 401/403	Metals in Soil and Sediment by ICPOES/MS
ARL No. 406	Mercury by Cold Vapour Atomic Absorption Spectrophotometry

NATA
WORLD RECOGNISED
ACCREDITATION
Accredited for compliance with ISO/IEC 17025 - Testing

LABORATORY REPORT

Emerge Associates
ARL Job No: *19-08948* *Revision:* *00* *Date:* 14 June 2019

Semi-Volatile Organic Compounds in Soil

The following compounds were identified with a greater than 70% match to the NIST 2008 Library.

ARL Lab No	Sample Marks	Compounds Detected
19-08948-15	SB05_1.8 10/06/2019	No SVOCs Detected
19-08948-19	SB07_1.5 10/06/2019	No SVOCs Detected
19-08948-20	SB08_1.1 10/06/2019	No SVOCs Detected

Unless indicated in the previous table, the following compounds were not detected by ARL Method 070.

Compound	Limit of Detection (mg/kg)	Compound	Limit of Detection (mg/kg)	Compound	Limit of Detection (mg/kg)
Phenol	0.5	Anthracene	0.2	Endosulfan II	0.2
2-Chlorophenol	0.5	Fluoranthene	0.2	Endosulfan Sulfate	0.2
2-Methylphenol	0.5	Pyrene	0.2	Diclofop Methyl	0.5
3+4-Methylphenol	1	Benz(a)anthracene	0.5	Amitraz	0.2
2-Nitrophenol	1	Chrysene	0.5	alpha-BHC (HCH)	0.5
2,4-Dimethylphenol	1	Benzo(b)fluoranthene	0.5	beta-BHC (HCH)	0.5
2,4-Dichlorophenol	1	Benzo(k)fluoranthene	0.5	Heptachlor	0.5
4-Chloro-3-methylphenol	1	Benzo(a)pyrene	0.5	delta-BHC (HCH)	0.5
2,4,6-Trichlorophenol	1	Indeno(1,2,3-c,d)pyrene	0.5	Hexachlorobenzene (HCB)	0.4
2,4,5-Trichlorophenol	1	Dibenz(a,h)anthracene	0.5	Lindane	0.5
4-Nitrophenol	2	Diuron	1	Aldrin	0.4
2,3,4,5-Tetrachlorophenol	2	Molinate	0.2	Diazinon	10
2,3,5,6-Tetrachlorophenol	2	Fluometuron	0.2	Heptachlor Epoxide	0.4
2,3,4,6-Tetrachlorophenol	2	Trifluralin	0.2	Oxychlordane	0.4
2,6-Dichlorophenol	1	Dimethoate	0.2	p,p-DDE	0.4
2-Methyl-4,6-dinitrophenol	4	Simazine	0.2	Dieldrin	0.4
Pentachlorophenol	4	Atrazine	0.2	p,p-DDD	0.4
Dinoseb	4	Propazine	0.2	p,p-DDT	1
Naphthalene	0.2	Prometryn	0.2	Chlordane	0.5
2-Methylnaphthalene	0.2	Terbutryn	0.2	Bifenthrin	2
Acenaphthylene	0.2	Fenitrothion	0.2	Bromophos Ethyl	0.5
Acenaphthene	0.2	Chlorpyrifos	0.2	Ethion	2
Fluorene	0.2	Endosulfan I	0.2		
Phenanthrene	0.2	Fenamiphos	2		

LABORATORY REPORT

Emerge Associates
ARL Job No: *19-08948* *Revision:* *00* *Date:* 14 June 2019

VOC's in Soil Sample No: Sample Description: Sample Date:	LOR	UNITS	19-08948-15 SB05_1.8 10/06/2019	19-08948-19 SB07_1.5 10/06/2019	19-08948-20 SB08_1.1 10/06/2019
Benzene	0.1	mg/kg	<0.1	<0.1	<0.1
Carbontetrachloride	0.1	mg/kg	<0.1	<0.1	<0.1
Chlorobenzene	0.1	mg/kg	<0.1	<0.1	<0.1
DCM	10	mg/kg	<10	<10	<10
Ethylbenzene	0.1	mg/kg	<0.1	<0.1	<0.1
Hexachlorobutadiene	0.1	mg/kg	<0.1	<0.1	<0.1
Methyl *tert* Butyl Ether	0.1	mg/kg	<0.1	<0.1	<0.1
Styrene	0.1	mg/kg	<0.1	<0.1	<0.1
Perchloroethene (PCE)	0.1	mg/kg	<0.1	<0.1	<0.1
Toluene	0.1	mg/kg	<0.1	<0.1	<0.1
Trichloroethylene (TCE)	0.1	mg/kg	<0.1	<0.1	<0.1
Vinyl Chloride	0.2	mg/kg	<0.2	<0.2	<0.2
Xylenes (Total)	0.2	mg/kg	<0.2	<0.2	<0.2
1,1-Dichloroethane	0.2	mg/kg	<0.2	<0.2	<0.2
1,2-Dichloroethane	0.1	mg/kg	<0.1	<0.1	<0.1
1,1-Dichloroethene	0.2	mg/kg	<0.2	<0.2	<0.2
cis-1,2-Dichloroethene	0.1	mg/kg	<0.1	<0.1	<0.1
trans-1,2-Dichloroethene	0.2	mg/kg	<0.2	<0.2	<0.2
1,1,1-Trichloroethane	0.2	mg/kg	<0.2	<0.2	<0.2
1,1,1,2-Tetrachloroethane	0.1	mg/kg	<0.1	<0.1	<0.1
1,1,2,2-Tetrachloroethane	0.1	mg/kg	<0.1	<0.1	<0.1
1,2-Dichlorobenzene	0.1	mg/kg	<0.1	<0.1	<0.1
1,3-Dichlorobenzene	0.1	mg/kg	<0.1	<0.1	<0.1
1,4-Dichlorobenzene	0.1	mg/kg	<0.1	<0.1	<0.1
1,2,3-Trichlorobenzene	0.1	mg/kg	<0.1	<0.1	<0.1
1,2,4-Trichlorobenzene	0.1	mg/kg	<0.1	<0.1	<0.1
1,3,5-Trichlorobenzene	0.1	mg/kg	<0.1	<0.1	<0.1

LABORATORY REPORT

Emerge Associates
ARL Job No: *19-08948* *Revision:* *00* *Date:* 14 June 2019

OCOP in Soil Sample No: Sample Description: Sample Date:	LOR	UNITS	19-08948-1 SB01_0.1 10/06/2019	19-08948-5 SB02_0.1 10/06/2019	19-08948-9 SB03_0.15 10/06/2019	19-08948-12 SB04_0.1 10/06/2019	19-08948-16 SB06_0.15 10/06/2019
Aldrin	0.01	mg/kg	1.2	<0.01	2.7	350	48
alpha-BHC (HCH)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
beta-BHC (HCH)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
delta-BHC (HCH)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Bifenthrin	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Bromophos Ethyl	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlordane	0.01	mg/kg	2.1	0.35	<0.01	<0.01	<0.01
Chlorpyrifos	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Dieldrin	0.01	mg/kg	2.8	0.03	3.5	13	45
p,p-DDD	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
p,p-DDE	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
p,p-DDT	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
o,p-DDT	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan I	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan II	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan Sulfate	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	0.01	mg/kg	0.15	<0.01	0.30	0.10	1.2
Heptachlor	0.01	mg/kg	0.46	0.13	<0.01	<0.01	<0.01
Heptachlor Epoxide	0.01	mg/kg	0.22	0.11	<0.01	<0.01	<0.01
Hexachlorobenzene (HCB)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Lindane	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Methoxychlor	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Oxychlordane	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Diazinon	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Ethion	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Fenitrothion	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Trifluralin	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2

LABORATORY REPORT

Emerge Associates
ARL Job No: *19-08948* *Revision:* *00* *Date:* 14 June 2019

OCOP in Soil Sample No: Sample Description: Sample Date:	LOR	UNITS	19-08948-21 SB09_0.1 10/06/2019	19-08948-25 SQA01 10/06/2019
Aldrin	0.01	mg/kg	0.04	3.0
alpha-BHC (HCH)	0.01	mg/kg	<0.01	<0.01
beta-BHC (HCH)	0.01	mg/kg	<0.01	<0.01
delta-BHC (HCH)	0.01	mg/kg	<0.01	<0.01
Bifenthrin	0.2	mg/kg	<0.2	<0.2
Bromophos Ethyl	0.05	mg/kg	<0.05	<0.05
Chlordane	0.01	mg/kg	0.38	<0.01
Chlorpyrifos	0.02	mg/kg	<0.02	<0.02
Dieldrin	0.01	mg/kg	0.13	4.0
p,p-DDD	0.01	mg/kg	<0.01	<0.01
p,p-DDE	0.01	mg/kg	<0.01	<0.01
p,p-DDT	0.01	mg/kg	<0.01	<0.01
o,p-DDT	0.01	mg/kg	<0.01	<0.01
Endosulfan I	0.01	mg/kg	<0.01	<0.01
Endosulfan II	0.01	mg/kg	<0.01	<0.01
Endosulfan Sulfate	0.01	mg/kg	<0.01	<0.01
Endrin	0.01	mg/kg	<0.01	0.32
Heptachlor	0.01	mg/kg	0.04	<0.01
Heptachlor Epoxide	0.01	mg/kg	0.03	<0.01
Hexachlorobenzene (HCB)	0.01	mg/kg	<0.01	<0.01
Lindane	0.01	mg/kg	<0.01	<0.01
Methoxychlor	0.2	mg/kg	<0.2	<0.2
Oxychlordane	0.01	mg/kg	<0.01	<0.01
Diazinon	0.2	mg/kg	<0.2	<0.2
Ethion	0.05	mg/kg	<0.05	<0.05
Fenitrothion	0.1	mg/kg	<0.1	<0.1
Malathion	0.1	mg/kg	<0.1	<0.1
Trifluralin	0.2	mg/kg	<0.2	<0.2

LABORATORY REPORT

Emerge Associates
ARL Job No: 19-08948 *Revision: 00* *Date:* 14 June 2019

TRH (C_6-C_{40}) in Soil Sample No: Sample Description: Sample Date:	LOR	UNITS	19-08948-15 SB05_1.8 10/06/2019	19-08948-19 SB07_1.5 10/06/2019	19-08948-20 SB08_1.1 10/06/2019
Benzene	0.1	mg/kg	<0.1	<0.1	<0.1
Toluene	0.1	mg/kg	<0.1	<0.1	<0.1
Ethylbenzene	0.1	mg/kg	<0.1	<0.1	<0.1
Xylenes (Total)	0.2	mg/kg	<0.2	<0.2	<0.2
Naphthalene	0.5	mg/kg	<0.5	<0.5	<0.5
TRH C_{6-10}	2	mg/kg	<2	<2	<2
TRH C_{6-10} minus BTEX (F1)	2	mg/kg	<2	<2	<2
TRH $C_{>10-16}$	20	mg/kg	<20	<20	<20
TRH $C_{>10-16}$ minus Naphthalene (F2)	20	mg/kg	<20	<20	<20
TRH $C_{>16-34}$	50	mg/kg	<50	<50	<50
TRH $C_{>34-40}$	50	mg/kg	<50	<50	<50

PAH in Soil Sample No: Sample Description: Sample Date:	LOR	UNITS	19-08948-15 SB05_1.8 10/06/2019	19-08948-19 SB07_1.5 10/06/2019	19-08948-20 SB08_1.1 10/06/2019
Naphthalene	0.1	mg/kg	<0.1	<0.1	<0.1
2-Methylnaphthalene	0.1	mg/kg	<0.1	<0.1	<0.1
Acenaphthylene	0.1	mg/kg	<0.1	<0.1	<0.1
Acenaphthene	0.1	mg/kg	<0.1	<0.1	<0.1
Fluorene	0.1	mg/kg	<0.1	<0.1	<0.1
Phenanthrene	0.1	mg/kg	<0.1	<0.1	<0.1
Anthracene	0.1	mg/kg	<0.1	<0.1	<0.1
Fluoranthene	0.1	mg/kg	<0.1	<0.1	<0.1
Pyrene	0.1	mg/kg	<0.1	<0.1	<0.1
Benz(a)anthracene	0.2	mg/kg	<0.2	<0.2	<0.2
Chrysene	0.2	mg/kg	<0.2	<0.2	<0.2
Benzo(b)fluoranthene	0.2	mg/kg	<0.2	<0.2	<0.2
Benzo(k)fluoranthene	0.2	mg/kg	<0.2	<0.2	<0.2
Benzo(a)pyrene	0.2	mg/kg	<0.2	<0.2	<0.2
Indeno(1,2,3-c,d)pyrene	0.2	mg/kg	<0.2	<0.2	<0.2
Dibenz(a,h)anthracene	0.2	mg/kg	<0.2	<0.2	<0.2
Benzo(ghi)perylene	0.2	mg/kg	<0.2	<0.2	<0.2

LABORATORY REPORT

Emerge Associates
ARL Job No: *19-08948* *Revision:* *00* *Date:* 14 June 2019

8 Heavy Metals in Soil Sample No: Sample Description: Sample Date:	LOR	UNITS	19-08948-1 SB01_0.1 10/06/2019	19-08948-5 SB02_0.1 10/06/2019	19-08948-9 SB03_0.15 10/06/2019	19-08948-12 SB04_0.1 10/06/2019	19-08948-15 SB05_1.8 10/06/2019
Arsenic	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	0.1	mg/kg	0.3	<0.1	0.1	0.1	0.2
Chromium	1	mg/kg	13	<1	13	13	10
Copper	1	mg/kg	11	1	7	13	8
Mercury	0.02	mg/kg	0.06	<0.02	0.02	0.02	0.02
Nickel	1	mg/kg	1	<1	<1	<1	<1
Lead	1	mg/kg	<1	<1	<1	<1	<1
Zinc	1	mg/kg	6	<1	<1	2	<1

8 Heavy Metals in Soil Sample No: Sample Description: Sample Date:	LOR	UNITS	19-08948-16 SB06_0.15 10/06/2019	19-08948-19 SB07_1.5 10/06/2019	19-08948-20 SB08_1.1 10/06/2019	19-08948-21 SB09_0.1 10/06/2019	19-08948-25 SQA01 10/06/2019
Arsenic	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	0.1	mg/kg	0.1	0.6	0.5	<0.1	0.1
Chromium	1	mg/kg	16	21	18	4	16
Copper	1	mg/kg	19	5	4	3	6
Mercury	0.02	mg/kg	0.03	0.04	0.04	<0.02	<0.02
Nickel	1	mg/kg	2	<1	<1	<1	<1
Lead	1	mg/kg	2	<1	2	<1	2
Zinc	1	mg/kg	3	2	4	<1	2

Result Definitions
LOR Limit of Reporting [NT] Not Tested [ND] Not Detected at indicated Limit of Reporting
* Denotes test not covered by NATA Accreditation

FOR MICROBIOLOGICAL TESTING - The data in this report may not be representative of a lot, batch or other samples and may not necessarily justify the acceptance or rejection of a lot or batch, a product recall or support legal proceedings. Tests are not routinely performed as duplicates unless specifically requested. Changes occur in the bacterial content of biological samples. Samples should be examined as soon as possible after collection, preferably within 6 hrs and must be stored at 4 degrees Celsius or below. Samples tested after 24 hrs cannot be regarded as satisfactory because of temperature abuse and variations.

LABORATORY REPORT

Job Number: 19-08948-A
Revision: 00
Date: 19 June 2019

ADDRESS: **Emerge Associates**
4/26 Railway Road
Subiaco WA 6008

ATTENTION: David Pond

DATE RECEIVED: 11/06/2019

YOUR REFERENCE: EP19-058(01) - TAFE Beaconsfield

PURCHASE ORDER:

APPROVALS:

Paul Nottle
Organics Manager

REPORT COMMENTS:

This report is issued by Analytical Reference Laboratory (WA) Pty Ltd. The report shall not be reproduced except in full without written approval from the laboratory.

Samples are analysed on an as received basis unless otherwise noted.

METHOD REFERENCES:

Methods prefixed with "ARL" are covered under NATA Accreditation Number: 2377
Methods prefixed with "PM" are covered under NATA Accreditation Number: 2561
Methods prefixed with "EDP" are covered under NATA Accreditation Number: 19290

Method ID	Method Description
ARL No. 003	OCOP and PCB in Soil

WORLD RECOGNISED ACCREDITATION
Accredited for compliance with ISO/IEC 17025 - Testing

OCOP in Soil		Sample No	19-08948-A-2	19-08948-A-3	19-08948-A-6	19-08948-A-7	19-08948-A-10
		Sample Description	SB01_0.3	SB01_0.5	SB02_0.3	SB02_0.5	SB03_0.3
		Sample Date	10/06/2019	10/06/2019	10/06/2019	10/06/2019	10/06/2019
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Aldrin	0.01	mg/kg	3.4	1.1	<0.01	<0.01	2.1
alpha-BHC (HCH)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
beta-BHC (HCH)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
delta-BHC (HCH)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Bifenthrin	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Bromophos Ethyl	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlordane	0.01	mg/kg	0.80	0.22	0.17	0.11	<0.01
Chlorpyrifos	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Dieldrin	0.01	mg/kg	16	5.2	0.20	0.31	2.4
p,p-DDD	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
p,p-DDE	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
p,p-DDT	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
o,p-DDT	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan I	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan II	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan Sulfate	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	0.01	mg/kg	0.14	0.04	<0.01	<0.01	0.16
Heptachlor	0.01	mg/kg	1.4	0.41	0.07	0.05	<0.01
Heptachlor Epoxide	0.01	mg/kg	0.12	0.03	0.13	0.12	<0.01
Hexachlorobenzene (HCB)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Lindane	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Methoxychlor	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Oxychlordane	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Diazinon	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Ethion	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Fenitrothion	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Trifluralin	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2

OCOP in Soil		Sample No	19-08948-A-11	19-08948-A-13	19-08948-A-14	19-08948-A-17	19-08948-A-18
		Sample Description	SB03_0.5	SB04_0.3	SB04_0.5	SB06_0.3	SB06_0.5
		Sample Date	10/06/2019	10/06/2019	10/06/2019	10/06/2019	10/06/2019
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Aldrin	0.01	mg/kg	3.1	67	18	20	0.02
alpha-BHC (HCH)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
beta-BHC (HCH)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
delta-BHC (HCH)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Bifenthrin	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Bromophos Ethyl	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlordane	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorpyrifos	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Dieldrin	0.01	mg/kg	4.0	7.4	5.0	24	0.02
p,p-DDD	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
p,p-DDE	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	0.08
p,p-DDT	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	0.12
o,p-DDT	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan I	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01

Emerge Associates — *LABORATORY REPORT*

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OCOP in Soil		Sample No	19-08948-A-11	19-08948-A-13	19-08948-A-14	19-08948-A-17	19-08948-A-18
		Sample Description	SB03_0.5	SB04_0.3	SB04_0.5	SB06_0.3	SB06_0.5
		Sample Date	10/06/2019	10/06/2019	10/06/2019	10/06/2019	10/06/2019
Endosulfan II	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan Sulfate	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	0.01	mg/kg	0.31	0.07	0.07	0.35	<0.01
Heptachlor	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor Epoxide	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Hexachlorobenzene (HCB)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Lindane	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Methoxychlor	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Oxychlordane	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Diazinon	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Ethion	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Fenitrothion	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Trifluralin	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2

OCOP in Soil		Sample No	19-08948-A-22	19-08948-A-23
		Sample Description	SB09_0.3	SB09_0.5
		Sample Date	10/06/2019	10/06/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**
Aldrin	0.01	mg/kg	0.02	0.03
alpha-BHC (HCH)	0.01	mg/kg	<0.01	<0.01
beta-BHC (HCH)	0.01	mg/kg	<0.01	<0.01
delta-BHC (HCH)	0.01	mg/kg	<0.01	<0.01
Bifenthrin	0.2	mg/kg	<0.2	<0.2
Bromophos Ethyl	0.05	mg/kg	<0.05	<0.05
Chlordane	0.01	mg/kg	0.28	0.86
Chlorpyrifos	0.02	mg/kg	<0.02	<0.02
Dieldrin	0.01	mg/kg	0.14	0.60
p,p-DDD	0.01	mg/kg	<0.01	<0.01
p,p-DDE	0.01	mg/kg	<0.01	<0.01
p,p-DDT	0.01	mg/kg	<0.01	<0.01
o,p-DDT	0.01	mg/kg	<0.01	<0.01
Endosulfan I	0.01	mg/kg	<0.01	<0.01
Endosulfan II	0.01	mg/kg	<0.01	<0.01
Endosulfan Sulfate	0.01	mg/kg	<0.01	<0.01
Endrin	0.01	mg/kg	<0.01	<0.01
Heptachlor	0.01	mg/kg	0.04	0.28
Heptachlor Epoxide	0.01	mg/kg	0.02	0.44
Hexachlorobenzene (HCB)	0.01	mg/kg	<0.01	<0.01
Lindane	0.01	mg/kg	<0.01	<0.01
Methoxychlor	0.2	mg/kg	<0.2	<0.2
Oxychlordane	0.01	mg/kg	<0.01	<0.01
Diazinon	0.2	mg/kg	<0.2	<0.2
Ethion	0.05	mg/kg	<0.05	<0.05
Fenitrothion	0.1	mg/kg	<0.1	<0.1
Malathion	0.1	mg/kg	<0.1	<0.1
Trifluralin	0.2	mg/kg	<0.2	<0.2

Result Definitions

Emerge Associates — *LABORATORY REPORT*

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LOR Limit of Reporting [NT] Not Tested [ND] Not Detected at indicated Limit of Reporting
* Denotes test not covered by NATA Accreditation

FOR MICROBIOLOGICAL TESTING - The data in this report may not be representative of a lot, batch or other samples and may not necessarily justify the acceptance or rejection of a lot or batch, a product recall or support legal proceedings. Tests are not routinely performed as duplicates unless specifically requested. Changes occur in the bacterial content of biological samples. Samples should be examined as soon as possible after collection, preferably within 6 hrs and must be stored at 4 degrees Celsius or below. Samples tested after 24 hrs cannot be regarded as satisfactory because of temperature abuse and variations.

Quality Control Report

Job Number: 19-08948

Date: 14/06/2019

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This Quality Control Report is issued in accordance with Section 18 of the ARL Quality Management Manual. All QC parameters are contained within the relevant ARL Method as indicated by the method reference, either on this report or the Laboratory Report.

Acceptance of Holding Times, Duplicate RPD, Spike, LCS and CRM Recoveries are determined at the time of analysis by the Signatory indicated on the Laboratory Report.

DEFINITIONS

Duplicate Analysis

A sample, chosen randomly by the analyst at the time of sample preparation, analysed in duplicate.

RPD

Relative Percent Difference is the absolute difference between the sample and a duplicate analysis compared to the average of the two analytical results. Acceptance Limits can be exceeded by matrix interference or when the result is less than 5 times the LOR.

Matrix Spike

An additional portion of sample to which known amounts of the target analytes are added before sample preparation. Acceptance Limits can be exceeded by matrix interference or when the target analytes are present in the sample.

Certified Reference Material (CRM)

A commercially available certified solution/mixture of the target analyte of known concentration.

Laboratory Control Sample (LCS)

An in-house certified solution/mixture of the target analyte of known concentration.

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46-48 Banksia Road, Welshpool, Western Australia 6106 Telephone: 08 6253 4444 Facsimile 08 6253 4440
www.arlwa.com.au ABN: 91 050 159 898

Quality Control Report

Job Number: 19-08948

Date: 14/06/2019

Environmental and Analytical Laboratory

SVOC's in Soil

Holding Time Criteria	Date
Extracted	13/06/2019
Analysed	14/06/2019

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Quality Control Report

Job Number: 19-08948

Date: 14/06/2019

VOCs in Soil

Holding Time Criteria	Date	
Extracted	13/06/2019	
Analysed	14/06/2019	
Duplicate Analysis (19-08948-20)	**RPD (%)**	**Limits (%)**
Benzene	0	200
Carbon tetrachloride	0	200
Chlorobenzene	0	200
DCM	0	200
Ethylbenzene	0	200
Hexachlorobutadiene	0	200
Methyl *tert* Butyl Ether	0	200
Styrene	0	200
Perchloroethene (PCE)	0	200
Toluene	0	200
Trichloroethylene(TCE)	0	200
Vinyl Chloride	0	200
Xylenes (Total)	0	200
1,1-Dichloroethane	0	200
1,2-Dichloroethane	0	200
1,1-Dichloroethene	0	200
cis-1,2-Dichloroethene	0	200
trans-1,2-Dichloroethene	0	200
1,1,1-Trichloroethane	0	200
1,1,1,2-Tetrachloroethane	0	200
1,1,2,2-Tetrachloroethane	0	200
1,2-Dichlorobenzene	0	200
1,3-Dichlorobenzene	0	200
1,4-Dichlorobenzene	0	200
1,2,3-Trichlorobenzene	0	200
1,2,4-Trichlorobenzene	0	200
1,3,5-Trichlorobenzene	0	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Benzene	<0.1	0.1
Carbon tetrachloride	<0.1	0.1
Chlorobenzene	<0.1	0.1
DCM	<10	10
Ethylbenzene	<0.1	0.1
Hexachlorobutadiene	<0.1	0.1
Methyl *tert* Butyl Ether	<0.1	0.1
Styrene	<0.1	0.1
Perchloroethene (PCE)	<0.1	0.1

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Blank Analysis	Result (mg/kg)	Limit (mg/kg)
Toluene	<0.1	0.1
Trichloroethylene(TCE)	<0.1	0.1
Vinyl Chloride	<0.2	0.2
Xylenes (Total)	<0.2	0.2
1,1-Dichloroethane	<0.2	0.2
1,2-Dichloroethane	<0.1	0.1
1,1-Dichloroethene	<0.2	0.2
cis-1,2-Dichloroethene	<0.1	0.1
trans-1,2-Dichloroethene	<0.2	0.2
1,1,1-Trichloroethane	<0.2	0.2
1,1,1,2-Tetrachloroethane	<0.1	0.1
1,1,2,2-Tetrachloroethane	<0.1	0.1
1,2-Dichlorobenzene	<0.1	0.1
1,3-Dichlorobenzene	<0.1	0.1
1,4-Dichlorobenzene	<0.1	0.1
1,2,3-Trichlorobenzene	<0.1	0.1
1,2,4-Trichlorobenzene	<0.1	0.1
1,3,5-Trichlorobenzene	<0.1	0.1
Matrix Spike (19-08948-20)	**Recovery (%)**	**Limits (%)**
Benzene	89	60 - 120
Ethylbenzene	101	60 - 120
Perchloroethene (PCE)	95	60 - 120
Toluene	96	60 - 120
Trichloroethylene(TCE)	92	60 - 120
Xylenes (Total)	108	60 - 120

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Quality Control Report

Job Number: 19-08948

Date: 14/06/2019

ARL
Environmental and Analytical Laboratory

OC/OP and PCB in Soil

Holding Time Criteria	Date	
Extracted	13/06/2019	
Analysed	14/06/2019	
Duplicate Analysis (19-08948-25)	**RPD (%)**	**Limits (%)**
Aldrin	3	25
alpha-BHC (HCH)	0	200
beta-BHC (HCH)	0	200
delta-BHC (HCH)	0	200
Bifenthrin	0	200
Bromophos Ethyl	0	200
Chlordane	0	200
Chlorpyrifos	0	200
Dieldrin	3	25
p,p-DDD	0	200
p,p-DDE	0	200
p,p-DDT	0	200
o,p-DDT	0	200
Endosulfan I	0	200
Endosulfan II	0	200
Endosulfan Sulfate	0	200
Endrin	12	25
Heptachlor	0	200
Heptachlor Epoxide	0	200
Hexachlorobenzene (HCB)	0	200
Lindane	0	200
Methoxychlor	0	200
Oxychlordane	0	200
Diazinon	0	200
Ethion	0	200
Fenitrothion	0	200
Malathion	0	200
Trifluralin	0	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Aldrin	<0.01	0.01
alpha-BHC (HCH)	<0.01	0.01
beta-BHC (HCH)	<0.01	0.01
delta-BHC (HCH)	<0.01	0.01
Bifenthrin	<0.2	0.2
Bromophos Ethyl	<0.05	0.05
Chlordane	<0.01	0.01
Chlorpyrifos	<0.02	0.02

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Quality Control Report

Job Number: 19-08948

Date: 14/06/2019

Blank Analysis	Result (mg/kg)	Limit (mg/kg)
Dieldrin	<0.01	0.01
p,p-DDD	<0.01	0.01
p,p-DDE	<0.01	0.01
p,p-DDT	<0.01	0.01
o,p-DDT	<0.01	0.01
Endosulfan I	<0.01	0.01
Endosulfan II	<0.01	0.01
Endosulfan Sulfate	<0.01	0.01
Endrin	<0.01	0.01
Heptachlor	<0.01	0.01
Heptachlor Epoxide	<0.01	0.01
Hexachlorobenzene (HCB)	<0.01	0.01
Lindane	<0.01	0.01
Methoxychlor	<0.2	0.2
Oxychlordane	<0.01	0.01
Diazinon	<0.2	0.2
Ethion	<0.05	0.05
Fenitrothion	<0.1	0.1
Malathion	<0.1	0.1
Trifluralin	<0.2	0.2
Matrix Spike (19-08948-25)	**Recovery (%)**	**Limits (%)**
p,p-DDT	85	60 - 120
Heptachlor	88	60 - 120
Lindane	87	60 - 120

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Quality Control Report

Job Number: 19-08948

Date: 14/06/2019

Environmental and Analytical Laboratory

TRH (NEPM 2013) in Soil

Holding Time Criteria	**Date**	
Extracted	13/06/2019	
Analysed	14/06/2019	
Duplicate Analysis (19-08948-20)	**RPD (%)**	**Limits (%)**
Benzene	0	200
Toluene	0	200
Ethylbenzene	0	200
Xylenes (Total)	0	200
Naphthalene	0	200
TRH C_{6-10}	0	200
TRH C_{6-10} minus BTEX (F1)	0	200
TRH $C_{>10-16}$	0	200
TRH $C_{>10-16}$ minus Naphthalene (F2)	0	200
TRH $C_{>16-34}$	0	200
TRH $C_{>34-40}$	0	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Benzene	<0.1	0.1
Toluene	<0.1	0.1
Ethylbenzene	<0.1	0.1
Xylenes (Total)	<0.2	0.2
Naphthalene	<0.5	0.5
TRH C_{6-10}	<2	2
TRH C_{6-10} minus BTEX (F1)	<2	2
TRH $C_{>10-16}$	<20	20
TRH $C_{>10-16}$ minus Naphthalene (F2)	<20	20
TRH $C_{>16-34}$	<50	50
TRH $C_{>34-40}$	<50	50
Laboratory Control Sample	**Recovery (%)**	**Limits (%)**
Benzene	78	70 - 140
Toluene	90	70 - 140
Ethylbenzene	83	70 - 140
Xylenes (Total)	125	70 - 140
Naphthalene	88	70 - 140
TRH C_{6-10}	71	70 - 140
TRH $C_{>10-16}$	112	70 - 140
TRH $C_{>16-34}$	101	70 - 140
TRH $C_{>34-40}$	86	70 - 140

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Quality Control Report

Job Number: 19-08948

Date: 14/06/2019

PAH in Soil

Holding Time Criteria	Date	
Extracted	13/06/2019	
Analysed	14/06/2019	
Duplicate Analysis (19-08948-20)	**RPD (%)**	**Limits (%)**
Naphthalene	0	200
2-Methylnaphthalene	0	200
Acenaphthylene	0	200
Acenaphthene	0	200
Fluorene	0	200
Phenanthrene	0	200
Anthracene	0	200
Fluoranthene	0	200
Pyrene	0	200
Benz(a)anthracene	0	200
Chrysene	0	200
Benzo(b)fluoranthene	0	200
Benzo(k)fluoranthene	0	200
Benzo(a)pyrene	0	200
Indeno(1,2,3-c,d)pyrene	0	200
Dibenz(a,h)anthracene	0	200
Benzo(ghi)perylene	0	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Naphthalene	<0.1	0.1
2-Methylnaphthalene	<0.1	0.1
Acenaphthylene	<0.1	0.1
Acenaphthene	<0.1	0.1
Fluorene	<0.1	0.1
Phenanthrene	<0.1	0.1
Anthracene	<0.1	0.1
Fluoranthene	<0.1	0.1
Pyrene	<0.1	0.1
Benz(a)anthracene	<0.2	0.2
Chrysene	<0.2	0.2
Benzo(b)fluoranthene	<0.2	0.2
Benzo(k)fluoranthene	<0.2	0.2
Benzo(a)pyrene	<0.2	0.2
Indeno(1,2,3-c,d)pyrene	<0.2	0.2
Dibenz(a,h)anthracene	<0.2	0.2
Benzo(ghi)perylene	<0.2	0.2
Matrix Spike (19-08948-20)	**Recovery (%)**	**Limits (%)**
Naphthalene	74	60 - 120

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Quality Control Report

Job Number: 19-08948
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Matrix Spike (19-08948-20)	Recovery (%)	Limits (%)
Acenaphthene	82	60 - 120
Phenanthrene	89	60 - 120
Pyrene	85	60 - 120
Chrysene	68	60 - 120
Benzo(a)pyrene	95	60 - 120

Metals in Soil and Sediment

Holding Time Criteria	Date	
Extracted	12/06/2019	
Analysed	12/06/2019	
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Arsenic	<5	5
Cadmium	<0.1	0.1
Chromium	<1	1
Copper	<1	1
Nickel	<1	1
Lead	<1	1
Zinc	<1	1
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Arsenic	84	80 - 120
Cadmium	89	80 - 120
Chromium	91	80 - 120
Copper	94	80 - 120
Nickel	99	80 - 120
Lead	100	80 - 120
Zinc	80	80 - 120

Mercury in Soils

Holding Time Criteria	Date	
Extracted	12/06/2019	
Analysed	13/06/2019	
Duplicate Analysis (19-08674-A-1)	**RPD (%)**	**Limits (%)**
Mercury	0	200
Duplicate Analysis (19-08725-8)	**RPD (%)**	**Limits (%)**
Mercury	17	50
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Mercury	<0.02	0.02
Matrix Spike (19-08674-A-1)	**Recovery (%)**	**Limits (%)**
Mercury	110	80 - 120
Matrix Spike (19-08725-8)	**Recovery (%)**	**Limits (%)**
Mercury	106	80 - 120
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Mercury	94	80 - 120

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Quality Control Report

Job Number: 19-08948

Date: 14/06/2019

Soil Parameters

Holding Time Criteria	Date
Analysed	12/6/2019

Analytical Reference Laboratory (WA) PTY. Ltd
46-48 Banksia Road, Welshpool, Western Australia 6106 Telephone: 08 6253 4444 Facsmile 08 6253 4440
www.arlwa.com.au ABN: 91 050 159 898

Quality Control Report

Job Number: 19-08948-A

Date: 19/06/2019

ARL
Environmental and Analytical Laboratory

This Quality Control Report is issued in accordance with Section 18 of the ARL Quality Management Manual. All QC parameters are contained within the relevant ARL Method as indicated by the method reference, either on this report or the Laboratory Report.

Acceptance of Holding Times, Duplicate RPD, Spike, LCS and CRM Recoveries are determined at the time of analysis by the Signatory indicated on the Laboratory Report.

DEFINITIONS

Duplicate Analysis
A sample, chosen randomly by the analyst at the time of sample preparation, analysed in duplicate.

RPD
Relative Percent Difference is the absolute difference between the sample and a duplicate analysis compared to the average of the two analytical results. Acceptance Limits can be exceeded by matrix interference or when the result is less than 5 times the LOR.

Matrix Spike
An additional portion of sample to which known amounts of the target analytes are added before sample preparation. Acceptance Limits can be exceeded by matrix interference or when the target analytes are present in the sample.

Certified Reference Material (CRM)
A commercially available certified solution/mixture of the target analyte of known concentration.

Laboratory Control Sample (LCS)
An in-house certified solution/mixture of the target analyte of known concentration.

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Quality Control Report

Job Number: 19-08948-A

Date: 19/06/2019

ARL Environmental and Analytical Laboratory

OC/OP and PCB in Soil

Holding Time Criteria	Date	
Extracted	18/06/2019	
Analysed	19/06/2019	
Duplicate Analysis (19-08948-A-2)	**RPD (%)**	**Limits (%)**
Aldrin	3	25
alpha-BHC (HCH)	0	200
beta-BHC (HCH)	0	200
delta-BHC (HCH)	0	200
Bifenthrin	0	200
Bromophos Ethyl	0	200
Chlordane	8	25
Chlorpyrifos	0	200
Dieldrin	13	25
p,p-DDD	0	200
p,p-DDE	0	200
p,p-DDT	0	200
o,p-DDT	0	200
Endosulfan I	0	200
Endosulfan II	0	200
Endosulfan Sulfate	0	200
Endrin	0	50
Heptachlor	15	25
Heptachlor Epoxide	9	50
Hexachlorobenzene (HCB)	0	200
Lindane	0	200
Methoxychlor	0	200
Oxychlordane	0	200
Diazinon	0	200
Ethion	0	200
Fenitrothion	0	200
Malathion	0	200
Trifluralin	0	200
Duplicate Analysis (19-09191-A-10)	**RPD (%)**	**Limits (%)**
Aldrin	50	50
alpha-BHC (HCH)	0	200
beta-BHC (HCH)	0	200
delta-BHC (HCH)	0	200
Bifenthrin	0	200
Bromophos Ethyl	0	200
Chlordane	15	50
Chlorpyrifos	0	200

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Quality Control Report

Job Number: 19-08948-A

Date: 19/06/2019

ARL Environmental and Analytical Laboratory

Duplicate Analysis (19-09191-A-10)	RPD (%)	Limits (%)
Dieldrin	3	25
p,p-DDD	0	200
p,p-DDE	0	200
p,p-DDT	0	200
o,p-DDT	0	200
Endosulfan I	0	200
Endosulfan II	0	200
Endosulfan Sulfate	0	200
Endrin	0	200
Heptachlor	40	200
Heptachlor Epoxide	0	200
Hexachlorobenzene (HCB)	0	200
Lindane	0	200
Methoxychlor	0	200
Oxychlordane	0	200
Diazinon	0	200
Ethion	0	200
Fenitrothion	0	200
Malathion	0	200
Trifluralin	0	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Aldrin	<0.01	0.01
alpha-BHC (HCH)	<0.01	0.01
beta-BHC (HCH)	<0.01	0.01
delta-BHC (HCH)	<0.01	0.01
Bifenthrin	<0.2	0.2
Bromophos Ethyl	<0.05	0.05
Chlordane	<0.01	0.01
Chlorpyrifos	<0.02	0.02
Dieldrin	<0.01	0.01
p,p-DDD	<0.01	0.01
p,p-DDE	<0.01	0.01
p,p-DDT	<0.01	0.01
o,p-DDT	<0.01	0.01
Endosulfan I	<0.01	0.01
Endosulfan II	<0.01	0.01
Endosulfan Sulfate	<0.01	0.01
Endrin	<0.01	0.01
Heptachlor	<0.01	0.01
Heptachlor Epoxide	<0.01	0.01
Hexachlorobenzene (HCB)	<0.01	0.01

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Quality Control Report

Job Number: 19-08948-A

Date: 19/06/2019

ARL Environmental and Analytical Laboratory

Blank Analysis	Result (mg/kg)	Limit (mg/kg)
Lindane	<0.01	0.01
Methoxychlor	<0.2	0.2
Oxychlordane	<0.01	0.01
Diazinon	<0.2	0.2
Ethion	<0.05	0.05
Fenitrothion	<0.1	0.1
Malathion	<0.1	0.1
Trifluralin	<0.2	0.2
Matrix Spike (19-09191-A-10)	**Recovery (%)**	**Limits (%)**
p,p-DDT	90	60 - 120
Endrin	87	60 - 120
Heptachlor	113	60 - 120
Lindane	90	60 - 120

Analytical Reference Laboratory (WA) PTY. Ltd
46-48 Banksia Road, Welshpool, Western Australia 6106 Telephone: 08 6253 4444 Facsmile 08 6253 4440
www.arlwa.com.au ABN: 91 050 159 898

19-09191

CHAIN OF COUSTODY

emerge ASSOCIATES

CLIENT: Emerge Associates	POSTAL ADDRESS: Suite 4, 6 Centro Avenue, Subiaco WA 6008	Page 1 of 1
PROJECT MANAGER: David Pond	CONTACT PHONE: 0451 154 505	**ARL LABORATORY:** Perth
PROJECT ID.: EP19-058(01)	PROJECT NAME: TAFE Beaconsfield	TURNAROUND REQUIREMENTS
SAMPLER(S): David Pond	SAMPLERS PHONE: 0451 154 505	☐ Standard (5-7 days) ☒ Non-standard (3 day TAT)
QUOTE NO.: ORDER NO.:		Email reports to: david.pond@emergeassociates.com.au
Laboratory Batch No:	Comments/special handling/storage or disposal	Email invoice to: accounts@emergeassociates.com.au

Laboratory Use	Yes	No	N/a
Custody seal intact:	☐	☐	☐
Free ice/frozen ice bricks present:	☐	☐	☐
Random sample temp on receipt:			°C

Comments: 3 day TAT please

ANALYSIS REQUIRED

Lab ID	Sample ID	Matrix	Date	Type & Preservative	Total No.	OCP/OPP	8 metals	HOLD	Additional information (likely contaminants, dilutions or specific QC analysis)
1	SB10_0.1	SOIL	13/6/19	1 x GLASS	1	X	X		
2	SB10_0.3				1			X	
3	SB10_0.5				1			X	
4	SB11_0.1				1	X	X		
5	SB11_0.3				1			X	
6	SB11_0.5				1			X	
7	SB12_0.1				1	X	X		
8	SB13_0.1				1	X	X		
9	SB13_0.3				1			X	
10	SB13_0.5				1			X	
TOTAL									

RELINQUISHED BY:		RECEIVED BY		CoC emailed to ARL?
NAME : DAVID POND	DATE: 13/6/19	NAME : MAJA GOVAS	DATE: 13/6/19	☐ Yes ☑ No
OF: Emerge Associates	TIME: 1700	OF: ARL	TIME: 4.30pm	
NAME :	DATE:	NAME :	DATE:	
OF:	TIME:	OF:	TIME:	

Water Container Codes: **P** = Unpreserved Plastic; **N** = Nitric Preserved Plastic; **ORC** = Nitric Preserved ORC; **SH** = Sodium Hydroxide/Cd Preserved; **S** = Sodium Hydroxide Preserved Plastic; **AG** = Amber Glass Unpreserved; **AP** = Airfreight Unpreserved Plastic; **V** = VOA Vial HCl Preserved; **VB** = VOA Vial Sodium Bisulphate Preserved; **VS** = VOA Vial Sulfuric Preserved; **AV** = Airfreight Unpreserved Vial; **SG** = Sulfuric Preserved Amber Glass; **H** = HCl preserved Plastic; **HS** = HCl Preserved Speciation bottle; **SP** = Sulfuric Preserved Plastic; **F** = Formaldehyde Preserved Glass; **Z** = Zinc Acetate Preserved Bottle; **E** = EDTA Preserved Bottles; **ST** = Sterile Bottle; **LI** = Lugols Iodine Preserved Bottles; **STT** = Sterile Sodium Thiosulfate Preserved Bottles. **Soil Container Codes**: **J** = Jar; **ASS** = Plastic Bag for Acid Sulfate Soils; **B** = Unpreserved Bag.

0.4°C

Paul Nottle

From:	Doug Todd
Sent:	Monday, 17 June 2019 13:29
To:	ARL Samples
Cc:	Paul Nottle
Subject:	FW: ARL 19-08948

Can we please put these on 48hr TA?

Regards

Doug

Douglas Todd | Laboratory Manager
Phone. +61 8 6253 4444 | Fax: +61 8 6253 4440
Email. dougtodd@arlgroup.com.au
Website. http://www.arlgroup.com.au
Address. 46-48 Banksia Road, WELSHPOOL, WA, 6106

ProMicro Pty Ltd
Science with Ethics

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ARL
Analytical Reference Laboratory

From: David Pond <David.Pond@emergeassociates.com.au>
Sent: Monday, 17 June 2019 13:18
To: Doug Todd <dougtodd@arlgroup.com.au>
Subject: RE: ARL 19-08948

Hi Doug,

Please proceed with OC/OPs on 48hr TAT on these samples:

Job 19-08948 - Pc
SB01_0.3 - 2
SB01_0.5 - 3
SB02_0.3 - 6
SB02_0.5 - 7
SB03_0.3 - 10
SB03_0.5 - 11

SB04_0.3-13
SB04_0.5 -14
SB06_0.3 -17
SB06_0.5 -18.
SB09_0.3 -22
SB09_0.5-23

Job 19-09191 – A
SB10_0.3 -2
SB10_0.5 -3
SB11_0.3 -5
SB11_0.5 -6.
SB13_0.3 -9
SB13_0.5 -10.

Thanks
David

David Pond
Lead Environmental Consultant - Contaminated Land & Acid Sulfate Soils
e David.Pond@emergeassociates.com.au
Suite 4, 26 Railway Road, Subiaco WA 6008
w emergeassociates.com.au // t 0893804988

From: Doug Todd [mailto:dougtodd@arlgroup.com.au]
Sent: Monday, 17 June 2019 10:18 AM
To: David Pond <David.Pond@emergeassociates.com.au>
Subject: RE: ARL 19-08948

Hi David

ARL Group
Proudly Western Australian

SAMPLE RECEIPT NOTICE

Job Number: 19-09191
Expected Due Date: 18 June 2019

Customer Information

Attention:	Stephen Edwards
Customer:	Emerge Associates
Address:	4/26 Railway Road Subiaco WA 6008
Phone Number:	9380 4988
Fax Number:	9380 9636
Report To:	Stephen Edwards
Report email:	david.pond@emergeassociates.com.au

Job Information

Project Reference:	EP19-058(01)
Purchase Order:	
ARL Quote Number:	

Receival Information

Date/Time Received:	13/06/2019	**Delivery Mode:**	Customer
Temperature of Samples °C:	0.4	**Relinquished by:**	David Pond
Security Seal:	N/A		

Contact Details

Registered by: Nicola Hannah samples@arlgroup.com.au
For any queries relating to sample condition (i.e. breakages/missing samples), registered analyses or sample labelling.

Laboratory Contact: Douglas Todd dougtodd@arlgroup.com.au
For any queries relating to analytical capability, status of testing or explanation of results.

Registration Comments

Disposal of non-microbiological samples will occur after the following time, from the date of issue of Final Report:

Aqueous Sample (non-micro) – 3 months Solid Samples (non-micro) – 6 months

Disposal of microbiological samples will occur after the following time, from the date of Testing:

Aqueous Sample (micro) – 2 weeks Solid Samples (micro) – 2 weeks

ARL Group
Proudly Western Australian

ARL ProMicro

SAMPLE RECEIPT NOTICE

Emerge Associates | *Job No: 19-09191* | *Expected Due Date: 18 June 2019*

ANALYSIS ASSIGNED

The following table outlines the procedures assigned to each sample, as taken from the client-supplied Chain of Custody.
Details of the individual tests assigned to each procedure can be requested from the laboratory at any time.
If any of the information in this document is incorrect, please contact the laboratory as soon as possible.

Sample Number	Sample Description	OCOP in Soil	8 Heavy Metals in Soil	Soil Parameters
19-09191-1	SB10_0.1	✔	✔	✔
19-09191-2	SB10_0.3			
19-09191-3	SB10_0.5			
19-09191-4	SB11_0.1	✔	✔	✔
19-09191-5	SB11_0.3			
19-09191-6	SB11_0.5			
19-09191-7	SB12_0.1	✔	✔	✔
19-09191-8	SB13_0.1	✔	✔	✔
19-09191-9	SB13_0.3			
19-09191-10	SB13_0.5			

ARL Group
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ARL ProMicro

LABORATORY REPORT

Job Number: 19-09191
Revision: 01
Date: 18 June 2019

ADDRESS: **Emerge Associates**
4/26 Railway Road
Subiaco WA 6008

ATTENTION: Stephen Edwards

DATE RECEIVED: 13/06/2019

YOUR REFERENCE: EP19-058(01)

PURCHASE ORDER:

APPROVALS:

Paul Nottle
Organics Manager

Sean Sangster
Inorganics Supervisor

REPORT COMMENTS:

This report is issued by Analytical Reference Laboratory (WA) Pty Ltd. The report shall not be reproduced except in full without written approval from the laboratory.

Samples are analysed on an as received basis unless otherwise noted.

Metals in soils analysis was conducted on a dry weight basis.

METHOD REFERENCES:
Methods prefixed with "ARL" are covered under NATA Accreditation Number: 2377
Methods prefixed with "PM" are covered under NATA Accreditation Number: 2561
Methods prefixed with "EDP" are covered under NATA Accreditation Number: 19290

Method ID	Method Description
ARL No. 003	OCOP and PCB in Soil
ARL No. 401/403	Metals in Soil and Sediment by ICPOES/MS
ARL No. 406	Mercury by Cold Vapour Atomic Absorption Spectrophotometry

NATA
WORLD RECOGNISED ACCREDITATION
Accredited for compliance with ISO/IEC 17025 - Testing

ARL Group
Proudly Western Australian

ARL ProMicro

Emerge Associates
Job No: 19-09191

LABORATORY REPORT
Revision: 01

Date: 18/06/19

OCOP in Soil		Sample No	19-09191-1	19-09191-4	19-09191-7	19-09191-8
		Sample Description	SB10_0.1	SB11_0.1	SB12_0.1	SB13_0.1
		Sample Date	13/06/2019	13/06/2019	13/06/2019	13/06/2019
ANALYTE	LOR	Units	Result	Result	Result	Result
Aldrin	0.01	mg/kg	1.8	16	10	0.04
alpha-BHC (HCH)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
beta-BHC (HCH)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
delta-BHC (HCH)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
Bifenthrin	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2
Bromophos Ethyl	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05
Chlordane	0.01	mg/kg	<0.01	<0.01	<0.01	0.06
Chlorpyrifos	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02
Dieldrin	0.01	mg/kg	5.4	23	12	0.32
p,p-DDD	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
p,p-DDE	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
p,p-DDT	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
o,p-DDT	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
Endosulfan I	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
Endosulfan II	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
Endosulfan Sulfate	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
Endrin	0.01	mg/kg	0.03	0.06	0.03	<0.01
Heptachlor	0.01	mg/kg	<0.01	<0.01	<0.01	0.02
Heptachlor Epoxide	0.01	mg/kg	<0.01	<0.01	<0.01	0.03
Hexachlorobenzene (HCB)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
Lindane	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
Methoxychlor	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2
Oxychlordane	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
Diazinon	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2
Ethion	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05
Fenitrothion	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
Malathion	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
Trifluralin	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2

8 Heavy Metals in Soil		Sample No	19-09191-1	19-09191-4	19-09191-7	19-09191-8
		Sample Description	SB10_0.1	SB11_0.1	SB12_0.1	SB13_0.1
		Sample Date	13/06/2019	13/06/2019	13/06/2019	13/06/2019
ANALYTE	LOR	Units	Result	Result	Result	Result
Arsenic	5	mg/kg	6	<5	120	<5
Cadmium	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
Chromium	1	mg/kg	19	17	15	2
Copper	1	mg/kg	3	4	3	<1
Mercury	0.02	mg/kg	0.05	0.05	0.04	<0.02
Nickel	1	mg/kg	<1	1	<1	<1
Lead	1	mg/kg	5	7	3	<1
Zinc	1	mg/kg	3	10	4	<1

Result Definitions
LOR Limit of Reporting [NT] Not Tested [ND] Not Detected at indicated Limit of Reporting
* Denotes test not covered by NATA Accreditation

FOR MICROBIOLOGICAL TESTING - The data in this report may not be representative of a lot, batch or other samples and may not necessarily justify the acceptance or rejection of a lot or batch, a product recall or support legal proceedings. Tests are not routinely performed as duplicates unless specifically requested. Changes occur in the bacterial content of biological samples. Samples should be examined as soon as possible after collection, preferably within 6 hrs and must be stored at 4 degrees Celsius or below. Samples tested after 24 hrs cannot be regarded as satisfactory because of temperature abuse and variations.

ARL Group
Proudly Western Australian

ARL ProMicro

LABORATORY REPORT

Job Number: 19-09191-A
Revision: 00
Date: 19 June 2019

ADDRESS: **Emerge Associates**
4/26 Railway Road
Subiaco WA 6008

ATTENTION: David Pond

DATE RECEIVED: 13/06/2019

YOUR REFERENCE: EP19-058(01)

PURCHASE ORDER:

APPROVALS:

Paul Nottle
Organics Manager

REPORT COMMENTS:

This report is issued by Analytical Reference Laboratory (WA) Pty Ltd. The report shall not be reproduced except in full without written approval from the laboratory.

Samples are analysed on an as received basis unless otherwise noted.

METHOD REFERENCES:
Methods prefixed with "ARL" are covered under NATA Accreditation Number: 2377
Methods prefixed with "PM" are covered under NATA Accreditation Number: 2561
Methods prefixed with "EDP" are covered under NATA Accreditation Number: 19290

Method ID	Method Description
ARL No. 003	OCOP and PCB in Soil

NATA
WORLD RECOGNISED ACCREDITATION
Accredited for compliance with ISO/IEC 17025 - Testing

ARL Group
Proudly Western Australian

ARL ProMicro

Emerge Associates — *LABORATORY REPORT*

Job No: 19-09191-A — *Revision: 00* — *Date: 19/06/19*

OCOP in Soil		Sample No	19-09191-A-2	19-09191-A-3	19-09191-A-5	19-09191-A-6	19-09191-A-9
		Sample Description	SB10_0.3	SB10_0.5	SB11_0.3	SB11_0.5	SB13_0.3
		Sample Date	13/06/2019	13/06/2019	13/06/2019	13/06/2019	13/06/2019
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Aldrin	0.01	mg/kg	2.0	0.09	29	1.1	0.04
alpha-BHC (HCH)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
beta-BHC (HCH)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
delta-BHC (HCH)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Bifenthrin	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Bromophos Ethyl	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Chlordane	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	0.13
Chlorpyrifos	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Dieldrin	0.01	mg/kg	7.7	0.40	33	1.7	1.1
p,p-DDD	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
p,p-DDE	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
p,p-DDT	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
o,p-DDT	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan I	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan II	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan Sulfate	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	0.01	mg/kg	0.04	<0.01	0.10	<0.01	<0.01
Heptachlor	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	0.07
Heptachlor Epoxide	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	0.08
Hexachlorobenzene (HCB)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Lindane	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Methoxychlor	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Oxychlordane	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01
Diazinon	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Ethion	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Fenitrothion	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Trifluralin	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2

OCOP in Soil		Sample No	19-09191-A-10
		Sample Description	SB13_0.5
		Sample Date	13/06/2019
ANALYTE	LOR	Units	Result
Aldrin	0.01	mg/kg	0.06
alpha-BHC (HCH)	0.01	mg/kg	<0.01
beta-BHC (HCH)	0.01	mg/kg	<0.01
delta-BHC (HCH)	0.01	mg/kg	<0.01
Bifenthrin	0.2	mg/kg	<0.2
Bromophos Ethyl	0.05	mg/kg	<0.05
Chlordane	0.01	mg/kg	0.07
Chlorpyrifos	0.02	mg/kg	<0.02
Dieldrin	0.01	mg/kg	0.58
p,p-DDD	0.01	mg/kg	<0.01
p,p-DDE	0.01	mg/kg	<0.01
p,p-DDT	0.01	mg/kg	<0.01
o,p-DDT	0.01	mg/kg	<0.01
Endosulfan I	0.01	mg/kg	<0.01

ARL Group
Proudly Western Australian

ARL ProMicro

Emerge Associates *LABORATORY REPORT*
Job No: 19-09191-A *Revision: 00* *Date: 19/06/19*

OCOP in Soil		Sample No	19-09191-A-10
		Sample Description	SB13_0.5
		Sample Date	13/06/2019
Endosulfan II	0.01	mg/kg	<0.01
Endosulfan Sulfate	0.01	mg/kg	<0.01
Endrin	0.01	mg/kg	<0.01
Heptachlor	0.01	mg/kg	0.03
Heptachlor Epoxide	0.01	mg/kg	0.03
Hexachlorobenzene (HCB)	0.01	mg/kg	<0.01
Lindane	0.01	mg/kg	<0.01
Methoxychlor	0.2	mg/kg	<0.2
Oxychlordane	0.01	mg/kg	<0.01
Diazinon	0.2	mg/kg	<0.2
Ethion	0.05	mg/kg	<0.05
Fenitrothion	0.1	mg/kg	<0.1
Malathion	0.1	mg/kg	<0.1
Trifluralin	0.2	mg/kg	<0.2

Result Definitions
LOR Limit of Reporting [NT] Not Tested [ND] Not Detected at indicated Limit of Reporting
* Denotes test not covered by NATA Accreditation

FOR MICROBIOLOGICAL TESTING - The data in this report may not be representative of a lot, batch or other samples and may not necessarily justify the acceptance or rejection of a lot or batch, a product recall or support legal proceedings. Tests are not routinely performed as duplicates unless specifically requested. Changes occur in the bacterial content of biological samples. Samples should be examined as soon as possible after collection, preferably within 6 hrs and must be stored at 4 degrees Celsius or below. Samples tested after 24 hrs cannot be regarded as satisfactory because of temperature abuse and variations.

ARL GROUP
46-48 Banksia Road, Welshpool, Western Australia 6106
Telephone: 08 6253 4444 Facsimile: 08 6253 4440 www.arlgroup.com.au

Quality Control Report

Job Number: 19-09191
Date: 18/06/2019

This report must not be reproduced except in full without prior written consent.

This Quality Control Report is issued in accordance with Section 18 of the ARL Quality Management Manual. All QC parameters are contained within the relevant ARL Method as indicated by the method reference, either on this report or the Laboratory Report.

Acceptance of Holding Times, Duplicate RPD, Spike, LCS and CRM Recoveries are determined at the time of analysis by the Signatory indicated on the Laboratory Report.

DEFINITIONS

Duplicate Analysis
A sample, chosen randomly by the analyst at the time of sample preparation, analysed in duplicate.

RPD
Relative Percent Difference is the absolute difference between the sample and a duplicate analysis compared to the average of the two analytical results. Acceptance Limits can be exceeded by matrix interference or when the result is less than 5 times the LOR.

Matrix Spike
An additional portion of sample to which known amounts of the target analytes are added before sample preparation. Acceptance Limits can be exceeded by matrix interference or when the target analytes are present in the sample.

Certified Reference Material (CRM)
A commercially available certified solution/mixture of the target analyte of known concentration.

Laboratory Control Sample (LCS)
An in-house certified solution/mixture of the target analyte of known concentration.

Analytical Reference Laboratory (WA) PTY. Ltd
46-48 Banksia Road, Welshpool, Western Australia 6106 Telephone: 08 6253 4444 Facsimile 08 6253 4440
www.arlwa.com.au ABN: 91 050 159 898

Quality Control Report

Job Number: 19-09191

Date: 18/06/2019

Environmental and Analytical Laboratory

OC/OP and PCB in Soil

Holding Time Criteria	Date	
Extracted	17/06/2019	
Analysed	18/06/2019	
Duplicate Analysis (19-09191-8)	**RPD (%)**	**Limits (%)**
Aldrin	0	200
alpha-BHC (HCH)	0	200
beta-BHC (HCH)	0	200
delta-BHC (HCH)	0	200
Bifenthrin	0	200
Bromophos Ethyl	0	200
Chlordane	15	50
Chlorpyrifos	0	200
Dieldrin	9	25
p,p-DDD	0	200
p,p-DDE	0	200
p,p-DDT	0	200
o,p-DDT	0	200
Endosulfan I	0	200
Endosulfan II	0	200
Endosulfan Sulfate	0	200
Endrin	0	200
Heptachlor	67	200
Heptachlor Epoxide	40	200
Hexachlorobenzene (HCB)	0	200
Lindane	0	200
Methoxychlor	0	200
Oxychlordane	0	200
Diazinon	0	200
Ethion	0	200
Fenitrothion	0	200
Malathion	0	200
Trifluralin	0	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Aldrin	<0.01	0.01
alpha-BHC (HCH)	<0.01	0.01
beta-BHC (HCH)	<0.01	0.01
delta-BHC (HCH)	<0.01	0.01
Bifenthrin	<0.2	0.2
Bromophos Ethyl	<0.05	0.05
Chlordane	<0.01	0.01
Chlorpyrifos	<0.02	0.02

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Quality Control Report

Job Number: 19-09191

Date: 18/06/2019

ARL
Environmental and Analytical Laboratory

Blank Analysis	Result (mg/kg)	Limit (mg/kg)
Dieldrin	<0.01	0.01
p,p-DDD	<0.01	0.01
p,p-DDE	<0.01	0.01
p,p-DDT	<0.01	0.01
o,p-DDT	<0.01	0.01
Endosulfan I	<0.01	0.01
Endosulfan II	<0.01	0.01
Endosulfan Sulfate	<0.01	0.01
Endrin	<0.01	0.01
Heptachlor	<0.01	0.01
Heptachlor Epoxide	<0.01	0.01
Hexachlorobenzene (HCB)	<0.01	0.01
Lindane	<0.01	0.01
Methoxychlor	<0.2	0.2
Oxychlordane	<0.01	0.01
Diazinon	<0.2	0.2
Ethion	<0.05	0.05
Fenitrothion	<0.1	0.1
Malathion	<0.1	0.1
Trifluralin	<0.2	0.2
Matrix Spike (19-09191-8)	**Recovery (%)**	**Limits (%)**
p,p-DDT	87	60 - 120
Endrin	86	60 - 120
Heptachlor	98	60 - 120
Lindane	120	60 - 120

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Quality Control Report

Job Number: 19-09191

Date: 18/06/2019

ARL
Environmental and Analytical Laboratory

Metals in Soil and Sediment

Holding Time Criteria	Date	
Extracted	14/06/2019	
Analysed	14/06/2019	
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Arsenic	<5	5
Cadmium	<0.1	0.1
Chromium	<1	1
Copper	<1	1
Nickel	<1	1
Lead	<1	1
Zinc	<1	1
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Arsenic	100	80 - 120
Cadmium	99	80 - 120
Chromium	96	80 - 120
Copper	88	80 - 120
Nickel	95	80 - 120
Lead	101	80 - 120
Zinc	80	80 - 120

Soil Parameters

Holding Time Criteria	Date
Analysed	14/06/2019

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www.arlwa.com.au ABN: 91 050 159 898

Quality Control Report

Job Number: 19-09191-A

Date: 19/06/2019

ARL
Environmental and Analytical Laboratory

This Quality Control Report is issued in accordance with Section 18 of the ARL Quality Management Manual. All QC parameters are contained within the relevant ARL Method as indicated by the method reference, either on this report or the Laboratory Report.

Acceptance of Holding Times, Duplicate RPD, Spike, LCS and CRM Recoveries are determined at the time of analysis by the Signatory indicated on the Laboratory Report.

DEFINITIONS

Duplicate Analysis
A sample, chosen randomly by the analyst at the time of sample preparation, analysed in duplicate.

RPD
Relative Percent Difference is the absolute difference between the sample and a duplicate analysis compared to the average of the two analytical results. Acceptance Limits can be exceeded by matrix interference or when the result is less than 5 times the LOR.

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An additional portion of sample to which known amounts of the target analytes are added before sample preparation. Acceptance Limits can be exceeded by matrix interference or when the target analytes are present in the sample.

Certified Reference Material (CRM)
A commercially available certified solution/mixture of the target analyte of known concentration.

Laboratory Control Sample (LCS)
An in-house certified solution/mixture of the target analyte of known concentration.

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Quality Control Report

Job Number: 19-09191-A

Date: 19/06/2019

ARL Environmental and Analytical Laboratory

OC/OP and PCB in Soil

Holding Time Criteria	Date	
Extracted	18/06/2019	
Analysed	19/06/2019	
Duplicate Analysis (19-08948-A-2)	**RPD (%)**	**Limits (%)**
Aldrin	3	25
alpha-BHC (HCH)	0	200
beta-BHC (HCH)	0	200
delta-BHC (HCH)	0	200
Bifenthrin	0	200
Bromophos Ethyl	0	200
Chlordane	8	25
Chlorpyrifos	0	200
Dieldrin	13	25
p,p-DDD	0	200
p,p-DDE	0	200
p,p-DDT	0	200
o,p-DDT	0	200
Endosulfan I	0	200
Endosulfan II	0	200
Endosulfan Sulfate	0	200
Endrin	0	50
Heptachlor	15	25
Heptachlor Epoxide	9	50
Hexachlorobenzene (HCB)	0	200
Lindane	0	200
Methoxychlor	0	200
Oxychlordane	0	200
Diazinon	0	200
Ethion	0	200
Fenitrothion	0	200
Malathion	0	200
Trifluralin	0	200
Duplicate Analysis (19-09191-A-10)	**RPD (%)**	**Limits (%)**
Aldrin	50	50
alpha-BHC (HCH)	0	200
beta-BHC (HCH)	0	200
delta-BHC (HCH)	0	200
Bifenthrin	0	200
Bromophos Ethyl	0	200
Chlordane	15	50
Chlorpyrifos	0	200

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Quality Control Report

Job Number: 19-09191-A

Date: 19/06/2019

ARL Environmental and Analytical Laboratory

Duplicate Analysis (19-09191-A-10)	RPD (%)	Limits (%)
Dieldrin	3	25
p,p-DDD	0	200
p,p-DDE	0	200
p,p-DDT	0	200
o,p-DDT	0	200
Endosulfan I	0	200
Endosulfan II	0	200
Endosulfan Sulfate	0	200
Endrin	0	200
Heptachlor	40	200
Heptachlor Epoxide	0	200
Hexachlorobenzene (HCB)	0	200
Lindane	0	200
Methoxychlor	0	200
Oxychlordane	0	200
Diazinon	0	200
Ethion	0	200
Fenitrothion	0	200
Malathion	0	200
Trifluralin	0	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Aldrin	<0.01	0.01
alpha-BHC (HCH)	<0.01	0.01
beta-BHC (HCH)	<0.01	0.01
delta-BHC (HCH)	<0.01	0.01
Bifenthrin	<0.2	0.2
Bromophos Ethyl	<0.05	0.05
Chlordane	<0.01	0.01
Chlorpyrifos	<0.02	0.02
Dieldrin	<0.01	0.01
p,p-DDD	<0.01	0.01
p,p-DDE	<0.01	0.01
p,p-DDT	<0.01	0.01
o,p-DDT	<0.01	0.01
Endosulfan I	<0.01	0.01
Endosulfan II	<0.01	0.01
Endosulfan Sulfate	<0.01	0.01
Endrin	<0.01	0.01
Heptachlor	<0.01	0.01
Heptachlor Epoxide	<0.01	0.01
Hexachlorobenzene (HCB)	<0.01	0.01

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www.arlwa.com.au ABN: 91 050 159 898

Quality Control Report

Job Number: 19-09191-A

Date: 19/06/2019

ARL Environmental and Analytical Laboratory

Blank Analysis	Result (mg/kg)	Limit (mg/kg)
Lindane	<0.01	0.01
Methoxychlor	<0.2	0.2
Oxychlordane	<0.01	0.01
Diazinon	<0.2	0.2
Ethion	<0.05	0.05
Fenitrothion	<0.1	0.1
Malathion	<0.1	0.1
Trifluralin	<0.2	0.2
Matrix Spike (19-09191-A-10)	**Recovery (%)**	**Limits (%)**
p,p-DDT	90	60 - 120
Endrin	87	60 - 120
Heptachlor	113	60 - 120
Lindane	90	60 - 120

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PLEASE FORWARD TO ALS.

CHAIN OF COUSTODY

emerge ASSOCIATES

CLIENT: Emerge Associates	POSTAL ADDRESS: Suite 4, 6 Centro Avenue, Subiaco WA 6008	Page 1 of 1
PROJECT MANAGER: David Pond	CONTACT PHONE: 0451 154 505	ALS LABORATORY: [illegible]
PROJECT ID.: EP19-058(01)	PROJECT NAME: TAFE Beaconsfield	[illegible]
SAMPLER(S): David Pond	SAMPLERS PHONE: 0451 154 505	[illegible] Standard [illegible]
QUOTE NO.: EN/222/18 ORDER NO.:		Email reports to: ~~simon.gregg@emergeassociates.com.au~~ david.pond@emergeassociates.com.au
Laboratory Use [illegible]	Comments/special handling/storage or disposal	Email invoice to: accounts@emergeassociates.com.au

ANALYSIS REQUIRED

SAMPLE DETAILS				CONTAINER INFORMATION		S-12 (OCP/OPPs)	S-2 (8 metals)	Additional information (likely contaminants, dilutions or specific QC analysis)
Lab ID	Sample ID	Matrix	Date	Type & Preservative	Total No.			
1	SQA02	SOIL	10/6/19	1 x GLASS	1	X	X	
TOTAL								

Environmental Division
Perth
Work Order Reference
EP1905622

Telephone : +61-8-9406 1301

RELINQUISHED BY:		RECEIVED BY		CoC emailed to ALS?
NAME: D. Pond	DATE: 11/6/19	NAME: [illegible]	DATE: 11/6/19	☐ Yes ☐ No
OF: Emerge Associates	TIME:	OF: ALS	TIME: 1250pm	
NAME:	DATE:	NAME:	DATE:	
OF:	TIME:	OF:	TIME:	

Water Container Codes: **P** = Unpreserved Plastic; **N** = Nitric Preserved Plastic; **ORC** = Nitric Preserved ORC; **SH** = Sodium Hydroxide/Cd Preserved; **S** = Sodium Hydroxide Preserved Plastic; **AG** = Amber Glass Unpreserved; **AP** = Airfreight Unpreserved Plastic; **V** = VOA Vial HCl Preserved; **VB** = VOA Vial Sodium Bisulphate Preserved; **VS** = VOA Vial Sulfuric Preserved; **AV** = Airfreight Unpreserved Vial; **SG** = Sulfuric Preserved Amber Glass. **H** = HCl preserved Plastic; **HS** = HCl Preserved Speciation bottle; **SP** = Sulfuric Preserved Plastic; **F** = Formaldehyde Preserved Glass; **Z** = Zinc Acetate Preserved Bottle; **E** = EDTA Preserved Bottles; **ST** = Sterile Bottle; **LI** = Lugols Iodine Preserved Bottles; **STT** = Sterile Sodium Thiosulfate Preserved Bottles. **Soil Container Codes**: J = Jar; **ASS** = Plastic Bag for Acid Sulfate Soils; **B** = Unpreserved Bag.

ALS Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order	: **EP1905622**		
Client	: **EMERGE ASSOCIATES**	Laboratory	: Environmental Division Perth
Contact	: David Pond	Contact	: Lauren Biagioni
Address	: SUITE 4, 26 RAILWAY ROAD SUBIACO WESTERN AUSTRALIA 6008	Address	: 26 Rigali Way Wangara WA Australia 6065
E-mail	: david.pond@emergeassociates.com .au	E-mail	: Lauren.biagioni@alsglobal.com
Telephone	: ----	Telephone	: 08 9406 1307
Facsimile	: ----	Facsimile	: +61-8-9406 1399
Project	: EP19-058(01) TAFE Beaconsfield	Page	: 1 of 2
Order number	: EP19-058(01)	Quote number	: EP2017EMEASS0008 (EN/222)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: David Pond		

Dates

Date Samples Received	: 11-Jun-2019 12:50	Issue Date	: 11-Jun-2019
Client Requested Due Date	: 19-Jun-2019	Scheduled Reporting Date	: **19-Jun-2019**

Delivery Details

Mode of Delivery	: Client Drop Off	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: 10.1 - Ice present
Receipt Detail	:	No. of samples received / analysed	: 1 / 1

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- Please see scanned COC for sample discrepencies: extra samples , samples not received etc.
- Please direct any queries related to sample condition / numbering / breakages to Sample Receipt (Samples.Perth@alsglobal.com)
- Analytical work for this work order will be conducted at ALS Environmental Perth.
- Please direct any turnaround / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months) from receipt of samples.
- **pH analysis should be conducted within 6 hours of sampling.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **SOIL**

Laboratory sample ID	Client sampling date / time	Client sample ID	SOIL - EA055-103 Moisture Content	SOIL - S-02 8 Metals (incl. Digestion)	SOIL - S-12 OC/OP Pesticides
EP1905622-001	10-Jun-2019 00:00	SQA02	✔	✔	✔

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

ACCOUNTS (INVOICES)

- A4 - AU Tax Invoice (INV)	Email	accounts@emergeassociates.com.au

David Pond

- *AU Certificate of Analysis - NATA (COA)	Email	david.pond@emergeassociates.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	david.pond@emergeassociates.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	david.pond@emergeassociates.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	david.pond@emergeassociates.com.au
- Chain of Custody (CoC) (COC)	Email	david.pond@emergeassociates.com.au
- EDI Format - ENMRG (ENMRG)	Email	david.pond@emergeassociates.com.au
- EDI Format - ESDAT (ESDAT)	Email	david.pond@emergeassociates.com.au
- EDI Format - XTab (XTAB)	Email	david.pond@emergeassociates.com.au

CERTIFICATE OF ANALYSIS

Work Order	: EP1905622	Page	: 1 of 5
Client	: EMERGE ASSOCIATES	Laboratory	: Environmental Division Perth
Contact	: David Pond	Contact	: Lauren Biagioni
Address	: SUITE 4, 26 RAILWAY ROAD SUBIACO WESTERN AUSTRALIA 6008	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1307
Project	: EP19-058(01) TAFE Beaconsfield	Date Samples Received	: 11-Jun-2019 12:50
Order number	: EP19-058(01)	Date Analysis Commenced	: 13-Jun-2019
C-O-C number	: ----	Issue Date	: 18-Jun-2019 16:43
Sampler	: David Pond		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Efua Wilson	Metals Chemist	Perth Inorganics, Wangara, WA
Vanessa Nguyen	Organic Chemist	Perth Organics, Wangara, WA

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP068: Poor duplicate precision due to suspected matrix effects. Confirmed by re-analysis.

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	SQA02	----	----	----	----
			Client sampling date / time	10-Jun-2019 00:00	----	----	----	----
				EP1905622-001	-----------	-----------	-----------	-----------
				Result	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**20.9**	----	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	----	----	----	----
Cadmium	7440-43-9	1	mg/kg	<1	----	----	----	----
Chromium	7440-47-3	2	mg/kg	**18**	----	----	----	----
Copper	7440-50-8	5	mg/kg	<5	----	----	----	----
Lead	7439-92-1	5	mg/kg	<5	----	----	----	----
Nickel	7440-02-0	2	mg/kg	<2	----	----	----	----
Zinc	7440-66-6	5	mg/kg	<5	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	----	----	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	----	----	----	----
beta-BHC	319-85-7	0.05	mg/kg	<0.05	----	----	----	----
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	----	----	----	----
delta-BHC	319-86-8	0.05	mg/kg	<0.05	----	----	----	----
Heptachlor	76-44-8	0.05	mg/kg	<0.05	----	----	----	----
Aldrin	309-00-2	0.05	mg/kg	**9.38**	----	----	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	----	----	----	----
^ Total Chlordane (sum)	----	0.05	mg/kg	<0.05	----	----	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	----	----	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	----	----	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	----	----	----	----
Dieldrin	60-57-1	0.05	mg/kg	**7.85**	----	----	----	----
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	----	----	----	----
Endrin	72-20-8	0.05	mg/kg	**0.09**	----	----	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	----	----	----	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	----	----	----	----
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	----	----	----	----
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	----	----	----	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	----	----	----	----
4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	----	----	----	----
Endrin ketone	53494-70-5	0.05	mg/kg	**0.15**	----	----	----	----

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	SQA02	----	----	----	----
			Client sampling date / time	10-Jun-2019 00:00	----	----	----	----
				EP1905622-001	-----------	-----------	-----------	-----------
				Result	----	----	----	----
EP068A: Organochlorine Pesticides (OC) - Continued								
Methoxychlor	72-43-5	0.2	mg/kg	<0.2	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	**17.2**	----	----	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	----	----	----	----
EP068B: Organophosphorus Pesticides (OP)								
Dichlorvos	62-73-7	0.05	mg/kg	<0.05	----	----	----	----
Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	----	----	----	----
Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	----	----	----	----
Dimethoate	60-51-5	0.05	mg/kg	<0.05	----	----	----	----
Diazinon	333-41-5	0.05	mg/kg	<0.05	----	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	----	----	----	----
Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	----	----	----	----
Malathion	121-75-5	0.05	mg/kg	<0.05	----	----	----	----
Fenthion	55-38-9	0.05	mg/kg	<0.05	----	----	----	----
Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	----	----	----	----
Parathion	56-38-2	0.2	mg/kg	**1.5**	----	----	----	----
Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	----	----	----	----
Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	----	----	----	----
Bromophos-ethyl	4824-78-6	0.05	mg/kg	<0.05	----	----	----	----
Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	----	----	----	----
Prothiofos	34643-46-4	0.05	mg/kg	<0.05	----	----	----	----
Ethion	563-12-2	0.05	mg/kg	<0.05	----	----	----	----
Carbophenothion	786-19-6	0.05	mg/kg	<0.05	----	----	----	----
Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.05	%	**106**	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.05	%	**55.3**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: SOIL		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	53	152
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	28	152

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EP1905622**	Page	: 1 of 6
Client	: **EMERGE ASSOCIATES**	Laboratory	: Environmental Division Perth
Contact	: David Pond	Contact	: Lauren Biagioni
Address	: SUITE 4, 26 RAILWAY ROAD SUBIACO WESTERN AUSTRALIA 6008	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1307
Project	: EP19-058(01) TAFE Beaconsfield	Date Samples Received	: 11-Jun-2019
Order number	: EP19-058(01)	Date Analysis Commenced	: 13-Jun-2019
C-O-C number	: ----	Issue Date	: 18-Jun-2019
Sampler	: David Pond		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Efua Wilson	Metals Chemist	Perth Inorganics, Wangara, WA
Vanessa Nguyen	Organic Chemist	Perth Organics, Wangara, WA

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	**Client sample ID**	**Method: Compound**	**CAS Number**	**LOR**	**Unit**	**Original Result**	**Duplicate Result**	**RPD (%)**	**Recovery Limits (%)**
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 2400881)									
EP1905622-001	SQA02	EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	18	15	13.6	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	<5	9	56.4	No Limit
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 2403629)									
EP1905622-001	SQA02	EA055: Moisture Content	----	0.1	%	20.9	21.2	1.50	0% - 20%
EP1905651-001	Anonymous	EA055: Moisture Content	----	0.1	%	25.8	25.6	0.736	0% - 20%
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2400880)									
EP1905622-001	SQA02	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP068A: Organochlorine Pesticides (OC) (QC Lot: 2404705)									
EP1905622-001	SQA02	EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Aldrin	309-00-2	0.05	mg/kg	9.38	# 5.74	48.1	0% - 20%
		EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Total Chlordane (sum)	----	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	**Client sample ID**	**Method: Compound**	**CAS Number**	**LOR**	**Unit**	**Original Result**	**Duplicate Result**	**RPD (%)**	**Recovery Limits (%)**
EP068A: Organochlorine Pesticides (OC) (QC Lot: 2404705) - continued									
EP1905622-001	SQA02	EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Dieldrin	60-57-1	0.05	mg/kg	7.85	# 6.10	25.0	0% - 20%
		EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin	72-20-8	0.05	mg/kg	0.09	0.06	41.7	No Limit
		EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Endrin ketone	53494-70-5	0.05	mg/kg	0.15	0.13	14.3	No Limit
		EP068: Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	17.2	# 11.8	37.1	0% - 20%
		EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
EP068B: Organophosphorus Pesticides (OP) (QC Lot: 2404705)									
EP1905622-001	SQA02	EP068: Dichlorvos	62-73-7	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Bromophos-ethyl	4824-78-6	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Prothiofos	34643-46-4	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Ethion	563-12-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Carbophenothion	786-19-6	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP068: Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP068: Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
		EP068: Parathion	56-38-2	0.2	mg/kg	1.5	1.1	28.1	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 2400881)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	22 mg/kg	102	70	130
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	5 mg/kg	98.0	70	130
EG005T: Chromium	7440-47-3	2	mg/kg	<2	42.2 mg/kg	87.4	70	130
EG005T: Copper	7440-50-8	5	mg/kg	<5	34 mg/kg	95.4	70	130
EG005T: Lead	7439-92-1	5	mg/kg	<5	40 mg/kg	97.2	70	130
EG005T: Nickel	7440-02-0	2	mg/kg	<2	55.5 mg/kg	96.3	70	130
EG005T: Zinc	7440-66-6	5	mg/kg	<5	62 mg/kg	100	70	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2400880)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	2.154 mg/kg	103	81	115
EP068A: Organochlorine Pesticides (OC) (QCLot: 2404705)								
EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	0.5 mg/kg	59.7	46	116
EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	0.5 mg/kg	74.2	53	133
EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	0.5 mg/kg	68.3	45	117
EP068: gamma-BHC	58-89-9	0.05	mg/kg	<0.05	0.5 mg/kg	95.3	46	122
EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	0.5 mg/kg	74.3	47	117
EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	0.5 mg/kg	75.0	40	118
EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	0.5 mg/kg	95.6	47	123
EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	0.5 mg/kg	97.8	41	119
EP068: Total Chlordane (sum)	----	0.05	mg/kg	<0.05	----	----	----	----
EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	0.5 mg/kg	96.2	43	119
EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	0.5 mg/kg	70.2	41	131
EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	0.5 mg/kg	103	41	119
EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	0.5 mg/kg	90.6	41	127
EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	0.5 mg/kg	85.9	44	122
EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	0.5 mg/kg	75.8	37	129
EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	0.5 mg/kg	112	41	127
EP068: Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	----	----	----	----
EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	0.5 mg/kg	103	42	122
EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	0.5 mg/kg	93.0	31	117
EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	0.5 mg/kg	103	38	120
EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	0.5 mg/kg	68.4	31	125
EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	0.5 mg/kg	110	31	123
EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	0.5 mg/kg	85.5	25	125

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP068A: Organochlorine Pesticides (OC) (QCLot: 2404705) - continued								
EP068: Sum of DDD + DDE + DDT	72-54-8/72-5 5-9/50-2	0.05	mg/kg	<0.05	----	----	----	----
EP068: Sum of Aldrin + Dieldrin	309-00-2/60- 57-1	0.05	mg/kg	<0.05	----	----	----	----
EP068B: Organophosphorus Pesticides (OP) (QCLot: 2404705)								
EP068: Dichlorvos	62-73-7	0.05	mg/kg	<0.05	0.5 mg/kg	114	61	141
EP068: Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	0.5 mg/kg	90.7	39	147
EP068: Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	0.5 mg/kg	10.5	4	154
EP068: Dimethoate	60-51-5	0.05	mg/kg	<0.05	0.5 mg/kg	78.1	40	136
EP068: Diazinon	333-41-5	0.05	mg/kg	<0.05	0.5 mg/kg	99.1	59	133
EP068: Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	0.5 mg/kg	73.0	57	135
EP068: Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	0.5 mg/kg	102	39	133
EP068: Malathion	121-75-5	0.05	mg/kg	<0.05	0.5 mg/kg	71.5	53	131
EP068: Fenthion	55-38-9	0.05	mg/kg	<0.05	0.5 mg/kg	75.1	53	133
EP068: Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	0.5 mg/kg	84.2	57	135
EP068: Parathion	56-38-2	0.2	mg/kg	<0.2	0.5 mg/kg	66.5	45	131
EP068: Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	0.5 mg/kg	95.1	53	137
EP068: Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	0.5 mg/kg	68.4	53	133
EP068: Bromophos-ethyl	4824-78-6	0.05	mg/kg	<0.05	0.5 mg/kg	104	49	133
EP068: Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	0.5 mg/kg	62.9	39	137
EP068: Prothiofos	34643-46-4	0.05	mg/kg	<0.05	0.5 mg/kg	77.7	57	137
EP068: Ethion	563-12-2	0.05	mg/kg	<0.05	0.5 mg/kg	73.8	53	135
EP068: Carbophenothion	786-19-6	0.05	mg/kg	<0.05	0.5 mg/kg	90.8	52	134
EP068: Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	0.5 mg/kg	25.6	20	154

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 2400881)							
EP1905622-001	SQA02	EG005T: Arsenic	7440-38-2	50 mg/kg	112	70	130
		EG005T: Cadmium	7440-43-9	50 mg/kg	94.0	70	130
		EG005T: Chromium	7440-47-3	50 mg/kg	93.4	70	130
		EG005T: Copper	7440-50-8	50 mg/kg	111	70	130
		EG005T: Lead	7439-92-1	50 mg/kg	96.8	70	130
		EG005T: Nickel	7440-02-0	50 mg/kg	93.3	70	130

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 2400881) - continued							
EP1905622-001	SQA02	EG005T: Zinc	7440-66-6	50 mg/kg	89.8	70	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2400880)							
EP1905622-001	SQA02	EG035T: Mercury	7439-97-6	10 mg/kg	104	70	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP1905622**	Page	: 1 of 4
Client	: **EMERGE ASSOCIATES**	Laboratory	: Environmental Division Perth
Contact	: David Pond	Telephone	: 08 9406 1307
Project	: EP19-058(01) TAFE Beaconsfield	Date Samples Received	: 11-Jun-2019
Site	: ----	Issue Date	: 18-Jun-2019
Sampler	: David Pond	No. of samples received	: 1
Order number	: EP19-058(01)	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **Duplicate outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Duplicate (DUP) RPDs							
EP068A: Organochlorine Pesticides (OC)	EP1905622--001	SQA02	**Aldrin**	309-00-2	48.1 %	0% - 20%	**RPD exceeds LOR based limits**
EP068A: Organochlorine Pesticides (OC)	EP1905622--001	SQA02	**Dieldrin**	60-57-1	25.0 %	0% - 20%	**RPD exceeds LOR based limits**
EP068A: Organochlorine Pesticides (OC)	EP1905622--001	SQA02	**Sum of Aldrin + Dieldrin**	309-00-2/60-57-1	37.1 %	0% - 20%	**RPD exceeds LOR based limits**

Outliers : Frequency of Quality Control Samples

Matrix: **SOIL**

Quality Control Sample Type / Method	Count: QC	Count: Regular	Rate (%): Actual	Rate (%): Expected	Quality Control Specification
Matrix Spikes (MS)					
Pesticides by GCMS	0	1	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EA055: Moisture Content (Dried @ 105-110°C)							
Soil Glass Jar - Unpreserved (EA055) SQA02	**10-Jun-2019**	----	----	----	**13-Jun-2019**	24-Jun-2019	✓
EG005(ED093)T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T) SQA02	**10-Jun-2019**	**13-Jun-2019**	07-Dec-2019	✓	**13-Jun-2019**	07-Dec-2019	✓
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T) SQA02	**10-Jun-2019**	**13-Jun-2019**	08-Jul-2019	✓	**13-Jun-2019**	08-Jul-2019	✓
EP068A: Organochlorine Pesticides (OC)							
Soil Glass Jar - Unpreserved (EP068) SQA02	**10-Jun-2019**	**14-Jun-2019**	24-Jun-2019	✓	**14-Jun-2019**	24-Jul-2019	✓
EP068B: Organophosphorus Pesticides (OP)							
Soil Glass Jar - Unpreserved (EP068) SQA02	**10-Jun-2019**	**14-Jun-2019**	24-Jun-2019	✓	**14-Jun-2019**	24-Jul-2019	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type / Analytical Methods	Method	Count: QC	Count: Regular	Rate (%): Actual	Rate (%): Expected	Evaluation	Quality Control Specification
Laboratory Duplicates (DUP)							
Moisture Content	EA055	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	1	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Pesticides by GCMS	EP068	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Pesticides by GCMS	EP068	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Pesticides by GCMS	EP068	0	1	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Pesticides by GCMS	EP068	SOIL	In house: Referenced to USEPA SW 846 - 8270D Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM (2013) Schedule B(3) (Method 504,505)

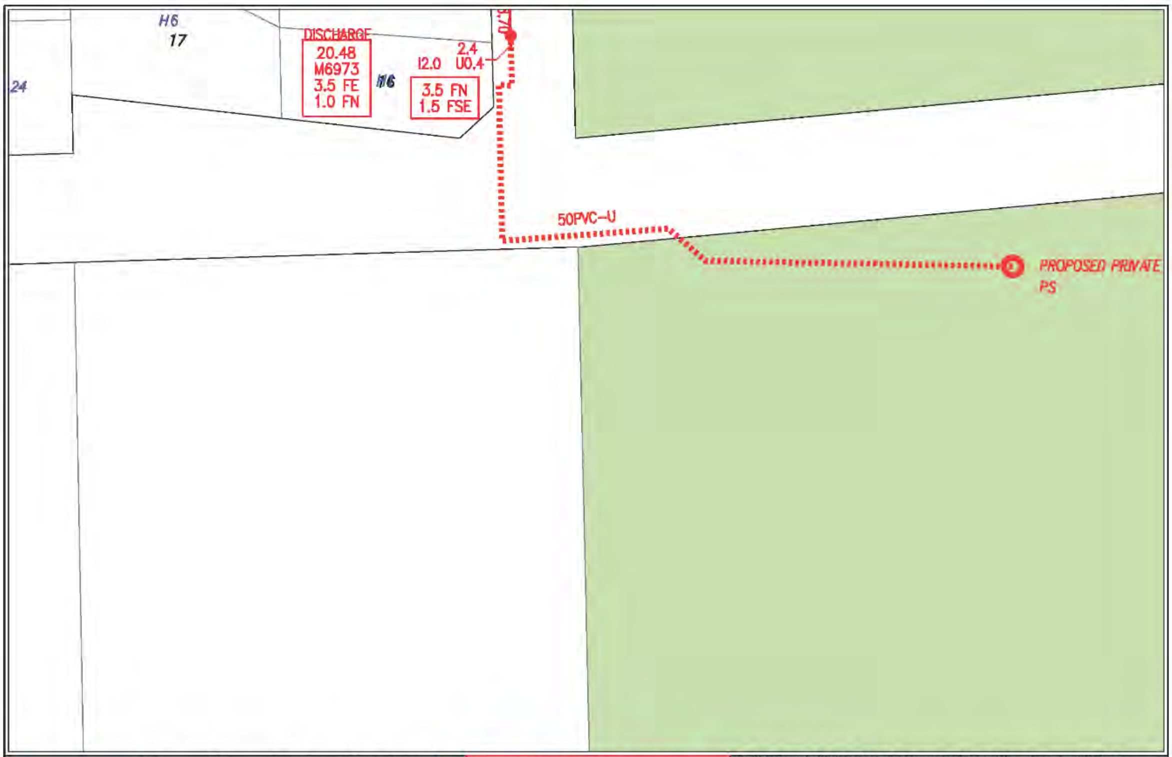
Preparation Methods	Method	Matrix	Method Descriptions
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion. 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (2013) Schedule B(3) (Method 202)
Tumbler Extraction of Solids	ORG17	SOIL	In house: Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.

Appendix Five: Water Corporation Sewer Infrastructure

Scale: 1:2284
Sequence No: 213055931
Print Date: 28/06/2022 Page: 1 of 7

Sewer

WARNING - CRITICAL PIPELINE
Refer to *Information Brochure Damage Prevention* and *Legend* for details



Scale: 1:750 Centre Point: 115.766°, -32.068°
Sequence No: 213055931
Print Date: 28/06/2022 Page: 2 of 7

Sewer

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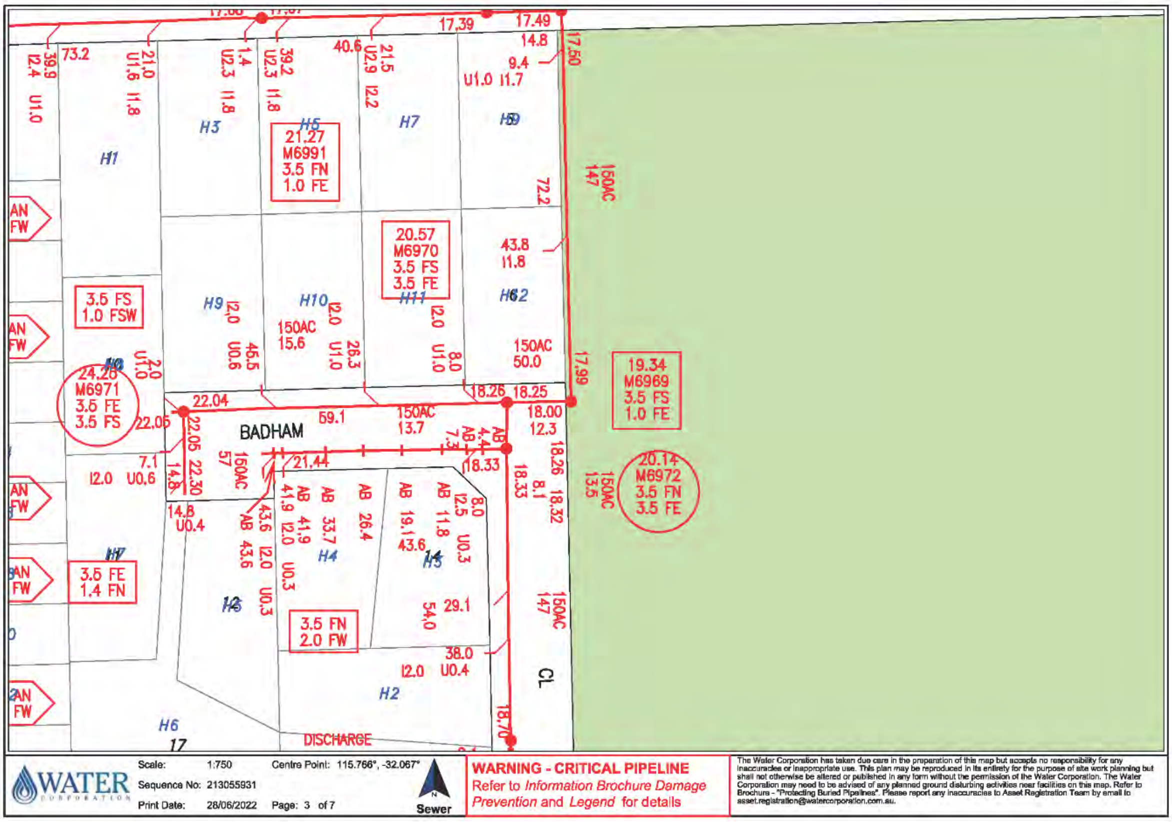
BADHAM
CL
DISCHARGE
WATER CORPORATION
Scale: 1:750
Centre Point: 115.766°, -32.067°
Sequence No: 213055931
Print Date: 28/06/2022
Page: 3 of 7
Sewer
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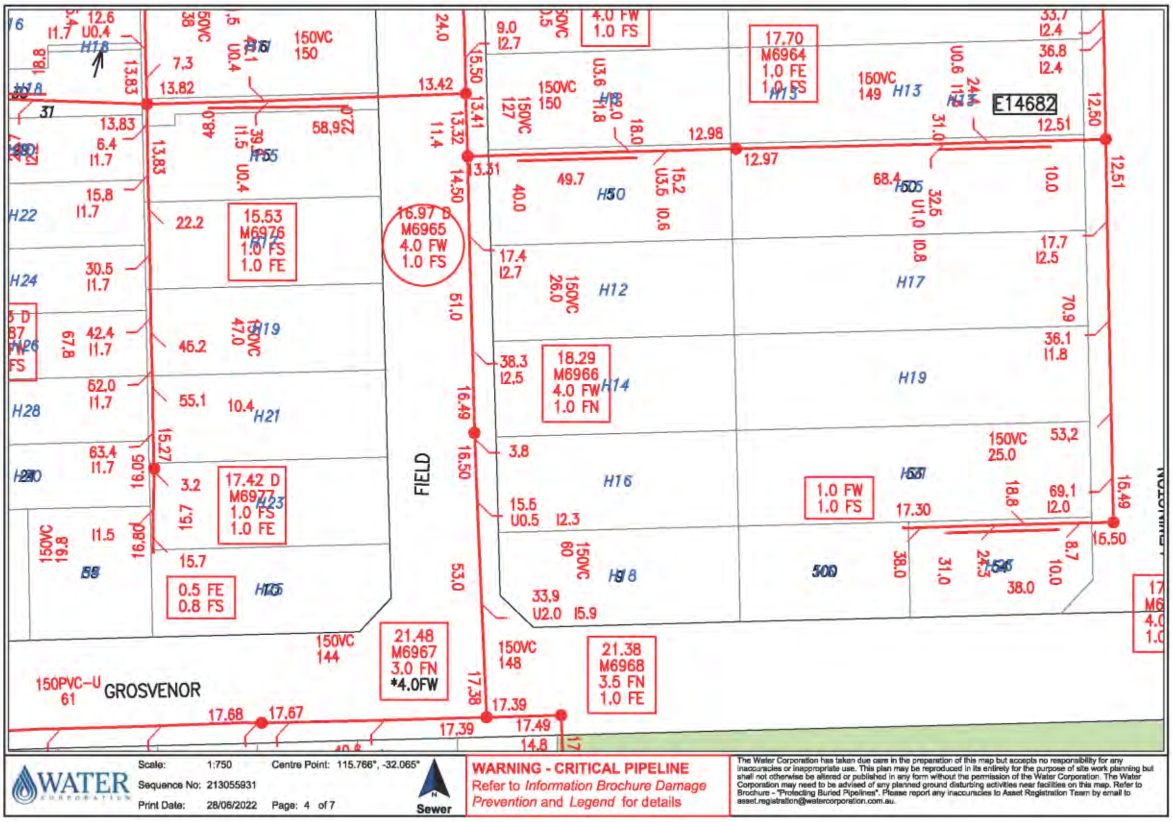
FIELD
GROSVENOR
E14682
WATER CORPORATION
Scale: 1:750
Centre Point: 115.766°, -32.065°
Sequence No: 213055931
Print Date: 28/06/2022
Page: 4 of 7
Sewer
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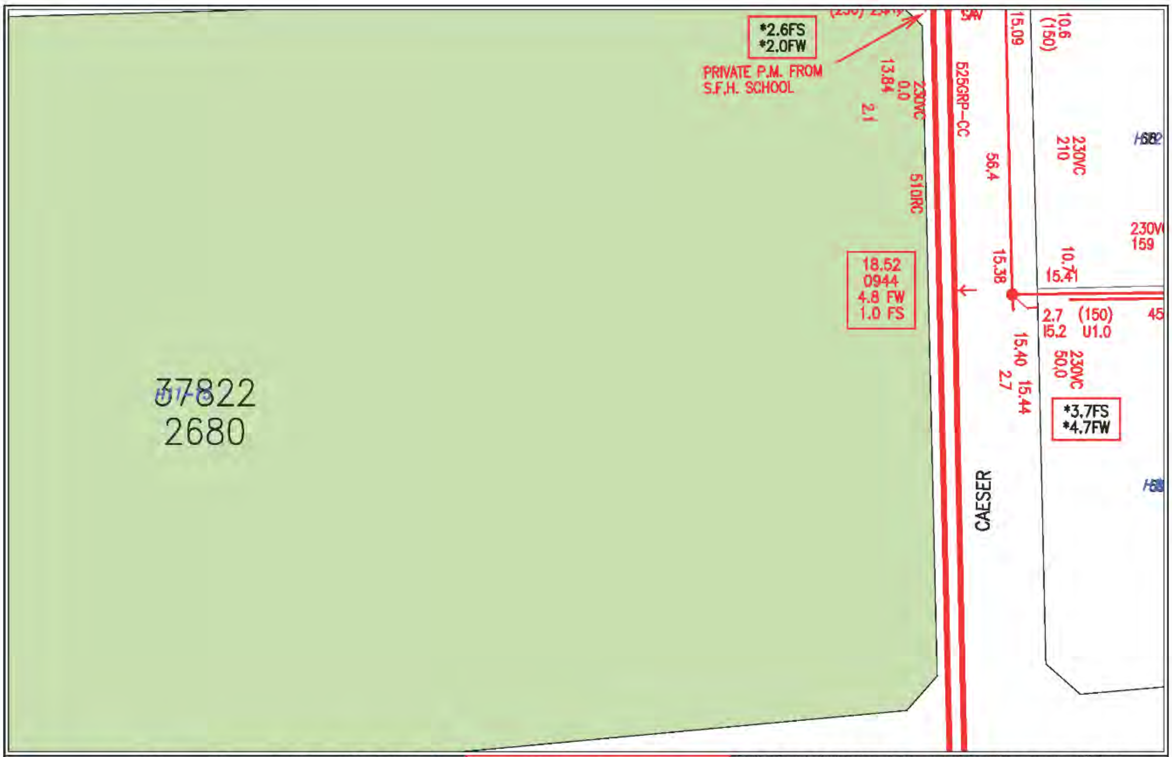
WATER CORPORATION

Scale: 1:750 Centre Point: 115.768°, -32.068°
Sequence No: 213055931
Print Date: 28/06/2022 Page: 5 of 7

Sewer

WARNING - CRITICAL PIPELINE
Refer to *Information Brochure Damage Prevention* and *Legend* for details



WATER CORPORATION

Scale: 1:750 Centre Point: 115.768°, -32.067°
Sequence No: 213055931
Print Date: 28/06/2022 Page: 6 of 7

Sewer

WARNING - CRITICAL PIPELINE
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WATER CORPORATION	Scale: 1:750 Sequence No: 213055931 Print Date: 28/06/2022	Centre Point: 115.768°, -32.065° Page: 7 of 7	Sewer	**WARNING - CRITICAL PIPELINE** Refer to *Information Brochure Damage Prevention* and *Legend* for details

Appendix Six: Water Corporation Water Infrastructure

WATER CORPORATION

Scale: 1:2284

Sequence No: 213055931

Print Date: 28/06/2022 Page: 1 of 7

Water

WARNING - CRITICAL PIPELINE

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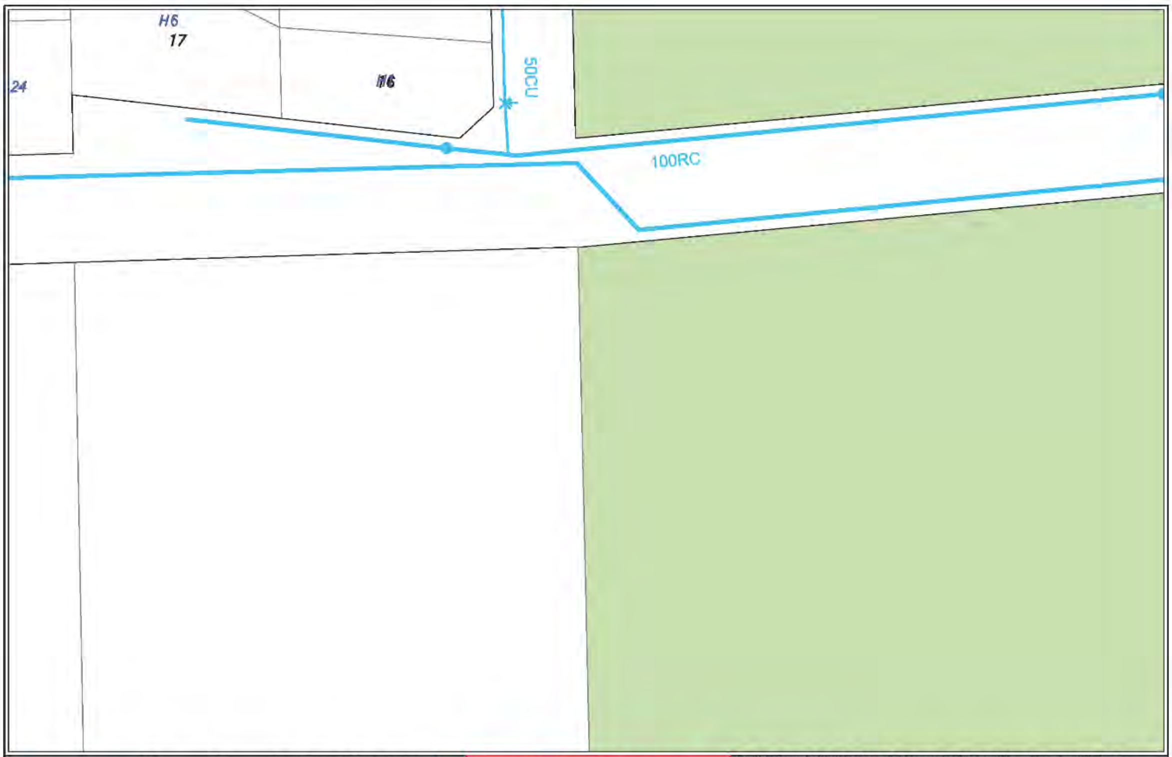

WATER CORPORATION

Scale: 1:750 Centre Point: 115.766°, -32.068°

Sequence No: 213055931

Print Date: 28/06/2022 Page: 2 of 7

Water

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WATER CORPORATION

Scale: 1:750 Centre Point: 115.766°, -32.067°

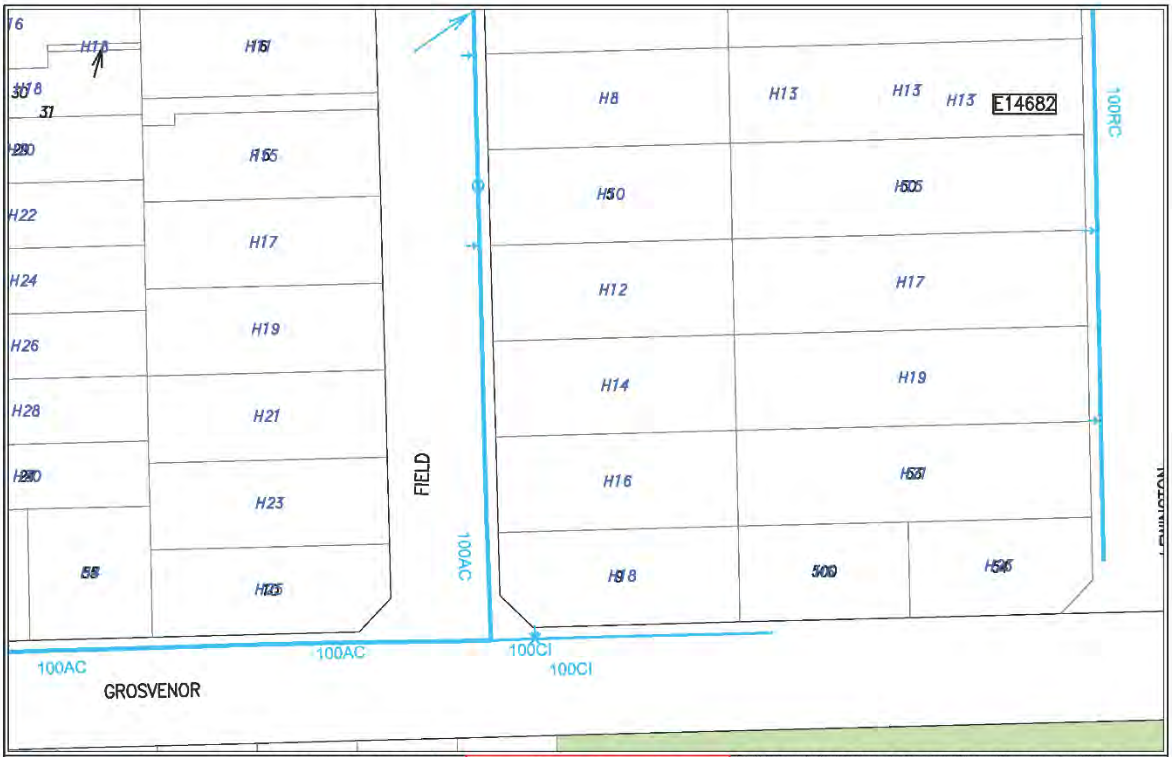
Sequence No: 213055931

Print Date: 28/06/2022 Page: 3 of 7

Water

WARNING - CRITICAL PIPELINE

Refer to *Information Brochure Damage Prevention* and *Legend* for details



WATER CORPORATION

Scale: 1:750 Centre Point: 115.766°, -32.065°

Sequence No: 213055931

Print Date: 28/06/2022 Page: 4 of 7

Water

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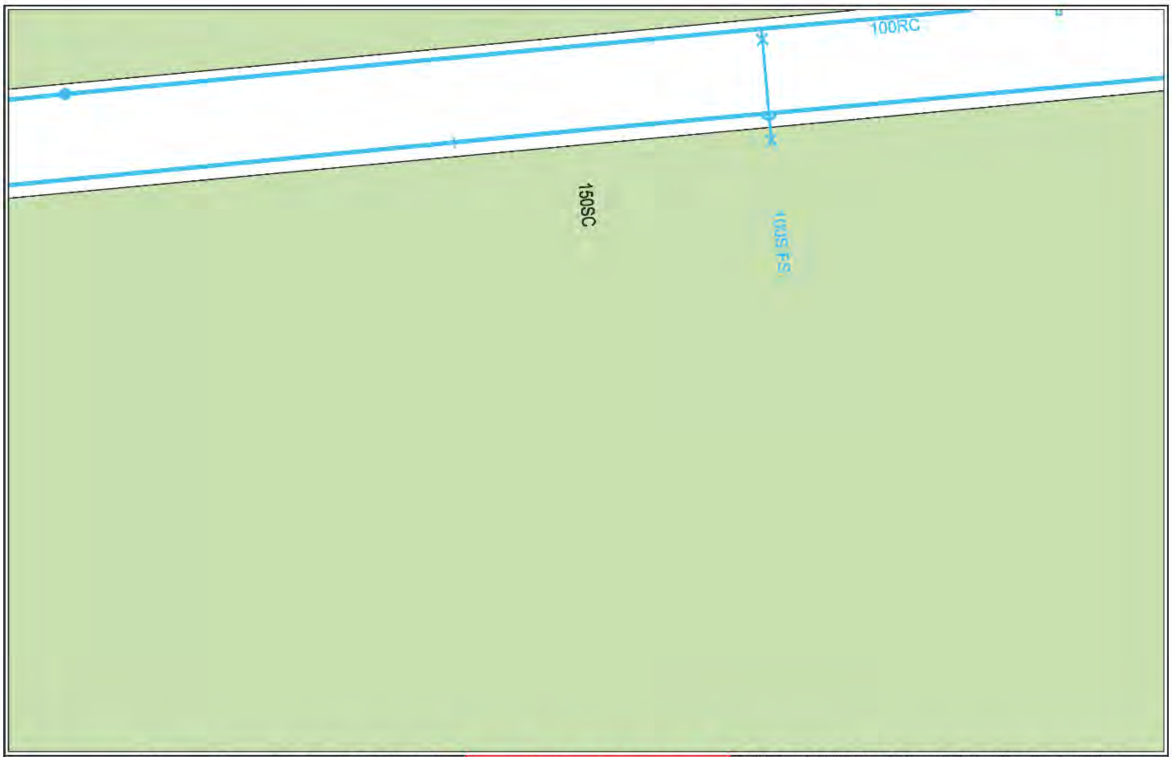

WATER CORPORATION

Scale: 1:750 Centre Point: 115.768°, -32.068°

Sequence No: 213055931

Print Date: 28/06/2022 Page: 5 of 7

N Water

WARNING - CRITICAL PIPELINE
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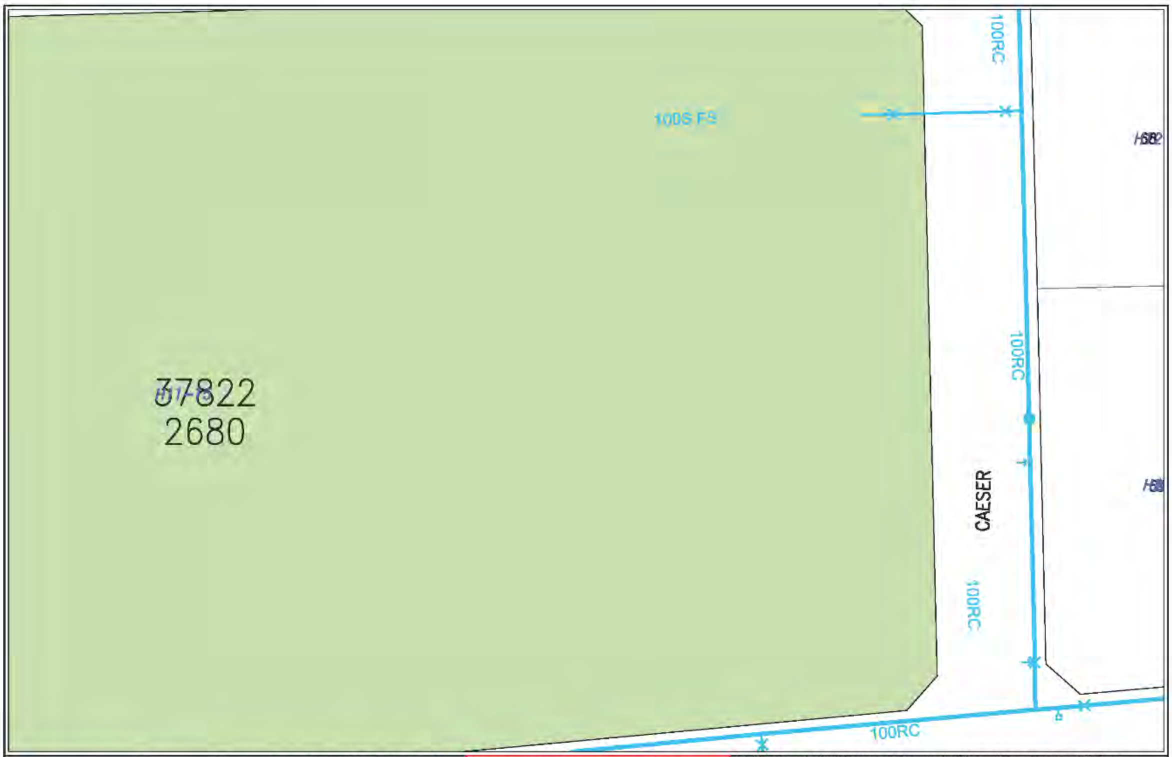

WATER CORPORATION

Scale: 1:750 Centre Point: 115.768°, -32.067°

Sequence No: 213055931

Print Date: 28/06/2022 Page: 6 of 7

N Water

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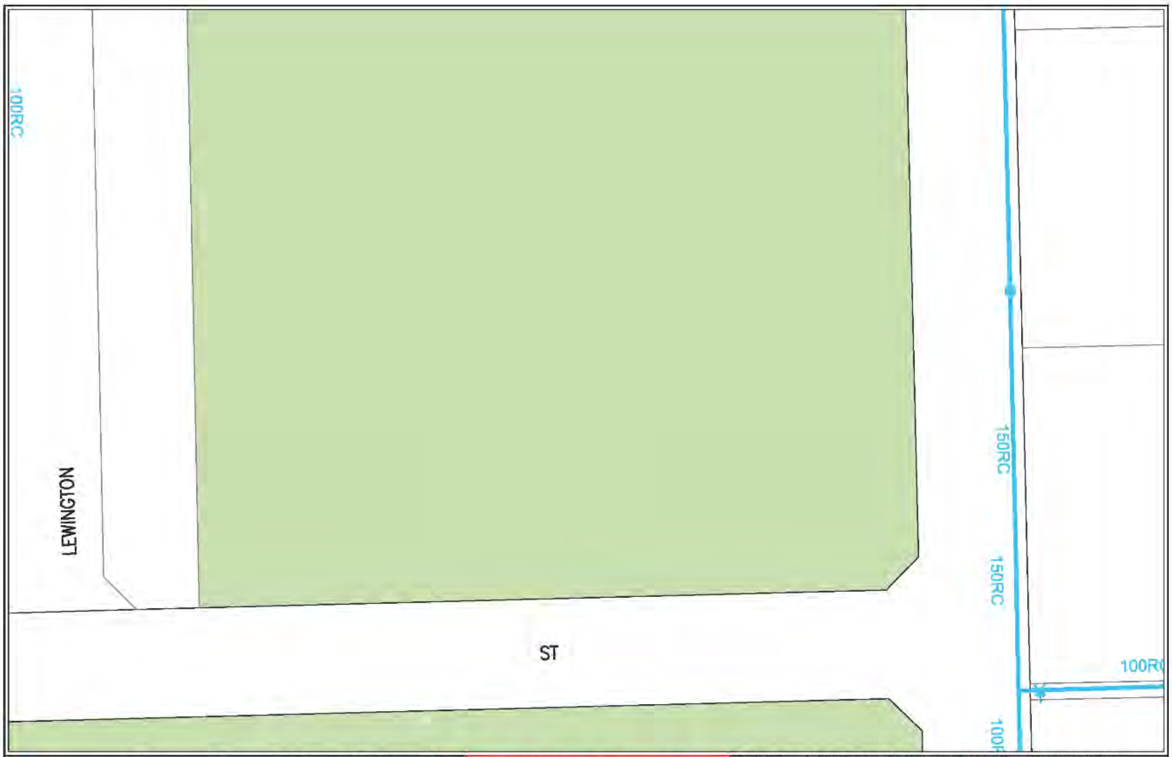


WATER CORPORATION

Scale: 1:750 Centre Point: 115.768°, -32.065°

Sequence No: 213055931

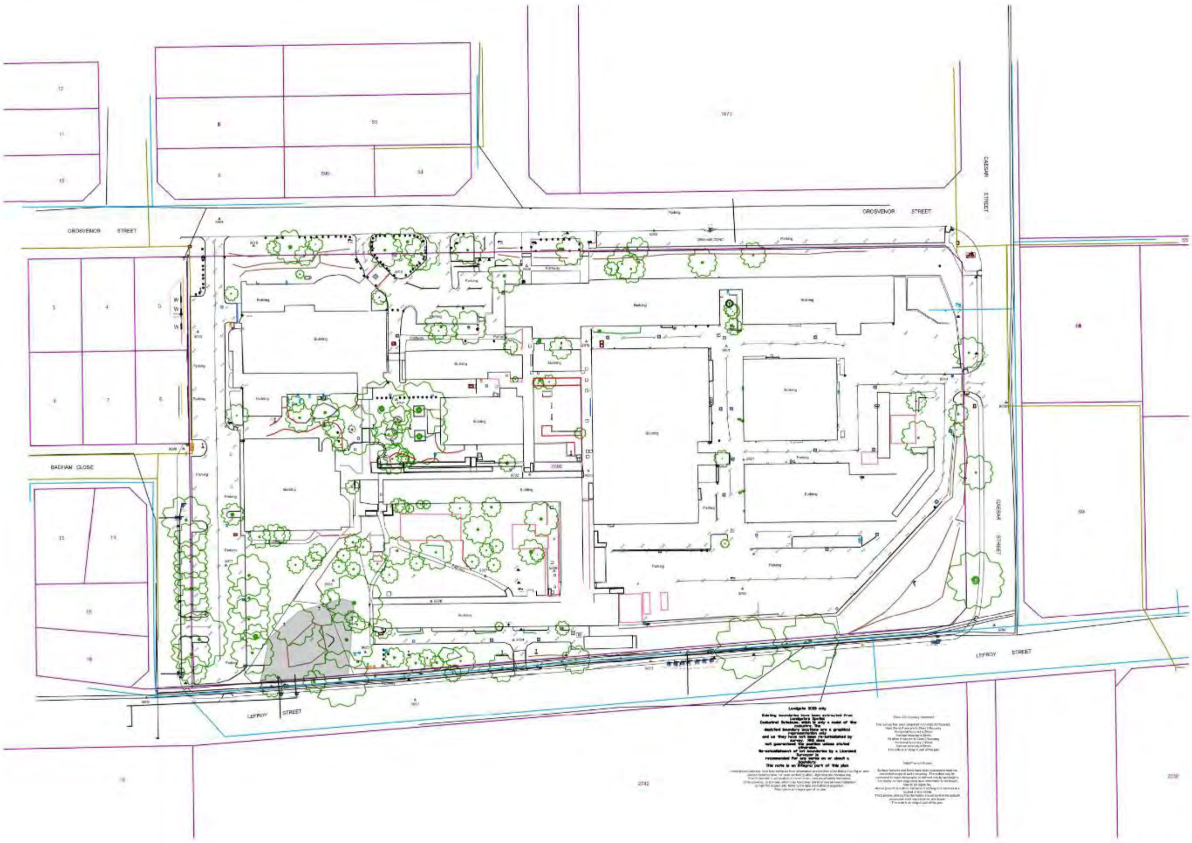
Print Date: 28/06/2022 Page: 7 of 7

N

Water

WARNING - CRITICAL PIPELINE
Refer to *Information Brochure Damage Prevention* and *Legend* for details

Appendix Seven: Existing Stormwater Infrastructure


GROSVENOR STREET
CAESAR STREET
LEFROY STREET
BADHAM CLOSE

Appendix Eight: City of Fremantle Stormwater Requirements

City of Fremantle

Engineering Technical Guidance Notes

Revision	Prepared By	Date
Original Doc		2004
Rev 3	Principal Engineer	2017-June
Rev 4	Principal Engineer	2018 -April

natural resources and provide sustainable solutions to protect the availability of these resources for future generations.

Selecting Recycled Materials

The selection of recycled materials shall be in accordance with "Recycled Materials in Road Pavements Specification" (IPWEA NSW 2010) Each material class (Base, Sub-Base etc.) must conform to the properties outlined in IPWEA specification for recycled materials. The supplier must provide certification of material testing by a NATA qualified independent testing authority in accordance with AS1289:2014.Stabilised road base material can be used for road construction, but the specification for these materials shall be lodged to the City prior to proceeding with the pavement design.

Compaction and Placement of Recycled Materials

When using recycled materials, appropriate method of compaction and placing technique shall be employed to avoid the possible breakdown of weakened constituents during construction.

14. Cycle Path

For specification of the Shared Path Design refer Department of Transport Shared Path design Technical Guidelines

15. Strom Water Drainage- Guideline

Design calculations

Design Average Recurrence Intervals. The average recurrence intervals (ARI) for the design of piped drainage systems in a residential, commercial or industrial area will depend on the local circumstances of the catchment area.

Type of Catchment

a) Central Business District
b) Commercial/Industrial Areas
c) High Rise, /Multiple residential(outside CBD)
d) Residential Area
e) Street Drainage System

Runoff Coefficients

The runoff coefficient can be calculated as the average (weighted by area) of the coefficients chosen for the portions of differing permeability. The adopted range of runoff coefficients for the City of Fremantle are as shown below:

Paved Surfaces 1.0
Intensely developed commercial & industrial areas 0.9
Single Residential development 0.5

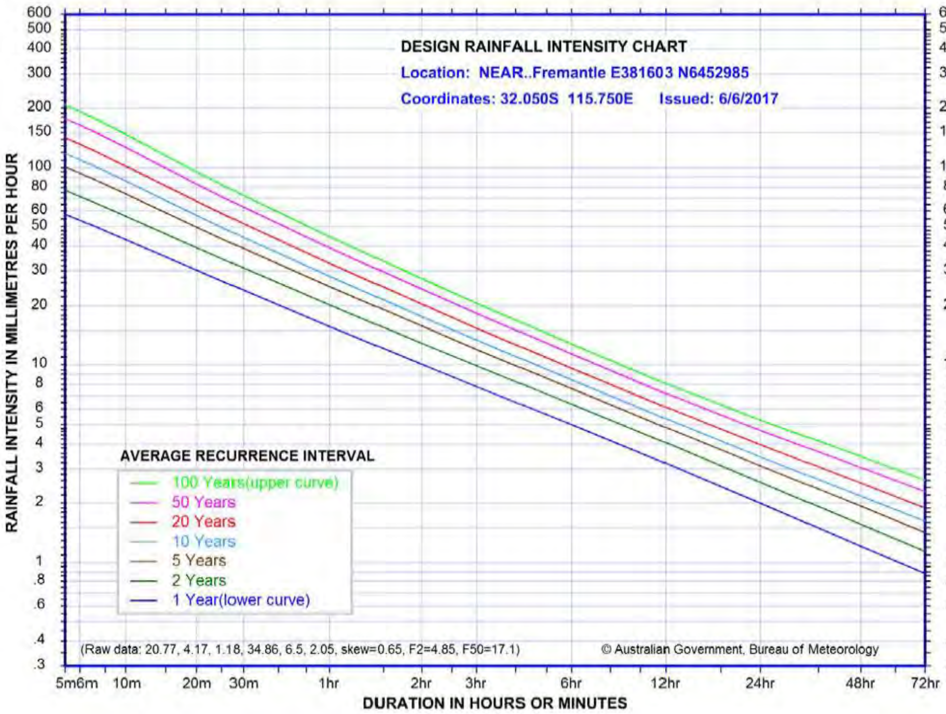
The stormwater runoff from properties are required to be retained onsite. If due to special circumstances such as multi-unit developments the water cannot be suitably retained on site, a connection to the Council's drainage system may be considered.

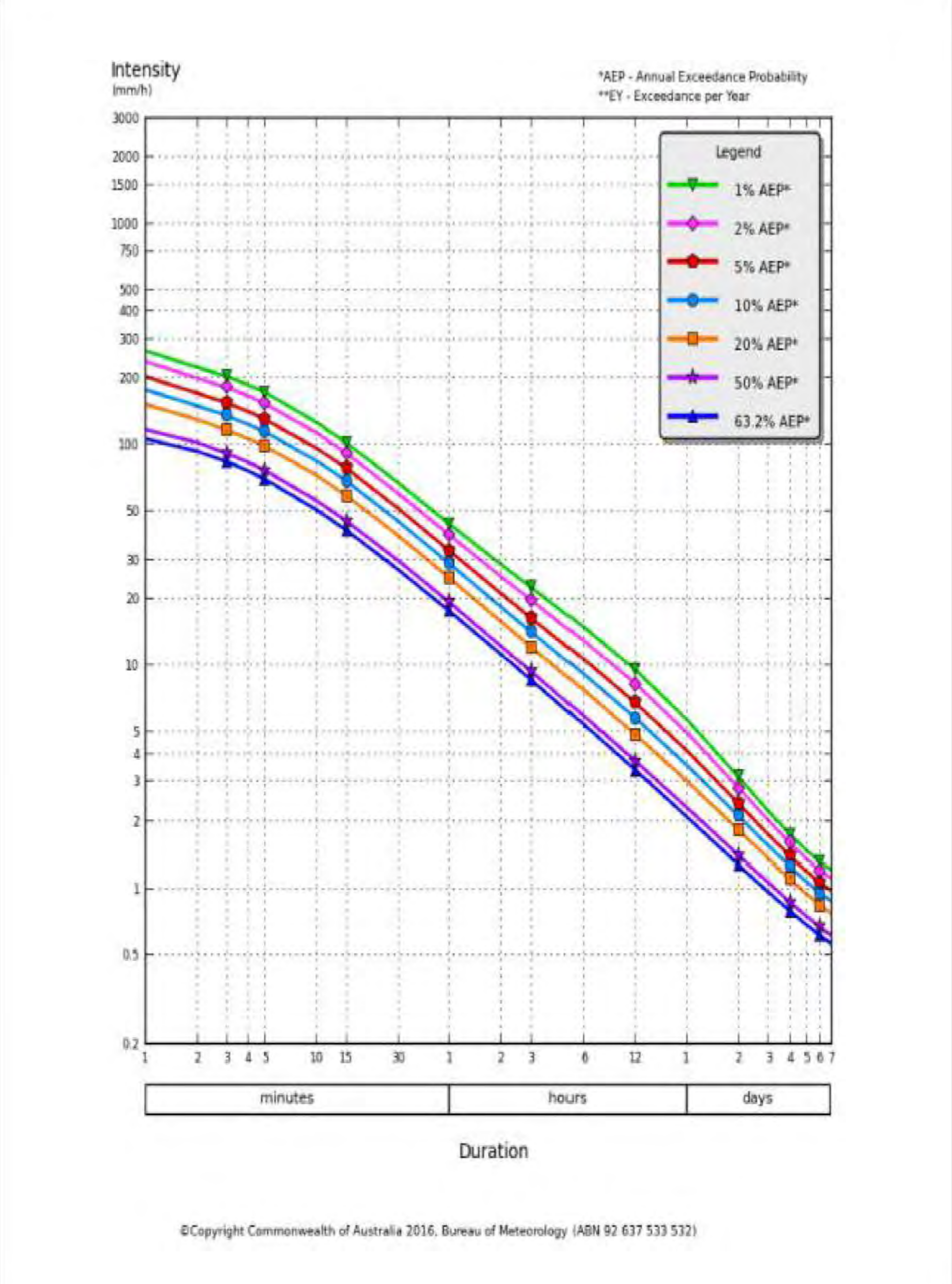
Rainfall Intensity-Frequency-Duration

The rainfall intensity-frequency-duration relationships are to be as set out in *"Australian Rainfall and Runoff, A Guide to Flood Estimation"*.

The Rainfall Intensity Chart for Fremantle

Information from Bureau of Meteorology




Intensity
(mm/h)
*AEP - Annual Exceedance Probability
**EY - Exceedance per Year
Legend
1% AEP*
2% AEP*
5% AEP*
10% AEP*
20% AEP*
50% AEP*
63.2% AEP*
3000
2000
1500
1000
750
500
400
300
200
100
50
30
20
10
5
4
3
2
1
0.5
0.2
1
2
3
4
5
10
15
30
1
2
3
6
12
1
2
3
4
5
6
7
minutes
hours
days
Duration
©Copyright Commonwealth of Australia 2016, Bureau of Meteorology (ABN 92 637 533 532)

Time of Concentration

Travel times may be calculated from charts for overland flow and gutter flows contained in the Australian Rainfall and Runoff publication, together with pipe and channel flow charts. The minimum time of concentration shall be taken as 5.0 minutes.

Flooding Hazards

Tailwater Level Assumption. An allowance of 1600mm change to the sea level due to climate change must be assumed for the design of minor drainage systems, where the stormwater rainage discharges into tidal waterways such as the Swan River. If tailwater is critical for managing major flows and setting flood immunity, a sensitive check must be undertaken to examine impacts of higher sea level in accordance with best climate change predictions at the time.

Hazard Estimation

For pedestrian safety the following criteria apply:
The velocity x depth product in a roadway in the designed major storm event is not to exceed 0.6 m2/s in the channel, kerb and the footpath.

Stormwater Pipes

Each section of pipe or conduit shall be designed to flow full and operate under pressure.

The hydraulic design of pipe size shall be based on the Colebrook-White formula using the charts for roughness coefficient K.

Reinforced Concrete Pipe.......... K = 0.6
UPVC Plastic.............................. K = 0.015
Clay... K = 0.15

The maximum and minimum velocity for full pipe flow shall be 4.5 m/s and 0.75m/s respectively. The pipe sizes shall have a minimum capacity designed for a storm event of average recurrence interval as outlined below.

Type of Catchment	Storage Tank	Drainage System
A,B &C	1 IN 100 ARI	1 IN 20 ARI
D	Retained on Site	1 IN 5 ARI
E	N/A	1IN 20 ARI

Loading & Overburden of Pipes

Steel reinforced concrete pipes shall be designed for installation in accordance with "AS/NZS 3725:2007 - Design for installation of buried concrete pipes." with the following exceptions.Clause 6.5 of AS/NZS 3725 shall be replaced by: The defects of superimposed live loads shall be calculated in accordance with AS5100.2-2004Distribution of live loads shall be in accordance with AS5100.2-2004

Dynamic load allowance shall be as follows: a value of 0.4 for zero height;

a) A value of 0.1 for fill heights of 2m of higher
b) A linear interpolation between 0.4 and 0.1 for depths between zero and 2m depths respectively.

Construction load cases shall be considered in addition to load cases associated with compaction of fill material.

Pit energy losses and pressure changes shall be taken into account for the hydraulic grade line analysis. For reliable values of energy losses and pressure changes for different types of pits and junctions, it's recommended that "Missouri Charts" are used.

Pipe Capacity Assumptions

a) Pipe capacity for trunk stormwater systems is to be estimated using hydraulic grade line analysis of the drainage system for the relevant design storm and using a suitable computer model.
b) For smaller pipelines, the capacity can be estimated using pipe flowing full at grade assumptions. The adopted pipe velocity when using this method must not be less than 3 m/s.

Soakage Sump

The sump for soakage purposes shall be designed to cope with the accumulated storage resulting from the runoff from a design storm of 1 in .20 years ARI to 1 in 50 years ARI depending on its location. A check shall also be made for a design storm of 1 in 100 years ARI in order to determine its impact on the surrounding land and installations.

In estimating storage requirements a mass - curve technique may be used. An example of this procedure is given in Book Eight, Technical Note 1 of *ARR 1997*. The City presently uses a simple inflow and outflow hydrograph relationship to analyse the storage capacity of soakwells. A soil investigation shall be carried out to determine the soil parameters required for the storage analysis of the sumps.

Detention Systems

On-site detention system may be designed to restrict peak outflows for selected design storms to either pre-development conditions, or to the maximum capacity of the existing downstream drainage network. If stormwater cannot be disposed of on-site due to adverse site conditions then connection to the City's street stormwater system may be considered. Approval of the proposed connection may require the installation of large on-site holding tanks to retain the critical storm. These on-site detention systems shall be designed to reduce the peak runoff from the developed sites for a once in a hundred (1:100) year storm to the runoff which would have occurred in a natural state of a once in twenty (1:20) storm of a duration equal to the natural time of concentration. The maximum allowable discharge to the City's system is 120litres/second/hectare of site and the minimum storage requirement is 290 cubic metres/hectare of site. In designing the storage tank allowance should be made for the additional area that may be created by high rise buildings on the site. A detailed design must be submitted to the City of Fremantle's Infrastructure Engineering Section before any drainage connection approval will be considered.

Retention Systems

Stormwater retention systems can be designed to reduce the total annual runoff volume and reduce the runoff volume from a specified design storm.

Grassed and Vegetated Drainage Channels

The application of ground channels is genuinely limited by the design standards and site conditions. Consideration should be given to the incorporation of the principles of natural channel design for the design of such drainage channels. All drainage channels of this design should have a natural appearance and fit with its surroundings.
Refer *Stormwater Management Manual for Western Australia* (WA 2004-2007).

Free Board

The Free Board level required is 300mm, this is the level between a flooded road reserve and the floor level of commercial/residential properties or carparks. Where the level of a property or carpark is below the level of the top of kerb it is required that in between is a raised footpath that is 100mm higher than the top of kerb. This requirement minimises the risk of flooding to private properties and carparks.

Non-Aggressive Ground Conditions

To install a pipe underground or above ground in ground conditions considered to be Non-aggressive, the following must apply:

a) The pipe must not come in to contact with salt-water or salt spray
b) The pipe must not be subject to and tidal conditions or forces
c) Internal and external surfaces of pipes exposed only to fresh or brackish water

d) The soil and ground conditions are not contaminated with Acid Sulphate Soil, as per the Department of Environment Regulations guidelines. (DER 2015)

Marine Environment

To install a pipe underground or above ground in ground conditions considered to be a Marine Environment, the following must apply:

a) Only the external pipe surface is to come in contact with salt water or salt spray
b) The soil and ground conditions are not contaminated with Acid Sulphate Soil, as per the Department of Environment Regulations guidelines. (DER 2015)

Acid Sulphate Soils

Planning of stormwater drainage systems within potential acid sulphate soil zones must be undertaken with considerations for items such as, but not limited to:

- Highly acidic soils affect on the surrounding and downstream environment;
- The potential that groundwater is also highly acidic; and
- The acidic conditions affect on existing and new infrastructure.

The Department of Environment and Conservation has produced guidelines to assist with the identification, treatment and management of acid sulphate soils within Western Australia. Refer *Identification and investigation of acid sulfate soils and acidic landscapes* (DER 2015) and *Treatment*

Subsoil Drains

Subsoil drains shall be provided where necessary to control ground water table and flow. Subsoil drainage systems are to be designed and constructed in accordance with *"AS/NZS3500.3:2003 - Plumbing and Drainage: Part 3 - Stormwater Drainage."* For subsoil drains, only approved perforated or slotted pipes and conduits shall be used. Drain cells or nylex strip drains shall be laid in a granular filter medium wrapped with an approved geotextile filter membrane.

Design Drawings

The proposed drainage design shall be clearly shown on plan drawings to a scale of 1:250, 1:500 or 1:1000 depending on the size of the project. Longitudinal sections of the proposed drainage pipe networks shall also be provided. All underground and above ground public utility services shall be clearly indicated on the plan drawings. Legends and symbols shall be clearly shown on the drawings, using standard notation wherever possible.

16. City of Fremantle - Guidelines for better management of Urban Stormwater for Commercial Properties

These guidelines provide information on simple practices that can be employed to Prevent contamination of the stormwater system by commercial properties and Businesses especially where storm water from the premises is discharged into Council's storm water drainage system. Only rainwater is allowed to enter the stormwater drainage system. Anything other than rainwater will pollute the receiving water bodies.

- Used water from inside commercial businesses is wastewater. Wastewater must not be discharged into stormwater drains. This includes water from swimming pools, air conditioners, window washing and mop cleaning.
- Wastewater that meet Water Corporations requirement should be directed to the sewer. Businesses should make their staff aware of disposal points for wastewater.
- Litter and sediment should be swept and disposed of in waste bins or recycled and not washed into drains.
- Bins should be washed in the designated bin wash area on the premises. Bin wash areas are required where bins are likely to be soiled or where businesses produce putrescible waste. Waste bins should not be allowed to overflow. Unsecured wastes can be blown into the stormwater drains and cause local flooding.
- Cardboard, paper, oil, drums, bottles and other materials that can be recycled should be recycled. Different bins to separate general waste from recyclables should be provided and identified.
- Spillage from oil and liquid storage areas can block stormwater drains and contaminate the stormwater system. Spills should be picked up using absorbent materials and disposed of into commercial bins and not hosed away. Chemicals and liquids should be stored away from stormwater drains and pits.
- Compliance with the Health Act 1911 and Environmental Protection Act 1986 with regards to Waste Management and discharges into the environment.

17. Guidelines for better management of Urban Stormwater for Residential Properties

These guidelines provide information on simple practices that can be employed to prevent contamination of the stormwater system by residential properties especially where storm water from the premises is discharged into Council's stormwater drainage system. Only rainwater is allowed to enter the stormwater drainage system. Anything other than rainwater will pollute the receiving waterbodies.

a) Used water from inside residential properties is wastewater. Wastewater and must not be discharged into stormwater drains. This includes water from swimming pools, air conditioners, window washing, car washing and mop cleaning. Wastewater that meet Water Corporations requirement should be directed to the sewer.
b) Litter and sediment should be swept and disposed of in waste bins or recycled and not washed into drains.
c) Bins should be washed in the designated bin wash area on the premises.
d) Waste bins should not be allowed to overflow. Unsecured wastes can be blown into the stormwater drains and cause local flooding.
e) Cardboard, paper, bottles and other materials that can be recycled should be recycled.
f) Compliance with Health Act 1911 and Environmental Protection Act 1986 with regards to Waste Management and discharges into the environment. (Further information)

18. Reinstatement of Flexible Pavement

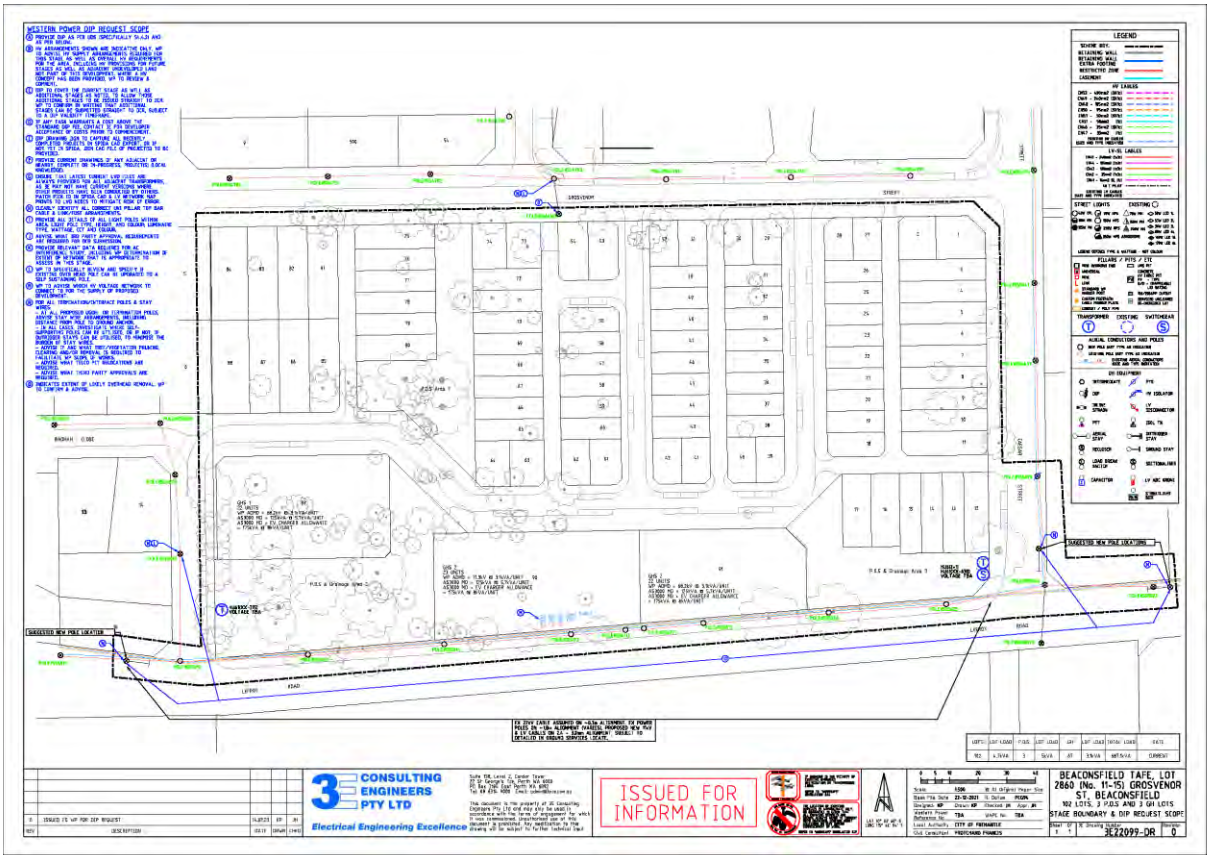
The reinstatement of sub-grade and pavement after trenching works must be carried out in accordance with the following specifications.

General

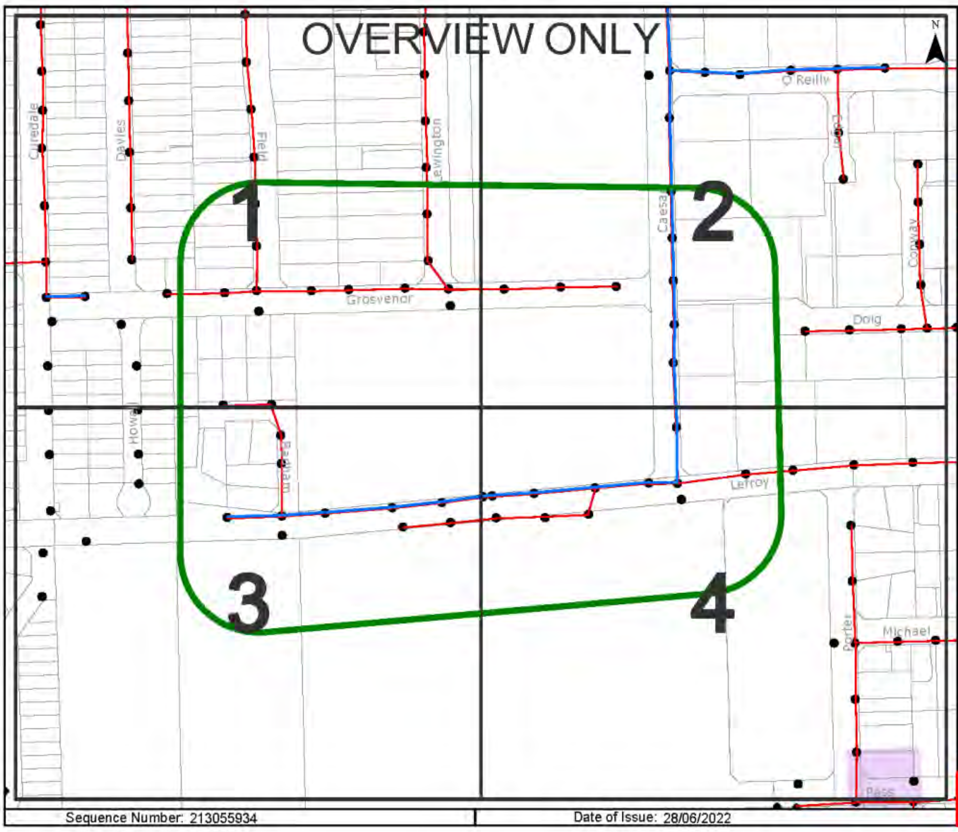
Erect adequate hoardings and/or barriers around the area to be excavated and implement appropriate Traffic Management in accordance with the City of Fremantle Procedure for Traffic Management within the Road reserve.

a) Make a neat saw cut to existing asphalt surfaces.
b) Keep the width of the excavation trench to a minimum.
c) Excavated material shall not be reused in the reinstatement to trenches and shall be removed from the site.
d) Roads and footpaths are to be reinstated to previous existing levels.
e) For longitudinal trenches (in roads) that are greater than 50m long, the resurfacing shall be carried out for the full width of the trafficable lane and shall match the previous existing asphalt layers.
f) All the construction joints on road surfaces shall be located away from the traffic wheel path/track. Where possible, joints in wearing course shall be located beneath traffic lane marking.
g) For asphalt surfaces, asphalt edges shall be tacked with bitumen emulsion prior to new asphalt being laid with a minimum rate of 0.6 l/m^2.
h) For asphalt surfaces, asphalt shall be laid in accordance with *AS2150-2005*.
i) For asphalt surfaces, the wearing course shall extend 150mm either side of the excavated trench.
j) The outer edge shall be saw cut and the shape of the patched area must be square or rectangular.

Appendix Nine: 3E Western Power DIP Scope Plan


WESTERN POWER DDP REQUEST SCOPE
EX 22kV CABLE ASSUMED ON ~0.3m ALIGNMENT. EX POWER POLES ON ~1.0m ALIGNMENT (VARIES). PROPOSED NEW 11kV & LV CABLES ON 2.4 - 3.0m ALIGNMENT. SUBJECT TO DETAILED IN GROUND SERVICES LOCATE.
SUGGESTED NEW POLE LOCATION
SUGGESTED NEW POLE LOCATIONS
LOTS | LOT LOAD | P.O.S | LOT LOAD | GH | LOT LOAD | TOTAL LOAD | RATE
102 | 4.7kVA | 3 | 5kVA | 87 | 3.9kVA | 887.5kVA | CURRENT
3E CONSULTING ENGINEERS PTY LTD
Electrical Engineering Excellence
ISSUED FOR INFORMATION
BEACONSFIELD TAFE, LOT 2860 (No. 11-15) GROSVENOR ST, BEACONSFIELD
102 LOTS, 3 P.O.S AND 3 GH LOTS
STAGE BOUNDARY & DIP REQUEST SCOPE
Base File Date 23-12-2021
Local Authority CITY OF FREMANTLE
Civil Consultant PRITCHARD FRANCIS
3E22099-DR
0

Appendix Ten: Western Power Infrastructure



westernpower

OVERHEAD LEGEND

Structures
Power Pole ■ Transmission Poles

Transmission Overhead Powerline
Transmission (33kV - 330kV)

Distribution Overhead Powerline
High Voltage (1kV - 33kV)
Low Voltage (< 1kV)

Proposed Construction Assets
Design Area *
High Voltage Overhead Powerline
Low Voltage Overhead Powerline
Power Pole

Communications Assets
Overhead Pilot Cable

Feature
Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

This map is INDICATIVE ONLY. Check that you have enough clearance from the DANGER ZONES near overhead powerlines.

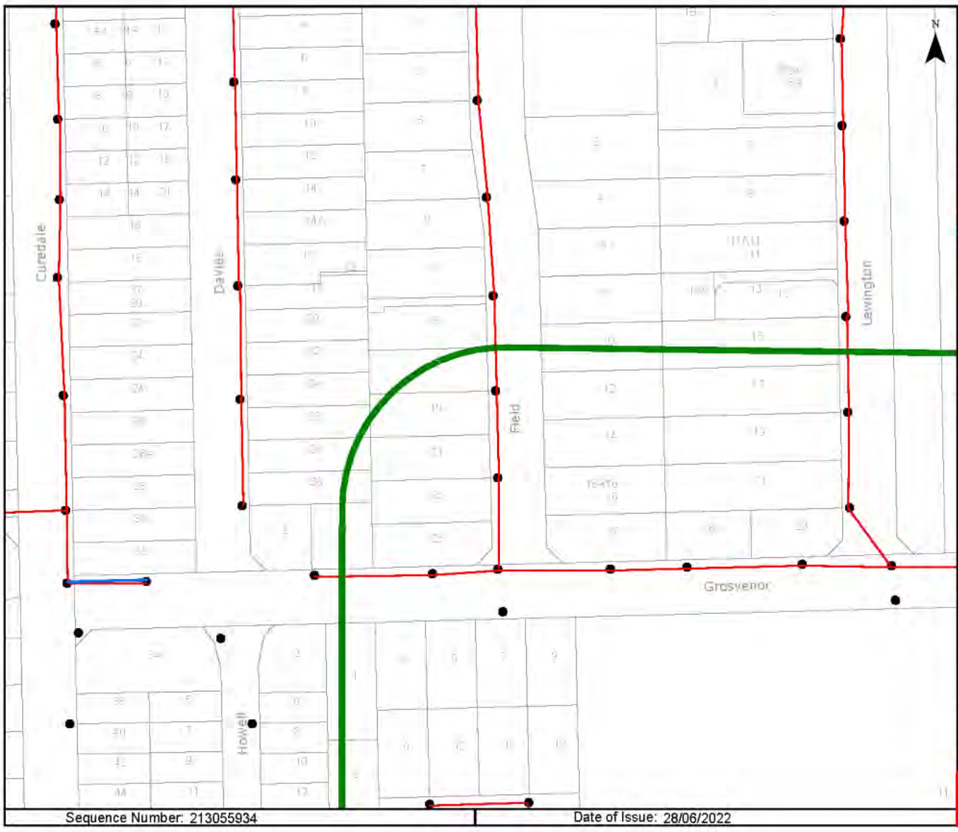
Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30

Information valid for 30 days from date of issue

A4 | Scale : 1:3075

WARNING! Look out for overhead power lines

Sequence Number: 213055934 | Date of Issue: 28/06/2022



westernpower

OVERHEAD LEGEND

Structures
Power Pole ■ Transmission Poles

Transmission Overhead Powerline
Transmission (33kV - 330kV)

Distribution Overhead Powerline
High Voltage (1kV - 33kV)
Low Voltage (< 1kV)

Proposed Construction Assets
Design Area *
High Voltage Overhead Powerline
Low Voltage Overhead Powerline
Power Pole

Communications Assets
Overhead Pilot Cable

Feature
Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

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Mon to Fri - 08:00 to 16:30

Information valid for 30 days from date of issue

A4 | Scale : 1:1500

WARNING! Look out for overhead power lines

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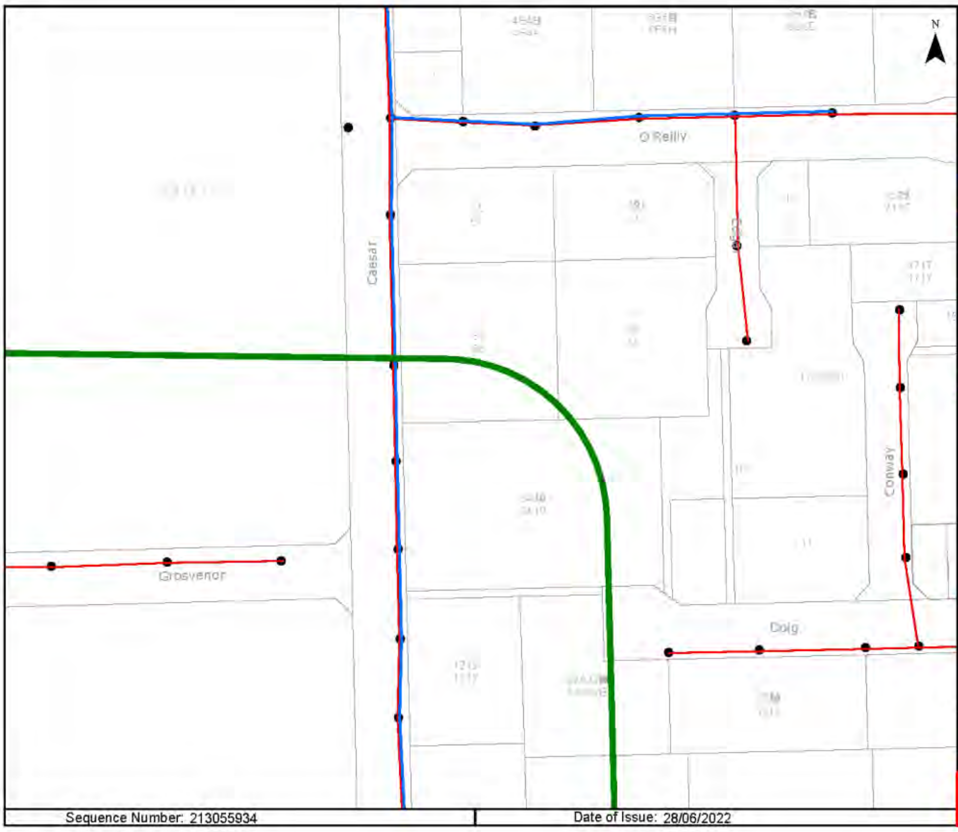

westernpower

OVERHEAD LEGEND

Structures

- Power Pole
- Transmission Poles

Transmission Overhead Powerline

- Transmission (33kV - 330kV)

Distribution Overhead Powerline

- High Voltage (1kV - 33kV)
- Low Voltage (< 1kV)

Proposed Construction Assets

- Design Area *
- High Voltage Overhead Powerline
- Low Voltage Overhead Powerline
- Power Pole

Communications Assets

- Overhead Pilot Cable

Feature

- Area of Interest

*** Please refer to coversheet**

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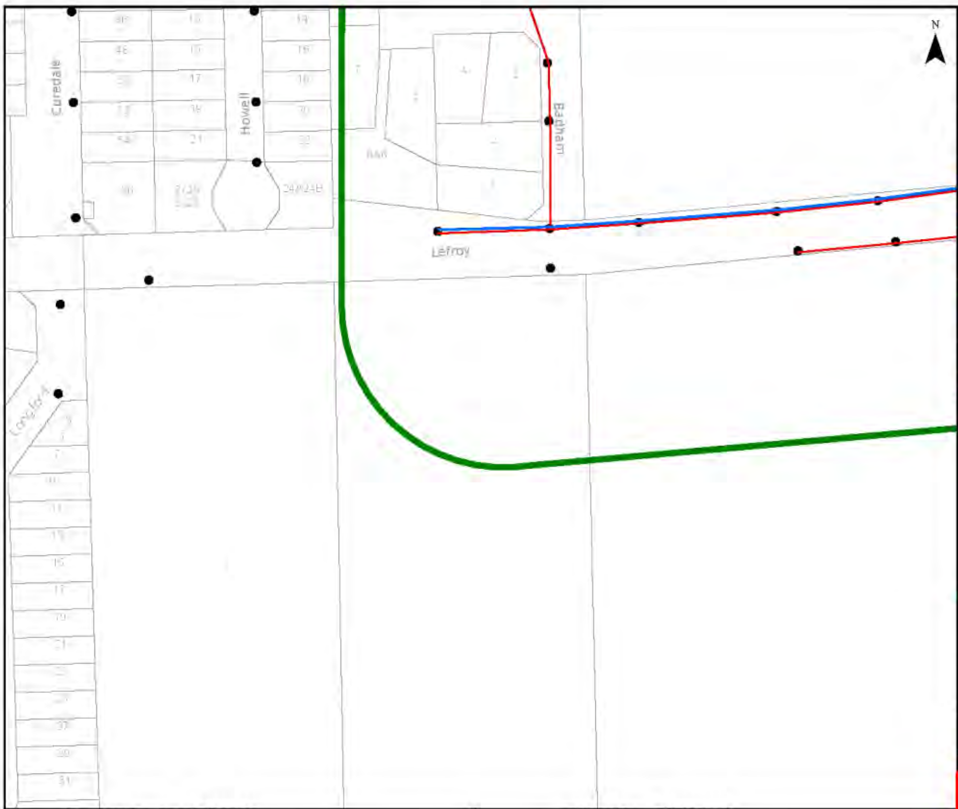
Sequence Number: 213055934 Date of Issue: 28/06/2022



westernpower

OVERHEAD LEGEND

Structures

- Power Pole
- Transmission Poles

Transmission Overhead Powerline

- Transmission (33kV - 330kV)

Distribution Overhead Powerline

- High Voltage (1kV - 33kV)
- Low Voltage (< 1kV)

Proposed Construction Assets

- Design Area *
- High Voltage Overhead Powerline
- Low Voltage Overhead Powerline
- Power Pole

Communications Assets

- Overhead Pilot Cable

Feature

- Area of Interest

*** Please refer to coversheet**

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WARNING! Look out for overhead power lines

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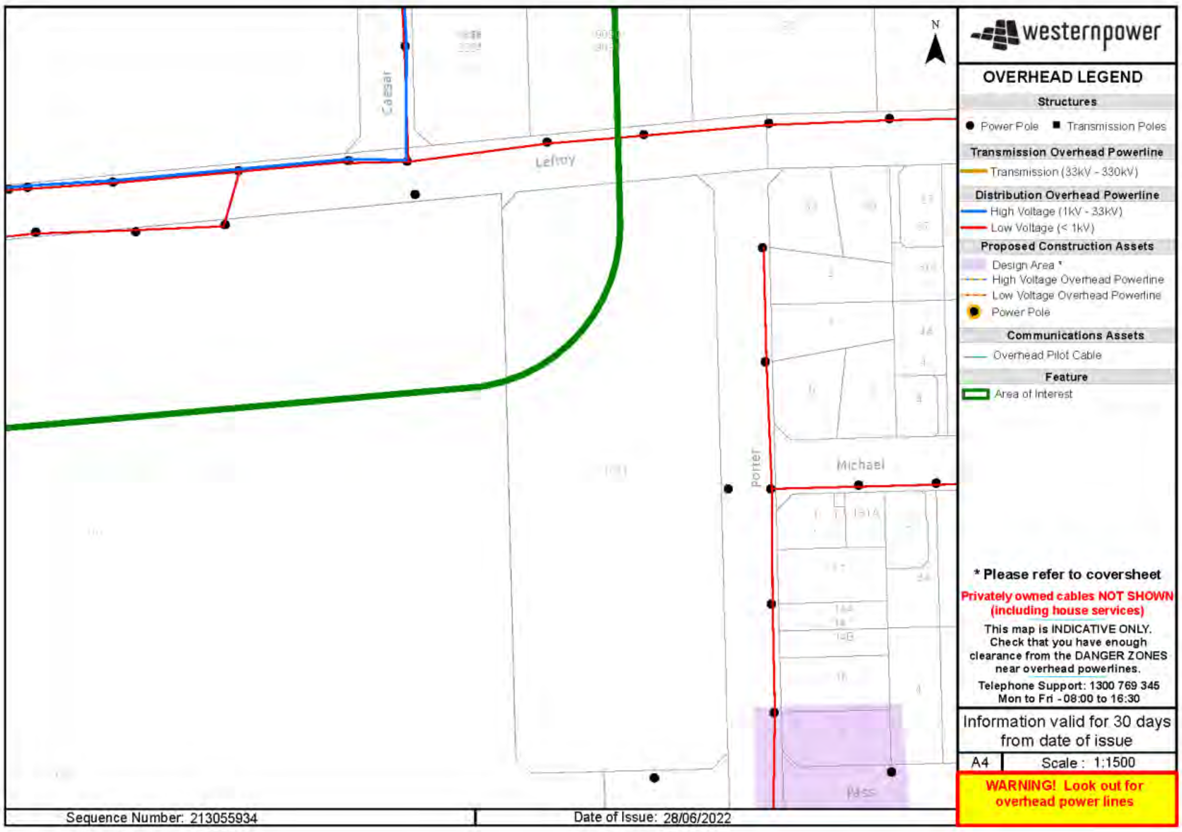

westernpower
OVERHEAD LEGEND
Structures
Power Pole
Transmission Poles
Transmission Overhead Powerline
Transmission (33kV - 330kV)
Distribution Overhead Powerline
High Voltage (1kV - 33kV)
Low Voltage (< 1kV)
Proposed Construction Assets
Design Area *
High Voltage Overhead Powerline
Low Voltage Overhead Powerline
Power Pole
Communications Assets
Overhead Pilot Cable
Feature
Area of Interest
* Please refer to coversheet
Privately owned cables NOT SHOWN (including house services)
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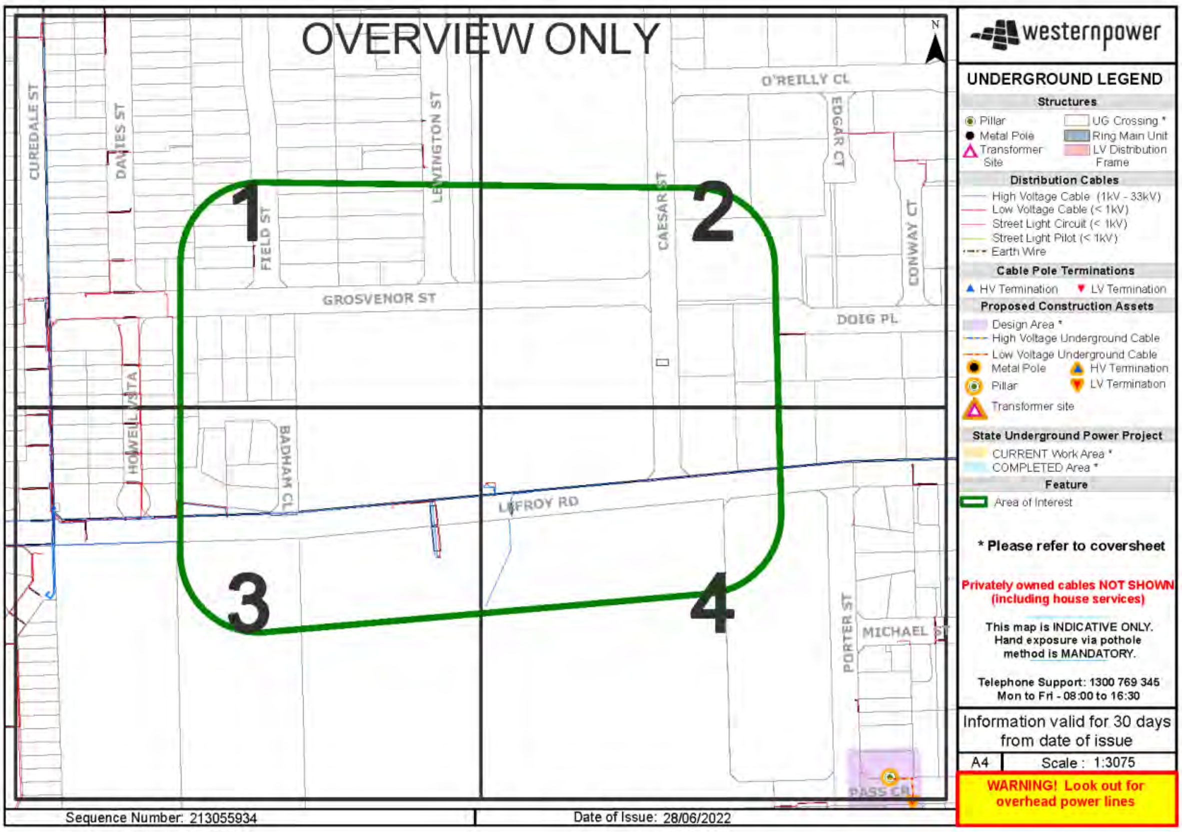
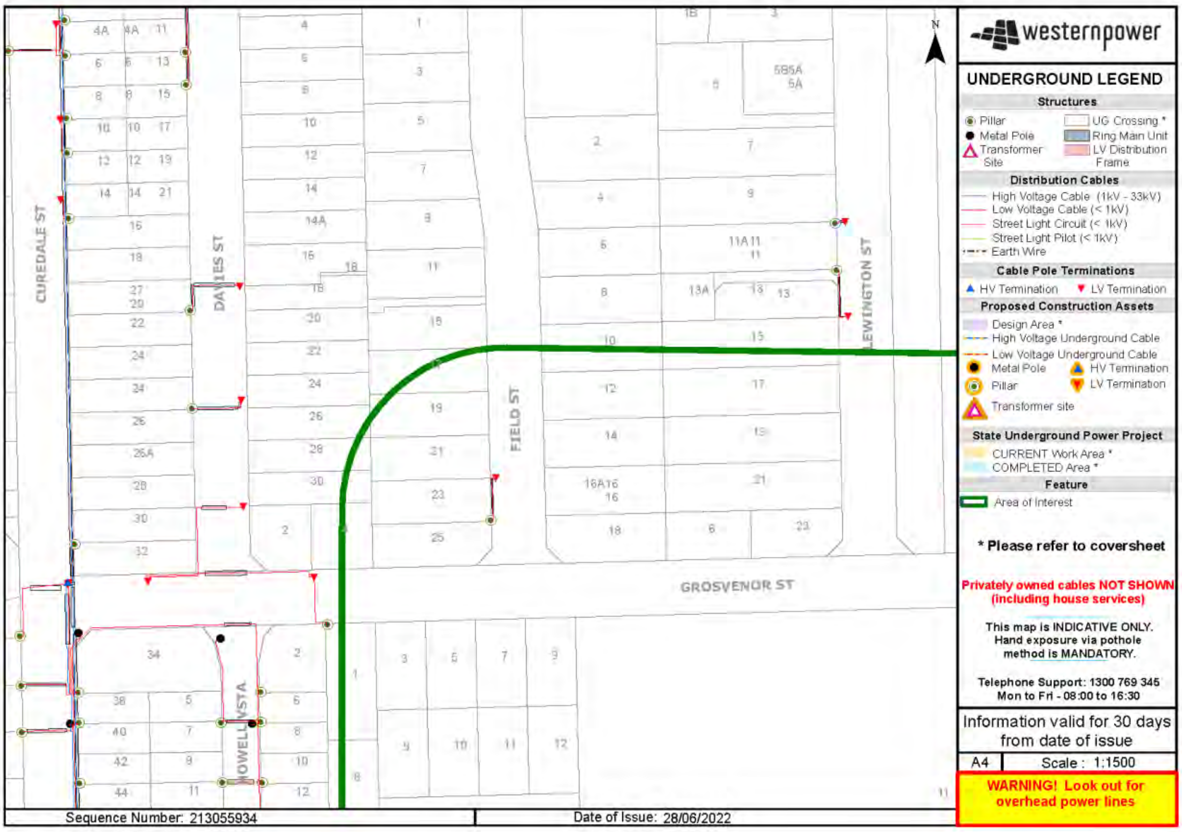
Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30
Information valid for 30 days from date of issue
A4
Scale : 1:1500
WARNING! Look out for overhead power lines
N
Caesar
Lefroy
Porter
Michael
Pass
Sequence Number: 213055934
Date of Issue: 28/06/2022



OVERVIEW ONLY
westernpower
UNDERGROUND LEGEND
Structures
Pillar
UG Crossing *
Metal Pole
Ring Main Unit
Transformer Site
LV Distribution Frame
Distribution Cables
High Voltage Cable (1kV - 33kV)
Low Voltage Cable (< 1kV)
Street Light Circuit (< 1kV)
Street Light Pilot (< 1kV)
Earth Wire
Cable Pole Terminations
HV Termination
LV Termination
Proposed Construction Assets
Design Area *
High Voltage Underground Cable
Low Voltage Underground Cable
Metal Pole
HV Termination
Pillar
LV Termination
Transformer site
State Underground Power Project
CURRENT Work Area *
COMPLETED Area *
Feature
Area of Interest
* Please refer to coversheet
Privately owned cables NOT SHOWN (including house services)
This map is INDICATIVE ONLY. Hand exposure via pothole method is MANDATORY.
Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30
Information valid for 30 days from date of issue
A4
Scale : 1:3075
WARNING! Look out for overhead power lines
N
CUREDALE ST
DAVIES ST
FIELD ST
LEWINGTON ST
CAESAR ST
O'REILLY CL
EDGAR CT
CONWAY CT
GROSVENOR ST
DOIG PL
HOWELL VISTA
BADHAM CL
LEFROY RD
PORTER ST
MICHAEL ST
PASS CR
1
2
3
4
Sequence Number: 213055934
Date of Issue: 28/06/2022


CUREDALE ST
DAVIES ST
HOWELL VSTA
FIELD ST
LEWINGTON ST
GROSVENOR ST
westernpower
UNDERGROUND LEGEND
Structures
Pillar
UG Crossing *
Metal Pole
Ring Main Unit
Transformer Site
LV Distribution Frame
Distribution Cables
High Voltage Cable (1kV - 33kV)
Low Voltage Cable (< 1kV)
Street Light Circuit (< 1kV)
Street Light Pilot (< 1kV)
Earth Wire
Cable Pole Terminations
HV Termination
LV Termination
Proposed Construction Assets
Design Area *
High Voltage Underground Cable
Low Voltage Underground Cable
Metal Pole
HV Termination
Pillar
LV Termination
Transformer site
State Underground Power Project
CURRENT Work Area *
COMPLETED Area *
Feature
Area of Interest
* Please refer to coversheet
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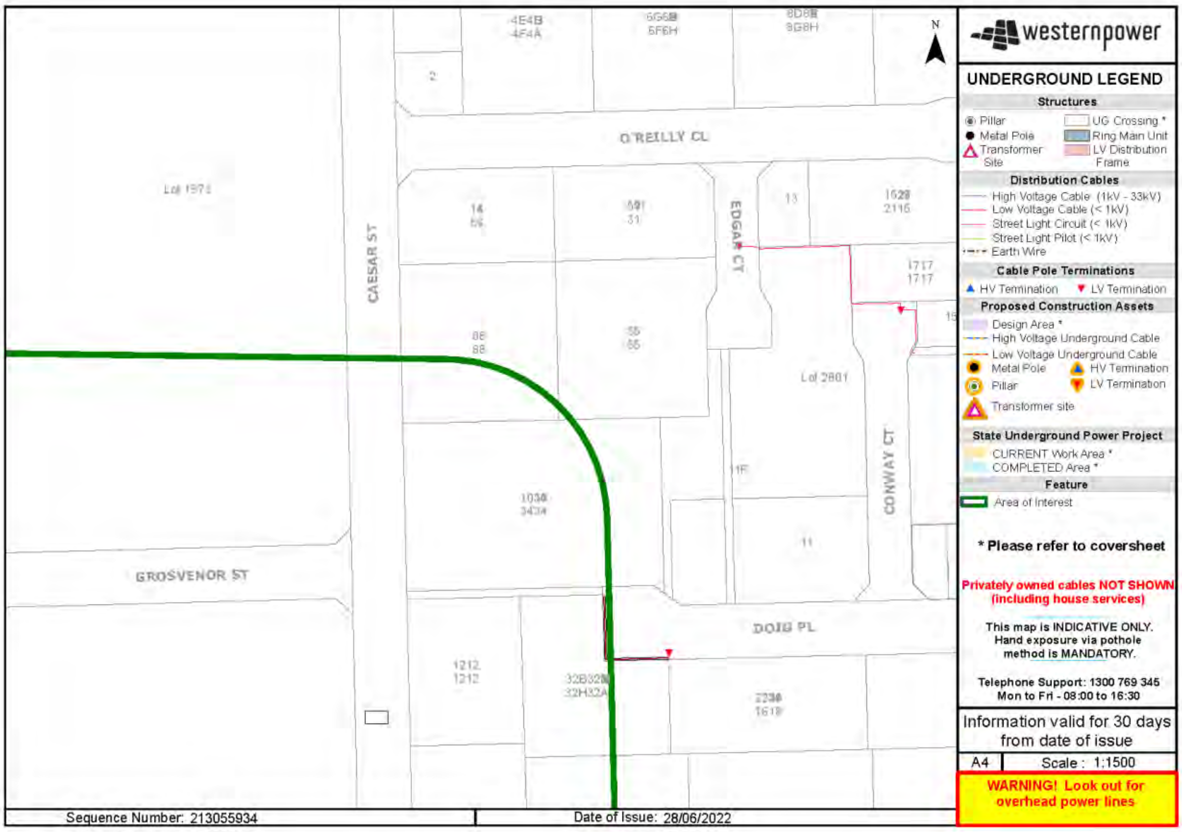
Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30
Information valid for 30 days from date of issue
A4
Scale : 1:1500
WARNING! Look out for overhead power lines
Sequence Number: 213055934
Date of Issue: 28/06/2022


CAESAR ST
O'REILLY CL
EDGAR CT
CONWAY CT
GROSVENOR ST
DOIG PL
Lot 1971
Lot 2801
westernpower
UNDERGROUND LEGEND
Structures
Pillar
UG Crossing *
Metal Pole
Ring Main Unit
Transformer Site
LV Distribution Frame
Distribution Cables
High Voltage Cable (1kV - 33kV)
Low Voltage Cable (< 1kV)
Street Light Circuit (< 1kV)
Street Light Pilot (< 1kV)
Earth Wire
Cable Pole Terminations
HV Termination
LV Termination
Proposed Construction Assets
Design Area *
High Voltage Underground Cable
Low Voltage Underground Cable
Metal Pole
HV Termination
Pillar
LV Termination
Transformer site
State Underground Power Project
CURRENT Work Area *
COMPLETED Area *
Feature
Area of Interest
* Please refer to coversheet
Privately owned cables NOT SHOWN (including house services)
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Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30
Information valid for 30 days from date of issue
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Scale : 1:1500
WARNING! Look out for overhead power lines
Sequence Number: 213055934
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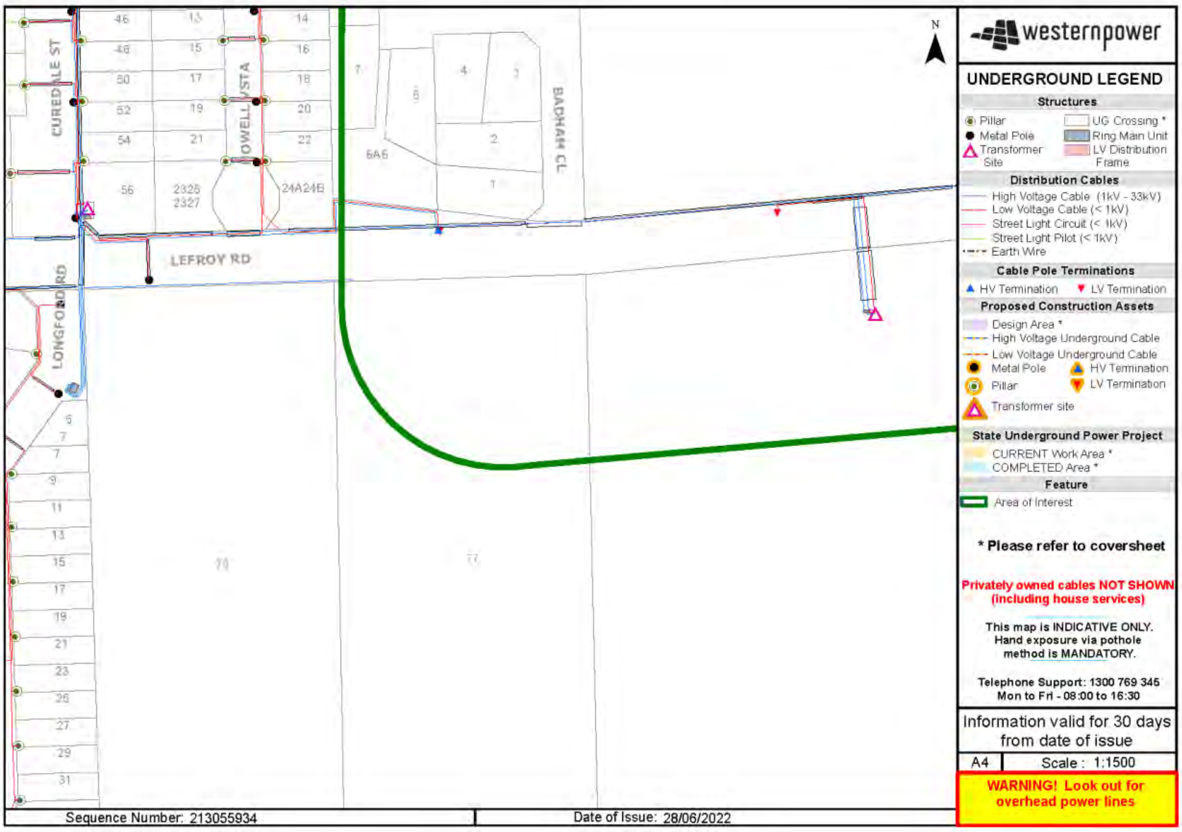
westernpower
UNDERGROUND LEGEND
Structures
Pillar
Metal Pole
Transformer Site
UG Crossing *
Ring Main Unit
LV Distribution Frame
Distribution Cables
High Voltage Cable (1kV - 33kV)
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CURRENT Work Area *
COMPLETED Area *
Feature
Area of Interest
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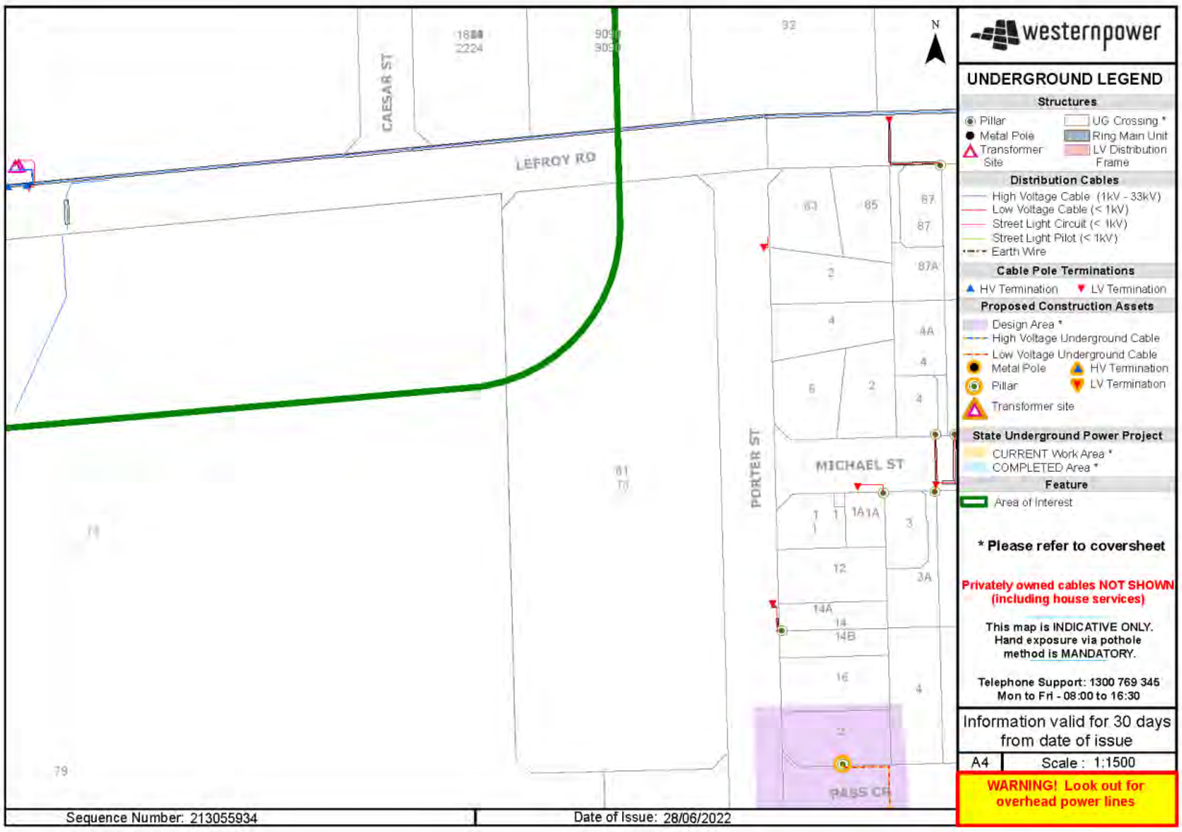
Telephone Support: 1300 769 345 Mon to Fri - 08:00 to 16:30
Information valid for 30 days from date of issue
A4
Scale : 1:1500
WARNING! Look out for overhead power lines
Sequence Number: 213055934
Date of Issue: 28/06/2022
LEFROY RD
LONGFORD RD
CUREDALE ST
OWELL VISTA
BADHAM CL
N


westernpower
UNDERGROUND LEGEND
Structures
Pillar
Metal Pole
Transformer Site
UG Crossing *
Ring Main Unit
LV Distribution Frame
Distribution Cables
High Voltage Cable (1kV - 33kV)
Low Voltage Cable (< 1kV)
Street Light Circuit (< 1kV)
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Low Voltage Underground Cable
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CURRENT Work Area *
COMPLETED Area *
Feature
Area of Interest
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Telephone Support: 1300 769 345 Mon to Fri - 08:00 to 16:30
Information valid for 30 days from date of issue
A4
Scale : 1:1500
WARNING! Look out for overhead power lines
Sequence Number: 213055934
Date of Issue: 28/06/2022
LEFROY RD
CAESAR ST
PORTER ST
MICHAEL ST
PASS CR
N

Appendix Eleven: Communications Infrastructure

To:	Andrew Tucker
Phone:	Not Supplied
Fax:	Not Supplied
Email:	andrew.t@pfeng.com.au

Dial before you dig Job #:	32230736
Sequence #	213055930
Issue Date:	28/06/2022
Location:	11-15 Grosvenor Street , Beaconsfield , WA , 6162

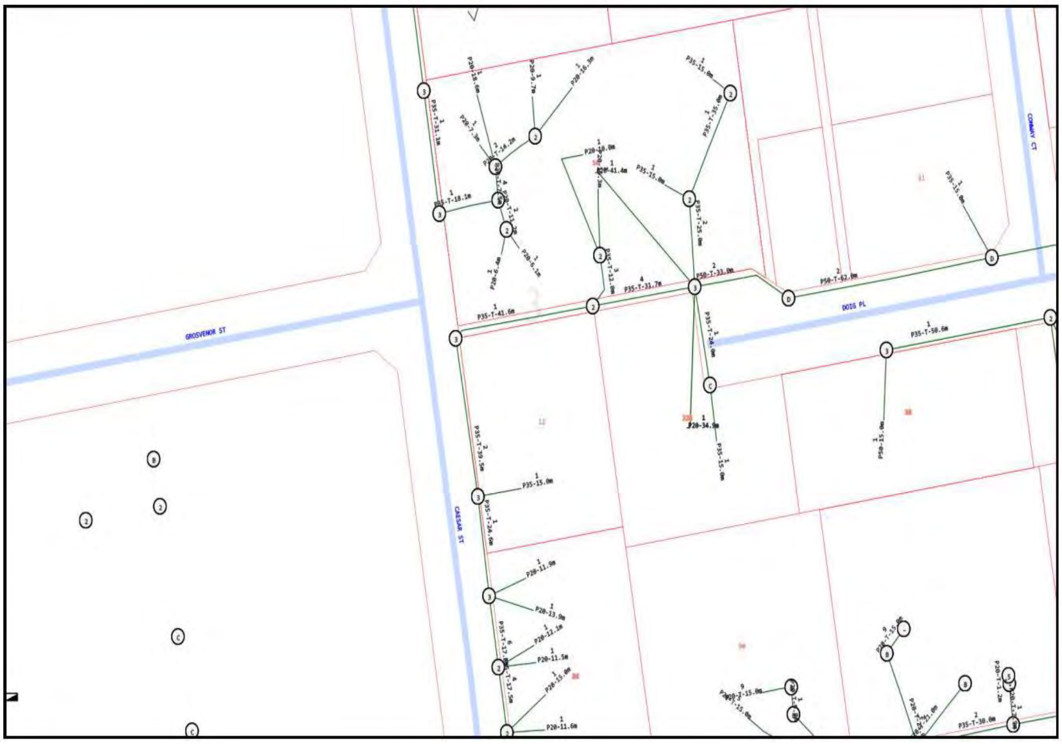
Indicative Plans

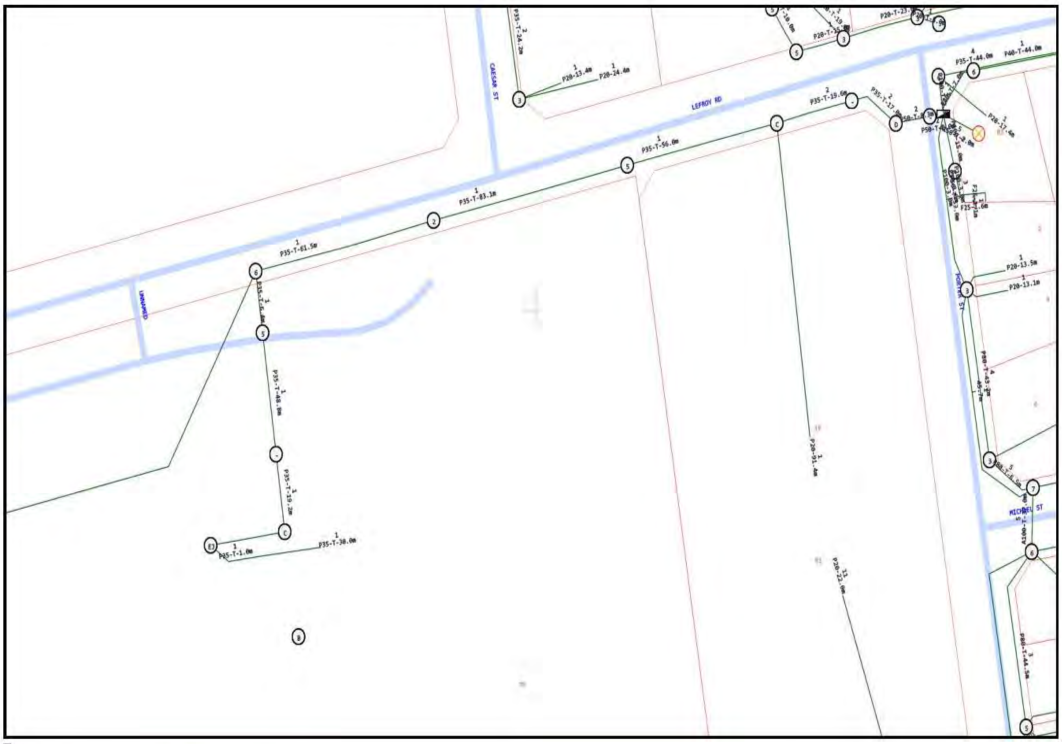
LEGEND

Symbol	Description
14	Parcel and the location
5	Pit with size "5"
2E	Power Pit with size "2E". Valid PIT Size: e.g. 2E, 5E, 6E, 8E, 9E, E, null.
	Manhole
	Pillar
2 PO – T- 25.0m P40 – 20.0m 5 9	Cable count of trench is 2. One "Other size" PVC conduit (PO) owned by Telstra (-T-), between pits of sizes, "5" and "9" are 25.0m apart. One 40mm PVC conduit (P40) owned by NBN, between pits of sizes, "5" and "9" are 20.0m apart.
2 10.0m 5 9	2 Direct buried cables between pits of sizes ,"5" and "9" are 10.0m apart.
5 9	Trench containing any INSERVICE/CONSTRUCTED (Copper/RF/Fibre) cables.
5 9	Trench containing only DESIGNED/PLANNED (Copper/RF/Fibre/Power) cables.
5 9	Trench containing any INSERVICE/CONSTRUCTED (Power) cables.
BROADWAY ST	Road and the street name "Broadway ST"
Scale	0 20 40 60 Meters 1:2000 1 cm equals 20 m

GROSVENOR ST
FIELD ST
DAVIES ST
P20-T-58.0m
P50-T-59.0m
P50-T-36.7m
P20-7.8m
P20-7.5m
P20-7.6m
P35-T-20.0m

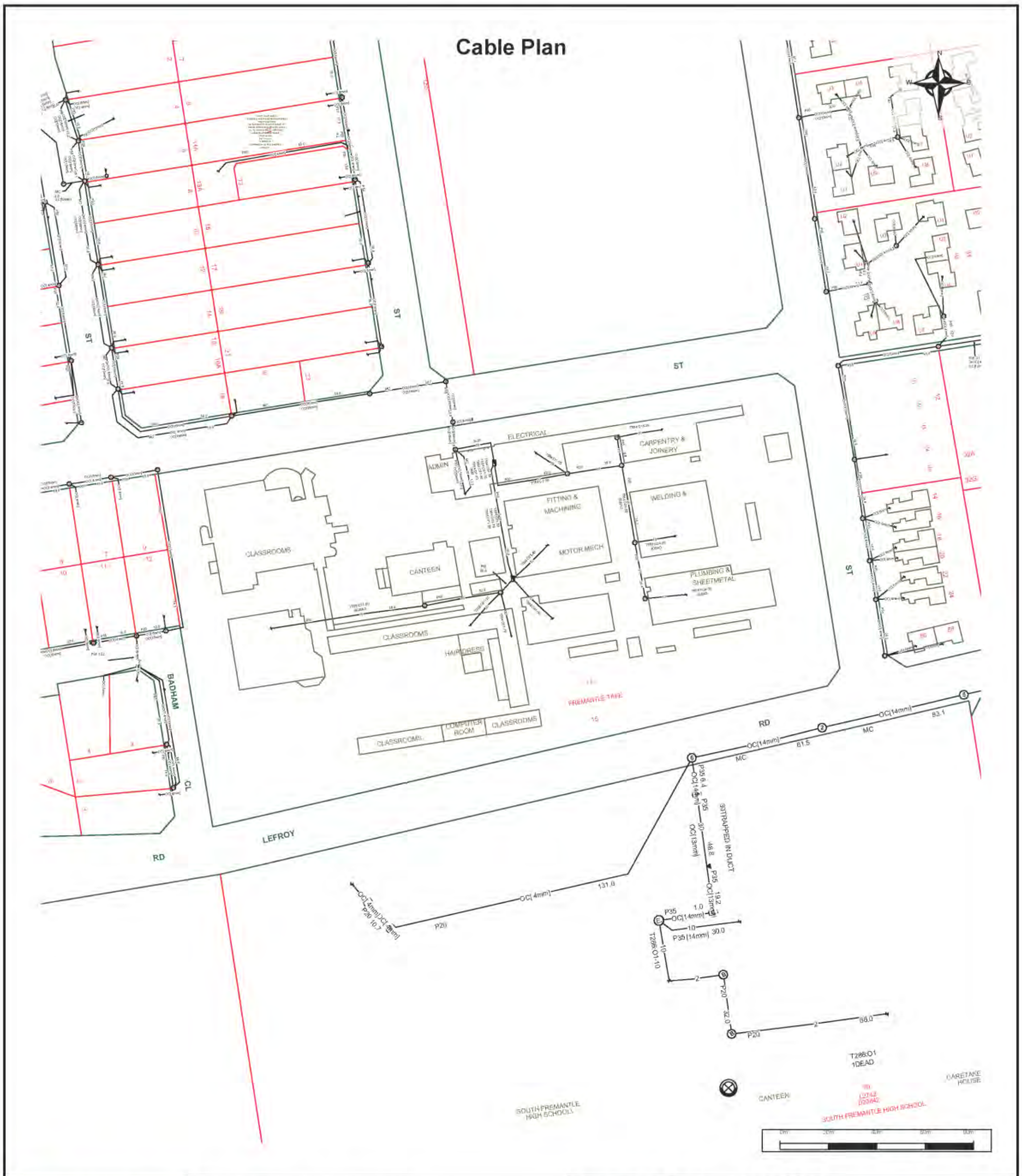

LEFROY RD
LONGFORD RD


GROSVENOR ST
CAESAR ST
DOIS PL
CONWAY CT
P50-T-33.0m
P50-T-62.0m
P35-T-50.6m
P35-T-41.6m
P35-T-31.7m



Emergency Contacts

You must immediately report any damage to the **nbn™** network that you are/become aware of. Notification may be by telephone - 1800 626 329.



Telstra	For all Telstra DBYD plan enquiries - email - Telstra.Plans@team.telstra.com For urgent onsite contact only - ph 1800 653 935 (bus hrs)	Sequence Number: 213055933
TELSTRA CORPORATION LIMITED A.C.N. 051 775 556		CAUTION: Fibre optic and/ or major network present in plot area. Please read the Duty of Care and contact Telstra Plan Services should you require any assistance.
Generated On 28/06/2022 21:59:44		

The above plan must be viewed in conjunction with the Mains Cable Plan on the following page

WARNING - Due to the nature of Telstra underground plant and the age of some cables and records, it is impossible to ascertain the precise location of all Telstra plant from Telstra's plans. The accuracy and/or completeness of the information supplied can not be guaranteed as property boundaries, depths and other natural landscape features may change over time, and accordingly the plans are indicative only. Telstra does not warrant or hold out that its plans are accurate and accepts no responsibility for any inaccuracy shown on the plans.

It is your responsibility to locate Telstra's underground plant by careful hand pot-holing prior to any excavation in the vicinity and to exercise due care during that excavation.

Please read and understand the information supplied in the duty of care statement attached with the Telstra plans. TELSTRA WILL SEEK COMPENSATION FOR LOSS CAUSED BY DAMAGE TO ITS PLANT.

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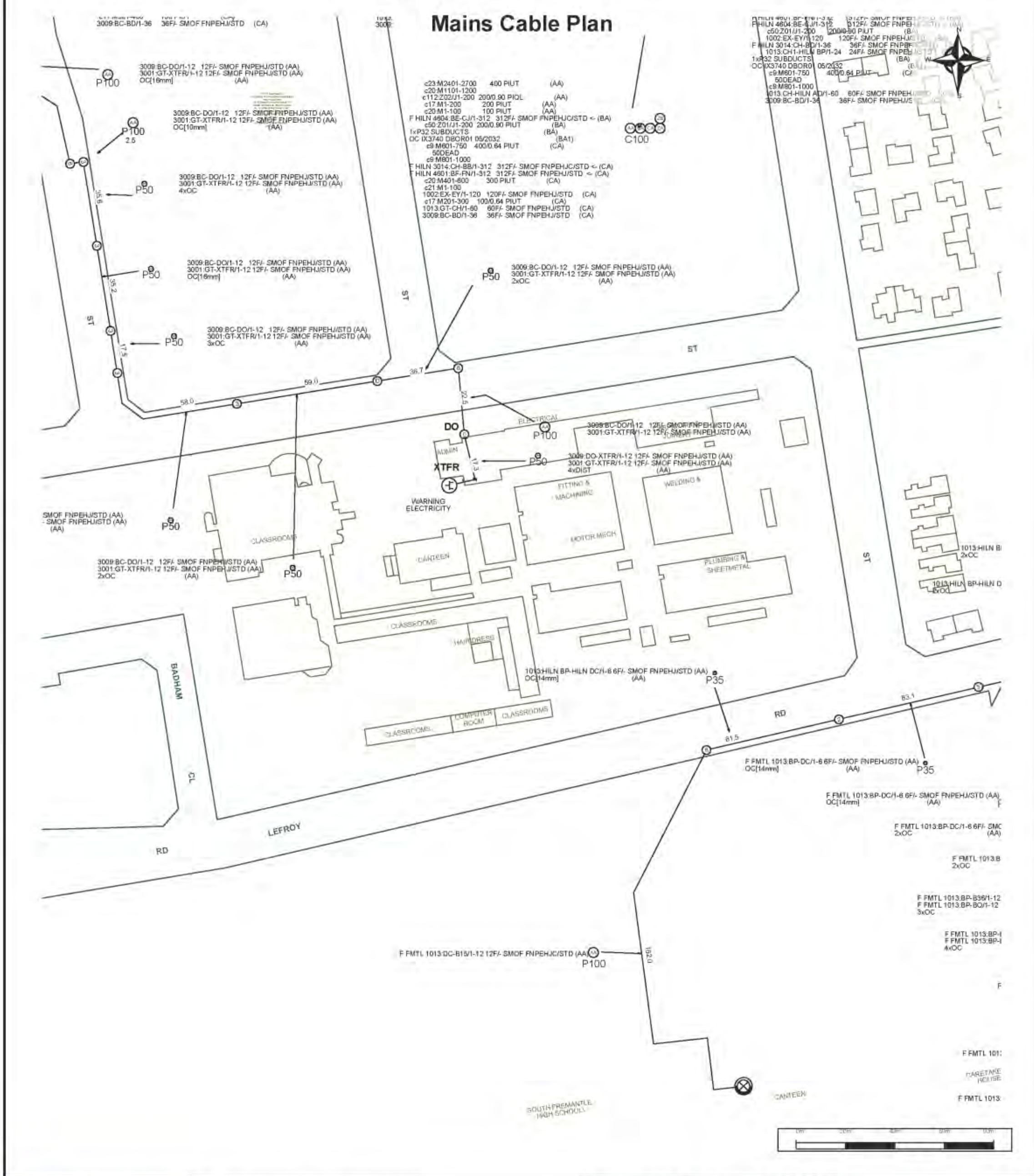
Mains Cable Plan



Telstra	For all Telstra DBYD plan enquiries - email - Telstra.Plans@team.telstra.com For urgent onsite contact only - ph 1800 653 935 (bus hrs)	Sequence Number: 213055933
TELSTRA CORPORATION LIMITED A.C.N. 051 775 556		CAUTION: Fibre optic and/ or major network present in plot area. Please read the Duty of Care and contact Telstra Plan Services should you require any assistance.
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WARNING - Due to the nature of Telstra underground plant and the age of some cables and records, it is impossible to ascertain the precise location of all Telstra plant from Telstra's plans. The accuracy and/or completeness of the information supplied can not be guaranteed as property boundaries, depths and other natural landscape features may change over time, and accordingly the plans are indicative only. Telstra does not warrant or hold out that its plans are accurate and accepts no responsibility for any inaccuracy shown on the plans.

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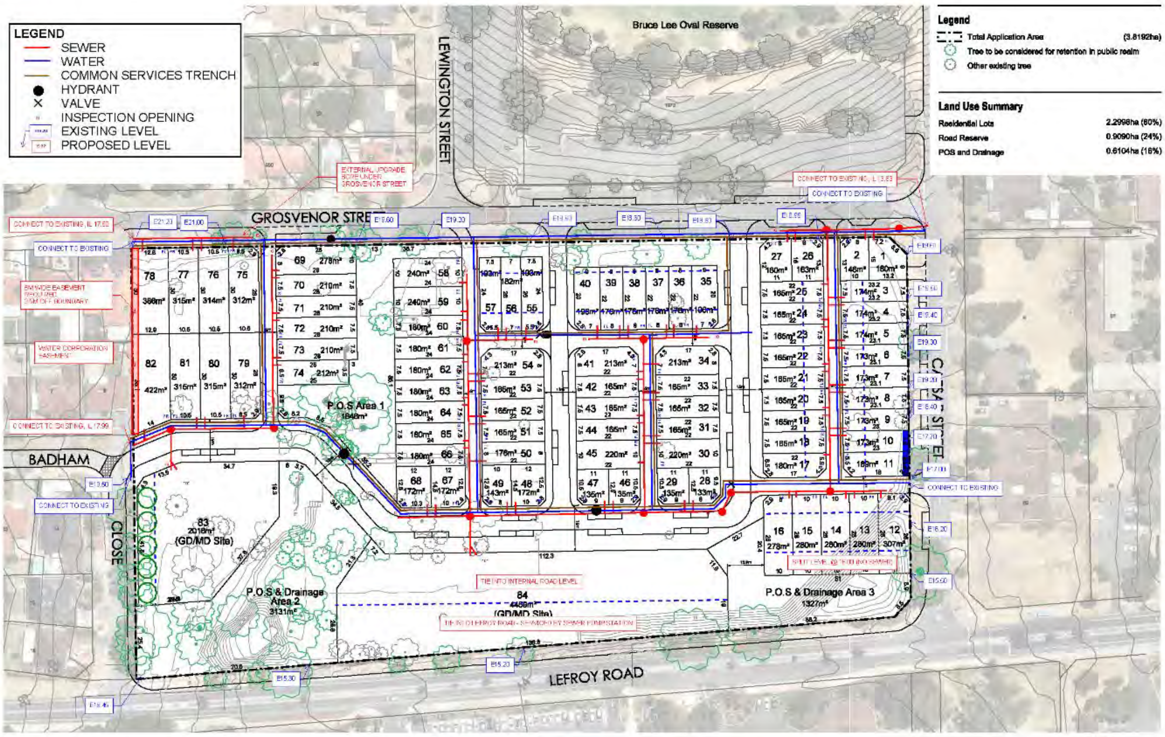
Appendix Twelve: Pritchard Francis Civil Servicing Concept Plan



Subdivision Concept Plan - Option G
LOT 2680 GROSVENOR STREET, BEACONSFIELD

A DevelopmentWA Project

29/03/2023
PLAN 9 - SERVICES ONLY
PRITCHARD FRANCIS SERVICING
MARKUP REV A

pritchard francis
civil and structural engineering consultants

Level 1, 430 Roberts Road
Subiaco WA 6008
PO Box 2150
Subiaco WA 6904
Telephone: (08) 9382 5111
admin@pfeng.com.au

DRAFT

scale 1:1000@A3 | 1:500@A1
plan 22/036/017A
date 23/01/2023

Taylor Burrell Barnett Town Planning & Design
Level 7, 160 St Georges Terrace, Perth WA 6000
p: (08) 9226 4276

Taylor Burrell Barnett

Appendix Thirteen: PJA Traffic Impact Assessment

Pritchard Francis for DevelopmentWA

Challenger TAFE Redevelopment LSP

Transport Impact Assessment

April 2023

Project Code: 07061

PJA
Level 27
St Martins Tower
44 St Georges Terrace
Perth
WA 6000
Australia
pja.com.au

Version Control and Approval

Version	Date	Main Contributor	Issued by	Approved by
A – Draft	17 March 2023	Rodney Ding	Rodney Ding	Tim Judd
B – Final	31 March 2023	Rodney Ding	Rodney Ding	Tim Judd
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D – Final	6 April 2023	Rodney Ding	Rodney Ding	Tim Judd

Prepared for

Andrew Tucker
Principal - Urban Renewal
Pritchard Francis for DevelopmentWA
Pritchard Francis
430 Roberts Road
SUBIACO WA 6008

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1 Introduction / Background

1.1.1 This Transport Impact Assessment (TIA) has been prepared by PJA on behalf of Pritchard Francis for Development WA in relation to a proposed local structure plan (LSP) on land at the old Challenger TAFE site, within the City of Fremantle.

1.1.2 The proposed LSP covers Lot 2680 Grosvenor Street, whilst the development will comprise 82 single residential lots and two larger grouped dwelling/mixed use lots providing up to 110 dwellings. The site location is shown in Figure 1-1.

Figure 1-1: Site Location

Source: MetroMap

1.1.3 Lot 2680 is included within The Heart of Beaconsfield Masterplan area for residential development. An extensive consultation period was involved with the final masterplan adopted by the City of Fremantle in 2021.

1.1.4 The LSP benefits from being well located for access to high-frequency bus routes on South Street, as well as a large number of master planned cycle and pedestrian routes, which will encourage the use of non-car modes and minimise the road impact of the LSP.

1.2 Purpose of this report

1.2.1 The *Western Australia Planning Commission Transport Assessment Guidelines* (WAPC Guidelines) sets out what level of assessment is necessary, based on the expected traffic impact of a proposed development. This specifies that where a development is forecast to generate more than 100 trips per hour in the peak operational hours, a Transport Impact Assessment (TIA) is required. Where this is not the case a Transport Impact Statement (TIS) would suffice. A TIA has a greater focus on the external traffic impact resulting from the development than a TIS.

1.2.2 Based on the proposed scale of development, it can be expected that more than 100 trips per hour would be generated, and therefore the impact would be 'high' and a TIA is required.

1.3 Transport Assessment objectives

1.3.1 In line with the WAPC Guidelines, this TIA seeks to demonstrate that the proposed LSP will:

- *"provide safe and efficient access for all modes;*
- *be well integrated with the surrounding land uses;*
- *not adversely impact the surrounding areas; and*
- *not adversely impact the surrounding transport networks or the users of those networks."*

1.3.2 This TIA considers all transport modes, including public transport, walking and cycling, as well as private motor vehicles and freight.

1.4 Layout of this report

1.4.1 The remaining chapters of this TIA cover the following:

- **Chapter 2** sets out details of the proposed LSP.
- **Chapter 3** provides details of the existing situation.
- **Chapter 4** establishes the proposals for the internal transport networks.
- **Chapter 5** sets out changes proposed to external transport networks.
- **Chapter 6** demonstrates how the LSP will integrate with the surrounding area.
- **Chapter 7** analyses the internal transport networks.
- **Chapter 8** analyses the external transport networks.
- **Chapter 9** includes a review of safety issues.
- **Chapter 10** concludes the TIA.

2 LSP Proposal

2.1 Regional Context

2.1.1 The Challenger TAFE Redevelopment LSP is located in the area covered by The Heart of Beaconsfield Masterplan.

2.1.2 Lot 2680 is bounded by Bruce Lee Oval to the north, residential development to the west a high school to the south and a proposed redevelopment area covering current community housing to the east.

2.1.3 A number of transport documents were prepared in GHD and GTA Consultants (now Stantec) for the Davis Park Structure Plan, lying immediately east of Lot 2680, including a traffic assessment and supplementary technical note assessment.

2.1.4 Once complete, The Heart of Beaconsfield masterplan area will comprise circa 600 dwellings, with the aim for it to be a walkable, transit-orientated development.

2.2 Proposed Land Uses

2.2.1 The proposed LSP for the redevelopment of the Challenger TAFE will include 82 single residential lots and two grouped dwellings/mixed use lots providing up to approximately 110 unit dwellings. No other land uses are proposed. The proposed layout is provided as Appendix **A**.

2.3 Proposed Connectivity

2.3.1 The LSP will be accessed direct from Grosvenor Street, Badham Close and Caesar Street, via new local internal streets. No direct connections are proposed onto Lefroy Road but the option of a direct access from the LSP to Lefroy Road has not been precluded at this stage.

2.4 Specific Issues

2.4.1 There are no specific transport issues that have been identified in relation to the proposed LSP.

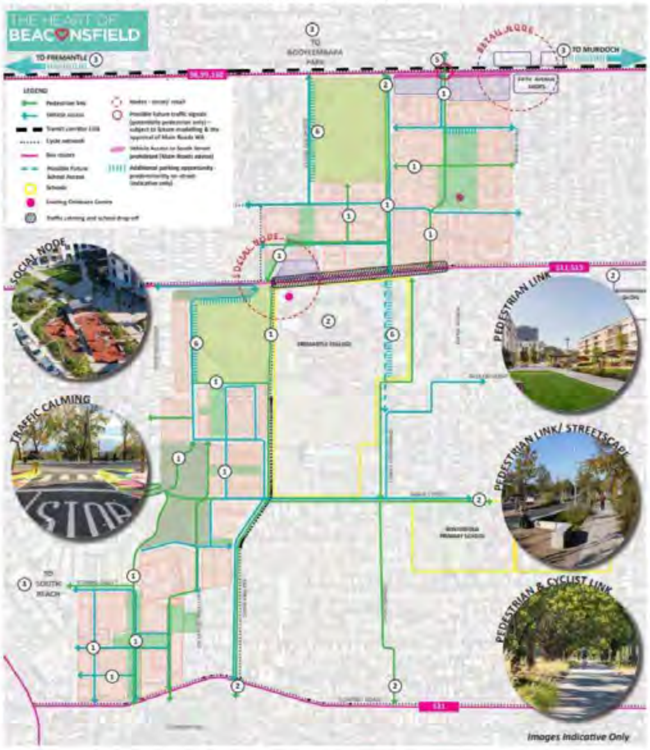
3 Existing Situation

3.1 Existing (2023) Land Uses

3.1.1 Lot 2680 currently has recently been cleared of the remnant buildings of the previous Challenger TAFE that has used this site for many years. As mentioned previously, the site is bounded by Bruce Lee Oval to the north, residential development to the west a high school to the south and a proposed redevelopment area covering current community housing to the east.

3.1.2 This lot is within the area zoned for Residential R25-40 development within The Heart of Beaconsfield Masterplan, as shown in Figure 3-1. It currently has vacant buildings on the site.

Figure 3-1: The Heart of Beaconsfield Masterplan



Source: City of Fremantle

3.2 Existing (2023) Road Network

3.2.1 The road network within the LSP has not yet been constructed but there are existing roads bordering the site.

3.2.2 The LSP will be accessed direct from Grosvenor Street, Badham Close and Caesar Street, via new local internal streets. Grosvenor Street links to Lewington Street and Caesar Street, beyond which South Street can be accessed and Lefroy Road, via Caesar Street. South Street and Lefroy Road subsequently link to Hampton Road and Carrington Street, whilst South Street also connects to the Kwinana Freeway further to the east. Badham Close intersects with Lefroy Road at the south western corner of the LSP site.

South Street

3.2.3 South Street is a Primary Distributor Road (Main Roads WA Road Hierarchy) which provides connectivity from the now deleted Fremantle Eastern Bypass through to the Kwinana Freeway and beyond to the east. South Street has a single lane in each direction, with unprotected on street cycle lanes within a 20m road reserve. It is subject to a 60km/hr speed limit.

Lefroy Road

3.2.4 Lefroy Road is a Local Distributor (Main Roads WA Road Hierarchy). It is a two-way single carriageway road which connects to Hampton Road in the west and Carrington Street in the east. It is subject to the built-up area 50km/h speed limit and this drops to 40km/h near the LSP site due to a School Zone. There is unprotected on-road cycle lanes and sits within a 20m road reserve.

Grosvenor Street

3.2.5 Grosvenor Street is an Access Road (Main Roads WA Road Hierarchy). It is a two-way single carriageway road which intersects with Lewington Street and Caesar Street. It is subject to the built-up area 50km/h speed limit and sits within a 20m road reserve with a 6m wide road pavement.

Caesar Street

3.2.6 Caesar Street is an Access Road (Main Roads WA Road Hierarchy). It is a two-way single carriageway road which intersects with South Street to the north and Lefroy Road in the south. It is subject to the built-up area 50km/h speed limit and sits within a 20m road reserve with a 6m wide road pavement.

Lewington Street

3.2.7 Lewington Street is an Access Road (Main Roads WA Road Hierarchy). It is a two-way single carriageway road which intersects with Grosvenor Street in the south and South Street in the north. It is subject to the built-up area 50km/h speed limit and sits within a 20m road reserve with a 6m wide road pavement.

Badham Close

3.2.8 Badham Close is an Access Road (Main Roads WA Road Hierarchy). It is a two-way single carriageway cul-de-sac with access via Lefroy Road. It is subject to the built-up area 50km/h speed limit and sits within a 15m road reserve with a 6m wide road pavement.

3.3 Existing Traffic Flows

Traffic count data has been obtained from Main Roads WA Traffic Map and from recent traffic surveys in March 2023, where available. This is shown in Table 3-1.

Table 3-1: Traffic Data

	Average Monday to Friday two-way	AM Peak		PM Peak	
		Eastbound/ Northbound	Westbound/ Southbound	Eastbound/ Northbound	Westbound/ Southbound
South Street – west of Carrington Street from Traffic Map 2020/21	20,385	635	955	780	750
Lefroy Road – derived from SCATS 2022	7,235	480	320	495	225
Lewington Street – south of South Street from survey	260	9	10	13	15
Caesar Street – north of Grosvenor Street from survey	1,110	68	51	43	59
Grosvenor Street – west of Caesar Street from survey	400	17	14	27	14

3.3.1 Whilst no traffic count data is available for the roads in the immediate vicinity of the LSP, these are local roads and it can therefore be expected that the flows are generally lower than 3,000vpd and in keeping with their function and form.

3.4 Existing Pedestrian and Cycle Provision

3.4.1 There are previous pedestrian routes within the site, which is currently unused, and these allowed a north to south route from Lefroy Road and Grosvenor Street along the western edge of the site.

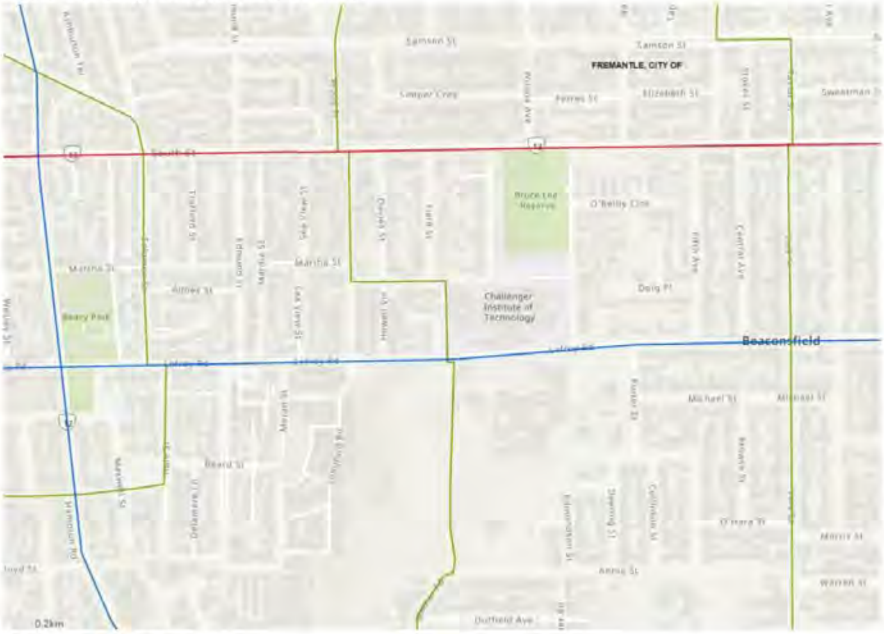
3.4.2 The roads within the vicinity of the site have some footpath provision, with a footpath located on at least one side of each street. These provide an interconnecting pedestrian route through Beaconsfield.

3.4.3 Cycle provision in the vicinity of the site is extensive, with unprotected cycle lanes along most of the main roads.. There are unprotected cycle lanes on both South Street (Primary Route as part of the Perth Long Term Cycle Network (LTCN)) and Lefroy Road (Secondary Route as part of the Perth LTCN), with connections to other routes within the Beaconsfield area.

3.4.4 To the west of the site, a local route on the LTCN is proposed connect with South Street near Wood Street.

3.4.5 Details of these routes are shown below in Figure 3-2.

Figure 3-2: Long Term Cycle Network Map



Source: Department of Transport

3.5 Existing Public Transport Provision

3.5.1 The LSP is located on Lefroy Road with bus stops in immediate proximity. South Street has bus stops that can be accessed within 250-300m of the redevelopment and to the north side of Bruce Lee Reserve. The bus routes on these roads connect with Fremantle Station and Murdoch Station, whilst the Circle Bus Routes (998 and 999) on South Street provide access to locations beyond these train stations.

3.5.2 Buse routes 511, 512 and 513 use Lefroy Road whilst routes 160, 998 and 999 use South Street. A summary of these services is provided in Table 3-2. The net effect of the frequency and number of these routes and services is that the stops on both South Street and Lefroy Road offer a bus service every 3-4 minutes in peak periods, within easy access of the LSP site.

Table 3-2: Bus Services

Bus No.	Route	Days of Operation	Times of Operation (weekday)	Peak frequency
	South Street			
160	Fremantle Station to East Perth	Monday – Sunday	5:25am – 9:02pm	Every 30 minutes
998	Circle Route	Monday – Sunday	5:49am – 8:08pm	Every 15 minutes
999	Circle Route	Monday – Sunday	5:29am – 8:55pm	Every 15 minutes
	Lefroy Road			
511	Fremantle Station to Murdoch Station	Monday – Sunday	5:25am – 9:02pm	Every 20 minutes
512	Fremantle Station to Murdoch Station	Monday – Sunday	5:49am – 8:08pm	Every 20 minutes
513	Fremantle Station to Murdoch Station	Monday – Sunday	5:29am – 8:55pm	Every 20 minutes

4 Proposed Internal Transport Networks

4.1 Proposed Road Network

4.1.1 The proposed road network within the LSP can be seen on the plan included as **Appendix** A, with a summary of the proposed roads set out in Table 4-1.

Table 4-1: Proposed Roads

Road	Road Reserve	Location Description	Liveable Streets Road Type
Street 1 (NW)	15-16m Road Reserve	Continuation of Badham Close to the east through the site then turns to north to intersect with Grosvenor Street west of Caesar Street	Based on Access Street D
Street 2 (NS)	11m Road Reserve	Runs NS from Grosvenor Street east of Lewington Street to Street 1	Based on Access Street D
Laneway 1	6m Road Reserve	Runs NS from Grosvenor Street west of Lewington Street to Street 1	Laneway
Laneway 2	6m Road Reserve	Runs NS from Grosvenor Street at Lewington Street to Street 1	Laneway
Laneway 3	6m Road Reserve	Runs NS from Lane 5 between Street 1 and Street 2 to Street 1	Laneway
Laneway 4	6m Road Reserve	Runs NS from Grosvenor Street between Street 1 and Caesar Street to Laneway 6	Laneway
Laneway 5	6m Road Reserve	Runs EW from Street 1 to Laneway 2	Laneway
Laneway 6	6m Road Reserve	Runs EW from Caesar Street to Street 1	Laneway

4.1.2 The road types have been reviewed based on the WA Liveable Neighbourhoods Update 02, dated January 2009. This specifies the following for Access Streets and Laneways:

Table 4-2: Liveable Streets Road Specifications

Street Type	Max Design Speed / Target Operating Speed (km/hr)	Indicative Volume (vehicles per day)	Indicative Street Reserve Width (m)	Indicative Road Pavement Width (m)
Access Street D – Narrow Yield or Give Way Street	50/30	1000	14.2	5.5-6
Laneway / Rear Lane	15	300	6-6.4	6 typical (3 - 6.4 range)

4.1.3 The Access Street D roads (Narrow Yield or Give Way Streets) will have a 6m wide carriageway, as well as at least one footpath of 1.8m width. In the few locations where the Road Reserve width is widened to 16m, embayed parking is proposed to be provided near grouped dwelling lots for Street 1. This road type has an indicative upper volume of 1,000 vehicles per day and is effective in constraining vehicle speeds. Street 2 is proposed to have an 11m wide road reserve as there is proposed to be little servicing required from this street. This width will allow a 6m wide carriageway and 2.5m wide verges each side.

4.1.4 The cross-section for a typical Access Street D is demonstrated in Figure 4-1.

Figure 4-1: Cross-Section for 15m Street 1

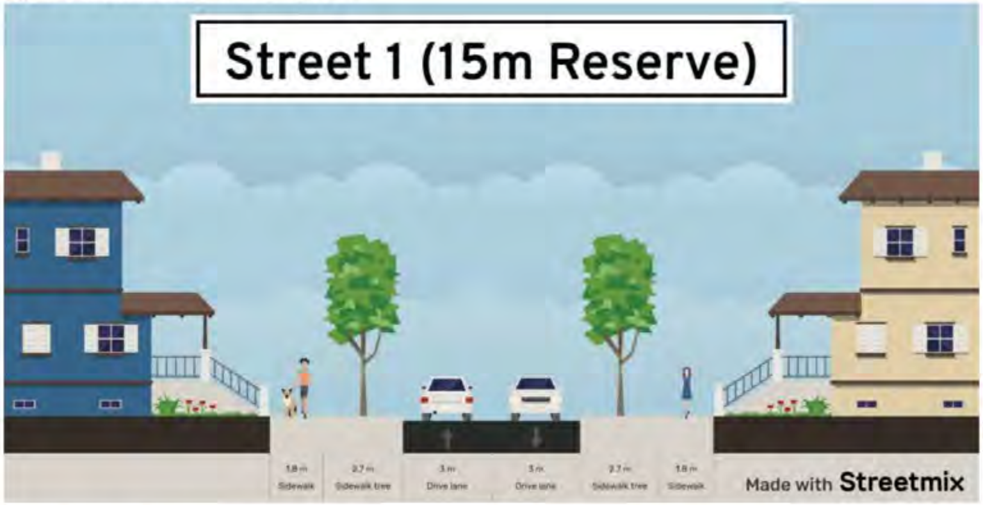


Figure 4-2: Cross-Section for 16m Street 1

Figure 4-3: Cross-Section for 11m Street 2

Figure 4-4: Cross-Section for 6m Laneways

4.1.5 Not shown on the above cross sections are proposed "throttle points" internally, particularly on Street 1, to promote lower vehicular speeds both internally and when driving to and from Lefroy Road via Badham Close. This will also allow Healthy Streets principles to be applied for the redevelopment area. These principles are based on the idea that streets should be designed to encourage physical activity, promote social interaction, and improve air quality. Some of the key principles include reducing traffic volume and speed, creating dedicated space for pedestrians and cyclists, increasing access to public transportation, and prioritizing green space and trees. By implementing Healthy Street principles, communities can create more liveable and sustainable urban environments that promote health, safety, and overall quality of life.

4.1.6 The laneways are suitable for carrying up to 300 vehicles per day. They will have a 6m wide two-way carriageways, with no parking and no footpath.

4.2 Intersection Controls

4.2.1 Due to the low volume and low speed residential nature of the LSP, all intersections within the LSP are intended to be constructed as priority-controlled T-intersections. The only exception is the four-way intersection formed by the intersection of Street 2 and Lane 5. Due to low traffic flows (expected well below 2,000vpd through the intersection), this format is considered acceptable. This intersection will then require signage on the Lane 5 approaches to Street 2.

4.2.2 The intersection of Street 1 and Badham Close will require the creation of a modified priority junction, with the east-west leg of Badham Close becoming the minor leg and the Badham Close north-south leg and Street 1 becoming the priority legs.

4.3 Pedestrian and Cycle Network

4.3.1 1.8m wide footpaths will be provided alongside the Access Street D roads, in accordance with the Liveable Neighbourhoods Guidelines. These paths will connect to the existing pedestrian network in the vicinity. Dropped kerb crossings will be provided as appropriate, including at junctions.

4.3.2 Cyclists can either use the footpaths, or cycle on the quiet streets within the LSP.

4.3.3 Also proposed is a "green link" to be provided to maintain connectivity between Bruce Lee Reserve north of the LSP to the continuation of this philosophy through the remainder of The Heart of Beaconsfield to the south though proposed parklands and paths. This connectivity will be maintained as there is presently a traffic island (with ramps and tactile pavers) on Lefroy Road east of Badham Close to facilitate the safe two-stage pedestrian crossing of Lefroy Road as the wider pedestrian linkages are developed as The Heart of Beaconsfield is further progressed.

4.4 Public Transport Routes

4.4.1 No public transport routes or stops will be provided within the LSP.

5 Changes to External Transport Networks

5.1.1 No changes to the external transport networks are proposed as a result of the LSP.

5.1.2 The roads in the vicinity of the site have been constructed for some time and not likely to be modified, whilst there is also existing provision for pedestrians and cyclists, and access to public transport services.

5.1.3 There may be modifications to external street networks as other local structure plans are developed, for example the Davis Park Structure Plan to the east. This project proposes a new signalised 4-way intersection at the current 3-way intersection of South Street and Nannine Avenue. In addition to this there is also possible movement bans at the intersection of South Street and Caesar Street.

6 Integration with Surrounding Area

6.1 Surrounding Attractors / Generators

6.1.1 The area in the vicinity of the site is mostly mature residential development to the west and north but the area to the east and further to the south is being redeveloped for residential use with some commercial offering near the intersection of South Street and Nannine Avenue, in line with The Heart of Beaconsfield masterplan.

6.1.2 Fremantle College is located opposite the development site on Lefroy Road. White Gum Valley Primary School is located north of South Street approximately 1km from the development site whilst Winterfold Primary School is located approximately 800m to the south of the site, south of Lefroy Road.

6.1.3 Further, the proposed shopping precinct to be delivered as part of the Davis Park Structure Plan near the intersection of South Street and Nannine Avenue is approximately 400m from the site (walk time approximately 5 minutes). Within the shopping centre there is proposed to be a supermarket and a number of complementary offerings.

6.1.4 There are additionally a number of parks and play areas in the vicinity of the site, including Bruce Lee Reserve to the immediate north of the site and a proposed parkland south of Lefroy Road, to be delivered as part of The Heart of Beaconsfield masterplan.

6.2 Travel Desire Lines

Pedestrian / Cycling

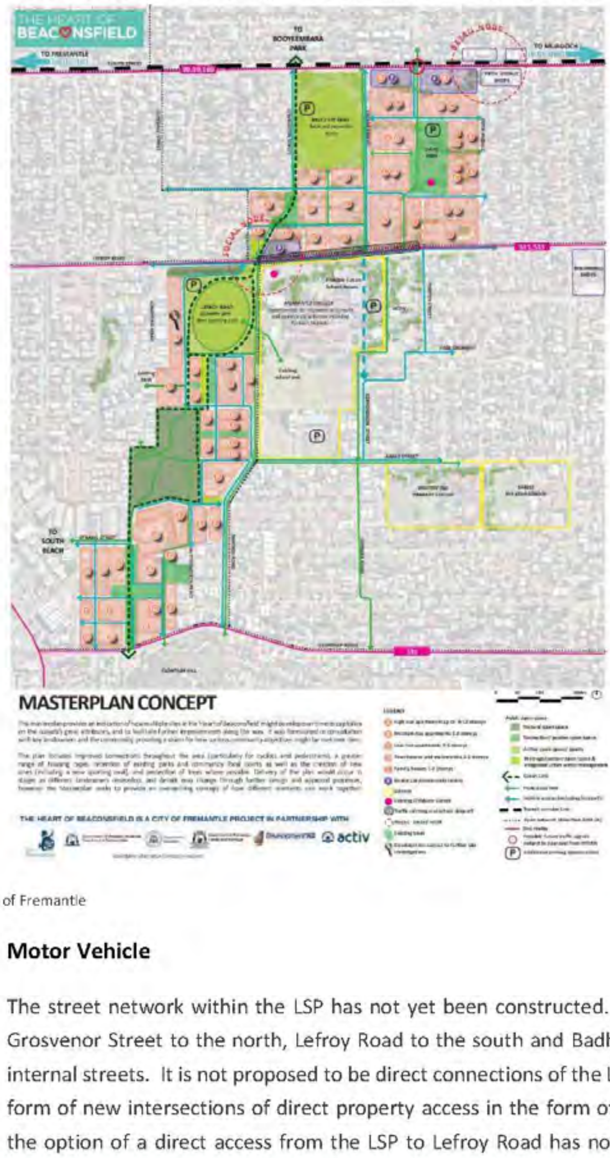
6.2.1 The travel desire lines between the LSP and the major attractors (schools, parks and shopping areas) will mainly be via the paths that connect back to the proposed redevelopment.

6.2.2 As mentioned in Section 4.2, footpaths will be provided alongside the Access Streets within the site. These paths will connect to the existing pedestrian network in the vicinity and comprises a network of footpaths with dropped kerb tactile paving crossings. Cyclists can either use the footpaths, or cycle on the quiet streets within the LSP.

6.2.3 The existing pedestrian and cycle provision requires no remedial measures as a result of this redevelopment. There are traffic islands/medians in South Street and Lefroy Road to allow two-staged crossings of these streets. Other local streets can be crossed in a single movement as these streets are narrower (typically 6m pavement) and carry significantly less traffic than South Street and Lefroy Road. This is the case in crossing Grosvenor Street to access Bruce Lee Reserve and in the future to cross Caesar Street to access to the commercial development proposed within.

6.2.4 Desire lines in the wider The Heart of Beaconsfield Masterplan have been identified as part of that project. These are shown below in Figure 6-1.

Figure 6-1: Pedestrian & Cycling Desire Lines from The Heart Masterplan



Source: City of Fremantle

Motor Vehicle

6.2.5 The street network within the LSP has not yet been constructed. The LSP will be accessed from Grosvenor Street to the north, Lefroy Road to the south and Badham Close to the west, via new internal streets. It is not proposed to be direct connections of the LSP to Lefroy Road, either in the form of new intersections of direct property access in the form of driveway/crossovers although the option of a direct access from the LSP to Lefroy Road has not been precluded at this stage.

These multiple connection points will distribute traffic amongst these streets and further afield and not overload the traffic carrying capacity for the street network.

6.2.6 The existing surrounding street network is deemed to be acceptable, and no remedial measures are needed.

Public Transport

6.2.7 There are currently no future public transport services being planned within the LSP.

6.2.8 As mentioned previously in Section 3.5, the LSP has good access to existing public transport services, with services on South Street and Lefroy Road offering high frequency access to buses on both streets.

6.2.9 The existing public transport provision requires no remedial measures as a result of this LSP.

7 Analysis of Internal Transport Networks

7.1.1 The LSP is currently undeveloped and does not generate traffic onto the existing road network.

7.1.2 Prior to the LSP, the site was used by Challenger TAFE. Although no traffic counts are available for the time the site was used by the TAFE, based on the approximate 17,500m² floor area of the buildings on the site and generation rates for a university (ITE Land Use Code 550), the site is likely to have been generating approximately 1,750 vehicle trips per day prior to its closure.

7.2 Redevelopment Traffic Generation

7.2.1 The predicted vehicle trips to be generated by the proposed LSP have been determined based on the rates outlined in Table 7-1 (based on WAPC Guidelines). The generation rate for the unit type of dwelling in the grouped dwelling sites, is less than the rates for the single residential dwelling sites, due to smaller size of these dwellings and the limited parking likely to be proposed for these dwellings (likely 1 vehicle versus the 2-3 with the single residential dwelling allowing for some on-street parking.

Table 7-1: Typical Land Use Vehicle Trip Rates (WAPC Guidelines Volume 2)

Land Use	Unit	AM peak hour trip rate			PM peak hour trip rate		
		In	Out	Total	In	Out	Total
Single Residential	Dwellings	0.15	0.45	0.6	0.375	0.225	0.6
Units	Dwellings	0.1	0.3	0.4	0.25	0.15	0.4

7.2.2 There are proposed to be 82 single residential dwellings plus up to another 110 unit type dwellings in the two grouped dwelling (although around 90 dwellings are planned, the 110 is the maximum yield possible) lots in total proposed in the LSP.

7.2.3 From the vehicle trip rates in Table 7-1, the AM peak hour vehicle trips predicted to be generated by the LSP are 23 inbound and 70 outbound respectively and the PM peak hour vehicle trips in and out are 58 and 35 respectively. This equates to 93 two-way vehicle movements in each peak. This equates to approximately 930 trips per day, which is considerably less, almost half, than the assessed traffic generation of the previous TAFE use of approximately 1,750 trips per day.

7.2.4 Given the scale of the LSP and that it is only residential, it is expected that all of these vehicle trips would be externally distributed onto the adjacent street network.

Table 7-2: Trip Generation Summary

	AM peak hour trips			PM peak hour trips		
	In	Out	Total	In	Out	Total
Single Residential	12	37	49	31	18	49
Units	11	33	44	28	16	44
Total	**23**	**70**	**93**	**58**	**35**	**93**

7.3 Trip Distribution

7.3.1 For the purposes of estimating vehicle movements, the directional distributions shown in Table 7-3 have been assumed for the proposed LSP. The proportions have been taken from the *Beaconsfield Masterplan: Traffic Impact Assessment (GHD, Feb 2019)* and it is considered that these assumptions are still reasonable for the proposed LSP site, being immediately adjacent to Davis Park. The internal 16% of trips from this previous assessment has been apportioned to the other external destinations.

Table 7-3: Trip Distribution (derived from Beaconsfield Masterplan/Davis Park)

External Route to/from	Percentage Distribution
Fremantle	25%
Perth and Eastern Destinations	25%
Cockburn	20%
Rockingham and Southern Destinations	20%
Northern Destinations	10%
Internal	0%

7.3.2 Applying these distribution proportions with the trip generation in Table 7-2 results in the following anticipated traffic flows onto the surrounding external roads.

Table 7-4: Resulting Trips Distributed

External Roads	AM peak hour trips		PM peak hour trips	
	In	Out	In	Out
South Street (West)	6	18	15	9
South Street (East)	8	24	20	12
Lefroy Road (East)	0	0	0	0
Lefroy Road (West)	9	28	23	14

7.4 Through Traffic

7.4.1 It is anticipated that through traffic within the LSP would be limited, as the LSP is not located on any through routes through the site and does not provide a route between any key destinations.

7.5 Roads and Intersections

7.5.1 Two-way, two-lane roads are proposed within the LSP to accommodate the anticipated traffic flows, as detailed previously in section 4.1.

7.5.2 Adequate sight distance is provided at each intersection.

7.5.3 As detailed in Section 4.1, all intersections will take the form of priority junctions to accommodate the anticipated traffic flows. Any delays to vehicles at these junctions would be minimal given the low vehicular traffic volumes forecast.

7.5.4 As the maximum anticipated two-way trips within site is 50 vehicles in the peak hours, and through traffic is forecast to be negligible, roads within the LSP would not carry more than 500 vehicles per day. Therefore, it is acceptable that properties fronting roads are accessed directly from the roads.

7.6 Pedestrian/Cycle Networks

7.6.1 As the internal roads within the LSP are anticipated to have low volumes of traffic, with up to 50 two-way vehicle trips within the AM peak hour, it is considered that none of the proposed roads within the LSP would be difficult for pedestrians and cyclists to cross.

7.6.2 This is in line with Table 4 of the *WA Transport Impact Assessment Guidelines Volume 2,* which has been reproduced below. This states that for a two-lane undivided road, which is what is proposed for the internal road network within the redevelopment, the ability of most pedestrians to cross would only be affected if there are more than 1,100 vehicles per hour.

Table 7-5: Traffic Volumes Affecting Pedestrian Crossing Amenity

Road cross-section	Traffic volume affecting ability of pedestrians to cross (vehicles per hour – two-way)
2 lane undivided	1,100 vph
2 land divided (or with pedestrian refuse islands)	2,800 vph
4 lane undivided (without pedestrian refuge islands)	700 vph
4 lane divided (or with pedestrian refuge islands)	1,600 vph

7.7 Safe Walk/Cycle to School Assessment

7.7.1 As discussed previously, Fremantle College is located opposite the LSP site on Lefroy Road. White Gum Valley Primary School is located north of South Street approximately 1km from the LSP site whilst Winterfold Primary School is located approximately 800m to the south of the LSP, south of Lefroy Road.

7.7.2 The likely routes that residents may take from the LSP site to access the schools are as follows:

7.7.3 White Gum Valley Primary School

- Onto the footpath on the south side of Grosvenor Street
- Cross Grosvenor Street onto Lewington Street path on western side
- Cross Lewington Street south of South Street
- Walk along footpath on south side of South Street
- Cross South Street west of Wiluna Avenue

7.7.4 Fremantle College

- Onto the footpath on the western side of Caesar Street or the north side of Lefroy Road
- Cross Caesar Street north of Lefroy Road
- Cross Lefroy Road east of Caesar Street to access the college

7.7.5 Winterfold Primary School

- Onto the footpath on the western side of Caesar Street or the north side of Lefroy Road
- Cross Caesar Street north of Lefroy Road
- Cross Lefroy Road east of Caesar Street
- Walk to Porter Street and then head south to the school

7.7.6 Each road mentioned has been assessed in terms of where any potential crossing difficulties are likely, this is presented in Table 7-6.

Table 7-6: Walk/Cycle to School Crossing Assessment

Road	Crossing Assessment
Grosvenor Street	Grosvenor Street is anticipated to have low traffic volumes, as it only currently serves a limited number of dwellings, therefore it is not anticipated that this road would be hard to cross for some people.
Lewington Street	Lewington Street is anticipated to have low traffic volumes, as it only currently serves a limited number of dwellings, therefore it is not anticipated that this road would be hard to cross for some people.
Caesar Street	Caesar Street is provided with uncontrolled dropped kerb crossings with tactile paving at junctions with block paving. At the junction with Lefroy Road, Caesar Street is provided with a central refuge to aid pedestrians crossing.
South Street	South Street experiences higher traffic volumes, but this section of South Street has a traffic island with refuge crossing South Street in two stages.
Lefroy Road	Lefroy Road experiences higher traffic volumes, but this section of Lefroy Road has a traffic island with refuge crossing Lefroy Road in two stages under the control of a warden controlled school crossing and a School Zone.

7.7.7 It is concluded from this assessment, that the likely routes that will be taken by residents of the LSP to access the nearby schools are suitable, as continuous footpaths are provided along all of the sections with some crossing facilities provided, either due to low traffic nature of the surrounding area and with appropriate two stage crossings on higher volume roads.

7.8 Pedestrian Permeability and Efficiency

7.8.1 Beaconsfield as a suburb has a Walk Score[1] of 60. This indicates that Beaconsfield is somewhat walkable which implies that some errands can be accomplished on foot in Beaconsfield. The development of Davis Park to the immediate east of this LSP may improve this as local shops will come within easy walking distance of the LSP area.

7.8.2 In the case of Beaconsfield, Western Australia, the pedestrian permeability of the area is generally quite high. The suburb is located close to Fremantle, a major urban centre, and is well-connected to public transport, including buses. Additionally, there are numerous footpaths throughout the area, allowing pedestrians to move around and access key destinations.

7.8.3 In terms of pedestrian efficiency, the surrounding area is also relatively well-designed. The suburb has a grid-like street network to navigate, with a mix of residential and commercial areas that are well-connected to each other. There are also numerous pedestrian crossings throughout the area, which help to ensure safe and efficient pedestrian movement.

7.8.4 The proposed LSP is located immediately adjacent to Davis Park and within 400m walkable catchment of existing and proposed commercial development either side of South Street near Fifth Avenue.

7.8.5 Overall, it is considered that the LSP is located within an accessible location, as the majority is within at least a 20-minute walk of key amenities, schools and public transport services.

[1] https://www.walkscore.com/AU-WA/Perth/Beaconsfield

8 Analysis of External Transport Networks

8.1 Scope of Assessment

8.1.1 Traffic surveys were undertaken at the following intersections in March 2023 and these form the basis of this traffic impact assessment:

- Lewington Street / South Street;
- Caesar Street / South Street;
- Caesar Street / Lefroy Road;

8.1.2 The LSP is estimated to be fully settled by approximately 2028. This brings the 10 years post build out scenario to 2038 and to accord with strategic road network forecast scenarios, the traffic impact assessment analyses have been based on a 2041 timeframe to align with a Main Roads WA ROM24 year:

- Scenario 1: 2041 Base case (i.e. "without development") operation of the intersections in SIDRA Intersection (SIDRA) for the anticipated year of development opening and nominal 18-year design horizon; and
- Scenario 2: 2041 Future case (i.e. "with development") operation of the subject intersections in SIDRA for equivalent design horizons for the purposes of comparison.

8.2 SIDRA Analysis

8.2.1 The operation of each intersection has been analysed using SIDRA Intersection (Version 9.1). The key outputs of SIDRA are summarised below:

- **Degree of Saturation (DOS)** is the ratio of the volume of traffic observed making a particular movement compared to the maximum capacity for that movement.
- The **95th Percentile (95th %ile) Queue** represents the maximum queue length that can be expected in 95% of observed queue lengths in the peak hour.
- **Average Delay** is the delay time that can be expected over all vehicles making a particular movement in the peak hour.

8.2.2 The WAPC Guidelines indicate an average delay for each vehicle passing through an intersection to be less than 55 seconds for a signalised intersection and 35 seconds for a priority intersection.

8.2.3 The SIDRA results for the intersections for the estimated future volumes is presented in the tables Table 8-1 to Table 8-3 .

8.2.4 For the assessments it has been assumed that the current geometry of the intersections will remain unchanged.

8.2.5 For the 2041 assessment with the LSP, the intersection of South Street and Lewington Street has included additional bunching of traffic on the eastern approach of the intersection. The reason for this is the proposed signalised intersection to be created at the intersection of South Street and Nannine Avenue with the development of Davis Park creating gaps and platooning of traffic on South Street. This signalised intersection will be required due to the amount of traffic attracted to the commercial development component of Davis Park because the intersection of South Street and Caesar Street will fail due to the Davis Park development alone.

8.2.6 The assessment of the intersection of South Street and Caesar Street in Table 8-2 for 2041 with the LSP, included the combined effect of both the Davis Park redevelopment and this site LSP. The assessment is shown to confirm that the intersection of South Street and Caesar Street will not function appropriately in its current form in 2041 with the LSP in this part of The Heart of Beaconsfield. It is expected that Caesar Street will become a cul-de-sac at South Street or be limited in movements so that the right turn from Caesar Street onto South Street is not permitted, as this movement is the problematic movement in 2041.

8.2.7 The assessment of the intersection of Lefroy Road and Caesar Street in Table 8-3 for 2041 with the LSP, included the combined effect of both the Davis Park redevelopment and this site LSP. The assessment is shown to confirm that the intersection of Lefroy Road and Caesar Street will continue to function at an acceptable level. Overall, there are presently acceptable delays and queuing at this intersection in peak periods. The addition of the proposed LSP traffic over and above the Davis Park redevelopment traffic is expected to have minimal impacts and also be acceptable. No special treatment is required for this intersection. Also, with minimal changes to this intersection, there is expected to be minimal to no impacts on Lefroy Road between Badham Close and Caesar Street, thus not impacting on the operation of this section of roadway and affecting the traffic flow to and from Fremantle College.

8.2.8 The assessment of the intersection of Lefroy Road and Badham Close was not modelled as the above intersection, carrying much more traffic was found to be expected to operate satisfactorily in 2041 with background traffic growth and the LSP traffic. The intersection of Lefroy Road and Badham Close is expected to operate in a slightly better level than the intersection of Lefroy Road and Caesar Street.

8.2.9 The adjacent Davis Park redevelopment on the east side of Caesar Street is expected to have a much higher generation of traffic than the LSP, and this effect has been included in the future 2041 base and with LSP modelling in the tables below.

8.2.10 An assessment was also undertaken to examine if a direct connection of the LSP to Lefroy Road could be contemplated on an operational viewpoint. This was assessed for the 2041 scenario only with result shown in Table 8-4. This has shown that such a connection, if contemplated, could function adequately in the AM and PM peak periods with minimal delays and queues. This direct connection could also have the benefit of less traffic travelling to and from South Street, and thus the performance of the intersection of South Street and Lewington Street could be slightly better compared to the scenario with no direct connection to Lefroy Road.

Table 8-1: South Street / Lewington Street – SIDRA Results

Lane	AM Peak				PM Peak			
	Degree of Saturation	Average Delay (s)	Level of Service	95th %ile Q (m)	Degree of Saturation	Average Delay (s)	Level of Service	95th %ile Q (m)
Current								
Lewington St S LT	0.01			0.4	0.01			0.1
Lewington St S RT	0.05			1	0.03			0.6
South St E LT/Thr	0.45			0	0.30			0
South St W Thr	0.30			0	0.41			0
South St W RT	0.01			0.1	0.01			0.2
Intersection (based on minor leg appr)	**0.05**	**21**	**C**	**1**	**0.03**	**15**	**C**	**0.6**
2041 Base								
Lewington St S LT	0.03			0.6	0.01			0.2
Lewington St S RT	0.12			2	0.06			1
South St E LT/Thr	0.57			0	0.38			0
South St W Thr	0.38			0	0.52			0
South St W RT	0.01			0	0.01			0.3
Intersection (based on minor leg appr)	**0.12**	**44**	**E**	**2**	**0.06**	**29**	**D**	**1**
2041 w Dev								
Lewington St S LT	0.04			1	0.01			0.3
Lewington St S RT	0.25			5	0.13			3
South St E LT/Thr	0.58			0	0.39			0
South St W Thr	0.38			0	0.52			0
South St W RT	0.01			0	0.02			0.6
Intersection (based on minor leg appr)	**0.25**	**38**	**E**	**5**	**0.13**	**28**	**D**	**3**

Table 8-2: South Street / Caesar Street – SIDRA Results

Lane	AM Peak				PM Peak			
	Degree of Saturation	Average Delay (s)	Level of Service	95th %ile Q (m)	Degree of Saturation	Average Delay (s)	Level of Service	95th %ile Q (m)
Current								
Caesar St S LT	**0.15**			4	**0.03**			1
Caesar St S RT	**0.07**			1	**0.07**			2
South St E LT/Thr	0.56			0	0.34			0
South St W Thr	0.32			0	0.43			0
South St W RT	0.09			2	0.06			2
Intersection (based on minor leg appr)	**0.15**	**15**	**C**	**4**	**0.07**	**13**	**B**	**2**
2041 Base								
Caesar St S LT	**0.34**			7	**0.04**			1
Caesar St S RT	**0.22**			4	**0.16**			3
South St E LT/Thr	0.70			0	0.42			0
South St W Thr	0.41			0	0.55			0
South St W RT	0.20			4	0.08			2
Intersection (based on minor leg appr)	**0.34**	**36**	**E**	**7**	**0.16**	**21**	**C**	**3**
2041 w Dev								
Caesar St S LT	**0.40**			9	**0.16**			4
Caesar St S RT	**0.91**			16	**1.20**			56
South St E LT/Thr	0.71			0	0.45			0
South St W Thr	0.41			0	0.55			0
South St W RT	0.23			5	0.23			6
Intersection (based on minor leg appr)	**0.91**	**80**	**F**	**16**	**1.20**	**112**	**F**	**56**

Table 8-3: Lefroy Road / Caesar Street – SIDRA Results

Lane	AM Peak				PM Peak			
	Degree of Saturation	Average Delay (s)	Level of Service	95th %ile Q (m)	Degree of Saturation	Average Delay (s)	Level of Service	95th %ile Q (m)
Current								
Lefroy Rd E Thr	0.26			0	0.12			0
Lefroy Rd E RT	0.05			1	0.04			1
Caesar St N LT	**0.04**			**1**	**0.06**			**2**
Caesar St N RT	**0.05**			**1**	**0.01**			**0.2**
Lefroy Rd W LT/Thr	0.21			0	0.13			0
Intersection (based on minor leg appr)	**0.05**	**8**	**A**	**1**	**0.06**	**6**	**A**	**2**
2041 Base								
Lefroy Rd E Thr	0.33			0	0.15			0
Lefroy Rd E RT	0.05			2	0.05			1
Caesar St N LT	**0.04**			**1**	**0.06**			**2**
Caesar St N RT	**0.07**			**2**	**0.01**			**0.3**
Lefroy Rd W LT/Thr	0.26			0	0.17			0
Intersection (based on minor leg appr)	**0.07**	**10**	**A**	**2**	**0.06**	**6**	**A**	**2**
2041 w Dev								
Lefroy Rd E Thr	0.33			0	0.15			0
Lefroy Rd E RT	0.05			2	0.07			2
Caesar St N LT	**0.04**			**1**	**0.08**			**2**
Caesar St N RT	**0.13**			**3**	**0.03**			**1**
Lefroy Rd W LT/Thr	0.26			0	0.20			0
Intersection (based on minor leg appr)	**0.13**	**11**	**B**	**3**	**0.08**	**6**	**A**	**2**

Table 8-4: Lefroy Road / Possible Direct Access – SIDRA Results

Lane	AM Peak				PM Peak			
	Degree of Saturation	Average Delay (s)	Level of Service	95th %ile Q (m)	Degree of Saturation	Average Delay (s)	Level of Service	95th %ile Q (m)
2041 w Dev								
Lefroy Rd E Thr	0.36			0	0.16			0
Lefroy Rd E RT	0.004			0.1	0.01			0.3
LSP Access N LT	**0.06**			**2**	**0.02**			**0.5**
LSP Access N RT	**0.06**			**2**	**0.02**			**0.5**
Lefroy Rd W LT/Thr	0.27			0	0.22			0
Intersection (based on minor leg appr)	**0.06**	**0.3**	**A**	**2**	**0.02**	**0.3**	**A**	**0.5**

8.3 Pedestrian / Cycle Networks

8.3.1 The local pedestrian and cycle networks will be able to accommodate the likely level of pedestrian and cycle trips generated by the proposed redevelopment.

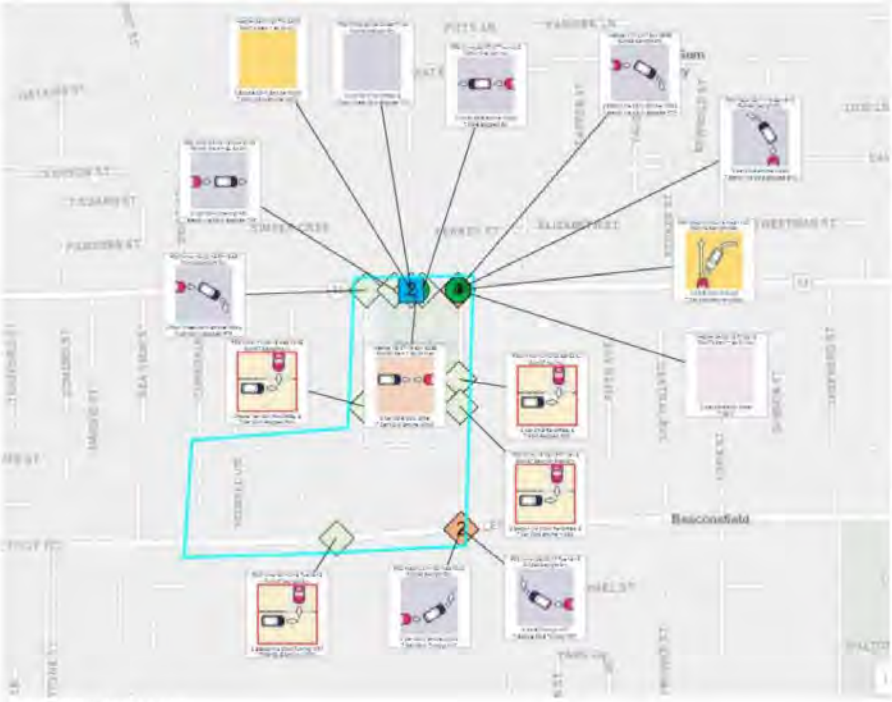
9 Safety Issues

9.1.1 The level of internal trips will be low given the nature of the LSP. Further, the internal roads will have a 6m carriageway widths or narrower, to encourage slower vehicle speeds. These characteristics will inherently improve the safety of the LSP.

9.1.2 In the vicinity of the site, there is pedestrian and cycle infrastructure provision. This includes the provision of dropped kerb crossings with tactile paving on the minor arm of priority junctions. There is also street lighting.

9.1.3 Crash history for the most recent five-year period (2017 to 2021) has been reviewed from the Main Roads WA Crash Information map on streets in the vicinity of the LSP site. Crashes in the vicinity of the site were identified and the locations of which are shown in Figure 9-1.

Figure 9-1: Location of Collisions



Source: MRWA Crash Map

9.1.4 The collisions located within the identified study area can be summarised as follows:

- Lewington Street:
  - There was a single crash resulting in minor damage as a car exited a driveway.
- Caesar Street:
  - There were two crashes, both resulting in minor damage as cars exited driveways.
- Lefroy Road:
  - There was a single crash resulting in minor damage as a car exited a driveway.
- Grosvenor Road:
  - No crashes
- Badham Close:
  - No Crashes
- South Street:
  - There have been five crashes between Lewington Street and Caesar Street, with one of those requiring hospitalisation (car versus bike at night) and another requiring medical attention (a head on crash in the west at night). The other three crashes resulted in property damage.
- Intersection of South Street and Lewington Street
  - The has been a single minor property damage crash at this intersection involving a car colliding with another stopped to turn right from South Street in Lewington Street
- Intersection of South Street and Caesar Street
  - There have been four crashes at this intersection. Two of these were rear ends, with one requiring medical attention, involving a car colliding with the rear of another stopped to turn right from South Street into Cesar Street.
- Intersection of Lefroy Road and Caesar Street
  - There have been two crashes at this intersection both resulting in major property damage and both were rear end crashes, one from the east and the other from the west both on Lefroy Road turning into Caesar Street.

9.1.5 With the cluster of crashes at the intersection of South Street and Caesar Street, the proposed intersection modification as a result of the Davis Park Structure Plan could address this problem. This may limit movements or be a partial close of this intersection. Access from north to south could then be replaced by the proposed future traffic signals at the intersection of South Street and Nannine Avenue. There is also a cluster of crashes on South Street near Wiluna Avenue, but these are almost entirely only involving vehicles, and this area is expected to have a high crossing demand for pedestrians as a result of the LSP.

10 Conclusion

10.1.1 This TIA has been prepared by PJA on behalf of Development WA in relation to a proposed LSP on land in Beaconsfield on the old Challenger TAFE site, within the City of Fremantle. The site is included within The Heart of Beaconsfield Master Plan area for residential development.

10.1.2 The LSP would generate approximately 95 two-way vehicle trips in each peak period. These trips would quickly dissipate across the local street network and are not forecast to have a significant impact in any location.

10.1.3 The only exception is the intersection of South Street and Caesar Street, which is proposed to be modified (by others) as a result of the adjacent Davis Park redevelopment. Also, the intersection of South Street and Lewington Street may be impacted, but proposed signalisation of the intersection of South Street and Nannine Avenue will create more gaps and platooning in traffic and generally maintain the performance of this intersection at acceptable levels.

10.1.4 The addition of a possible direct property access to the proposed apartment site on Lefroy Road has been found to be able to operate satisfactory, with minimal disruption to Lefroy Road traffic flows and could be allowed, if so desired.

10.1.5 Within the LSP site, traffic is expected to be limited to site generated trips, with minimal through traffic. Thus, the internal road network would comprise two-way streets with dropped kerb tactile paving pedestrian crossings. Footpaths will be provided alongside the roads, which will link to existing provision. Cyclists can utilise the network of cycle paths and lanes in the area, with potential for longer distance cycling via the proposed LTCN.

10.1.6 The LSP benefits from being within walking distance of nearby schools and within walking distance of the proposed commercial shopping precinct in Davis Park. There are frequent bus services on South Street and Lefroy Road providing access to both Fremantle and Murdoch train stations.

Appendix A Proposed Layout

LEGEND

ZONES

Residential

RESERVES

Public Open Space

OTHER

Scheme Area Boundary

R60 R Codes

Local Street Link (Indicative location)

Structure Plan Map

0 20 40m

scale: 1:2000@A4

plan: 22/038/021

date: 28/02/2023

Taylor Burrell Barnett Town Planning & Design
Level 7, 160 St Georges Terrace, Perth WA 6000
e: admin@tbbplanning.com.au
p: (08) 9226 4276

Taylor Burrell Barnett

Appendix B WAPC Guideline - TIA for Structure Pans Checklist

Item	Provided	Comments/Proposals
Summary		
Introduction / Background		
name of applicant and consultant	Y	
structure plan location and context	Y	
brief description of structure plan	Y	
key issues	Y	No key issues identified, key opportunities set out
background information	Y	
Structure Plan Proposal		
regional context	Y	
proposed land uses	Y	
table of land uses and quantities	Y	
major attractors/generators	Y	Site to be fully residential
any specific issues	Y	
Existing Situation		
existing land uses within structure plan	Y	
existing land uses surrounding the structure plan	Y	
existing road network within structure plan	N/A	No road network within LSP at present
existing road network surrounding the structure plan	Y	
traffic flows on roads within structure plan (AM and PM peak hours)	N/A	No road network within LSP at present
traffic flows on roads surrounding the structure plan (AM and PM peak hours)	Y	
existing pedestrian/cycle networks within the structure plan	N/A	No pedestrian / cycle network within LSP at present
existing pedestrian/cycle networks surrounding the structure plan	Y	
existing public transport services within the structure plan	N/A	No public transport services within LSP at present
existing public transport services surrounding the structure plan	Y	
Proposed Internal Transport Networks		
changes/additions to existing road network	Y	
road reservation widths	Y	
road cross-sections & speed limits	Y	
intersection controls	Y	
pedestrian/cycle networks and crossing facilities	Y	
public transport routes	Y	

Changes to external transport networks		
road network	N/A	No changes to the external transport networks are proposed, except as proposed by the Davis Park development
intersection controls	N/A	No changes to the external transport networks are proposed, except as proposed by the Davis Park development
pedestrian/cycle networks and crossing facilities	N/A	No changes to the external transport networks are proposed
public transport services	N/A	No changes to the external transport networks are proposed
Integration with surrounding area		
surrounding attractors/generators	Y	
proposed changes to surrounding land uses	Y	
travel desire lines from structure plan to these attractors/generators	Y	
adequacy of existing transport networks	Y	
deficiencies in existing transport networks	N/A	No deficiencies identified
remedial measures to address deficiencies	N/A	No remedial measures needed
Analysis of internal transport networks		
assessment years and time periods	N/A	Peak periods assessed, assessment year not relevant as very limited through traffic
structure plan generated traffic	Y	
extraneous (through) traffic	Y	
design traffic flows	Y	Details provided in Chapter 4
road cross-sections	Y	Details provided in Chapter 4
intersection sight distances	Y	
intersection operation and method of control	Y	Details provided in Chapter 4
frontage access strategy	Y	
pedestrian/cycle networks	Y	
safe walk/cycle to school assessment (residential structure plans only)	Y	
pedestrian permeability & efficiency	Y	
access to public transport	N/A	No public transport provision proposed within the structure plan
Analysis of external transport networks		
base flows for assessment years	Y	
total traffic flows	Y	
road cross-sections	N/A	No changes to external road networks proposed
intersection operation	N/A	Low traffic volumes forecast to be generated
pedestrian/cycle networks	Y	

Safety issues		
identify issues	Y	
remedial measures	N/A	remedial measures to be provided through intersection changes proposed due to Davis Park development
Conclusions	Y