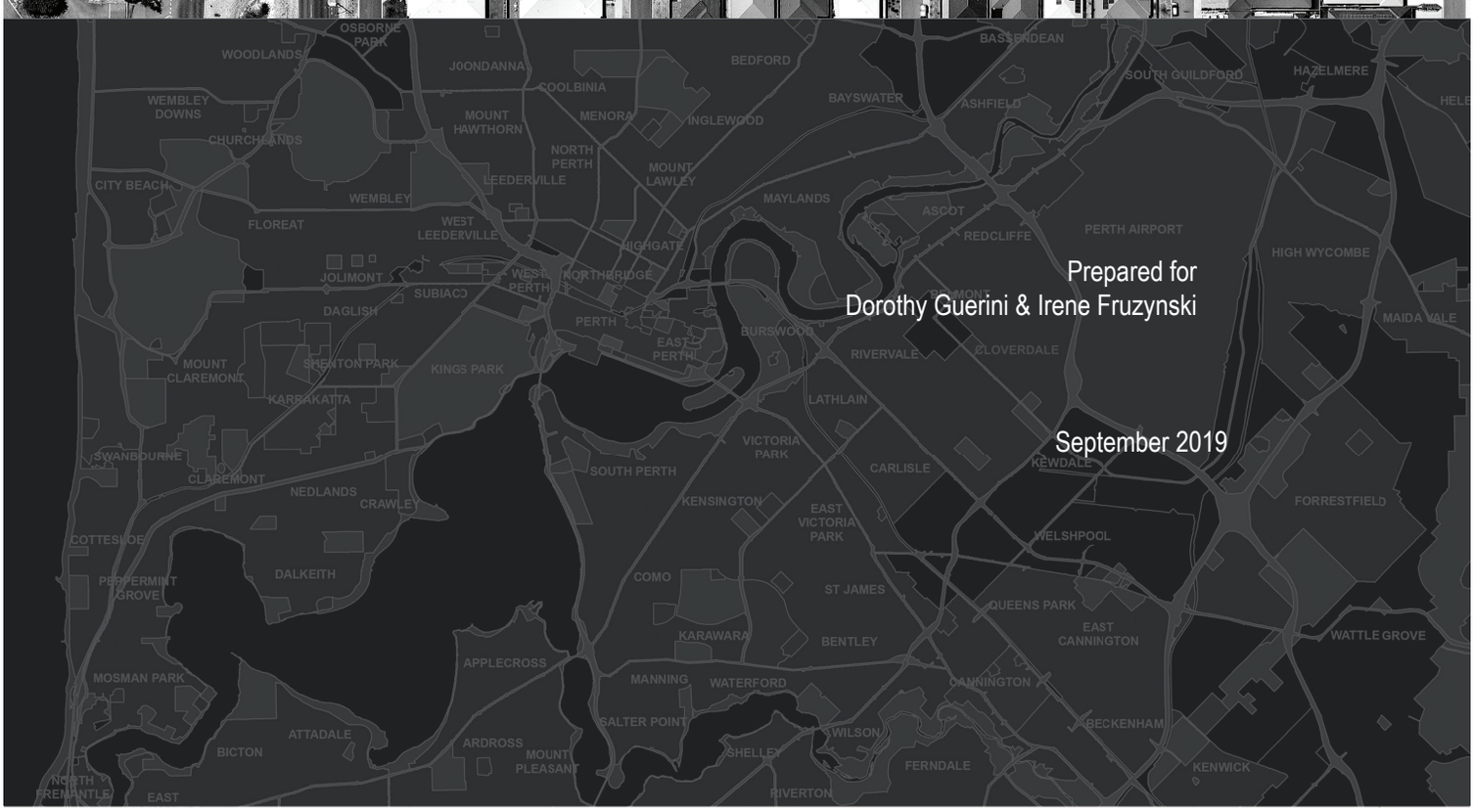
Structure Plan Report

Lot 176 (119) Hammond Road
Success, WA

PLANNING SOLUTIONS
URBAN & REGIONAL PLANNING
PS





Prepared for
Dorothy Guerini & Irene Fruzynski

September 2019

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Project details

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	Landscaping	LD Total

Document control

Revision number	File name	Document date
Rev 0	190111 4900 Structure Plan - Rev 0 (final - lodged)	11 January 2019
Rev 1	190926 4900 Structure Plan - Rev 1	26 September 2019

Endorsement page

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

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

3 October 2019
.....Date

Signed for and on behalf of the Western Australian Planning Commission



.....Signature

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:

M. Wreclaw
..... Witness

4 October 2019
..... Date

3 October 2029
..... Date of Expiry

Table of amendments

Amendment No.	Summary of the Amendment	Amendment type	Date approved by WAPC

Executive summary

This Structure Plan applies to Lot 176 (119) Hammond Road, Success (**subject site**), located within the municipality of the City of Cockburn. It forms part of a broader development area that is progressively being developed for residential purposes.

The proposed Structure Plan is intended to facilitate the subdivision of the subject site for residential purposes. The justification and rationale for the proposed mix of residential densities, street block and road layout, and positioning of public open space is contained within this Structure Plan, with details provided on the planning background, site conditions and proposed concept plan.

This Structure Plan is intended to provide the necessary information and justification to support the subject site being subdivided and developed for a mix of single and grouped residential lots.

Table (i) below provides a summary of the proposed development of the subject site.

Table (i) – Structure Plan summary

Item	Data	Structure Plan Ref (section no.)
Total area covered by the structure plan	2.0493 hectares (excludes 330m² portion of lot reserved Other Regional Roads)	Part 1, Section 1 Part 2, Section 1.2
Area of each land use proposed: • Residential • Public open space (unrestricted) • Roads	 1.2432ha 2,130m² 5,925m²	Part 1, Section 4.1 – 4.2 Part 2, Section 3
Estimated lot yield	35 lots	Part 2, Section 3.3
Estimated number of dwellings	40 dwellings	Part 2, Section 3.3
Estimated residential site density	32 dwellings per site hectare	Part 1, Section 4.8
Estimated population	112 people (assumes 2.8 persons per dwelling)	Part 2, Section 3.3
Number of high schools	Nil	N/A
Number of primary schools	Nil	N/A

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Appendix No.	Document title	Approval required OR supporting document only	Approval status	Approval agency
1	Feature Survey	Supporting document	N/A	N/A
2	Certificate of Title and Deposited Plan	Supporting document	N/A	N/A
3	Traffic Impact Statement	Supporting document	N/A	N/A
4	Drainage Strategy	Approval required	Approved (enclosed)	Department of Water and Environmental Regulation and City of Cockburn
5	Environmental Assessment Report	Supporting document	N/A	N/A
6	Bushfire Management Plan	Supporting document	N/A	N/A
7	Transport Noise Assessment	Supporting document	N/A	N/A
8	Landscape Concept Plan	Supporting document	N/A	N/A
9	Servicing Report	Supporting document	N/A	N/A

Part One: Implementation

1 Structure Plan area

This Structure Plan applies to Lot 176 (119) Hammond Road, Success, being the land contained within the inner edge of the line denoting the Structure Plan boundary on the Structure Plan Map (**Plan 1**), herein referred to as the Structure Plan area.

Refer to **Plan 1** – Structure Plan Map.

2 Operation

This Structure Plan commences operation on the date it is approved by the Western Australian Planning Commission (**WAPC**).

3 Staging

Subdivision is likely to occur in a single stage, continuing north from the existing residential subdivision immediately south of the subject site.

Servicing of the Structure Plan area is capable through the extension of existing services.

4 Subdivision and development requirements

4.1 Zones and reserves

The Structure Plan Map (**Plan 1**) outlines zones and reserves applicable within the Structure Plan area. Decisions relating to the future subdivision and development of the land within the Structure Plan area shall have due regard to the detail contained within this Structure Plan including the technical appendices.

The Structure Plan consists of the following zones and reserves:

- Residential (R30, R40 and R60)
- Parks and Recreation
- Local Road

4.2 Land use permissibility

Land use permissibility within the Structure Plan area shall be in accordance with the corresponding zone or reserve under the City of Cockburn Town Planning Scheme No. 3 (**TPS3**).

4.3 Development requirements

The City of Cockburn's Local Planning Policy 1.16 – Single House Standards for Medium Density Housing in the Development Zone (**LPP 1.16**) sets out acceptable variations to the deemed-to-comply provisions of the Residential Design Codes (**R-Codes**) for single dwellings on lots coded R25-R60 in areas zoned 'Development' under TPS3. Except in a situation where an approved Local Development Plan imposing R-Code variations for lots coded R60 or less applies, the variations set out in LPP 1.16 apply to this Structure Plan and thereby constitute acceptable development within the Structure Plan area.

4.4 Bushfire hazard

The Structure Plan area is located within an area where the surrounding bushfire hazard is assessed as being 'Extreme', 'Moderate' and 'Low', and is designated as a bushfire prone area on the Department of Fire and Emergency Services *Map of Bushfire Prone Areas 2018.* The staged clearing of the Structure Plan area, adequate separation of future built assets from classified vegetation, and ongoing fuel management will be undertaken to ensure future dwellings will be located in areas with an appropriate Bushfire Attack Level rating.

A bushfire management plan (**BMP**) has been prepared in support of this Structure Plan, which identifies the bushfire management measures required to be implemented by the developer in the initial stages of subdivision to ensure the relevant standards and performance criteria are met.

4.5 Transportation noise

The Structure Plan area is affected by transportation noise emanating from Beeliar Drive and Hammond Road. Any development proposal for noise-sensitive uses (e.g. residential) must be accompanied by a site-specific noise assessment undertaken by a qualified acoustic consultant, consistent with *State Planning Policy 5.4 – Road and Rail Transport Noise and Freight Considerations in Land Use Planning.* As such, a noise management plan will be required at subdivision stage to implement noise attenuation measures.

4.6 Protection of environmental features

The Structure Plan area currently consists of areas of native vegetation and cleared areas. Intact remnant vegetation [trees] are to be retained in the nominated POS area where possible, to the satisfaction of the local government.

A fauna Relocation Management Plan may be required as a condition of subdivision approval.

Advice note: *The City of Cockburn recommends the landowner/proponent liaise with the Department of the Environment and Energy in relation to compliance with the Environment Protection and Biodiversity Conservation Act 1999.*

4.7 Interface to adjoining land

The Structure Plan provides for an extension to Langano Chase and two new access streets extending from Delaronde Drive within the adjoining residential area to the south. A priority T-junction is the proposed form of control for the two new intersections with Delaronde Drive.

The Structure Plan has been designed to integrate seamlessly with the adjoining land, and provides a logical progression of residential development extending from the south.

4.8 Density targets

Strategy / Policy Document	Density Target	Provided (based on 40 lots)
Directions 2031 and Beyond	15 dwellings per gross urban zoned hectare	19.5 dwellings per gross hectare

Perth and Peel @ 3.5 million	26 dwellings per residential site hectare	32 dwellings per residential site hectare
Liveable Neighbourhoods	22 dwellings per site hectare	

5 Local Development Plans

Local Development Plan/s are to be prepared in accordance with Part 6 of the *Planning and Development (Local Planning Schemes) Regulations 2015* – Schedule 2 – Deemed Provisions. The main issues to be addressed include:

- Road noise amelioration requirements for dwellings.
- Building orientation to public open space.

6 Other requirements

6.1 Infrastructure upgrades

The Structure Plan area is capable of being serviced through the extension of existing services in the vicinity. No infrastructure upgrades are required to support the subdivision of the land.

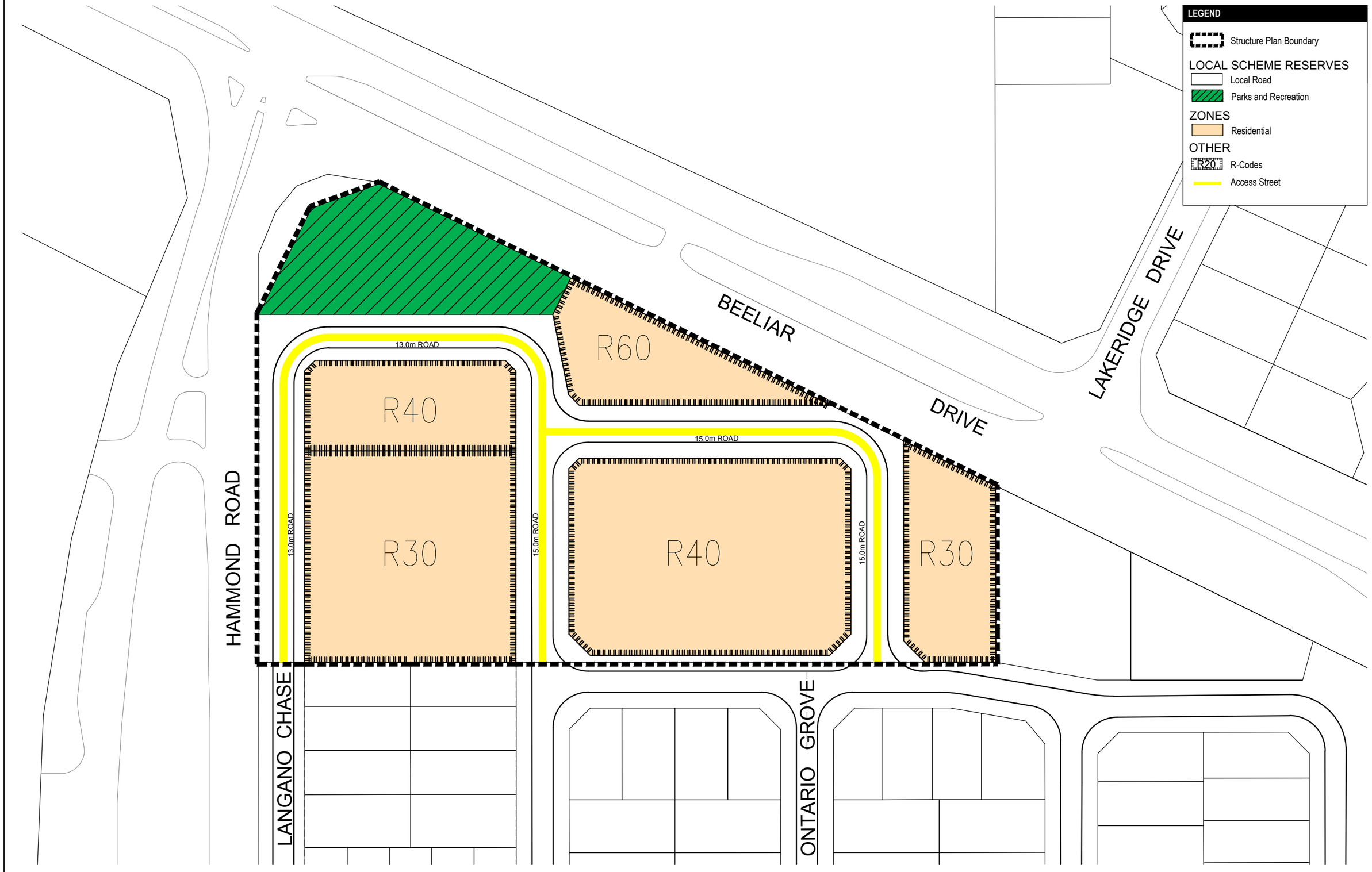
6.2 Developer contributions

Pursuant to the City of Cockburn Town Planning Scheme No. 3, the subject site is located within existing Development Contribution Area 1 (Success North) and Development Contribution Area 13 (Community Infrastructure).

7 Additional information

The following additional information is required to be submitted at the subdivision or development stage.

Additional information	Approval stage	Consultation required
Bushfire Attack Level Assessment (if required)	Subdivision and/or Development Application for identified lots	City of Cockburn
Mosquito Management Plan (if required)	Subdivision Approval Condition	City of Cockburn
Acid Sulfate Soils investigation (if required)	Subdivision Approval Condition	City of Cockburn



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STRUCTURE PLAN

LOT 176 (119) HAMMOND ROAD,
SUCCESS, WA

PLAN
01

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Part Two: Explanatory Section

1 Planning background

1.1 Introduction and purpose

This Structure Plan has been prepared in accordance with the City of Cockburn (**City**) Town Planning Scheme No. 3 (**TPS3**) and the relevant Deemed Provisions of the *Planning and Development (Local Planning Scheme) Regulations 2015* (**Planning Regulations**). The purpose of the Structure Plan is to facilitate the urban development of Lot 176 (119) Hammond Road, Success (**subject site**).

With the support of the technical data, the proposed Structure Plan provides for the following:

- Pattern of land use.
- Network and hierarchy of roads.
- Public open space.
- Bushfire management.
- Water management.
- Servicing strategy.

Once endorsed, the proposed Structure Plan will guide the subdivision, land use and residential density for the subject site. In accordance with the Planning Regulations, the proposed Structure Plan does not seek to provide detailed development standards, nor does it seek to vary the requirements of the Residential Design Codes (**R-Codes**). Local Development Plans are able to fulfil this role if required.

As required by the Department of Planning, Lands and Heritage (**DPLH**), the proposed structure plan has been prepared in accordance with the requirements of *Liveable Neighbourhoods* (**LN**)*,* and has been structured in accordance with the requirements of TPS3 and the WAPC's *Structure Plan Framework* (August 2015).

1.2 Land description

1.2.1 Location and regional context

The subject site has a street address of 119 Hammond Road, Success, and is located within the City of Cockburn local government area. It is situated approximately 20km south of Perth City Centre, 12km south east of Fremantle City Centre and 1km west of Cockburn Central Town Centre. Cockburn Central Station is approximately 1.5km east of the subject site, providing train services between Perth and Mandurah, and local bus services to surrounding areas.

The subject site is bound by Hammond Road to the west, Beeliar Drive to the north and Delaronde Drive to the south. Langano Chase abuts the south west corner of the subject site. All roads are sealed and gazetted. The Armadale Road / Beeliar Drive interchange to the Kwinana Freeway is located approximately 1.5km east of the subject site, providing convenient access to metropolitan Perth and Peel and regions beyond.

Abutting the subject site to the south is the Lakeside Success Structure Plan area, comprising a mix of residential zoned land and public open space. The Lakeside Success Structure Plan was originally adopted by Council in July 2012 and endorsed by the WAPC in March 2013, and the land is now largely built out.

1.2.2 Area and land use

The subject site comprises a single lot, with an area of approximately 2.0823 hectares and frontages of approximately 196m to Beeliar Drive, 116m to Hammond Road and 136m to Delaronde Drive.

The subject site is currently vacant, containing areas of native vegetation with clearing around the former residential dwelling and associated structures. The land is surrounded by a mix of residential and non-residential land uses. The land immediately north of the subject site on Beeliar Drive generally comprises commercial development, with a BP service station and car wash facility, storage facility and tavern located directly opposite the subject site. The land at the north west corner of the Beeliar Drive / Hammond Road intersection is broadly undeveloped, and identified for future mixed business and local centre development. The western side of Hammond Road comprises commercial development and educational facilities, with an 'Anytime Fitness' gym, various bulky goods retailing tenants and Emmanuel Catholic College located directly opposite the subject site to the west. The southern side of Delaronde Drive generally comprises low to medium density residential development and areas of open space and conservation to protect wetlands. Land adjoining the subject site to the east is currently cleared and zoned for residential development.

The topography of the subject site is generally flat, with height ranging between approximately 25m AHD in the south west and grading up to 28m AHD in the east (refer **Appendix 1**, Feature Survey).

Refer **Figure 1**, Aerial Photograph.

1.2.3 Legal description and ownership

The subject site is currently held in single land ownership. The lot details are outlined in **Table 1**.

Table 1 – Lot details

Lot	Deposited Plan	Volume	Folio	**Area** (hectares)
176	36818	2547	33	2.0823

Refer **Appendix 2** for a copy of the Certificate of Title and Deposited Plan.

The north-west corner of the subject site is reserved 'Other Regional Roads' under the Metropolitan Region Scheme. This portion of the lot, comprising an area of approximately 330m², does not form part of the Structure Plan area.



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SCALE	1: 2,000 @ A4
DATE	23 November 2018
FILE	01 1811123 4900 Aerial Photograph.dwg
REVISION	1/DR/First Draft/23.11.2018

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AERIAL PHOTOGRAPH

LOT 176 (119) HAMMOND ROAD, SUCCESS, WA

FIGURE 01

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1.3 Planning framework

1.3.1 Zoning and reservations

1.3.1.1 Metropolitan Region Scheme

Under the provisions of the Metropolitan Region Scheme (**MRS**) the subject site is predominantly zoned Urban. The subject site fronts Beeliar Drive and Hammond Road, which are reserved Other Regional Roads under the MRS.

The north west corner of the subject site is affected by the Other Regional Roads reserve, which has been excluded from the Structure Plan area.

The proposed Structure Plan applies only to the Urban zoned portion of the subject site, and is therefore consistent with the provisions of the MRS.

Refer **Figure 2**, MRS zoning map.

1.3.1.2 City of Cockburn Town Planning Scheme No. 3

The subject site is zoned Development under the provisions of the City of Cockburn Town Planning Scheme No. 3 (**TPS3**). Refer **Figure 3**, TPS3 zoning map. Clause 3.2 states the objective of the Development zone is:

> *To provide for **future residential**, **industrial** or **commercial** development to be guided by a comprehensive **Structure Plan** prepared under the Scheme.*

The proposed Structure Plan facilitates the coordinated development of the subject site for residential purposes. It takes into consideration future development and the existing land uses surrounding the subject site. The proposed Structure Plan has been prepared with due regard to the amenity of the existing locality and will demonstrate how integration with the surrounding land has been achieved. As such, the proposed Structure Plan is consistent with the objectives of the Development zone.

Under Table 9 of TPS3, the subject site is identified as Development Area 13 (DA13) – Hammond Road (Development Zone). The following provisions therefore apply:

1. *An approved Structure Plan together with all approved amendments shall be given due regard in the assessment of applications for subdivision, land use and development in accordance with clause 27(1) of the Deemed Provisions.*
2. *To provide for Residential development.*

Schedule 2 of the Planning Regulations provide a set of deemed provisions which automatically form part of every local planning scheme in the State. Clause 27 of the deemed provisions relates to the effect of a structure plan, with clause 27 (1) stating:

> *A decision-maker for an application for development approval or subdivision approval in an area that is covered by a structure plan that has been approved by the Commission is to have due regard to, but is not bound by, the structure plan when deciding the application.*

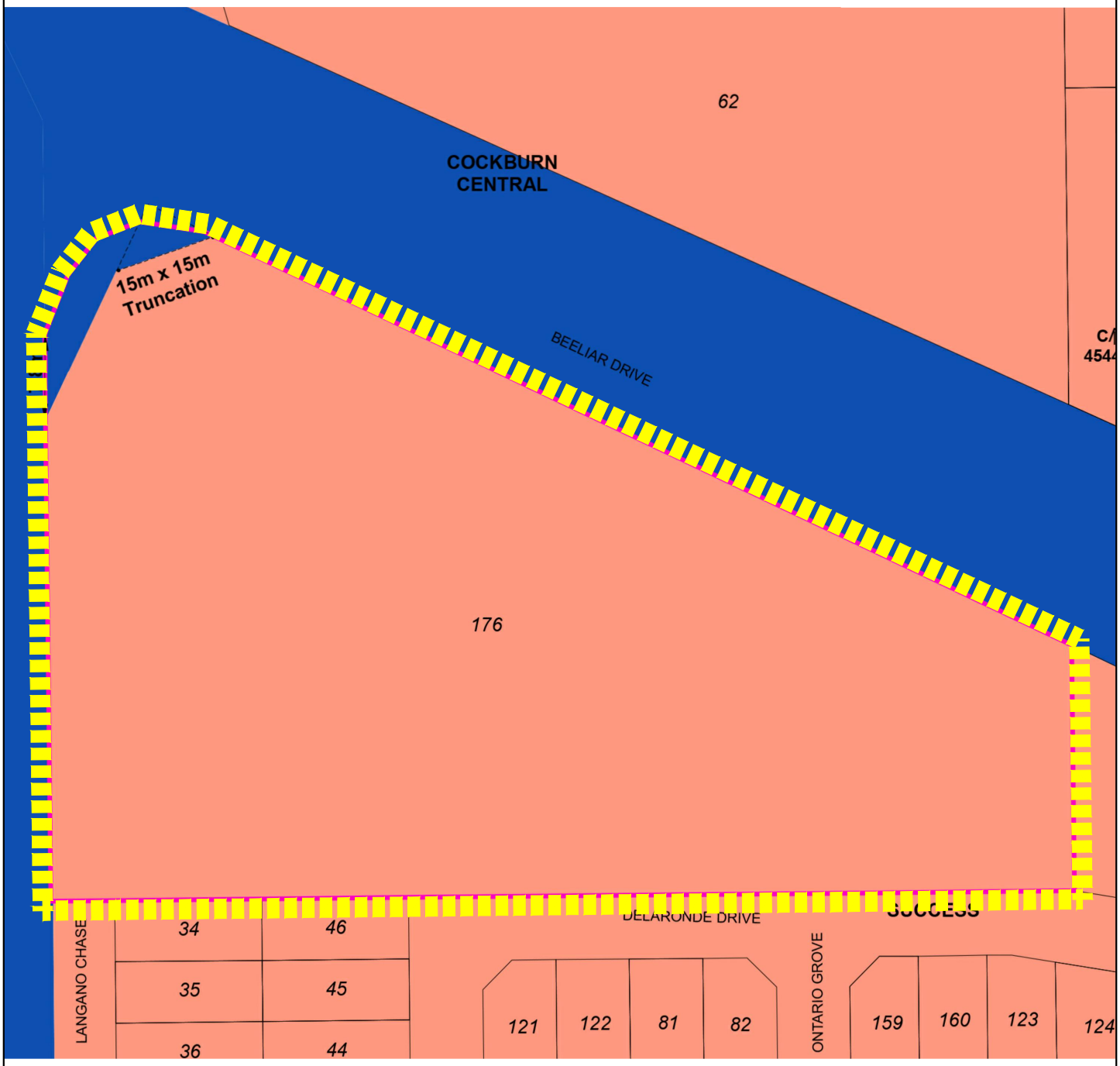
Consistent with the provisions of the Planning Regulations and TPS3, the proposed Structure Plan will guide the future subdivision and residential development of the subject site.

Under the provisions of TPS3, the subject site is also identified as being within Development Contribution Area 1 – Success North (**DCA 1**) and Development Contribution Area 13 (**DCA 13**).

Under Table 10 of TPS3, all landowners within DCA 1 are required to make a proportional contribution to the widening and upgrading of Hammond Road between Beeliar Drive and Bartram Road, Success. The developed contribution rate is calculated on a per hectare basis.

DCA 13 covers regional, sub-regional and local community infrastructure across the City of Cockburn, and applies to all land within the City which is to be subdivided and/or developed for residential purposes. Under DCA 13, rates are different for each suburb, with the contribution calculated on the basis of the number of lots/dwellings created.

Developer contributions will apply at the point of subdivision and/or development of the subject site.



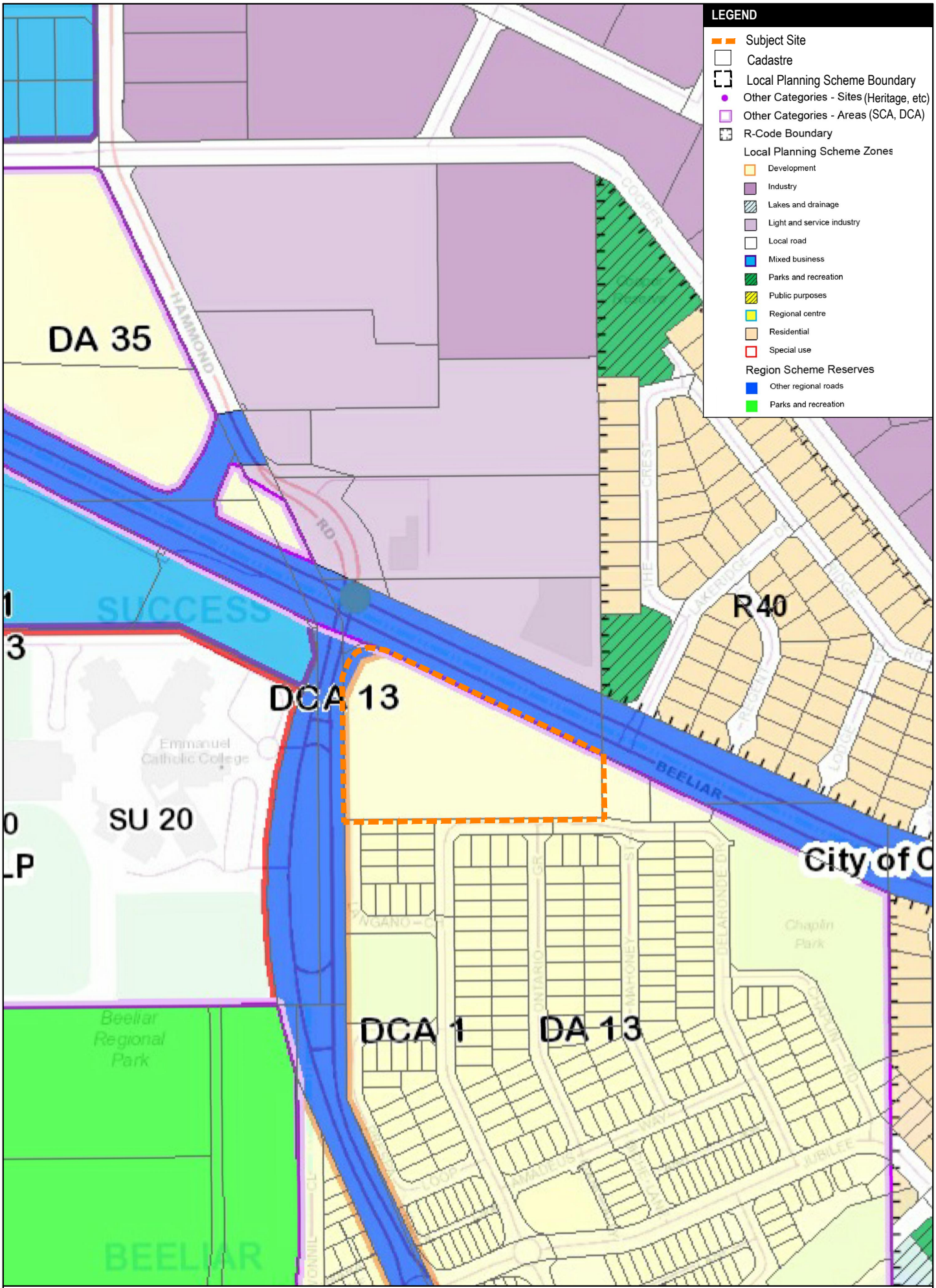
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MRS ZONING MAP
METROPOLITAN REGION SCHEME
LOT 176 (119) HAMMOND ROAD, SUCCESS, WA

FIGURE 02

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LPS ZONING MAP
LOCAL PLANNING SCHEME

LOT 176 (119) HAMMOND ROAD, SUCCESS, WA

FIGURE 03

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1.3.2 Planning strategies

1.3.2.1 Directions 2031 and Beyond

Directions 2031 and Beyond (**Directions 2031**) is the overarching spatial framework and strategic plan that establishes a vision for the future growth of the Perth and Peel regions. It provides the framework to guide detailed planning and delivery of housing, infrastructure and services for a variety of growth scenarios. A medium density connected city model is put forward as the preferred means to achieve a liveable, prosperous, accessible, sustainable and responsible city.

In relation to the proposed structure plan, Directions 2031 promotes a diversity of dwelling types and increases in choice for residential areas. Directions 2031 seeks to address population growth scenarios and land use patterns for the medium to long-term increase of more than half a million people in Perth and Peel by 2031, as well as being prepared to provide for a city of 3.5 million people after 2050.

Directions 2031 sets a target of 15 dwellings per gross urban zoned hectare of land in new development areas. The residential portion of the proposed Structure Plan provides for approximately 40 dwellings, including single residential R30 and R40 lots, and R60 grouped dwellings, equating to a density of approximately 19 dwellings per gross urban zoned hectare, exceeding the target set under Directions 2031.

Due to the size and complexity of strategic planning for the metropolitan area, sub-regional strategies are prepared to provide guidance at the local level. The subject site falls within the south-west sub-region, which has a dwelling target of an additional 41,000 dwellings by 2031.

The proposed residential densities within this structure plan are in accordance with the Directions 2031 objectives and density targets.

1.3.2.2 Perth and Peel @ 3.5million and South Metropolitan Peel Sub-Regional Planning Framework

The *Perth and Peel @3.5million* strategy was published in draft form in 2015, and ultimately approved in final form in March 2018. The final version of the strategy was accompanied by a suite of sub-regional planning frameworks, defining the spatial plan of the Perth and Peel regions for the next 30 years in order to accommodate a population of 3.5 million people. The Strategy sets an increased residential density target of 26 dwellings per residential site hectare.

The South Metropolitan Peel Sub-Regional Planning Framework (**Sub-Regional Framework**) is a strategic planning document intended to guide the delivery of the objectives of Directions 2031. The Sub-Regional Framework covers an area of almost 5,000 square kilometres, and sets out proposals to meet future housing, employment and infrastructure needs while protecting environmental and landscape values. In order to progress urban growth in a coordinated and sustainable manner, the Sub-Regional Framework suggests the development of land zoned Urban and Urban Deferred is to accommodate increased urban infill development and higher densities in undeveloped areas already zoned for urban use.

Within the Sub-Regional Framework, Cockburn is identified as a Secondary Centre in the hierarchy of Activity Centres, and the subject site is identified as 'Urban'. The Sub-Regional Framework also identifies Cockburn as an area required to accommodate increased infill development in established urban areas, with a minimum urban infill dwelling target of 14,680 dwellings by 2050. The proposed residential infill development within this structure plan is in accordance with the Sub-Regional Framework urban infill objectives and dwelling targets for the Cockburn local government area.

1.3.3 Planning policies

1.3.3.1 State Planning Policy 3.0 – Urban Growth and Settlement

State Planning Policy 3.0 – Urban Growth Settlement (**SPP 3.0**) applies to all development throughout Western Australia. The policy notes that orderly planning of urban growth and settlement should be facilitated by structure plans, which should take into account the strategic and physical context of the locality, provide for the development of safe, convenient and attractive neighbourhoods which meet the diverse needs of the community, and facilitate logical and timely provision of infrastructure and services. The Structure Plan is consistent with the intent of SPP 3.0 in terms of attaining the policy's stated objectives. Accordingly, the proposed Structure Plan for the subject site warrants the support and endorsement of the determining authorities.

1.3.3.2 State Planning Policy 7.3 – Residential Design Codes Volume 1

State Planning Policy 7.3 – Residential Design Codes Volume 1 (**R-Codes**) applies to residential development in Western Australia. Clause 4.2.2 of TPS3 requires the development of land for residential purposes to conform to the provisions of the R-Codes.

The R30, R40 and R60 density codes identified on the proposed Structure Plan are interpreted by the R-Codes. Future subdivision and residential development across the subject site is to comply with the requirements of the R-Codes.

1.3.3.3 State Planning Policy 3.7 – Planning in Bushfire Prone Areas

State Planning Policy 3.7 – Planning in Bushfire Prone Areas (**SPP 3.7**) seeks to implement effective, risk-based land use planning and development to preserve life and reduce the impact of bushfires on property and infrastructure, and is supported by the *Guidelines for Planning in Bushfire Prone Areas*. The policy contains objectives and policy measures, which apply to all land-use development proposals at varying stages of the development process. Refer to Section 2.4 of this report for further detail in relation to bushfire risk management.

1.3.3.4 State Planning Policy 3.6 – Development Contributions for Infrastructure

State Planning Policy 3.6 – Development Contributions for Infrastructure (**SPP 3.6**) outlines the relevant considerations and principles for developer contributions for infrastructure, and the preparation of development contribution plans. The subject site is located within the City of Cockburn's DCA 1 and DCA 13, as outlined previously. The subject site is capable of being developed independently through the extension of surrounding roads and services, and no further developer contribution arrangements are proposed.

1.3.3.5 State Planning Policy 5.4 – Road and Rail Transport Noise and Freight Considerations in Land Use Planning

State Planning Policy 5.4 – Road and Rail Transport Noise and Freight Considerations in Land Use Planning (**SPP 5.4**) aims to promote a system in which sustainable land use and transport are mutually compatible. Under SPP 5.4, Beeliar Drive is classified as a primary freight route, under Main Roads jurisdiction. According to Main Roads Trafficmap, Beeliar Drive (west of North Lake Road) carried an average 34,113 vehicles per day Monday to Friday in 2014/15, with Hammond Road (south of Beeliar Drive) carrying 8,395 vehicles per day in the same period. A Transport Noise Assessment has been prepared to assess the potential impact of traffic noise on future dwellings; refer to Section 2.6 of this report for further detail.

1.3.3.6 Liveable Neighbourhoods

The proposed Structure Plan has been prepared in accordance with the current (January 2009) version of Liveable Neighbourhoods (**LN**) as outlined in Section 3.3 of this report.

An updated version of LN was released by the DPLH for the purposes of public review in October 2015. Section 3.3 of this report only refers to the draft LN where necessary.

1.3.3.7 Development Control Policy 5.1 – Regional Roads (Vehicular Access)

The WAPC's Development Control Policy 5.1 Regional Roads (Vehicular Access) (**DC 5.1**) sets out the principles to be applied when considering proposals for vehicle access to or from developments abutting regional roads. DC 5.1 includes the following considerations:

> *3.3.1 In considering applications for access on regional roads, the effects of the proposals on traffic flow and road safety will be the primary consideration. The more important the regional road, the greater the importance attached to these factors. In general, the Commission will seek to minimise the creation of new driveways on regional roads and rationalise existing access arrangements.*
>
> *3.3.5 In determining applications for development involving the formation, laying out or alteration of a means of access to regional roads, the following must be considered:*
>
> *i) the effects of the development on traffic flow and safety, the character and function of the road, the volume and speed of traffic, the width of the carriageway and visibility; and*
>
> *ii) the volume and type of traffic generated by the development.*

No direct vehicular access between the subject site and Beeliar Drive or Hammond Road is proposed. Vehicles will access the subject site via Delaronde Drive to the south, which connects to Jubilee Avenue and beyond to Hammond Road and Wentworth Parade via Alabaster Drive.

Refer to **Appendix 3** Traffic Impact Statement for consideration of the above factors.

1.3.3.8 Planning Bulletin 112/2016 – Medium-density single house development standards – Development Zones

Planning Bulletin 112/2016 – Medium-density single house development standards – Development Zones (**R-MD Codes**) outlines acceptable variations to the deemed-to-comply provisions of the R-Codes for medium-density single houses in development areas for consistent application across the State. Implementation of the R-MD Codes can be either through incorporation into a local planning scheme or by the adoption of a local planning policy. The basis for implementation of the R-MD Codes is provided for under the City's LPP 1.16, adopted in December 2017. Part One of this Structure Plan identifies that the R-MD Codes apply, consistent with the provisions of LPP 1.16.

1.3.3.9 Local Planning Policies

The City's planning framework comprises a suite of local planning policies pertaining to various matters and planning considerations. Relevant are the following local planning policies, which have been paid due regard in the preparation of the proposed Structure Plan:

- Local Planning Policy 1.12 – Noise Attenuation
- Local Planning Policy 1.16 – Single House Standards for Medium Density Housing in the Development Zone
- Local Planning Policy 5.1 – Public Open Space
- Local Planning Policy 5.5 – Local Development Plans
- Local Planning Policy 5.15 – Access Street Road Reserve Pavement Standards
- Local Planning Policy 5.18 – Subdivision & Development – Street Trees

1.3.4 Pre-lodgement consultation

1.3.4.1 City of Cockburn

Consultation and pre-lodgement engagement has occurred with the City of Cockburn (**City**) with respect to this structure plan.

On 9 January 2018, Planning Solutions contacted the City regarding the proposed subdivision of the subject site. On 17 January 2018, the City advised that a structure plan is required for the subject site prior to considering a subdivision proposal, and provided the following preliminary comments with respect to the proposal:

- Structure Plan report is to comply with the WAPC's current framework.
- Structure Plan report appendices are to include:
    - Traffic Impact Statement
    - Acoustic report
    - Bushfire Management Plan
    - Servicing report
    - Local Water Management Strategy
    - Appropriate Flora Survey reports
- Subdivision / Structure Plan is to provide for 10% public open space.

Further to receiving the City's preliminary advice, Planning Solutions contacted the Department of Planning, Lands and Heritage seeking their comments on the proposed subdivision of the subject site. The outcomes of these consultations are detailed in the section below.

In the following months, various co-consultants were engaged to undertake the necessary assessments and reporting for the subject site, in accordance with the City's instructions. All required reporting is provided in support of this structure plan, including a Drainage Strategy which was approved by the Department of Water and Environmental Regulation (**DWER**) on 20 September 2018, in lieu of a Local Water Management Strategy. The Drainage Strategy was also submitted to the City's engineering department for review and acceptance, with acceptance provided by the City on 8 October 2018 (via email). Refer to **Appendix 4**, approved Drainage Strategy and DWER letter of advice.

On 27 November 2018, Planning Solutions attended a meeting with senior planning officers at the City to discuss the draft Structure Plan concept, which proposed 31 single residential lots zoned Residential R30 and R40. The City provided feedback on various matters with respect to the proposed structure plan for the subject site, which was subsequently updated to address the City's feedback, including:

- Provision of an area of public open space equating to 10% of the total site area;
- A modified internal road layout; and
- Adjustments to the residential densities across the site.

A follow up meeting with the City's officers on 7 December 2018 highlighted the City's general acceptance of the updated structure plan concept plan, and the co-consultant reporting intended to support the Structure Plan.

1.3.4.2 Department of Planning, Lands and Heritage

Consultation and pre-lodgement engagement has occurred with the DPLH with respect to this structure plan. The DPLH provided various written correspondence in April and May 2018 confirming the requirement for a Structure Plan for the subject site, addressing the following:

- Threatened ecological communities
- Remnant Vegetation and Black Cockatoo Habitat
- Banksia Woodlands
- Bushfire Risk
- Public Open Space
- Transport Noise
- Residential Density

The Structure Plan has been prepared with regard to the DPLH's preliminary advice.

2 Site conditions and constraints

2.1 Biodiversity and natural area assets

2.1.1 Vegetation and Flora

The Structure Plan area currently consists of areas of native vegetation and cleared areas. A site visit conducted by Eco Logical Australia identified two vegetation associations within the subject site, comprising EmBaBm vegetation (*Banksia attenuta, Eucalyptus marginata* subsp. *marginata* and *Banksia menziesii* woodland) and Planted Pines (*Pinus pinaster*). Significant disturbance was also found throughout the site in the form of cleared areas, modified vegetation and weed infested areas.

No threatened flora species were recorded within the subject site, as listed under section 178 of the *Environmental Protection and Biodiversity Conservation Act 1999* (**EPBC Act**) or pursuant to Schedule 1 of the *Wildlife Conservation Act 1950* and as listed by Department Biodiversity, Conservation and Attractions (**DBCA**) or Priority flora species as listed by Western Australian Herbarium.

Vegetation condition within the subject site ranged from Completely Degraded to Very Good based on the *EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment.* The areas associated with EmBaBm vegetation were mapped as being in Very Good (0.39 ha), Good (0.53 ha) and Degraded (0.32 ha) conditions. The areas associated with the Planted Pines vegetation were mapped as being in Completely Degraded condition (0.43 ha). The cleared areas were mapped as being in Completely Degraded condition (0.41 ha).

With regard to Threatened Ecological Communities (TEC), the site is designated in an area where the Banksia Woodlands of the Swan Coastal Plain TEC may occur. The EmBaBm vegetation recorded on site contained banksia species known to be associated with this TEC. Accordingly, a diagnostic assessment (see Appendix D of Appendix 5) was conducted to determine if the proposal is required to be referred to the Department of Environment and Energy under the EPBC Act. For EPBC Act referral, assessment and compliance purposes, the national ecological community is limited to patches that meet key diagnostic characteristics, condition thresholds, and minimum patch sizes. The minimum patch sizes are assessed on the condition of the vegetation. For vegetation assessed as being in Very Good and Good condition, the minimum patch sizes are 1 ha and 2 ha respectively. The EmBaBm patch on site covers a total area of 1.24 ha and is not considered to form part of a larger patch outside of the structure plan site. As the patch consists of 0.53 ha of EmBaBm in Very Good condition and 0.39 ha in Good condition, it does not meet the minimum patch size requirements to be considered as part of the Banksia Woodlands of the Swan Coastal Plain TEC. In respect of this, the proposal has not been referred to the Department of Environment and Energy under the EPBC Act.

Refer **Appendix 5**, Environmental Assessment Report prepared by Eco Logical Australia.

2.1.2 Black Cockatoos

Eco Logical Australia undertook a targeted habitat assessment for black cockatoos listed as Threatened under the *Environmental Protection and Biodiversity Conservation Act 1999*, being the Carnaby's Black-Cockatoo, Baudin's Black-Cockatoo and Forest Red-tailed Black-Cockatoo.

No black cockatoos were observed within the site at the time of assessment however evidence of foraging was observed. Vegetation within the site provides potential suitable foraging habitat for all three species of black cockatoos, however the quality of this habitat is predominantly poor.

Eleven potential significant trees for black cockatoos were recorded throughout the site. Only one tree was observed to have a hollow of suitable size for breeding purposes, however no signs of use were observed. There was no evidence of black cockatoo breeding activity at the time of assessment.

Refer **Appendix 5**, Environmental Assessment Report.

2.2 Landform and soils

2.2.1 Topography

The subject site is generally flat, with site levels ranging between approximately 25m AHD in the south west and grading up to 26m AHD in the north west and 28m AHD in the north east.

Refer to **Appendix 1**, Feature Survey.

2.2.2 Soils

Geological mapping shows the subject site to be underlain by the sands of the Bassendean Formation.

A geotechnical investigation of the subject site found topsoil present across much of the site to a depth of about 0.1m. The material is unsuitable for foundation support and should be removed from the site prior to development or stockpiled for later use in landscaping. The topsoil is underlain by well-draining, medium grained, grey and orange brown, cohesionless sand to a depth of at least 2m. The in-situ sand contains low fines content and zero plasticity. Laboratory gradings with in-situ permeability tests show drainage characteristic of the sand to be good, with a permeability of approximately $1x10^{-3}$m/s. The sand is typical of the Bassendean Formation. No uncontrolled fill was encountered in the test holes.

The site classification will be Class 'A', in accordance with AS 2870 – 2011, with the foundation defined as *"most sand and rock sites with little or no ground movement from moisture changes".* The land is therefore suitable for development.

Refer **Appendix 4**, Drainage Strategy prepared by Porter Consulting Engineers, which includes a copy of the Geotechnical Investigation report prepared by Brown Geotechnical.

2.2.3 Acid sulfate soils

A search of the Acid Sulfate Soil (**ASS**) Risk Map, Swan Coastal plan (DWER-055) shows that the whole site is at moderate to low risk of ASS occurring within 3m of natural soil surface, but high to moderate risk of ASS beyond 3m of natural soil surface (DWER 2018). An ASS assessment may be required at subsequent stages of subdivision/development, where there is risk of disturbing ASS.

2.2.4 Contamination

The subject site is not listed as a contaminated site on the DWER database.

2.3 Groundwater and surface water

No groundwater was encountered during the geotechnical investigation fieldwork. The Perth Groundwater Map indicates the historical maximum groundwater level for the site to be approximately

23m AHD. The site level falls from approximately 28m AHD in the east to 25m AHD in the west. Groundwater levels are therefore expected to be at least 3m below the existing ground level.

Refer to **Appendix 4**, Drainage Strategy and Geotechnical Investigation report.

2.4 Bushfire hazard

The Bushfire Management Plan (**BMP**) for the subject site has been prepared by Eco Logical Australia. Refer to **Appendix 6**, Bushfire Management Plan. The purpose of the BMP is to address the fire protection risks within the subject site. Implementation of the BMP will reduce the threat to the landowners, residents, visitors and firefighters in the event of a bushfire within or near the site. It achieves this by presenting the minimum requirements to be implemented.

Eco Logical Australia undertook a bushfire assessment of the vegetation within the subject site and surrounding 150m, in accordance with the *Guidelines for Planning in Bushfire Prone Areas v 1.3* (**Guidelines**) and AS 3959-2009 *Construction of Buildings in Bushfire Prone Areas.* The bushfire assessment identified two vegetation classes and exclusions within the assessment area, comprising Class B woodland and Class G grassland, and exclusions of single areas of vegetation less than 1 hectare in size, and non-vegetated areas and low-threat vegetation.

As part of the subdivision process, the on-site vegetation extent is proposed to be predominantly cleared to enable the residential development of the land, with managed landscaping in the area of public open space. Bushfire hazards can therefore be managed through a staged clearing process, adequate separation of future built assets from classified vegetation, and ongoing fuel management within the site.

As outlined in the BMP, the pre-development bushfire hazard level (**BHL**) assessment of the Structure Plan area was mapped as a moderate and extreme bushfire hazard, as defined under the Guidelines. The post-development BHL assessment mapped the Structure Plan area as a low bushfire hazard for the majority of the site, with only a minor portion of the subject site (where POS is proposed) mapped as a moderate hazard. The BMP includes a list of bushfire protection requirements which will provide for an adequate standard of bushfire protection for the Structure Plan area. The BMP concludes that the proposed development of the subject site is consistent with the aims and objectives of SPP3.7 and associated Guidelines for the site, and should be supported accordingly.

2.5 Heritage

2.5.1 Aboriginal heritage

A search of the DPLH Aboriginal Heritage Inquiry System has confirmed there is a Registered Aboriginal Site affecting the Structure Plan area. The subject site is within the 'Yangebup Lake' registered site (site ID 18937). Development of the land will not compromise the cultural and heritage values of this site.

2.5.2 European heritage

There are no sites of European heritage significance listed for the subject site on any Commonwealth, State or Local heritage lists and inventories. The subject site is not constrained from development in this regard.

2.6 Transport noise

A Transport Noise Assessment (**TNA**) for the subject site has been prepared by Lloyd George Acoustics, as the Structure Plan area is located adjacent to two major roads (Beeliar Drive and Hammond Road). The assessment was undertaken in accordance with the requirements of SPP5.4. Refer **Appendix 7**, Transport Noise Assessment.

As outlined in the TNA, with no noise control, the road traffic noise levels for future dwellings at the subject site will be above the daytime target of 55 db $L_{Aeq(Day)}$. As such, the following noise controls are required to comply with the provisions of SPP5.4:

- Construct a solid 1.8m high (relative to finished lot levels) noise wall along the Beeliar Drive boundary to the extent of the proposed residential lots, as an extension of the existing acoustic wall located to the east of the subject site, with a minor extent of the noise wall to wrap around the north western portion of the proposed R60 grouped dwelling lot.
- Where residences are predicted to experience future noise levels between, and including, 55 db and 60 db $L_{Aeq(Day)}$, Package A architectural treatments are to be incorporated, as defined under the Implementation Guidelines for SPP5.4.
- Where residences are predicted to experience future noise levels between, and including, 61 db and 63 db $L_{Aeq(Day)}$, Package B architectural treatments are to be incorporated, as defined under the Implementation Guidelines for SPP5.4.
- All affected lots are to have notifications on lot titles as per the SPP5.4 requirements.
- Where an affected lot is to be of double storey construction, specialist advice must be sought since the upper level will not receive the same level of attenuation provided by the walls or other dwellings.

The TNA states that outdoor entertaining areas will be generally within the 5db margin and therefore considered acceptable.

2.7 Context and other land use constraints and opportunities

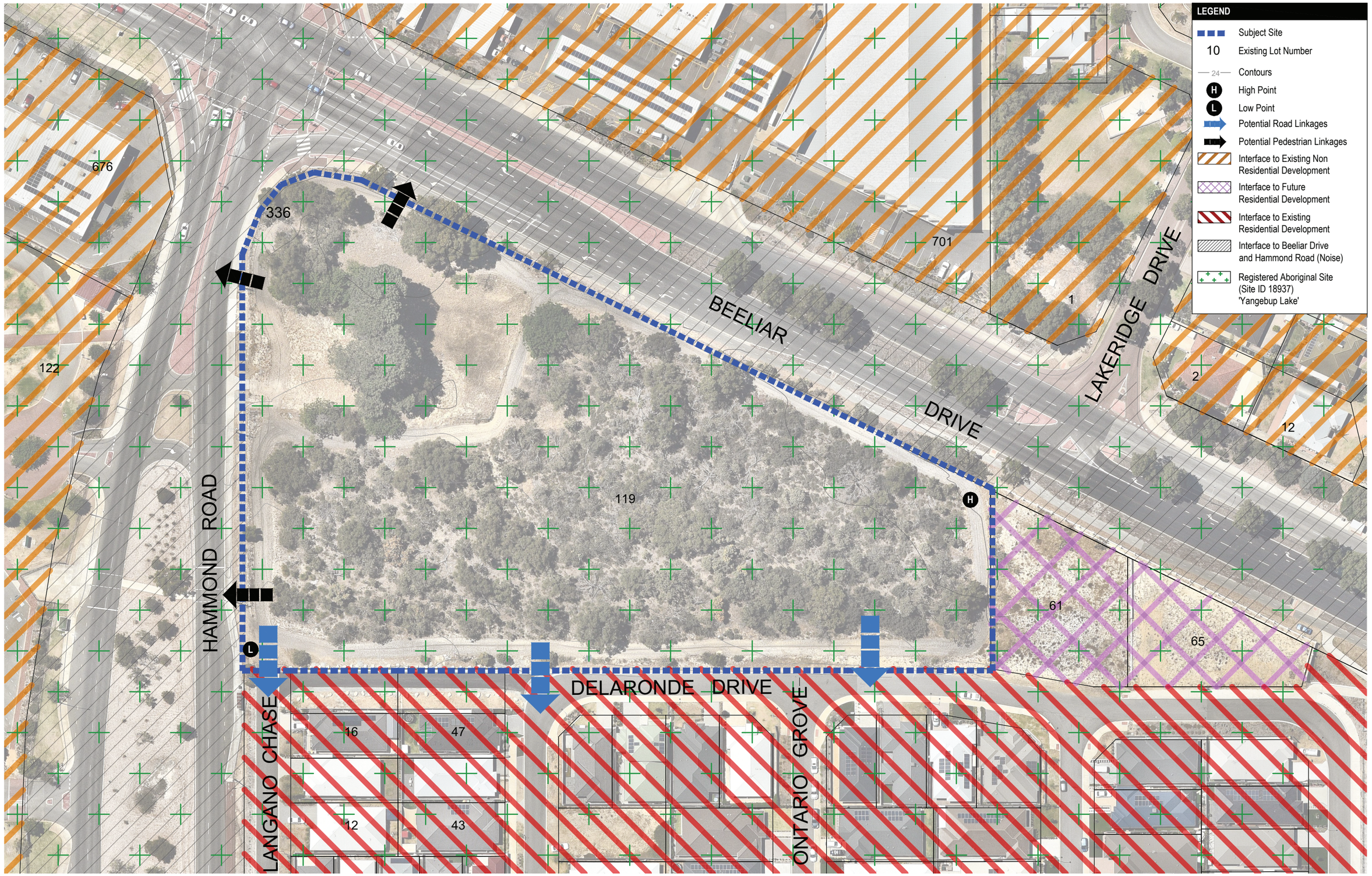
The site context and constraints have been identified and are discussed below. Refer to **Figure 4**, context and constraints map.

2.7.1 Residential interface

The subject site abuts residential development to the south and future residential development to the east. Integration with the surrounding residential development is an important factor which has been considered in the preparation of the Structure Plan. The existing approved road network through the land to the south has influenced the road configuration through the subject site to ensure seamless connectivity. The layout of the structure plan allows the adjoining land to the east to be subdivided and developed in the future, in a coordinated and integrated manner. The mix of residential densities of R30, R40 and R60 proposed under the Structure Plan are compatible with the land to the south and the east of the site with corresponding densities.

2.7.2 Beeliar Drive and Hammond Road interface

The subject site fronts Beeliar Drive to the north and Hammond Road to the west, both of which are reserved 'Other Regional Roads' under the provisions of the MRS. There is a general presumption against providing individual lot access or multiple road intersections with major arterial routes such as these, which is reflected in LN and DC5.1. Accordingly, all vehicular access to the Structure Plan area is intended to be taken through extension to the existing internal road network to the south.



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CONTEXT AND CONSTRAINTS

LOT 176 (119) HAMMOND ROAD,
SUCCESS, WA

FIGURE
04

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3 Structure Plan

3.1 Land use

The proposed Structure Plan (refer to **Plan 1**) provides for the development of the subject site for residential purposes, consistent with the intent of the 'Development' zoning of the subject site under TPS3 and the 'Urban' zoning under the MRS. The proposed Structure Plan will facilitate the development of single and grouped housing across the subject site, designating the following reserves, zones and residential densities:

Zones and Residential Design Codes Densities

- Residential (R30, R40 and R60)

Reserves

- Parks and Recreation
- Local Road

The proposed land uses integrate with the existing use of the land in the vicinity for residential purposes, and proposes a logical extension of urban development extending from the south. The proposed land use complements and integrates with the current and future use of the surrounding land for residential purposes.

3.2 Open space

The proposed Structure Plan contains one defined area of Public Open Space (**POS**), within the north-western corner of the subject site, fronting the intersection of Beeliar Drive and Hammond Road. The POS comprises an area of 2,130m², and is intended to provide for local passive and recreational activities. The POS will be attractively landscaped and will form a feature entrance statement to the estate, reducing the visual impact of the busy Beeliar Drive / Hammond Road intersection.

It is noted that LN has been reviewed by the WAPC, with the *Draft Liveable Neighbourhoods 2015* document being released for public comment in October 2015. Under the Draft LN document, the proposed POS is classified as a Small Park, which are identified as being up to 4,000m² (0.4 ha) in size, with an accessibility catchment of 300m. Small Parks are designed to contribute to the landscape character and amenity of the neighborhood and make walking through the area more enjoyable and appealing to residents. These parks are primarily designed to be used as linkages in a network of green, shaded streetscapes and linear parklands, and facilitate ease of access for local residents to recreational opportunities.

The total proportion of POS provided is 10.4% of the gross subdivisible area of subject site – refer to **Table 2**, Public Open Space Schedule. This exceeds the minimum requirement for 10% of the gross subdivisible area to be provided as POS under LN. Minor adjustments to the ultimate size and configuration of the POS may be made at the subdivision stage, subject to complying with the minimum 10% requirement of LN.

Table 2 – Public Open Space Schedule

Total site area (ha)		**2.0823**
Deductions		
'Other Regional Roads' Reserve	0.0336	
Total Deductions		**0.0336**
Gross subdivisible area (total area minus deductions)		**2.0487**
Public open space @ 10 per cent		**0.2049**
May comprise:		
Minimum 80% unrestricted public open space	0.1639	
Maximum 20% restricted use public open space	0.0410	0.2049
Breakdown of POS provided		
Restricted use public open space	0	
Unrestricted public open space	0.2130	
Total public open space provision		**0.2130**
POS Provision as Percentage of Gross Subdivisible Area		**10.4%**

Given the approved Drainage Strategy (refer **Appendix 4**) does not rely on drainage within the POS, the entire area is classified as 'Unrestricted POS' under LN. Consistent with the objectives of LN, the POS provided will serve a number of functions, including recreation activities and enhancing the amenity of the area. The local park is intended to incorporate a mix of trees and garden beds along its frontages to Beeliar Drive and Hammond Road, providing an enhanced outlook from within the subject site. A mix of spaces for passive and active recreation will be provided, such as picnic areas and kickabout areas. A feature footpath through the POS will link the residential estate with the existing external path network.

The POS is bordered by roads on all sides, with a small portion adjoining the R60 grouped housing site. The layout of the proposed Structure Plan provides for future dwellings on adjacent lots to be oriented towards the POS to benefit from the amenity of the natural features and to encourage surveillance of the space. All of the proposed lots within the Structure Plan area are located within 200m walking distance of the POS via the internal pedestrian path network. The lots are also located in close proximity to other areas of POS, including Delaronde Park, Lakeridge Park and Chaplin Park, which provide for additional recreational functions for future residents.

The POS is intended to be ceded free of cost to the Crown under Section 152 of the *Planning and Development Act 2005*. The POS will be developed to acceptable standards.

Refer **Appendix 8** for a copy of the landscape concept plan prepared by LD Total, depicting the proposed landscaping of the POS.

3.3 Residential

The proposed Structure Plan will achieve a variety of residential densities to ensure a diversity of housing. The subject site is proposed to be zoned Residential with a mix of R30, R40 and R60 density codings. The R30 and R40 densities are reflective of the existing and proposed surrounding residential development, which generally ranges from R30 to R40.

A higher density R60 grouped housing site is proposed adjacent to the POS and Beeliar Drive. Due to the unusual configuration of this site and the required noise wall along the northern boundary, a grouped housing development is considered to be the most appropriate development outcome for the site, as it will allow for an innovative and site-responsive design to be considered.

A Structure Plan concept plan has been prepared to demonstrate one way in which the subject site could be subdivided in accordance with the proposed Structure Plan (refer to **Figure 5**).

Residential lots will be oriented toward the primary street and POS where possible, and all single lots will gain direct access from the internal road network.

The proposed Structure Plan will provide for the development of approximately 34 single residential lots and one R60 grouped housing lot. The potential residential lot and dwelling yield is summarised in **Table 3** below.

Table 3 – Yield summary

Zoning	Average lot size	Estimated number of lots	Estimated number of dwellings
Residential R30	450m²	12	12
Residential R40	300m²	22	22
Residential R60	150m²	1	6 grouped dwellings
	Total	**35**	**40**

Assuming an average household size of approximately 2.8 based on current and future trends within Success, the estimated population within the subject site equates to approximately 112 people.

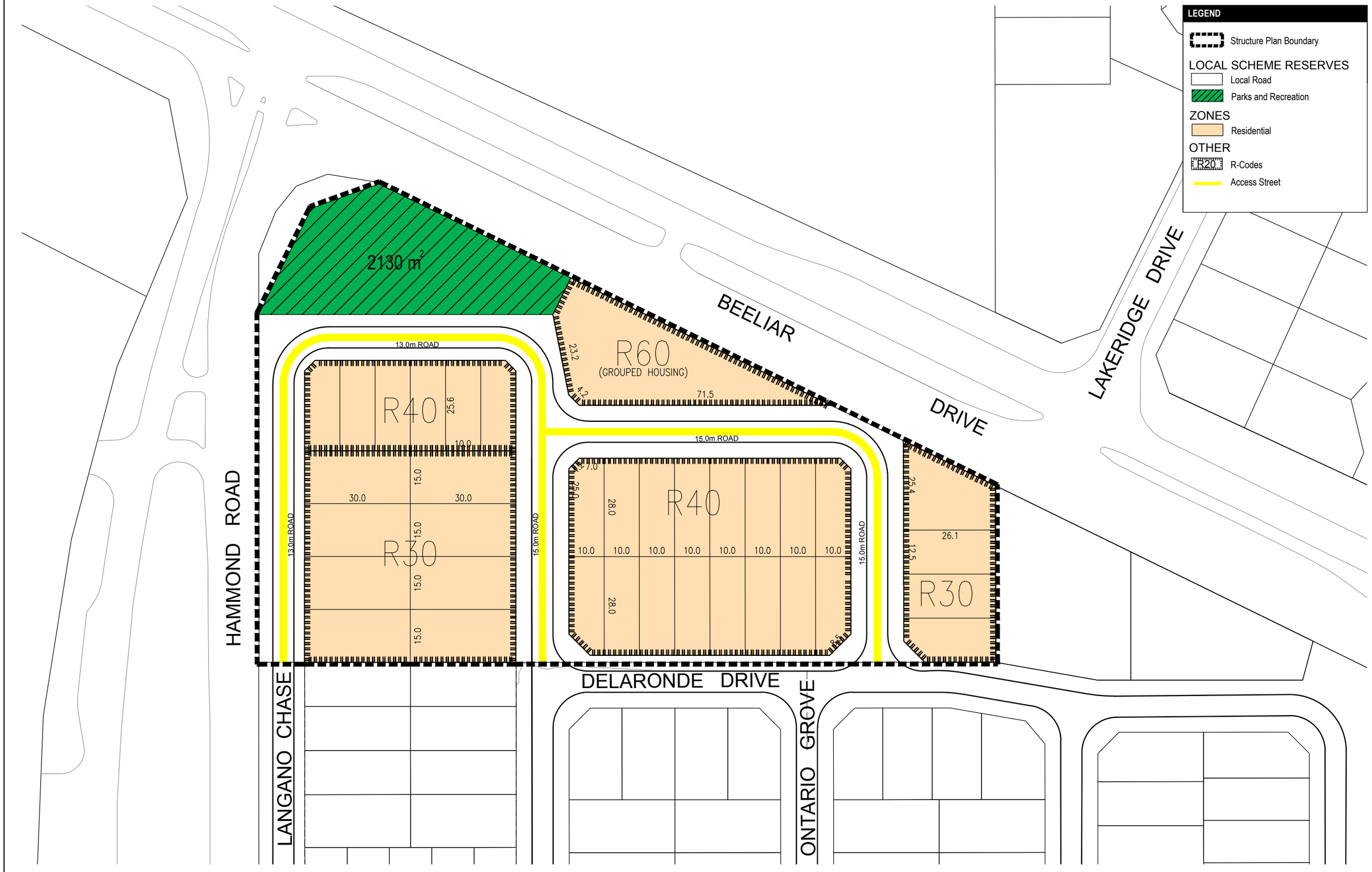
The proposed residential densities are in accordance with the objectives of State-level strategic planning documents, which advocate increased housing diversity, adaptability, affordability and choice. The Structure Plan concept plan (**Figure 5**) has been prepared in accordance with *Liveable Neighbourhoods* design principles and provides for increased residential densities in areas of high amenity.

The dwellings capable of being achieved under the Structure Plan exceed the applicable density targets set out under the State planning framework, as outlined in **Table 4** below.

Table 4 – Structure Plan density calculations

Strategy / Policy Document	Density Target	Structure Plan area	Density Achieved (based on 40 lots)
Directions 2031 and Beyond	15 dwellings per gross hectare	2ha gross urban zoned area	19.5 dwellings per gross hectare
Perth and Peel @ 3.5 million	26 dwellings per residential site hectare	1.2ha residential site area (excludes local road reserves and POS)	32 dwellings per residential site hectare
Liveable Neighbourhoods	22 dwellings per site hectare		

The proposed Structure Plan will deliver a variety of lot sizes and types to facilitate housing diversity and choice, and meet the projected requirements of people with different housing needs.



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CONCEPT PLAN

LOT 176 (119) HAMMOND ROAD,
SUCCESS, WA

FIGURE 05

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3.4 Movement network

A Traffic Impact Statement (**TIS**) has been prepared by Porter Consulting Engineers to address the traffic implications of the proposed Structure Plan, including estimation of the traffic which would be generated by the subject site and the resultant impacts on the surrounding road network. The TIS includes a capacity analysis of the proposed Structure Plan access system and the key local intersections as well as making recommendations for any traffic management measures that may be required to ensure satisfactory traffic operations. Refer **Appendix 3** for the complete Traffic Impact Statement.

3.4.1 Road hierarchy

Traffic projections for the subject site show that, in accordance with LN, all internal roads can be classified as Access Street D. The maximum desirable traffic volume for this type of road is 1,000 vehicles per day (**vpd**). The typical road reserve for Access Street D under the current LN provisions entails a width of 14.2m with 6m wide trafficable carriageway pavement and 4.1m wide verges on both sides. If fronting POS, access street verges adjacent to the POS may be reduced to 1.0m. However, in considering the draft LN requirements and in order to ensure consistency with the existing road network to the immediate south, the Structure Plan proposes road reserves of 15.0m, and 13.0m adjacent to POS and where dwellings are located on one side of the road only.

The street network provides a high level of internal connectivity and good external linkages for local vehicle, pedestrian and bike movements. The layout of streets enables development to front all streets and areas of POS.

3.4.2 Traffic projections and distribution

The subject site is expected to generate approximately 378 total daily vehicular trips for a typical weekday. The total daily vehicular traffic includes both inbound and outbound trips. Trip generation during the AM and PM peak periods for the subject site is estimated to be in the order of 36 trips per hour.

Of the generated daily traffic, 189 vehicle movements are assumed to be inbound and 189 vehicle movements are assumed to be outbound. Based on the connectivity of the surrounding road network, various trip purposes and the surrounding land uses, it is expected that proportionally more traffic from the subject site will access the distributor road network using the intersection of Hammond Road/Jubilee Avenue (75%) compared to Jubilee Avenue and Alabaster Drive (25%). The additional increase in traffic from the Structure Plan area can be readily accommodated within the spare capacity of the surrounding road network, and the additional peak hours increase will have an insignificant impact on the existing operation of the roundabout at the Jubilee Avenue / Hammond Road intersection.

Based on the above, it is concluded that the adjacent road network has the capacity to accommodate the anticipated Structure Plan traffic.

3.4.3 External intersections

The proposed road network will result in the creation of two new intersections along Delaronde Drive, which have been assessed to operate satisfactorily. A priority T junction is the proposed form of control for each of the intersections. The former bend along Delaronde Drive is to become a T-junction and a new T-junction is to be created 20m to the east of the existing T-junction of Delaronde Drive and Ontario Grove. The proposed layout is the preferred arrangement for closely staggered T-junctions.

3.4.4 Public transport

The subject site has good access to public transport, with bus stops located on Beeliar Drive and Hammond Road within 200m walking distance of the site. Bus service Routes 530 and 531 travel along Hammond Road and bus service Routes 522, 530, 531 and 532 travel along Beeliar Drive. These bus services connect the subject site to Coogee beach to the west, Fremantle Strategic Metropolitan Centre to the north, and Cockburn Central Regional Centre and Cockburn train station to the east.

3.4.5 Pedestrian and cycling facilities

Beeliar Drive and Hammond Road both have dual use paths in proximity to the subject site. The signalised intersection of these roads has pedestrian signals to accommodate the crossing of pedestrians. The local access streets immediately south of the subject site typically have a footpath on one side to accommodate the local residential pedestrian and cyclist movements. The path network will be extended through the subject site, and integrated with the existing surrounding path network.

Due to the relatively low level of traffic forecast for internal Structure Plan roads, cyclists and vehicles can be expected to safely share the road network, and no dedicated cyclist facilities are proposed or required for the Structure Plan area.

3.5 Water management

A Drainage Strategy has been prepared by Porter Consulting Engineers in support of this Structure Plan, in lieu of a Local Water Management Plan, which the Department of Water and Environmental Regulation (**DWER**) determined was not required due to the small, infill nature of the Structure Plan. Refer **Appendix 4** Drainage Strategy and DWER letter of advice dated 20 September 2018.

The proposed subdivision layout and drainage network has been designed to meet best practice water management requirements and promote the integration of stormwater management into the urban form.

Flat level lots will be provided with low retaining walls as required. All roads will sit above the adjacent road level. Runoff from lots up to the 5% annual exceedance probability (**AEP**) storm event will be contained onsite via soakwells installed at building stage. Excess lot runoff up to 1% AEP storm event will be stored and disposed of within the adjacent road reserve. The existing drainage network along Delaronde Drive will manage the excess lot runoff from the eight residential lots fronting Delaronde Drive.

The development will consist of a kerbed road network with paths that follow the natural lay of the land. The road network will free drain with no trapped lows. Standard drainage inlet arrangements are proposed.

The road reserve runoff will be stored and infiltrated onsite via soakwells and an approved underground leach tank system. The drainage system has been sized to cater for road reserve runoff and excess lot runoff up to the 1% AEP storm event.

Based on the proposed development layout and existing soil properties of the subject site, the site can hold and dispose of runoff from the 1% AEP storm event onsite via standard inlet and below ground drainage system. Excess runoff from extreme storm events will be directed away from the site and to the natural low to the south.

3.6 Education facilities

There are no education facilities proposed as part of this Structure Plan. The subject site is located opposite Emmanuel Catholic College to the west, which is a religious school catering for Years 7 to 12. The subject site is located within the local intake areas for Jandakot Primary School and Atwell College, which are both Independent Public Schools. Jandakot Primary School is located approximately 1.2km south of the subject site, catering to Kindergarten – Year 6. Atwell College is located approximately 2.6km to the south east of the subject site, catering to Years 7 – 12. Other non-government schools within close proximity to the subject site include Mater Christi Catholic Primary School and Divine Mercy College.

The existing education facilities located in the surrounding area are considered adequate to cater to the primary and secondary schooling needs of the community.

3.7 Activity centres and employment

There are no activity centres proposed as part of this Structure Plan. The subject site is located in close proximity the recently approved Hammond Road North Structure Plan (**HRNSP**) area, which is sited on the opposite corner of Beeliar Drive and Hammond Road to the north-west. The HRNSP is intended to facilitate the development of a neighbourhood centre, and is identified as a 'Strategic Employment Centre' under the City's Local Commercial Activity Centre Strategy. This future neighbourhood centre will provide for the daily convenience shopping needs and opportunities for local employment for future residents. The subject site is also located less than 1km from the Cockburn Gateway Shopping Centre, which is the main activity centre for the broader region, providing a range of services, facilities and employment opportunities.

The residential zoning of the land within the Structure Plan area will allow for home-based businesses, home occupations and home offices to be established within the subject site, pursuant to separate approval by the City of Cockburn.

3.8 Infrastructure coordination, servicing and staging

Investigations into the engineering works and civil infrastructure required to develop the site has been undertaken by Porter Consulting Engineers. Refer to **Appendix 9** for the complete Servicing Report.

3.8.1 Siteworks and earthworks

Clearing of existing structures and/or vegetation will be required to accommodate development. Top soil across the site is not suitable for foundation support and will be removed and/or screened to remove any root material and re-used in landscaping areas. Alternatively, the topsoil could be screened to remove all coarse organic material and blended with clean sand fill material for use as engineering fill.

It is anticipated that imported fill will be required to achieve suitable site classifications in accordance with Australian Standard AS2870-1996.

Minor cut and fill may be required depending to shape the site. It is expected a Class A site will be achieved. Minor retaining walls may be required to account for level differences between lots.

3.8.2 Water supply

Direct connections to the existing water mains to the south will be made to service the subject site. Standard water reticulation mains and pre-laid taps will be required to service each of the proposed lots.

3.8.3 Sewer reticulation

The subject site will be serviced off the existing sewer reticulation mains to the south. Standard reticulation infrastructure will be required to service each of the proposed lots.

3.8.4 Power supply

Western Power mapping indicates the area has spare capacity in the order of 5MVA (2019). This is sufficient to service a residential development of this size.

High voltage infrastructure, including transformers and switchgears, may be required to service the subject site with low voltage servicing each lot. It is anticipated direct connections to the adjoining existing infrastructure can be made.

3.8.5 Telecommunications

The subject site will be serviced via direct connections to the existing NBN infrastructure to the south.

3.8.6 Gas

The existing gas network to the south will be extended north into the subject site to service all lots.

3.9 Developer contribution arrangements

Developer contributions are to be made in accordance with City's requirements, as detailed in section 1.3.1.2 of this report. No further developer contributions are proposed or required to facilitate the future subdivision and development of the subject site.

Appendix 1
Feature Survey

A MISCLOSE IS PRESENT IN LOT 176.
A BOUNDARY RE-ESTABLISHMENT SURVEY IS RECOMMENDED TO CONFIRM POSITION AND DIMENSIONS.

NOTE:
THIS PLAN HAS BEEN PREPARED WITH 3D VALUES AND HAS PCG COORDINATES.

NOTE:
AHD LEVEL DERIVED FROM STANDARD SURVEY MARK THOMPSON 85.

WARNING!
BOUNDARY RE-ESTABLISHMENT SURVEY REQUIRED TO CONFIRM LOT BOUNDARY POSITION AND DIMENSIONS.

REV	DESCRIPTION	DRN	DATE	APP

LOT	: 176 (# 119) HAMMOND ROAD	CLIENT	: PLANNING SOLUTIONS (AUST) PTY Ltd
SUBURB	: SUCCESS	DEPSOITED PLAN 36818	SURVEYED ON : 13/07/2018
AUTHORITY	: COCKBURN	C/T : 2547 / 33	SURVEYOR : DJ
BUILDERS / CLIENTS: SITE SURVEY only. The information shown on this plan is current as at the date of survey. Boundary information, easements etc, to be verified from the Certificate of Title, Plan / Diagram or a Boundary Reped. Boundary position approximate only. Location of boundary pegs or fences in relation to the boundary lines are not guaranteed. Sewer / Drainage may vary from schematic presentation, clearances to be checked on site. Services information to be confirmed with relevant AUTHORITIES. For underground services - Any "DIAL BEFORE YOU DIG" for confirmation of those services.		DRAFTER	: NP

LandSurveys
PO Box 744
BELMONT WA 6984
Telephone (08) 9477 4477
Fax (08) 9477 4499
admin@landsurveys.net.au

SCALE : 1:200 @ A2 Landscape (0 2.5 5 10 15)

JOB No : 1800678 · PLAN: FS - 001 · DRG: - · REV. A · SHEET 1 OF 1

Z:\3. Survey Projects\2018\1800678 - Dorothy Guerinii - Hammond Rd Success\03 Delivery\3.1 Drafting\3.13 Feature\1800678-FS-001-A.dwg

SERVICE LEGEND

DRAINAGE
COMBO PIT
GRATE
SIDE ENTRY PIT
STORM WATER MANHOLE

ELECTRICITY
CABLE DOME
CABLE MANHOLE
CABLE PIT
CONSUMER POLE
LIGHT POLE
POWER POLE
STAY POLE
STAY WIRE ANCHOR
O/H POWER LINE

GAS
GAS MANHOLE
GAS MARKER
GAS METER
GAS VALVE

SEWERAGE
SEWER MANHOLE
PROPERTY CONNECTION
SEWER LINE

TELECOMMUNICATION
TEL / COMMS MANHOLE
TEL / COMMS MARKER
TEL / COMMS PIT

WATER
FLUSH POINT
HYDRANT
STOP VALVE
TAP
WATER MARKER
WATER METER
WATER LINE

SURVEY
DATUM
PEG FOUND

OTHER
AWNING / EAVES
ROOF RIDGE
FLOOR RL
WINDOW / DOOR
BANK - BOTTOM
BANK - TOP

SERVICE RECORD

STATUS / SERVICE

SERVICE	LOCATED	AVAILABLE	NO SERVICE	CONFIRM
WATER	✓			
SEWERAGE			✓	✓
GAS		✓		✓
TEL / COMM	✓			
POWER U/G				✓
POWER O/H	✓			

SERVICES MARKED CONFIRM REQUIRE BUILDER / CLIENT TO CONFIRM POSITION AND / OR AVAILABILITY ON SITE.

BEELIAR DRIVE
HAMMOND ROAD
DELARONDE DRIVE
LANGANO CHASE

176
2.0823ha
VACANT
SAND / GRASS / THICK NATURAL BUSH VEGETATION
SHRUBS & TREES HT 4m - 6m

294
VACANT
SAND / GRASS

34
VACANT / SAND / GRASS / GRAVEL

46
VACANT / SAND / GRASS / GRAVEL

Appendix 2
Certificate of Title and Deposited Plan

WESTERN AUSTRALIA

REGISTER NUMBER	
176/DP36818	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
3	27/6/2016

VOLUME 2547 FOLIO 33

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.

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 176 ON DEPOSITED PLAN 36818

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

DOROTHY MARY GUERINI OF 11B LAING LANE MOSMAN PARK
IRENE ANNE FRUZYNSKI OF 1 TUART LANE APPLECROSS WA 6153
AS TENANTS IN COMMON IN EQUAL SHARES

(T N363311) REGISTERED 24/6/2016

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

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* 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.

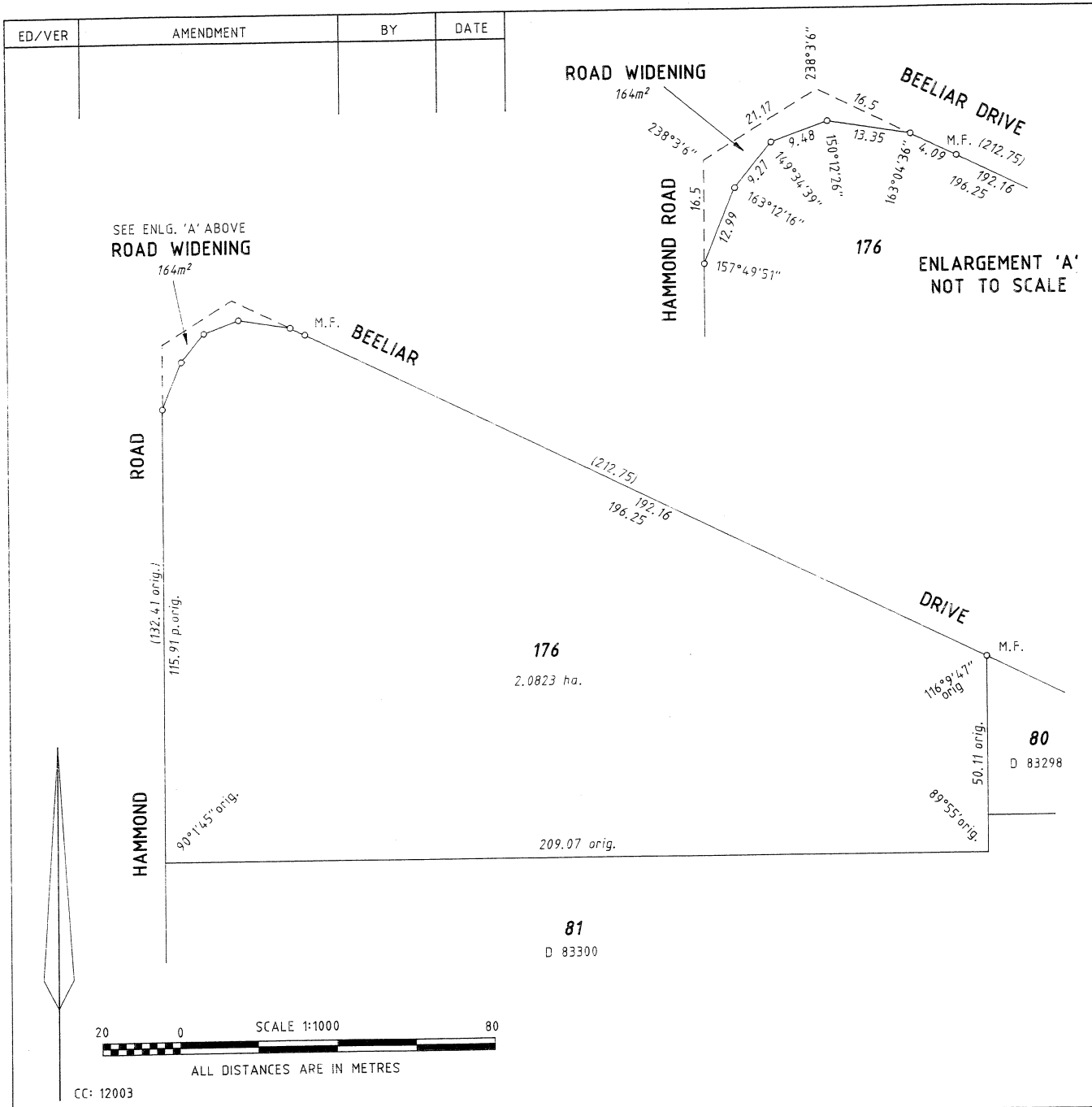
SKETCH OF LAND:	DP36818
PREVIOUS TITLE:	1947-854
PROPERTY STREET ADDRESS:	119 HAMMOND RD, SUCCESS.
LOCAL GOVERNMENT AUTHORITY:	CITY OF COCKBURN

LANDGATE COPY OF ORIGINAL NOT TO SCALE Mon Oct 30 13:25:05 2017 JOB 55211335

Landgate
www.landgate.wa.gov.au

LANDGATE COPY OF ORIGINAL NOT TO SCALE Mon Jun 11 08:51:39 2018 JOB 56910321
www.landgate.wa.gov.au
Landgate

ED/VER	AMENDMENT	BY	DATE



TYPE: FREEHOLD

PURPOSE: SUBDIVISION — SSA - NO

PLAN OF

LOT 176 AND ROAD WIDENING

DP 36818

DISTRICT: COCKBURN SOUND (JANDAKOT A.A.) — DOLA FILE

LOCALITY: SUCCESS
LOCAL AUTHORITY: CITY OF COCKBURN

FORMER TENURE	ON	FIELD BOOK
LOT 76 D 83299 C/T 1947/854	INDEX BG34 (5) 05.02	88465

SCALE: 1:1000
ALL DISTANCES ARE IN METRES

Cadastral Cartographics
PO Box 1501, South Perth, 6951
Ph 9368 0886 Fax 9368 1995

SURVEYOR'S CERTIFICATE - Reg 54

I RUSSELL WELLINGTON hereby certify that:

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

Licensed Surveyor ... Date 16-04-2003

LODGED
DATE 17.4.2003
FEE PAID $208
ASSESS No. 379313

TYPE OF VALIDATION
FULL AUDIT
LEGAL COMPONENT BLG
DOCKET PLAN/~~DIAGRAM~~ 36364
CERTIFIED CORRECT 16.5.5.03
I.S.C.
F.S.C.

Russell Wellington & Associates
52 Cricklewood Way, Carine, 6020
Phone / Fax 9448 2989 Mobile 0412 985 498

APPROVED BY
WESTERN AUSTRALIAN PLANNING COMMISSION
FILE 120611
DATE 30-5-03
DELEGATED UNDER S.20 W.A.P.C. Act 1985

IN ORDER FOR DEALINGS
SUBJECT TO
Sec 28(3) of T.P. & D. Act.

J. Chernowski 3.6.03
FOR INSPECTOR OF PLANS & SURVEYS/ AUTHORIZED LAND OFFICER — DATE

APPROVED
APPROVED 1.8.2003
INSPECTOR OF PLANS & SURVEYS/ AUTHORIZED LAND OFFICER — DATE

Department of Land Administration

DEPOSITED PLAN
36818

SHEET 1 OF 1
EDITION 1 VERSION 1

AS ORIGINAL

Appendix 3
Traffic Impact Statement

Porter
Consulting Engineers

LOT 176 (#119) HAMMOND ROAD SUCCESS

TRAFFIC IMPACT STATEMENT

Porter

REPORT PREPARED FOR

Dorothy Guerini
c/o Planning Solutions

Prepared by	**Porter Consulting Engineers**
Postal address	PO Box 1036 Canning Bridge WA 6153
Phone	(08) 9315 9955
Email	office@portereng.com.au

Job number	18-06-070
Date	19/12/2018
Our reference	R32.18
Checked	EW/JH

HISTORY AND STATUS OF THE DOCUMENT

Revision	Date issued	Author	Issued to	Revision type
Rev A	02/07/2018	J Hopfmueller	Planning Solutions	First draft
Rev B	19/12/2018	J Hopfmueller	Planning Solutions	Final

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Appendix A Structure Plans

1.0 INTRODUCTION

1.1 Background

Porter Consulting Engineers has been engaged to prepare a Transport Impact Statement (TIS) for a proposed structure plan of Lot 176, (No. 119) Hammond Road, Success in the City of Cockburn. The structure plan comprising the creation of 34 single residential lots and 1 group dwelling lot.

Lot 176 is presently undeveloped unoccupied land. The northern and western boundaries of the Lot are Hammond Road and Beeliar Drive respectively and no direct access is provided. Access to the residential dwellings will be via new road connection to the adjacent local access road Delaronde Drive.

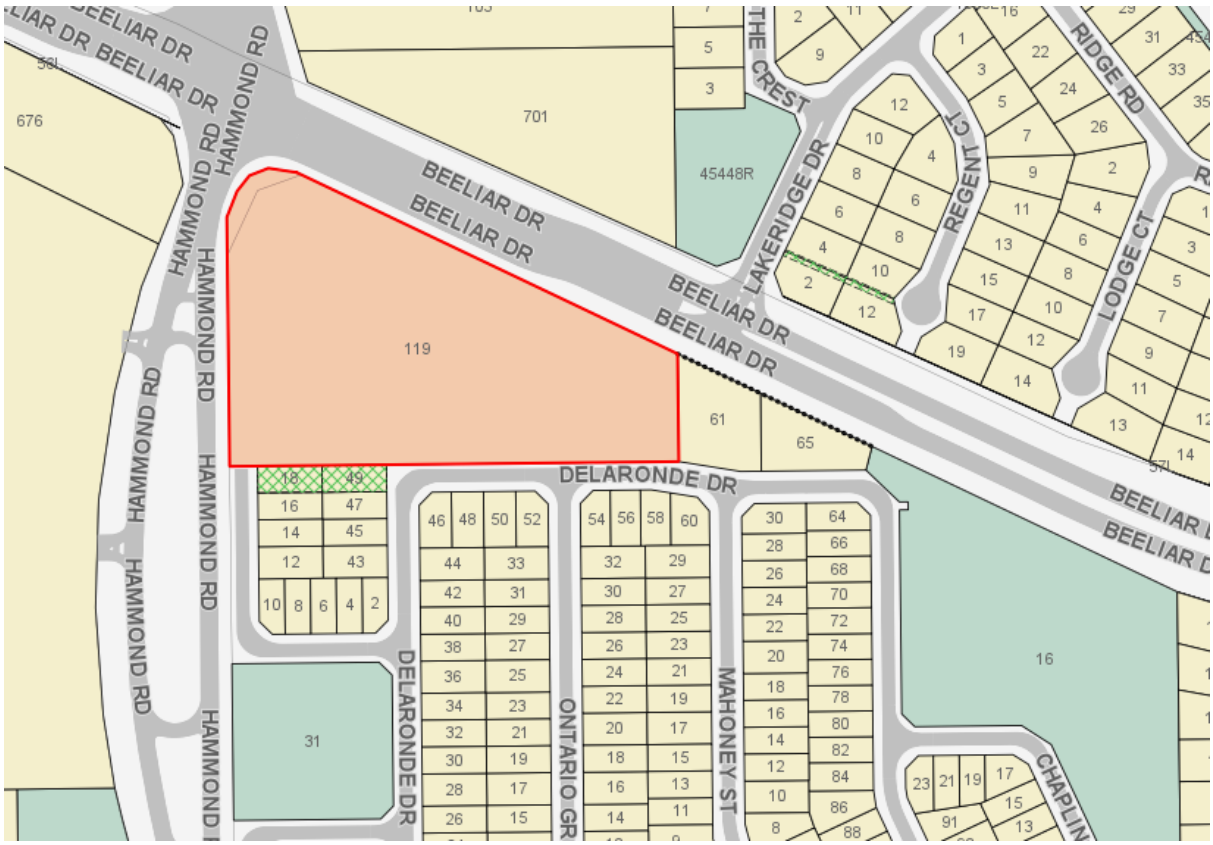


Figure 1. Lot176, (No.119) Hammond Road (City of Cockburn Intramaps)

1.2 Scope of Work

This Transport Statement has been prepared in accordance with the Western Australian Planning Commission's (WAPC's) *Transport Assessment Guidelines for Developments Volume 2 Structure Plans* (2006).

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

2.0 STRUCTURE PLAN PROPOSAL

2.1 Structure Plan Context

The subject Site is currently undeveloped. The Site is typically surrounded by existing residential land uses. **Figure 2** contains an aerial view of the subject Site and its immediate surrounds and its location in a local context. Key non-residential land uses in close proximity include Emmanuel Catholic College on the western side of Hammond Road, Cockburn Central on the northern side of Beeliar Drive and Cockburn Gateway Shopping Centre approximately 1.5km to the east of the Site.



Figure 2. Location in a Local Context

The Site is located in the suburb of Success. It is located approximately 25km south of the Perth CBD. Major arterial roads within close proximity include Beeliar Drive to the north and the Kwinana Freeway to the east. **Figure 3** shows the Site in a regional context.

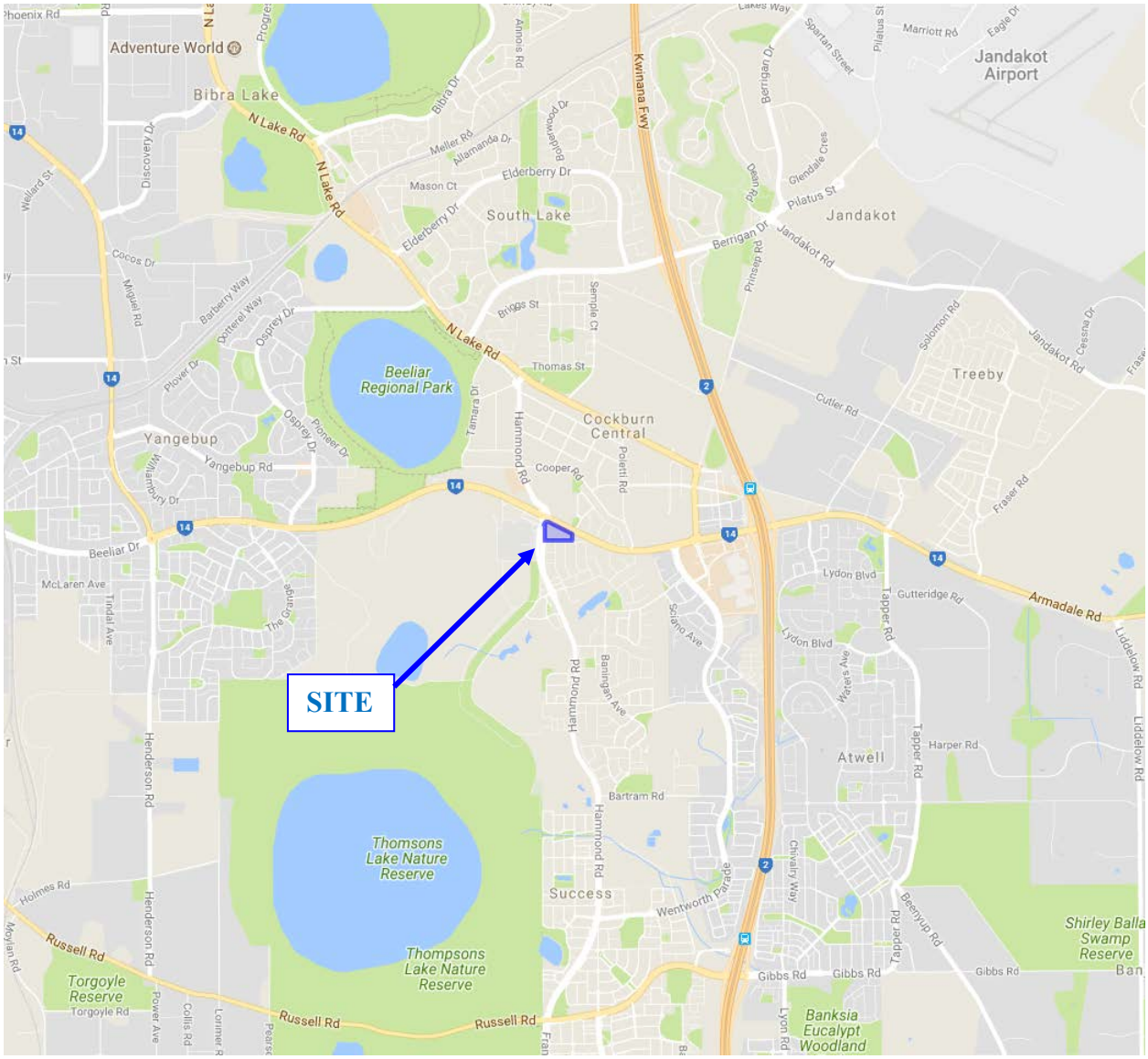


Figure 3. Location in a Regional Context

2.2 Proposed Land Uses

The structure plan proposes residential zoning at R30, R40 and R60 densities. Based on an indicative lot layout it is estimated that the total number of lots created will be 35. This residential zoning is in line with the adjacent established residential development of R30, R40 and R60 zoning as outlined in the Lakeside Success Structure Plan.

Appendix A contains a copy of the proposed Structure Plan and the adjacent Lakeside Success Structure Plan.

2.3 Major Attractors and Generators of Traffic

Within the proposed structure plan, the residential lots are the major traffic generating land use. Surrounding attractors include:

- Cockburn Gateway Shopping Centre (to the east)
- Jandakot Primary School (to the south)
- Atwell High School (to the southeast)
- Emmanuel Catholic College (to the west)
- Cockburn Aquatic and Recreational Centre (to the northeast)
- Cockburn Central (to the north)

Traffic generated by the proposed subdivision would typically be firstly attracted north of the Site along Beeliar Drive and then subsequent connections to the primary distributor road network such as Kwinana Freeway.

3.0 ROAD NETWORK SITUATION

3.1 Existing Road Network

Figure 4 illustrates the road network servicing the subject Site. The Site is bordered by three existing roads, being Hammond Road (western boundary), Beeliar Drive (northern boundary) and Delaronde Drive (southern boundary). Access to the residential dwellings will be via road connections to the adjacent local access road Delaronde Drive. No direct access is provided to either Hammond Road or Beeliar Drive.

Residential traffic can access the distributor road network (i.e. Hammond Road and Beeliar Drive) via the local distributor roads of Jubilee Avenue and Alabaster Dr/Wentworth Parade.

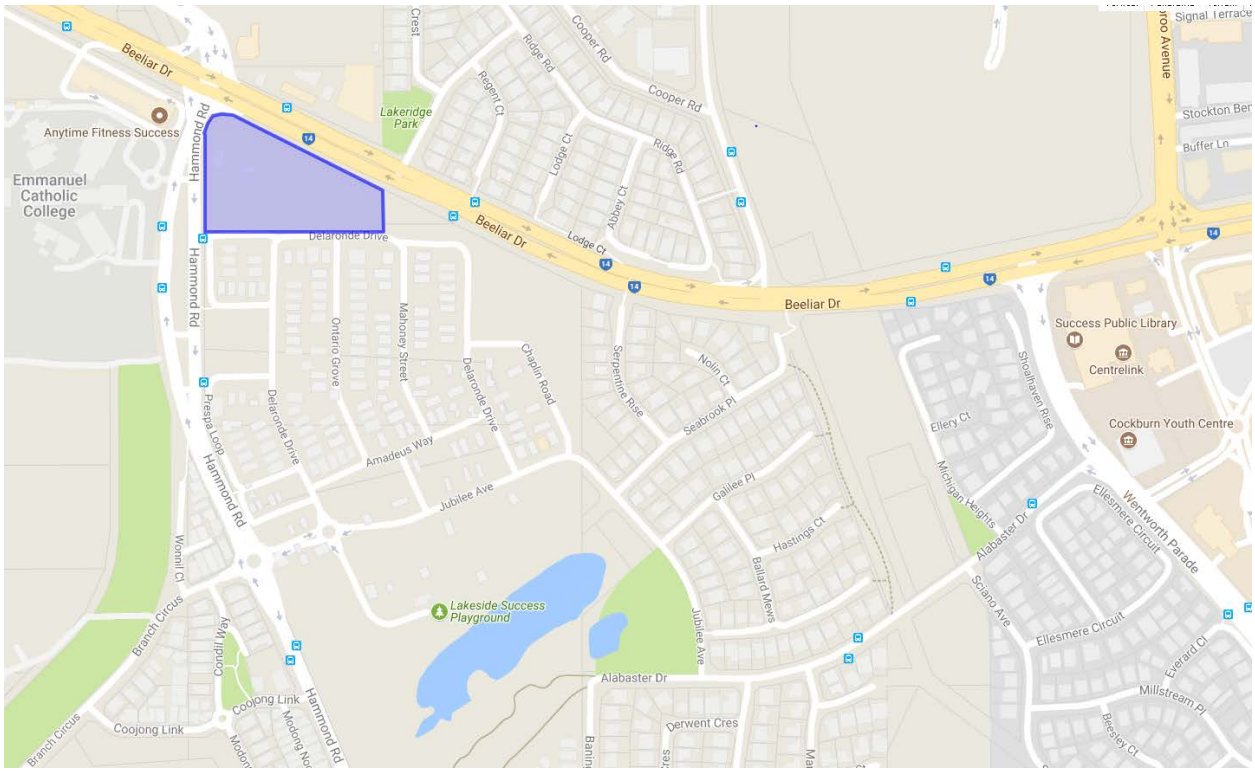


Figure 4. Surrounding Road Network

3.2 Road Infrastructure and Road Hierarchy Classification

The road hierarchy classification of the surrounding road network as defined by Main Roads WA functional road hierarchy is shown in **Figure 5**.



Figure 5. Functional Road Hierarchy (MRWA)

Delaronde Drive

Delaronde Drive is a Local Access road constructed to a two lane undivided and unmarked standard with a pavement width of approximately 6m. The function of a Local Access road is *"to provide access to abutting properties with amenity, safety and aesthetic aspects having priority"*. Street lighting is located along the southern side of the road. Immediately adjacent to the Site the footpath is located on the southern side of the road however to the east of the Site the footpath is located along the northern side of the road.



Figure 6. Delaronde Drive adjacent to the Site

Jubilee Avenue
Jubilee Avenue is a Local Distributor road whose function is defined as being to "*carry traffic within a cell and link to District Distributors….. should discourage through traffic so that it only carries traffic belonging to or serving the area."* The road is constructed to a two lane divided standard west of its intersection with Delaronde Drive and to a two lane undivided unmarked standard to the east of its intersection with Delaronde Drive. Parking embayments are located on both sides of the road as well as footpaths.

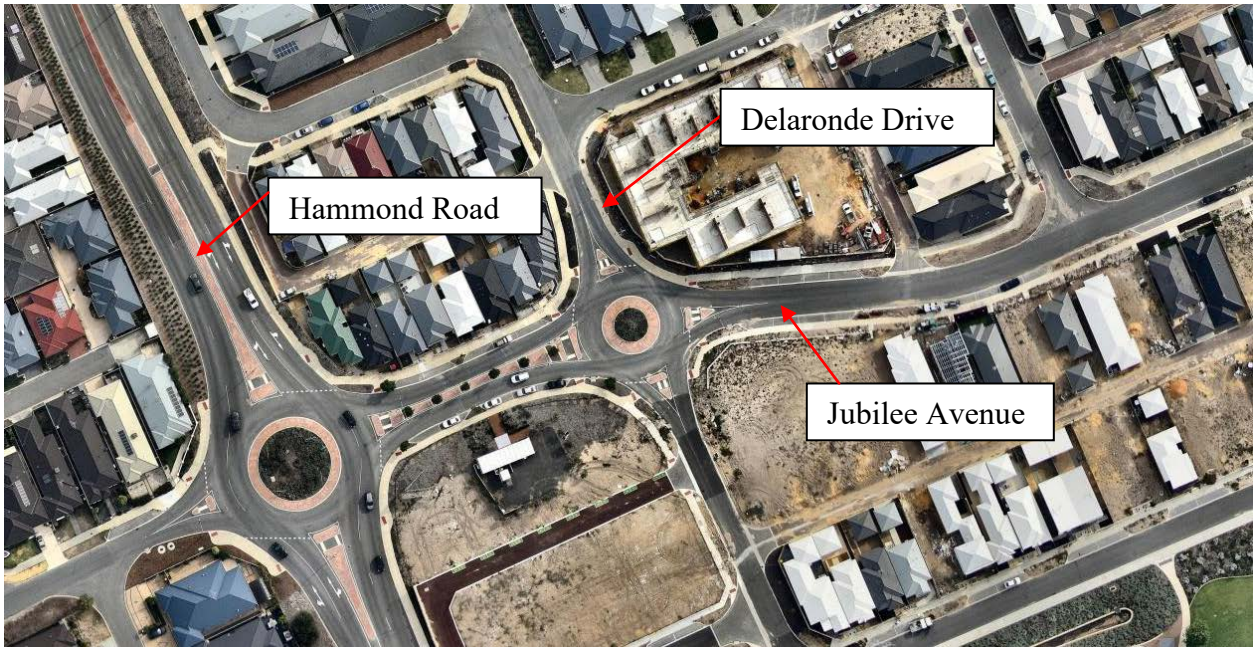


Figure 7. Jubilee Avenue

Alabaster Drive
Alabaster Drive is a Local Distributor road constructed to a two lane undivided unmarked standard. Its intersection with Jubilee Avenue incorporates median island treatments that define the intersection and provide safe refuge for pedestrians crossing at the intersection. A path is typically located on the southern side of the road.

Hammond Road
Hammond Road is a District Distributor (B) road constructed to a four lane divided carriageway standard. Its intersection with Jubilee Avenue is controlled via a roundabout whilst its intersection with Beeliar Drive is controlled by traffic signals. As a District Distributor (B) its role is to "*carry traffic between industrial, commercial and residential areas and generally to connect to Primary Distributors….they have reduced capacity due to flow restrictions from access to and roadside parking alongside adjoining property".* A footpath is located on both sides of the road adjacent to the Site.

Beeliar Drive
Beeliar Drive is a District Distributor (A) road constructed to a four lane divided carriageway standard. As a District Distributor (B) its function is to "*carry traffic between industrial, commercial and residential areas and generally to connect to Primary Distributors*". Its intersection with Hammond Road is controlled by traffic signals. A footpath is located on both

sides of the road adjacent to the Site.



Figure 8. Alabaster Drive



Figure 9. Hammond Road and Beeliar Drive

3.3 Existing Traffic Volumes

Tables 1 shows the peak hour traffic flows recorded on the road network surrounding the development Site. Traffic data was sourced from the City of Cockburn IntraMaps database.

Table 1. Recorded Traffic Volumes on the Sounding Road Network

Location	Data Source	Date	AWT	% HV	AM Peak Volume	PM Peak Volume
Hammond Road, south of Beeliar Dr	Cockburn	10/12/2014	4,467	4.0%	-	-
Jubilee Ave, east of Hammond Rd	Cockburn	25/10/2016	1,619	5.7%	-	-
Jubilee Ave, north of Alabaster Dr	Cockburn	25/10/2016	1,440	3.0%	-	-
Alabaster Dr, west of Sciano Ave	Cockburn	11/05/2006	3,052	-	-	-

3.4 Crash History

A study of the recent crash history for the surrounding road network including Delaronde Drive, Langano Chase, Ontario Grove, Mahoney Street and Jubilee Avenue has been conducted for the five year period to the end of December 2017 from the Main Roads Western Australia Integrated Road Information System (IRIS) crash database. There was a total of 4 crashes within the extracted data which is summarised as follows.

- 1 intersection crash at Jubilee Avenue and Alabaster Dr involving a motorcyclist losing control resulting in minor property damage.
- 1 midblock side swipe crash along Jubilee Avenue from a vehicle overtaking on the right of a vehicle waiting to turn right resulting in major property damage.
- 1 rear end intersection crash at Jubilee Avenue and Hammond Road roundabout resulting in major property damage. Road conditions were wet at the time of the crash.
- 1 midblock crash on Mahoney Street involving a vehicle leaving a driveway resulting in minor property damage.

3.5 Public Transport

The Site has good access to public transport. Several bus routes travel along both Hammond Road (Routes 530 and 531) and Beeliar Drive (Routes 522, 530, 53 and 532). Potentially boundary fencing along either side may increase the walking distances although **Figure 10** suggests that the typical walking distances would still be less than 400m.



Figure 10. Existing Public Transport Routes Surrounding the Site (GoogleMaps)

3.6 Pedestrian and Cyclist Facilities

Figure 11 shows an aerial photo of the pedestrian and cyclist facilities within the immediate surrounds of the Site. Hammond Road has a dual use path located on the western and eastern side of Hammond Road, south of Beeliar Drive. North of Beeliar Drive is a dual use path on the western side. The signalised intersection of Hammond Road and Beeliar Drive has pedestrian signals to accommodate the crossing of both roads.

Beeliar Drive adjacent to the Site has a dual use path located on its southern side. An uncontrolled staged pedestrian road crossing in located on the western side of Lakeridge Drive.

The local access streets immediately to the south of the subdivision typically have a footpath on one side to accommodate the local residential pedestrian and cyclist movements.

The network of local paths and adjacent dual use paths provide good links external to the subdivision that can be connected to, and provide a complete pedestrian and cyclist network to the immediate surrounds i.e. Cockburn Central, Emmanuel College and Cockburn Gateway Shopping Centre typically within a 1000m radius or a 10-12 minute walk. **Figure 12** shows the

existing cycling facilities within the surrounding road network as documented within the Department of Transport "Perth Map Series".



Figure 11. Aerial Image of Pedestrian and Cyclist Facilities

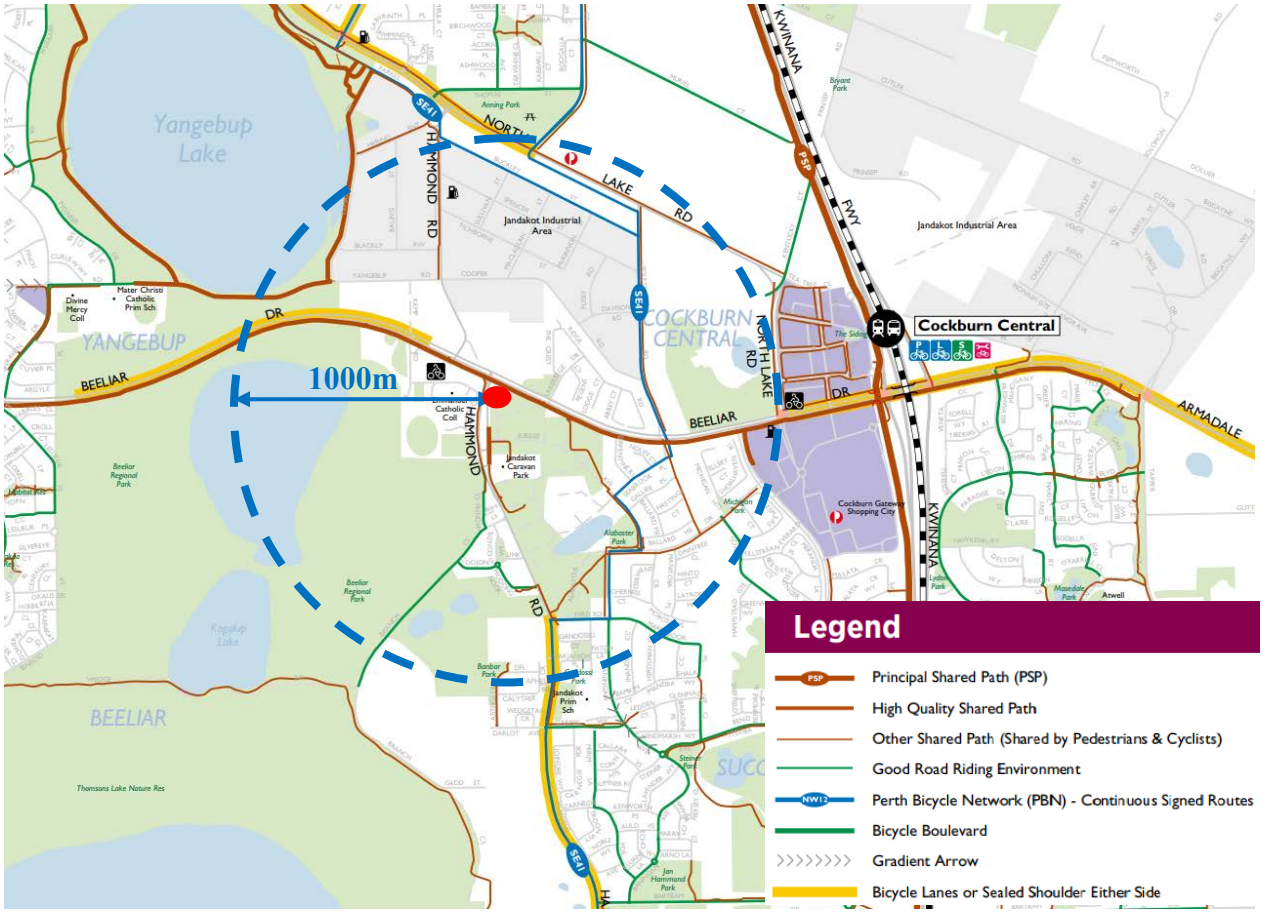


Figure 12. Existing Public Transport Routes Surrounding Site (Department of Transport)

4.0 ASSESSMENT OF VEHICLE TRANSPORT NETWORK

4.1 Internal Road Network

The proposed internal road network layout is shown in **Figure 13**. The road reserve widths for the proposed new internal road network are proposed to be 13m and 15m. These widths adhere to those of the adjacent external road network i.e. Delaronde Drive (15m) and Langano Chase (13m) as documented within the Lakeside Success Structure Plan. It is noted however that the *Draft Liveable Neighbourhoods* (WAPC 2015) suggests an indicative road reserve width of 15.5m based on a 5.5m pavement width and 5.0m verge widths as shown in **Figure 14.** The road cross section is yet to be confirmed in this application.

These internal roads within the structure plan are likely to carry less than 1,000 vehicles per day hence it would be considered appropriate to adopt a 5.5m wide pavement as shown. Based on a 13m and 15m road reserve, a verge width of 3.75m to 4.75m remain respectively. Their widths are adequate to provide a footpath but must also be adequate to contain the appropriate services. The development servicing report should be referred to in this instance.

No footpaths are provided within the 13m road reserve in the adjacent structure plan i.e. Langano Chase. The reduced verge width of Langano Chase may have been achievable due to the adjacent footpath on Hammond Road as well as use of the Hammond Road verge. The same principles may be able to be applied to adjacent to the POS.

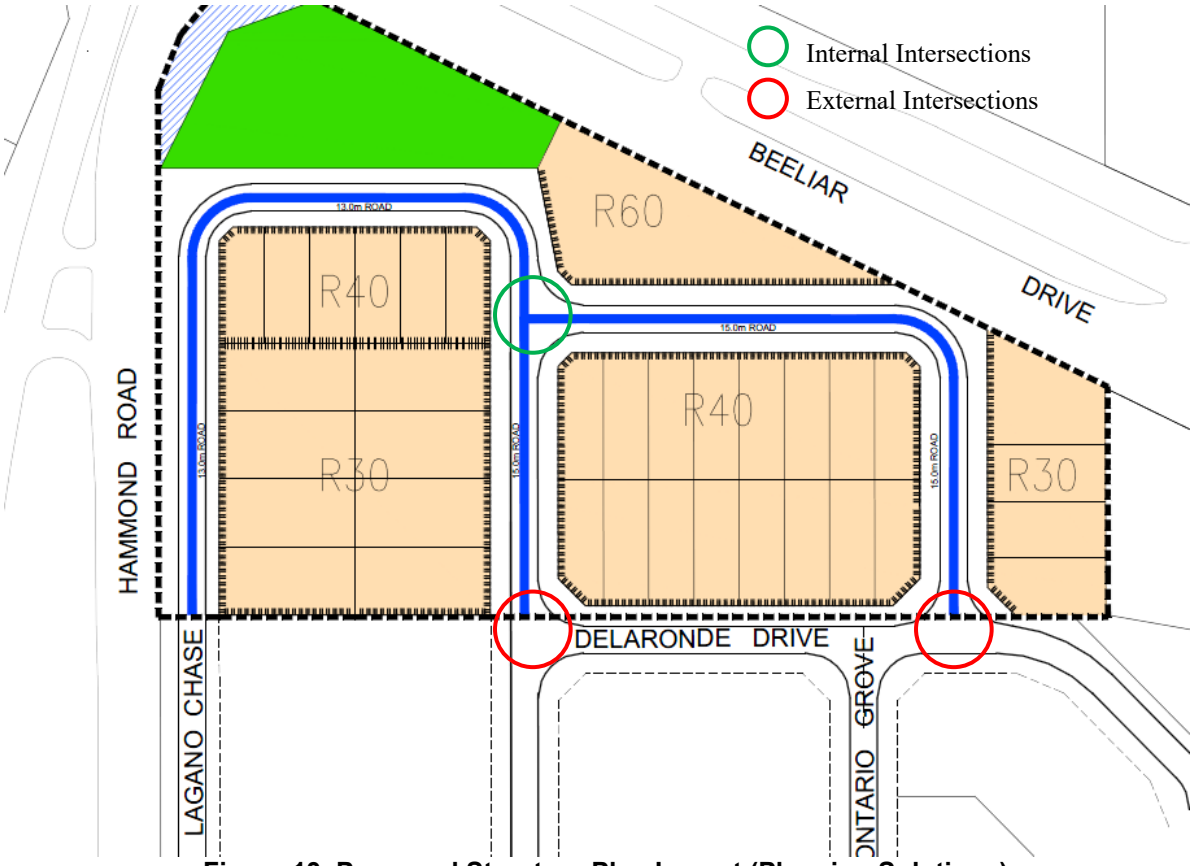


Figure 13. Proposed Structure Plan Layout (Planning Solutions)

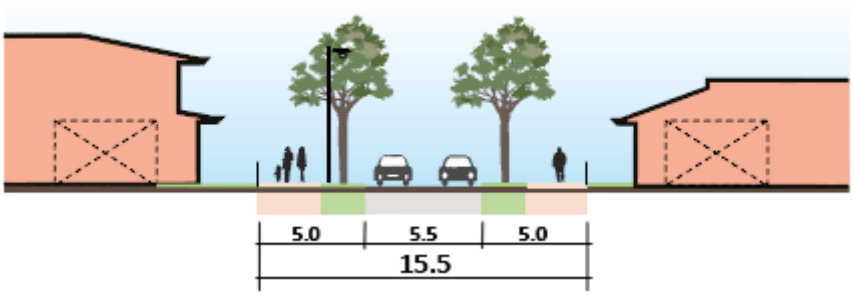


Figure 14. Local Access Street (Liveable Neighbourhoods, WAPC)

The lot layout will result in the creation of one new internal intersection. A priority T-junction treatment is the proposed form of geometry and control. The intersection is located near a bend which restricts sight lines to/from the intersection. Based on a design speed of 30km/h around the bend it is estimated that the stopping sight distance (ASD) being 27m can be provided allowing vehicles to stop should a vehicle enter from the intersection. Safe intersection sight distance (SISD) for 30km/h is 52m and is not available at the intersection looking towards the bend. For this reason the intersection is considered to pose a moderate risk only due to the low volume of traffic anticipated to travel through the intersection.

Three bends are created within the lot layout. These roads are low volume carrying only traffic from the dwellings located along the roads. Consequently the bends are considered "low risk" and will assist in maintaining a low speed street environment. Good practice would be to include a median island to separate turning movements which will require localised widening of the road reservation at the bend. Truncations on corner lots should be provided to ensure the appropriate sight lines around the bend are available for the design speed of the bend.

4.2 External Road Network

The proposed road network will result in the creation of two new intersections with an existing road. These new intersections are both along Delaronde Drive. A priority T junction is the proposed form of control for each of the intersections. The former bend along Delaronde Drive is to become a T-junction and a new T-junction is to be created 20m to the east of the existing T-junction of Delaronde Drive and Ontario Grove. The layout is such that a right-left stagger is created. This being the preferred arrangement for closely staggered T-junctions. Based on the lot layout and number of dwellings it is expected that only a small number of vehicles will undertake this turn.

4.3 Traffic Generation

The traffic generated by the proposed structure plan is forecast using rates suggested in the *Guide to Traffic Generating Developments, Roads and Traffic Authority, NSW, 2002*. These rates are:

- 0.85 vehicle trips per dwelling for the am and pm peak hours.
- 9 vehicle trips per dwelling daily

There are a total of 35 lots assumed to translate to 42 dwellings. On this basis, it is estimated that there will be 378 daily trips (with 36 peak hour trips) generated within the structure plan Site.

Due to the Site layout no extra non-subdivisional generated traffic is anticipated to travel through the Site's roads.

4.4 Traffic Distribution

Of the generated daily traffic, 189 vehicle movements are assumed to be inbound and 189 vehicle movements are assumed to be outbound.

The resulting trip assignment at the external connections to the existing road network is shown in **Figure 15.** Based on the connectivity of the surrounding road network, various trip purposes and the surrounding land uses, it is expected that proportionally more structure plan traffic will access the distributor road network using the intersection of Hammond Road/Jubilee Avenue (75%) compared to Jubilee Avenue and Alabaster Drive (25%).

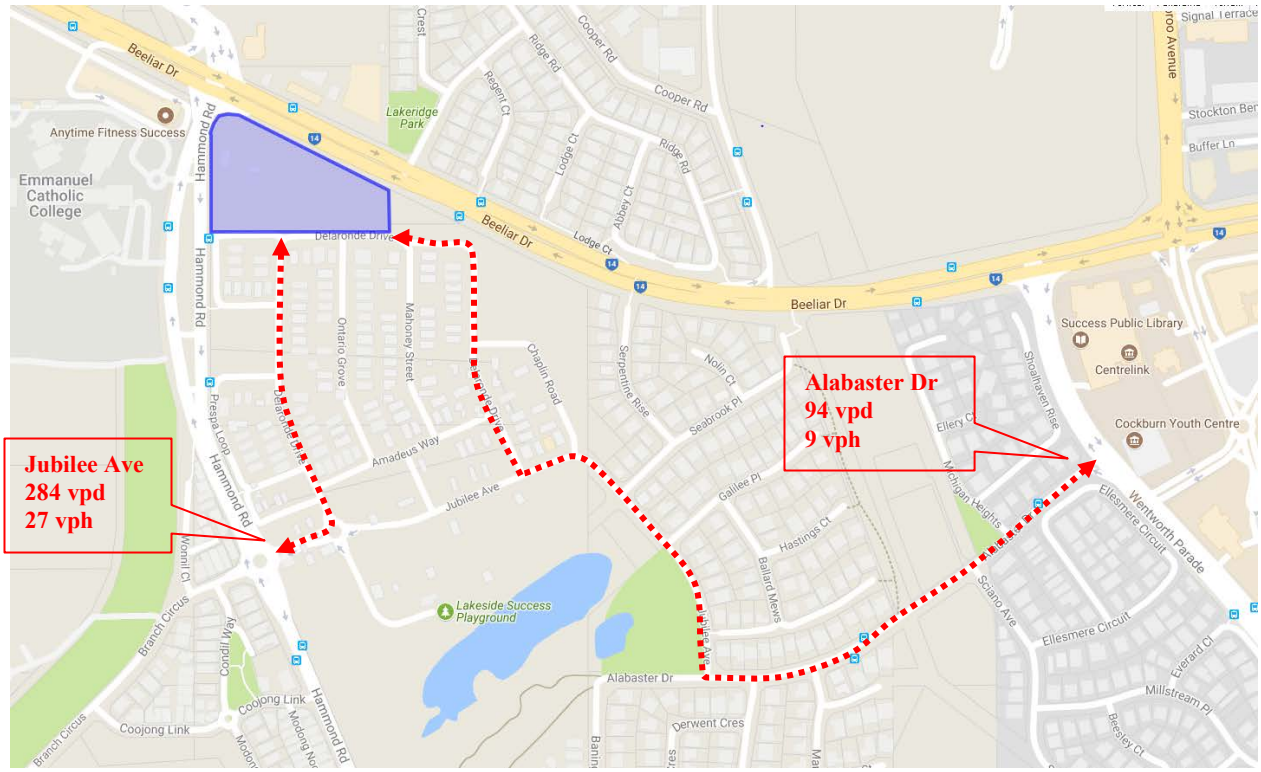


Figure 15. Daily Traffic Volumes

4.5 Impact of the Local Road Network

The structure plan is expected to generate an average of approximately 378 vehicle trips per day. The indicative maximum volume of traffic suitable for a "narrow yield" or Access Street D is up to 1,000 vehicles per day. (*Liveable Neighbourhoods, WAPC 2015*) On this basis the majority of the roads will carry significantly less than the indicative maximum based on function and amenity.

Jubilee Avenue, east of Hammond Road, carries in the order of 1,619 vehicles per day. (*AWT, Oct 2016).* Jubilee Avenue, east of Hammond Road is constructed to a two lane divided carriageway standard. According to the *Main Roads Functional Hierarchy* Jubilee Avenue is classified as a *Local Distributor*. In line with this classification, Jubilee Avenue is expected to carry up to 6,000 vpd based on its function. With the existing volume being 1,619 vehicles per day this is only 27% of the maximum. With respect to the cross section and road reserve width, Jubilee Avenue is likely to be defined as a *Neighbourhood Connector B* under *Liveable Neighbourhoods* guidelines. The indicative maximum volume for this category of road is 3,000 vehicles per day. Again, this is some 50% below the desirable volume. Accordingly, there is adequate spare capacity for this additional traffic on Jubilee Avenue and the resultant traffic volumes will remain in line with the road classification and function. There is still room for traffic growth not yet reflected in the traffic counts due to a small section of residential lots still to be built on.

The additional peak hours increase of only 27 vehicles will have insignificant impact on the existing operation of the roundabout of Jubilee Avenue and Hammond Road.

Alabaster Drive, west of Sciano Ave, carries in the order of 3,052 vehicles per day. (*AWT, May 2006*). Alabaster Drive is constructed to a two lane undivided carriageway standard. According to the *Main Roads Functional Hierarchy* Alabaster Drive is classified as a *Local Distributor*. As outlined for Jubilee Avenue this classification of road is expected to carry up to 6,000 vpd based on its function. With the latest recorded traffic volume being 3,052 vehicles per day on Alabaster Drive this is approximately 50% of the preferred maximum. It is expected that a 2018 traffic count on this road would be higher than the 2006 volume due to the residential development outlined in the Lakeside Success Structure Plan. The additional increase of approximately 94 vehicles per day can be readily accommodated within the spare capacity of this road.

5.0 CONCLUSION

The Structure Plan for Lot 176, (No. 119) Hammond Road, Success, proposes R30, R40 and R60 densities of residential living zoning. Based on an indicative lot layout it is estimated that the total number of lots created will be 35 translating to approximately 42 residential dwellings.

The subject Site is bordered by three existing roads, being Beeliar Drive, Hammond Road and Delaronde Drive. The northern and western boundary of the Site are Hammond Road and Beeliar Drive respectively and no direct access is to be provided to those roads. Access to the residential dwellings will be via road connections to the adjacent local access road of Delaronde Drive. Major arterial roads within close proximity include Beeliar Drive and the Kwinana Freeway.

Two new intersections will be created on to Delaronde Drive which have been assessed to operate satisfactorily. A new intersection is created internally and is located near a right angle bend. Whilst the bend encourages a low speed environment the proximity of the bend to the intersection is such that only Stopping Sight Distance (SSD) is provided and not Safe Intersection Sight Distance (SISD).

The internal road network of the proposed structure plan is consistent with the road reservations outlined for the adjacent subdivision outlined in the Lakeside Success Structure Plan. It is noted however that the 13m and 15m road reservation widths are slightly less than the typical 15.5m reserve widths outlined within *Liveable Neighbourhoods*. A pavement width of 5.5m will be adequate based on the predicted traffic volumes. The resultant reduced verge widths of 3.75m and 4.75m will be adequate to allow for a path however the servicing requirements within the verge widths should be confirmed. Good practice would be to include a median island to separate turning movements at the proposed bends within the new internal road network which will require localised widening of the road reservation. Truncations on corner lots should be provided to ensure the appropriate sight lines around the bend are available for the design speed of the bend.

The volume of traffic expected to be generated by this development is 378 vehicles per day with 36 peak hour trips. It is expected that proportionally more development generated traffic will access the distributor road network using the intersection of Hammond Road/Jubilee Avenue (75%) compared to Jubilee Avenue and Alabaster Drive (25%). The additional development traffic volumes are within the spare capacity of the roads and the increased traffic volumes are in line with the respective road functions. The forecast traffic movements at the intersections are below those that require capacity analysis to occur.

The structure plan has yet to propose a network of paths to facilitate cyclist and pedestrian movements.

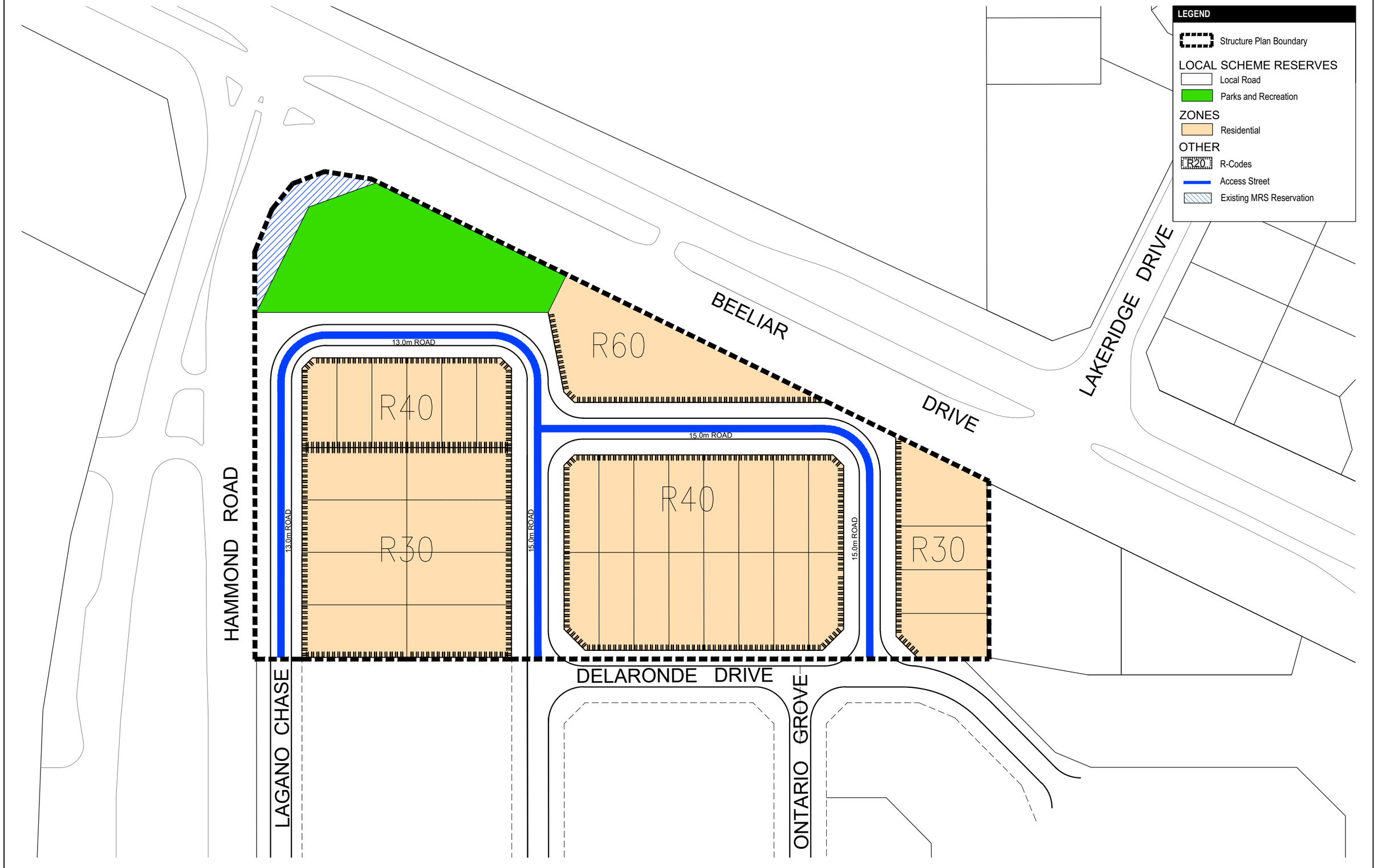
Based on the findings within this Transport Impact Statement, the Structure Plan presents no significant traffic operation and capacity issues.

APPENDIX A

STRUCTURE PLANS

Proposed Structure Plan
Lakeside Success Structure Plan

DRAFT WITHOUT PREJUDICE



PLANNING SOLUTIONS | PS
URBAN & REGIONAL PLANNING

SCALE	1: 750 @ A3
DATE	19 December 2018
FILE	181219 4900 Concept Plan.dwg
REVISION	1/DR/First Draft/17.12.2018

CONCEPT PLAN

LOT 176 (119) HAMMOND ROAD,
SUCCESS, WA

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Appendix 4
Drainage Strategy & DWER letter of advice

Government of **Western Australia**
Department of **Water and Environmental Regulation**

Your ref: R36.18
Our ref: PA22572 RF3769-05
Enquiries: Nicolene Gault, Ph (08) 9550 4237

Porter Consulting Engineers
PO Box 1036
CANNING BRIDGE WA 6153

Attention: Shane Highman

Dear Shane

RE: DRAINAGE STRATEGY – LOT 176 HAMMOND ROAD SUCCESS

Thank you for referring the above mentioned water management strategy received by the Department of Water and Environmental Regulation (DWER) by correspondence dated 24th August 2018.

It is the Department's understanding this report is intended to fulfil water management information requirements of *Better Urban Water Management* (WAPC, 2008), as it is recognised that this relatively small, infill style structure plan does not warrant a full Local Water Management Strategy.

The DWER has reviewed the strategy and wishes to advise that the document satisfies these requirements subject to any advice from the City of Cockburn.

If you have any queries relating to the above matter, please contact Nicolene Gault at DWER's Mandurah office on (08) 9550 4237.

Yours sincerely,

Brett Dunn
Program Manager – Land Use Planning
Kwinana Peel Region
20 / 09 / 2018

CC: Sabbir Hussien
City of Cockburn
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Porter
Consulting Engineers

DRAINAGE STRATEGY

Lot 176 Hammond Road, Success

Porter

Report Prepared For:

DOROTHY GUERINI

Report Prepared By:

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Job No:	18-06-070
Date:	19 December 2018
Our Ref:	R36C.18
Rev:	C
Checked:	

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APPENDIX 2 – Geotechnical Report
APPENDIX 3 – Development Layout
APPENDIX 4 – Drainage Calculations
APPENDIX 5 – Drainage Strategy Plan

1.0 INTRODUCTION

Porter Consulting Engineers has been commissioned by Dorothy Guerini to prepare a Drainage Strategy for the proposed development of Lot 176 Hammond Road in Success.

The site is located at the south-eastern corner of Beeliar Drive and Hammond Road. Please refer to **Figure 1** for the site location details.

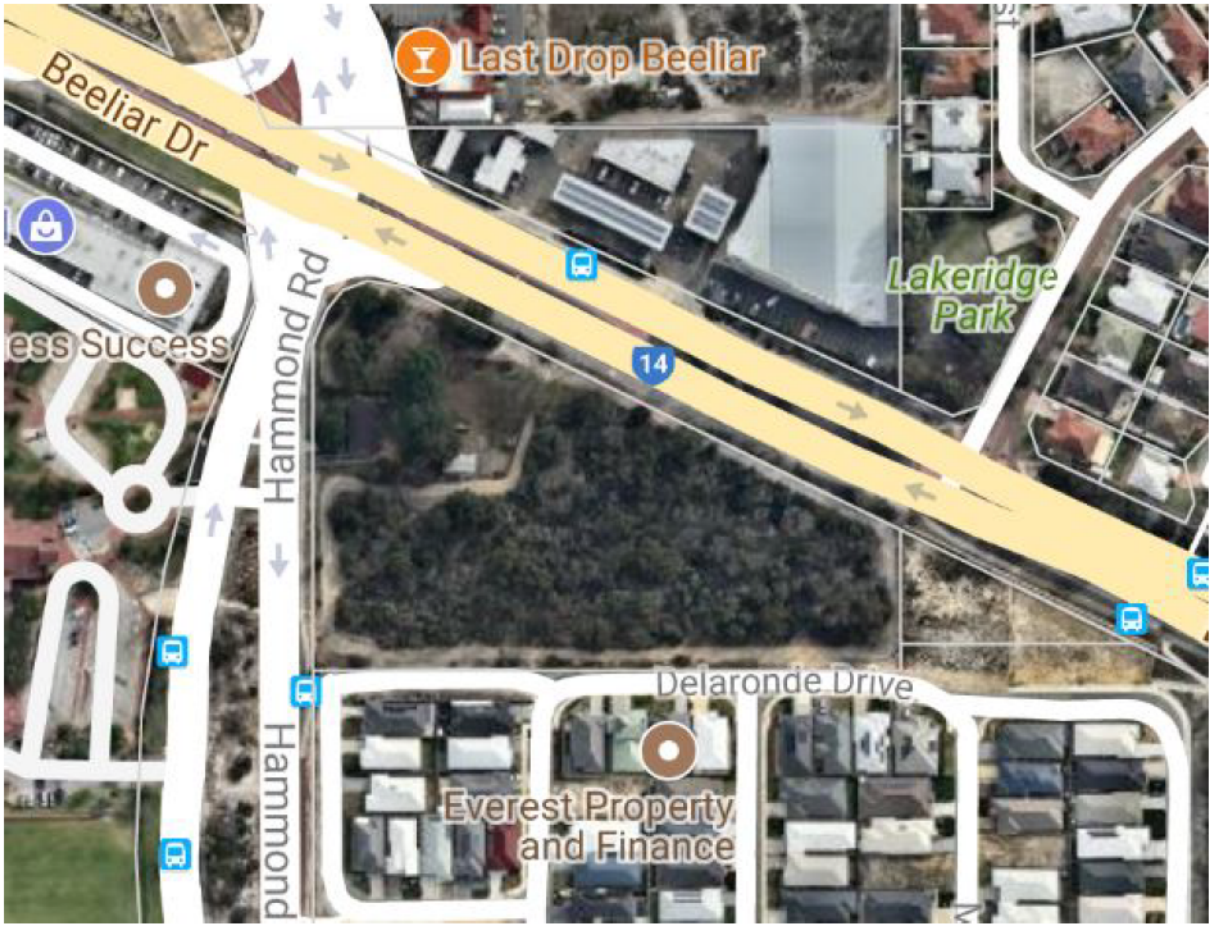


Figure 1 – Site Location

The parent lot is 2.08 hectares and is surrounded by Beeliar Drive to the north, Hammond Road to the west and existing residential development to the south and east. The site is vegetated and varies in elevation from RL 25m in the south west grading evenly up to RL 28.5m in the north east.

2.0 EXISTING DRAINAGE INFRASTRUCTURE

The existing residential development to the south has a pit and pipe drainage network discharging to a POS/ basin area. A plan of the existing drainage network is shown in **Appendix 1.** It is understood no allowances for runoff from Lot 176 have been made.

3.0 EXISTING GROUND CONDITIONS

A Geotechnical Investigation has been completed for the site by Brown Geotechnical Pty Ltd (Report No. 18018.01). A copy of the report is included in **Appendix 2**.

The investigation identified the existing soil profile to be predominately Bassendean sand overlain by a thin layer of topsoil. Permeability of the existing sands is good, with a measured permeability rate (two locations) of 86m/day. The soil permeability is expected to reduce during the life of the asset. A design permeability rate of 20m/day has been used which reflects a 76% de-rating.

Groundwater was not encountered during the investigation (test pits extended 2m down). The Perth Ground Water Atlas (Water and Rivers Commission 1997) estimates the maximum ground water level to be within 3m of the natural surface. All drainage infrastructure shall be shallower than 3m.

4.0 DEVELOPMENT DRAINAGE STRATEGY

The development layout is included in **Appendix 3**. It contains a road network with 34 residential lots, a grouped housing site and a Public Open Space in the north-east corner.

4.1 Lot Drainage

Flat level lots will be provided with low retaining walls as required. All lots will sit above the adjacent road level.

Runoff from lots up to the 5% AEP storm event will be contained onsite via soakwells installed at building stage. Based on an average lot size, each lot will require approximately two 1.8x0.9m soakwells. Excess lot runoff up to the 1% AEP storm event will be stored and disposed of within the adjacent road reserve.

The excess lot runoff from the 8 lots fronting Delaronde Drive is expected to total 5l/s (critical storm duration 1Hr). The existing drainage network will manage this.

4.2 Road Reserve Drainage

The development will consist of a kerbed road network with paths that follow the natural lay of the land. The road network will free drain with no trapped lows. Standard drainage inlet arrangements are proposed.

Road reserve runoff will be stored and infiltrated onsite via soakwells (1.8m deep) and an approved underground leach tank system (Tunnelwell or similar). The drainage system has been sized to cater for road reserve runoff and excess lot runoff up to the 1% AEP storm event.

Drainage calculations and the Drainage Strategy Plan including concept earthwork levels and drainage details are included in **Appendix 4** and **5** respectively. The location of the proposed drainage infrastructure is indicative and is subject to detailed design. The proposed development layout allows for reduced verge widths adjacent to Beeliar Drive and Hammond Road. Where possible the underground leach tanks have been positioned outside of pavement areas.

4.3 Extreme Storm Events

The road and lot drainage will be designed for the 1% AEP events. All lots site above their road frontages and the roads free drain south. During extreme storm events, any excess runoff will flow to the existing drainage basin in the development to the south.

4.4 Maintenance

As with all drainage systems, it is essential that the infrastructure is maintained on a regular basis. At construction completion, the assets will be handed to the City of Cockburn for their operation and maintenance. It is expected the City has a maintenance regime that can be applied to this system.

5.0 CONCLUSION

Based on the development layout and the existing soil properties, the site can hold and dispose of runoff from the 1% AEP storm event onsite via standard inlet and below ground drainage system. Excess runoff from extreme storm events will be directed away from the site and to the natural low to the south.

APPENDIX 1

Existing Drainage Infrastructure



Existing Drainage Network south of Lot 176 Hammond Road, Success

APPENDIX 2

Geotechnical Report

GEOTECHNICAL INVESTIGATION

LOT 176 (119) HAMMOND ROAD
SUCCESS
WESTERN AUSTRALIA

July 2018
Ref: 18018.01

FOR
D. GUERINI & I. FRUZYNSKI

Brown Geotechnical

CONDITIONS RELATING TO THIS REPORT

1. This report has been prepared for the sole use of D. Guerini and I. Fruzynski. It has been issued in accordance with the agreed terms and scope detailed in the proposal for the investigation. No responsibility or liability to any third party is accepted for any damages arising out of the use of this report.

2. This report has been prepared by suitably qualified and experienced personnel for the purposes stated herein. Every care is taken with the report as it relates to interpretation of sub-surface conditions, discussion of findings and recommendations given. No responsibility for the consequences of extrapolation by others is accepted by the company.

3. Findings and conclusions produced in the report are based on the investigation of the sub-surface through isolated locations. Conditions between investigated sites are based on extrapolation, interpretation and professional estimates. Unexpected variations in ground conditions often occur which cannot always be anticipated. The conclusions and recommendations in the report were considered accurate at the time of issue and based on certain assumptions at the time. Conditions and assumptions change with time and may affect the accuracy of the report.

4. Certain content within this report is based on information provided by the client and/or other parties and the accuracy of this information cannot be guaranteed.

5. These conditions must be read as part of the report and must be reproduced with all future copies.

6. The recommendations of this report should be considered a starting point. Recommendations should be continuously reviewed during the earthworks stage as sub-surface information and results from monitoring become available. It is strongly recommended that the Company be retained to provide consultancy and/or inspections during the earthwork stages.

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Appendix A Test Hole Logs

Appendix B Perth Sand Penetrometer Plots

Appendix C Laboratory Test Certificates

1 Introduction

In June 2018 Brown Geotechnical was commissioned by D. Guerini and I. Fruzynski to undertake a geotechnical investigation for the proposed subdivision of Lot 176 (119) Hammond Road, Success (the site), refer Figure 1. This report presents the results of the investigation conducted at the site. Fieldwork commenced on 29 June 2018.

Details of the development were supplied by the planner - Planning Solutions. The proposed subdivision will consist of 31 new residential lots with access roads.

At the time the fieldwork was carried out, most of the site was covered in dense scrub vegetation and small to medium sized trees. An existing residence with outbuildings occupied the north west corner. Occasional large trees surround the buildings.

2 Brief

The brief discussed with the planner, required the report to address subsurface conditions, the existing soil classification in accordance with AS2870-2011 [1], any earthworks required to obtain a classification suitable for development, the presents of uncontrolled fill, suitability of fill or natural soils for use in the future development, retaining wall parameters, CBR for road pavement design, site permeability and drainage issues.

3 Desk Studies

The geological map for the area [2] shows the site to be underlain by sands of the Bassendean Formation.

The Perth Groundwater Map indicates the historical maximum groundwater level for the site to be approximately 23m AHD.

The site level falls from approximately 28m AHD in the east to 26m AHD in the west.

4 Fieldwork and Laboratory Testing

4.1 Scope of Work

As detailed in the Brown Geotechnical proposal, the following scope of work was undertaken:

- Tests holes excavated for soil descriptions,
- Groundwater levels noted in test holes,
- Perth sand penetrometer (PSP) tests carried out to determine relative density of the sand,
- Collection of soil samples for laboratory testing to determine geotechnical properties of the soils,
- Permeability testing to determine soil permeability below the site.

Test locations are shown on Figure 1, with test hole logs enclosed in Appendix A and PSP plots in Appendix B.

4.2 Laboratory Testing

Soil samples were delivered to the NATA accredited Liquid Labs WA for geotechnical testing. The laboratory test certificates are presented in Appendix C.

5 Geotechnical Results

5.1 Subsurface Condition

Subsurface conditions encountered in the test holes are summarised in Table 1.

Table 1 – Summary of Subsurface Conditions

Soil Type	Depth	Average Thickness	Description
Topsoil	0.0 to 0.15m	0.1m	Loose, grey, silty sand with occasional tree roots (variable cover)
Sand	0.1 to >2m	>2m	Medium dense, medium grained, grey and orange brown sand, trace silt

5.2 Laboratory Test Results

Laboratory test results are summarised in Table 2.

Table 2 – Laboratory Test Results

Location	Depth (m)	Particle Size Distribution				
		Fines (%)	Sand			Gravel (%)
			Fine (%)	Medium (%)	Coarse (%)	
TH01	0.5 – 1.5	2	3	61	34	0
TH05	0.5 – 1.5	3	5	64	28	0

5.3 Site Density Testing Results

A numbers of compaction tests were carried out across the site using the Perth sand penetrometer. The compaction of the in-situ sand was tested every 300mm to a depth of 1.2m. The in-situ near surface sand is medium dense. PSP plots are enclosed in Appendix B.

5.4 Groundwater

No groundwater was encountered during the investigation.

5.5 Soil Permeability

Permeability test results are summarized in Table 3.

Table 3 – Permeability Test Results

Test Location	Testing Material	In-situ Permeability Test Result (m/s)	Drainage Characteristics
P1 (TH05)	medium grained sand trace silt	$1x10^{-3}$ m/s	Good
P2 (TH02)	medium grained sand trace silt	$1x10^{-3}$ m/s	Good

Results are typical for Bassendean Sands which can vary from $1x10^{-3}$ to $1x10^{-5}$m/s.

6 Analysis and Conclusions

6.1 Subsurface Conditions

Topsoil is present across much of the site to a depth of about 0.1m. The material is unsuitable for foundation support and should be removed from site prior to development or stockpiled for later use in landscaping. Tree roots are present, and topsoil may require some screening to remove root material prior to re-use. Alternatively, the topsoil may be screened to remove all coarse organic material and blended with clean sand fill for use as engineering fill.

No uncontrolled fill was encountered in the test holes. It is understood that the existing buildings are to be demolished, so all fill associated with the demolition, including deeper footings, must be removed from site.

The topsoil is underlain by well-draining, medium grained, grey and orange brown, cohesion less sand to at least 2m depth. The relative density of the sands is medium dense. The sand contains low fines content and laboratory gradings with in-situ permeability tests show drainage characteristic to be good. The sands are typical of the Bassendean Formation.

6.2 Groundwater

No groundwater was encountered during the fieldwork. The Perth Groundwater Map indicates the historical maximum groundwater level for the site to be approximately 23m AHD. The site level falls from approximately 28m AHD in the east to 26m AHD in the west. Groundwater levels are therefore expected to be at least 3m below the existing ground level.

6.3 Site Classification

The site is underlain by cohesionless sandy soils with low fines content. The site classification in accordance with AS 2870 – 2011 will be Class 'A' (refer Table 4), subject to requirements stated in Section 6.4. The land is therefore suitable for development.

Table 4 – Definition of Site Classifications (Australian Standard AS2870-2011)

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement for moisture changes (y_s<20mm).
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes (y_s 20-40mm).
H1	Highly reactive clay site, which can experience moderate to high ground movement from moisture changes (y_s 40-60mm)
H2	Highly reactive clay site, which can experience high ground movement from moisture changes (y_s 60-75mm)
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes (y_s>75mm)
P	Sites which include: soft soils, such as soft clays or silts or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

y_s: Characteristic Surface Movement

6.4 Earthworks

6.4.1 Introduction

All earthworks should be undertaken in accordance with AS3798-1996 "Guidelines on earthworks for commercial and residential developments" [4].

6.4.2 Topsoil and Fill Management

Topsoil is not suitable for foundation support and should be removed. The material may be screened to remove any root material and stockpiled for later re-use in landscaping.

Alternatively, the topsoil could be screened to remove all coarse organic material and blended with clean sand fill for use as engineering fill. Testing of the screened topsoil for organic content and fines will be required before actual blending ratios can be determined.

An inspection by the geotechnical consultant will be required to confirm the removal of topsoil, roots, any uncontrolled fill, fill blending ratios, and to confirm subsurface conditions identified in the test holes are consistent across the site.

6.4.3 Proof Rolling and Site Compaction

Prior to footing placement or placing any additional fill on site, the surface should be proof rolled to achieve at least 95% SMDD. This approximates to at least 8 blows per 300mm using a Perth Sand Penetrometer to a depth of 750mm. Moisture conditioning (wetting) of the sand may to be required to optimise compaction.

6.4.4 Imported Fill Material

Any additional sand fill imported to obtain site formation levels should be compacted in layers not more than 300mm thick to at least 95% SMDD. In-situ density tests should be carried out to calibrate the PSP to specific densities of the compacted material. Moisture conditioning (wetting) of the sand may to be required to optimise compaction. Imported sand should ideally contain less than 5% non-plastic fines to retain good drainage characteristics and should be compacted at optimum moisture content.

Following excavation for foundations, the bases of pad and strip footings should also be compacted to achieve at least 95% SMDD.

6.4.5 Earthwork Inspections

The geotechnical consultant should inspect the site following the removal of vegetation, roots and unsuitable materials, and to confirm the compaction of subsurface following proof rolling. Inspections and auditing of the earthworks should be carried out by the geotechnical consultant to enable confirmation of the final site classification for each new Lot.

6.5 Suitability of In-situ Soils as Engineering Fill

The in-situ soils contain low fines content and zero plasticity. The soils will be suitable for use as engineering fill in the future development.

6.6 Design CBR

The in-situ sands have been identified as being from the Bassendean Sand Formation. The sands should be compacted to a minimum of 96% MMDD at optimum moisture content prior to pavement construction. A minimum design CBR of 12% for the compacted in-situ sand is recommended.

6.7 Retaining Wall Parameters

Assuming proof rolling of the soils has been carried out as stated in Section 6.4 above, the following retaining wall parameters have been based on a dense sand soil with ϕ=40°.
γ=19 kN/m^3
Ko=0.36
Ka=0.22
Kp=4.

The parameters detailed above assume design of the retaining structure and compaction of the foundations are in accordance with AS 4678-2002 [5], and that backfill material is composed of clean cohesionless sand.

6.8 Soil Permeability

The in-situ sand contains low fines, zero plasticity and are free draining. The drainage condition within the sands prior to proof rolling is good. Permeability across the site is approximately $1x10^{-3}$m/s (refer Table 3).

6.9 Site Drainage Recommendations

Due to the low fines content, zero plasticity and free draining nature of the in-situ sand, soakwells will be suitable for stormwater runoff. A permeability of $1x10^{-3}$m/s would be appropriate for soakwell design within the in-situ sand. For imported fill the permeability can vary depending on the source but could be expected to vary between $1x10^{-3}$ and a $1x10^{-5}$ m/s based on observed results on typical Perth fill sands.

It should be noted that permeability will decrease somewhat following proof rolling and within compacted fill areas. Additional permeability testing should be carried out following earthworks to confirm the final site permeability for soakwell design.

BROWN GEOTECHNICAL

Ken Brown
Geotechnical Engineer

REFERENCES

1. Standards Australia AS 2870 (2011). Residential Slabs and Footings – Construction.

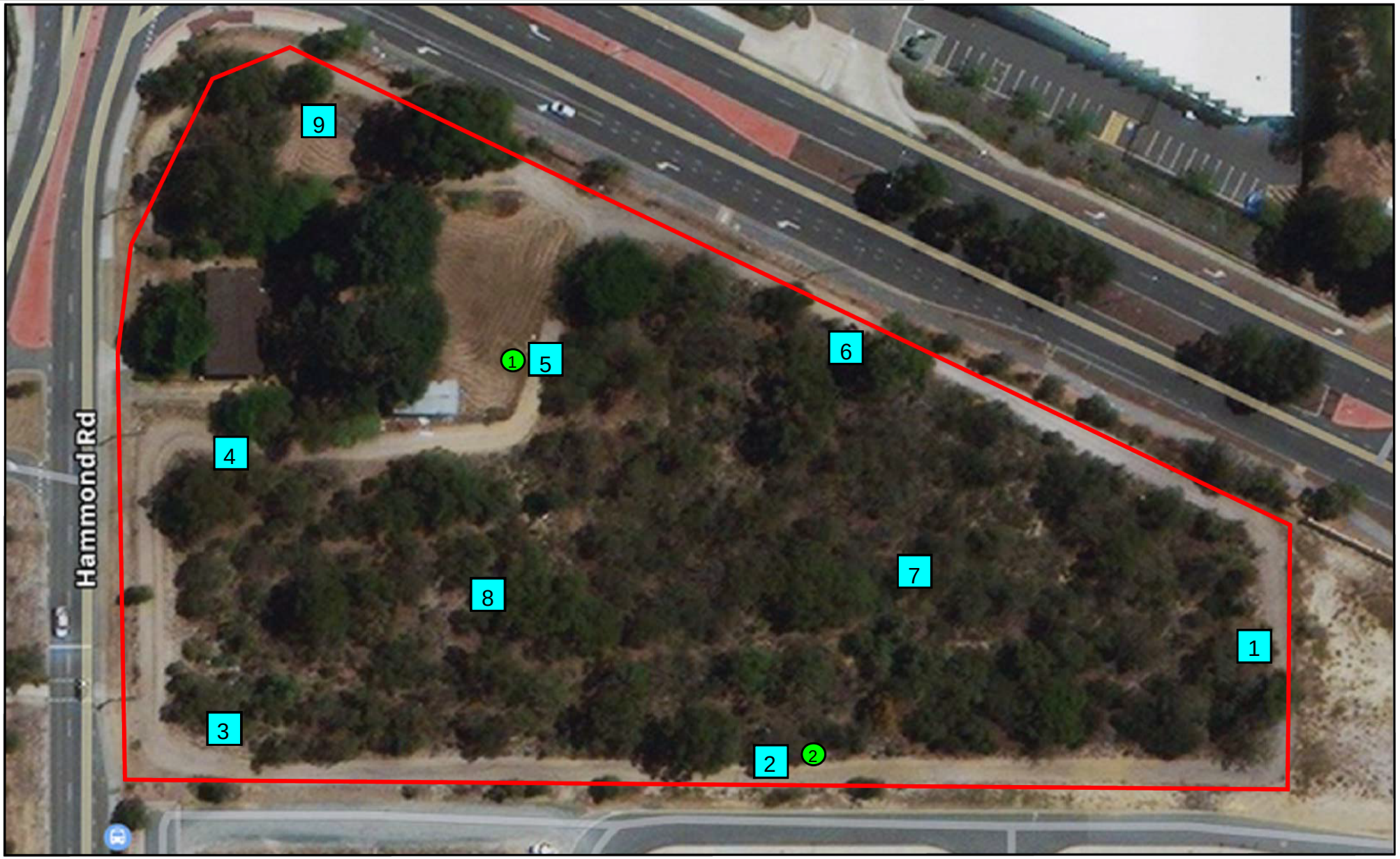
2. Geological Survey of Western Australia. 1:50,000 Environmental Geology Series.

3. Water and Rivers Commission. *Perth Groundwater Atlas*

4. Standards Australia AS3798-2011. "Guidelines on earthworks for commercial and residential developments"

5. Standards Australia AS 4678-2002. Earth-Retaining Structures.

FIGURES



BG
Brown
Geotechnical

Date	Description	Drawn	Checked	Approved
02.07.2018	Test Location Plan	KB	KB	KB

TEST LOCATION PLAN

LOT 176 (119) HAMMOND ROAD
SUCCESS

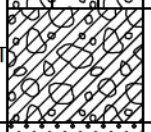
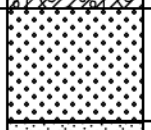
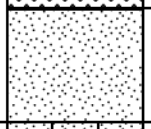
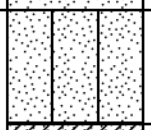
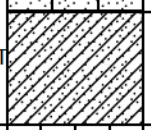
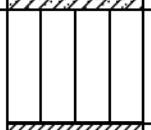
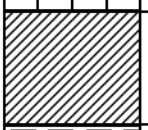
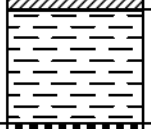
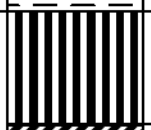
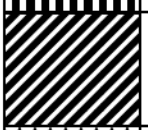
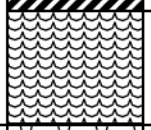
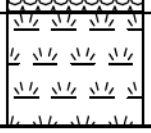
CLIENT

PLANNING SOLUTIONS

Drawing No.18018 Fig1
Scale: NTS
Sheet Size: A4
Job No: 18018
FIGURE 1

APPENDIX A

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

BOREHOLE NUMBER TH01

BG Brown Geotechnical

CLIENT Planning Solutions **PROJECT NAME** Lot 176 Hammond Road

PROJECT NUMBER 18018 **PROJECT LOCATION** Success

DATE STARTED 29/6/18 **COMPLETED** 29/6/18 **R.L. SURFACE** 27.6 **DATUM** m AHD

DRILLING CONTRACTOR **SLOPE** 90° **BEARING** ---

EQUIPMENT Mech Auger **HOLE LOCATION** -32.12834 115.84431

HOLE SIZE 100mm dia **LOGGED BY** KB **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
		27.5				TOPSOIL: Grey silty sand with organics and occasional roots		
					SP	SAND: Medium dense, medium grained, grey, trace silt, moist, with occasional roots to 0.5m		
			0.5					
		27.0				becoming light brown below 0.8m		
	Not Encountered		1.0				LL=NP PL=NP Fines=2% Sand=98% (medium=61%)	
		26.5				becoming orange brown below 1.3m		
			1.5					
		26.0						
			2.0					
		25.5				Borehole TH01 terminated at 2m		
			2.5					
		25.0						
			3.0					

BOREHOLE NUMBER TH02

BG Brown Geotechnical

CLIENT Planning Solutions **PROJECT NAME** Lot 176 Hammond Road

PROJECT NUMBER 18018 **PROJECT LOCATION** Success

DATE STARTED 29/6/18 **COMPLETED** 29/6/18 **R.L. SURFACE** 26.0 **DATUM** m AHD

DRILLING CONTRACTOR **SLOPE** 90° **BEARING** ---

EQUIPMENT Mech Auger **HOLE LOCATION** -32.12854 115.84334

HOLE SIZE 100mm dia **LOGGED BY** KB **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Grey silty sand with organics and occasional roots		
	Not Encountered	25.5	0.5		SP	SAND: Medium dense, medium grained, grey, trace silt, moist, with occasional roots to 0.4m becoming orange brown below 0.25m		
		25.0	1.0					
		24.5	1.5					
		24.0	2.0					
						Borehole TH02 terminated at 2m		
		23.5	2.5					
		23.0	3.0					

BOREHOLE NUMBER TH03

BG Brown Geotechnical

CLIENT Planning Solutions **PROJECT NAME** Lot 176 Hammond Road

PROJECT NUMBER 18018 **PROJECT LOCATION** Success

DATE STARTED 29/6/18 **COMPLETED** 29/6/18 **R.L. SURFACE** 25.1 **DATUM** m AHD

DRILLING CONTRACTOR **SLOPE** 90° **BEARING** ---

EQUIPMENT Mech Auger **HOLE LOCATION** -32.12851 115.84240

HOLE SIZE 100mm dia **LOGGED BY** KB **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered	25.0				TOPSOIL: Grey silty sand with organics		
					SP	SAND: Medium dense, medium grained, grey, trace silt, moist		
			0.5			becoming orange brown below 0.4m		
		24.5						
			1.0					
		24.0						
			1.5					
		23.5						
			2.0					
		23.0				Borehole TH03 terminated at 2m		
			2.5					
		22.5						
			3.0					

BOREHOLE NUMBER TH04

BG Brown Geotechnical

CLIENT Planning Solutions **PROJECT NAME** Lot 176 Hammond Road

PROJECT NUMBER 18018 **PROJECT LOCATION** Success

DATE STARTED 29/6/18 **COMPLETED** 29/6/18 **R.L. SURFACE** 26.2 **DATUM** m AHD

DRILLING CONTRACTOR **SLOPE** 90° **BEARING** ---

EQUIPMENT Mech Auger **HOLE LOCATION** -32.12801 115.84237

HOLE SIZE 100mm dia **LOGGED BY** KB **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered	26.0				TOPSOIL: Grey silty sand with organics		
			0.5		SP	SAND: Medium dense, medium grained, orange brown, trace silt, moist		
		25.5						
			1.0					
		25.0						
			1.5					
		24.5						
			2.0					
		24.0				Borehole TH04 terminated at 2m		
			2.5					
		23.5						
			3.0					

BOREHOLE NUMBER TH05

BG Brown Geotechnical

CLIENT Planning Solutions **PROJECT NAME** Lot 176 Hammond Road

PROJECT NUMBER 18018 **PROJECT LOCATION** Success

DATE STARTED 29/6/18 **COMPLETED** 29/6/18 **R.L. SURFACE** 26.7 **DATUM** m AHD

DRILLING CONTRACTOR **SLOPE** 90° **BEARING** ---

EQUIPMENT Mech Auger **HOLE LOCATION** -32.12790 115.84295

HOLE SIZE 100mm dia **LOGGED BY** KB **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
		26.5				TOPSOIL: Grey silty sand with organics		
	Not Encountered		0.5		SP	SAND: Medium dense, medium grained, orange brown, trace silt, moist	LL=NP PL=NP Fines=3% Sand=97% (medium=64%)	
		26.0						
		25.5	1.0					
			1.5					
		25.0						
			2.0					
		24.5				Borehole TH05 terminated at 2m		
			2.5					
		24.0						
			3.0					

BOREHOLE / TEST PIT HAMMOND RD.GPJ GINT STD AUSTRALIA.GDT 25/7/18

BOREHOLE NUMBER TH06

BG Brown Geotechnical

CLIENT Planning Solutions **PROJECT NAME** Lot 176 Hammond Road

PROJECT NUMBER 18018 **PROJECT LOCATION** Success

DATE STARTED 29/6/18 **COMPLETED** 29/6/18 **R.L. SURFACE** 25.3 **DATUM** m AHD

DRILLING CONTRACTOR **SLOPE** 90° **BEARING** ---

EQUIPMENT Mech Auger **HOLE LOCATION** -32.12784 115.84358

HOLE SIZE 100mm dia **LOGGED BY** KB **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered	25.0	0.0			TOPSOIL: Grey silty sand with organics and occasional roots		
					SP	SAND: Medium dense, medium grained, grey, trace silt, moist, with occasional roots to 0.4m		
						becoming light brown below 0.25m		
			0.5			becoming orange brown below 0.5m		
		24.5	1.0					
		24.0	1.5					
		23.5	2.0			Borehole TH06 terminated at 2m		
		23.0	2.5					
		22.5	3.0					

BOREHOLE / TEST PIT HAMMOND RD.GPJ GINT STD AUSTRALIA.GDT 25/7/18

BOREHOLE NUMBER TH07

BG Brown Geotechnical

CLIENT Planning Solutions **PROJECT NAME** Lot 176 Hammond Road

PROJECT NUMBER 18018 **PROJECT LOCATION** Success

DATE STARTED 29/6/18 **COMPLETED** 29/6/18 **R.L. SURFACE** 27.1 **DATUM** m AHD

DRILLING CONTRACTOR **SLOPE** 90° **BEARING** ---

EQUIPMENT Mech Auger **HOLE LOCATION** -32.12824 115.84365

HOLE SIZE 100mm dia **LOGGED BY** KB **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
		27.0				TOPSOIL: Grey silty sand with organics and tree roots		
					SP	SAND: Medium dense, medium grained, grey, trace silt, moist, with tree roots to 0.6m		
			0.5			becoming light brown below 0.4m		
		26.5						
	Not Encountered					becoming orange brown below 0.7m		
			1.0					
		26.0						
			1.5					
		25.5						
			2.0					
		25.0				Borehole TH07 terminated at 2m		
			2.5					
		24.5						
			3.0					

BOREHOLE NUMBER TH08

BG Brown Geotechnical

CLIENT Planning Solutions **PROJECT NAME** Lot 176 Hammond Road

PROJECT NUMBER 18018 **PROJECT LOCATION** Success

DATE STARTED 29/6/18 **COMPLETED** 29/6/18 **R.L. SURFACE** 26.1 **DATUM** m AHD

DRILLING CONTRACTOR **SLOPE** 90° **BEARING** ---

EQUIPMENT Mech Auger **HOLE LOCATION** -32.12828 115.84284

HOLE SIZE 100mm dia **LOGGED BY** KB **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
		26.0				TOPSOIL: Dark grey silty sand with organics and tree roots		
	Not Encountered				SP	SAND: Medium dense, medium grained, dark grey, trace silt, moist, with tree roots to 0.5m		
			0.5			becoming grey brown below 0.4m		
		25.5				becoming orange brown below 0.7m		
			1.0					
		25.0						
			1.5					
		24.5						
			2.0					
		24.0				Borehole TH08 terminated at 2m		
			2.5					
		23.5						
			3.0					

BOREHOLE NUMBER TH09

BG Brown Geotechnical

CLIENT Planning Solutions **PROJECT NAME** Lot 176 Hammond Road

PROJECT NUMBER 18018 **PROJECT LOCATION** Success

DATE STARTED 29/6/18 **COMPLETED** 29/6/18 **R.L. SURFACE** 26.2 **DATUM** m AHD

DRILLING CONTRACTOR **SLOPE** 90° **BEARING** ---

EQUIPMENT Mech Auger **HOLE LOCATION** -32.12750 115.84255

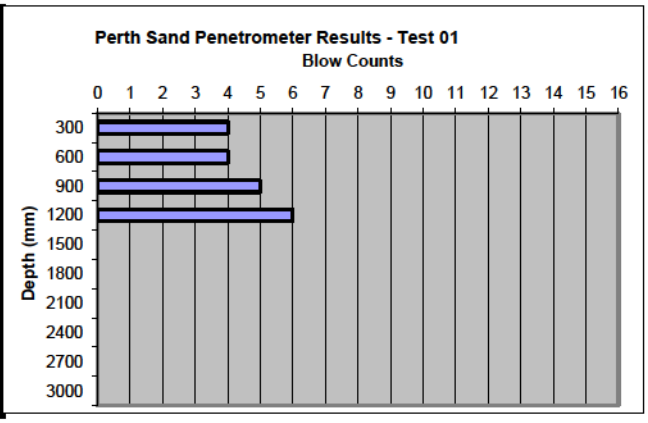
HOLE SIZE 100mm dia **LOGGED BY** KB **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered	26.0	0			TOPSOIL: Dark grey silty sand with organics and tree roots		
					SP	SAND: Medium dense, medium grained, dark grey, trace silt, moist, with tree roots to 0.5m becoming orange brown below 0.25m		
		25.5	0.5					
			1.0					
		25.0						
			1.5					
		24.5						
			2.0					
		24.0				Borehole TH09 terminated at 2m		
			2.5					
		23.5						
			3.0					

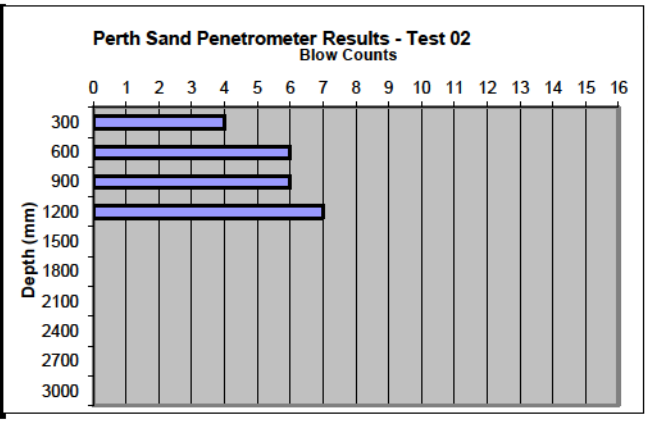
APPENDIX B

Depth (mm)	Blow Counts
300	4
600	4
900	5
1200	6
1500	
1800	
2100	
2400	
2700	
3000	



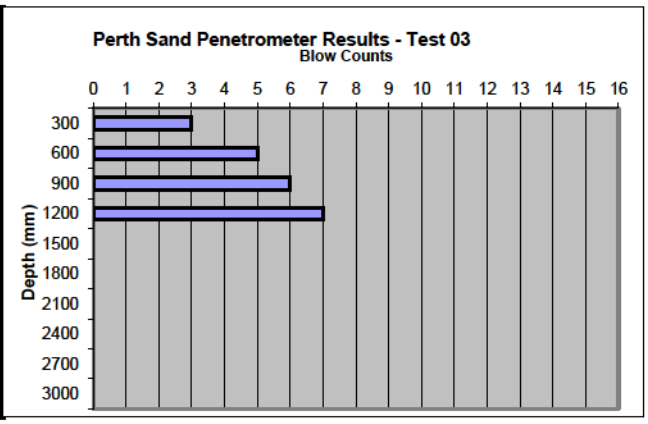
Job Name: Lot 176 Hammond Road
Job No: 18018
Date: 29/06/2018
Location: TH01

Depth (mm)	Blow Counts
300	4
600	6
900	6
1200	7
1500	
1800	
2100	
2400	
2700	
3000	



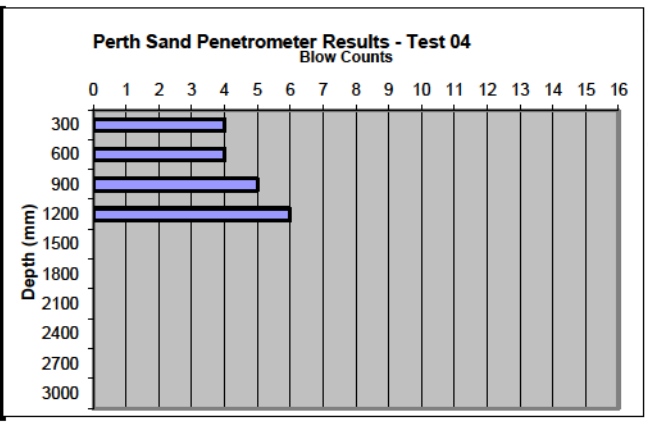
Job Name: Lot 176 Hammond Road
Job No: 18018
Date: 29/06/2018
Location: TH02

Depth (mm)	Blow Counts
300	3
600	5
900	6
1200	7
1500	
1800	
2100	
2400	
2700	
3000	



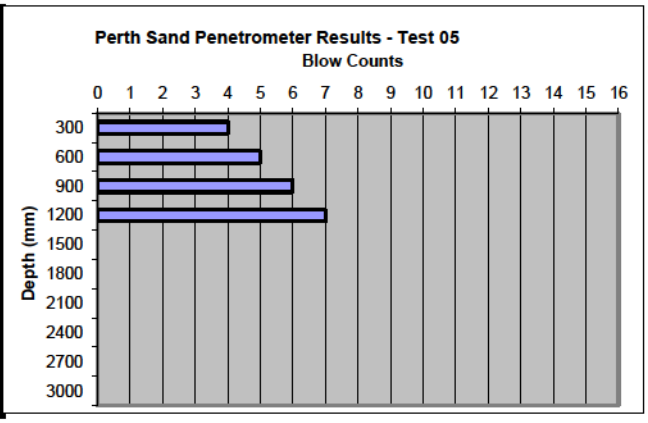
Job Name: Lot 176 Hammond Road
Job No: 18018
Date: 29/06/2018
Location: TH03

Depth (mm)	Blow Counts
300	4
600	4
900	5
1200	6
1500	
1800	
2100	
2400	
2700	
3000	



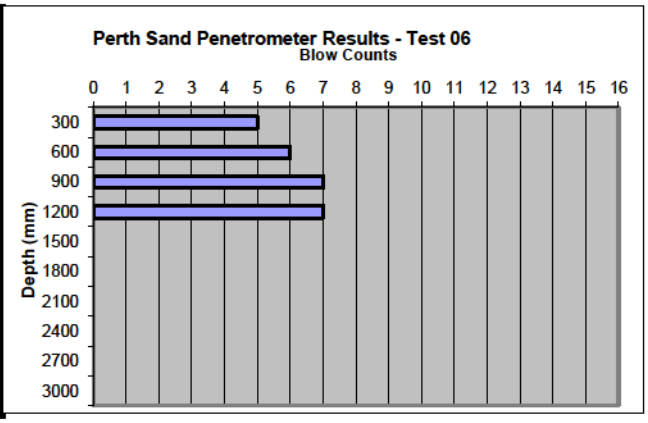
Job Name: Lot 176 Hammond Road
Job No: 18018
Date: 29/06/2018
Location: TH04

Depth (mm)	Blow Counts
300	4
600	5
900	6
1200	7
1500	
1800	
2100	
2400	
2700	
3000	



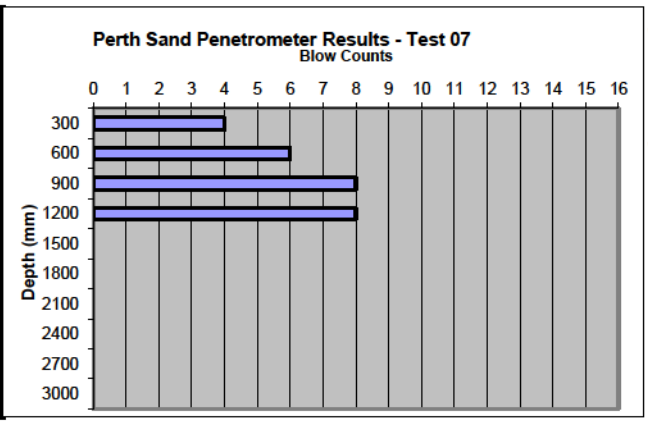
Job Name: Lot 176 Hammond Road
Job No: 18018
Date: 29/06/2018
Location: TH05

Depth (mm)	Blow Counts
300	5
600	6
900	7
1200	7
1500	
1800	
2100	
2400	
2700	
3000	



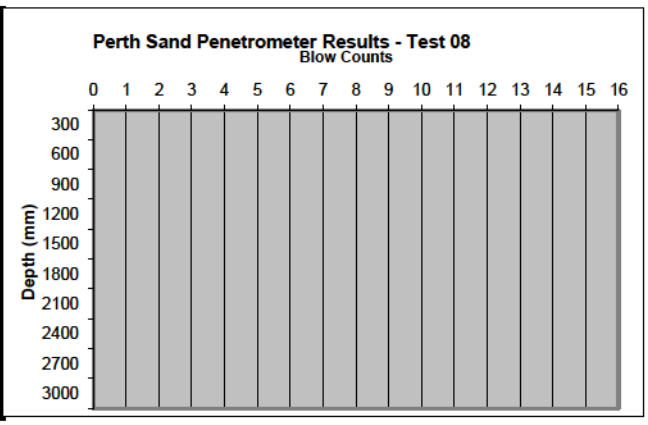
Job Name: Lot 176 Hammond Road
Job No: 18018
Date: 29/06/2018
Location: TH06

Depth (mm)	Blow Counts
300	4
600	6
900	8
1200	8
1500	
1800	
2100	
2400	
2700	
3000	



Job Name: Lot 176 Hammond Road
Job No: 18018
Date: 29/06/2018
Location: TH09

Depth (mm)	Blow Counts
300	
600	
900	
1200	
1500	
1800	
2100	
2400	
2700	
3000	



Job Name: Lot 176 Hammond Road
Job No: 18018
Date: 29/06/2018
Location:

APPENDIX C

LIQUIDLABSWA
CONSTRUCTION MATERIALS TESTING LABORATORY

Liquid Labs WA
08 94723349
16B/81 Briggs Street
Carlisle, WA 6101

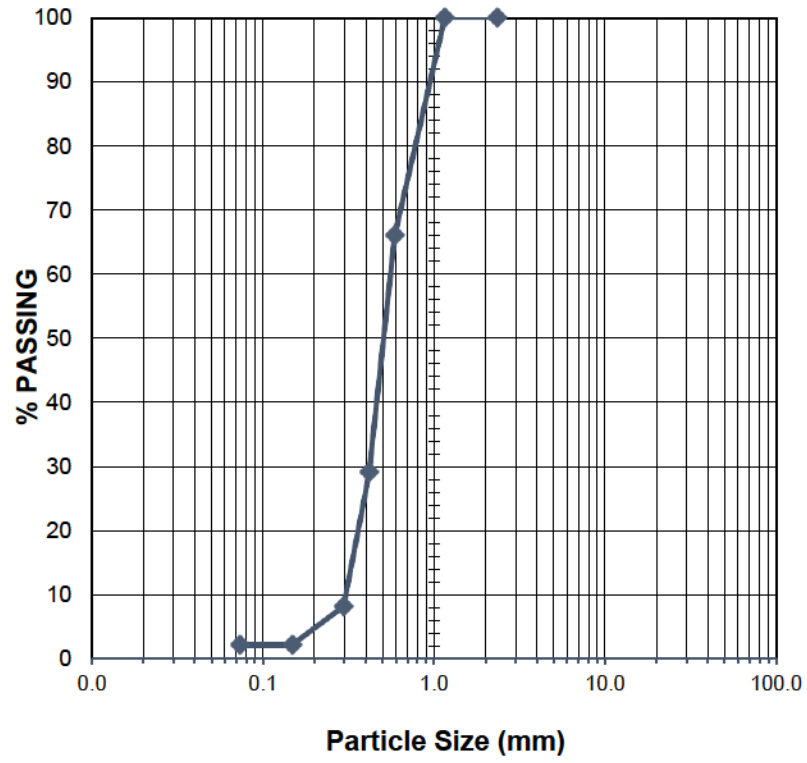
SOIL CLASSIFICATION TEST REPORT

AS 1289.3.6.1

Client	**Brown Geotechnical**	Ticket No.	**S1957**
Client Address	**PO Box 278, Como WA 6952**	Report No.	**LLS18/3092_1_PSD**
Project	**Hammond Road**	Sample No.	**LLS18/3092**
Sampling Location	**Success**	Sampled By	**Client**
Sample Identification	**TH1 0.5-1.5m**		
Sampling Method	**Sampled by Client, Tested as Received**	Preparation Method	**AS 1289.1.1**

PARTICLE SIZE DISTRIBUTION - ANALYSIS BY SIEVING

AS 1289.3.6.1



Sieve Size (mm)	Percent Passing Sieve (%)
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	66
0.425	29
0.300	8
0.150	2
0.075	2

Comments:

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Approved Signatory

Name M. van Herk
Function Laboratory Manager
Issue Date 16-July-2018

LIQUIDLABSWA
CONSTRUCTION MATERIALS TESTING LABORATORY

Liquid Labs WA
08 94723349
16B/81 Briggs Street
Carlisle, WA 6101

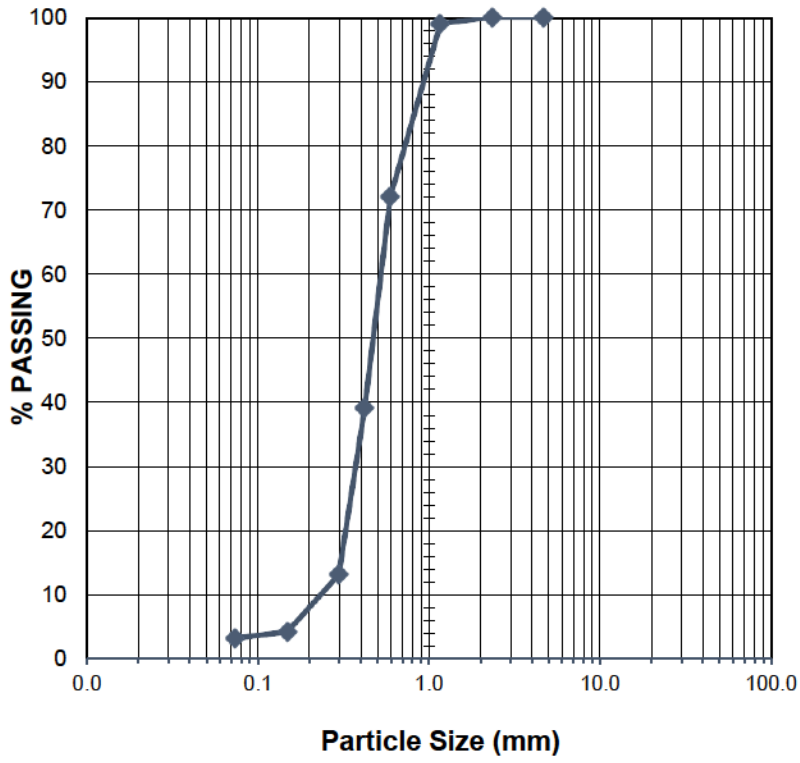
SOIL CLASSIFICATION TEST REPORT

AS 1289.3.6.1

Client	**Brown Geotechnical**	Ticket No.	**S1957**
Client Address	**PO Box 278, Como WA 6952**	Report No.	**LLS18/3093_1_PSD**
Project	**Hammond Road**	Sample No.	**LLS18/3093**
Sampling Location	**Success**	Sampled By	**Client**
Sample Identification	**TH5 0.5-1.5m**		
Sampling Method	**Sampled by Client, Tested as Received**	Preparation Method	**AS 1289.1.1**

PARTICLE SIZE DISTRIBUTION - ANALYSIS BY SIEVING

AS 1289.3.6.1



Sieve Size (mm)	Percent Passing Sieve (%)
75.0	
37.5	
19.0	
9.5	
4.75	100
2.36	100
1.18	99
0.600	72
0.425	39
0.300	13
0.150	4
0.075	3

Comments:

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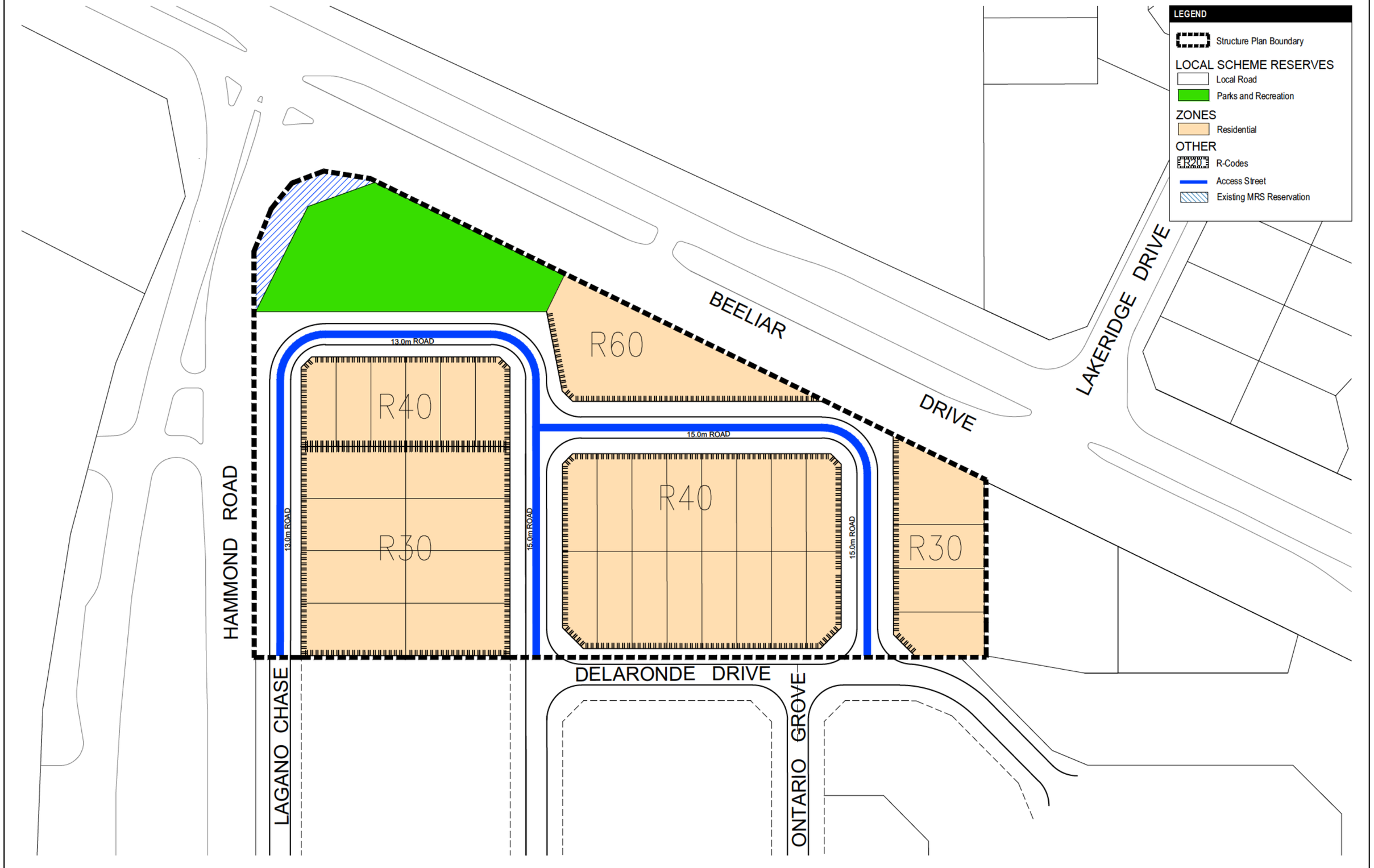
Approved Signatory

Name M. van Herk
Function Laboratory Manager
Issue Date 16-July-2018

APPENDIX 3

Development Layout

DRAFT WITHOUT PREJUDICE



PLANNING SOLUTIONS | PS
URBAN & REGIONAL PLANNING

SCALE	1: 750 @ A3
DATE	19 December 2018
FILE	181219 4900 Concept Plan.dwg
REVISION	1/DR/First Draft/17.12.2018

CONCEPT PLAN

LOT 176 (119) HAMMOND ROAD,
SUCCESS, WA

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APPENDIX 4

Drainage Calculations

Project	**Lot 176 Hammond Road, Success**
Job Number	**18-06-070**
Date	**19 December 2018**
Engineer	**Jamie King**
Summary	**Soakwells**
Scenario	**TW2000**
File Name	**Drainage Calculations Catchment 1**
Revision	**B**
Reference Document	**Drainage Strategy R036.18**
IFD Used	**Beeliar IFD used (32.138° S,115.793° E) generated from BoM website**
Ground Conditions	**High permeability due to s_8 sand**
Groundwater	**Medium (RL 22.0m)**

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www.portereng.com.au

Intensities (mm/hr)		
1 EY (1 year)	6 minute	55
	30 minute	24.30
	1 hour	15.90
	3 hour	7.92
	6 hour	5.09
	12 hour	3.27
0.2 EY (5 year)	6 minute	95.70
	30 minute	39.90
	1 hour	25.60
	3 hour	12.40
	6 hour	7.83
	12 hour	5.01
10% AEP (10 Year)	6 minute	112.00
	30 minute	45.70
	1 hour	29.00
	3 hour	13.90
	6 hour	8.73
	12 hour	5.57
1% AEP 100 Year	6 minute	199.00
	30 minute	75.50
	1 hour	46.90
	3 hour	21.70
	6 hour	13.40
	12 hour	8.53
	24 hour	5.62
	72 hour	2.86

Catchment Details

Area (ha) =	0.101
Co-efficient of Runoff =	0.70

Soakwell details

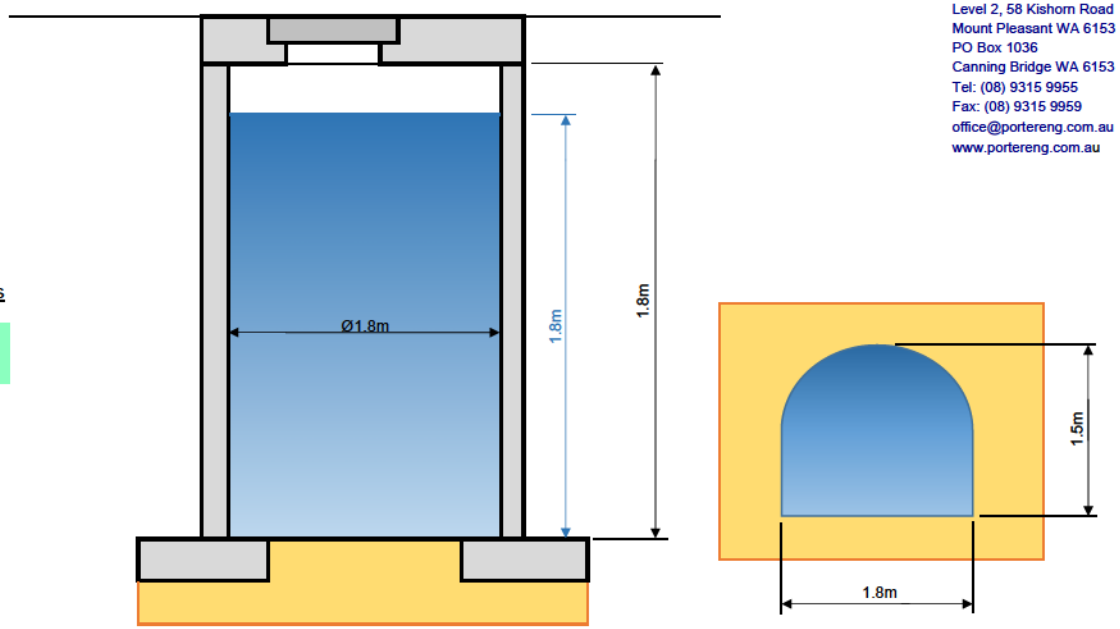
Soakwell Diameter (m) =	1.8
Liner Depth (m) =	1.8
Effective Depth (m) =	1.8
Soakwell base area (m^2) =	2.54
Soakwell Volume (m^3) =	4.58
No of Soakwells =	2

Infiltration

Rate of Soakage (m/day) =	20

Storage Cells

Length (m) =	6.000
Width (m) =	1.800
Height (m) =	1.500
Volume (m^3) =	12.00
Base Area (m^2) =	10.80



Event	1EY (1 Year)						0.2 EY (5 Year)						10% AEP (10 Year)						1% AEP (100 Year)							
Duration	6 min	30 min	1 hour	3 hour	6 hour	12 hour	6 min	30 min	1 hour	3 hour	6 hour	12 hour	6 min	30 min	1 hour	3 hour	6 hour	12 hour	6 min	30 min	1 hour	3 hour	6 hour	12 hour	24 hour	72 hour
Intensities	55	24.3	15.9	7.92	5.09	3.27	95.70	39.9	25.6	12.40	7.83	5.01	112	45.7	29	13.90	8.73	5.57	199	75.50	46.90	21.70	13.40	8.53	5.62	2.86
Q (m^3/s)	0.0108	0.0048	0.0031	0.0016	0.0010	0.0006	0.0188	0.0078	0.0050	0.0024	0.0015	0.0010	0.0220	0.0090	0.0057	0.0027	0.0017	0.0011	0.0390	0.0148	0.0092	0.0043	0.0026	0.0017	0.0011	0.0006
Volume	**3.88**	**8.58**	**11.23**	**16.78**	**21.57**	**27.71**	**6.76**	**14.09**	**18.08**	**26.27**	**33.18**	**42.45**	**7.91**	**16.14**	**20.48**	**29.45**	**36.99**	**47.20**	**14.05**	**26.66**	**33.12**	**45.97**	**56.78**	**72.28**	**95.25**	**145.41**
SW Vol.	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16
Soak Vol	0.42	2.12	4.24	12.72	25.45	50.89	0.42	2.12	4.24	12.72	25.45	50.89	0.42	2.12	4.24	12.72	25.45	50.89	0.42	2.12	4.24	12.72	25.45	50.89	101.79	305.36
SW Total	9.58	11.28	13.40	21.88	34.61	60.05	9.58	11.28	13.40	21.88	34.61	60.05	9.58	11.28	13.40	21.88	34.61	60.05	9.58	11.28	13.40	21.88	34.61	60.05	110.95	314.52
Cell Vol	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
Cell Soak	0.90	4.50	9.00	27.00	54.00	108.00	0.90	4.50	9.00	27.00	54.00	108.00	0.90	4.50	9.00	27.00	54.00	108.00	0.90	4.50	9.00	27.00	54.00	108.00	216.00	648.00
Cell Total	12.90	16.50	21.00	39.00	66.00	120.00	12.90	16.50	21.00	39.00	66.00	120.00	12.90	16.50	21.00	39.00	66.00	120.00	12.90	16.50	21.00	39.00	66.00	120.00	228.00	660.00
Total Vol	**22.48**	**27.78**	**34.40**	**60.88**	**100.61**	**180.05**	**22.48**	**27.78**	**34.40**	**60.88**	**100.61**	**180.05**	**22.48**	**27.78**	**34.40**	**60.88**	**100.61**	**180.05**	**22.48**	**27.78**	**34.40**	**60.88**	**100.61**	**180.05**	**338.95**	**974.52**
	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS

Project	**Lot 176 Hammond Road, Success**
Job Number	**18-06-070**
Date	**19 December 2018**
Engineer	**Jamie King**
Summary	**Soakwells**
Scenario	**TW2000**
File Name	**Drainage Calculations Catchment 2**
Revision	**B**
Reference Document	**Drainage Strategy R036.18**
IFD Used	**Beeliar IFD used (32.138° S,115.793° E) generated from BoM website**
Ground Conditions	**High permeability due to s_8 sand**
Groundwater	**Medium (RL 22.0m)**

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www.portereng.com.au

Intensities (mm/hr)		
1 EY (1 year)	6 minute	55
	30 minute	24.30
	1 hour	15.90
	3 hour	7.92
	6 hour	5.09
	12 hour	3.27
0.2 EY (5 year)	6 minute	95.70
	30 minute	39.90
	1 hour	25.60
	3 hour	12.40
	6 hour	7.83
	12 hour	5.01
10% AEP (10 Year)	6 minute	112.00
	30 minute	45.70
	1 hour	29.00
	3 hour	13.90
	6 hour	8.73
	12 hour	5.57
1% AEP 100 Year	6 minute	199.00
	30 minute	75.50
	1 hour	46.90
	3 hour	21.70
	6 hour	13.40
	12 hour	8.53
	24 hour	5.62
	72 hour	2.86

Catchment Details

Area (ha) =	0.265
Co-efficient of Runoff =	0.76

Soakwell details

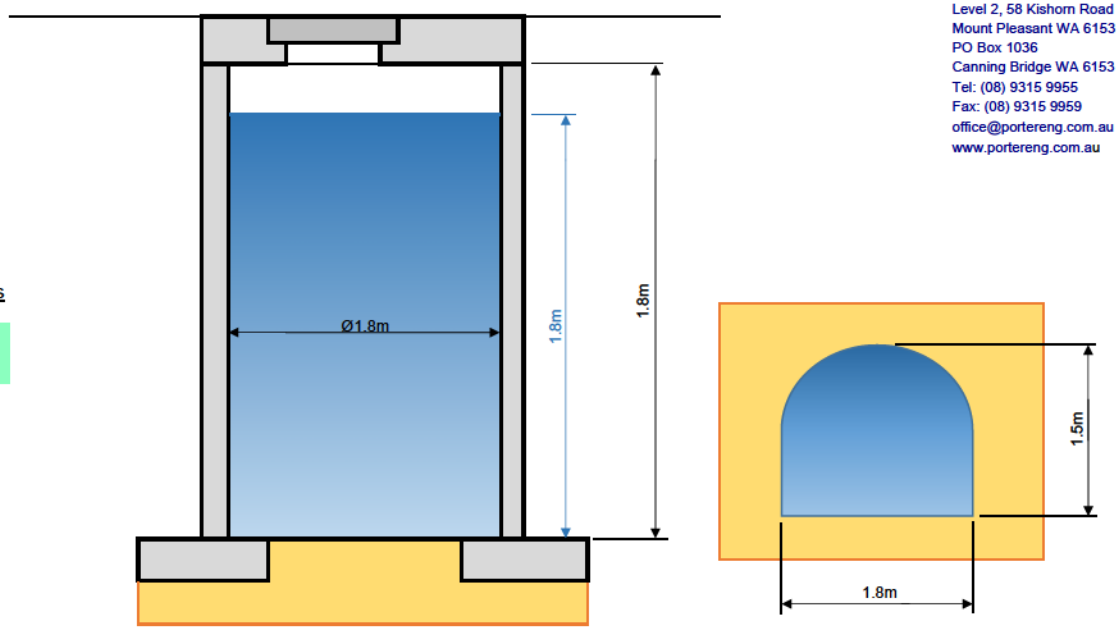
Soakwell Diameter (m) =	1.8
Liner Depth (m) =	1.8
Effective Depth (m) =	1.8
Soakwell base area (m^2) =	2.54
Soakwell Volume (m^3) =	4.58
No of Soakwells =	6

Infiltration

Rate of Soakage (m/day) =	20

Storage Cells

Length (m) =	16.000
Width (m) =	1.800
Height (m) =	1.500
Volume (m^3) =	32.00
Base Area (m^2) =	28.80



Event	1EY (1 Year)						0.2 EY (5 Year)						10% AEP (10 Year)						1% AEP (100 Year)							
Duration	6 min	30 min	1 hour	3 hour	6 hour	12 hour	6 min	30 min	1 hour	3 hour	6 hour	12 hour	6 min	30 min	1 hour	3 hour	6 hour	12 hour	6 min	30 min	1 hour	3 hour	6 hour	12 hour	24 hour	72 hour
Intensities	55	24.3	15.9	7.92	5.09	3.27	95.70	39.9	25.6	12.40	7.83	5.01	112	45.7	29	13.90	8.73	5.57	199	75.50	46.90	21.70	13.40	8.53	5.62	2.86
Q (m^3/s)	0.0308	0.0136	0.0089	0.0044	0.0029	0.0018	0.0536	0.0224	0.0143	0.0070	0.0044	0.0028	0.0628	0.0256	0.0163	0.0078	0.0049	0.0031	0.1115	0.0423	0.0263	0.0122	0.0075	0.0048	0.0032	0.0016
Volume	**11.10**	**24.52**	**32.08**	**47.95**	**61.63**	**79.18**	**19.31**	**40.26**	**51.66**	**75.07**	**94.80**	**121.32**	**22.60**	**46.11**	**58.52**	**84.15**	**105.70**	**134.88**	**40.16**	**76.18**	**94.64**	**131.36**	**162.24**	**206.55**	**272.17**	**415.52**
SW Vol.	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48	27.48
Soak Vol	1.27	6.36	12.72	38.17	76.34	152.68	1.27	6.36	12.72	38.17	76.34	152.68	1.27	6.36	12.72	38.17	76.34	152.68	1.27	6.36	12.72	38.17	76.34	152.68	305.36	916.09
SW Total	28.75	33.84	40.21	65.65	103.82	180.16	28.75	33.84	40.21	65.65	103.82	180.16	28.75	33.84	40.21	65.65	103.82	180.16	28.75	33.84	40.21	65.65	103.82	180.16	332.85	943.57
Cell Vol	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00
Cell Soak	2.40	12.00	24.00	72.00	144.00	288.00	2.40	12.00	24.00	72.00	144.00	288.00	2.40	12.00	24.00	72.00	144.00	288.00	2.40	12.00	24.00	72.00	144.00	288.00	576.00	1728.00
Cell Total	34.40	44.00	56.00	104.00	176.00	320.00	34.40	44.00	56.00	104.00	176.00	320.00	34.40	44.00	56.00	104.00	176.00	320.00	34.40	44.00	56.00	104.00	176.00	320.00	608.00	1760.00
Total Vol	63.15	77.84	96.21	169.65	279.82	500.16	63.15	77.84	96.21	169.65	279.82	500.16	63.15	77.84	96.21	169.65	279.82	500.16	63.15	77.84	96.21	169.65	279.82	500.16	940.85	2703.57
	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS

Project	**Lot 176 Hammond Road, Success**
Job Number	**18-06-070**
Date	**19 December 2018**
Engineer	**Jamie King**
Summary	**Soakwells**
Scenario	**TW2000**
File Name	**Drainage Calculations Catchment 3**
Revision	**B**
Reference Document	**Drainage Strategy R036.18**
IFD Used	**Beeliar IFD used (32.138° S,115.793° E) generated from BoM website**
Ground Conditions	**High permeability due to s_8 sand**
Groundwater	**Medium (RL 22.0m)**

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Intensities (mm/hr)		
1 EY (1 year)	6 minute	55
	30 minute	24.30
	1 hour	15.90
	3 hour	7.92
	6 hour	5.09
	12 hour	3.27
0.2 EY (5 year)	6 minute	95.70
	30 minute	39.90
	1 hour	25.60
	3 hour	12.40
	6 hour	7.83
	12 hour	5.01
10% AEP (10 Year)	6 minute	112.00
	30 minute	45.70
	1 hour	29.00
	3 hour	13.90
	6 hour	8.73
	12 hour	5.57
1% AEP 100 Year	6 minute	199.00
	30 minute	75.50
	1 hour	46.90
	3 hour	21.70
	6 hour	13.40
	12 hour	8.53
	24 hour	5.62
	72 hour	2.86

Catchment Details

Area (ha) =	0.211
Co-efficient of Runoff =	0.76

Soakwell details

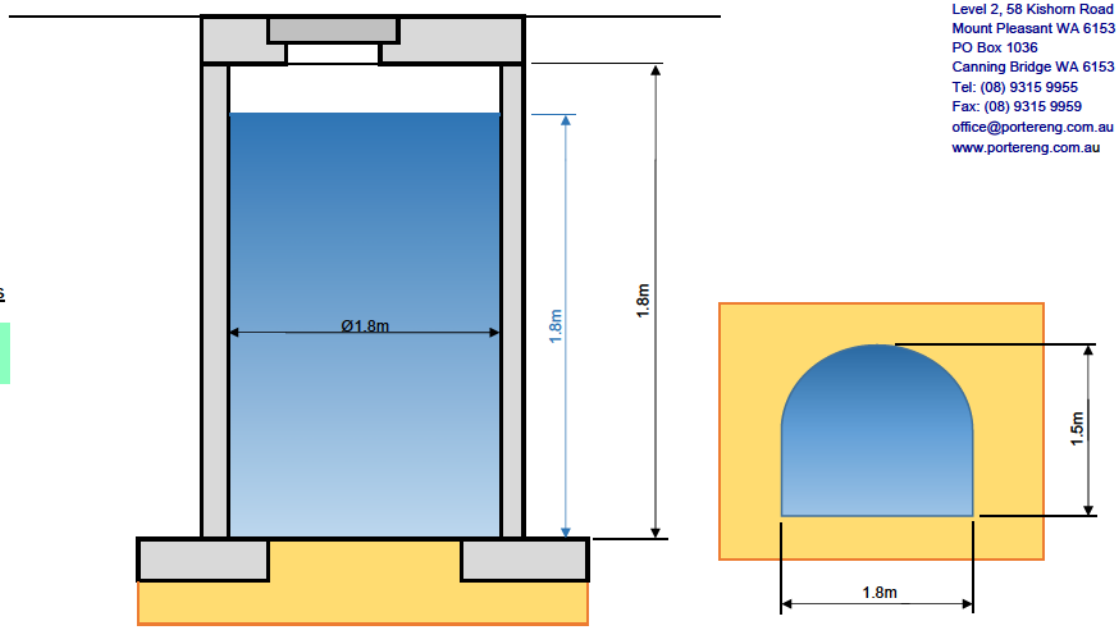
Soakwell Diameter (m) =	1.8
Liner Depth (m) =	1.8
Effective Depth (m) =	1.8
Soakwell base area (m^2) =	2.54
Soakwell Volume (m^3) =	4.58
No of Soakwells =	8

Infiltration

Rate of Soakage (m/day) =	20

Storage Cells

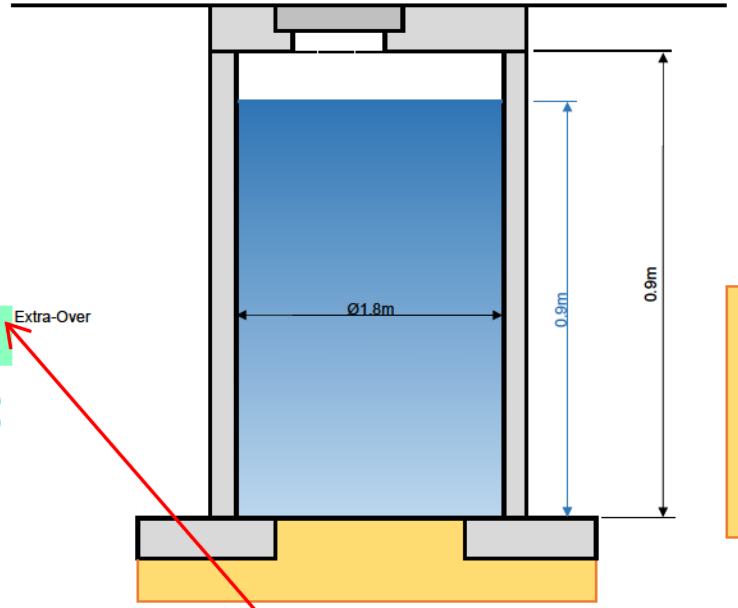
Length (m) =	7.000
Width (m) =	1.800
Height (m) =	1.500
Volume (m^3) =	14.00
Base Area (m^2) =	12.60

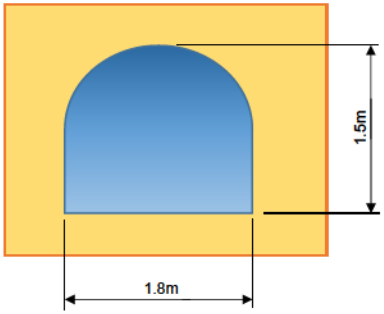


Event	1EY (1 Year)						0.2 EY (5 Year)						10% AEP (10 Year)						1% AEP (100 Year)							
Duration	6 min	30 min	1 hour	3 hour	6 hour	12 hour	6 min	30 min	1 hour	3 hour	6 hour	12 hour	6 min	30 min	1 hour	3 hour	6 hour	12 hour	6 min	30 min	1 hour	3 hour	6 hour	12 hour	24 hour	72 hour
Intensities	55	24.3	15.9	7.92	5.09	3.27	95.70	39.9	25.6	12.40	7.83	5.01	112	45.7	29	13.90	8.73	5.57	199	75.50	46.90	21.70	13.40	8.53	5.62	2.86
Q (m^3/s)	0.0245	0.0108	0.0071	0.0035	0.0023	0.0015	0.0427	0.0178	0.0114	0.0055	0.0035	0.0022	0.0500	0.0204	0.0129	0.0062	0.0039	0.0025	0.0888	0.0337	0.0209	0.0097	0.0060	0.0038	0.0025	0.0013
Volume	**8.84**	**19.52**	**25.54**	**38.17**	**49.06**	**63.04**	**15.37**	**32.05**	**41.12**	**59.76**	**75.47**	**96.58**	**17.99**	**36.71**	**46.59**	**66.99**	**84.14**	**107.37**	**31.97**	**60.64**	**75.34**	**104.58**	**129.15**	**164.43**	**216.67**	**330.79**
SW Vol.	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64
Soak Vol	1.70	8.48	16.96	50.89	101.79	203.58	1.70	8.48	16.96	50.89	101.79	203.58	1.70	8.48	16.96	50.89	101.79	203.58	1.70	8.48	16.96	50.89	101.79	203.58	407.15	1221.45
SW Total	38.34	45.13	53.61	87.54	138.43	240.22	38.34	45.13	53.61	87.54	138.43	240.22	38.34	45.13	53.61	87.54	138.43	240.22	38.34	45.13	53.61	87.54	138.43	240.22	443.79	1258.09
Cell Vol	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00
Cell Soak	1.05	5.25	10.50	31.50	63.00	126.00	1.05	5.25	10.50	31.50	63.00	126.00	1.05	5.25	10.50	31.50	63.00	126.00	1.05	5.25	10.50	31.50	63.00	126.00	252.00	756.00
Cell Total	15.05	19.25	24.50	45.50	77.00	140.00	15.05	19.25	24.50	45.50	77.00	140.00	15.05	19.25	24.50	45.50	77.00	140.00	15.05	19.25	24.50	45.50	77.00	140.00	266.00	770.00
Total Vol	53.39	64.38	78.11	133.04	215.43	380.22	53.39	64.38	78.11	133.04	215.43	380.22	53.39	64.38	78.11	133.04	215.43	380.22	53.39	64.38	78.11	133.04	215.43	380.22	709.79	2028.09
	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS

Project	**Lot 176 Hammond Road, Success**
Job Number	**18-06-070**
Date	**19 December 2018**
Engineer	**Jamie King**
Summary	**Extra-over Lot Runoff**
Scenario	**Additional Tunnelwell**
File Name	**Drainage Calculations - Lots**
Revision	**B**
Reference Document	**Drainage Strategy R036.18**
IFD Used	**Beeliar IFD used (32.138° S,115.793° E) generated from BoM website**
Ground Conditions	**High permeability due to s_8 sand**
Groundwater	**Medium (RL 22.0m)**

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Intensities (mm/hr)

1 EY (1 year)	6 minute	55
	30 minute	24.30
	1 hour	15.90
	3 hour	7.92
	6 hour	5.09
	12 hour	3.27
0.2 EY (5 year)	6 minute	95.70
	30 minute	39.90
	1 hour	25.60
	3 hour	12.40
	6 hour	7.83
	12 hour	5.01
5% AEP (20 Year)	6 minute	135.00
	30 minute	53.80
	1 hour	34.00
	3 hour	16.00
	6 hour	10.00
	12 hour	6.40
1% AEP 100 Year	6 minute	199.00
	30 minute	75.50
	1 hour	46.90
	3 hour	21.70
	6 hour	13.40
	12 hour	8.53
	24 hour	5.62
	72 hour	2.86

Catchment Details

Area (ha) = 1.023
Co-efficient of Runoff = 0.80

Soakwell details

Soakwell Diameter (m) = 1.8
Liner Depth (m) = 0.9
Effective Depth (m) = 0.9
Soakwell base area (m^2) = 2.54
Soakwell Volume (m^3) = 2.29
Soakwells on lots (34 lots x 2 SW's) + 8 (GH) = 76

Infiltration

Rate of Soakage (m/day) = 20

Storage Cells

Length (m) = 20.000 Extra-Over
Width (m) = 1.800
Height (m) = 1.500

Volume (m^3) = 40.00
Base Area (m^2) = 36.00

Event	1EY (1 Year)						0.2 EY (5 Year)						5% AEP (20 Year)						1% AEP (100 Year)							
Duration	6 min	30 min	1 hour	3 hour	6 hour	12 hour	6 min	30 min	1 hour	3 hour	6 hour	12 hour	6 min	30 min	1 hour	3 hour	6 hour	12 hour	6 min	30 min	1 hour	3 hour	6 hour	12 hour	24 hour	72 hour
Intensities	55	24.3	15.9	7.92	5.09	3.27	95.70	39.9	25.6	12.40	7.83	5.01	135	53.8	34	16.00	10.00	6.4	199	75.50	46.90	21.70	13.40	8.53	5.62	2.86
Q (m^3/s)	0.1252	0.0553	0.0362	0.0180	0.0116	0.0074	0.2178	0.0908	0.0583	0.0282	0.0178	0.0114	0.3072	0.1224	0.0774	0.0364	0.0228	0.0146	0.4529	0.1718	0.1067	0.0494	0.0305	0.0194	0.0128	0.0065
Volume	**45.06**	**99.54**	**130.27**	**194.66**	**250.21**	**321.49**	**78.41**	**163.45**	**209.74**	**304.78**	**384.90**	**492.56**	**110.60**	**220.39**	**278.56**	**393.26**	**491.58**	**629.22**	**163.04**	**309.28**	**384.25**	**533.36**	**658.71**	**838.63**	**1105.06**	**1687.09**
SW Vol.	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06	174.06
Soak Vol	16.12	80.58	161.16	483.49	966.98	1933.96	16.12	80.58	161.16	483.49	966.98	1933.96	16.12	80.58	161.16	483.49	966.98	1933.96	16.12	80.58	161.16	483.49	966.98	1933.96	3867.93	11603.79
SW Total	190.17	254.64	335.22	657.55	1141.04	2108.02	190.17	254.64	335.22	657.55	1141.04	2108.02	190.17	254.64	335.22	657.55	1141.04	2108.02	190.17	254.64	335.22	657.55	1141.04	2108.02	4041.99	11777.84
Cell Vol	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Cell Soak	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	15.00	30.00	90.00	180.00	360.00	720.00	2160.00
Cell Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.00	55.00	70.00	130.00	220.00	400.00	760.00	2200.00
Total Vol	190.17	254.64	335.22	657.55	1141.04	2108.02	190.17	254.64	335.22	657.55	1141.04	2108.02	190.17	254.64	335.22	657.55	1141.04	2108.02	233.17	309.64	405.22	787.55	1361.04	2508.02	4801.99	13977.84
	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS

These calculations are for runoff generated from the lots only. 5% AEP is to be contained on each lot.

5% AEP calculations show no storage in Tunnelwell system, only in soakwells.

76 soakwells (1.8x0.9m) required or 2 on each lots to manage the 5% AEP

The extra over rainfall for the 1% AEP is to be disposed of within the road network.

20m of Tunnelwell manages this.

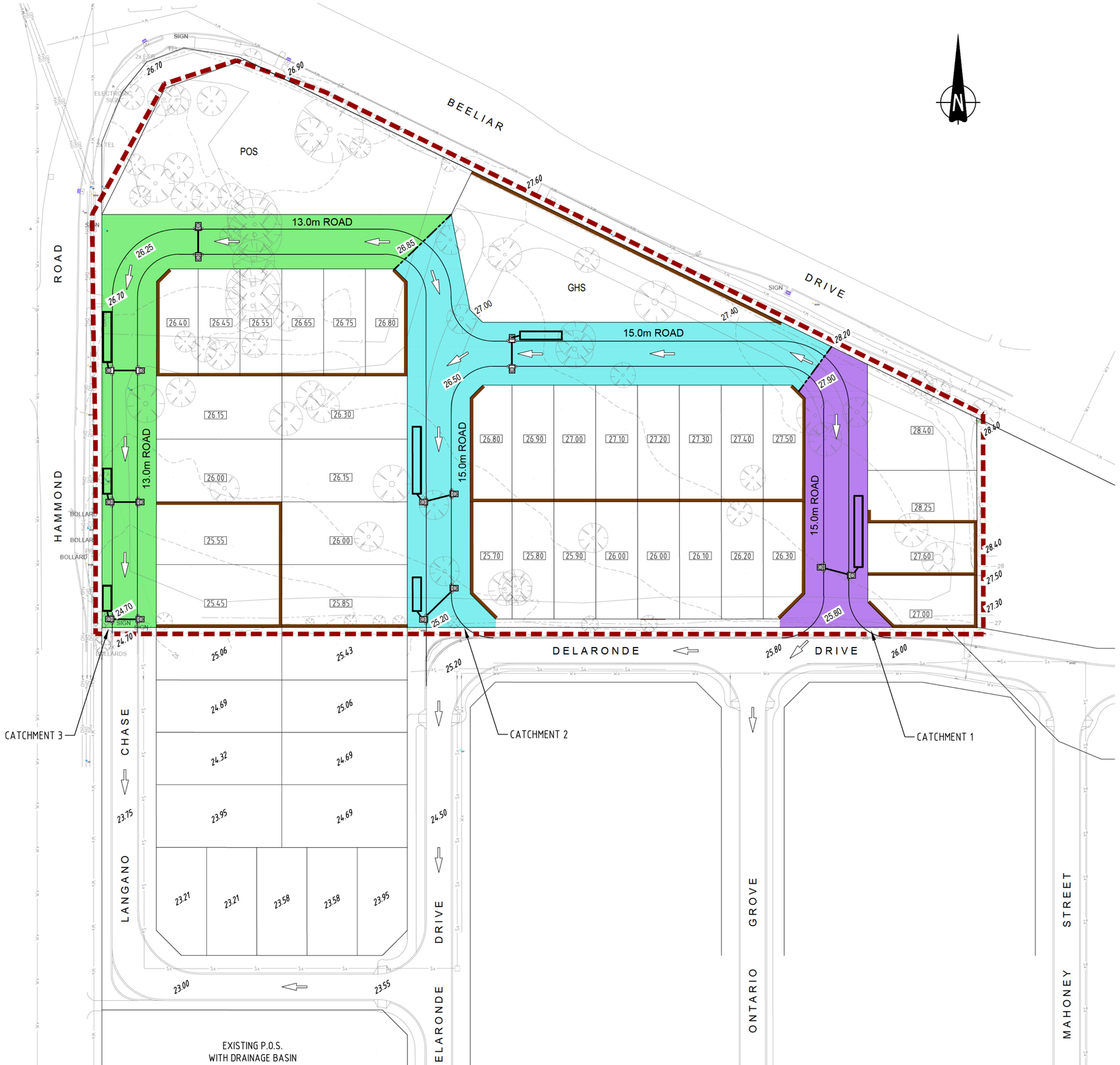
15% of the lot area flows into Catchment 1, 15% of 20m = 3m

55% of the lot area flows into Catchment 2, 55% of 20m = 11m

30% of the lot area flows into Catchment 3, 30% of 20m = 6m

APPENDIX 5

Drainage Strategy Plan



LEGEND

- SITE BOUNDARY
- 4.50 PROPOSED LOT LEVELS
- 25.00 PROPOSED ROAD LEVELS
- 24.70 EXISTING SPOT LEVELS
- OVERLAND FLOW PATH (EXTREME EVENT)
- PROPOSED CREST IN ROAD
- GRATED GULLY PIT / SOAKWELL (Ø1.8 x 1.8m)
- TUNNELWELL 'T2000'
- CONCEPT RETAINING WALLS

COEFFICIENT OF RUNOFF

13m ROAD RESERVE:

C_r = 1.0 *(8.6m - ROADS, KERB & PATH)*

C_v = 0.3 *(4.4m - VERGE)*

C_{13m} = 0.76 $\left(\frac{(8.6 \times 1) + (4.4 \times 0.3)}{15}\right)$

15m ROAD RESERVE:

C_r = 1.0 *(8.6m - ROADS, KERB & PATH)*

C_v = 0.3 *(6.4m - VERGE)*

C_{15m} = 0.7 $\left(\frac{(8.6 \times 1) + (6.4 \times 0.3)}{15}\right)$

LOTS

$C_{building}$ = 1.0 *(70% OF LOT AREA)*

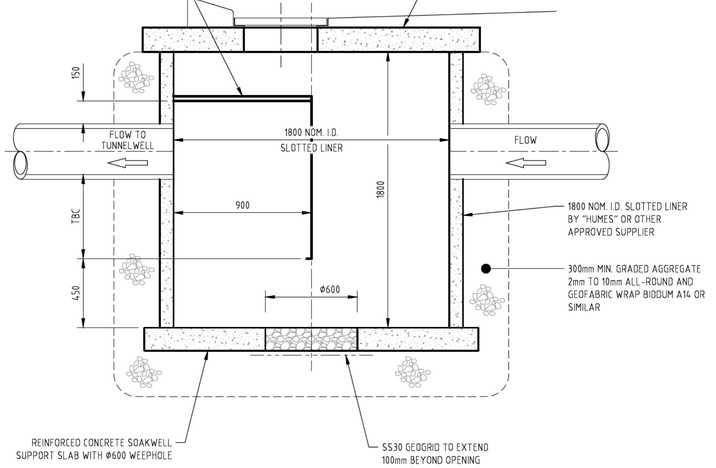
C_{yard} = 0.3 *(30% OF LOT AREA)*

C_{lots} = 0.8 *(10.7 x 1) + (0.3 x 0.3)*

DRAINAGE DESIGN SUMMARY

CATCHMENT	ROAD RESERVE AREA	SOAKWELL GRATED GULLY PITS	TUNNELWELL (T2000) *ROAD RESERVE AREA*	TUNNELWELL (T2000) *EXCESS LOT RUNOFF*	TOTAL TUNNELWELL (T2000)
1	1008m²	2	6m	3m	9m
2	2653m²	6	16m	11m	27m
3	2102m²	8	7m	6m	13m
TOTAL	5763m²	16	29m	20m	49m

NOTE: REFER SPREADSHEETS FOR DRAINAGE CALCULATIONS.



ELEVATION

SOAKWELL GRATED GULLY PIT WITH TRASH RACK

SCALE 1:20

PROJECT: **LOT 176 HAMMOND ROAD SUCCESS**

No	DATE	REVISION	BY
B	19-12-2018	LOT LAYOUT, LEVELS AND DRAINAGE TABLE ALTERED TO SUIT	MEG
A	5-10-2018	ISSUED FOR APPROVAL	DLC

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

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CLIENT: **DOROTHY GUERINI**

DRAWING: **DRAINAGE STRATEGY PLAN**

STATUS: **FOR APPROVAL**

SCALE	1:500
DATE	OCT 2018
DESIGN	JK
DRAWN	DLC
CHECK	
APP'D	

DRAWING No. **18-6-70/800** REV No. **B** ORIGINAL DRAWING SIZE **A1**

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Appendix 5
Environmental Assessment Report

Environmental Assessment Report

119 Hammond Road, Success

Prepared for
Planning Solutions

11 January 2019



DOCUMENT TRACKING

Item	Detail
Project Name	Environmental Assessment Report - 119 Hammond Road, SuccessAssessment
Project Number	18PER-10345
Project Manager	Daniel Panickar 08 6218 2200 Level 1, Bishops See, 235 St Georges Terrace
Prepared by	James Leonard
Reviewed by	Jen Longstaff
Approved by	Jen Longstaff
Status	Final
Version Number	1
Last saved on	11 January 2019

This report should be cited as 'Eco Logical Australia January 2019. *Environmental Assessment Report 119 Hammond Road, Success*. Prepared for Planning Solutions.'

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Template 29/9/2015

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1 Introduction

1.1 Background

Planning Solutions on behalf of Dorothy Guerini is proposing a Structure Plan (SP) to support future residential development of 119 Hammond Road, Success located within the City of Cockburn, herein referred to as 'the site'. The site is approximately 2.08 ha in size. A SP has been prepared for the subject site which includes residential lots, roads and areas of active and managed Public Open Space (POS) as illustrated in Figure 1 and Figure 2.

This environmental assessment will assist the SP for the site as well as the environmental approvals process associated with the project. This Environmental Assessment Report (EAR) addresses the following factors listed below:

- Flora and vegetation;
- Habitat of threatened fauna;
- Bushfire risk;
- Groundwater; and
- Acid Sulphate Soils.

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Figure 1: Site Overview



Legend

- Site Boundary
- Cadastre

0 25 50 100
Metres
Datum/Projection:
GDA 1994 MGA Zone 50

N

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Prepared by: JL Date: 09/01/2019

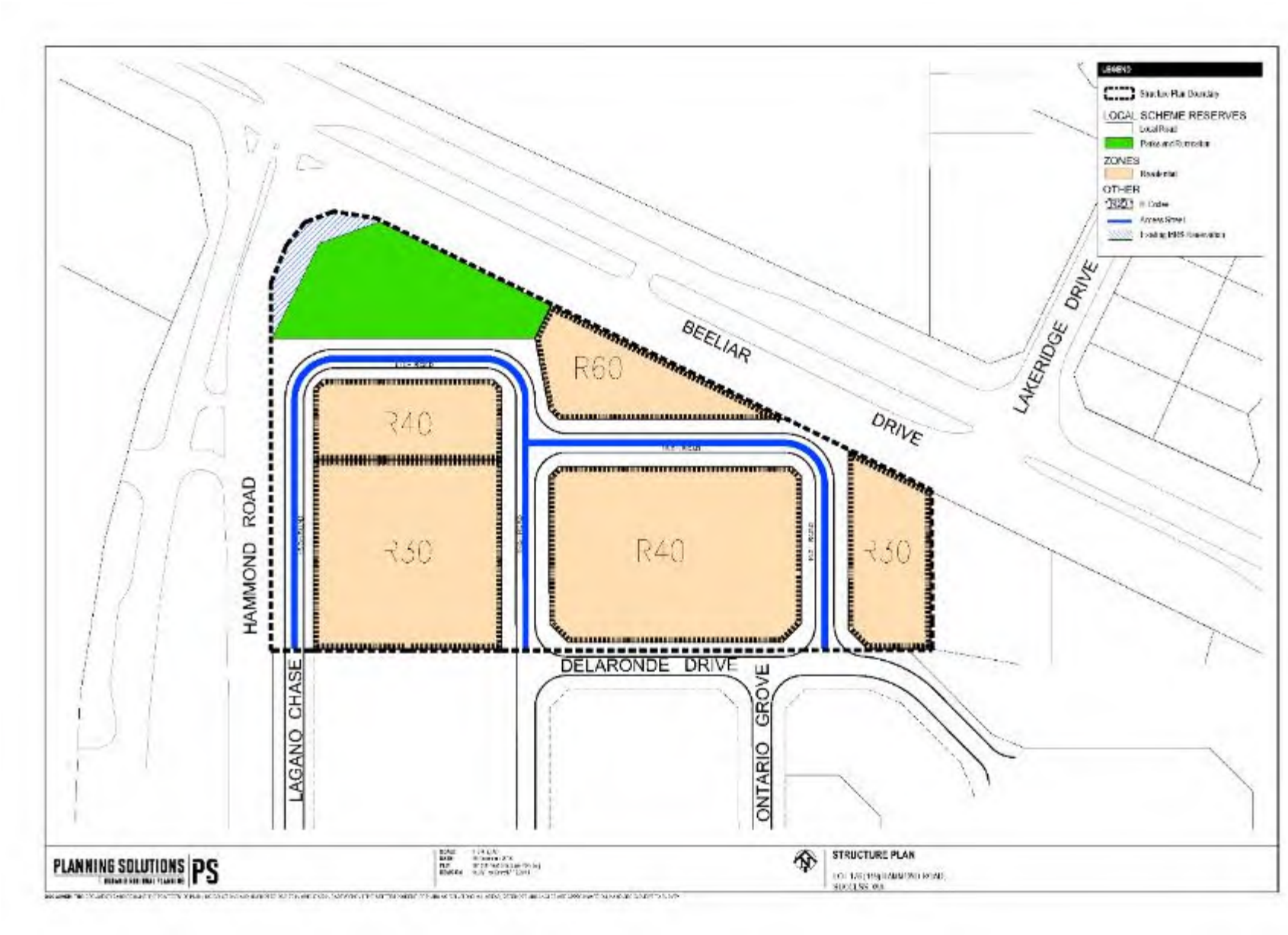


Figure 2: Proposed Structure Plan

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2 Key legislation and history

2.1 Site description

2.1.1 Location and Zoning

The site is located in the suburb of Success, within the local government of the City of Cockburn and is 20 km south of the Perth CBD. The site is bound by Beeliar Drive to the north and east, Urban Development to the south and Hammond Road to the west. The site is zoned as 'Urban' under the Metropolitan Regional Scheme (MRS) and 'Development' under the City of Cockburn's Town Planning Scheme (TPS).

2.1.2 Land use

The site has historically been used for private residential purposes, with one house previously located on the site surrounded by native vegetation. The house was removed in September 2018. Historical aerial imagery shows that the house was constructed between 1965 and 1974 (City of Cockburn 2019) and vegetation within and surrounding the site has become progressively more fragmented and degraded from approximately 1965 onwards.

A variety of land uses occur in the vicinity of the site:

- Commercial and residential development to the north;
- Residential development to the east,
- The Emmanual Catholic College to the west; and
- Residential Development to the south.

2.2 Legislation

The following legislation and guidance has been considered during the development of this EAR:

- *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Environmental Protection Acct 1986* (EP Act)
- *Biodiversity Conservation Act 2016* (BC Act)
- *Bush Fires Act 1954*
- *Conservation and Land Management Act 1984*
- *Contaminated Sites Act 2003*
- *Planning and Development Act 2005*
- *Statement of Planning Policy 3.7: Planning in Bushfire Prone Areas*
- *EPA Guidance Statement No. 2: Environmental Protection of Native Vegetation in Western Australia (2000)*
- *EPA Guidance Statement No. 33: Environmental Guidance for Planning and Development (2008)*

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3 Existing environment, impacts and management

3.1 Landform and topography

The topography of the site is predominantly flat, with height ranging between 26 to 29 m above sea level, as illustrated in Figure 3. No potential environmental risks associated with topography are considered likely as a result of development.

3.2 Geology and soils

The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone with dominant vegetation comprised of heath and/or Tuart woodlands on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages, and Marri on colluvial and alluvial sands. The subregion also includes a complex series of seasonal wetlands (Mitchell et al. 2002).

The site is situated on Bassendean Sands over the Guildford Formation, (Figure 3, DAFWA 2007). The soils here are characterised as:

> "Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant."

3.2.1 Contamination

The *Contaminated Sites Act 2003* provides for the identification, recording, management and remediation of contaminated sites. Investigating and remediating contaminated sites is, in most cases, the responsibility of the polluter or current site owner and it is therefore important to understand the contamination status of a site prior to acquisition.

The DWER Contaminated Sites Database (DWER 2018a) does not identify the site as contaminated, with the nearest registered contaminated site being located approximately 470 m north-west of the site. Historical imagery shows that the site has been partially cleared in the past for the construction of a house, with adjacent vegetation being maintained. There is no historical evidence that contamination has occurred on the site. Given historical land use at the site, it is considered unlikely that gross contamination exists.

3.2.2 Acid Sulphate Soils

Acid Sulphate Soils (ASS) naturally occur in the form of soils, sediments and peats that contain iron sulphides in the form of pyrite materials (DER 2015).

A search of the ASS Risk Map, Swan Coastal Plain (DWER-055) shows that the whole site is at Medium risk of ASS occurring within 3 m of the soil surface (Figure 4, DWER 2018b). The generation of ASS can result in the release of sulphuric acid and iron into the soil and groundwater. If acid sulphates are mobilised the acid can release aluminium, nitrates and other heavy metals into the soil. This can in turn cause degradation to vegetation, flora, fauna and can also degrade built form such as concrete or steel. The long-term changes in soil chemistry will reduce the biodiversity and cause potential land sterilisation.

It is not anticipated that ASS will be mobilised if standard avoidance and mitigation measures applicable to construction activities are implemented however soil testing and investigation of the presence of Potential Acid Sulphate Soil (PASS) material should be undertaken prior to construction.

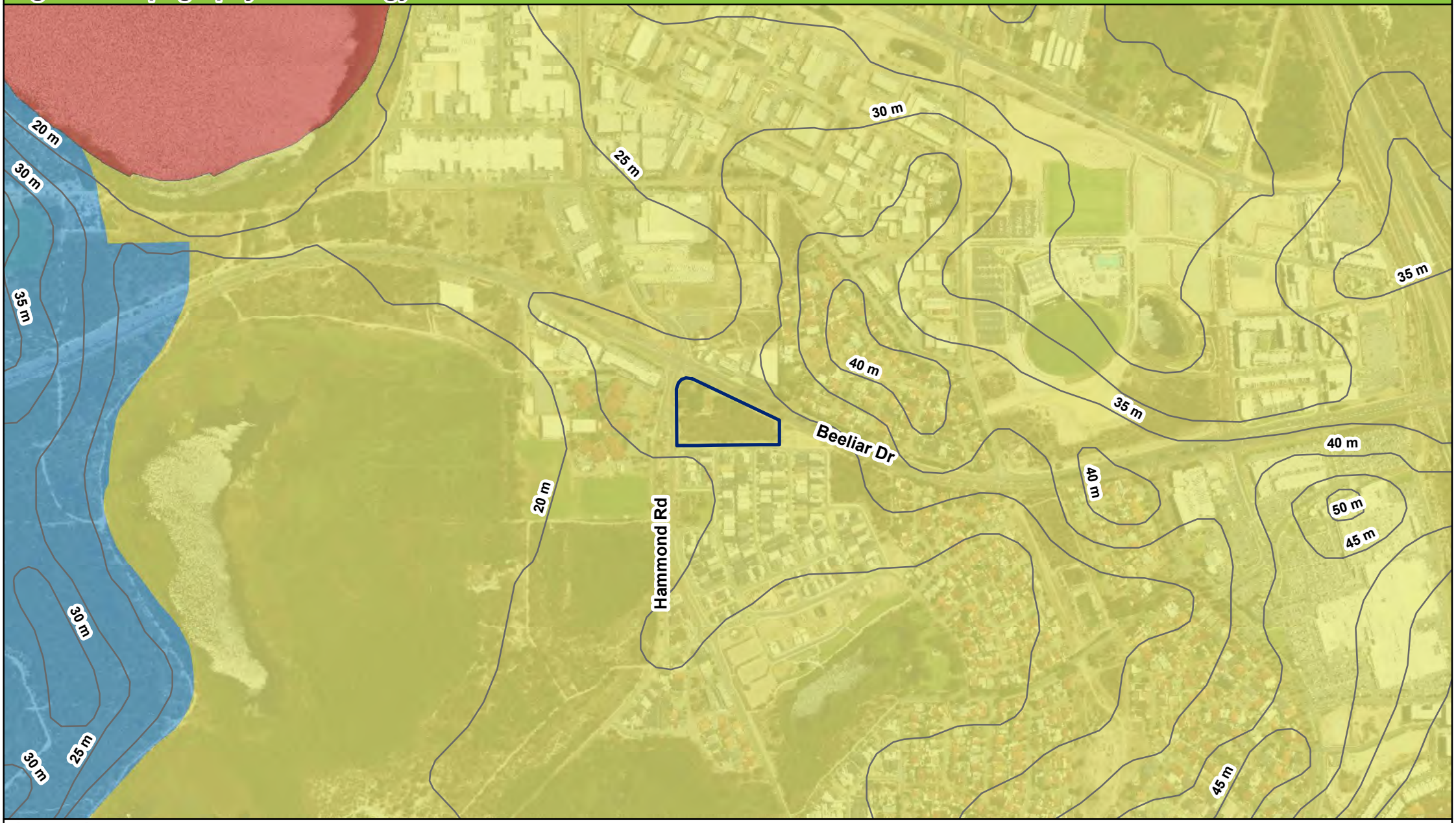
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3.2.3 Soil management

The potential impacts of clearing and construction, such as land degradation from erosion, sedimentation, contamination and ASS will be managed by undertaking the standard avoidance and mitigation measures applicable to construction activities, installation of wind fencing around the perimeter of the proposed clearing area to minimise impacts on adjacent vegetation, soil testing and ASS investigations. If ASS investigation finds there to be PASS present, then a management plan will be implemented. A construction management plan will be written prior to commencement of the development of the site.

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Figure 2: Topography and Geology/soils



Legend

- Site Boundary
- Contours Statewide (5m Intervals)

Soil landscape mapping

- Bassendean System
- Pinjarra System
- Spearwood System

0 75 150 300

Metres

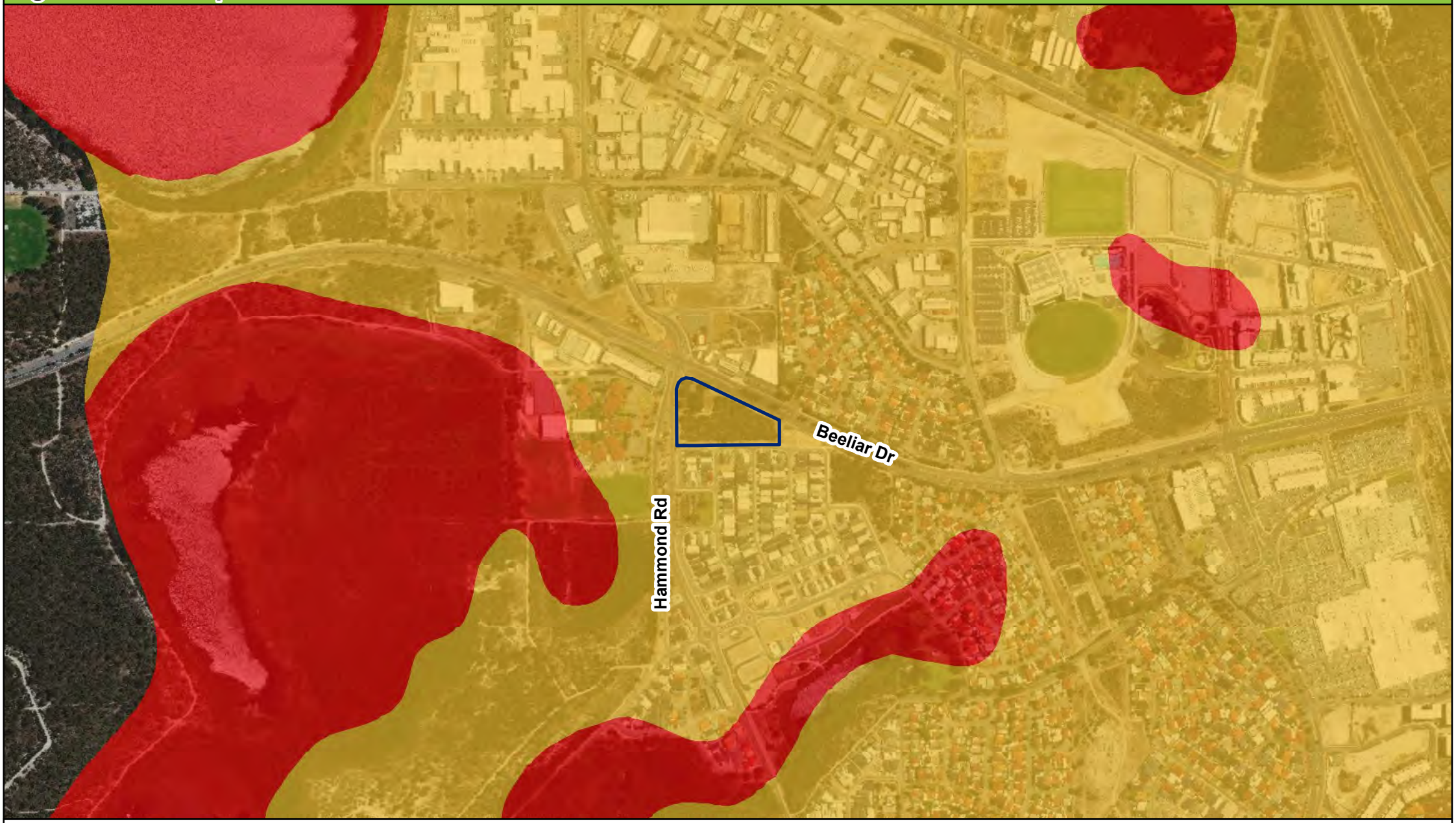
Datum/Projection:
GDA 1994 MGA Zone 50

N

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Prepared by: JL Date: 08/01/2019

Figure 3: Acid Sulphate Soil Risk



Legend

Site Boundary

Acid Sulphate Soil Risk Categories

High to moderate risk

Moderate to low risk

0 75 150 300

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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Prepared by: JL Date: 08/01/2019

3.3 Hydrology

There is no surface water or drainage lines within or adjacent to the site. In addition, field observations did not identify any water bodies to be present on site. The closest Geomorphic (Resource Enhancement) wetlands are approximately 135 m south-west and 233 m north of the site. The closest water features include an unnamed water body 450 m south, Kogolup Lake 830 m west, Yangebup Lake (Beeliar Regional Park) 950 m north west and Thomsons Lake (Thomsons Lake Nature Reserve) 2 km south west, all of which are Conservation Geomorphic wetlands (Figure 5).

The Perth Groundwater Atlas shows the regional groundwater contours and identifies that the depth to Groundwater is approximately 8.3 m below the surface with the base of aquifer 47.3 m below the surface (DWER 2018c).

No dewatering is anticipated for the development of the site. There are no watercourses or wetlands located within the site and given the significant distance to the closest surface water body and inferred depth to groundwater, the development of site is not considered likely to any impact on local or regional hydrology.

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Figure 5: Geomorphic Wetlands



Legend

Site Boundary

Geomorphic Weltnads of the Swan Coastal Plain (DBCA 2019)

Conservation

Multiple Use

Resource Enhancement

0 75 150 300

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

www.ecoaus.com.au

Prepared by: JL Date: 11/01/2019

3.4 Bush Forever

The Government of West Australia's Bush Forever Policy is a strategic plan for conserving regionally significant bushland within the Swan Coastal Plain portion of the Perth Metropolitan Region. The objective of Bush Forever is to protect comprehensive representations of all original ecological communities by targeting a minimum of 10 % of each vegetation complex for protection. Bush Forever Sites are representative of regional ecosystems and habitat and have a key role in the conservation of Perth's biodiversity.

The closet conservation area is Bush Forever Site 391 (Thomsons Lake Nature Reserve) located approximately 400 m to the south west (DPLH 2018). Bush Forever Site 256 (Beeliar Regional Park) is located approximately 675 m the north. It is not anticipated that either Bush Forever Site will be impacted by the development of the site.

3.5 Flora and vegetation

3.5.1 Regional context

Interim Biogeographic Regionalisation for Australia (IBRA) divides Western Australia into 26 biogeographic regions and 53 subregions based on dominant landscape characteristics of climate, lithology, geology, landform and vegetation (DotEE 2018a). The site is located within the Swan Coastal Plain bioregion, which is dominated by woodlands of Banksia and Tuart on sandy soils, Sheoaks on outwash plains and Paperbarks in swampy areas (DotEE 2018a).

Vegetation occurring within the region was initially mapped at a broad scale (1:1 000 000) by Beard during the 1970s. This dataset has formed the basis of several regional mapping systems, including physiographic regions defined by Beard (1981); System 6 Vegetation Complex mapping undertaken by Heddle *et al.* (1980); the biogeographical region dataset (Interim Biogeographic Regionalisation for Australia) for Western Australia (DotEE 2018b).

The site is within the Drummond Botanical Subdistrict which is characterised by low Banksia woodlands on leached sands; *Melaleuca* swamps on poorly-drained depressions; and *Eucalyptus gomphocephala* (Tuart), *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) woodlands on less leached soils (Beard 1990).

The site is within the Bassendean Central- South Complex which is described as:

> Woodland of *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri) with well defined second storey of *Allocasuarina fraseriana* (Sheoak) and *Banksia grandis* (Bull Banksia) on the deeper soils and a closed scrub on the moister sites. The understorey species reflect similarities with the adjacent vegetation complexes.

At a finer scale, the site falls within the Bassendean 1001 vegetation system association (Medium very sparse woodland; Jarrah, with low woodland; *Banksia* and *Casuarina*) as defined in Government of Western Australia (2018).

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Table 1: Beard's mapping unit occurring within the Site, its current and Pre-European extent within the Bassendean system and its extent across the Site

Beard's Mapping Unit (Shepherd vegetation association)	Pre-European extent (ha) (Government of WA 2016)	Current extent (ha) (Government of WA 2016)	Extent within the site (ha) (% of current extent)
Bassendean 1001	53,283.54	11,436.60	1.24 (0.01)

The EPA recognises that vegetation complexes with less than 10% of pre-European extent remaining may be considered regionally significant (EPA 2006). The Bassendean complex has greater than 10% of its pre-European extent remaining (Table 1). The subject site consists of fragmented remnant native vegetation, with the presence of some cleared areas. The surrounding areas comprises of urban and residential development, with minimal vegetation in direct proximity to the site.

3.5.2 Vegetation Complex

ELA undertook a detailed spring survey of the site on 25 September 2018 (**Appendix A**). The flora and vegetation survey was conducted in accordance with the Environmental Protection Authority (EPA) *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).

Two vegetation associations were identified within the site (not including cleared areas). Vegetation associations are described in full in Table 2 and in Figure 6. Only one of these associations is resemblant of its' native structure and composition and is well represented in the broader area. The other association is comprised of introduced species.

Table 2: Vegetation communities of the Proposed Site

Vegetation community	Area (ha)
EmBaBm - *Banksia attenuata*, *Eucalyptus marginata* subsp. *marginata* and *Banksia menziesii* woodland over *Allocasuarina humilis* and *Xanthorrhoea preissii* open to sparse shrubland over *Hibbertia hypercoides*, *Gompholobium tomentosum* and *Stirlingia latifolia* shrubland to open shrubland over **Ehrharta calycina* and **Briza maxima* isolated clumps of grasses over **Gladiolus caryophyllaceus* isoloated clumps of forbs over *Mesomelaena pseudostygia* sparse sedgeland;	1.24 ha
Planted Pines (**Pinus pinaster*) and *Eucalyptus robusta* with other exotic trees and shrubs with cleared areas	0.43 ha
Cleared areas, tracks and previously cleared dwellings	0.41 ha

These vegetation associations are considered common on the Swan Coastal Plain (Commonwealth of Australia 2016). There is representative large portions of intact Banksia woodland, that is ecologically linked in Bush Forever Site 256 and 391 (City of Cockburn 2019, Commonwealth of Australia 2016; Government of Western Australia 2018). This has large portions of intact remnant vegetation t is proposed that the vegetation will be cleared for the future development of the site, with retention of vegetation occurring in nominated POS areas where possible.

3.5.3 Vegetation Condition

Vegetation condition within the site ranged from Completely Degraded to Very Good based on the EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016;

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Table 3; Figure 7). Significant disturbance was noted throughout the site in the form of cleared areas, modified vegetation and weed infested areas.

Table 3: Vegetation condition of the proposed site

Vegetation association	Vegetation condition	Area (ha)
EmBaBm	Very Good	0.39 ha
	Good	0.53 ha
	Degraded	0.32 ha
Planted Pines (**Pinus pinaster*)	Completely Degraded	0.43 ha
Cleared	Completely Degraded	0.41 ha

3.5.4 Conservation Significant Vegetation

Given that EmBaBm contained banksia species that are known to form part of the Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community, an assessment was undertaken to determine if this community occurs within the site. To be considered as part of the EPBC Act ecological community a patch should meet at least the Good Condition category and meet the minimum patch size thresholds. Analysis found that EmBaBM was not representative of the Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community, due to the small remnant patch size and condition of the vegetation (Appendix D within **Appendix A**). For the vegetation community to be representative of the Banksia Woodland TEC, the remnant patch required a minimum of 1 ha of 'Very Good' or 2 ha of 'Good' condition vegetation.

The remnant patch is also not considered to be part of a much larger patch. The closest patch is a portion of remnant vegetation, approximately 117 m to the south-east of the site. Bush Forever Site 391 (Thomsons Lake Nature Reserve and Adjacent Bushland, Beeliar) is also within the vicinity of the site, approximately 160 m to the south west. The site is not connected through continuous vegetation to the adjacent remnant vegetation or the Bush Forever site and therefore does not contribute to the overall function of the ecological community across the landscape

The vegetation associations within the site do not resemble any other known Threatened Ecological Communities (TECs) listed under the EPBC Act or Priority Ecological Communities (PECs) listed by DBCA (ELA 2018).

3.5.5 Flora

Desktop Assessment

Prior to the survey, ELA conducted a desktop assessment to gather information on potentially occurring conservation listed flora, vegetation and fauna within the site. The following databases searches were undertaken to inform the desktop assessment:

- Commonwealth EPBC Act Protected Matters Search Tool (PMST) for Threatened species and communities listed under the EPBC Act (DotEE 2018c); and
- DBCA and WA Museum's NatureMap (DBCA 2007 – 2018).

A total of 96 flora taxa from 81 genera and 38 families were recorded within the site (ELA 2018). Families with the highest number of species included Fabaceae (15 species) and Proteaceae (eight species). No Threatened flora species as listed under section 178 of the EPBC Act or pursuant to the BC Act and as

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listed by DBCA (2018) or Priority flora species as listed by Western Australian Herbarium (1998-) were recorded within the site (ELA 2018). Five conservation significant flora species were initially considered to have the potential to occur within the site, however were not recorded during the survey and are no longer considered to occur. Results of the data base searches are provided within **Appendix A**.

Introduced species

A total of 31 weed species were recorded within the site, six of which are from the Poaceae family. One of the recorded weed species (**Asparagus asparagoides*) is listed as a Declared Plant species in Western Australia pursuant to Section 22 of the Biosecurity and Agriculture Management Act 2007 (BAM Act; DPRID 2018). This species is also considered to be a Weed of National Significance (WON) (ELA 2018).

3.5.6 Flora and vegetation management

Due to the small size of the development area it is envisaged that significant trees may be identified for retention within the POS area located in the north west of the site. Some vegetation may also be considered for retention within road reserves, however will be subject to further engineering and design considerations.

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Figure 6: Vegetation associations of the site



Legend

Site Boundary

Vegetation associations

- EmBaBm - *Banksia attenuta, Eucalyptus marginata* subsp. *marginata* and *Banksia menziesii* woodland
- Planted Pines (**Pinus pinaster*) and **Eucalyptus robusta* with other exotic trees and shrubs with cleared areas
- Cleared tracks

0 10 20 40

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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Prepared by: JL Date: 11/01/2019

Figure 7: Vegetation condition of the site



Legend

Site Boundary

Vegetation condition

- Very Good
- Good
- Degraded
- Completely Degraded

0 10 20 40

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

www.ecoaus.com.au

Prepared by: JL Date: 11/01/2019

3.6 Fauna

A targeted Black Cockatoo assessment was undertaken on the site during the vegetation survey, however no other targeted fauna assessment has been undertaken. A 1 km buffer search of the Naturemap database (DPaW 2019) and Protected Matters Search Tool (PMST) (Department of Environment and Energy 2019) was undertaken for the site. A total of 155 species were returned by the search results including ten threatened and two priority species, as well as 23 migratory species protected under international agreement. Of these, six conservation species are considered to potentially occur in the vicinity of the site (or their habitat likely to occur). Due to the historical clearing surrounding the site, causing segmentation from surrounding vegetation, the site provides limited habitat and therefore provides little opportunity to support significant fauna. This is also exacerbated by large weed invasion (**Section 3.5.5**) and no connectivity to other native vegetation (**Section 3.5.2**). No fauna was observed during the site assessment.

3.6.1 Conservation significant fauna

The database searches resulted in a total of 35 conservation significant species with six considered as having the potential to occur. These species and the likelihood of their occurrence is discussed in **Appendix C**. The six conservation listed species with the potential to occur within the site are:

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) (Endangered under the WC Act and EPBC Act);
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) (Vulnerable under the WC Act and EPBC Act);
- Fork-tailed Swift (*Apus pacificus*) (Migratory under the WC Act and EPBC Act);
- Osprey (*Pandion haliaetus*) (Migratory under the WC Act and EPBC Act);
- Grey Wagtail (*Motacilla cinerea*) (Migratory under the WC Act and EPBC Act); and
- Quenda (*Isoodon fusciventer*) (Priority 4 under the WC Act).

The aerial nature and large home range of Fork-tailed Swift, Rainbow Bee-eater, Grey Wagtail and Ospey means the proposed clearing area would only be used on an occasional basis by these species, if at all. The habitat present is not considered significant in a local or regional context for the Quenda, and similar habitat is present within adjacent bushland areas to the south west, within Bush Forever Site 256 and 391. Due to the small size of the remnant vegetation and the relatively poor quality of the site, in comparison to other remnant vegetation within the area, all species are considered to vagrants for the site.

3.6.2 Black Cockatoo habitat assessment

No Black Cockatoos were observed within the site at the time of assessment, however scattered signs of foraging were noted. Foraging habitat, was identified for all three threatened Black Cockatoo species (e.g. *Banksia attenuata, Eucalyptus marginata subsp. M*arginate *and* * Pinus pinaster), however the habitat is of varying quality throughout the site (Table 4, ELA 2018). The remnant vegetation on site ranges from Good to Poor for the Carnaby's Black Cockatoo. The remnant patch sizes are small and are already considered to be degraded (Figure 8). The foraging habitat for Baudin's and Forest Red-tailed Black Cockatoos is considered to be of poor to nil quality (Figure 9 and Figure 10). Eleven potentially significant trees, with a diameter at breast height over 500 m, were also identified within the site. One tree contained a hollow of sufficient size to be utilised, however no signs of use were observed (ELA 2018).

The Black Cockatoo habitat that occurs within the site is common on the Swan Coastal Plain and is well represented in the region (DSEWPaC 2012). This vegetation is well represented within Bush Forever Site 391 (Thomsons Lake Nature Reserve), approximately 400 m to the south west (CALM 2005), and

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Bush Forever Site 256 Beeliar Regional Park approximately 675 m to the north (CALM 2006; Government of Western Australia 2018). The vegetation within these areas is in close proximity and of high-quality value. These sites are well utilised by the Black Cockatoos. Due to the fragmented nature of the site and the close proximity of other foraging, roosting and breeding habitat, it is not considered that site will be well utilised by the Black Cockatoos.

Table 4: Vegetation types and Carnaby's Black Cockatoo foraging habitat quality within the site (ELA 2018)

Vegetation community	Assessed foraging quality	Justification	Area impacted (ha)
Carnaby's Black-Cockatoo			
EmBaBm	Good	Foraging species: *Banksia attenuta*, *Eucalyptus marginata* subsp. *marginata* and *Banksia menziesii*	0.39 ha
	Moderate		0.53 ha
	Poor		0.32 ha
Pines	Moderate	Foraging habitat limited to **Pinus pinaster* and **Eucalyptus robusta*	0.06 ha
Cleared	Nil	No suitable foraging species	0.41 ha
Baudin's Black Cockatoo			
EmBaBm	Poor	Foraging species: *Eucalyptus marginata* subsp. *marginata*	1.24 ha
Pines	Poor	Foraging habitat limited to **Pinus pinaster*	0.06 ha
Cleared	Nil	No suitable foraging species	0.41 ha
Forest Red-tailed Black Cockatoo			
EmBaBm	Poor	Foraging species: *Eucalyptus marginata* subsp. *marginata*	1.24 ha
Pines	Nil	No suitable foraging species	0.06 ha
Cleared	Nil	No suitable foraging species	0.41 ha

3.6.3 Fauna and Black Cockatoo management

The POS area in the north west of the site may provide opportunities to retain potentially significant trees where possible and will be identified upon completion of final engineering and landscape design. Trees will be tagged for protected prior to the commencement of bulk earthworks activities.

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Figure 8: Carnaby's Black Cockatoo Habitat



Legend

Site Boundary

Potential Significant Trees

- *Eucalyptus marginata* subsp. *marginata*
- *Eucalyptus robusta*
- **Pinus pinaster*

Black Cockatoo Habitat

- Good
- Moderate
- Poor

0 10 20 40

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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Figure 9: Baudin's Black Cockatoo Habitat



Legend

Site Boundary

Potential Significant Trees

- *Eucalyptus marginata* subsp. *marginata*
- **Pinus pinaster*

Black Cockatoo Habitat

Poor

0 10 20 40

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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Prepared by: JL Date: 11/01/2019

Figure 10: Forest Red-tailed Black Cockatoo Habitat



Legend

Site Boundary

Potential Significant Trees

Eucalyptus marginata subsp. *marginata*

Black Cockatoo Habitat

Poor

0 10 20 40

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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Prepared by: JL Date: 11/01/2019

3.7 Bushfire Management

The proposed Structure Plan is located in a designated bushfire prone area as per the Western Australia State Map of Bushfire Prone Areas (DFES 2019). As a result, ELA has prepared a Bushfire Management Plan (BMP) to support the Structure Plan in accordance with *State Planning Policy 3.7: Planning in Bushfire Prone Areas.* The supporting BMP addresses bushfire risk and management, and therefore will not be discussed further in this report.

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4 Conclusion

The environmental values and attributes have been investigated to support the preparation of the Structure Plan for the proposed development of 119 Hammond Road, Success.

The key findings and conclusions of the environmental assessment are as follows:

- The vegetation complexes within the site are considered to be common to the swan coastal plain;
- The vegetation is not considered to represent any state or federally listed Threatened or Priority Ecological Communities;
- Adjacent land uses do not represent a bushfire constraint to the developable area, with appropriate mitigation strategies employed to manage potential impacts from bushfire risk;
- No conservation-significant wetlands exist on site; and
- The development of the site is not considered likely to result in significant impacts.

Based on the information available, there are no known significant environmental factors which would impede development potential of the site. The development of the site will be managed through the following:

- A Construction Environmental Management Plan (CEMP), written prior to commencement of the development of the site;
- Installation of wind fencing around the perimeter of the proposed clearing area to minimise impacts on adjacent vegetation;
- Soil testing and ASS investigations and an ASS management plan, if required;
- No dewatering to occur on site;
- POS area and road reserves may retain significant trees where possible, subject to engineering and design considerations;
- Implementation of the prepared bushfire management plan.

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Appendix A : 119 Hammond Rd, Success – Flora, Vegetation and Black Cockatoo Assessment (ELA 2018)

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Jesse Dunbar
Planning Solutions
1/251 St Georges Terrace
Perth WA 6000

ELA Reference: 18PER - 10345

25 October 2018

Dear Jesse,

119 Hammond Road, Success– Flora, vegetation and Black Cockatoo Assessment

Introduction

Eco Logical Australia (ELA) has been engaged by Planning Solutions to undertake a Detailed and Targeted flora survey and a black cockatoo habitat assessment to support environmental approvals facilitating the development of 119 Hammond Road, Success (the site; **Figure 1**). The site is bound by Beeliar Dr to the north and east, Urban Development to the south and Hammond Rd to the west.

The objectives of the survey were to:

- Delineate and characterise the flora and vegetation associations present within the site;
- Undertake targeted searches for Threatened flora listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), State *Wildlife Conservation Act 1950* (WC Act) or Priority flora species as listed by the Department of Biodiversity, Conservation and Attractions (DBCA) and Western Australian Herbarium (1998-), including the presence of any suitable habitat for these species; and
- A targeted habitat assessment for black cockatoos listed as Threatened under the EPBC Act (Carnaby's Black-Cockatoo [*Calyptorhynchus latirostris*], Baudin's Black-Cockatoo [*Calyptorhynchus baudinii*] and Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*]).

Methodology

Desktop review and likelihood of occurrence

Prior to the survey, ELA conducted a desktop assessment to gather information on potentially occurring conservation listed flora, vegetation and fauna within the site. The following databases were searched:

- Commonwealth EPBC Act Protected Matters Search Tool (PMST) for Threatened species and communities listed under the EPBC Act (DotEE 2018a); and
- DBCA and WA Museum's NatureMap (DBCA 2007 – 2018).

A 10 km buffer around the site was used for each of the above database searches. This buffer is considered suitable based on flora and fauna assemblages expected to occur within the site. An initial five conservation listed flora taxa were identified as possibly occurring within the Site based on database searches.

Survey team and timing

The survey was conducted on 25 September 2018 by Joel Collins (Senior Ecologist). The flora and vegetation survey was conducted in accordance with the Environmental Protection Authority (EPA) *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016). The black cockatoo habitat assessment was undertaken in accordance with the Department of the Environment and Energy's (DotEE) *EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species* (DSEWPaC 2012).

Based on climate data from the nearby Bureau of Meteorology (BoM) Jandakot Aero Weather Station (Station number 9172, rainfall data 1972 – current, approximately 6.1 km north east of the site), a total of 597.4 millimetres (mm) of rainfall was received between May and August 2018, which is above the annual average rainfall of 561.9 mm for the same period (BoM 2018). The weather conditions were considered suitable for survey as the amount and timing of rainfall resulted in sufficient material present (flowering herbs) at the time of the survey.

Flora, vegetation and black cockatoo survey

The desktop review, including review of aerial imagery and database searches, informed the approximate number of sites required to describe vegetation communities within the site. Three quadrats were established across the site to delineate and characterise vegetation communities. Location of quadrats are shown in **Figure 1**.

The following tasks were undertaken within the site as part of the flora and vegetation survey:

- Vegetation assessment (including quadrats) to delineate and characterise vegetation associations, including a vegetation condition assessment;
- Targeted survey for conservation significant flora and habitat supporting these species; and
- Record of opportunistic introduced flora.

Desktop assessments identified the potential occurrence of all three species of Threatened black cockatoos occurring in Western Australia (Forest Red-tailed Black-Cockatoos [FRTBC], Baudin's Black- Cockatoos [BBC] and Carnaby's Black-Cockatoos [CBC]) within the site.

A targeted black cockatoo habitat assessment was undertaken which incorporated the following:

- A foraging assessment to identify potential black cockatoo foraging species; and
- A significant tree assessment to identify any trees with the potential to be utilised by black cockatoos for breeding.

The site was traversed on foot to record any flora species with the potential to provide a food source for black cockatoos. Following the assessment, vegetation units were defined and mapped based on dominant flora species contained within. These units were then assigned a foraging value based on the presence and quantity of potential food species and any evidence of foraging by black cockatoos.

Significant trees are defined as trees of suitable species with a diameter at breast height (DBH) greater than 500 mm (> 300 mm for salmon gum and wandoo) (DSEWPaC 2012). Trees with a DBH greater than 500 mm (or >300 mm for salmon gum and wandoo) are large enough to potentially contain hollows suitable for nesting black cockatoos, or have the potential to develop suitable hollows over the next 50 years. Trees of this size may also be large enough to provide roosting habitat (i.e. trees which provide a roost or rest area for the birds). The locations of such trees within the site were recorded using a Global Positioning System (GPS) device. In addition to the location and DBH, the species of each tree was also recorded.

Environmental setting

Climate

The site is situated within the Swan Coastal Plain 2 (Perth) sub-region of the Swan Coastal Plain bioregion under the Interim Biogeographic Regionalisation for Australia (IBRA). This subregion experiences a warm, Mediterranean climate with hot dry summers and mild wet winters (Mitchell et al. 2002).

Landform, topography and soils

The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone with dominant vegetation comprised of heath and/or Tuart woodlands on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages, and Marri on colluvial and alluvial sands. The subregion also includes a complex series of seasonal wetlands (Mitchell et al. 2002).

The topography of the site was noted to be flat, with height ranging between 26 to 29 m above sea level. The watertable is approximately 8.3 m below the surface with the base of aquifer 47.3 m below the surface (DWER 2018).

The site is situated on Bassendean Sands over the Guildford Formation (DAFWA 2007). The soils here are characterised as:

> "Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant."

Regional vegetation

Vegetation occurring within the region was initially mapped at a broad scale (1:1 000 000) by Beard during the 1970s. This dataset has formed the basis of several regional mapping systems, including physiographic regions defined by Beard (1981); System 6 Vegetation Complex mapping undertaken by Heddle et al. (1980); the biogeographical region dataset (Interim Biogeographic Regionalisation for Australia) for Western Australia (DotEE 2018b).

Beard (1990) Botanical Subdistrict

The site is within the Drummond Botanical Subdistrict which is characterised by low Banksia woodlands on leached sands; Melaleuca swamps on poorly-drained depressions; and Eucalyptus gomphocephala (Tuart), Eucalyptus marginata (Jarrah) and Corymbia calophylla (Marri) woodlands on less leached soils (Beard 1990).

Interim Biogeographic Regionalisation for Australia subregion

Interim Biogeographic Regionalisation for Australia (IBRA) divides Western Australia into 26 biogeographic regions and 53 subregions based on dominant landscape characteristics of climate, lithology, geology, landform and vegetation (McKenzie et al. 2003). The site is located within the Swan Coastal Plain bioregion, which is dominated by woodlands of Banksia and Tuart on sandy soils, Sheoaks on outwash plains and Paperbarks in swampy areas (McKenzie et al. 2003).

System 6 mapping

The site is within the Bassendean Central- South Complex which is described as:

> Woodland of *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri) with well defined second storey of *Allocasuarina fraseriana* (Sheoak) and *Banksia grandis* (Bull Banksia) on the deeper soils and a closed scrub on the moister sites. The understorey species reflect similarities with the adjacent vegetation complexes.

At a finer scale, the site falls within the Bassendean 1001 vegetation system association (Medium very sparse woodland; Jarrah, with low woodland; *Banksia* and *Casuarina*) as defined in Government of Western Australia (2018).

Figure 1: Site Overview



Legend

- Site Boundary
- Quadrats

0 20 40 80

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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Prepared by: JL Date: 25/10/2018

Results

Flora and vegetation

A total of 96 flora taxa from 81 genera and 38 families were recorded within the site. A complete flora species list is provided in **Appendix A**. Families with the highest number of species included Fabaceae (15 species) and Proteaceae (eight species). Site data is presented in **Appendix B**.

No Threatened flora species as listed under section 178 of the EPBC Act or pursuant to Schedule 1 of the WC Act and as listed by DBCA (2018) or Priority flora species as listed by Western Australian Herbarium (1998-) were recorded within the site. Five conservation significant flora species were initially considered to have the potential to occur within the Site, however were not recorded during the survey and are no longer considered to occur (**Appendix C**).

Two vegetation associations were identified within the site (not including cleared areas). Vegetation associations are described in full in **Table 1** and are presented in Error! Reference source not found.. Only one of these associations is resemblant of its' native structure and composition and is well represented in the broader area. The other association is comprised of introduced species. Given that one of the vegetation associations contained banksia species that are known to form part of the Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community, an assessment was undertaken to determine if this community occurs within the site (**Appendix D**). Based on the results of the assessment, it has been determined that the Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community does not occur within the site as the vegetation association within the site does not meet the minimum patch size diagnostic criteria for the TEC. In addition, the vegetation associations within the site do not resemble any other known Threatened Ecological Communities (TECs) listed under the EPBC Act or Priority Ecological Communities (PECs) listed by DBCA.

Vegetation condition within the site ranged from Completely Degraded to Very Good based on the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016; **Table 2; Figure 3**). Significant disturbance was noted throughout the site in the form of cleared areas, modified vegetation and weed infested areas.

A total of 31 weed species were recorded within the site, six of which are from the Poaceae family. One of the recorded weed species (**Asparagus asparagoides*) is listed as a Declared Plant species in Western Australia pursuant to Section 22 of the Biosecurity and Agriculture Management Act 2007 (BAM Act; DPRID 2018). This species is also considered to be a Weed of National Significance (WON).

Table 1: Vegetation associations within the site

Vegetation description	Area occupied (ha)	Quadrat
EmBaBm - *Banksia attenuata*, *Eucalyptus marginata* subsp. *marginata* and *Banksia menziesii* woodland over *Allocasuarina humilis* and *Xanthorrhoea preissii* open to sparse shrubland over *Hibbertia hypercoides*, *Gompholobium tomentosum* and *Stirlingia latifolia* shrubland to open shrubland over **Ehrharta calycina* and **Briza maxima* isolated clumps of grasses over **Gladiolus caryophyllaceus* isoloated clumps of forbs over *Mesomelaena pseudostygia* sparse sedgeland.	1.24 ha	ELA_01; ELA_02; ELA_03
  		
Planted Pines (**Pinus pinaster*) and *Eucalyptus robusta* with other exotic trees and shrubs with cleared areas	0.43 ha	N/A
 		

Vegetation description	Area occupied (ha)	Quadrat
Cleared: Cleared area used tracks and previously cleared dwellings (on right hand side	0.41 ha	N/A





Table 2: Vegetation condition of the site

Vegetation association	Vegetation condition	Area (ha)
EmBaBm	Very Good	0.39 ha
	Good	0.53 ha
	Degraded	0.32 ha
Planted Pines (**Pinus pinaster*)	Completely Degraded	0.43 ha
Cleared	Completely Degraded	0.41 ha

Figure 2: Vegetation associations of the site



Legend

- Site Boundary
- Quadrats

Vegetation associations

- EmBaBm - *Banksia attenuta, Eucalyptus marginata* subsp. *marginata* and *Banksia menziesii* woodland
- Planted Pines (**Pinus pinaster*) and **Eucalyptus robusta* with other exotic trees and shrubs with cleared areas
- Cleared tracks

0 5 10 20
Metres
Datum/Projection:
GDA 1994 MGA Zone 50

N

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Prepared by: JL Date: 25/10/2018

Figure 3: Vegetation condition of the site



Legend

- Site Boundary
- Quadrats

Vegetation condition

- Very Good
- Good
- Degraded
- Completely Degraded

0 10 20 40

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

www.ecoaus.com.au

Prepared by: JL Date: 25/10/2018

Black Cockatoo Assessment

No black cockatoos were observed within the site at the time of assessment, however scattered signs of foraging were noted.

Foraging habitat for black cockatoos is generally defined as the availability of plant food sources within an area (Finn 2012). Food availability for black cockatoos is a function of the diversity, abundance, distribution, energetic and nutritional qualities, and seasonality (phenology) of the food sources within a particular area.

Black cockatoo foraging habitat has been determined using vegetation associations defined in the vegetation assessment. The quality of foraging habitat for black cockatoo species within the site (as defined in **Table 3** below) has been assessed based on the availability and density of plant food sources. As with vegetation condition, foraging quality is not uniform throughout an entire vegetation association and these variations have been accounted for within the assessment. Where habitat quality falls between two scores, a conservative approach has been taken and the higher of the two scores has been used.

Table 3: Definition of Black Cockatoo foraging habitat quality

Foraging quality	Justification
Excellent	High density of species suitable for foraging by Black Cockatoos (i.e. foliage cover of suitable species >60%) and presence of food sources at several strata (i.e. canopy, midstorey and understorey).
Good	High density of species suitable for foraging by Black Cockatoos (i.e. foliage cover of suitable species >60%) but food sources only present at one or two strata (e.g. canopy and midstorey).
Moderate	Moderate foraging value density of species suitable for foraging by Black Cockatoos (i.e. foliage cover of suitable species 20-40%) and food sources only present at one or two strata (e.g. canopy and midstorey).
Poor	Low density of species suitable for foraging by Black Cockatoos (i.e. foliage cover of suitable species 10-20%) and presence of food sources at only one stratum (e.g. canopy).
Very poor	Very low density of species suitable for foraging by Black Cockatoos (i.e. foliage cover of suitable species <10%) and presence of food sources at only one stratum (e.g. canopy).
Nil	Cleared areas or no suitable vegetation present.

Table 4 contains a summary of each vegetation association occurring within the site and its respective foraging quality score. Vegetation within the site provides foraging habitat for Carnaby's Black Cockatoo, Forest Red-tailed Black Cockatoo and Baudin's Black Cockatoo. These results are depicted in **Figure 4**.

Table 4: Vegetation types and Carnaby's Black Cockatoo foraging habitat quality within the site

Vegetation community	Assessed foraging quality	Justification	Area impacted (ha)
Carnaby's Black-Cockatoo			
EmBaBm	Good	Foraging species: *Banksia attenuta*, *Eucalyptus marginata* subsp. *marginata* and *Banksia menziesii*	0.39 ha
	Moderate		0.53 ha
	Poor		0.32 ha
Pines	Moderate	Foraging habitat limited to **Pinus pinaster* and **Eucalyptus robusta*	0.06 ha
Cleared	Nil	No suitable foraging species	0.41 ha
Baudin's Black Cockatoo			
EmBaBm	Poor	Foraging species: *Eucalyptus marginata* subsp. *marginata*	1.24 ha
Pines	Poor	Foraging habitat limited to **Pinus pinaster*	0.06 ha
Cleared	Nil	No suitable foraging species	0.41 ha
Forest Red-tailed Black Cockatoo			
EmBaBm	Poor	Foraging species: *Eucalyptus marginata* subsp. *marginata*	1.24 ha
Pines	Nil	No suitable foraging species	0.06 ha
Cleared	Nil	No suitable foraging species	0.41 ha

'Breeding habitat' for black cockatoos is defined in DSEWPaC (2012) as trees of species known to support breeding within the range of the species which either have a suitable nest hollow or are of a suitable DBH to develop a nest hollow (> 300 mm for salmon gum and wandoo, and >500 mm for other species). These trees are known as significant trees. Trees of this size may also be large enough to provide roosting habitat (i.e. trees which provide a roost or rest area for the birds). Significant trees which contain hollows that have an entrance diameter of more than 100 mm are suitable for use by Black Cockatoos (Whitford & Williams 2002). In general, hollows of sufficient size to support black-cockatoos do not form until trees are at least 230 years old, and the majority of nests are found in 300-500 year old trees (Johnstone 2006).

The black cockatoo habitat assessment identified 11 potentially significant trees within the site (**Table 5, Figure 4**). One tree contained a hollow of sufficient to be utilised by black cockatoos for breeding purposes, however no signs of use were observed.

Table 5: Potentially significant trees Black Cockatoo habitat trees within the Site

Tree number	Species	Hollows noted	Diameter at Breast Height (DBH; mm)
1	*Eucalyptus marginata* subsp. *marginata*	No hollows	600
2	*Eucalyptus marginata* subsp. *marginata*	No hollows	500
3	*Eucalyptus marginata* subsp. *marginata*	No hollows	500
4	*Eucalyptus marginata* subsp. *marginata*	No hollows	700
5	*Eucalyptus marginata* subsp. *marginata*	No hollows	500
6	**Pinus pinaster*	Roosting only	
7	*Eucalyptus robusta*	No hollows	500
8	*Eucalyptus robusta*	No hollows	650
9	*Eucalyptus marginata* subsp. *marginata*	No hollows	500
10	*Eucalyptus marginata* subsp. *marginata*	No hollows	500
11	*Eucalyptus marginata* subsp. *marginata*	Yes – scar tree	2000

Figure 4: Carnaby's Black Cockatoo Habitat



Legend

Site Boundary

Potential Significant Trees

- *Eucalyptus marginata* subsp. *marginata*
- *Eucalyptus robusta*
- **Pinus pinaster*

Black Cockatoo Habitat

- Good
- Moderate
- Poor

0 10 20 40

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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Prepared by: JL Date: 25/10/2018

Figure 5: Baudin's Black Cockatoo Habitat



Legend

Site Boundary

Potential Significant Trees

- *Eucalyptus marginata* subsp. *marginata*
- **Pinus pinaster*

Black Cockatoo Habitat

Poor

0 10 20 40

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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Prepared by: JL Date: 25/10/2018

Figure 6: Forest Red-tailed Black Cockatoo Habitat



Legend

Site Boundary

Potential Significant Trees

Eucalyptus marginata subsp. *marginata*

Black Cockatoo Habitat

Poor

0 10 20 40

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

www.ecoaus.com.au

Prepared by: JL Date: 25/10/2018

Summary

Vegetation within the site has been subject to degradation over a prolonged period and consequently, is not a high-quality representation of the vegetation of the Swan Coastal plain bioregion.

A total of 96 flora taxa were identified within the site (65 native and 31 introduced taxa). None of these species is a Threatened flora species as listed under section 178 of the EPBC Act or pursuant to Schedule 1 of the WC Act and as listed by DBCA (2018) or Priority flora species as listed by Western Australian Herbarium (1998-).

Two vegetation associations were identified within the site. None of the associations resembles any known Threatened Ecological Communities (TECs) listed under the EPBC Act or WC Act, or Priority Ecological Communities (PECs) listed by DBCA. Vegetation condition ranged from Completely Degraded to Very Good based which is consistent with the historical disturbance noted throughout the site.

No black cockatoos were observed within the site at the time of assessment however evidence of foraging was observed. Vegetation within the site provides potential suitable foraging habitat for all three species of black cockatoos, however the quality of this habitat is predominantly poor. A summary of the quality of habitat for each black cockatoo species is provided below:

- Carnaby's Black-Cockatoo:
    - Good: 0.39 ha;
    - Moderate: 0.59 ha;
    - Poor: 0.32 ha;
- Baudin's Black-Cockatoo:
    - Poor: 1.30 ha;
- Forest Red-tailed Black-Cockatoo:
    - Poor: 1.24 ha.

Eleven potential significant trees for black cockatoos, *Eucalyptus marginata* subsp. *marginata* and *Eucalyptus robusta*, were recorded throughout the site. One tree was observed to have a hollow of suitable size for breeding purposes, however no signs of use were observed. There was no evidence of black cockatoo breeding activity at the time of assessment.

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Appendix A: Flora species list

Family	Species
Araceae	**Zantedeschia aethiopica*
Araliaceae	*Trachymene pilosa*
Asparagaceae	**Asparagus asparagoides*
	Laxmannia ramosa
	Lomandra micrantha
	Thysanotus manglesianus
Asteraceae	**Arctotheca calendula*
	**Hypochaeris glabra*
	**Ursinia anthemoides*
	**Osteospermum ecklonis*
Brassicaceae	**Brassica tournefortii*
Casuarinaceae	*Allocasuarina fraseriana*
	Allocasuarina humilis
Colchicaceae	*Burchardia congesta*
Crassulaceae	**Crassula colorata*
Cyperaceae	*Gahnia trifida*
	Lepidosperma leptostachyum
	Mesomelaena pseudostygia
Dasypogonaceae	*Calectasia narragara*
	Dasypogon bromeliifolius
Dilleniaceae	*Hibbertia cuneiformis*
	Hibbertia hypercoides
	Hibbertia subvaginata
Droseraceae	*Drosera macrantha*
Ericaceae	*Leucopogon propinquus*
Euphorbiaceae	**Euphorbia terracina*
	Euphorbia peplus
Fabaceae	**Acacia longifolia*
	**Lupinus cosentinii*
	Acacia pulchella
	Acacia saligna
	Acacia stenoptera
	Bossiaea eriocarpa
	Daviesia divaricata
	Daviesia triflora
	Gompholobium tomentosum
	Hovea pungens
	Hovea trisperma
	Jacksonia sternbergiana

Family	Species
	Kennedia prostrata
	**Chamaecytisus palmensis*
	**Trifolium campestre*
Geraniaceae	**Pelargonium capitatum*
	Erodium sp.
Goodeniaceae	*Dampiera linearis*
	Scaevola canescens
Haemodoraceae	*Conostylis aculeata*
	Anigozanthos humilis
Hemerocallidaceae	*Dianella revoluta*
Iridaceae	**Gladiolus caryophyllaceus*
	**Romulea rosea*
	**Freesia alba x leichtlinii*
	**Watsonia meriana*
	Patersonia occidentalis occidentalis
Lamiaceae	*Hemiandra pungens*
Loranthaceae	*Nuytsia floribunda*
Meliaceae	**Melia azedarach*
Montiaceae	*Calandrinia flava*
Myrtaceae	**Eucalyptus robusta*
	Eucalyptus marginata
	Eucalyptus marginata marginata
	Calytrix flavescens
	Eremaea pauciflora
	Hypocalymma robustum
	Kunzea glabrescens
Oleaceae	**Olea europaea*
Orchidaceae	*Caladenia discoidea*
	Diuris longifolia
	Pterostylis sanguinea
Oxalidaceae	**Oxalis pes-caprae*
Papaveraceae	**Fumaria capreolata*
Pinaceae	**Pinus pinaster*
Poaceae	**Avena barbata*
	**Briza maxima*
	**Briza minor*
	**Bromus diandrus*
	**Ehrharta calycina*
	**Cynodon dactylon*
	Amphipogon turbinatus
Proteaceae	*Banksia attenuata*
	Banksia ilicifolia

Family	Species
	Banksia menziesii
	Conospermum stoechadis
	Adenanthos cygnorum
	Isotropis cuneifolia
	Petrophile linearis
	Stirlingia latifolia
Restionaceae	*Desmocladus fasciculatus*
Stylidiaceae	*Stylidium brunonianum*
	Stylidium repens
Thymelaeaceae	*Pimelea rosea*
Tropaeolaceae	**Tropaeolum majus*
Violaceae	*Hybanthus calycinus*
Xanthorrhoeaceae	*Xanthorrhoea preissii*
	Chamaescilla corymbosa
Zamiaceae	*Macrozamia riedlei*

Appendix B: Quadrat Site Data

Site number	Date	Site type	Observer
ELA01 (Quadrat)	25/09/2018	Quadrat	JC
Landscape type	Soils	Easting	Northing
Flat	Grey sand	0390886	6444778
Soil condition	Fire	Condition	Disturbance
Moist	10-20 years	Good	Weeds (low covers)



Species	Cover (%)	Stratum (U=Upper, M=Middle, L=Low)	Height (m)
Banksia menziesii	20	U	12
Eucalyptus marginata marginata	5		14
Allocasuarina humilis	2	M	2.5
Hibbertia hypercoides	40	L	1
Eremaea pauciflora	10	L	0.5
Gompholobium tomentosum	10	L	0.5
Calectasia narragara	1	L	0.5
Hovea pungens	0.1	L	0.5
Anigozanthos humilis	0.1	L	0.2
Burchardia congesta	0.1	L	0.2
Stirlingia latifolia	2	L	0.8
Dasypogon bromeliifolius	2	L	0.4
Calandrinia flava	0.1	L	0.2

Laxmannia ramosa	0.1	L	0.15
**Ursinia anthemoides*	0.1	L	0.1
**Briza maxima*	0.2	L	0.2
**Ehrharta calycina*	0.8	L	1
Mesomelaena pseudostygia	5	L	0.5
**Gladiolus caryophyllaceus*	0.5	L	1
Desmocladus fasciculatus	0.1	L	0.15
Lomandra micrantha	0.1	L	0.2
**Hypochaeris glabra*	0.1	L	0.1
Thysanotus manglesianus	0.1	L	0.2
Gahnia trifida	0.5	L	0.4
Trachymene pilosa	0.1	L	0.1
Bossiaea eriocarpa	0.5	L	0.2
Leucopogan propinquus	3	L	0.5
Drosera macrantha	0.1	L	0.3
Amphipogon turbinatus	0.1	L	0.25
Hovea trisperma	0.1	L	0.2
Dampiera linearis	0.1	L	0.2
Acacia pulchella	0.2	L	0.4
Hemiandra pungens	1	L	0.15
Hypocalymma robustum	2	L	0.5
Scaevola canescens	0.1	L	0.2
Conostylis aculeata	0.2	L	0.2
Patersonia occidentalis occidentalis	0.1	L	0.2
Macrozamia riedlei	0.1	L	0.3
Pterostylis sanguinea	0.1	L	0.15
Kunzea glabrescens	0.5	L	0.5
Lepidosperma leptostachyum	1	L	1
Stylidium repens	2	L	0.15

Calytrix flavescens	0.2	L	0.2
Stylidium brunonianum	0.1	L	0.2
Acacia stenoptera	0.1	L	0.2
**Romulea rosea*	0.1	L	0.15

Site number	Date	Site type	Observer
ELA02 (Quadrat)	25/09/2018	Quadrat	JC
Landscape type	Soils	Easting	Northing
Flat	Grey sand	0390886	6444804
Soil condition	Fire	Condition	Disturbance
Moist	10 - 20 years	Very Good	Weeds, edge effects



Species	Cover (%)	Stratum (U=Upper, M=Middle, L=Low)	Height
Banksia menziesii	5	U	8
Banksia attenuata	5	U	8
Allocasuarina humilis	10	M	2
Xanthorrhoea preissii	10	M	2
Stirlingia latifolia	10	M	1
Hibbertia hypercoides	5	M	0.5
Gomphylobium tomentosum	2	M	0.8
**Ehrharta calycina*	1	M	1
**Briza maxima*	0.1	L	0.2
**Briza minor*	0.1	L	0.15
**Gladiolus caryophyllaceus*	0.5	L	1
Burchadia congesta	0.1	L	0.4
Dianella revoluta	0.1	L	0.4
Chamaescilla corymbosa	0.1	L	0.3
**Avena barbata*	0.1	L	0.3

Mesomelaena pseudostygia	10	L	0.5
Romulea rosea	0.1	L	0.15
**Ursinia anthemoides*	0.1	L	0.15
Hypocalymma robustum	0.1	L	0.8
Laxmannia ramosa	0.5	L	0.15
Trachymene Pilosa	0.1	L	0.1
Drosera macrantha	0.1	L	0.2
Leucopogon propinquus	1	L	0.5
**Hypchaeris glabra*	0.1	L	0.1
**Crassula colorata*	0.1	L	0.1
Erodium sp.	0.1	L	0.1
Thysantous manglesianus	0.1	L	0.2
Euphorbia peplus	0.1	L	0.15
Jacksonia sternbergiana	0.1	L	1
**Lupinus cosentinii*	0.1	L	0.1
Hybanthus calycinus	0.1	L	0.3
Anigozanthos humilis	0.1	L	0.15
Acacia stenoptera	0.1	L	0.2
Eucalyptus marginate	2	L	5
Daviesa trifloral	1	L	1
Scaevola canescens	0.5	L	0.15
Daviesta divaricata	1	L	1
Desmocladus fasciculatus	0.1	L	0.15
Kennedia prostrata	0.1	L	0.15
**Trifolium campestre*	0.1	L	0.1
Calectasia narragara	0.5	L	0.2
Gahnia trifida	0.3	L	0.2
Amphipogon turbinatus	0.1	L	0.2

Diuris longifolia	0.1	L	0.1

Site number	Date	Site type	Observer
ELA03 (Quadrat)	25/09/2018	Quadrat	JC
Landscape type	Soils	Easting	Northing
Flat	Grey sand	0390940	6444774
Soil condition	Fire	Condition	Disturbance
Moist	10 - 20 years	Very Good	Weeds



Species	Cover (%)	Stratum (U=Upper, M=Middle, L=Low)	Height
Banksia menziesii	10	U	15
Banksia attenuata	15	U	12
Allocasuarina humilis	30	M	2
Stirlingia latifolia	10	L	1
Hibbertia hypercoides	15	L	0.5
Gomphylobium tomentosum	2	L	0.8
**Ehrharta calycina*	0.5	L	1
**Briza maxima*	0.2	L	0.2
**Gladiolus caryophyllaceus*	1	L	1
Burchadia congesta	0.1	L	0.4
Chamaescilla corymbosa	0.1	L	0.3
Mesomelaena pseudostygia	2	L	0.5
Romulea rosea	0.1	L	0.15
**Ursinia anthemoides*	0.1	L	0.15
Laxmannia ramosa	2	L	0.15

Trachymene pilosa	0.1	L	0.1
Drosera macrantha	0.1	L	0.2
Leucopogon propinquus	0.1	L	0.5
**Hypchaeris glabra*	0.1	L	0.1
**Crassula colorata*	0.1	L	0.1
Thysantous manglesianus	0.1	L	0.2
Hybanthus calycinus	0.5	L	0.3
Anigozanthos humilis	0.1	L	0.15
Scaevola canescens	0.1	L	0.15
Desmocladus fasciculatus	0.5	L	0.15
Hovea trisperma	0.1	L	0.3
Jacksonia sternbergiana	0.1	L	0.5
Acacia pulchella	3	L	1
Stylidium repens	0.1	L	0.15
Adenanthos cygnorum	1	L	0.15
Patersonia occidentalis occidentalis	0.2	L	0.3
Dampiera linearis	0.1	L	0.2
Lomandra micrantha	0.1	L	0.3
Conostylis aculeata	0.1	L	0.15
Caladenia discoidea	0.1	L	0.15
Isotropis cuneifolia	0.1	L	0.15

Appendix C: Flora likelihood of occurrence

Species	Conservation code		Source[3]	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Ranking[1]	WA Ranking[2]				
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CR	S1	PMST	A sub-shrub ranging from 0.25-0.65 tall. Flowers are yellow in colour, narrow, hairy and are openly spaced. Flowering occurs from September through to November. It can be found on areas with clayey-sand with lateritic pebbles and prefers low woodland areas that are situated near winter flats (DotEE 2018c).	Does not occur	Preferred habitat does not occur
Synaphea sp. Serpentine (G.R. Brand 103)	CR	S1	PMST	This species is a clumped subshrub reaching a height of up to 0.6 m. Flowers are yellow in colour, narrow, hairy and are openly spaced. Flowering occurs from late August through to November. Habitat for this species is grey-brown sandy loams to clay soil occurring on predominately flat, seasonally wet terrain (DotEE 2018c).	Does not occur	Preferred habitat does not occur
Andersonia gracilis	EN	-	PMST	Slender erect or open straggly shrub grows to 0.1-0.5(-1) m high. Grows in white/grey sand, sandy clay, gravelly loam in winter-wet areas and near swamps (WAH 1998 - 2018).	Does not occur	Preferred habitat does not occur
Caladenia huegelii	EN	S1	PMST; NatureMap	A slender orchid 30 to 50 cm tall. One or two striking flowers characterised by a greenish-cream lower petal with a maroon tip. Other petals are cream with red or pink suffusions. Habitat for this species occurs within well-drained, deep sandy soils of the Bassendean and Spearwood systems in low mixed Banksia, *Allocasuarina* and Jarrah woodlands (Western Australian Herbarium 1998, DotEE 2018c).	Does not occur	Adequate survey effort did not record this species.

Species	Conservation code		Source[3]	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Ranking[1]	WA Ranking[2]				
Diuris purdiei	EN	S2	PMST	A slender orchid to 0.35 m tall. Flowers are yellow and visible from September to October. Habitat for this species is grey-black sand substrates in winter-wet swamps which have high moisture (Western Australian Herbarium 1998-). It grows on sand to sandy clay soils, in areas subject to winter inundation, and amongst native sedges and dense heath with scattered emergent *Melaleuca preissiana*, *Corymbia calophylla*, *E*. marginata and *Nuytsia floribunda* (DotEE 2018c).	Does not occur	Preferred habitat does not occur
Drakaea elastica	EN	S1	PMST	A slender flower stem up to 30 cm high with a single glossy green, heart shaped leaf. The single flower is 3 to 4 cm long. It can be found on bare patches of sand within dense vegetation in low lying winter-wet swamps. *D. elastica* often occurs with other orchid species (DotEE 2018c).	Does not occur	Preferred habitat does not occur
Grevillea curviloba subsp. *incurva*	EN	S2	PMST	A shrub with greyish-green leaves that reaches a height and width of up to 2.5 m. The flowers are creamy white in colour and generally flowers between September-October. The species is said to occur in a small area between Muchea and Badgingarra and can be found in areas of open heath and areas wet in winter on sand over limestone, or on ironstone with a high-water table (DotEE 2018c).	Does not occur	Preferred habitat does not occur
Lepidosperma rostratum	EN	S2	PMST	A clumped, rhizomatous herb that grows to roughly 30 cm in diameter and 50 cm in height. The flowers are brown in colour and the plant can be seen to glower between May and June. This plant can be found amongst low heath in winter-wet swamps in peaty sand and clay substrate (DotEE 2018c).	Does not occur	Preferred habitat does not occur

Species	Conservation code		Source[3]	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Ranking[1]	WA Ranking[2]				
Thelymitra dedmaniarum	EN	S1	PMST	This orchid can grow up to 0.8 m in height with leaves that can reach up to 0.15 m long. It has golden-bronze flowers that have a distinctive cinnamon scent and can be seen to flower from late October through to December. This species can be found to grow on red-brown sandy-loam soils along dolerite and granite outcrops (DotEE 2018c).	Does not occur	Preferred habitat does not occur
Diuris micrantha	VU	S3	PMST	A slender orchid to 60 cm tall. Flowers are yellow with reddish-brown markings and visible from September to October. Habitat for this species occurs within clay-loam substrates in winter-wet depressions or swamps (DotEE 2018c).	Does not occur	Preferred habitat does not occur
Drakaea micrantha	VU	S2	PMST	A tuberous, terrestrial herb which has a diminutive red and yellow flower, 1.2–2.5 cm long, on a stem that grows to 30 cm. Flowering occurs form September to October. Its heart-shaped leaf, about 1.5 cm long, is silvery grey with prominent green veins. Habitat for this species occurs within cleared firebreaks or open sandy patches that have been disturbed, where competition from other plants has been removed in lower lying areas near wetlands under Spearwood (*Kunzea glabrescens*) thickets (Western Australian Herbarium 1998-, DotEE 2018c).	Does not occur	Adequate survey effort did not record this species.
Eleocharis keigheryi	VU	S3	PMST	A rhizomatous, tufted/clumped perennial herb, reaching a maximum diameter of 40 cm. When this species grows in water, there are numerous hair-like sterile stems at the base of the main stems. Flowering occurs from August to November, but will extend to December if conditions are favourable. This species grows in small clumps in a substrate of clay or sandy loam. This species is emergent in freshwater creeks and claypans (DotEE 2018c).	Does not occur	Preferred habitat does not occur

Species	Conservation code		Source[3]	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Ranking[1]	WA Ranking[2]				
Acacia lasiocarpa var. bracteolata long peduncle variant (G.J. Keighery 5026)		P1	Nature Map	A shrub type species that grows to 0.4-1.5m high with a yellow flow that generally flowers between May-August. This species is found in swampy areas, lowlands that are wet in the winter and in areas of grey/black sand over clay (Western Australian Herbarium 1998-).	Does not occur	Preferred habitat does not occur
Thelymitra variegata	-	P2	Nature Map	A tuberous perennial herb that can grow to a height between 0.1-0.35 m tall. The flower is orange, red, purple and pink in colour and is seen to flower between June to September. This species grows on sandy clay, sand and laterite substrates (Western Australian Herbarium 1998-).	Unlikely	Preferred habitat unlikely to be present
Cyathochaeta teretifolia	-	P3	Nature Map	A perennial grass-like sedge that can grow up to 2 m high and 1 m wide. Has a brown flower and can be found within swamps and along creek edges on grey sand/sandy clay (Western Australian Herbarium 1998-).	Does not occur	Preferred habitat does not occur
Jacksonia gracillima	-	P3	Nature Map	A non-lignotuberous shrub reaching heights of 0.2-2 m high with pink, purple and red flowers. Is generally found in swampy areas of sand, sandy clay, gravelly sandy soils over laterite substrate (Western Australian Herbarium 1998-).	Does not occur	Preferred habitat does not occur
Phlebocarya pilosissima subsp. *pilosissima*	-	P3	Nature Map	A compacted perennial, grass-like herb growing to a height of 0.15-0.4 m tall. The herb has a creamy white flower that generally flowers between August-October and can be found on white or grey sand substrates or lateritic gravel (Western Australian Herbarium 1998-).	Does not occur	Adequate survey effort did not record this species.
Pimelea calcicola	-	P3	Nature Map	A straight growing/spreading shrub, growing to a height of 0.2-1 m in height. Has a pink flower that generally flowers between September to November and can be found on sandy substrate or coastal limestone ridges (Western Australian Herbarium 1998-).	Does not occur	Preferred habitat does not occur

Species	Conservation code		Source[3]	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Ranking[1]	WA Ranking[2]				
Stylidium paludicola	-	P3	Nature Map	Reed-like perennial, herb grows to 0.35-1 m high. Flowers October to December. Grows in Peaty sand over clay in winter wet habitats with Marri and Melaleuca woodland, Melaleuca shrubland (Western Australian Herbarium 1998-).	Does not occur	Preferred habitat does not occur
Styphelia filifolia	-	P3	Nature Map	A shrub that stands roughly 0.9 m high and can grow to 0.7 m wide and consists of white flowers that generally flower between March and May. Is known to grow on sandy soils along the coastal plain within Banksia or Jarrah woodlands. (Western Australian Herbarium 1998-).	Does not occur	Adequate survey effort did not record this species.
Dodonaea hackettiana	-	P4	Nature Map	A straight, tall shrub reaching 1-5 m in height. Has a yellow-green/red flower that generally blooms from July to October. It can be found in areas of sand and along outcropping limestone (Western Australian Herbarium 1998-).	Does not occur	Preferred habitat does not occur
Kennedia beckxiana	-	P4	Nature Map	A prostrate/twining shrub with red flowers that tend to blossom between September to December. Can be found in sand, loam substrate and on granite hills and outcrops (Western Australian Herbarium 1998-)..	Does not occur	Preferred habitat does not occur
Microtis quadrata	-	P4	Nature Map	Species habitat information unavailable.	Does not occur	Adequate survey effort did not record this species.
Stylidium longitubum	-	P4	Nature Map	Erect annual (ephemeral), herb grows 0.05-0.12 m high. Flowers October to December. Grows in sandy clay, clay in seasonal wetlands (Western Australian Herbarium 1998-)..	Does not occur	Preferred habitat does not occur

Species	Conservation code		Source[3]	Preferred habitat	Likelihood of occurrence	Justification for likelihood rating
	EPBC Ranking[1]	WA Ranking[2]				
Tripterococcus sp. Brachylobus (A.S. George 14234)	-	P4	Nature Map	Annual herb up to 0.6 m grows in grey sand and clay soils in moist environments such as winter wet flats (WAH 1998 - 2018).	Does not occur	Preferred habitat does not occur

[1]Species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
CR = listed as Critically Endangered under the EPBC Act.
EN = listed as Endangered under the EPBC Act.
VU = listed as Vulnerable under the EPBC Act.
[2]Species listed in Western Australia under the *Wildlife Conservation Act 1950* (WC Act) or by the Department of Biodiversity, Conservation and Attractions (DBCA).
S1 = Schedule 1: Flora that are considered likely to become extinct or rare, as critically endangered flora (CR) under the WC Act.
S2 = Schedule 2: Flora that are considered likely to become extinct or rare, as endangered flora (EN) under the WC Act.
S3 = Schedule 3: Flora that are considered likely to become extinct or rare, as vulnerable flora (VU) under the WC Act.
P1 = Priority 1: Poorly-known species – species that are known from one or a few locations (generally five or less) which are potentially at risk (DBCA).
P2 = Priority 2: Poorly-known species – species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation (DBCA).
P3 = Priority 3: Poorly known species – species that are known from several locations, and the species does not appear to be under imminent threat (DBCA).
P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring (DBCA).
[3]NatureMap = NatureMap database search (DBCA 2007-2018).
PMST = EPBC Act Protected Matters Search Tool (DotEE 2018).

Appendix D: Diagnostic assessment: Banksia Woodlands of the Swan Coastal Plain

The Banksia Woodlands of the Swan Coastal Plain TEC has recently been listed as Endangered under the EPBC Act by the Threatened Species Scientific Community (DotEE 2016). For information to assist in referral, environmental assessment and compliance issues, it has been recommended to refer to the Listing Advice and/or Conservation Advice and Recovery Plan under the Species Profile and Threats Database (DotEE 2016). The Listing and/or Conservation Advice defines the national ecological community and includes key diagnostic characteristics, condition thresholds and additional considerations (DotEE 2016).

In order to determine whether the Banksia Woodlands of the Swan Coastal Plain TEC is present in the site, key diagnostic characteristics must be met under Section 2 of the Conservation Advice (DotEE 2016).

For EPBC Act referral assessment and compliance purposes, the national ecological community is limited to patches that meet the key diagnostic characteristics (Step 1), condition thresholds (Step 2), and minimum patch sizes (Step 3).

Assessing the key diagnostic characteristics is the first step in identifying the Banksia Woodlands ecological community, acknowledging that the ecological community encompasses a number of recognised sub-communities previously assigned as FCTs (Gibson et al. 1994).

Step two involves assessing the condition threshold of the site. Condition threshold categories describe different values and functional attributes of the ecological community and the thresholds for their inclusion in the ecological community protected under the EPBC Act. It is recognised that any single patch of a threatened ecological community may be degraded to some degree but contributes to the overall function of the ecological community (and other environmental components) across the often fragmented landscape (DotEE 2016).

Step three involves assessing the patch size as minimum patch sizes apply for consideration of a patch as part of the listed ecological community for EPBC Act referral, assessment and compliance purposes (DotEE 2016). This concept recognises that even small, fragmented patches of a TEC can contribute to the overall function of the ecological community (and other environmental components) across the landscape.

Step four involves assessing further information to assist in determining the presence of the ecological community and significant impacts.

Table 6: Assessment of the Banksia Woodland within the Site for TEC Status

Step	Key diagnostic characteristics (DotEE 2016)	Outcome
1	Location and physical environment - the Banksia Woodlands ecological community primarily occurs in the Swan Coastal Plain IBRA bioregion: and	Yes - The site is located on the Swan Coastal Plain
	Soil and landform - the Banksia Woodlands typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands; and	Yes - The site is located on Bassendean Dune System
	Structure - the structure of the Banksia Woodlands is a low woodland to forest with these features: • A distinctive upper sclerophyllous layer of low trees* (occasionally large shrubs more than 2 m tall), typically dominated or co-dominated by one or more of the Banksia species identified under composition; and • Emergent trees of medium or tall (>10 m) height *Eucalyptus* or *Allocasuarina* species may sometimes be present above the Banksia canopy; and • An often highly species-rich understorey that consists of: o a layer of sclerophyllous shrubs of various heights; and, o a herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs, that sometimes includes grasses. The development of a ground layer may vary depending on the density of the shrub layer and disturbance history.	Yes - The vegetation community EmBaBm consists of a woodland dominated by the key diagnostic species *Banksia attenuata* and *Banksia menziesii*. *Eucalyptus marginata* subsp. *marginata* is present and the community has an herbaceous ground layer of sedges and perennial and ephemeral forbs that sometimes includes grasses. Refer to **Appendix B** for the site dominant species list.
	Composition – • The canopy is most commonly dominated or co-dominated by *Banksia attenuata* (candlestick banksia, slender banksia) and/or *B. menziesii* (firewood banksia). Other Banksia species that dominate in some examples of the ecological community are *B. prionotes* (acorn banksia) or *B.ilicifolia* (holly-leaved banksia); and • The patch must include at least one of the following diagnostic species: o *Banksia attenuata* (candlestick banksia) o *Banksia menziesii* (firewood banksia)	Yes - The canopy is dominated by the diagnostic species *Banksia attenuata* and *Banksia menziesii*. Other co-dominant species are present, such as *Eucalyptus marginata* subsp. *marginata*. The community has a medium diversity of shrubs and herb species with many indicator species recorded. Refer to **Appendix B** for the site dominant species list. The contra-indicators of *Banksia littoralis* and *Banksia burdettii* were not recorded. The community does not represent FCT 20c – Eastern shrublands and woodlands.

Step	Key diagnostic characteristics (DotEE 2016)	Outcome
	○ *Banksia prionotes* (acorn banksia) ○ *Banksia ilicifolia* (holly-leaved banksia); and • If present, the emergent tree layer often includes *Corymbia calophylla* (marri), *E. marginata* (jarrah), or less commonly *Eucalyptus gomphocephala* (tuart); and • Other trees of a medium height that may be present, and may be codominant with the Banksia species across a patch, include *Eucalyptus todtiana* (blackbutt, pricklybark), *Nuytsia floribunda* (Western Australian Christmas tree), *Allocasuarina fraseriana* (western sheoak), *Callitris arenaria* (sandplain cypress), *Callitris pyramidalis* (swamp cypress) and *Xylomelum occidentale* (woody pear); and • The understorey typically contains a high to very high diversity of shrub and herb species that often vary from patch to patch*** • Contra-indicators: ○ Patches clearly dominated by *Banksia littoralis* are not part of the Banksia Woodlands ecological community but indicates a different, dampland community is present. ○ Patches clearly dominated by *Banksia burdettii* are not part of the Banksia Woodlands ecological community but indicates a tall shrubland and not the Banksia Woodlands ecological community. ○ FCT 20c – Eastern shrublands and woodlands, corresponds with a separate EPBC ecological community listing, Shrublands and Woodlands of the eastern Swan Coastal Plain. Occurrences of this FCT should be considered under that separate listing.	
2	Condition thresholds – • Assessments of a patch should initially be centered on the area of highest native floristic diversity and/or cover, i.e. the best condition area of the patch.	Yes - The community was assessed and sampled in the highest condition representation available in the Site. The survey was completed in Spring, representing the most appropriate season to survey on the Swan Coastal Plain (EPA 2016). The community

Step	Key diagnostic characteristics (DotEE 2016)	Outcome
	• Consideration must be given to the timing of surveys and recent disturbance. Ideally surveys should be undertaken in spring with two sampling periods to capture early and late flowering species. • The surrounding context of a patch must also be taken into account when considering factors that add to the importance of a patch that meets the condition thresholds. • Certain vegetation components of the Banksia Woodlands ecological community merit consideration as critical elements to protect. Three components are recognised as threatened in their own right in WA and, as such, are priorities for protection; refer to Table 1 in the Approved Conservation Advice (DotEE 2016). • A relevant expert (e.g. ecological consultant, local NRM or environment agency) may be useful to help identify the ecological community and its condition	present in the site is not part of larger communities that are adjacent to the site on both public and private land.
3	Minimum patch size - Minimum patch sizes apply for consideration of a patch as part of the listed ecological community for EPBC Act referral, assessment and compliance purposes. Where patches meet different levels of condition, different minimum patch sizes apply: • 'Pristine' – no minimum patch size applies • 'Excellent' – 0.5 ha or 5,000 m2 (e.g. 50 m x 100 m) • 'Very Good' – 1 ha or 10,000 m2 (e.g. 100 m x 100 m) • 'Good' – 2 ha or 20,000 m2 (e.g. 200 m x 100 m) • To be considered as part of the EPBC Act ecological community a patch should meet at least the Good Condition category.	No - The condition of the vegetation community EmBaBm was mapped with the areas shown in **Table 2**. EmBaBm covered a total of 1.24 ha and was made up of 0.39 ha of Very Good condition and 0.53 ha of Good Condition. Therefore, the vegetation within the site does not meet the condition requirements of a minimum of 1 ha of Very Good condition or 2 ha of Good condition when considered in isolation from surrounding vegetation.
4	Further information to assist in determining the presence of the ecological community and significant impacts. The landscape position of the patch, including its position relative to surrounding vegetation also influences how important it is in the broader landscape. For example, if it enables movement of native fauna or plant material or supports other ecological processes:	The vegetation community EmBaBm is not considered part of a much larger patch. The closest patch is a portion of remnant vegetation, approximately 117 m to the south-east of the site. Bush Forever Site 391 (Thomsons Lake Nature Reserve and Adjacent Bushland, Beeliar) is also within the vicinity of the site, approximately 160 m to the south west.

Step	Key diagnostic characteristics (DotEE 2016)	Outcome
	• A patch is a discrete and mostly continuous area of the ecological community. A patch may include small-scale (<30 m) variations, gaps and disturbances, such as tracks, paths or breaks. Where there is a break in native vegetation cover, from the edge of the tree canopy of 30 m or more (e.g. due to permanent artificial structures, wide roads or other barriers; or due to water bodies typically more than 30m wide) then the gap typically indicates that separate patches are present. • Variation in canopy cover, quality or condition of vegetation across a patch should not initially be considered to be evidence of multiple patches. Patches can be spatially variable and are often characterised by one or more areas within a patch that meet the key diagnostic characteristics and condition threshold criteria amongst areas of lower condition. Average canopy cover and quality across the broadest area that meets the general description of the ecological community should be used initially in determining overall canopy cover and vegetation condition. Also note any areas that are either significantly higher or lower in quality, gaps in canopy cover and the condition categories that would apply across different parts of the site respectively. Where the average canopy cover or quality falls below the minimum thresholds, the next largest area or areas that meet key diagnostics (including minimum canopy cover requirements) and minimum condition thresholds should be specified and protected. This may result in multiple patches being identified within the overall area first considered. • A buffer zone is a contiguous area immediately adjacent to a patch of the ecological community that is important for protecting its integrity. The purpose of the buffer zone is to help protect and manage the national threatened ecological community. The edges of a patch are considered particularly susceptible to disturbance and the presence of a buffer zone is intended to act as a barrier to further direct disturbance. • The recommended minimum buffer zone for the ecological community is 20–50 metres from the outer edge of a patch, and the appropriate size depends on the nature of the buffer and local context (e.g. slope). A larger buffer zone	It is unlikely that the vegetation community EmBaB, represents the TEC Banksia Woodlands of the Swan Coastal Plain as it is not connected through continuous vegetation to the adjacent remnant vegetation or the Bush Forever site and therefore does not contribute to the overall function of the ecological community across the landscape.

Step	Key diagnostic characteristics (DotEE 2016)	Outcome
	should be applied, where practical, to protect patches that are of particularly high conservation value, or if patches are down slope of drainage lines or a source of nutrient enrichment, or groundwater drawdown.	

* The term 'woodland' has been chosen as the most typical structure, but the ecological community may also be considered to include examples of shrubland, open woodland or forest under some classification systems. The percentage canopy cover is more than 2% and typically less than 50%. The structure and appearance may also vary due to disturbance history. Similarly, component species of the dominant upper sclerophyllous layer may be variously considered 'tall or large shrubs' or 'small trees'.

** Refers to relevant *Banksia* species typically being amongst the most common plant species in the upper sclerophyllous layer. There may be localised exceptions to this, either as natural variation or due to disturbance history (e.g. fire).

*** Key species in the sclerophyllous shrub layer of the ecological community include members of the families Asteraceae, Dilleniaceae, Ericaceae, Fabaceae, Myrtaceae and Proteaceae. Widespread species include *Adenanthos cygnorum* (woolly bush), *Allocasuarina humilis* (dwarf sheoak), *Bossiaea eriocarpa* (common brown pea), *Conostephium pendulum* (pearl flower), *Daviesia* spp., *Eremaea pauciflora*, *Gompholobium tomentosum* (hairy yellow pea), *Hibbertia hypericoides* (yellow buttercups), *Jacksonia* spp., *Kunzea glabrescens, Petrophile linearis* (pixie mops), *Philotheca spicata* (pepper and salt), *Stirlingia latifolia* (blueboy), *Phlebocarya ciliata, Hypolaena exsulca* and *Xanthorrhoea preissii* (balga). Key species in the herbaceous ground layer include members of the families Cyperaceae, Droseraceae, Haemodoraceae, Orchidaceae, Restionaceae and "lilies" from various families. Widespread species include *Amphipogon turbinatus* (tufted beard grass), *Burchardia congesta* (milkmaids), *Caladenia* spp. (spider orchids), *Dasypogon bromeliifolius* (pineapple bush), *Desmocladus flexuosus, Drosera erythrorhiza* (red ink sun dew), *Lepidosperma squamatum* (a tufted sedge), *Lomandra hermaphrodita, Lyginia barbata* (southern rush), *Lyginia imberbis, Mesomelaena pseudostygia* (semaphore sedge), *Patersonia occidentalis* (purple flag), *Podolepis* spp., *Stylidium brunonianum* (pink fountain trigger plant), *Stylidium piliferum* (common butterfly trigger plant), *Trachymene pilosa* (dwarf parsnip), and *Xanthosia huegelii* (heath xanthosia).

Appendix B : Database Searches

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Appendix C : Fauna Likelihood

Species	Conservation Code		Source[3]	Preferred Habitat	Likelihood and justification
	EPBC Act[1]	WC Act[2]			
Calidris ferruginea - Curlew Sandpiper	CR & IA	S3	PMST	This species is migratory. Known habitat includes intertidal mudflats in sheltered coastal areas, such as estuaries and non-tidal swamps and lakes near the coast. The species has been recorded less often inland around lakes, dams and bore drains with bare edges of mud or sand. The distribution of the species is limited by land clearing and disturbance at roost and feeding sites (DotEE 2018c).	Unlikely to occur – preferred habitat is not present
Numenius madagascariensis - Eastern Curlew	CR	S3, S5	PMST	This species is migratory with a primarily coastal distribution and is commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (DotEE 2018c).	Unlikely to occur – preferred habitat is not present
Pseudocheirus occidentalis – Western Ring-tail Possum	CR	S2, S5	PMST, NatureMap	This species is an arboreal species, preferring areas of Peppermint (*Agonis flexuosa*) woodlands and peppermint/tuart associations. This species generally prefers areas of higher water content, predominately inhabiting areas of the south-western corner of Western Australia (DotEE 2018c).	Unlikely to occur – preferred habitat is not present
Botaurus poiciloptilus - Australasian Bittern	EN	S2	PMST	Occurs in terrestrial freshwater wetlands and, rarely, estuarine habitats. It favours wetlands with tall, dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. The species favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and/or reeds (e.g. *Phragmites*, *Cyperus, Eleocharis, Juncus*, *Typha, Baumea, Bolboschoenus*) or cutting grass (*Gahnia*) growing over muddy or peaty substrate (DotEE 2018c).	Unlikely to occur – preferred habitat is not present

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Species	Conservation Code		Source[3]	Preferred Habitat	Likelihood and justification
	EPBC Act[1]	WC Act[2]			
Calidris canutus - Red Knot	EN	S5	PMST	This species is migratory. During the non-breeding season in Australasia, the Red Knot mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts and sometimes on sandy ocean beaches or shallow pools on exposed rock platforms. They are occasionally seen on terrestrial saline wetlands near the coast and on sewage ponds and salt works (DotEE 2018c).	Unlikely to occur – preferred habitat is not present
Calyptorhynchus latirostris - Carnaby's Cockatoo	EN	S2	PMST, NatureMap	Known habitat includes remnant eucalypt woodlands, and shrubland or Kwongan heathland dominated by proteaceous species. The species is also known from the Perth metropolitan area and in remnant patches of native vegetation on land cleared for agriculture (DotE 2015b). Known to utilise *C. calophylla, *C. citriodora, E. patens, E. marginata, X. preissii* and *A. fraseriana* as a foraging plant, *C. calophylla* as breeding habitat and *C. calophylla* and *E. marginata* as roosting habitat (DotEE 2018c).	Potential to occur - There is suitable foraging species, very sparse, represent low to moderate quality habitat
Rostratula australis - Australian Painted Snipe	EN	S2	PMST, Naturemap	This species generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum *Muehlenbeckia* or canegrass or sometimes tea-tree (*Melaleuca*) (DotEE 2018c).	Unlikely to occur – preferred habitat is not present
Calyptorhynchus banksii naso - Forest Red-tailed Black-Cockatoo	VU	S3	PMST, NatureMap	Known habitat includes remnant eucalypt woodlands, especially Jarrah, Marri and Karri forest. The species is also known from the Perth metropolitan area and in remnant patches of native vegetation on land cleared for development or agriculture. Known to utilise *Corymbia calophylla*, **Corymbia citriodora, Allocasuarina fraseriana*, *Eucalyptus patens* and *Eucalyptus marginata* as a foraging plant and *C. calophylla* as breeding habitat (DotEE 2018c).	Potential to occur - There is suitable foraging species but very sparse and likely to represent low to

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Species	Conservation Code		Source[3]	Preferred Habitat	Likelihood and justification
	EPBC Act[1]	WC Act[2]			
					moderate quality habitat
Dasyurus geoffroii - Chuditch, Western Quoll	VU	S3	PMST, NatureMap	Current habitat largely restricted to the southwest forests of WA. The species prefers to rest in hollow logs and earth burrows during the day, and will predominately forage along the ground at night. The distribution of the species is limited by land clearing and predation by feral cats and foxes (DotEE 2018c).	Unlikely to occur – preferred habitat is not present
Leipoa ocellata - Malleefowl	VU	S3	PMST	This species is found principally in the semi-arid to arid zone in shrublands and low woodlands dominated by mallee and associated habitats such as Broombush and Scrub Pine. In Western Australia, they are also found in some shrublands dominated by acacia, and occasionally in woodlands dominated by eucalypts (DotEE 2018).	Does not occur - The Site is not in arid or semi-arid conditions
Actitis hypoleucos – Common Sandpiper	IA	-	PMST, Naturemap	This species is a migratory species. During the non-breeding season, the population migrates from the Russian far east. The Common Sandpiper mainly inhabit wetlands, predominately coastal but occasionally inland as well. This species is commonly found in areas of muddy margins or rocky shores where they forage with the protection of obstacles from varying substrates (DotEE 2018c).	Unlikely to occur – preferred habitat is not present
Apus pacificus – Fork-tailed Swift	IA	-	PMST	This species is almost exclusively aerial. They are most common over inland plains but sometimes over foothills in coastal areas. It is thought they roost aerially but are occasionally observed to land. There is one record of them roosting in a tree, using a bare exposed branch emergent above the foliage (DotEE 2018).	Potential occurrence - vagrant
Ardea alba – Great Egret	IA	S5	PMST	This species has been reported in a wide range of wetland (inland, coastal, saline, freshwater etc.), swamp and marsh habitats. They prefer shallow waters and may retreat to permanent wetlands or coastal areas when other wetlands are dry (DotEE 2018c).	Unlikely to occur – preferred habitat is not present

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Species	Conservation Code		Source[3]	Preferred Habitat	Likelihood and justification
	EPBC Act[1]	WC Act[2]			
Ardea ibis – Cattle Egret	M	-	PMST	The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. It has occasionally been seen in arid and semi-arid regions however this is extremely rare. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures. It has been recorded on earthen dam walls and ploughed fields. It is commonly associated with the habitats of farm animals, particularly cattle, but also pigs, sheep, horses and deer. The Cattle Egret is known to follow earth-moving machinery and has been located at rubbish tips. It uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and abundant aquatic flora. They have sometimes been observed in swamps with tall emergent vegetation (DotEE 2018c).	Unlikely to occur – preferred habitat is not present
Calidris acuminata - Sharp-tailed sandpiper	IA	S5	PMST, NatureMap	Habitat for this species is muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline salt lakes inland. They also occur in salt works and sewage farms and use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. They tend to occupy coastal mudflats mainly after ephemeral terrestrial wetlands have dried out, moving back during the wet season (DotEE 2018c).	Unlikely to occur – preferred habitat is not present
Calidris melanotos – Pectoral Sandpiper	IA	-	PMST, NatureMap	This is a migratory species. Known habitat includes shallow wetlands either fresh or saline usually in coastal/near coastal habitats but can be found further inland. Prefers areas with low, emergent or fringing vegetation with open fringing mud flats. During the non-breeding season, the species occurs mainly the Eastern part of Australia, rarely being sighted in Western Australia (DotEE 2018c).	Unlikely to occur – preferred habitat is not present

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Species	Conservation Code		Source[3]	Preferred Habitat	Likelihood and justification
	EPBC Act[1]	WC Act[2]			
Calidris ruficollis - Red-necked Stint	IA	-	PMST, NatureMap	A migratory species that is found predominately in coastal areas such as sheltered inlets, bays, lagoons and estuaries. Occasionally they can be found on stony/rocky shores, reefs and flooded paddocks. They will usually feed in areas of intertidal mudflats or sandflats and generally in very shallow waters (DotEE 2018c).	Unlikely to occur – preferred habitat is not present
Calidris subminuta – Long-toed Stint	IA	-	PMST, NatureMap	This species is typically found along the coast when present in Western Australia. It is predominately a terrestrial wetland species, preferring shallow freshwater/brackish wetlands. Has preference to areas of low vegetation such as rushes, sedges, samphire and short grasses (DotEE 2018b).	Unlikely to occur – preferred habitat is not present
Charadrius dubius – Little Ringed Plover	IA	-	PMST, NatureMap	Is a vagrant species within Australia with an extremely large range. Prefers areas of sand banks, the shores of rivers, lakes, residual flood waters and areas of short grass. It is not likely for this species to inhabit coastal areas as it prefers lowland habitats (IUCN 2018).	Unlikely to occur – preferred habitat is not present
Haliaeetus leucogaster – White-bellied Sea Eagle	M	-	PMST	The White-bellied Sea-Eagle is found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea). Birds have been recorded in (or flying over) a variety of terrestrial habitats (DotEE 2018).	Unlikely to occur – preferred habitat is not present
Limosa limosa – Black-tailed Godwit	IA	-	NatureMap	The Black-tailed Godwit is found to prefer coastal habitats within sheltered bays, estuaries and lagoons with intertidal mudflats and sandflats. The generally prefer areas with sparse vegetation such as salt marshes and salt flats. (DotEE 2018c).	Unlikely to occur – preferred habitat is not present

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Species	Conservation Code		Source[3]	Preferred Habitat	Likelihood and justification
	EPBC Act[1]	WC Act[2]			
Merops ornatus – Rainbow Bee-eater	M	S5	PMST	The Rainbow Bee-eater occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation. It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water (DotEE 2018c)	Unlikely to occur – preferred habitat is not present
Motacilla cinerea - Grey Wagtail	M	S5	PMST	This species inhabits fast-flowing mountain streams and rivers with riffles and exposed rocks or shoals, often in forested areas. It is also found in more lowland watercourses, even canals, where there are artificial waterfalls, weirs, millraces or lock gates. Outside of the breeding season it occupies a wider variety of habitats, including farmyards, sewage farms, forest tracks, tea estates and even town centres (IUCN 2017).	Potential occurrence - vagrant
Pandion haliaetus - Osprey	M	S5	PMST	This species inhabits the areas around shallow waters, being sufficiently tolerant of human settlement to persist in suburban and sometimes urban environments. The species predominantly feeds on live fish and builds large nests high in exposed trees (IUCN 2017).	Potential occurrence - vagrant
Thinornis rubricollis - Hooded Plover	M	P4	PMST, NatureMap	The hooded plover (western) inhabits ocean beaches and the edges of near-coastal and inland salt-lakes that may be hundreds of kilometres from the coast. It occasionally occurs inland from the edges of lakes, on nearby grassy freshwater seepages, and in estuaries. It appears nomadic, forming flocks of hundreds on inland lakes in the early breeding season and forming very large non-breeding flocks near coastal salt-lakes (Marchant & Higgins 1990).	Does not occur – preferred habitat is not present
Himantopus himantopus – Pied Stilt	M		PMST	This is a marine shore bird and is found on the coast and in estuaries. Found to feed along the muddy margins of wetlands.	Does not occur – preferred habitat is not present

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Species	Conservation Code		Source[3]	Preferred Habitat	Likelihood and justification
	EPBC Act[1]	WC Act[2]			
Charadrius ruficapillus -Red-capped Plover	M		PMST	Beach-nesting shore bird on coastline but found in saltlakes inland. They usually inhabit wide, bare sandflats or mudflats at the margins of saline, brackish or freshwater wetlands.	Does not occur – preferred habitat is not present
Philomachus pugnax — Ruff	M		PMST, Naturemap	Found on generally fresh, brackish of saline wetlands with exposed mudflats at the edges. It is found in terrestrial wetlands including lakes, swamps, pools, lagoons, tidal rivers, swampy fields and floodlands. They are occasionally seen on sheltered coasts, in harbours, estuaries, seashores and are known to visit sewage farms and saltworks.	Does not occur – preferred habitat is not present
Plegadis falcinellus – Glossy Ibis	IA		Naturemap	A migratory marine bird that prefers fresh water marshes that can be found along the edges of lakes, rivers, lagoons, flood-plains, sewage ponds and cultivated areas under irrigation. The species can also be found along coastal habitats such as estuaries, saltmarshes and coastal lagoons. (DotEE 2018c).	Does not occur – preferred habitat is not present
Recurvirostra novaehollandiae – Red-necked Avocet	M		PMST	Found to forage in the water of shallow wetlands.	Does not occur – preferred habitat is not present
Tringa glareola – Wood Sandpiper	IA	-	Naturemap	Uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. inundated grasslands, short herbage or wooded floodplains, where floodwaters are temporary or receding, and irrigated crops. They are also found at some small wetlands only when they are drying (DotEE 2018c	Does not occur – preferred habitat is not present
Tringa nebularia – Common Greenshank	IA	-	Naturemap	The Common Greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayment's, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal	Does not occur – preferred

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Species	Conservation Code		Source[3]	Preferred Habitat	Likelihood and justification
	EPBC Act[1]	WC Act[2]			
				pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and salt flats DotEE 2018c).	habitat is not present
Tringa stagnatilis – Marsh Sandpiper	IA	-	Naturemap	This species is commonly found along coastal and inland wetlands within Australia. Within Western Australia records are scattered and are mainly found along the coast. They prefer permanent or ephemeral wetlands with varying salinity levels such as swamps, saltpans, saltmarshes, intertidal mudflats and estuaries (DotEE 2018c).	Does not occur – preferred habitat is not present
Isoodon fusciventer - Quenda		P4	NatureMap	Known habitat is swampy and/or scrubby vegetation with dense cover, often feeds in adjacent forests and woodland that is burnt on a regular basis. The species will thrive in open habitat in the absence of introduced predators.	Potential – Preferred habitat is present.
Oxyura australis – Blue-billed Duck	-	P4	NatureMap	Can be found in areas of deep, permanent wetlands and swamps with dense aquatic vegetation and predominately lives in the water, only leaving if disturbed or to move for breeding (NSW OEH 2018).	Does not occur – preferred habitat is not present

[1]Species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
CR = listed as Critically Endangered under the EPBC Act.
EN = listed as Endangered under the EPBC Act.
VU = listed as Vulnerable under the EPBC Act.
[2]Species listed in Western Australia under the *Wildlife Conservation Act 1950* (WC Act) or by the Department of Biodiversity, Conservation and Attractions (DBCA).
S1 = Schedule 1: Fauna that is rare or likely to become extinct as critically endangered fauna (CR) under the WC Act.
S2 = Schedule 2: Fauna that is rare or likely to become extinct as endangered fauna (EN) under the WC Act.
S3 = Schedule 3: Fauna that is rare or likely to become extinct as vulnerable fauna (VU) under the WC Act.
S7 = Schedule 7: Other specially protected fauna (OS) under the WC Act.
P2 = Priority 2: Poorly-known species – species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation (DBCA).
P3 = Priority 3: Poorly known species – species that are known from several locations, and the species does not appear to be under imminent threat (DBCA).
P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring (DBCA).
[3]NatureMap = NatureMap database search (DBCA 2007-2018).
PMST = EPBC Act Protected Matters Search Tool (DotEE 2018).

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Appendix 6
Bushfire Management Plan

Bushfire Management Plan

119 Hammond Rd, Success

Prepared for
Planning Solutions

09 January 2019







DOCUMENT TRACKING

Item	Detail
Project Name	119 Hammond Road, Success BMP
Project Number	18PER-10345
Project Manager	Daniel Panickar
Prepared by	Sarah Muller, James Leonard
Reviewed by	Daniel Panickar (BPAD37802-L2)
Approved by	Daniel Panickar (BPAD37802-L2)
Status	FINAL
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Template 29/9/2015

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1 Introduction

1.1 Proposal details

Eco Logical Australia (ELA) was commissioned by Planning Solutions to prepare a Bushfire Management Plan (BMP) to support a Structure Plan for 119 Hammond Road, Success (hereafter referred to as the subject site **Figure 1**).

The entirety of the subject site is within a designated bushfire prone area as per the *Western Australia State Map of Bush Fire Prone Areas* (DFES 2017; **Figure 2**), which triggers bushfire planning requirements under *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7; WAPC 2015) and reporting to accompany submission of the master plan in accordance with the associated *Guidelines for Planning in Bushfire Prone Areas v 1.3* (the Guidelines; WAPC 2017).

This assessment has been prepared by ELA Bushfire Consultants Sarah Muller and James Leonard with quality assurance undertaken by WA Bushfire Lead Daniel Panickar (FPAA BPAD Level 2 Certified Practitioner No. BPAD37802-L2).

1.2 Purpose and application of the plan

The primary purpose of this BMP is to act as a technical supporting document to inform planning assessment.

This BMP is also designed to provide guidance on how to plan for and manage the bushfire risk to the subject site through implementation of a range of bushfire management measures in accordance with the Guidelines.

1.3 Environmental Considerations

Some bushfire prone areas also have high biodiversity values. SPP 3.7 policy objective 5.4 recognises the need to consider bushfire risk management measures alongside environmental, biodiversity and conservation values.

The proposed development will involve the clearing of native vegetation. ELA has worked with the project team to ensure that any environmental values within the subject site are identified prior to development and relevant approvals pathways are recognised.

A Public Open Space (POS) is part of the proposed structure plan. There is planned tree retention within the POS area with managed vegetation and reticulation.

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Figure 1: Site Overview



Legend

Site Boundary

0 20 40 80

Metres

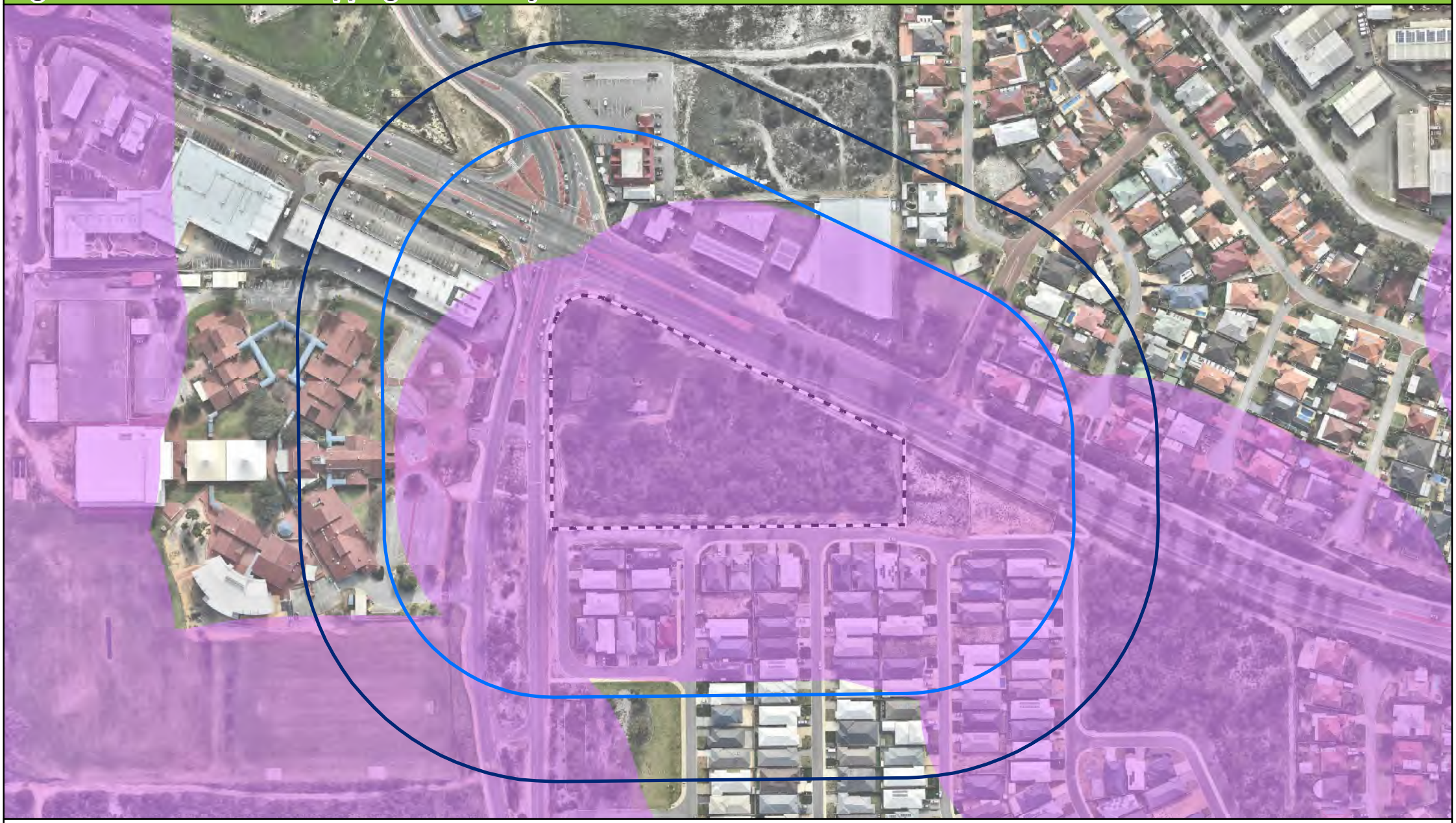
Datum/Projection:
GDA 1994 MGA Zone 50

N

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Figure 2: Bushfire Prone Mapping for the subject site



Legend

- Site Boundary
- 100m assessment area
- 150m assessment area
- Bushfire Prone Mapping (DFES 2018)

0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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2 Bushfire Assessment Results

2.1 Assessment inputs

The following section is a consideration of spatial bushfire risk and has been used to inform the bushfire assessment in this report.

2.1.1 General

The subject site is located in the City of Cockburn, and is bound by:

- Beeliar Drive to the North and East;
- Urban Development to the South and
- Hammond Road to the West.

Visual assessment of the vegetation within the subject site and surrounds did not identify any recent fire scars and fire history was not able to be determined. Accumulation of vegetative matter over time, combined with the moderate to high risk of ignition associated with high levels of public access and proximity to urban areas would potentially facilitate a bushfire occurrence in this area.

2.1.2 Vegetation classification

Vegetation within the subject site and surrounding 150 m (the assessment area) was assessed in accordance with the Guidelines and AS 3959-2009 *Construction of Buildings in Bushfire Prone Areas* (SA 2009) with regard given to the *Visual guide for bushfire risk assessment in Western Australia* (DoP 2016). The site inspection was undertaken on 13 July 2018.

The following vegetation classes and exclusions were identified within the assessment area as depicted in and listed below:

- Class B woodland;
- Class G grassland;
- Exclusions as per clause 2.2.3.2 (b) (i.e. single areas of vegetation less than 1 ha in size and over 100 m away from classifiable vegetation); and
- Exclusions as per clause 2.2.3.2 (e) and (f) (i.e. non-vegetated areas and low-threat vegetation).

Photographs relating to each vegetation type are included in **Appendix A.**

2.1.3 Topography and slope under vegetation

Effective slope under vegetation was assessed for a distance of 150 m from the subject site in accordance with the Guidelines and AS 3959-2009. Slope under all classified vegetation was assessed as upslope/flat land (**Figure 3**).

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Figure 3: Vegetation Classification



Legend

- Site Boundary
- 100m assessment area
- 150m assessment area
- Photo locations
- Contours (5m Intervals)

Vegetation classification

- Class B woodland
- Class G grassland
- Excluded under 2.2.3.2 (b)
- Excluded under 2.2.3.2 (e) and (f)

0 25 50 100
Metres
Datum/Projection:
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2.2 Assessment outputs

A BHL assessment has been undertaken in accordance with SPP 3.7, the Guidelines and the bushfire assessment inputs in **Section 2.1**.

2.2.1 Bushfire Hazard Level (BHL) assessment

Pre-development BHLs have been assessed for the subject site in accordance with the methodology contained within the Guidelines and incorporates the following factors:

- Vegetation class (as depicted in **Figure 3**); and
- Slope under classified vegetation.

Table 1 contains a summary of the BHL assessment for each vegetation class or exclusion. All land within 100 m of Extreme and Moderate BHLs has also been mapped as a Moderate hazard as per the Guidelines, and the final result is depicted in **Figure 4**.

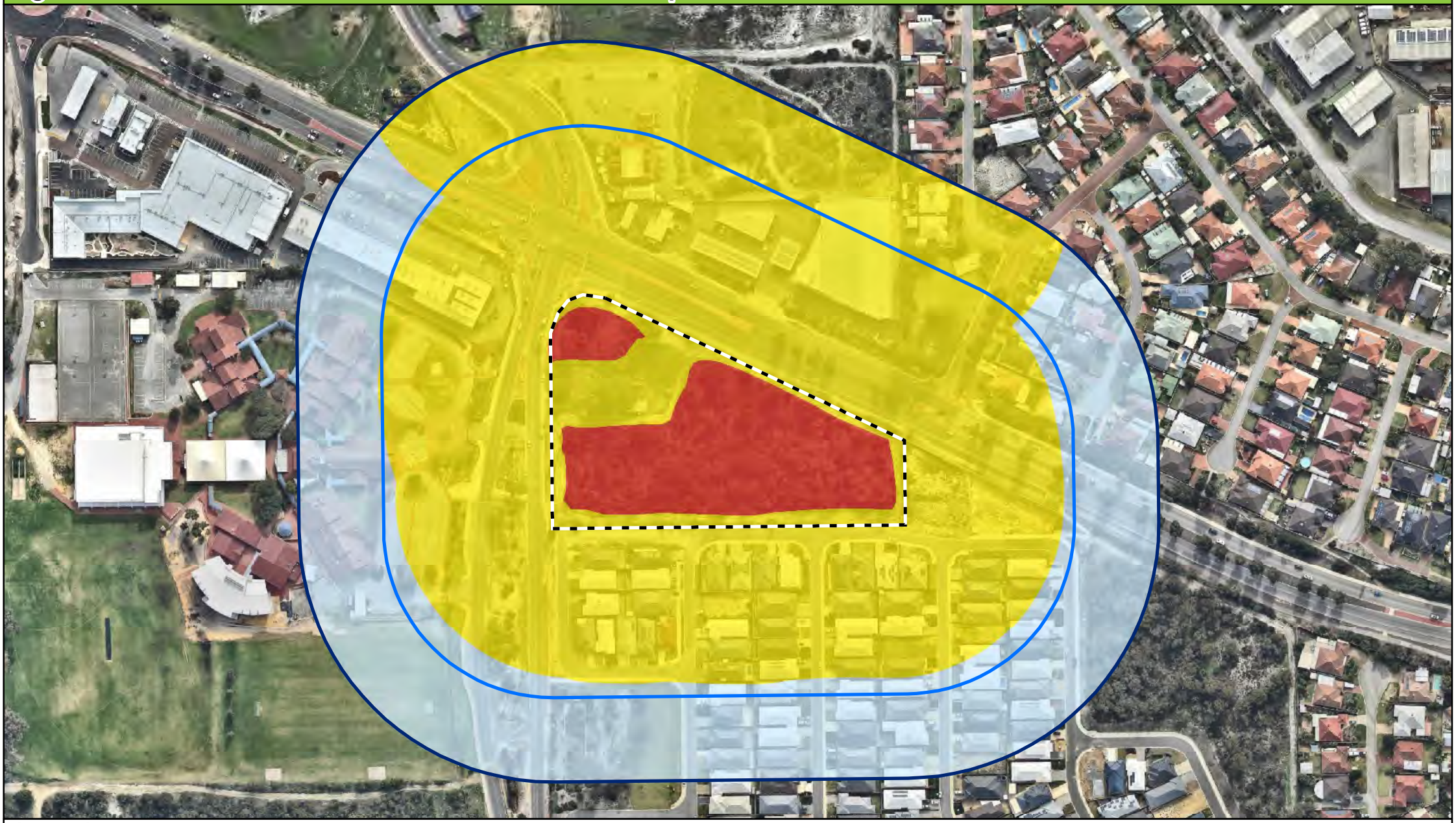
Table 1: Bushfire Hazard Level (BHL) Assessment

Plot	Vegetation Classification	Effective Slope	Bushfire Hazard Level
1	Class B Woodland	Upslope/flat	Extreme
2	Grassland	Upslope/flat	Moderate
3	Excluded as per clause 2.2.3.2 (b)	N/A	Low
4	Excluded as per clause 2.2.3.2 (e) & (f)	N/A	Low

As the subject site is proposed to be cleared for development, the pre-development BHLs are subject to change. A post-development BHL assessment is provided in **Figure 5** based on expected changes to vegetation within the subject site. A POS area is planned for the north-western corner of the subject site (**Appendix D**). This area will be managed, such as maintained lawns, with some tree retention and water irrigation system and is not considered a hazard.

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Figure 4: Bushfire Hazard Level Assessment - Pre-development



Legend

- Site Boundary
- 100m assessment area
- 150m assessment area

Bushfire Hazard Level

- Extreme
- Moderate
- Low

0 25 50 100

Metres

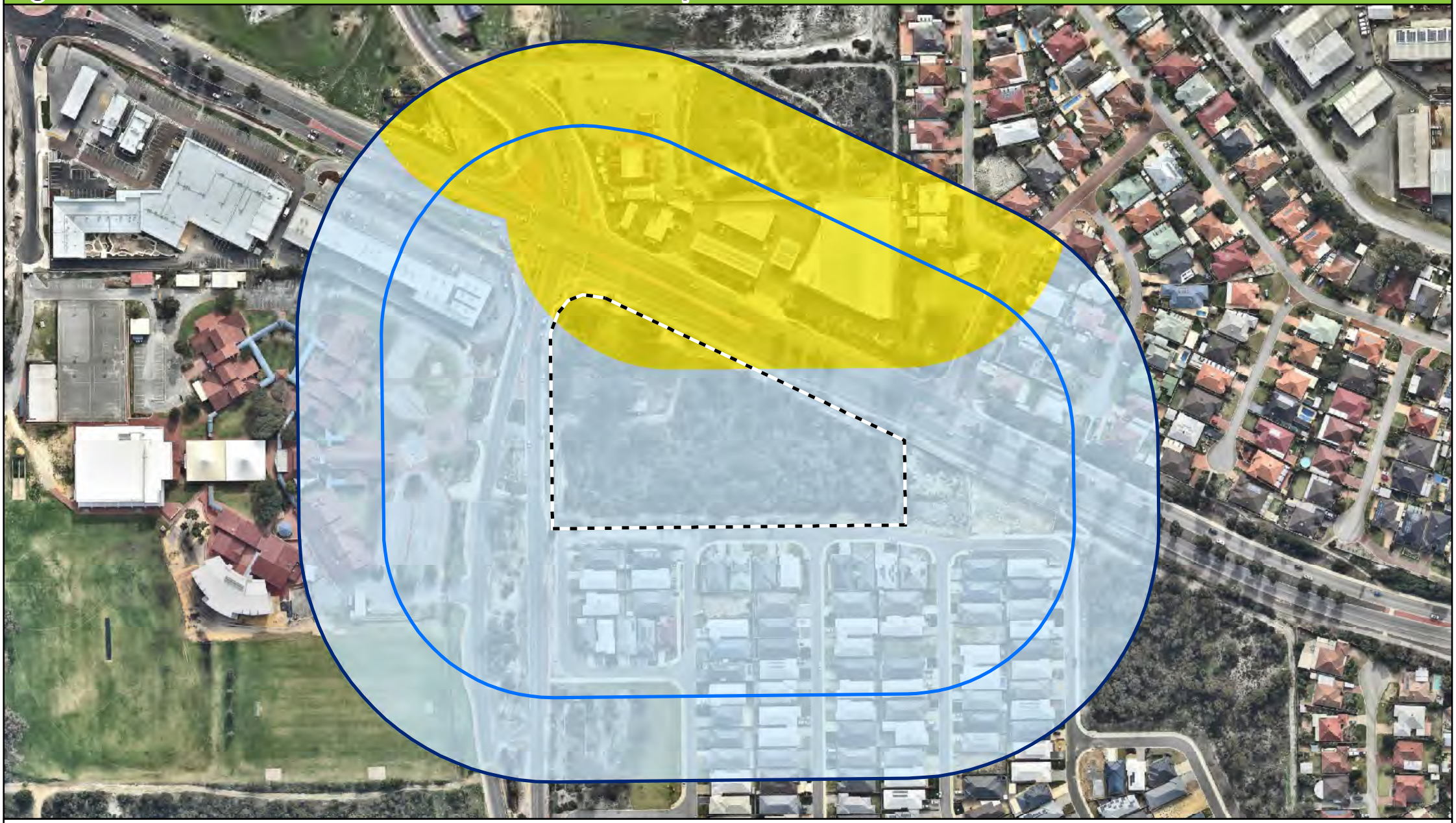
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Figure 5: Bushfire Hazard Level Assessment - Post-development



Legend

- Site Boundary
- 100m assessment area
- 150m assessment area

Bushfire Hazard Level

- Moderate
- Low

0 25 50 100

Metres

Datum/Projection:
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N

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3 Identification of Bushfire Hazard issues

The on-site vegetation extent is proposed to be cleared to enable development of a significant urban built footprint amongst areas of landscaped/managed areas and various easements. Therefore, for the purposes of strategic level planning, ELA does not consider the current on-site vegetation extent to be a bushfire hazard issue post-development, since these hazards can be managed through a staged clearing process, adequate separation of future built assets from classified vegetation, and ongoing fuel management that can be undertaken in and around individual development stages. The proposed Public Open Space (POS) will be managed, such as maintained lawns, with some tree retention and water irrigation system and is not considered a hazard (**Appendix D**).

On the basis of the above information, ELA considers that the bushfire hazards within and adjacent to the subject site and the associated bushfire risk is readily manageable through standard management responses and compliance with acceptable solutions outlined in the Guidelines and AS 3959-2009. These management measures will need to be factored into the development design as early as possible to ensure a suitable, compliant and effective bushfire management outcome is achieved to ensure protection of future life and property assets.

Demonstration of compliance with the relevant requirements of SPP 3.7, the Guidelines and AS 3959-2009 at future planning stages will also depend on the City of Cockburn's ability to coordinate the timing and staging of clearing and development works within the subject site with the aim of avoiding bushfire impacts from 'temporary' retained vegetation.

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4 Assessment against the Bushfire Protection Criteria

4.1 Compliance

The proposed master plan is required to comply with policy measures 6.2 and 6.3 of SPP 3.7 and the Guidelines. Implementation of this BMP is expected to meet objectives 5.1 - 5.4 of SPP 3.7.

Bushfire management measures have been devised for the proposed development in accordance with Guideline acceptable solutions to meet compliance with bushfire protection criteria.

The 'acceptable solutions assessment' is provided below to assess the proposed bushfire management measures against each bushfire protection criteria in accordance with the Guidelines. The assessment demonstrates that the proposed measures meet the intent of each element of the bushfire protection criteria. **Figure 6** depicts bushfire management strategies where necessary.

Table 2: Summary of solutions used to achieve bushfire performance criteria

Bushfire Performance Criteria	AS	PS	N/A	Proposed bushfire management strategies
Element 1: Location A1.1 Development location	☒	☐	☐	Post-development, all buildings within the subject site will be situated in areas subject to BHLs of Moderate or Low (refer to **Figure 6**). The proposed development is considered to be compliant with A1.1.
Element 2: Siting and design of development A2.1 Asset Protection Zone (APZ)	☒	☐	☐	APZs can be accommodated between all future buildings and classified vegetation within the proposed subject site (refer to **Figure 6**). Future development would result in the clearing of the native vegetation within the proposed area. There will be some tree retention within the proposed POS area and managed landscaping (**Appendix D**). Due the clearing of native vegetation, APZs may not be required. This is to be assessed during future stages of planning. The proposed development is considered to be compliant with A2.1.
Element 3: Vehicular access A3.1 Two access routes	☒	☐	☐	The internal public road network of the subdivision connects to the outer road network at three points, providing safe access to the public that lead away from the subject site should an emergency occur (refer to **Figure 6**). The proposed development is considered to be compliant with A3.1.
Element 3: Vehicular access A3.2 Public Road	☐	☐	☐	All proposed public roads will comply with vehicular access requirements (refer to **Appendix C**).

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Bushfire Performance Criteria	AS	PS	N/A	Proposed bushfire management strategies
Element 3: Vehicular access A3.3 Cul-de-sac	☐	☐	☒	No cul-de-sacs are proposed as part of the development.
Element 3: Vehicular access A3.4 Battle-axe	☐	☐	☒	No battle-axe lots are proposed as part of the development.
Element 3: Vehicular access A3.5 Private Driveway longer than 50 m	☐	☐	☒	There are no Private Driveways longer than 50 m proposed as part of the development.
Element 3: Vehicular access A3.6 Emergency Access way	☐	☐	☒	No emergency access way routes are proposed or required as part of the development.
Element 3: Vehicular access A3.7 Fire-service access route	☐	☐	☒	No fire service access routes are proposed or required as part of the development.
Element 3: Vehicular access A3.8 Firebreak width	☐	☐	☒	No firebreaks are proposed or required as part of the development.
Element 4: Water A4.1 Reticulated areas	☒	☐	☐	The subject site will be connected to a reticulated water supply. The proposed development is considered to be compliant with A4.1. A4.2 and A4.3 are not applicable to this proposed development.

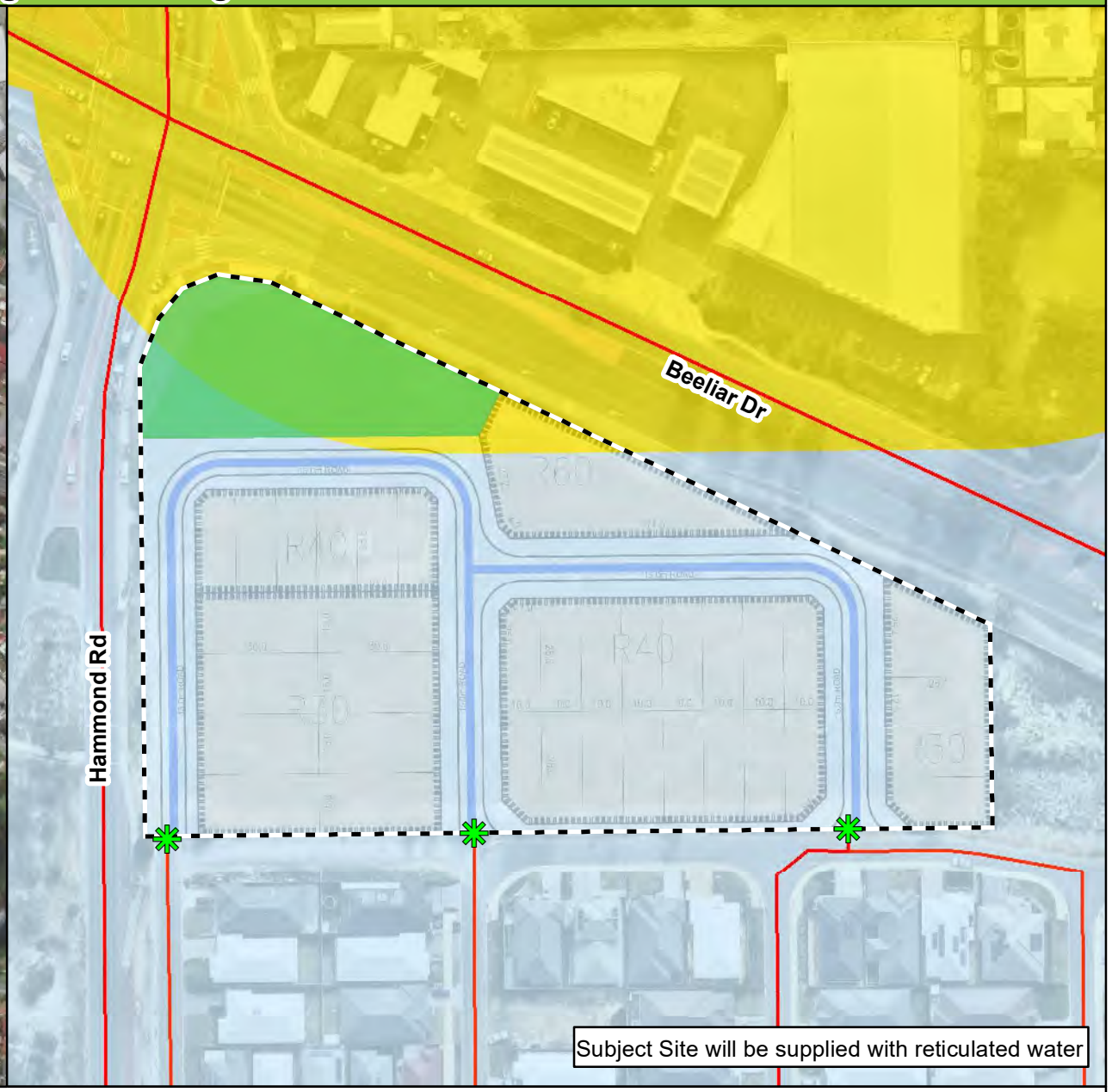
4.2 Additional management strategies

Future demonstration of compliance with the relevant requirements of SPP 3.7, the Guidelines and AS 3959-2009 will depend on the developer's ability to coordinate the timing of development works within the subject site. Updated BMPs will be prepared to support subsequent planning applications where relevant and will contain re-assessments of bushfire risk including Bushfire Attack Level assessments etc.

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Figure 6: Spatial representation of the bushfire management strategies





Legend

- Site Boundary
- Proposed Public Open Space (POS)
- Access_points
- Access/ Egress route

Bushfire Hazard Level

- Moderate
- Low

0 15 30 60
Metres
Datum/Projection:
GDA 1994 MGA Zone 50

N

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Prepared by: JL Date: 09/01/2019

5 Responsibilities for Implementation and Management of Bushfire Measures

Implementation of the BMP applies to the Developer, the City of Cockburn, and future landowners to ensure bushfire management measures are adopted and implemented on an ongoing basis. This BMP has been prepared as a strategic guide to demonstrate how development compliance will be delivered at future planning stages in accordance with the Guidelines. In this respect, management measures documented in **Section 4**, where applicable, will be incorporated into development design as early as possible and confirmed through subdivision design. Therefore, aside from the revision of this BMP or preparation of a BMP addendum to accompany future subdivision applications, there are no further items to implement, enforce or review at this stage of the planning process.

The revised BMP or addendum to this BMP is required to meet the relevant commitments outlined in this strategic level BMP, address the relevant requirements of SPP 3.7 (i.e. Policy Measure 6.4) and demonstrate in detail how the proposed development will incorporate the relevant acceptable solutions to meet the performance requirements of the Guidelines.

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6 Conclusion

In the author's professional opinion, the bushfire protection requirements listed in this assessment provide an adequate standard of bushfire protection for the proposed development. As such, the proposed development is consistent with the aims and objectives of SPP 3.7 and associated guidelines and is recommended for approval.



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Senior Bushfire Consultant
FPAA BPAD Certified Practitioner
No. BPAD37802-L2



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Appendix A Plates

Plot	Photo ID	Photo and vegetation class
1	1	 Class B woodland
1	2	 Class B woodland

Plot	Photo ID	Photo and vegetation class
1	3	 Class B woodland (background)
2	4	 Class G grassland

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Plot	Photo ID	Photo and vegetation class
2	5	 Class G grassland
3	6	 Excluded as per clause 2.2.3.2 (b) (single area of vegetation less than 1 ha in size and greater than 100 m from other areas of classified vegetation)

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Plot	Photo ID	Photo and vegetation class
4	7	 Excluded as per clause 2.2.3.2 (e) and (f)
4	8	 Excluded as per clause 2.2.3.2 (e) and (f)

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Plot	Photo ID	Photo and vegetation class
4	9	 Excluded as per clause 2.2.3.2 (e) and (f)
4	10	 Excluded as per clause 2.2.3.2 (e) and (f)

Plot	Photo ID	Photo and vegetation class
4	11	 Excluded as per clause 2.2.3.2 (e) and (f)

Appendix B Standards for Asset Protection Zones

The following standards have been extracted from the *Guidelines for Planning in Bushfire Prone Areas v 1.3* (WAPC 2017).

Every habitable building is to be surrounded by, and every proposed lot can achieve, an APZ depicted on submitted plans, which meets the following requirements:

a. Width: Measured from any external wall or supporting post or column of the proposed building, and of sufficient size to ensure the potential radiant heat impact of a fire does not exceed 29kW/m² (BAL 29) in all circumstances.

b. Location: the APZ should be contained solely within the boundaries of the lot on which a building is situated, except in instances where the neighbouring lot or lots will be managed in a low-fuel state on an ongoing basis, in perpetuity (see explanatory notes).

c. Management: the APZ is managed in accordance with the requirements of '*Standards for Asset Protection Zones*' (below):

- Fences: within the APZ are constructed from non-combustible materials (e.g. iron, brick, limestone, metal post and wire). It is recommended that solid or slatted non-combustible perimeter fences are used;
- Objects: within 10 metres of a building, combustible objects must not be located close to the vulnerable parts of the building i.e. windows and doors;
- Fine Fuel load: combustible dead vegetation matter less than 6 millimetres in thickness reduced to and maintained at an average of two tonnes per hectare;
- Trees (> 5 metres in height): trunks at maturity should be a minimum distance of 6 metres from all elevations of the building, branches at maturity should not touch or overhang the building, lower branches should be removed to a height of 2 metres above the ground and or surface vegetation, canopy cover should be less than 15% with tree canopies at maturity well spread to at least 5 metres apart as to not form a continuous canopy (**Figure 7**).

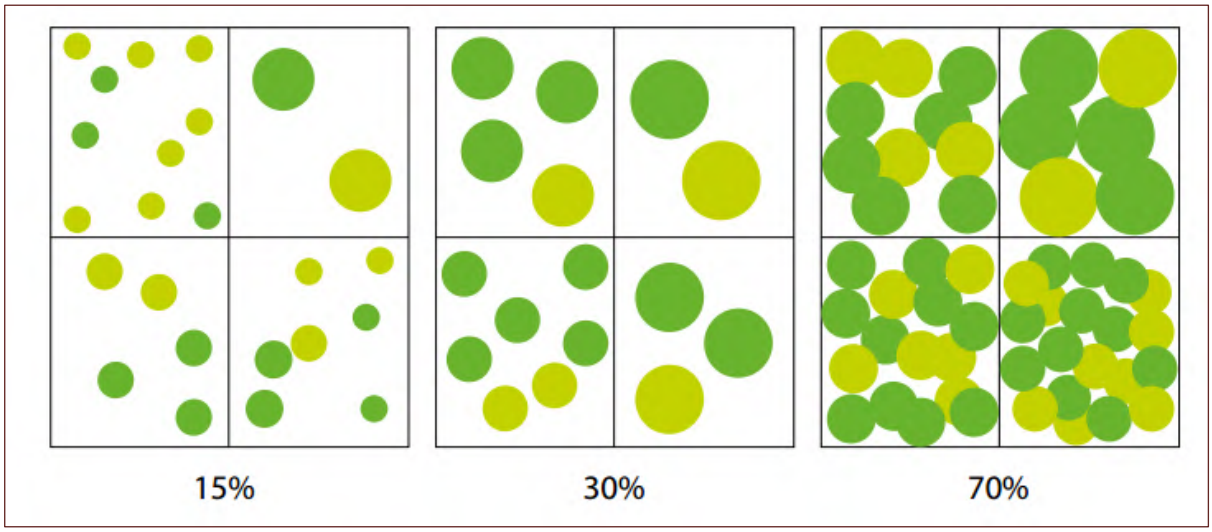


Figure 7: Illustrated tree canopy cover projection (WAPC 2017)

- **Shrubs (0.5 metres to 5 metres in height):** should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m2 in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 5 metres in height are to be treated as trees;
- **Ground covers (<0.5 metres in height):** can be planted under trees but must be properly maintained to remove dead plant material and any parts within 2 metres of a structure, but 3 metres from windows or doors if greater than 100 millimetres in height. Ground covers greater than 0.5 metres in height are to be treated as shrubs;
- **Grass:** should be managed to maintain a height of 100 millimetres or less.

Additional notes

An APZ is an area surrounding a building that is managed to reduce the bushfire hazard to an acceptable level. The width of the required APZ varies with slope and vegetation. The APZ should at a minimum be of sufficient size to ensure the potential radiant heat impact of a fire does not exceed 29kW/m² (BAL-29). It should be lot specific.

The APZ includes a defendable space which is an area adjoining the asset within which firefighting operations can be undertaken to defend the structure. Vegetation within the defendable space should be kept at an absolute minimum and the area should be free from combustible items and obstructions. The width of the defendable space is dependent on the space which is available on the property, but as a minimum should be 3 metres.

The APZ should be contained solely within the boundaries of the lot on which the building is situated, except in instances where the neighbouring lot or lots will be managed in a low-fuel state on an ongoing basis, in perpetuity. The APZ may include public roads, waterways, footpaths, buildings, rocky outcrops, golf courses, maintained parkland as well as cultivated gardens in an urban context, but does not include grassland or vegetation on a neighbouring rural lot, farmland, wetland reserves and unmanaged public reserves.

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Appendix C Vehicular access technical requirements (WAPC 2017)

Technical requirements	Public road	Cul-de-sac	Private driveway	Emergency access way	Fire service access route
Minimum trafficable surface (m)	6*	6	4	6*	6*
Horizontal distance (m)	6	6	6	6	6
Vertical clearance (m)	4.5	N/A	4.5	4.5	4.5
Maximum grade <50 m	1 in 10	1 in 10	1 in 10	1 in 10	1 in 10
Minimum weight capacity (t)	15	15	15	15	15
Maximum crossfall	1 in 33	1 in 33	1 in 33	1 in 33	1 in 33
Curves minimum inner radius	8.5	8.5	8.5	8.5	8.5

* Refer to E3.2 Public roads: Trafficable surface

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Appendix D : Landscaping Master Plan

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ISO 14001 Environmental Management

AS/NZS 4801:2001 Occupational Health and Safety Management

ISO 9001 Quality Management

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Appendix 7
Transport Noise Assessment

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Transportation Noise Assessment

Lot 176 (#119) Hammond Road, Success

Reference: 18054419-01

Prepared for:
Dorothy Guerini c/- Planning Solutions

Report: 18054419-01

Lloyd George Acoustics Pty Ltd

ABN: 79 125 812 544

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Date:	Rev	Description	Prepared By	Verified
10/01/19	-	Final issued to Client	Matt Moyle	Daniel Lloyd

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A Deemed to Comply Facade Packages
B Terminology

1 INTRODUCTION

This report relates to a proposed structure plan at Lot 176 (#119) Hammond Road, Success. As this structure plan area is located adjacent to a major road (Beeliar Drive), an assessment of the traffic noise impacts is required. Hammond Road is also identified to be a source of noise impact although it is not strictly major road based on traffic volumes, and has been included in the assessment.

The results of the assessment are compared against the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning* and recommendations are provided on noise mitigation requirements under this policy.

For a general locality map, refer to *Figure 1-1* and the proposed subdivision layout is shown in *Figure 1-2*.

Appendix B contains a description of some of the terminology used throughout this report.



Figure 1-1 Project Locality (Google Earth)

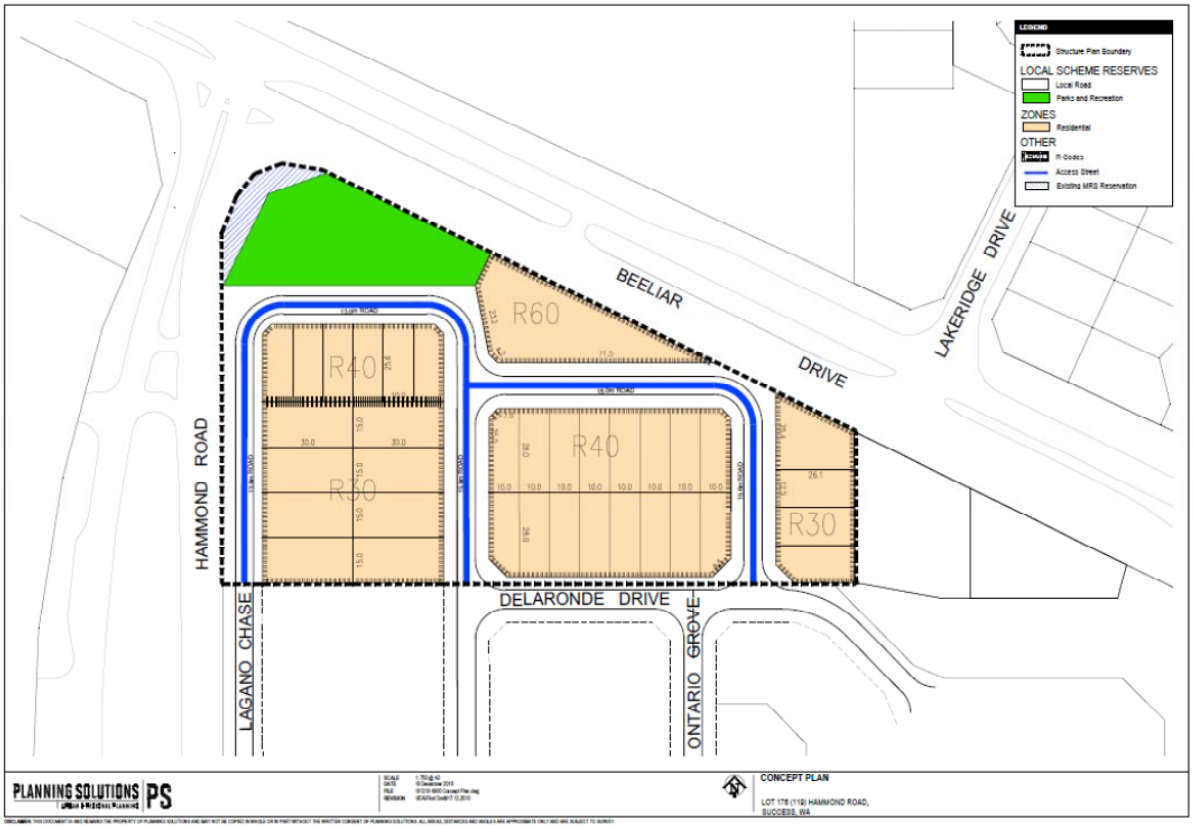


Figure 1-2 Concept Subdivision Layout

2 CRITERIA

The criteria relevant to this assessment is the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning* (hereafter referred to as the Policy) produced by the Western Australian Planning Commission (WAPC). The objectives in the Policy are to:

- Protect people from unreasonable levels of transport noise by establishing a standardised set of criteria to be used in the assessment of proposals;
- Protect major transport corridors and freight operations from incompatible urban encroachment;
- Encourage best practice design and construction standards for new development proposals and new or redevelopment transport infrastructure proposals; and
- Facilitate the strategic co-location of freight handling facilities.

The Policy's outdoor noise criteria are shown below in *Table 2-1*. These criteria apply at any point 1-metre from a habitable façade of a noise sensitive premises and in one outdoor living area.

Table 2-1 Outdoor Noise Criteria

Period	Target	Limit
Day (6am to 10pm)	55 dB $L_{Aeq(Day)}$	60 dB $L_{Aeq(Day)}$
Night (10pm to 6am)	50 dB $L_{Aeq(Night)}$	55 dB $L_{Aeq(Night)}$

Note: The 5 dB difference between the target and limit is referred to as the margin.

In the application of these outdoor noise criteria to new noise sensitive developments, the objectives of this Policy is to achieve -

- acceptable indoor noise levels in noise-sensitive areas (e.g. bedrooms and living rooms of houses); and
- a 'reasonable' degree of acoustic amenity in at least one outdoor living area on each residential lot.

If a noise sensitive development takes place in an area where outdoor noise levels will meet the *target*, no further measures are required under this policy.

In areas where the *target* is exceeded, but noise levels are likely to be within the 5 dB margin (i.e. less than the *limit*), mitigation measures should be implemented by the developer with a view to achieving the *target* levels in at least one outdoor living area on each residential lot. Where indoor spaces are planned to be facing any outdoor area in the *margin*, mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces.

In areas where the *limit* is exceeded (i.e. above $L_{Aeq(Day)}$ of 60dB(A) or $L_{Aeq(Night)}$ of 55dB(A)), a detailed noise assessment is to be undertaken. Customised noise mitigation measures should be implemented with a view to achieving the *target* in at least one outdoor living area on each residential lot, or if this is not practicable, within the *margin*. Where indoor spaces are planned to be facing outdoor areas that are above the *target*, mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces.

3 METHODOLOGY

Noise measurements and modelling have been undertaken in accordance with the requirements of the Policy as described below in *Sections 3.1 and 3.2*.

3.1 Site Measurements

As the site is impacted by both Beeliar Drive and Hammond Road traffic, noise monitoring was undertaken adjacent (25 metres) to both road edges on the proposed subdivision site. The monitoring was undertaken between 19 and 23 July 2018, being sufficient time to obtain 3 full weekdays of data. The data is used to determine the differences between acoustic parameters $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$ and to calibrate the noise prediction model.

The instruments used were ARL Ngara noise data loggers. Sound pressure levels were measured in accordance with Australian Standard 2702-1984: *Acoustics -Method For Measurement of Road*

Traffic Noise. The loggers were placed in free field with a microphone height of 1.4 metres above ground floor level.

The loggers were field calibrated before and after the measurement session and found to be accurate to within +/- 1 dB. Lloyd George Acoustics also holds current laboratory calibration certificate for the loggers.

From the hourly measurements, the $L_{Aeq(Day)}$ and $L_{Aeq\ (Night)}$ values were determined for each complete measurement day. These results were averaged and the mean level reported.



Figure 3-1 Noise Data Loggers on Site (Top: Beeliar Drive, Bottom: Hammond Road)

The noise data collected was verified by inspection and professional judgement. Where hourly data was considered atypical, an estimated value was inserted as required by MRWA.

3.2 Noise Modelling

The computer programme *SoundPLAN 8.1* was utilised incorporating the *Calculation of Road Traffic Noise* (CoRTN) algorithms, modified to reflect Australian conditions. The modifications included the following:

- Vehicles were separated into heavy (Austroads Class 3 upwards) and non-heavy (Austroads Classes 1 & 2) with non-heavy vehicles having a source height of 0.5 metres above road level and heavy vehicles having two sources, at heights of 1.5 metres and 3.6 metres above road level, to represent the engine and exhaust respectively. By splitting the noise source into three, allows for less barrier attenuation for high level sources where barriers are to be considered. Note that corrections are applied to the exhaust of –8.0 dB (based on Transportation Noise Reference Book, Paul Nelson, 1987) and to the engine source of –0.8 dB, so as to provide consistent results with the CoRTN algorithms for the no barrier scenario;
- An adjustment of –1.7 dB has been applied to the predicted levels based on the findings of An Evaluation of the U.K. DoE Traffic Noise Prediction; Australian Road Research Board, Report 122 ARRB – NAASRA Planning Group 1982.

Predictions are made at heights of 1.4 m above ground floor level for single storey houses and 4.4 m for double storey houses. The noise is predicted at 1.0 metre from an assumed building facade resulting in a + 2.5 dB correction due to reflected noise.

Various input data are included in the modelling such as ground topography, road design, traffic volumes etc. These model inputs are discussed below.

3.2.1 Ground Topography, Road Design & Cadastral Data

Topographical data for the existing and future scenarios are based on publicly available Google Geo-Data. It is noted that a 1.8m high noise wall exists along Beeliar Drive at the adjacent property to the east. A 1.8m boundary wall has been assumed the northern boundary of the subject site to tie into the existing wall on the adjacent lot to the east. Future lot levels were not available at the time of assessment, and have been assumed similar to existing terrain.

Buildings have also been included as these can provide barrier attenuation when located between a source and receiver, in much the same way as a hill or wall provides noise shielding. All single storey buildings are assumed to have a height of 4.0 metres.

3.2.2 Traffic Data

Traffic data includes:

- Road Surface – The existing and future road surface is assumed to be dense-graded asphalt. The noise relationship between the various road surfaces is provided in *Table 3-1*. As a guide, 14 mm chip seal would be the noisiest surface and open-graded asphalt the quietest.

Table 3-1 Noise Relationship Between Different Road Surfaces

Road Surfaces						
Chip Seal			Asphalt			
14mm	10mm	5mm	Dense Graded	Novachip	Stone Mastic	Open Graded
+3.5 dB	+2.5 dB	+1.5 dB	0.0 dB	-0.2 dB	-1.5 dB	-2.5 dB

- Vehicle Speed – The existing and future posted speed for Beeliar Drive is assumed to be 70km/h. For Hammond Road, it is 60 km/h.

- Traffic Volumes – Existing and future traffic volumes used in the modelling have been provided by Main Roads sourced from Trafficmap. Forecast 2031 volumes were provided by Main Roads Analyst, Clare Yu (Request #40973, 1 August 2018). *Tables 3-2 and 3-3* summarise the traffic information used in the assessment.

Table 3-2 Traffic Information Used in the Modelling – Beeliar Drive

Parameter	Scenario			
	Existing - 2018		Future - 2037	
	Eastbound[1]	Westbound[1]	Eastbound[2]	Westbound[2]
24 Hour Volume	16,874	17,239	24,467	22,411
18 Hour Volume[3]	15,861	16,204	27,504	24,479
% Heavy	17	15	11	11

Notes:

1. Provided by MRWA, calibrated and extrapolated from 2016 LVP plots.
2. Provided by MRWA, calibrated and extrapolated from 2031 LVP plots.
3. Shown as a percentage of the 24-hour volume. The 18-hour volumes is used to calibrate the noise model against the predicted $L_{A10,18hour}$ value.

Table 3-3 Traffic Information Used in the Modelling – Hammond Road

Parameter	Scenario			
	Existing - 2018		Future - 2037	
	Northbound[1]	Southbound[1]	Northbound[2]	Southbound[2]
24 Hour Volume	4,300	4,100	7,660	8,440
18 Hour Volume[3]	4,042	3,854	7,200	7,933
% Heavy	9	7	9	7

Notes:

1. Provided by MRWA, calibrated and extrapolated from 2016 LVP plots.
2. Provided by MRWA, calibrated and extrapolated from 2031 LVP plots.
3. Shown as a percentage of the 24-hour volume. The 18-hour volumes is used to calibrate the noise model against the predicted $L_{A10,18hour}$ value.

3.2.3 Ground Attenuation

The ground attenuation has been assumed to be 0.0 (0%) within the road reserve, 0.75 (75%) within the subdivision. Note 0.0 represents hard reflective surfaces such as asphalt and water and 1.00 represents absorptive surfaces such as grass.

3.2.4 Parameter Conversion

The CoRTN algorithms used in the *SoundPLAN* modelling package were originally developed to calculate the $L_{A10,18hour}$ noise level. The Policy however uses $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$. The relationship between the parameters varies depending on the composition of traffic on the road (volumes in each period and percentage heavy vehicles). The *SoundPLAN* model converts these parameters based on the findings from the technical paper *Converting the UK Traffic Noise Index $L_{A10,18h}$ to EU Noise Indices for Noise Mapping*; TRL Limited. The results are also compared against the measured data for consistency.

4 RESULTS

4.1 Noise Monitoring

The results of the noise monitoring at both locations are summarised in *Tables 4-1 to 4-2* and shown graphically in *Figures 4-1 to 4-2*.

Table 4-1 Measured Average Noise Levels Adjacent to Beeliar Drive

Date	Average Weekday Noise Level, dB		
	$L_{A10,18hour}$	$L_{Aeq\ (Day)}$	$L_{Aeq\ (Night)}$
19/7/18	60.4	58.1	53.3
20/7/18	61.4	58.8	53.9
23/7/18	59.9	57.8	53.4
Weekday Average	**60.6**	**58.2**	**53.6**

Table 4-2 Measured Average Noise Levels Adjacent to Hammond Road

Date	Average Weekday Noise Level, dB		
	$L_{A10,18hour}$	$L_{Aeq\ (Day)}$	$L_{Aeq\ (Night)}$
19/7/18	56.4	54.6	47.8
20/7/18	57.1	55.3	49.1
23/7/18	57.0	55.3	50.8
Weekday Average	**56.8**	**55.1**	**49.3**

The average differences between the weekday $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$ is greater than 5 dB. As such, it is the day period noise levels that will dictate compliance. Therefore the modelling will only consider the day period levels. The average difference between $L_{A10,18hour}$ and $L_{Aeq(day)}$ is 2.2 dB and this factor has been used throughout the future prediction results.

4.2 Noise Modelling

The result of the existing traffic noise modelling is shown in *Figure 4-3.* Future traffic conditions assuming the 1.8m noise wall mitigation measure is provided in *Figure 4-4* for ground floors.

Figure 4-1: Noise Logging - Beeliar Drive, Success

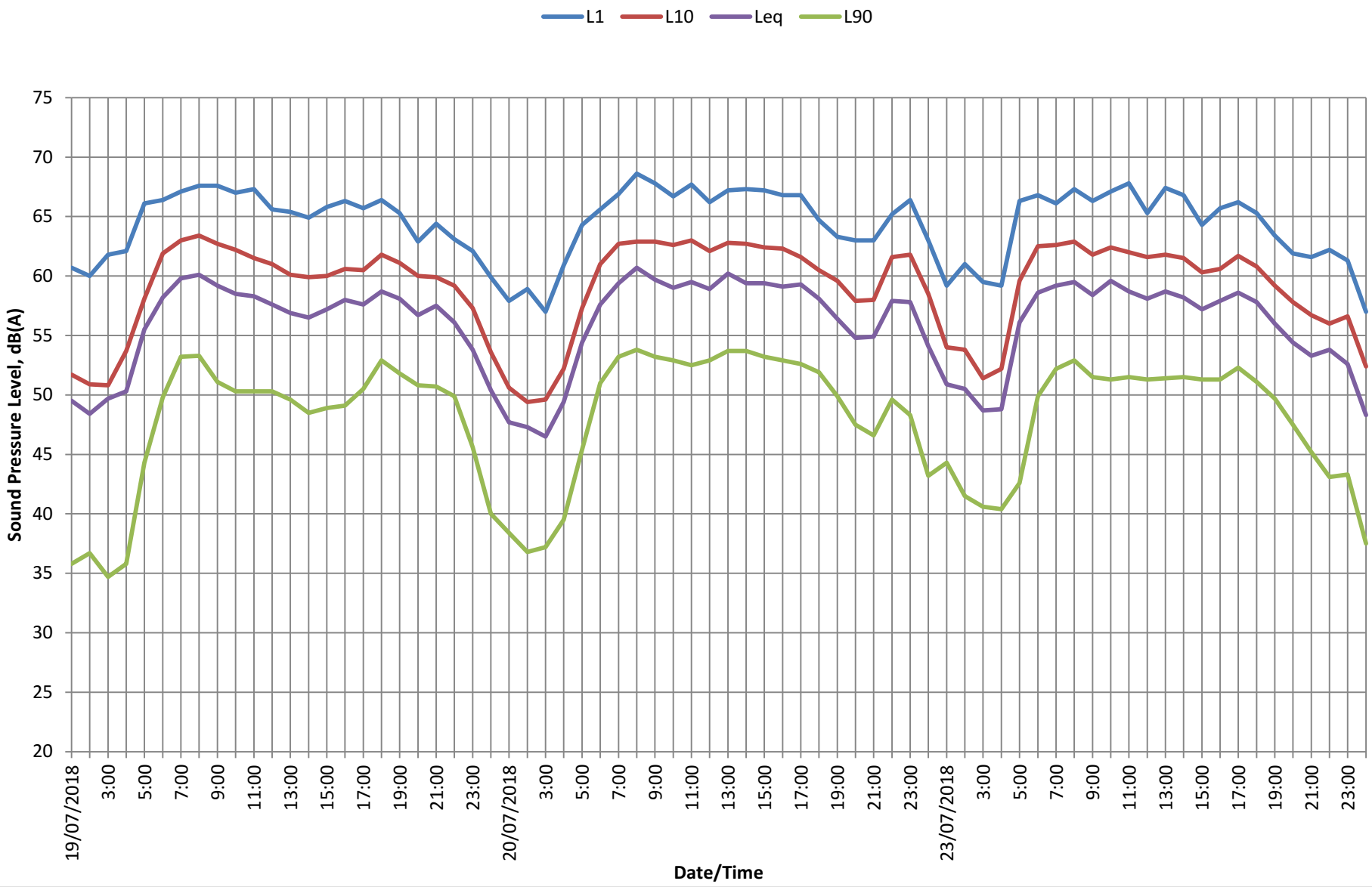


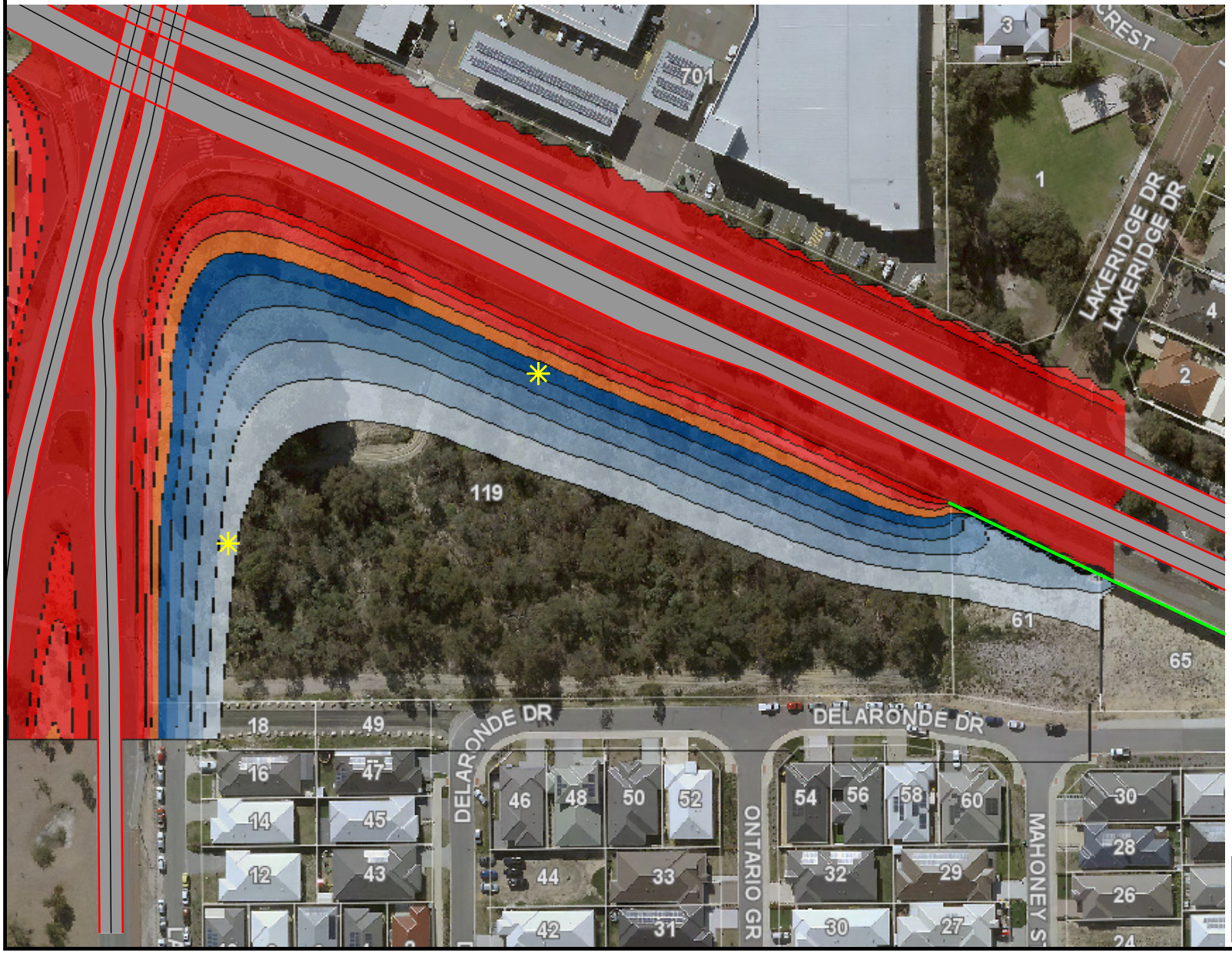
Figure 4-2: Noise Logging - Hammond Road, Success



Figure 4-3

Lot 176 (119) Hammond Road, Success

$L_{Aeq(Day)}$ Noise Level Contours - Existing 2018 Traffic



Noise levels

$L_{Aeq,Day}$ dB

= 55
= 56
= 57
= 58
= 59
= 60
= 61
= 62
= 63

Signs and symbols

- Building
- Road
- Wall
- Calibration Logger

N

Length Scale 1:1500

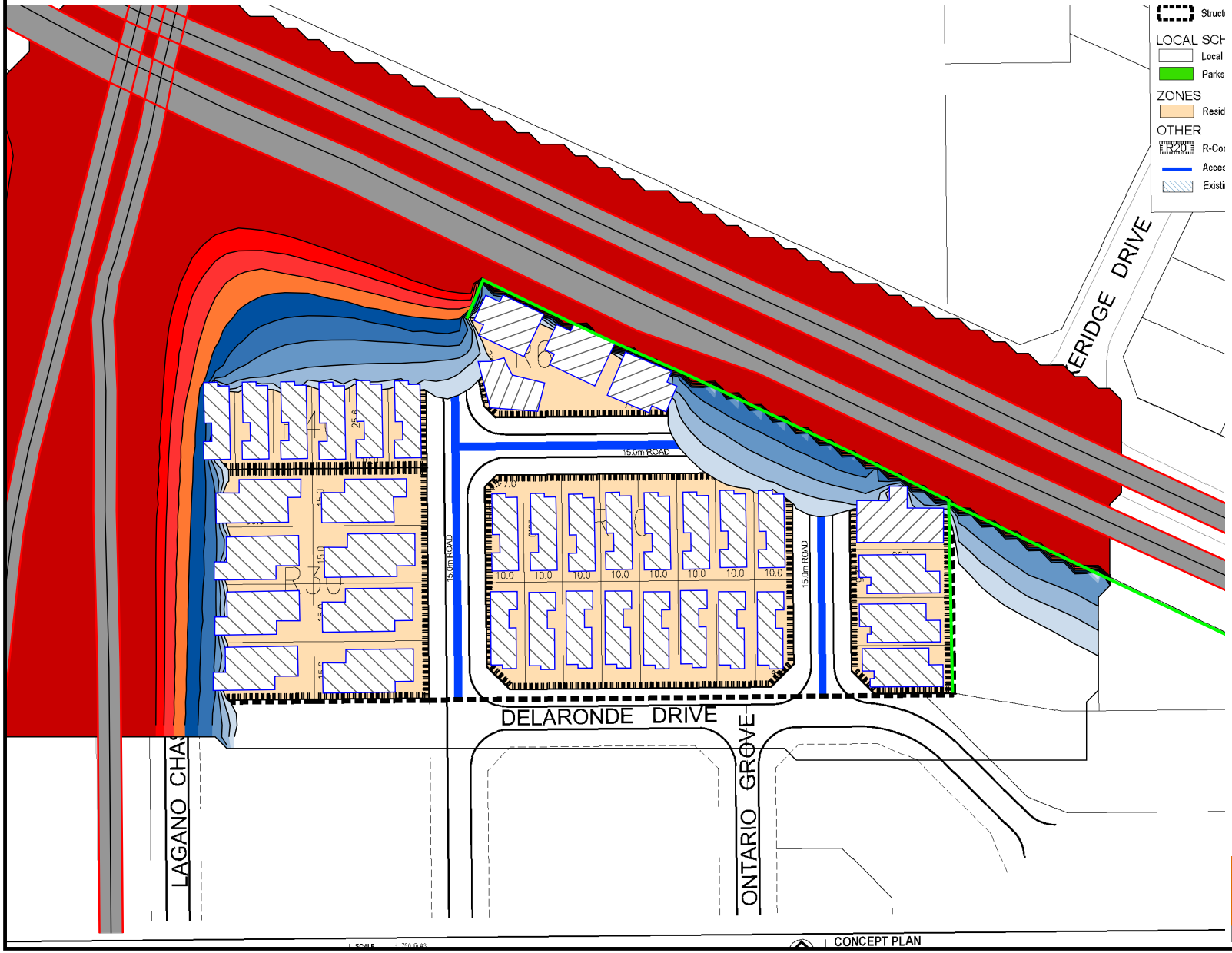
0 10 20 40 60

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Figure 4-4

Lot 176 (119) Hammond Road, Success

$L_{Aeq(Day)}$ Noise Level Contours - Future 2038 Traffic



Noise levels
LAeq,Day dB

= 55
= 56
= 57
= 58
= 59
= 60
= 61
= 62
= 63

Signs and symbols

Building

Road

Wall

N

Length Scale 1:1500

0 10 20 40 60

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5 ASSESSMENT

The objectives of the criteria are for noise at all houses to be no more than the *limit* and preferably no more than the *target*. Where the *target* is achieved, no further controls are required. Where the *target* is exceeded, further controls are necessary.

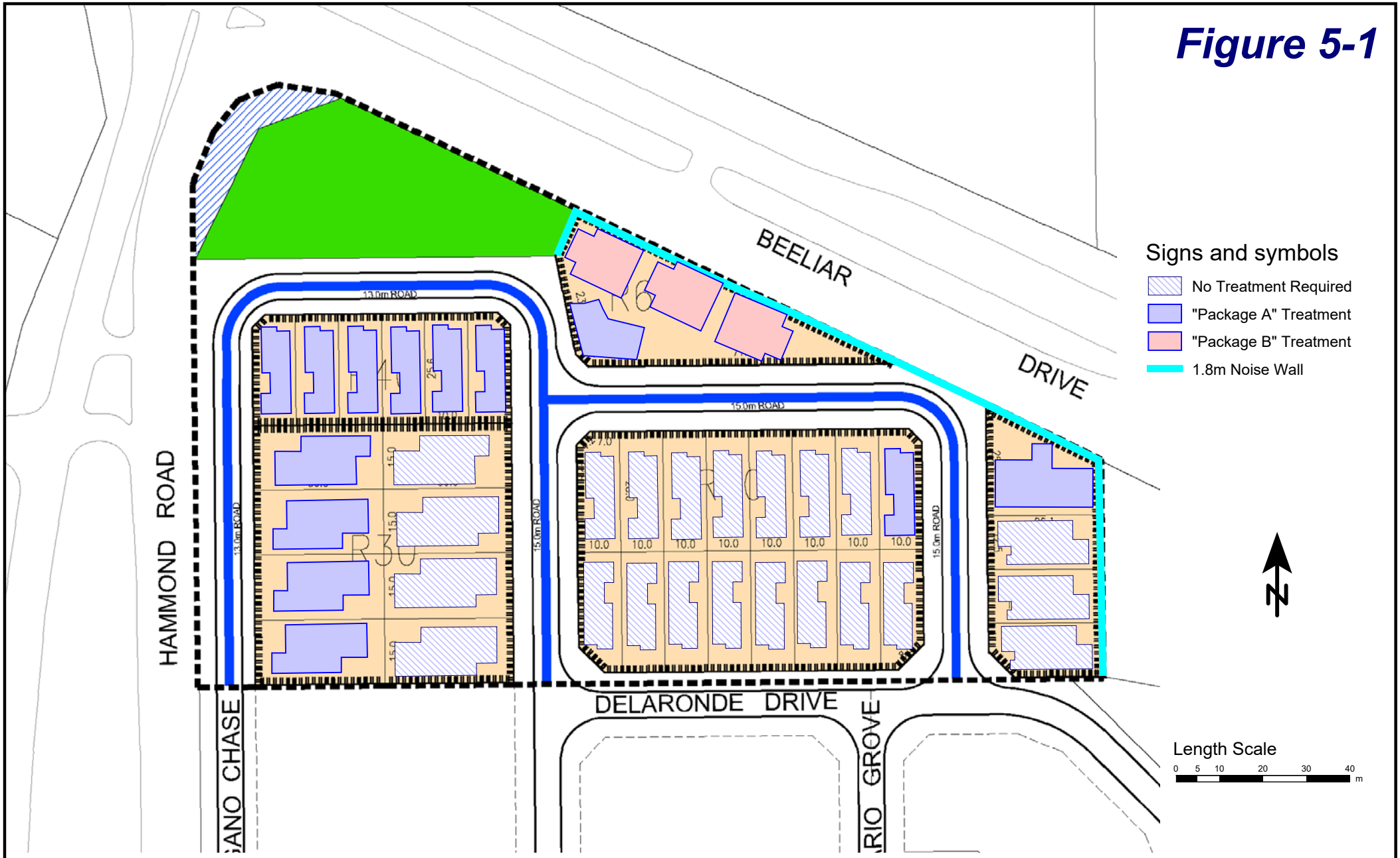
With no noise control, road traffic noise levels for future dwellings will be above the daytime ***target*** of 55 dB $L_{Aeq(Day)}$. It has been determined to reduce noise levels to within the *margin*, a 1.8 metre high (relative to finished lot levels) noise wall will be required. The location of this wall is provided on *Figure 4-4*, along with the predicted noise contours.

As noise levels will still be above the *target* at some residences, Package A architectural treatments (refer *Appendix A*) will also be required. As such, based on the current design information, the following noise controls (as shown on *Figure 5-2*) are required to comply with the Policy:

- Construct a 1.8m high noise wall to the extent as shown on *Figure 5-1*. The noise wall is to be solid, free of gaps and have a minimum surface mass of 15kg/m^2;
- Where residences are predicted to experience future noise levels between, and including, 56 dB and 60 dB $L_{Aeq(Day)}$, Package A is to be incorporated (refer *Appendix A*). Alternative constructions may be acceptable if supported by a report undertaken by a suitably qualified acoustical consultant once the lots specific building plans are available.
- Where residences are predicted to experience future noise levels between, and including, 61 dB and 63 dB $L_{Aeq(Day)}$, Package B is to be incorporated (refer *Appendix A*) and are generally shown on *Figure 5-1.* Alternative constructions may be acceptable if supported by a report undertaken by a suitably qualified acoustical consultant once the lots specific building plans are available;
- All affected lots are to have notifications on lot titles as per the Policy requirements – refer *Appendix A*.
- Where an affected lot is to be of double storey construction, specialist advice must be sought since the upper level will not receive the same level of attenuation provided by walls or other dwellings.

Outdoor entertaining areas are generally within the margin, and therefore considered acceptable under the Policy. However, where possible, an outdoor entertaining area should be considered on the side of the house facing away from the highway.

Figure 5-1



Lot 176 (119) Hammond Road, Success - Required Façade Treatments - Ground Floor

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6 CONCLUSION

The results of this assessment show that assuming the 1.8m noise wall, there remains a number of lots predicted to receive a future road traffic noise level that will be above the *target* criteria at ground floor. Therefore under the requirements of the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning* the following noise mitigation measures are required as detailed in *Section 5* of this assessment.

In addition to the mitigation measures, the following should be considered:

- For dwellings requiring Packages A or B, alternative treatment to the deemed to satisfy can be accepted if supported by a report by a suitable qualified acoustical engineer (member firm of the Association of Australasian Acoustical Consultants);
- All affected lots are to have notifications on lot titles as per the Policy requirements – refer *Appendix A*.
- All affected lots are to provide one outdoor entertaining area where noise levels are below the *limit*.
- Where the mixed use or grouped development consists of residential dwellings, it is recommended that specialist acoustic advice be sought at the time of development.

Appendix A

Deemed to Comply Facade Packages

The packages and information provided on the following pages are taken from *Implementation Guidelines for State Planning Policy 5.4 Road and Rail Transport Noise and freight Considerations in Land Use Planning*; December 2014.

Where outdoor noise levels are above the ***target*** level, excluding the effect of any boundary fences, the Guidelines propose acceptable treatment packages that may be implemented without requiring detailed review. The packages are also intended for residential development only. At higher noise levels or for other building usages, specialist acoustic advice will be needed.

The acceptable treatment packages are intended to simplify compliance with the noise criteria, and the relevant package should be required as a condition of development in lieu of a detailed assessment.

Transition between each package should be made on the basis of the highest incident $L_{Aeq(Day)}$ or $L_{Aeq(Night)}$ value to the nearest whole number determined for the building development under assessment.

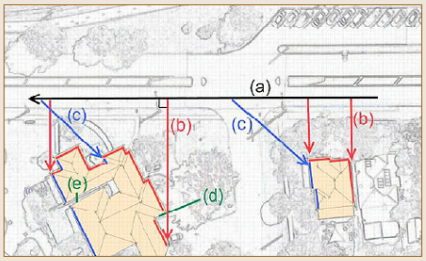
Any departures from the acceptable treatment specifications need to be supported by professional advice from a competent person that the proposal will achieve the requirements of the Policy.

With regards to the packages, the following definitions are provided:

- **Facing** the transport corridor: Any part of a building façade is 'facing' the transport corridor if any straight line drawn perpendicular to its nearest road lane or railway line intersects that part of the façade without obstruction (ignoring any fence).
- **Side-on** to transport corridor: Any part of a building façade that is not 'facing' is 'side-on' to the transport corridor if any straight line can be drawn from it to intersect the nearest road lane or railway line without obstruction (ignoring any fence).
- **Opposite** to transport corridor: Neither 'side on' nor 'facing', as defined above.

Determining building face orientation

The following sketch shows two residences in proximity to a road.



'Facing' façades are identified by drawing straight lines (b) perpendicular (at a 90 degree angle) to the road (a). Where these lines intersect a façade – without obstruction – the façades are shown in red as 'facing' the road.

Façades shown in blue are not 'facing' but have clear lines (c) that intersect the road at any angle, and are therefore classed as 'side on' to the road.

The remaining façades are 'opposite' to the road.

Package A

Area	Orientation to Road or Rail Corridor	Package A (up to 60 dB $L_{Aeq(Day)}$ and 55 dB $L_{Aeq(Night)}$)
Bedrooms	Facing	• Windows systems: Glazing up to 40% of floor area (minimum $R_w + C_{tr}$ 28) – 6mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings.
	Side	• Windows systems: As above.
	Opposite	No requirements
Other Habitable Rooms Including Kitchens	Facing	• Windows and external door systems: Glazing up to 60% of floor area (minimum $R_w + C_{tr}$ 28) – 6mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings. Doors to be either 35mm thick solid timber core door with full perimeter acoustic seals. Glazed inserts to match the above. Sliding glass doors to be same performance including brush seals.
	Side	• Windows and external door systems: As above.
	Opposite	No requirements
General	Any	• Walls (minimum $R_w + C_{tr}$ 45) – Two leaves of 90mm thick brick with minimum 50mm cavity • Roof and ceiling (minimum $R_w + C_{tr}$ 35) – Standard roof construction with 10mm plasterboard ceiling and minimum R2.5 insulation between ceiling joists. • Eaves to be closed using 4mm compressed fibre cement sheet. • Mechanical ventilation – Refer following pages.
Outdoor Living Area		• Locate on the side of the building that is opposite to the corridor if practicable; or • Locate within alcove area so that the house shields it from corridor if practicable.

Note: Any penetrations in a part of the building envelope must be acoustically treated so as to not downgrade the performance of the building elements affected. Most penetrations in external walls such as pipes, cables or ducts can be sealed through caulking gaps with non-hardening mastic or suitable mortar.

Package B

Area	Orientation to Road or Rail Corridor	Package B (up to 63 dB $L_{Aeq(Day)}$ and 58 dB $L_{Aeq(Night)}$)
Bedrooms	Facing	• Windows systems: Glazing up to 40% of floor area (minimum $R_w + C_{tr}$ 31) – 10mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings.
	Side	• Windows systems: As above.
	Opposite	• Windows systems: Glazing up to 40% of floor area (minimum $R_w + C_{tr}$ 25) – 4mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings. Alternatively, 6mm thick glass (monolithic, toughened or laminated) in sliding frame.
Other Habitable Rooms Including Kitchens	Facing	• Windows and external door systems: Glazing up to 60% of floor area (minimum $R_w + C_{tr}$ 31) – 10mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings. Doors to be either 35mm thick solid timber core door with full perimeter acoustic seals. Glazed inserts to match the above. Sliding glass doors to have laboratory certificate confirming $R_w + C_{tr}$ 31 performance. Alternative, change to hinged door with perimeter acoustic seals and 10mm thick glass.
	Side	• Windows and external door systems: Glazing up to 60% of floor area (minimum $R_w + C_{tr}$ 28) – 6mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings. Doors to be either 35mm thick solid timber core door with full perimeter acoustic seals. Glazed inserts to match the above. Glass doors to be same performance ($R_w + C_{tr}$ 28) including brush seals.
	Opposite	No requirements
General	Any	• Walls (minimum $R_w + C_{tr}$ 50) – Two leaves of 90mm thick brick with minimum 50mm cavity. Cavity to include 25mm thick, 24kg/m^3 insulation and where wall ties are required, these are to be anti-vibration/resilient type. • Roof and ceiling (minimum $R_w + C_{tr}$ 35) – Standard roof construction with 10mm plasterboard ceiling and minimum R2.5 insulation between ceiling joists. • Eaves to be closed using 4mm thick compressed fibre cement sheet. • Mechanical ventilation – Refer following pages.
Outdoor Living Area		• Locate on the side of the building that is opposite to the corridor; or • Locate within alcove area so that the house shields it from corridor.

Note: Any penetrations in a part of the building envelope must be acoustically treated so as to not downgrade the performance of the building elements affected. Most penetrations in external walls such as pipes, cables or ducts can be sealed through caulking gaps with non-hardening mastic or suitable mortar.

Mechanical Ventilation requirements

It is noted that natural ventilation must be provided in accordance with F4.6 and F4.7 of Volume One and 3.8.5.2 of Volume Two of the National Construction Code. Where the noise *limit* is likely to be exceeded, a mechanical ventilation system is usually required. Mechanical ventilation systems will need to comply with AS 1668.2 – *The use of mechanical ventilation and air-conditioning in buildings*.

In implementing the acceptable treatment packages, the following must be observed:

- Evaporative air conditioning systems will meet the requirements for Packages A and B provided attenuated air vents are provided in the ceiling space and designed so that windows do not need to be opened.
- Refrigerant based air conditioning systems need to be designed to achieve fresh air ventilation requirements.
- External openings (e.g. air inlets, vents) need to be positioned facing away from the transport corridor where practicable.
- Ductwork needs to be provided with adequate silencing to prevent noise intrusion.

Notification

Notifications on certificates of title and advice to prospective purchasers warning of the potential for noise impacts from major transport corridors help with managing expectations.

The area of land for which notification is required should be identified in the noise management plan and contain a description of major noise sources nearby (e.g. 24-hour freight rail).

Notification should be provided to prospective purchasers, and required as a condition of subdivision (including strata subdivision) for the purposes of noise sensitive development or planning approval involving noise sensitive development, where external noise levels are forecast or estimated to exceed the 'target' criteria as defined by the Policy.

In the case of subdivision and development, conditions of approval should include a requirement for registration of a notice on title, which is provided for under Section 165 of the Planning and Development Act 2005 and Section 70A of the Transfer of Land Act 1893. An example of a suitable notice is:

Notice: This lot is situated in the vicinity of a transport corridor and is currently affected, or may in the future be affected, by transport noise. Transportation noise controls and Quiet House design strategies at potential cost to the owner may be required to achieve an acceptable level of noise reduction. Further information is available on request from the relevant local government offices.

Appendix B

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)
The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting
An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

L_1
An L_1 level is the noise level which is exceeded for 1 per cent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{10}
An L_{10} level is the noise level which is exceeded for 10 per cent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{90}
An L_{90} level is the noise level which is exceeded for 90 per cent of the measurement period and is considered to represent the "*background*" noise level.

L_{eq}
The L_{eq} level represents the average noise energy during a measurement period.

$L_{A10,18hour}$
The $L_{A10,18\ hour}$ level is the arithmetic average of the hourly L_{A10} levels between 6.00 am and midnight. The *CoRTN* algorithms were developed to calculate this parameter.

$L_{Aeq,24hour}$
The $L_{Aeq,24\ hour}$ level is the logarithmic average of the hourly L_{Aeq} levels for a full day (from midnight to midnight).

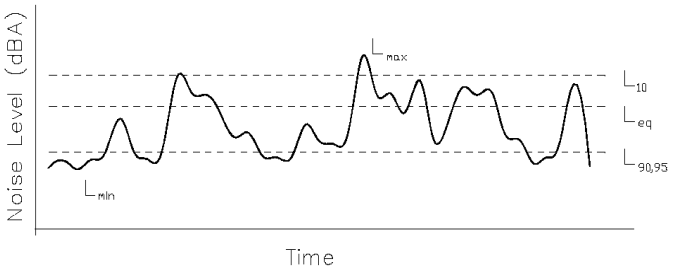
$L_{Aeq,8hour}$ / $L_{Aeq\ (Night)}$
The $L_{Aeq\ (Night)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 10.00 pm to 6.00 am on the same day.

$L_{Aeq,16hour}$ / $L_{Aeq\ (Day)}$
The $L_{Aeq\ (Day)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 6.00 am to 10.00 pm on the same day. This value is typically 1-3 dB less than the $L_{A10,18hour}$.

Satisfactory Design Sound Level
The level of noise that has been found to be acceptable by most people for the environment in question and also to be not intrusive.

Maximum Design Sound Level
The level of noise above which most people occupying the space start to become dissatisfied with the level of noise.

Chart of Noise Level Descriptors



Austroads Vehicle Class

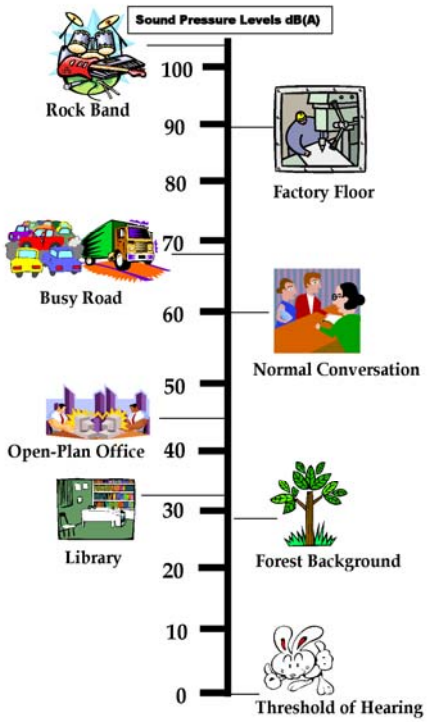
AUSTROADS Vehicle Classification System

Level 1 Length (indicative) Type	Level 2 Axles and Axle Groups Axles	Groups	Level 3 Vehicle Type Typical Description	AUSTROADS Classification Class	Parameters	Typical Configuration
			LIGHT VEHICLES			
Short up to 5.5m		1 or 2	**Short** Sedan, Wagon, 4WD, Utility, Light Van, Bicycle, Motorcycle, etc	1	d(1) ≤ 3.2m and axles = 2	
	3, 4 or 5	3	**Short - Towing** Trailer, Caravan, Boat, etc	2	groups = 3 d(1) ≥ 2.1m, d(1) ≤ 3.2m, d(2) ≥ 2.1m and axles = 3, 4 or 5	
			HEAVY VEHICLES			
Medium 5.5m to 14.5m	2	2	**Two Axle Truck or Bus**	3	d(1) > 3.2m and axles = 2	
	3	2	**Three Axle Truck or Bus**	4	axles = 3 and groups = 2	
	> 3	2	**Four Axle Truck**	5	axles > 3 and groups = 2	
Long 11.5m to 19.0m	3	3	**Three Axle Articulated** Three axle articulated vehicle, or Rigid vehicle and trailer	6	d(1) > 3.2m, axles = 3 and groups = 3	
	4	> 2	**Four Axle Articulated** Four axle articulated vehicle, or Rigid vehicle and trailer	7	d(2) < 2.1m or d(1) < 2.1m or d(1) > 3.2m axles = 4 and groups > 2	
	5	> 2	**Five Axle Articulated** Five axle articulated vehicle, or Rigid vehicle and trailer	8	d(2) < 2.1m or d(1) < 2.1m or d(1) > 3.2m axles = 5 and groups > 2	
	≥ 6	> 2	**Six Axle Articulated** Six axle articulated vehicle, or Rigid vehicle and trailer	9	axles = 6 and groups > 2 or axles > 6 and groups = 3	
Medium Combination 17.5m to 36.5m	> 6	4	**B Double** B Double, or Heavy truck and trailer	10	groups = 4 and axles > 6	
	> 6	5 or 6	**Double Road Train** Double road train, or Medium articulated vehicle and one dog trailer (M.A.D.)	11	groups = 5 or 6 and axles > 6	
Large Combination Over 33.0m	> 6	> 6	**Triple Road Train** Triple road train, or Heavy truck and three trailers	12	groups > 6 and axles > 6	

Definitions: Group: Axle group, where adjacent axles are less than 2.1m apart; Groups: Number of axle groups; Axles: Number of axles (maximum axle spacing of 10.0m)

d(1): Distance between first and second axle
d(2): Distance between second and third axle

Typical Noise Levels



Appendix 8
Landscape Concept Plan



KEY PLAN NTS

LEGEND

1. Structure Plan Boundary
2. Proposed Residential Lots
3. Proposed Grouped Housing
4. Potential Continuation of Acoustic Wall
5. Proposed P.O.S.
6. Proposed main feature footpath within P.O.S. from Hammond Rd up to GHS
7. Proposed grey concrete footpath
8. Proposed P.O.S. node with picnic setting
9. Proposed feature tree and logs in mulched area
10. 2no existing trees to retain
11. Proposed garden bed
12. Proposed road reserved: street trees on verges
13. Proposed kickabout area

0 50m

REV	DATE	DWN	APRV	DESCRIPTION
B	8/01/2019	GM	EP	AMENDMENTS. FOR APPROVAL
A	9/12/2018	GM	EP	ISSUED FOR APPROVAL

LOT 176 (119) HAMMOND RD

LANDSCAPE CONCEPT PLAN

LD TOTAL LEADERS IN LANDSCAPING

PLANNING SOLUTIONS CLIENT | 10.1648 PROJECT NO | A REVISION | 19.12.18 DATE | 1 OF 2 PAGE

LD TOTAL DESIGN + CONSTRUCT

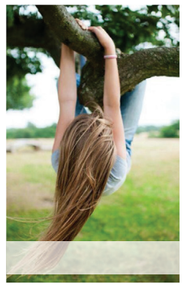


















PRECEDENT IMAGES

DESIGN OBJECTIVES

- Subject site is within a designated bushfire prone area

- Clearing of native vegetation is involved prior to development; site relatively flat;

- 2no existing trees to retain - *Eucalyptus robusta*

- Possibly irrigated water-wise native planting with feature trees and turfed areas is proposed

- Focus on low-fuel planting selection and potential black cockatoo foraging species

- Internal meandering pathway incorporating surrounding path network

- Minimal asset distribution: picnic setting and seating logs

- Reuse dead wood trimmed from the site;

- No drainage design function within P.O.S. area

Note:

P.O.S. design subject to water allocation, detailed design, budget allocation and approval with City of Cockburn.

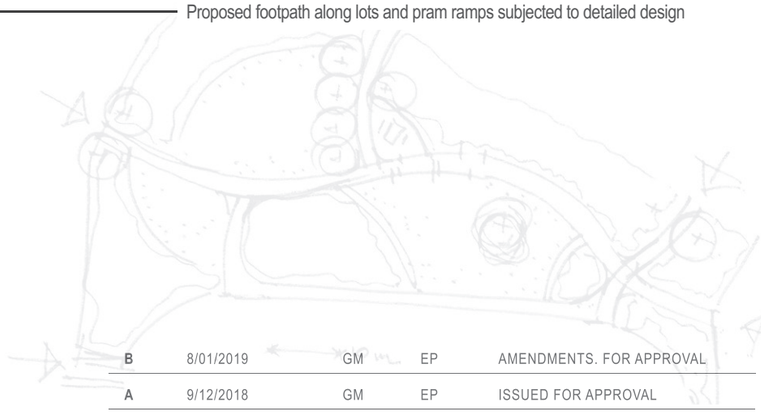




KEY PLAN NTS

LEGEND

- Existings balustrade
- Existing shared path
- Structure Plan Boundary
- Proposed grey concrete internal P.O.S footpaths (2m wide)
- Proposed feature trees in grassed area
- 2no. *Eucalyptus robusta* to retain
- Proposed turfed area (kikuyu)
- Proposed main node with picnic setting
- Proposed main meandering feature footpath: coloured or salt finished concrete (2m wide)
- Reuse dead wood trimmed from the site as sleeper inserts in footpath
- Proposed feature mature tree / deciduous soliter
- Proposed mulched area under the tree with timber logs as seatings
  (reuse dead wood trimmed from the site)
- Proposed garden bed with trees and native selection of low and medium
- Potential continuation of Acoutic Wall
- Proposed timber bollards
- Possible connection to Grouped Housing
- 6m wide accesss road (13m wide road reserved)
- Proposed medium street trees to verges
- Proposed footpath along lots and pram ramps subjected to detailed design



REV	DATE	DWN	APRV	DESCRIPTION
B	8/01/2019	GM	EP	AMENDMENTS. FOR APPROVAL
A	9/12/2018	GM	EP	ISSUED FOR APPROVAL

LOT 176 (119) HAMMOND RD

LANDSCAPE CONCEPT PLAN

LD TOTAL LEADERS IN LANDSCAPING

PLANNING SOLUTIONS — CLIENT

10.1648 — PROJECT NO

A — REVISION

19.12.18 — DATE

2 OF 2 — PAGE

LD TOTAL DESIGN + CONSTRUCT

Appendix 9
Servicing Report

Porter
Consulting Engineers

SERVICING REPORT

Lot 176 Hammond Road, Success

Porter

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Report Prepared By:

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Job No: 18-06-070
Date: 27 June 2018
Our Ref: R034.18
Rev: A
Checked:



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APPENDIX 1 – Existing Services
APPENDIX 2 – Plan of Subdivision

1.0 INTRODUCTION

Porter Consulting Engineers has been commissioned by Dorothy Guerini to undertake a servicing investigation for the proposed development of Lot 176 Hammond Road, Success. The site is located at the south-eastern corner of Beeliar Drive and Hammond Road. Please refer to **Figure 1** for the site location details.



Figure 1

2.0 EXISTING SITE

The Site is approximately 2.12 hectares and is surrounded by Beeliar Drive to the north, Hammond Road to the west and existing residential development to the south. The site varies in elevation from RL 25m in the south west grading up to RL 28.5m in the north east.

The site has an existing homestead with direct access to Hammond Road. The proposed development will include the demolition and removal of all existing buildings and crossover to Hammond Road.

The site also has informal access to Delaronde Drive to the south which will be formalized as part of the development.

Based on a desktop review of the Perth Ground Water Atlas (Water and Rivers Commission 1997), we estimate the maximum ground water level to be within 3m of the natural surface. The Department of Mines and Petroleum Geological Series Mapping indicates the site comprises of a thin layer of topsoil overlying Bassendean Sands.

The site classification and depth to groundwater will be confirmed in the Pre-Construction Geotechnical Report. It is expected a class A site will be achieved.

3.0 EXISTING SERVICES

A copy of the existing services surrounding the Site is included in **Appendix 1.** Further description of various services is noted below.

3.1 Water Reticulation

Both Delaronde Drive and Langano Chase contain existing 100P water reticulation mains. The existing house is serviced from by an existing 150S main within Hammond Road.

3.2 Sewer Reticulation

The existing development to the south contains sewer reticulation. The Water Corporation planning shows this site connects into the existing network to the south.

3.3 Power

The existing development to the south contains underground power infrastructure. The existing house is serviced from the overhead power line network within Hammond Road.

3.4 Telecommunications

The existing road networks to the south and Hammond Road contain NBN infrastructure. Hammond Road also contains Telstra infrastructure. The existing house is serviced from Hammond Road.

3.5 Gas

The existing residential development to the south and Hammond Road both contain ATCO gas infrastructure.

3.6 Drainage

The existing development to the south contains drainage infrastructure as typically expected for a residential development. It is unclear if the development to the south has made any allowances for drainage from your Site. This will be investigated and confirmed in the Drainage Strategy.

4.0 DEVELOPMENT SERVICING

The plan of subdivision is included in **Appendix 2**. The development contains a simple road network supporting 31 residential lots.

4.1 Siteworks and Earthworks

The existing house and outbuildings will be demolished and all vegetation cleared. Top soil across the site will be stripped and either blended with fill material or disposed offsite depending on the findings of the Geotechnical Report. Minor cut and fill may be required depending to shape the site. It is expected a Class A site will be achieved.

Minor retaining walls may be required to account for level differences between lots.

4.2 Water Reticulation

Direct connections to the existing water mains to the south will be made to service the site.

Standard water reticulation mains and pre-laid taps will be required to service each of the proposed lots.

4.3 Sewer Reticulation

The Site will be serviced off the existing sewer reticulation mains to the south. Standard reticulation infrastructure will be required to service each of the proposed lots.

4.4 Power

Western Power mapping indicates the area has spare capacity in the order of 5MVA (2019). This is sufficient to service a residential development of this size.

High voltage infrastructure, including transformers and switchgears, may be required to service the site with low voltage servicing each lot. It is anticipated direct connections to the adjoining existing infrastructure can be made.

4.5 Telecommunications

The site will be serviced via direct connections to the existing NBN infrastructure to the south.

4.6 Gas

The existing gas network to the south will be extended north into the Site to service all lots.

4.7 Drainage

Typical drainage infrastructure will be required to service this development. This includes a pit and pipe network to accommodate runoff from the road reserve. Lot runoff will be held and disposed of onsite.

A subsoil drainage network is not expected.

A Drainage Strategy is being prepared. This will confirm he specific drainage requirements for the Site.

4.8 Roads and Paths

A standard road and path network will be established along the proposed road reserves. Intersection treatments may be detailed at the connections to Delaronde Drive. Access or intersections off Beeliar Drive or Hammond Road will not be provided.

A Traffic Impact Statement (TIS) is being prepared, refer to the TIS for further details.

5.0 CONCLUSIONS

The expected ground conditions confirm the site is suitable for development. Earthworks and retaining will be required as typically expected for a development of this nature.

Water and sewer reticulation can be extended off the existing networks to service the Site.

Western Power mapping confirms their network has sufficient capacity to service the Site. The site will have low voltage infrastructure to service the proposed lots. A high voltage network may be required pending detailed design.

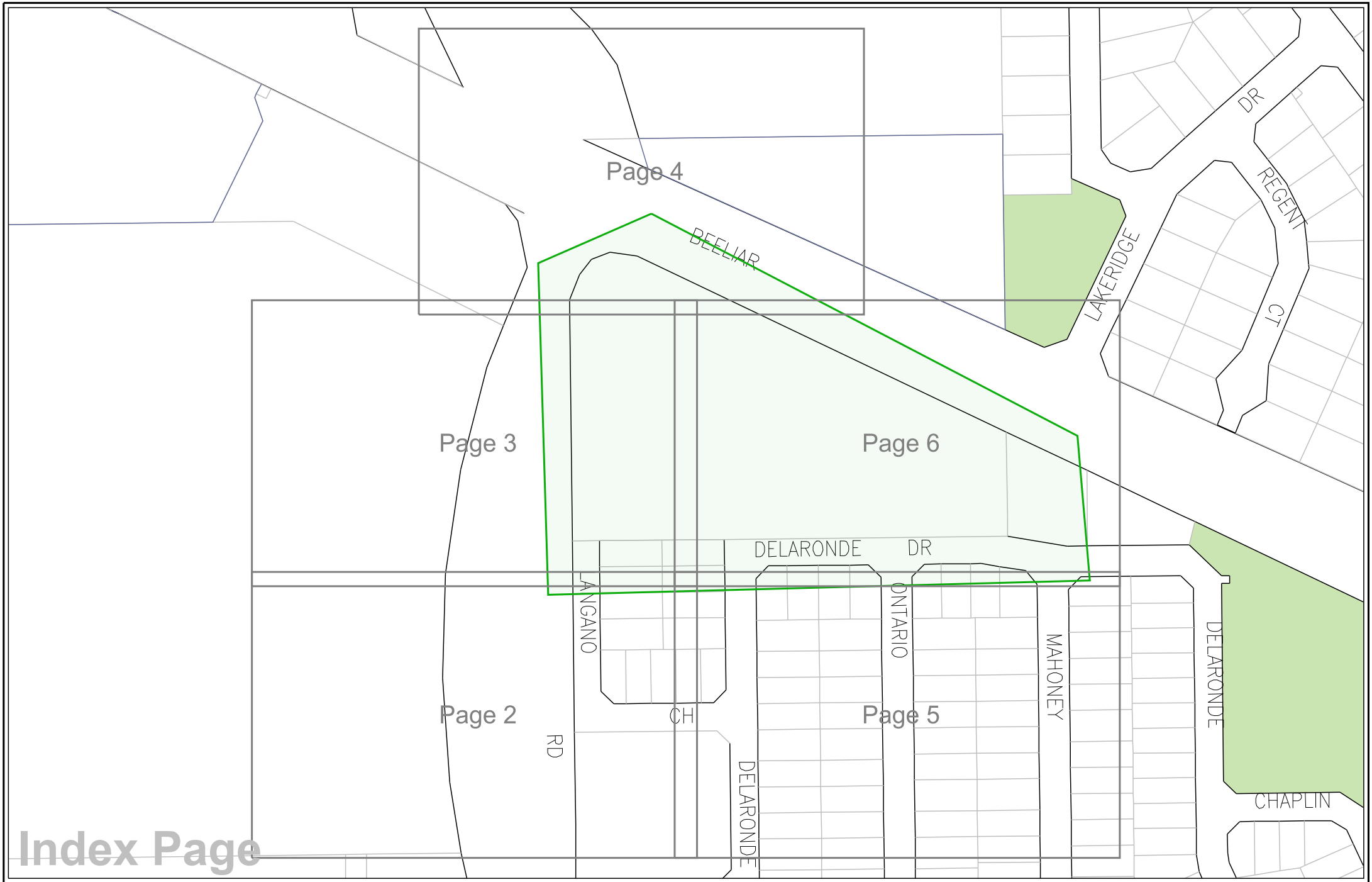
It is expected the existing gas and telecommunications network can be extended to service the site.

Road, path and drainage networks will be constructed as typically expected for development of this nature.

All of the servicing information received confirms there are no servicing constraints on the Site.

APPENDIX 1

Existing Services



WATER CORPORATION

Scale: 1:2284

Sequence No: 72300532

Print Date: 08/06/2018 Page: 1 of 6

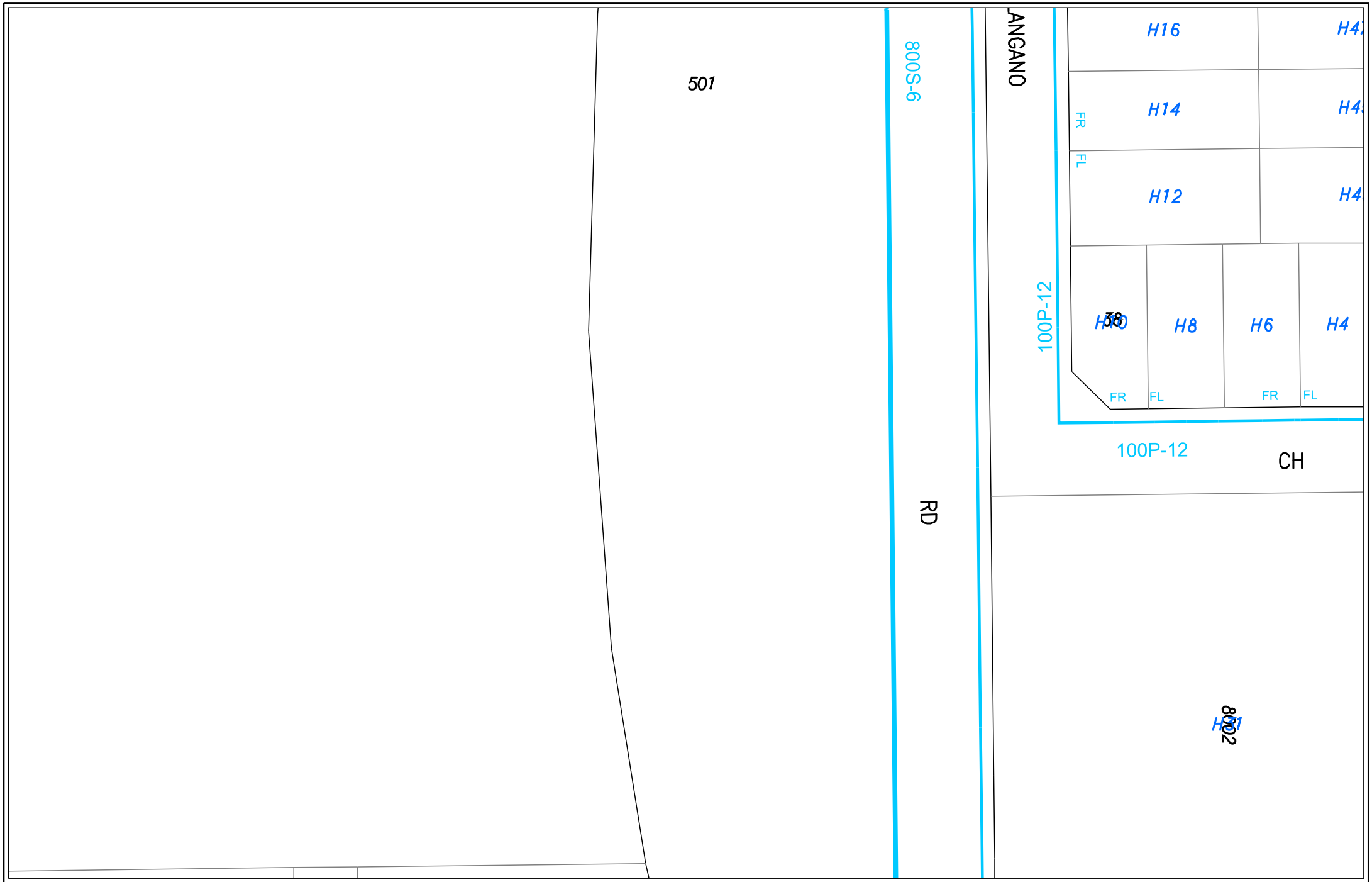
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Water

WARNING - CRITICAL PIPELINE

Refer to *Information Brochure Damage Prevention* and *Legend* for details

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Scale: 1:750 Centre Point: 115.842°, -32.129°

Sequence No: 72300532

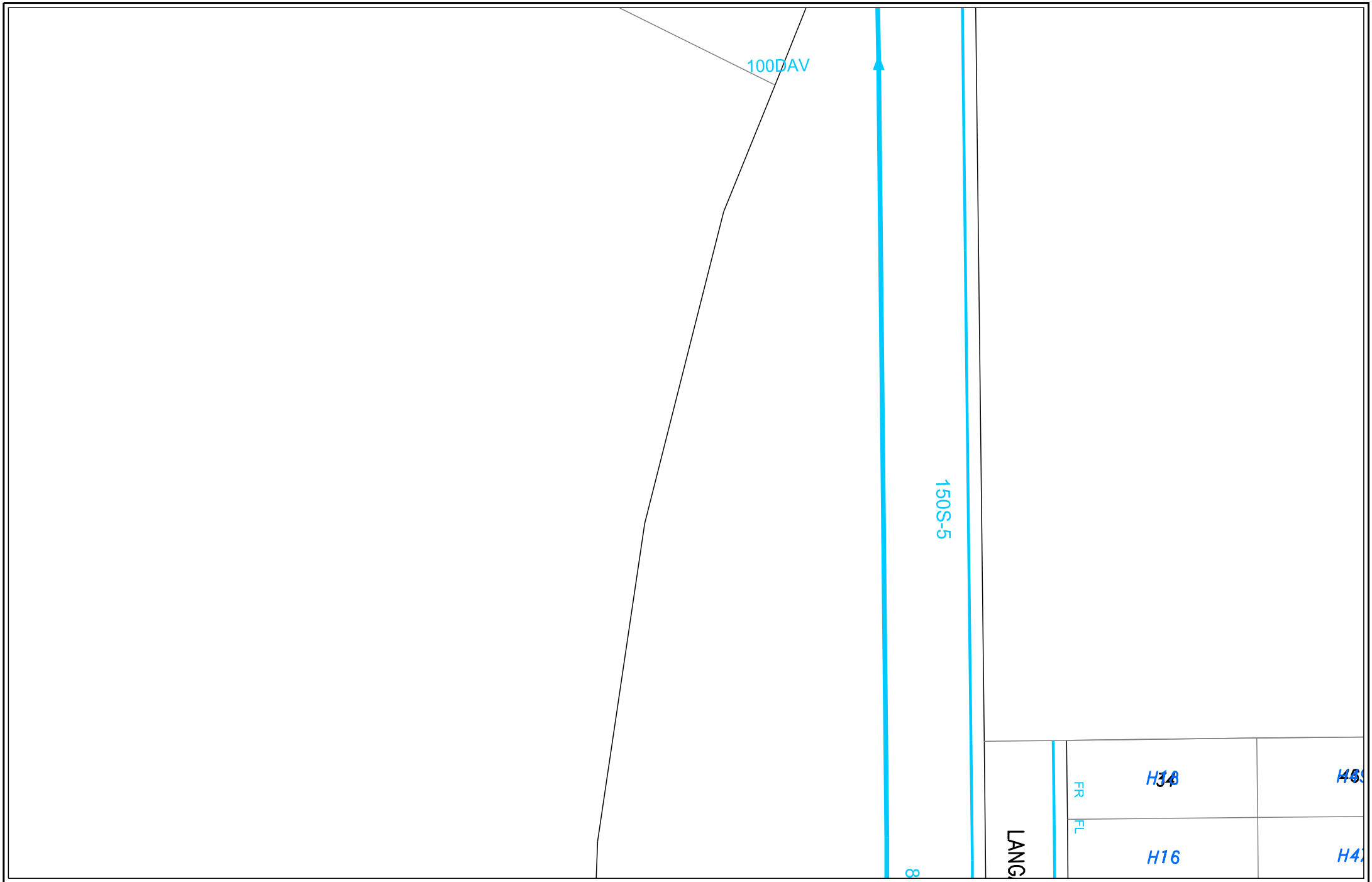
Print Date: 08/06/2018 Page: 2 of 6

Water

WARNING - CRITICAL PIPELINE

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WATER CORPORATION

Scale: 1:750 Centre Point: 115.842°, -32.128°

Sequence No: 72300532

Print Date: 08/06/2018 Page: 3 of 6

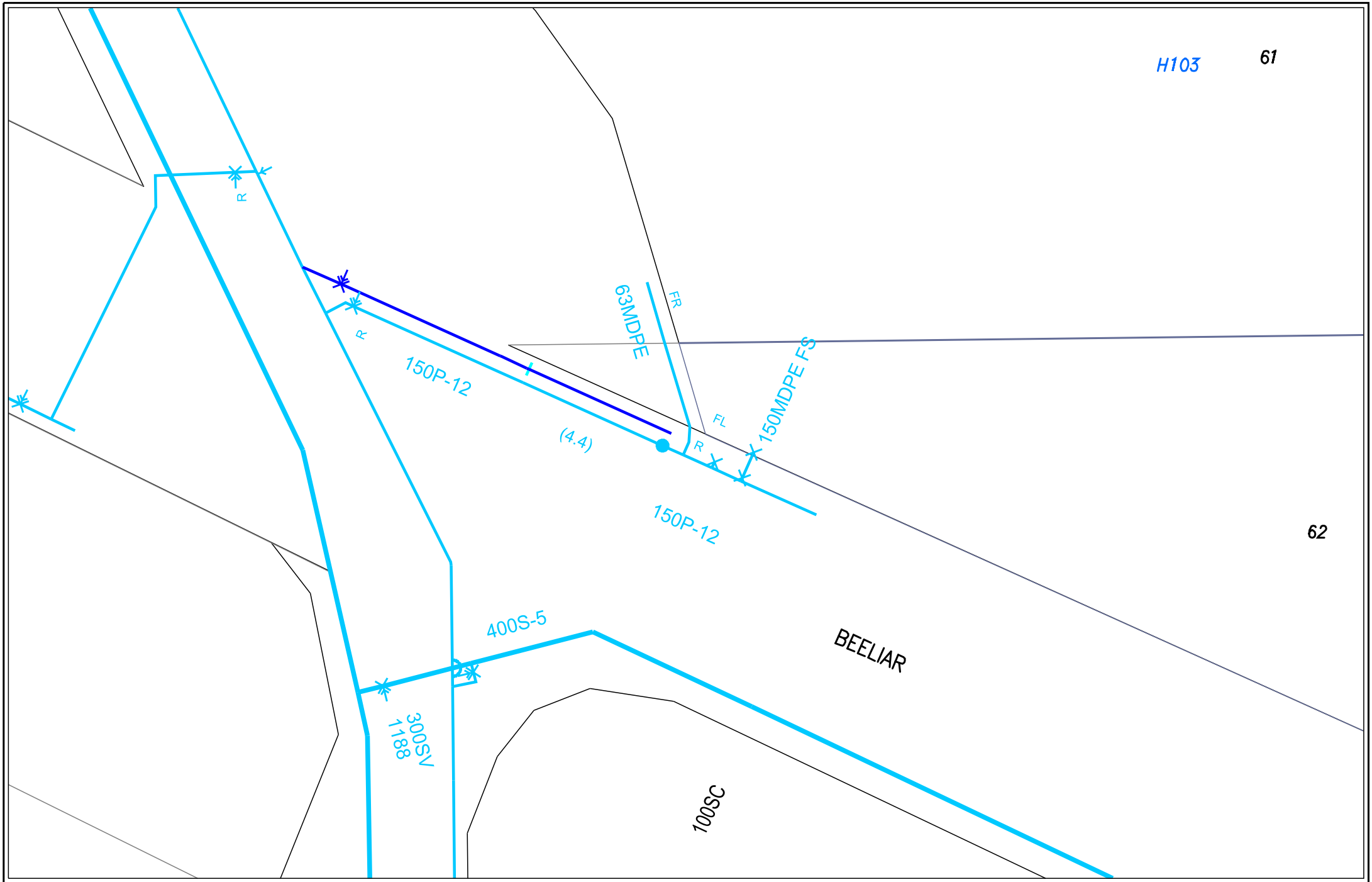
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Water

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WATER CORPORATION

Scale: 1:750 Centre Point: 115.843°, -32.127°

Sequence No: 72300532

Print Date: 08/06/2018 Page: 4 of 6

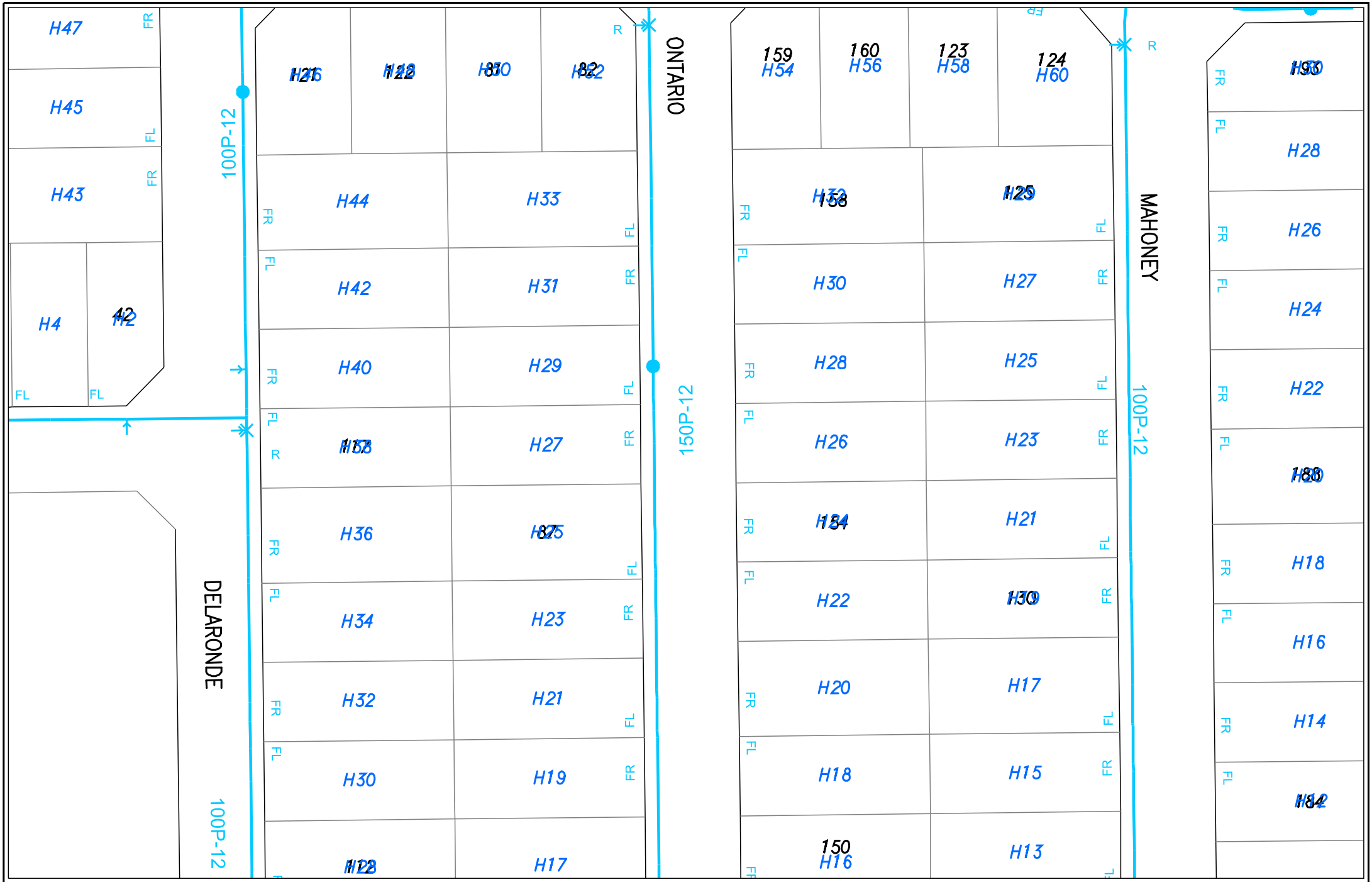
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Water

WARNING - CRITICAL PIPELINE

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WATER CORPORATION

Scale: 1:750 Centre Point: 115.844°, -32.129°

Sequence No: 72300532

Print Date: 08/06/2018 Page: 5 of 6

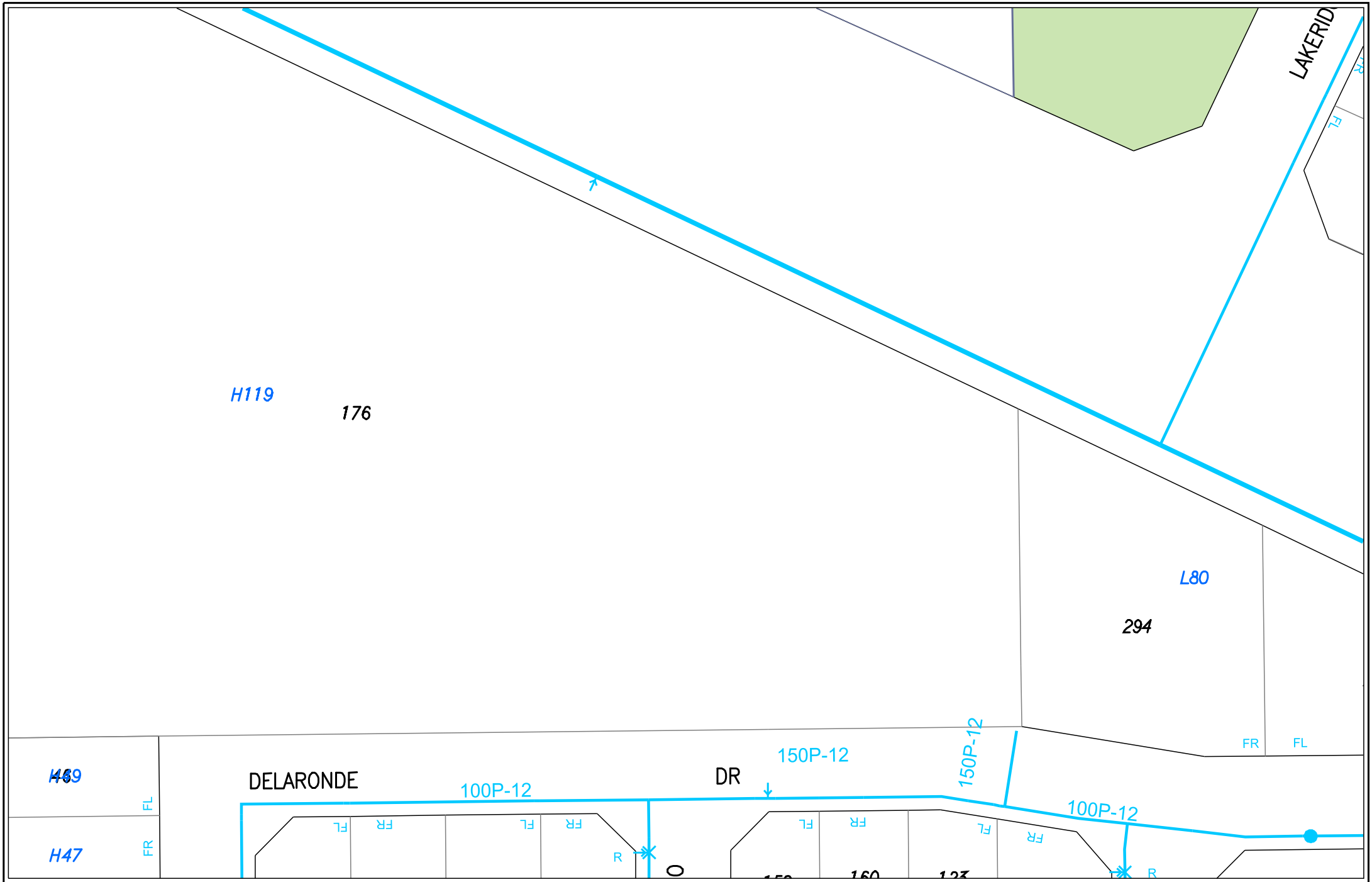
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Water

WARNING - CRITICAL PIPELINE

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WATER CORPORATION

Scale: 1:750 Centre Point: 115.844°, -32.128°

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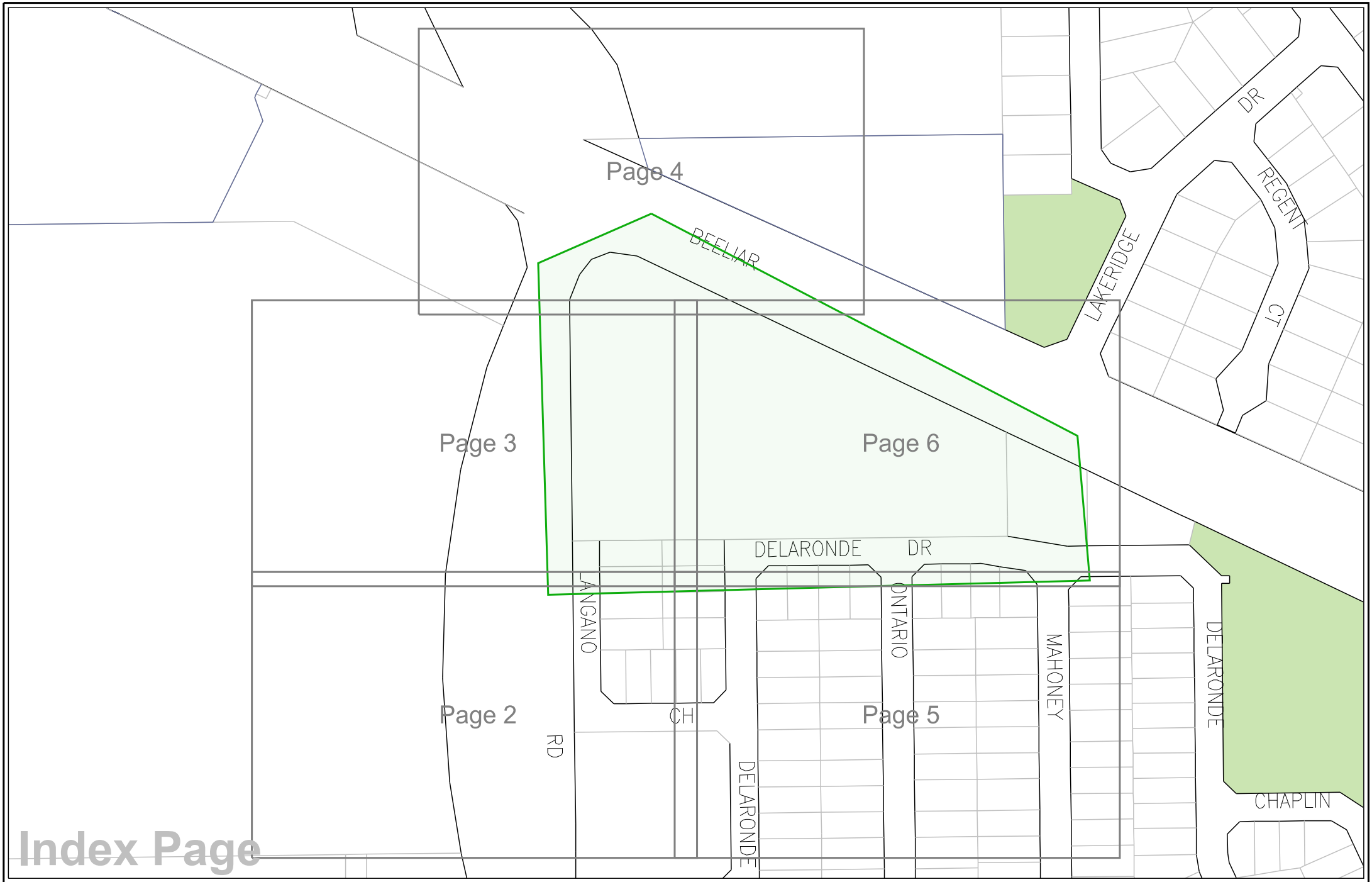
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Water

WARNING - CRITICAL PIPELINE

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WATER CORPORATION

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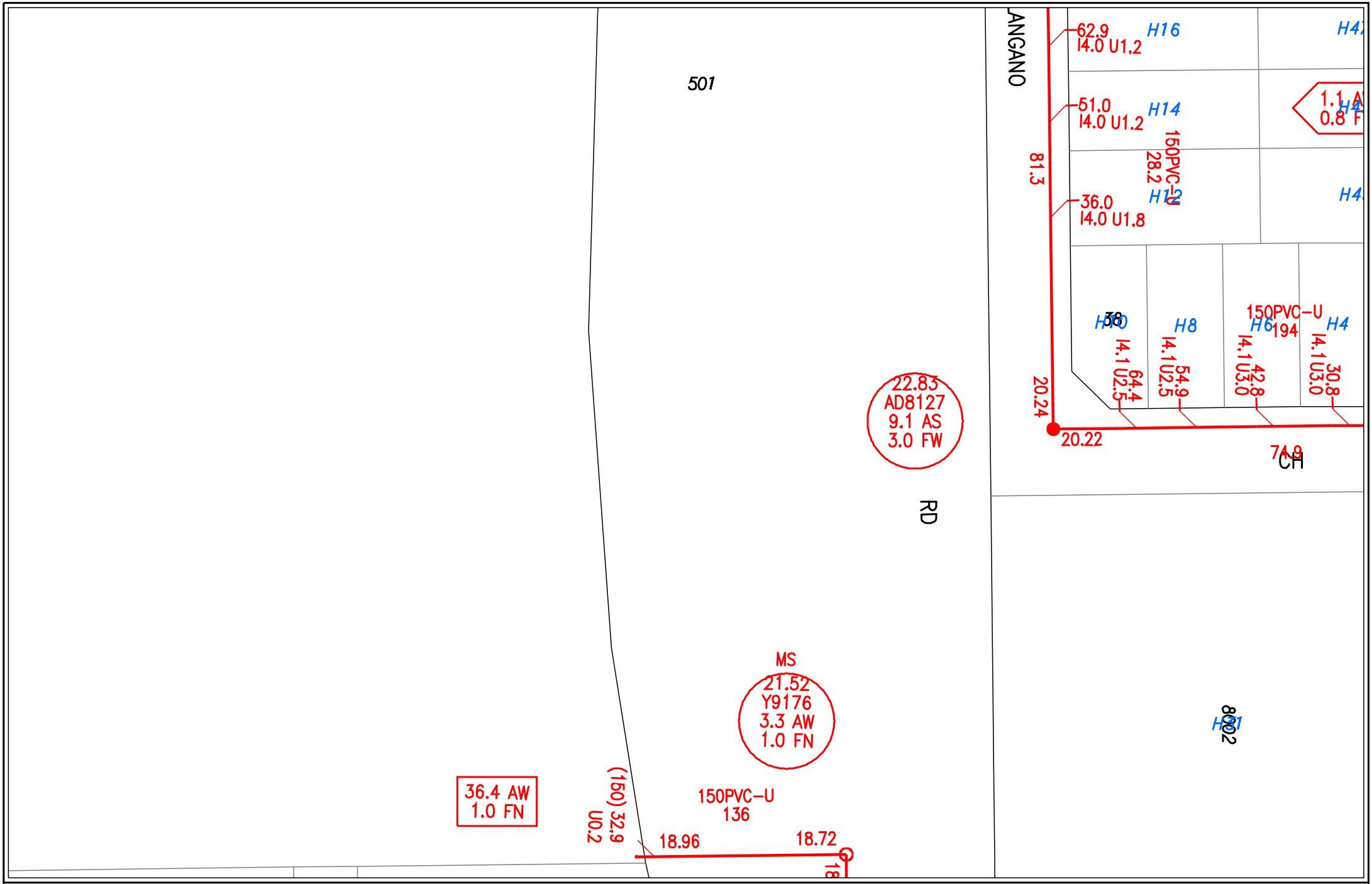
Sequence No: 72300532

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Sewer

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WATER CORPORATION

Scale: 1:750 Centre Point: 115.842°, -32.129°

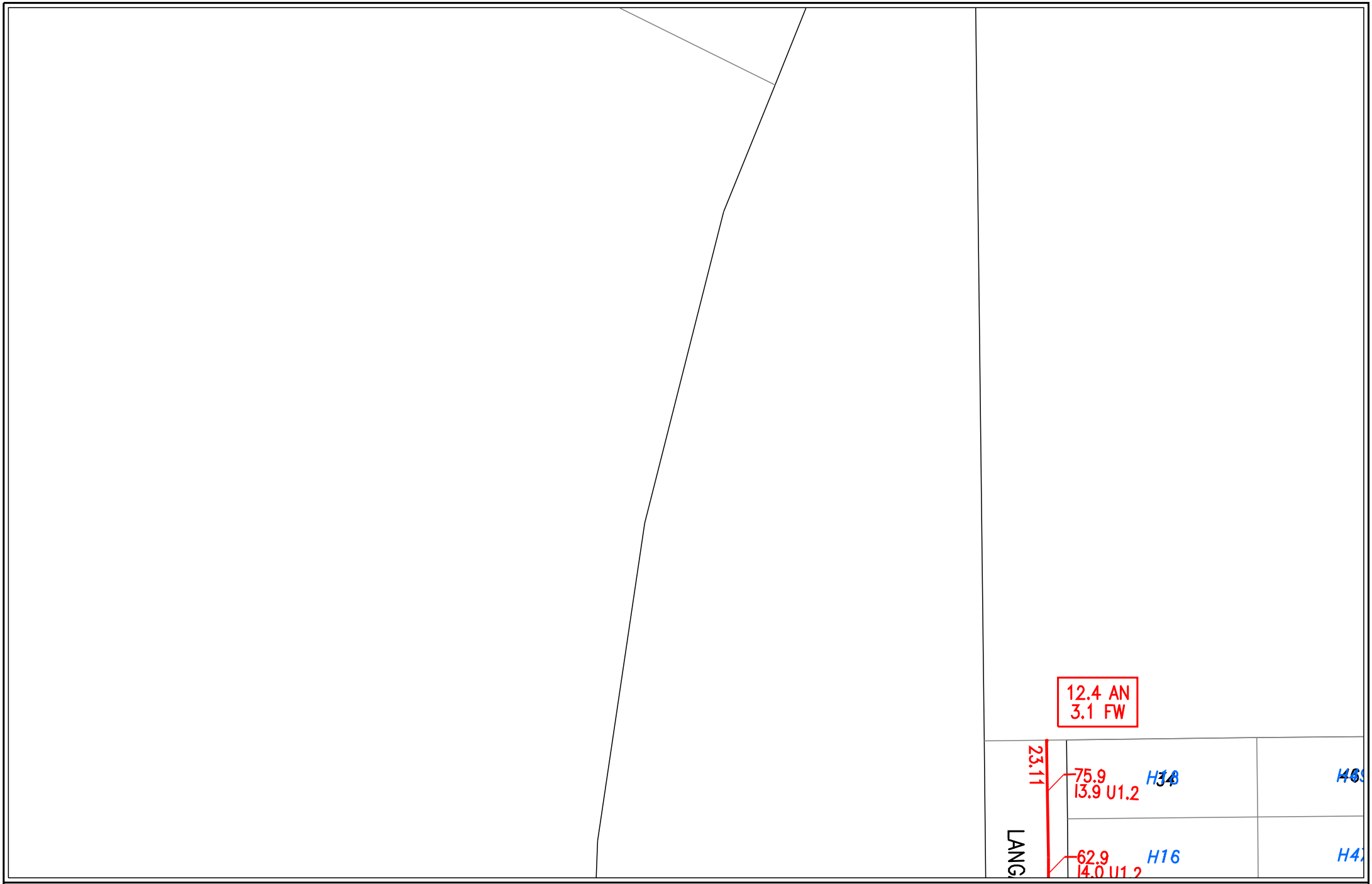
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N

Sewer

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WATER CORPORATION

Scale: 1:750 Centre Point: 115.842°, -32.128°

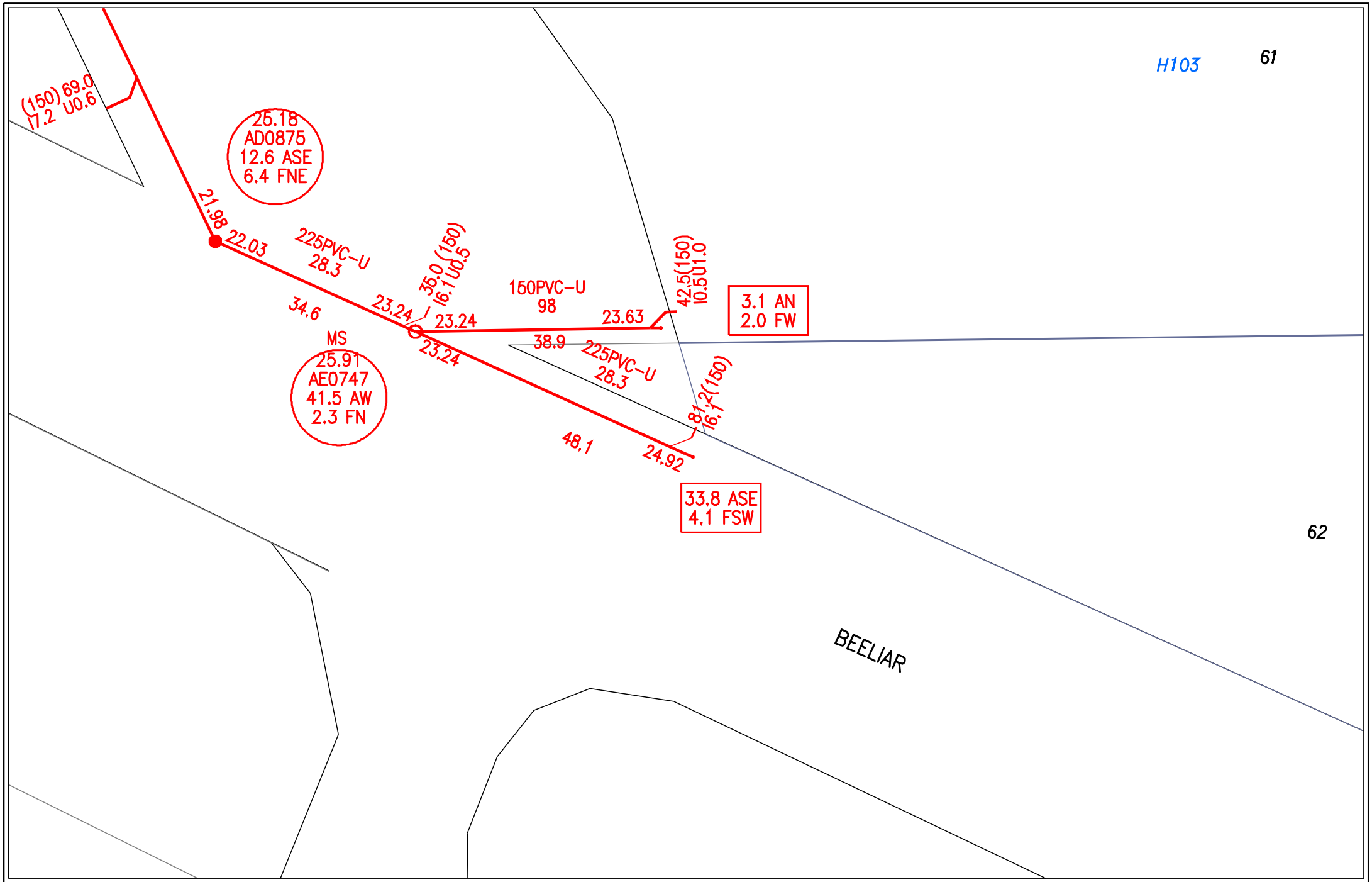
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Sewer

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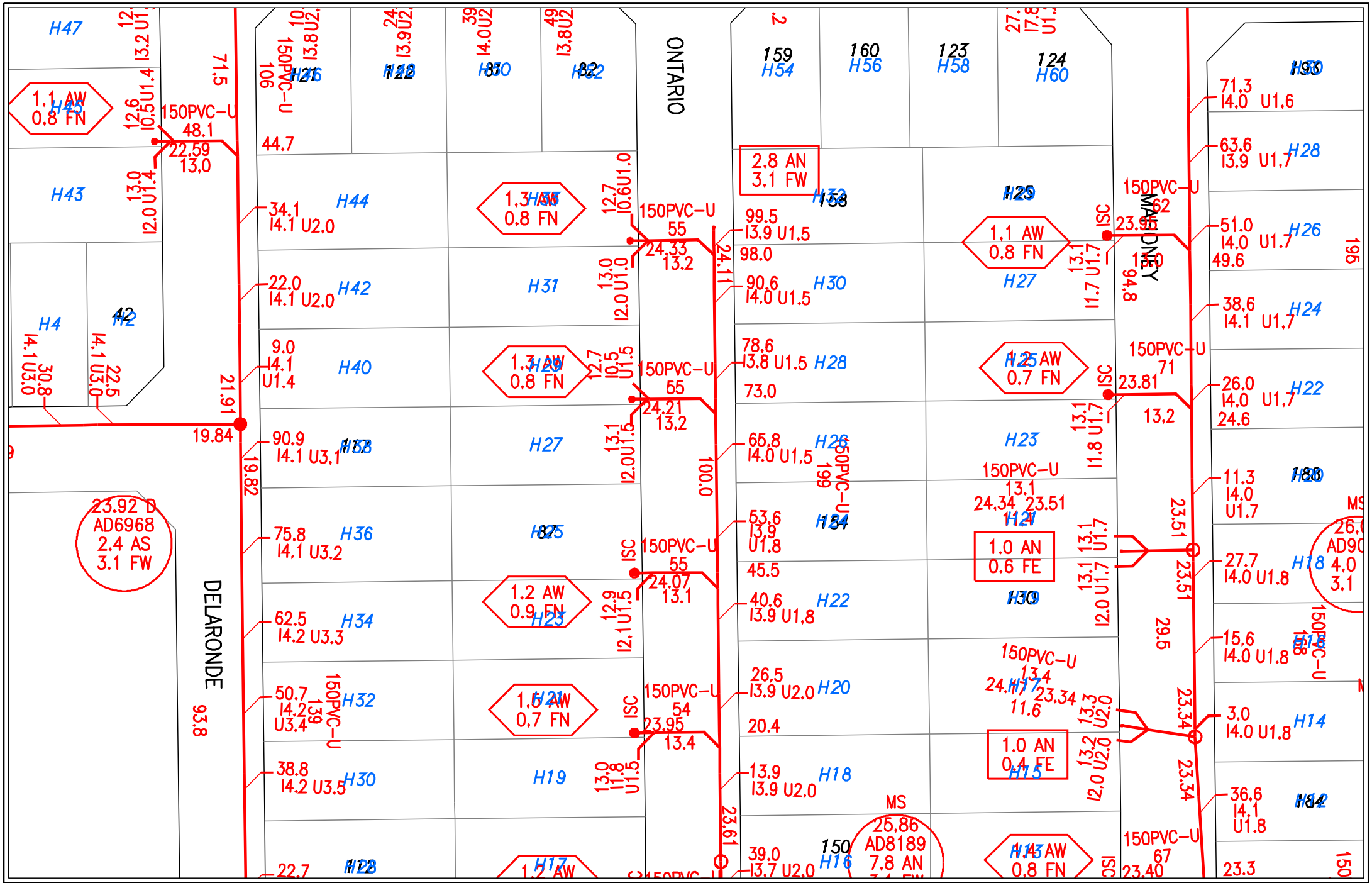
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WATER CORPORATION

Scale: 1:750 Centre Point: 115.844°, -32.129°

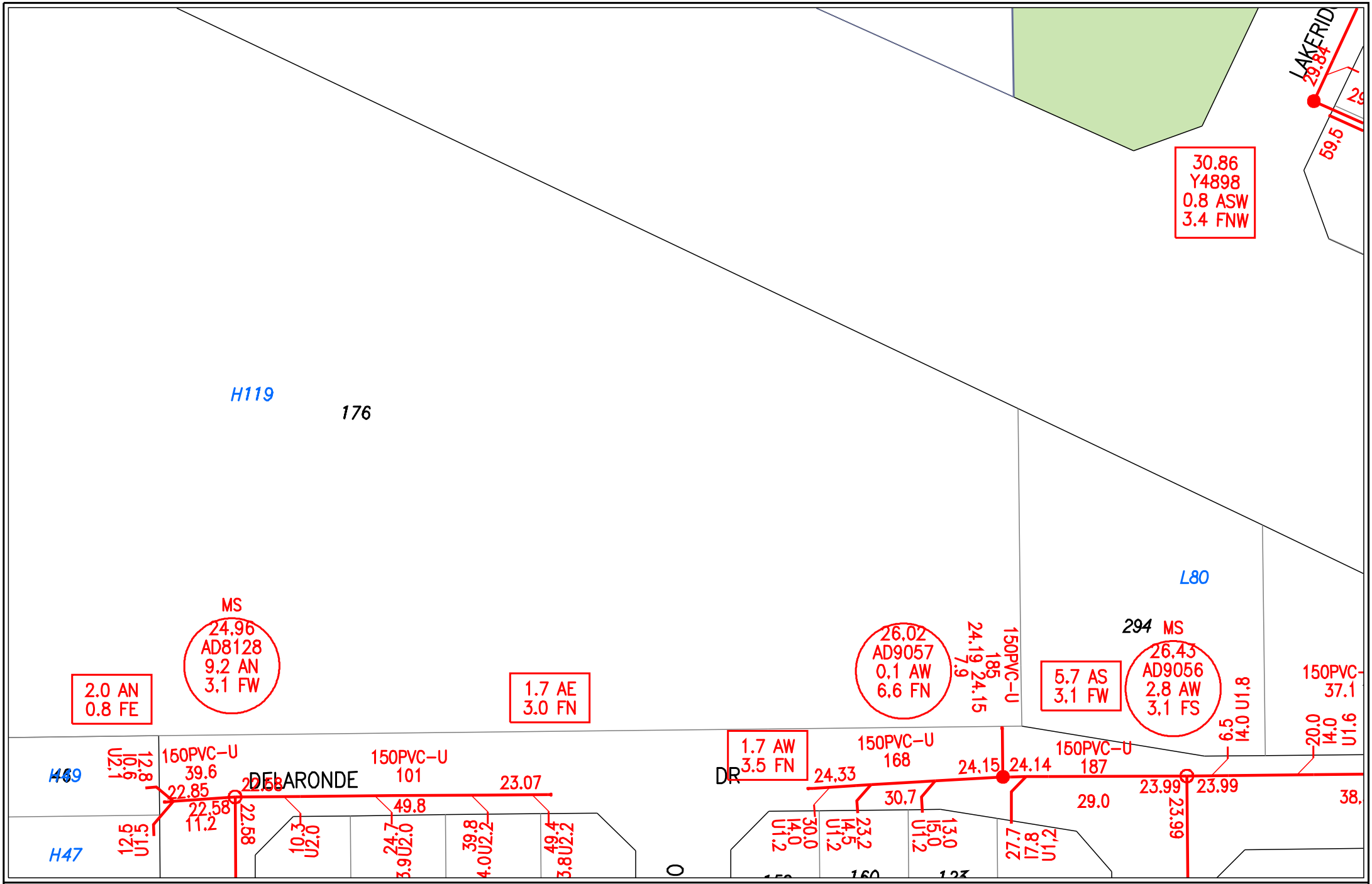
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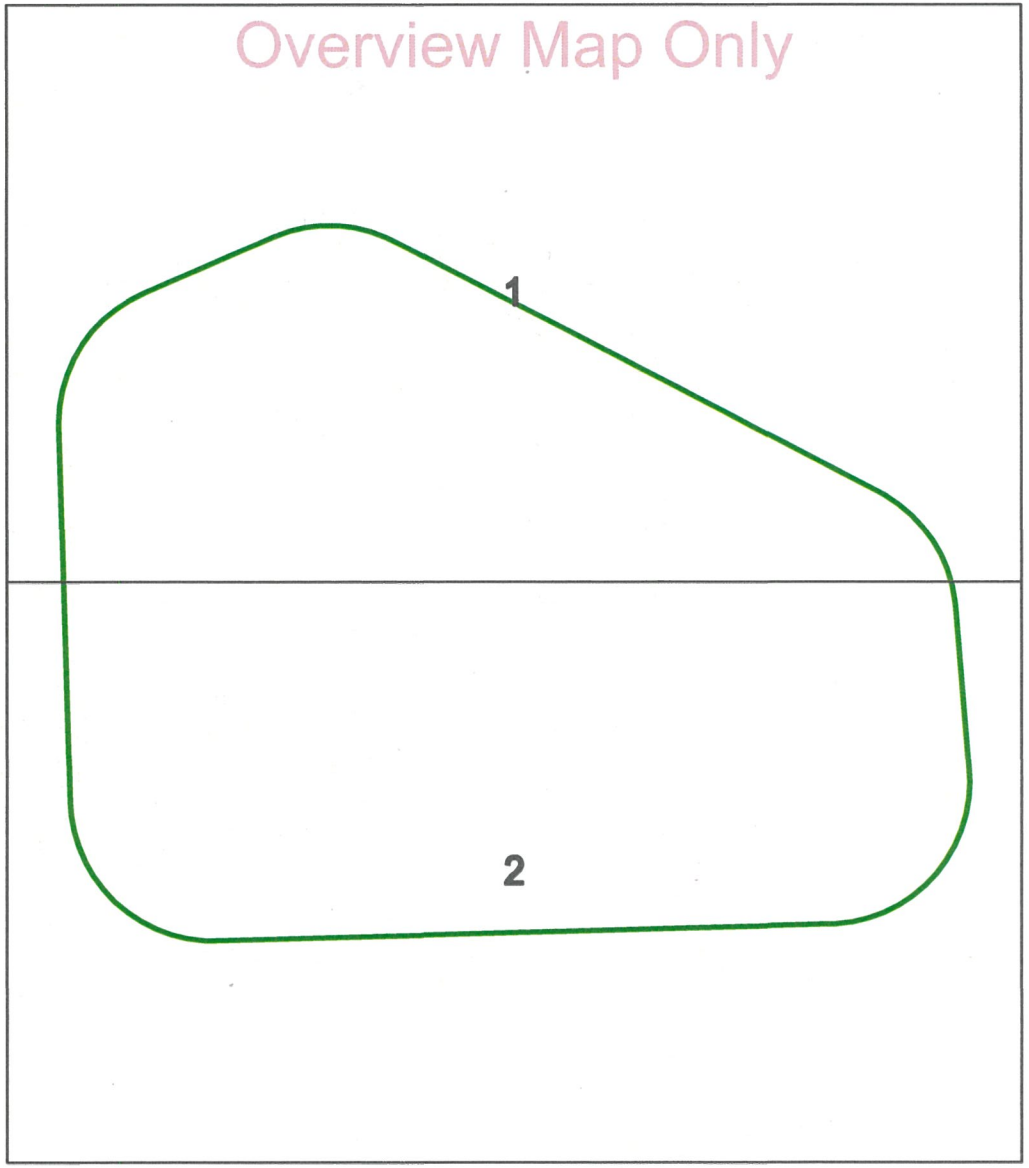
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Sewer

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Overview Map Only



Sequence No: 72300530 Map Tile: Scale: 1:3075

Job No: 14366882 Date:8/06/2018 Location: Hammond Road, Success 6164

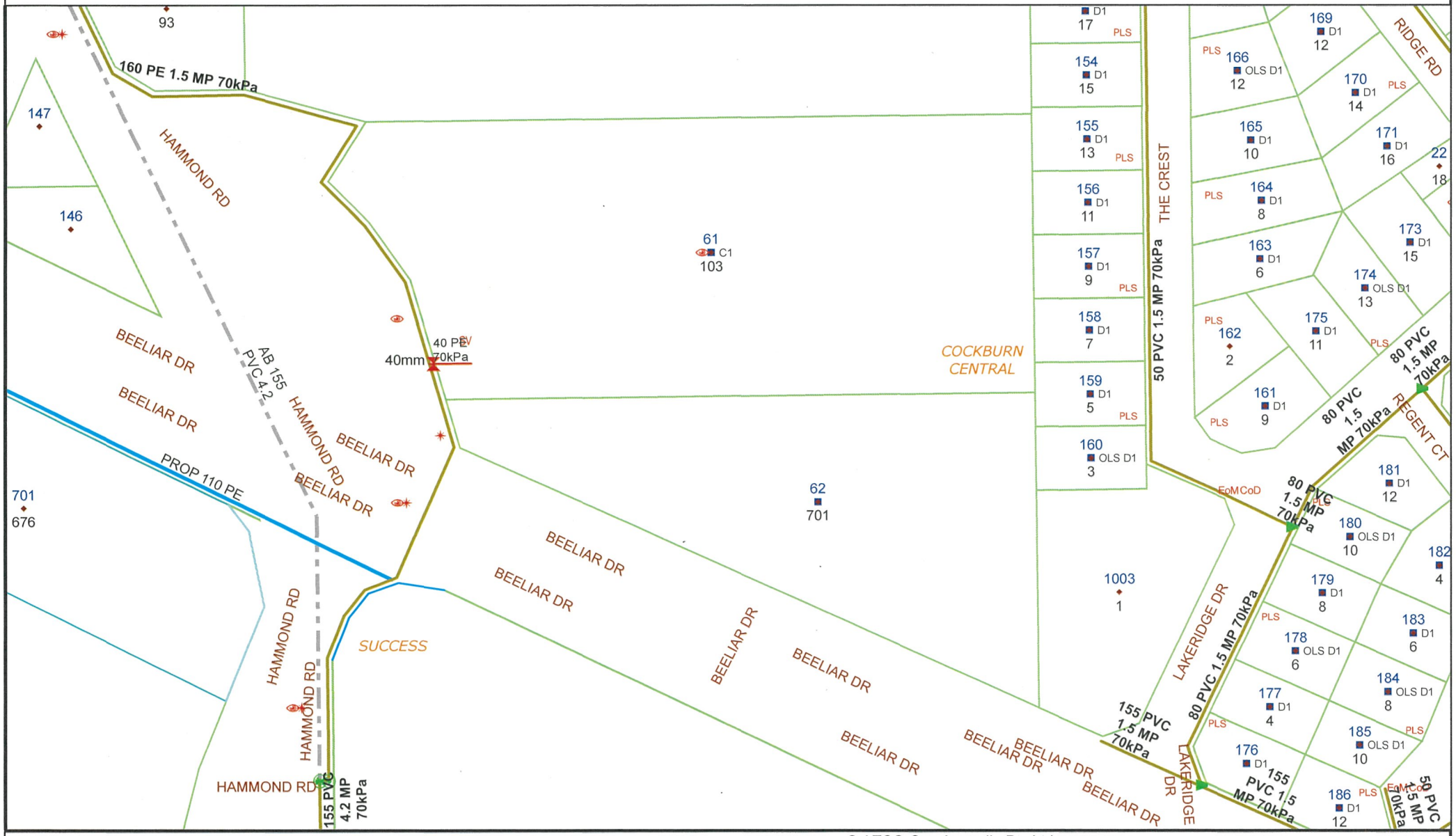
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ATCO Gas AUSTRALIA

Please read all **warnings**, conditions and information on the attached "Underground Asset Details" information sheet. This plan is issued subject to that information and those conditions and **warnings** (including, but not limited to, the "NO HOT WORKS" warning). Plans are current for only **30 days** from date of request, indicative only and not warranted to be accurate. It is your responsibility to carefully locate underground assets and follow safe work practises and procedures (eg pot-holing). ATCO Gas Australia will seek compensation for damage caused to assets.

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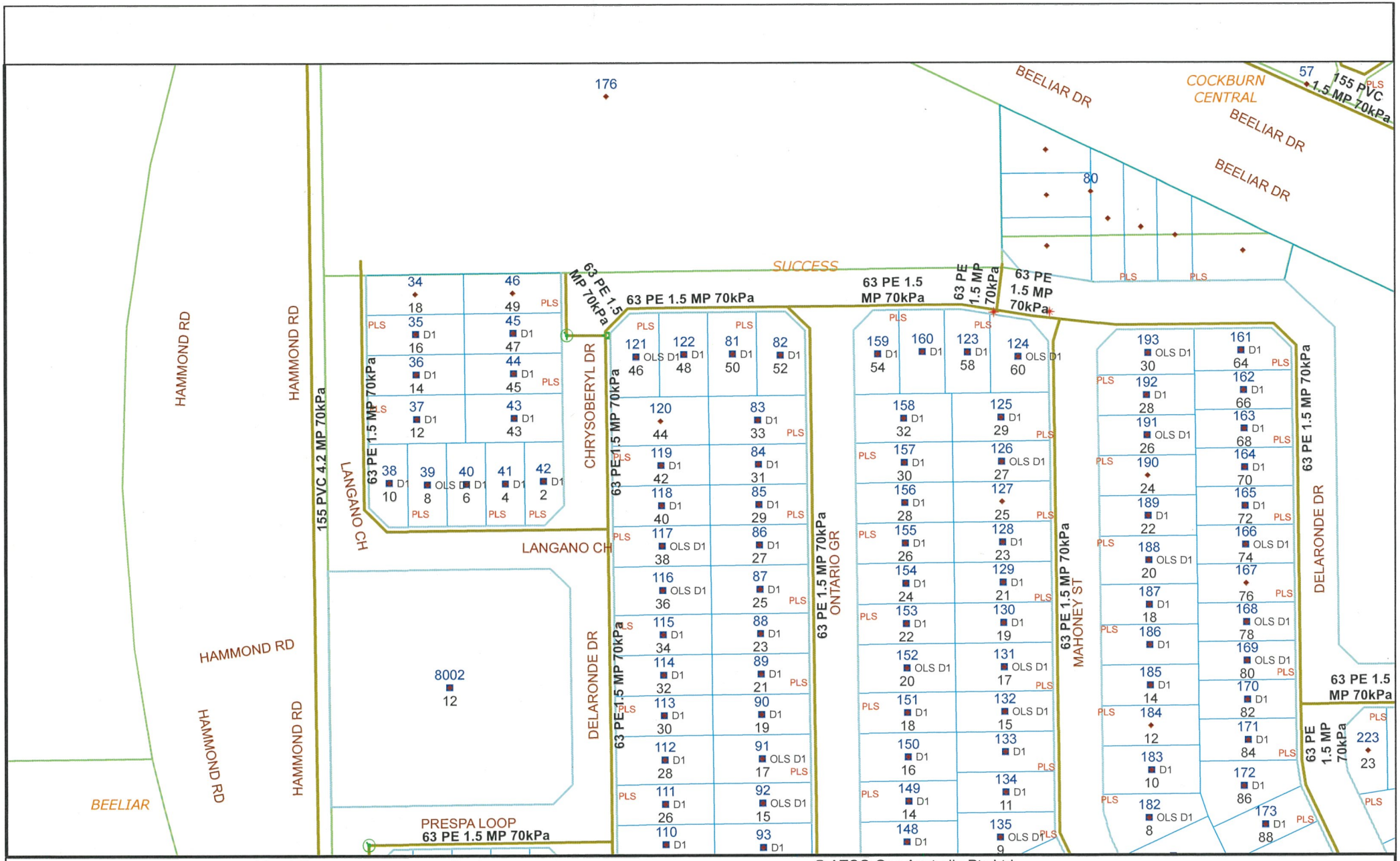
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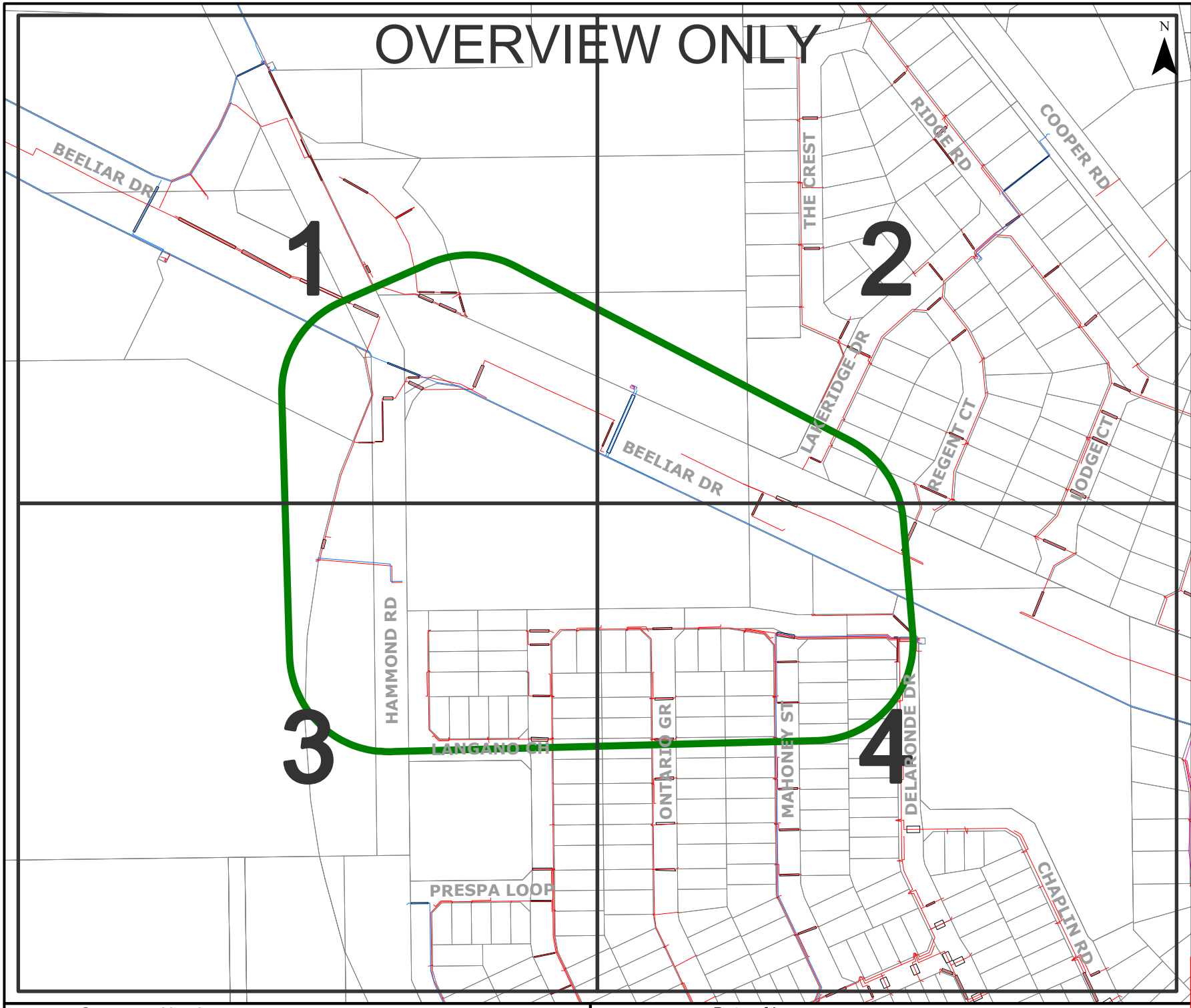
Job No: 14366882 Date:8/06/2018 Location: Hammond Road, Success 6164

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HAMMOND RD
HAMMOND RD
HAMMOND RD
HAMMOND RD
HAMMOND RD
BEELIAR
155 PVC 4.2 MP 70kPa
176
BEELIAR DR
COCKBURN CENTRAL
BEELIAR DR
BEELIAR DR
BEELIAR DR
57
155 PVC 1.5 MP 70kPa
80
SUCCESS
63 PE 1.5 MP 70kPa
63 PE 1.5 MP 70kPa
63 PE 1.5 MP 70kPa



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)
- 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
- Pillar
- Transformer site
- HV Termination
- LV Termination

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

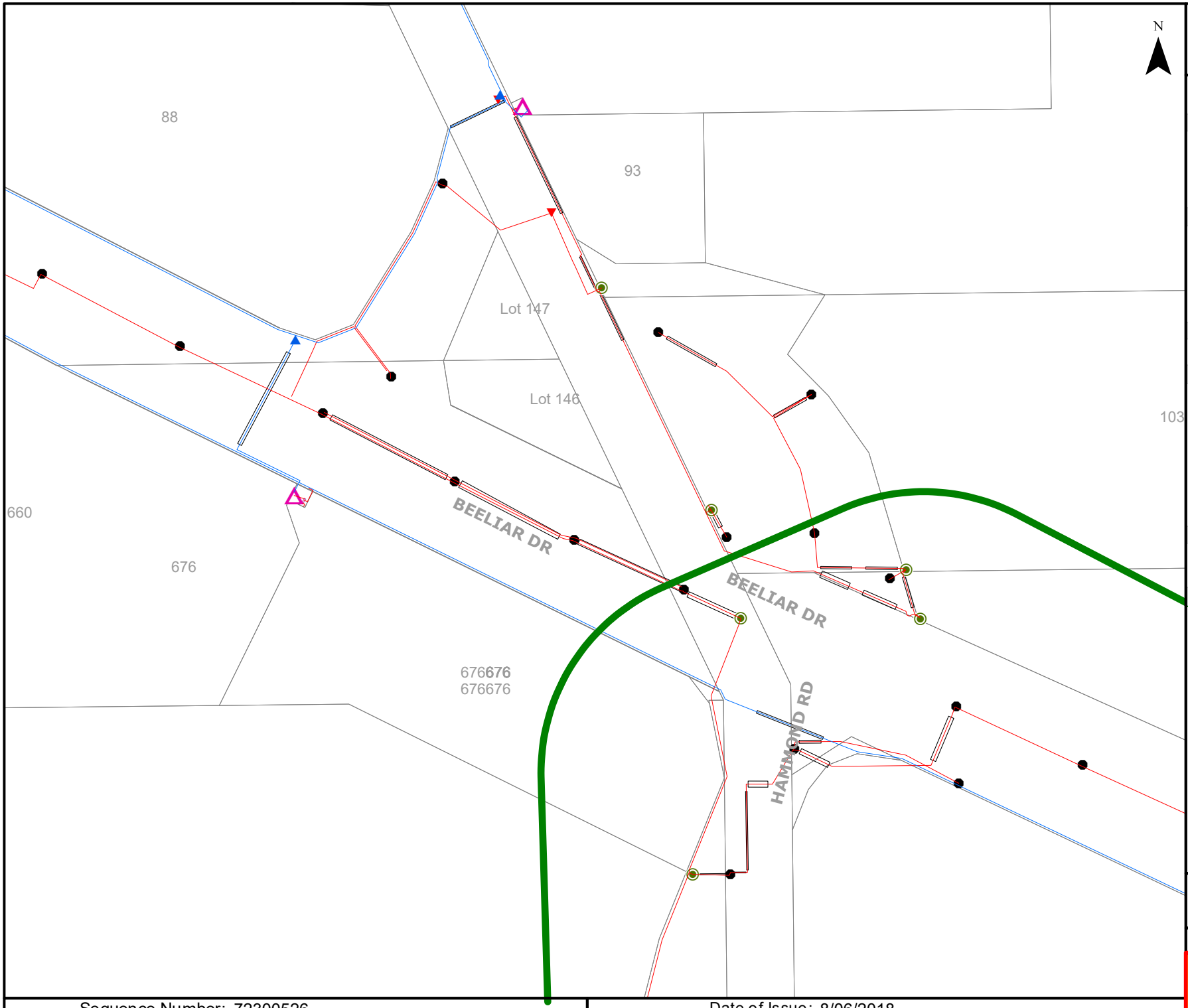
Information valid for 30 days from date of issue

A4 | Scale : 1:3075

WARNING! Look out for overhead power lines

Sequence Number: 72300526

Date of Issue: 8/06/2018



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)
- 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
- Pillar
- Transformer site
- HV Termination
- LV Termination

State Underground Power Project

- CURRENT Work Area *
- COMPLETED Area *

Feature

- Area of Interest

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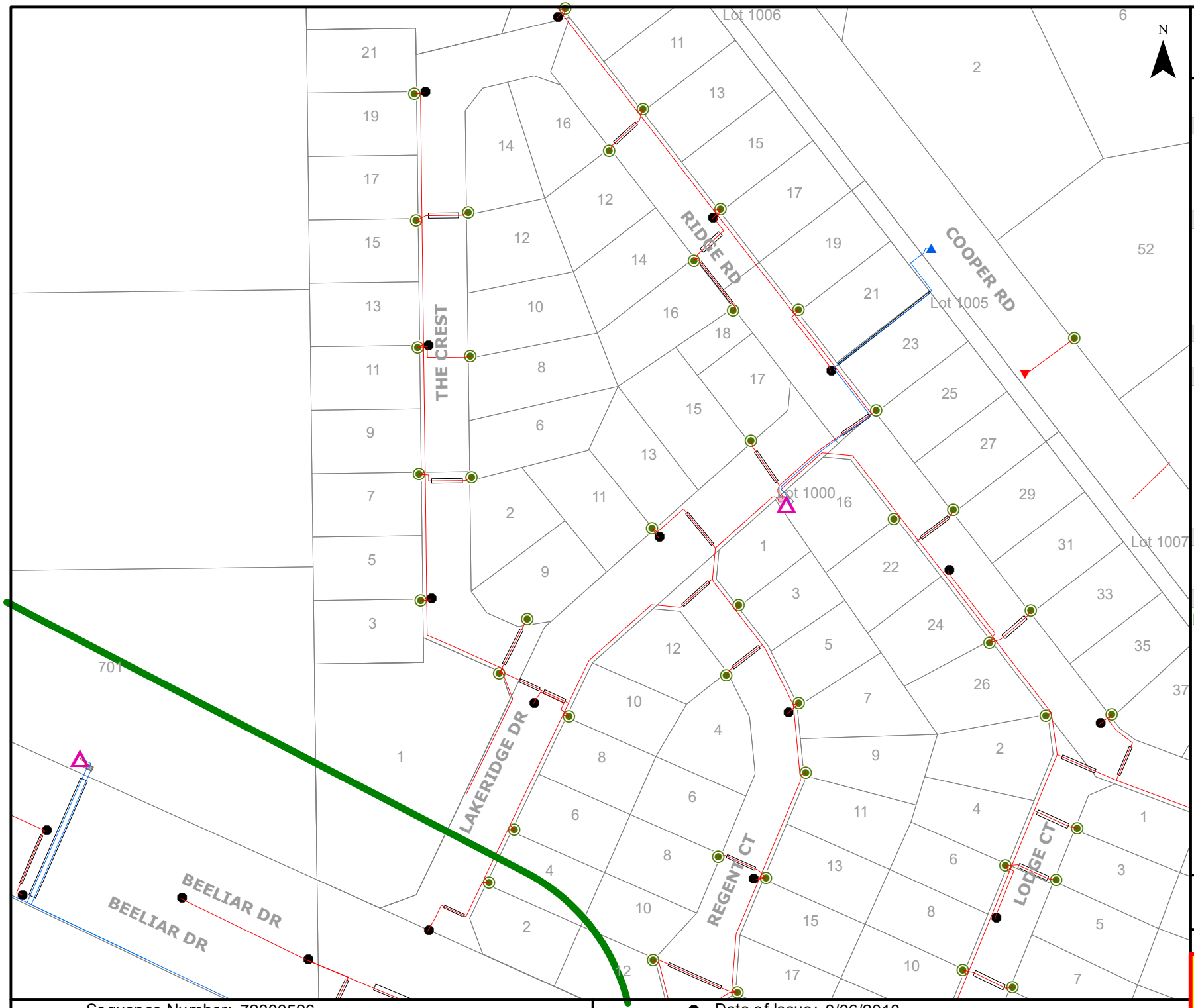
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A4	Scale : 1:1500

WARNING! Look out for overhead power lines

Sequence Number: 72300526

Date of Issue: 8/06/2018



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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)
- 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
- Pillar
- Transformer site
- HV Termination
- LV Termination

State Underground Power Project

- CURRENT Work Area *
- COMPLETED Area *

Feature

- Area of Interest

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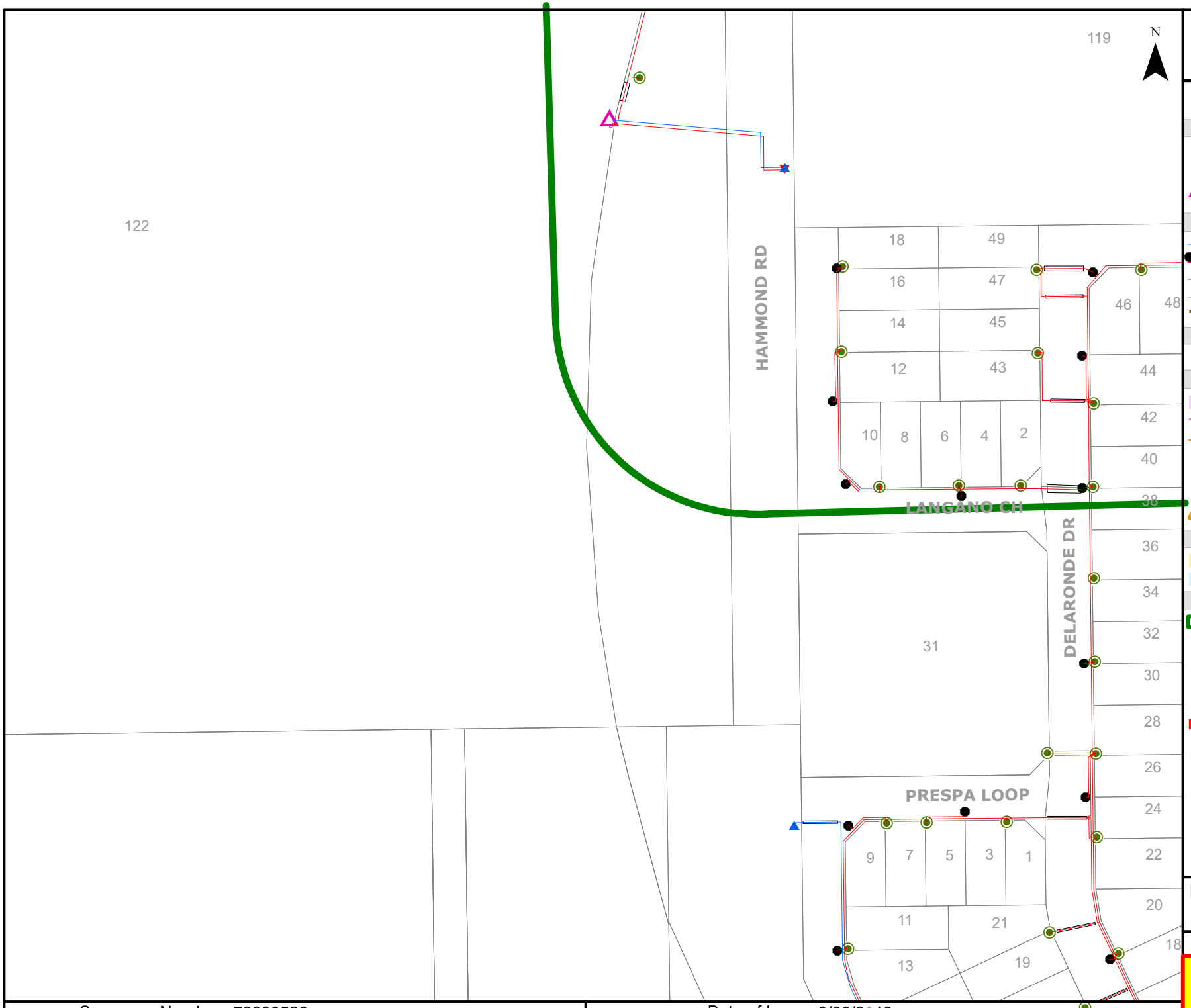
Information valid for 30 days from date of issue

A4 | Scale : 1:1500

WARNING! Look out for overhead power lines

Sequence Number: 72300526

Date of Issue: 8/06/2018



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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)
- 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
- Pillar
- Transformer site
- HV Termination
- LV Termination

State Underground Power Project

- CURRENT Work Area *
- COMPLETED Area *

Feature

- Area of Interest

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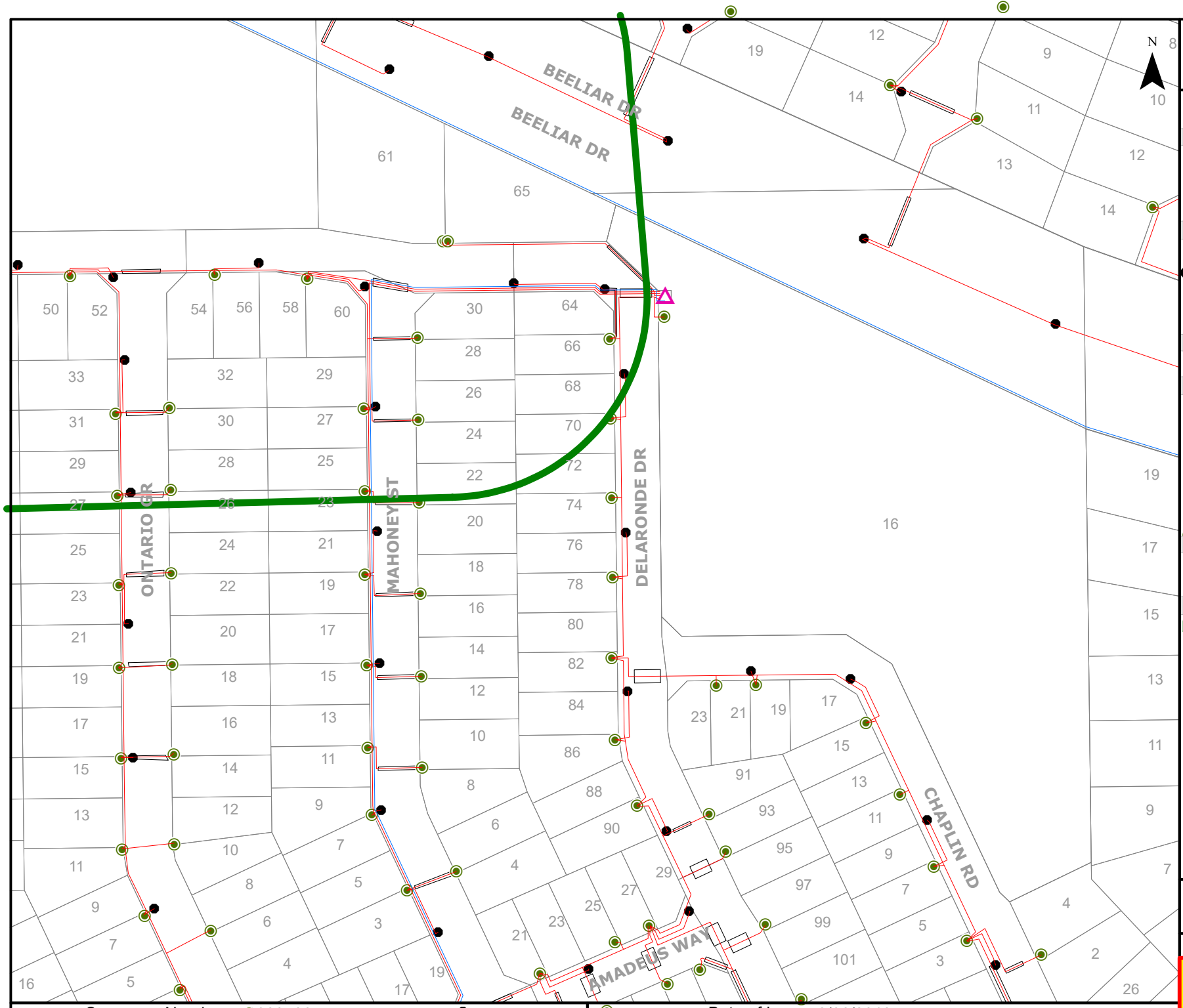
Information valid for 30 days from date of issue

A4 | Scale : 1:1500

WARNING! Look out for overhead power lines

Sequence Number: 72300526

Date of Issue: 8/06/2018



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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)
- 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
- Pillar
- Transformer site
- HV Termination
- LV Termination

State Underground Power Project

- CURRENT Work Area *
- COMPLETED Area *

Feature

- Area of Interest

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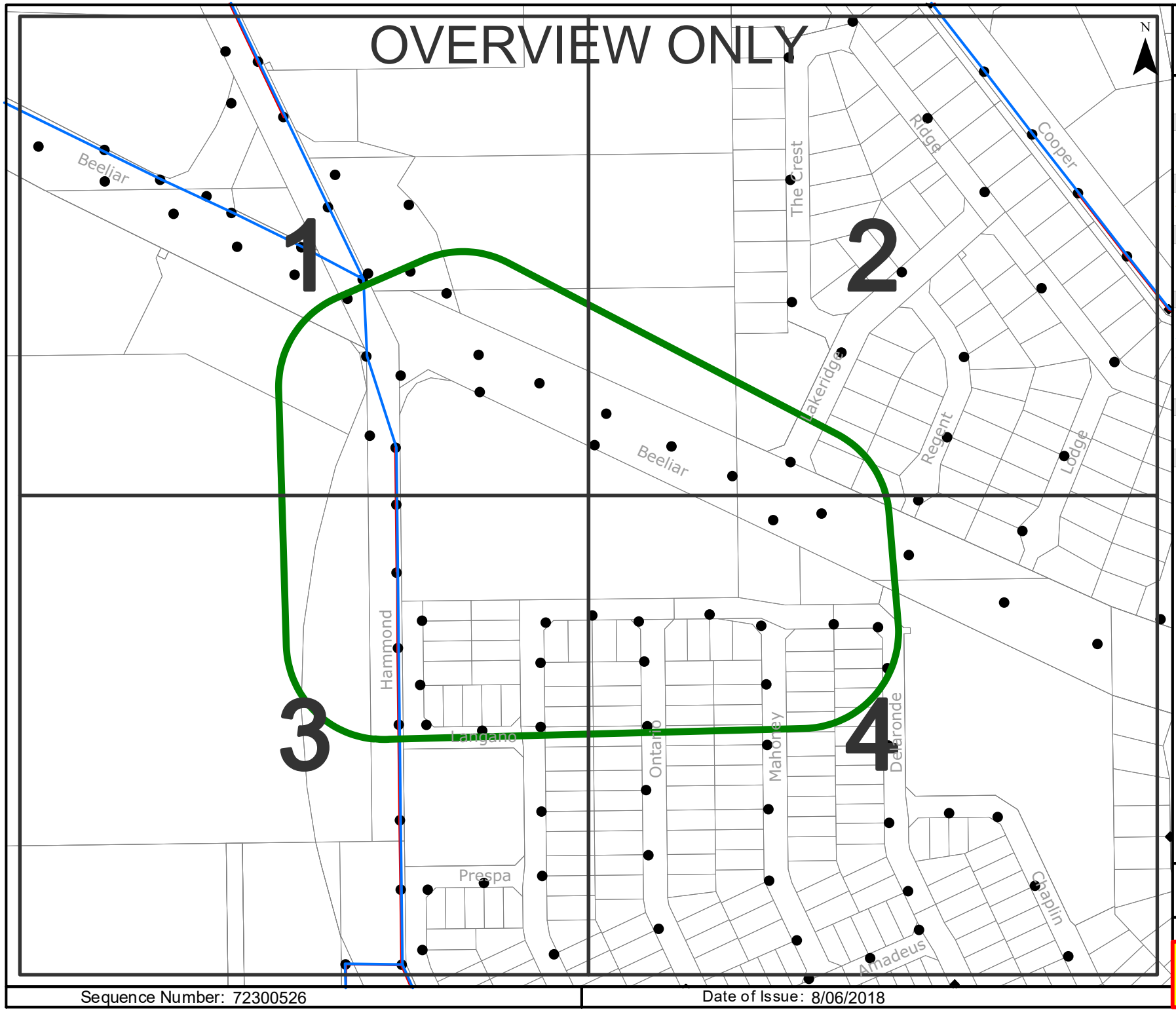
Information valid for 30 days from date of issue

A4	Scale : 1:1500

WARNING! Look out for overhead power lines

Sequence Number: 7300526

Date of Issue: 8/06/2018



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.

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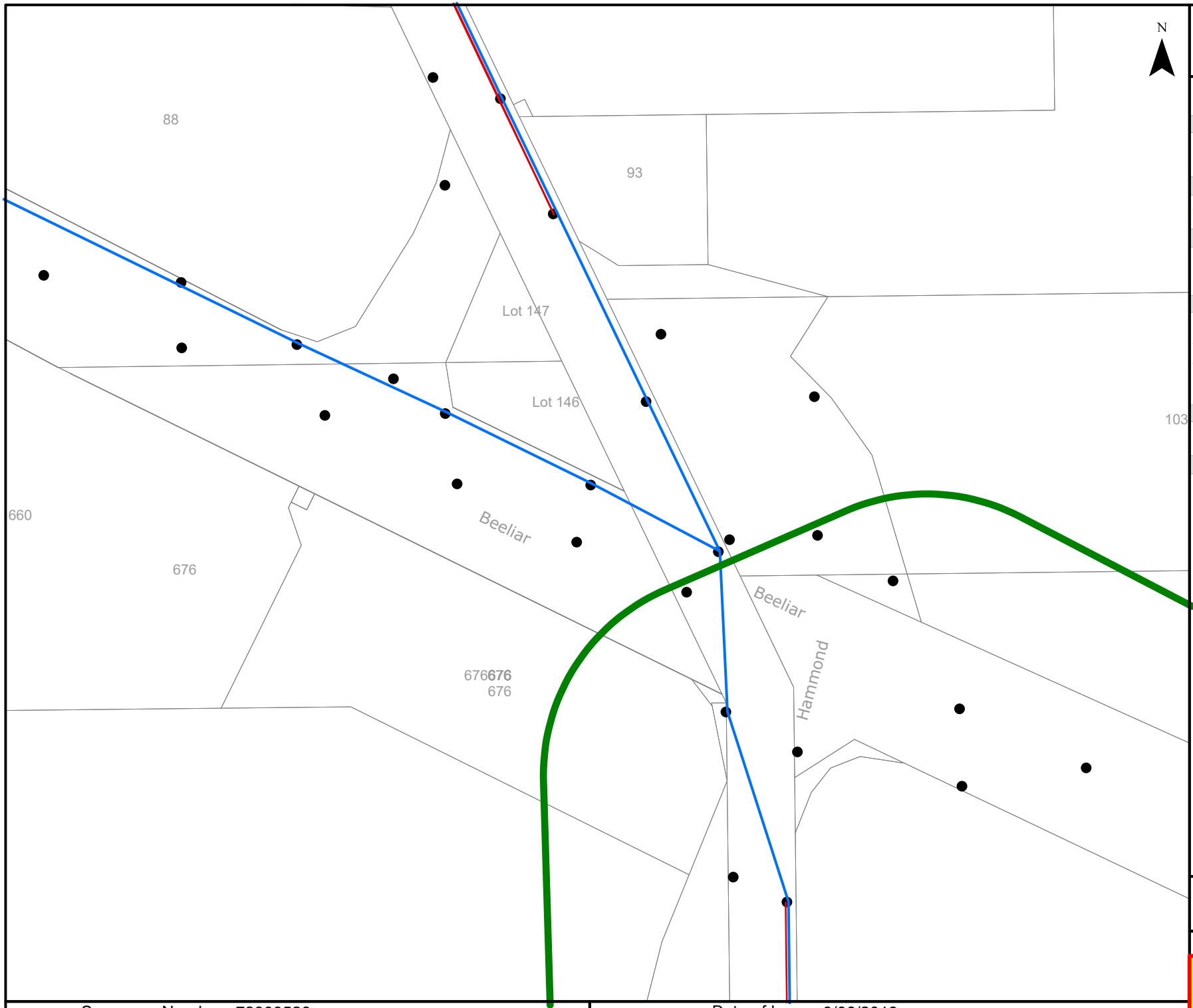
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A4	Scale : 1:3075

WARNING! Look out for overhead power lines

Sequence Number: 72300526

Date of Issue: 8/06/2018



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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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Mon to Fri - 08:00 to 16:30

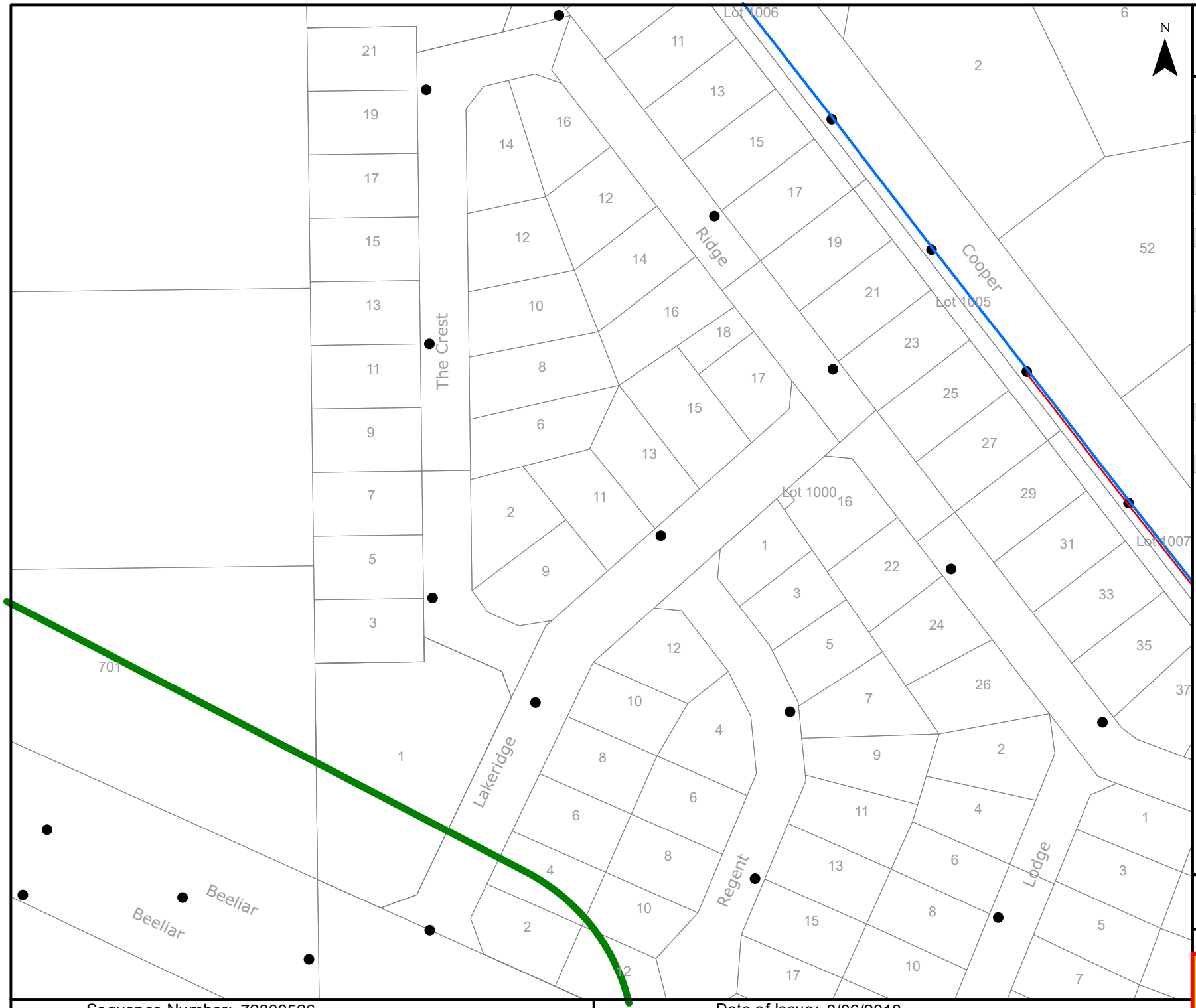
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A4	Scale : 1:1500

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Date of Issue: 8/06/2018



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

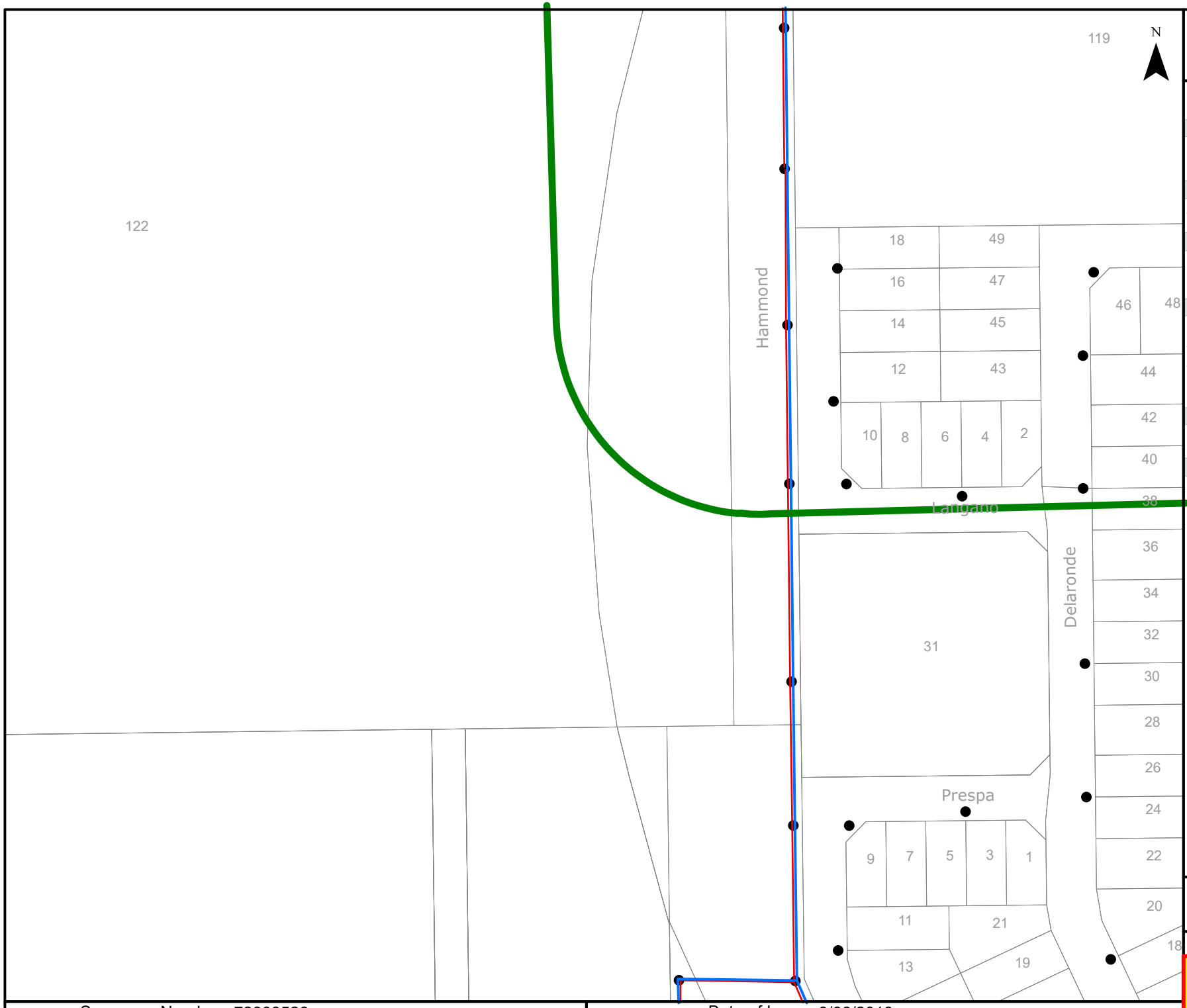
Information valid for 30 days from date of issue

A4 | Scale : 1:1500

WARNING! Look out for overhead power lines

Sequence Number: 72300526

Date of Issue: 8/06/2018



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

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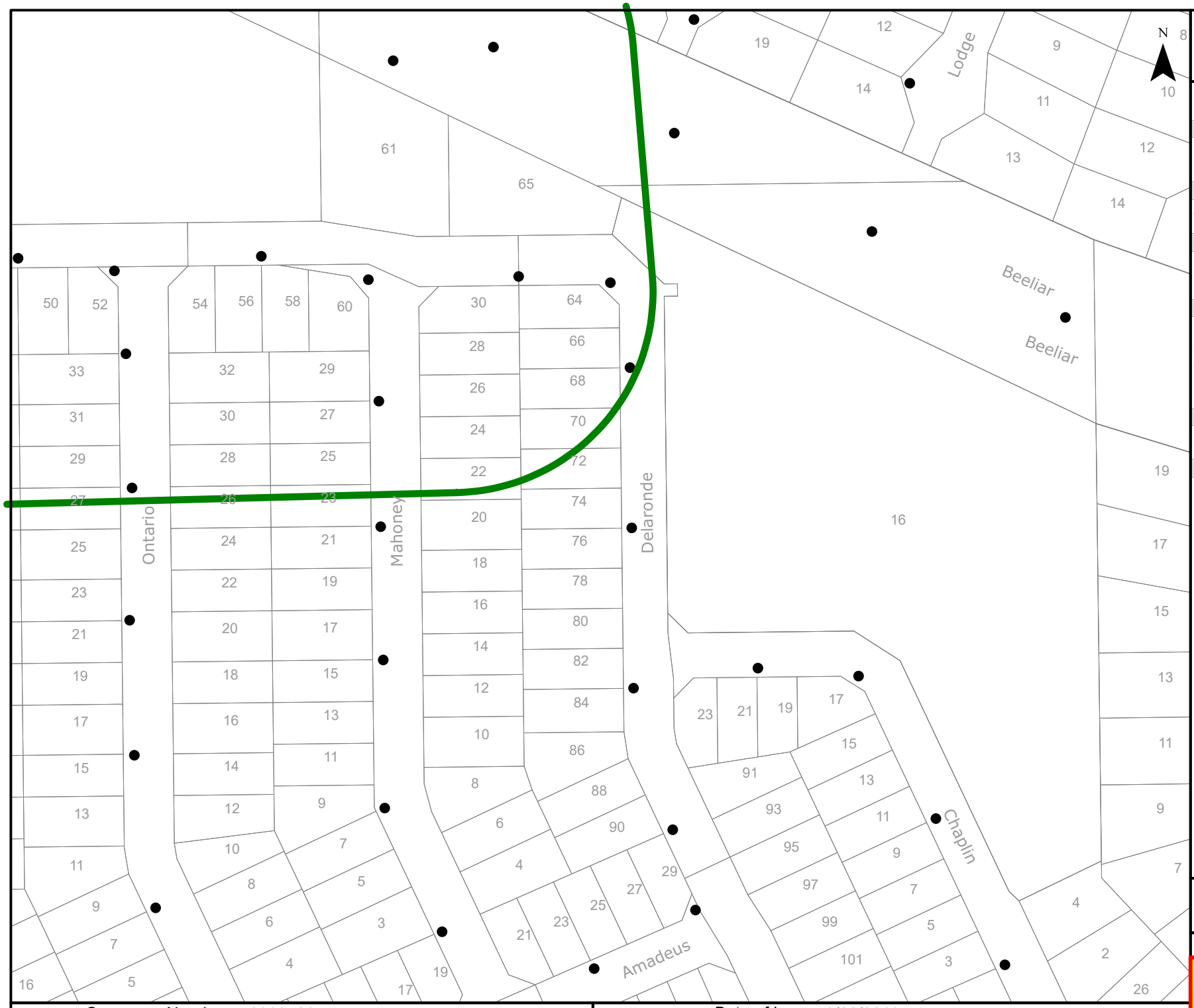
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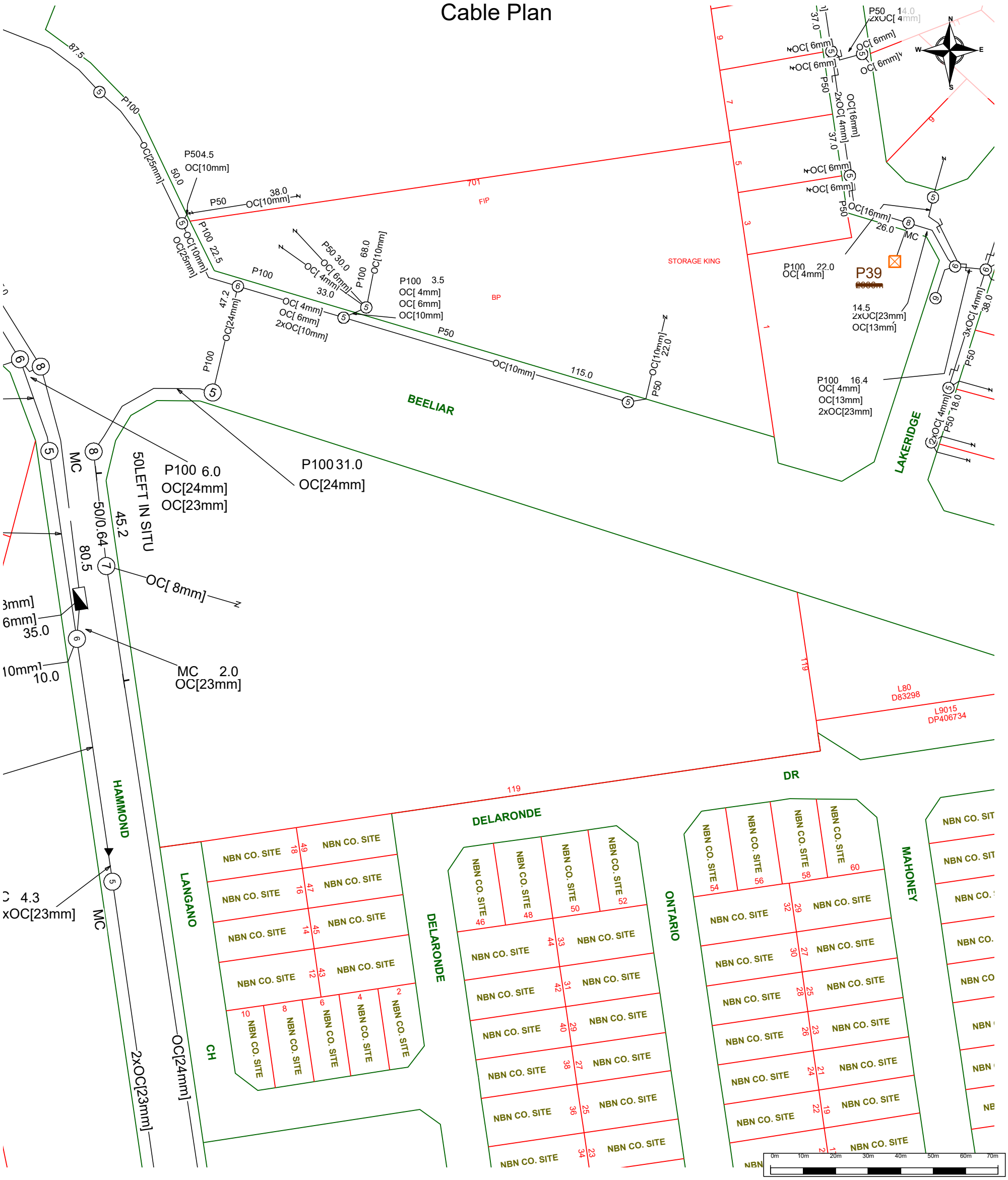
A4	Scale : 1:1500

WARNING! Look out for overhead power lines

Sequence Number: 72300526

Date of Issue: 8/06/2018

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)

TELSTRA CORPORATION LIMITED A.C.N. 051 775 556

Generated On 11/06/2018 13:59:16

Sequence Number: 72300528

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.

The above plan must be viewed in conjunction with the Mains Cable Plan on the following page

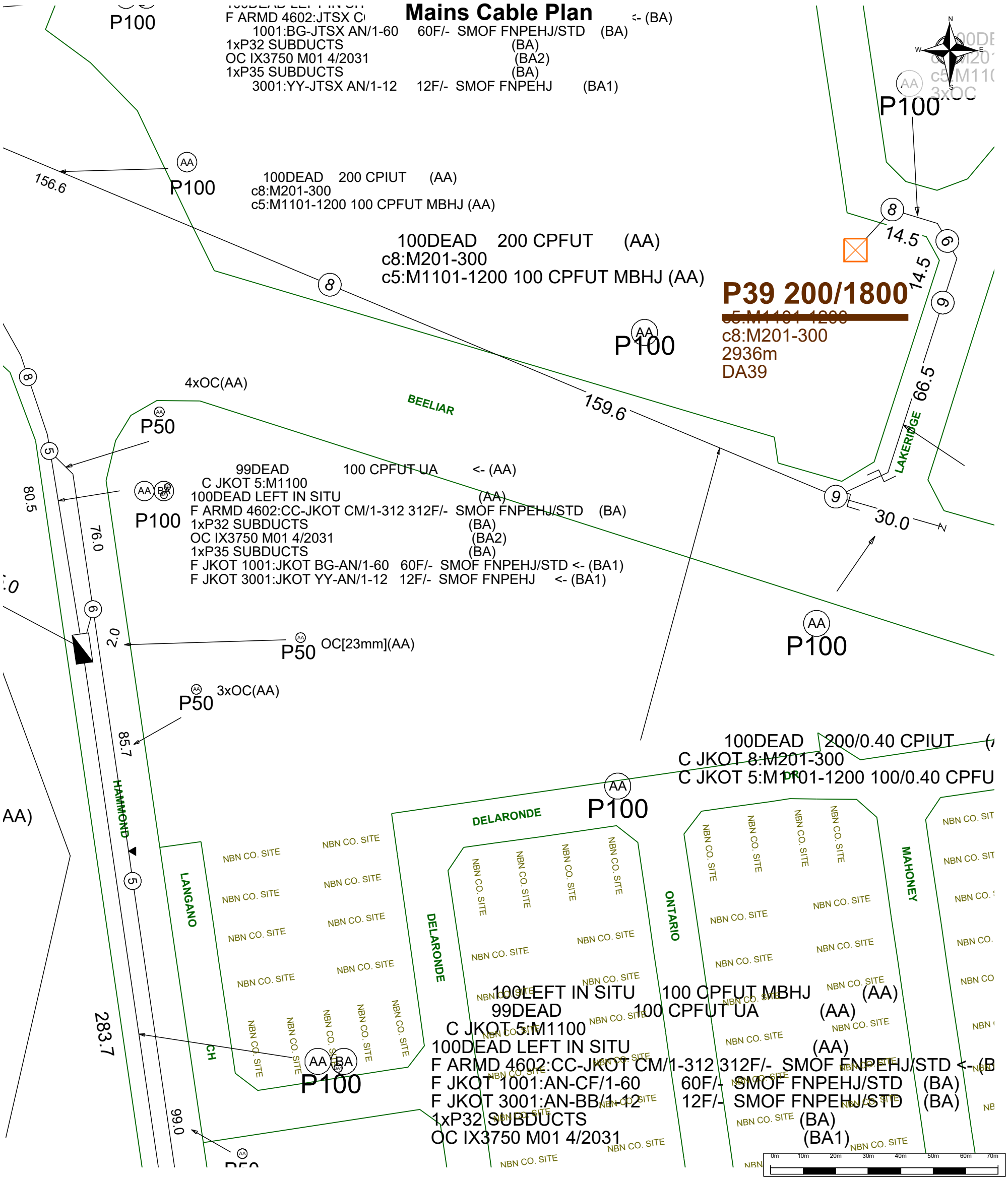
WARNING - Due to the nature of Telstra underground plant and the age of some cables and records, it is impossible to ascertain the precise location of all Telstra plant from Telstra's plans. The accuracy and/or completeness of the information supplied can not be guaranteed as property boundaries, depths 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.

Telstra plans and information supplied are valid for 60 days from the date of issue. If this timeframe has elapsed, please reapply for plans.

Mains Cable Plan



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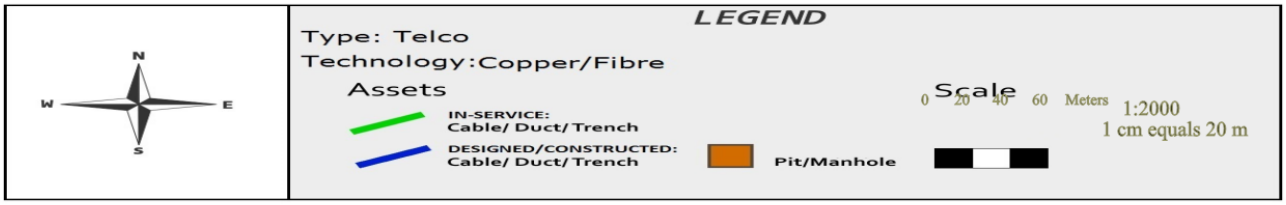
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Indicative Plans

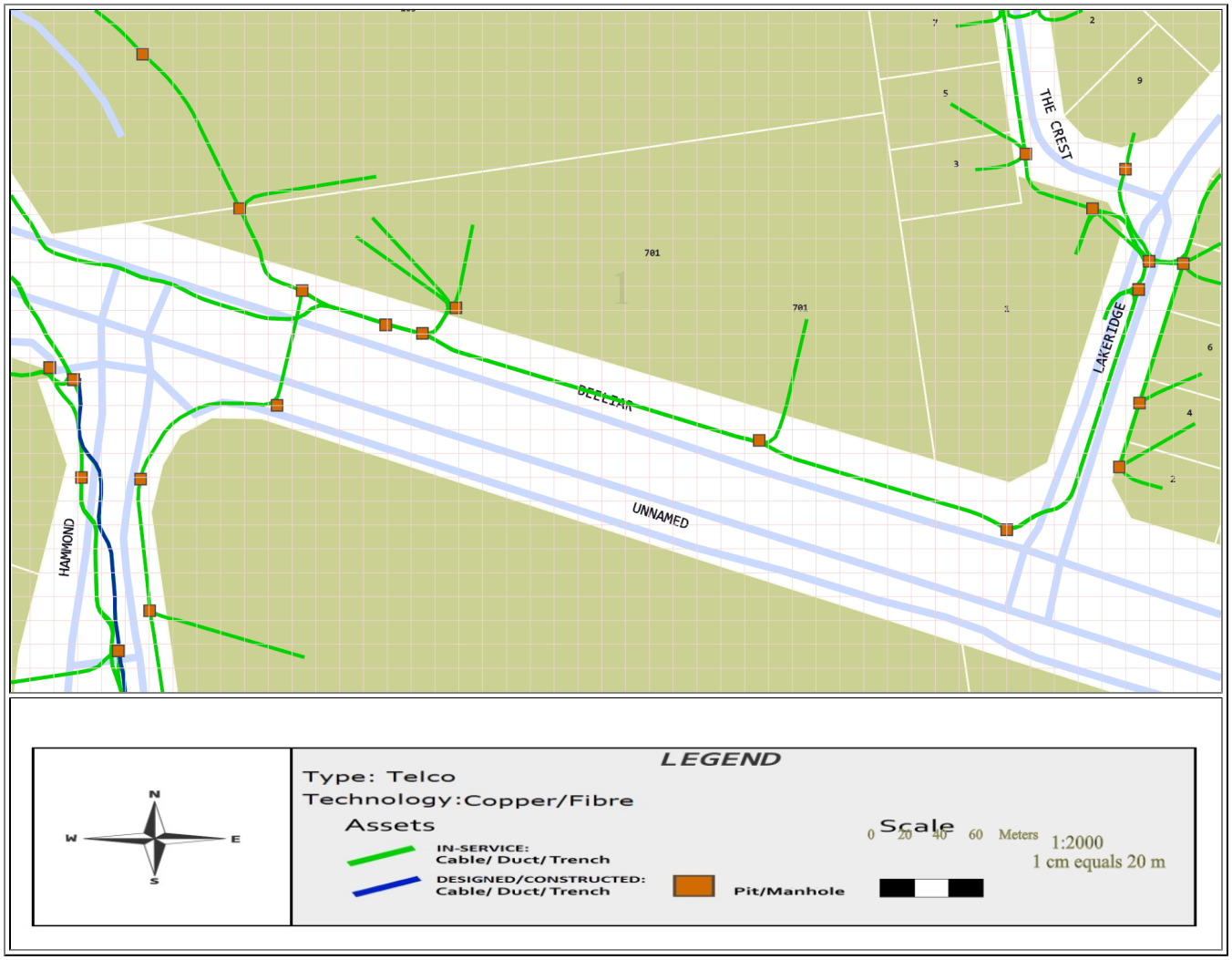
Issue Date:	08/06/2018
Location:	Hammond Road,Success,WA-6164

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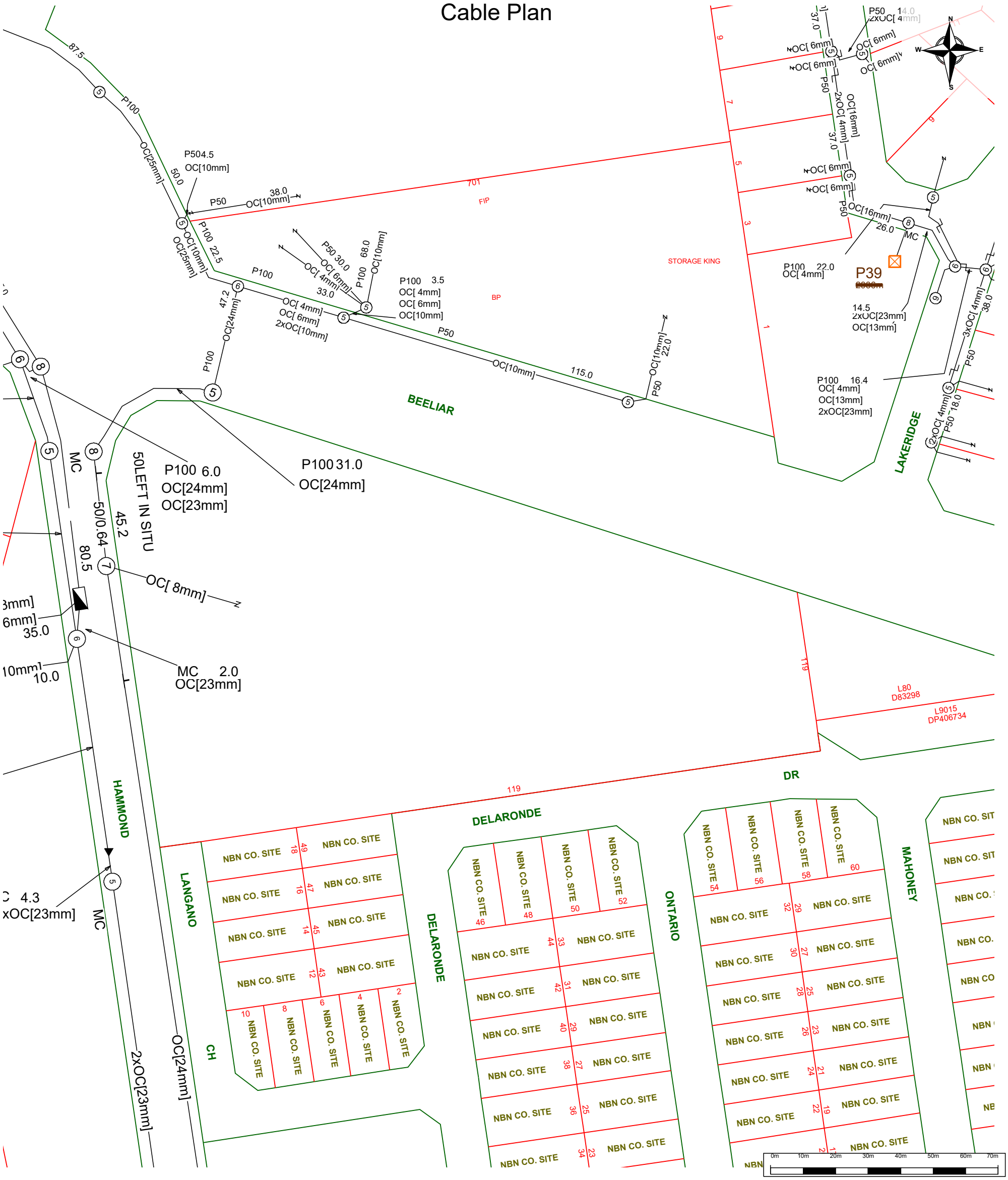


Emergency Contacts

You must immediately report any damage to **nbn™** network that you are/become aware of. Notification may be by telephone - 1800 626 329.

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Cable Plan



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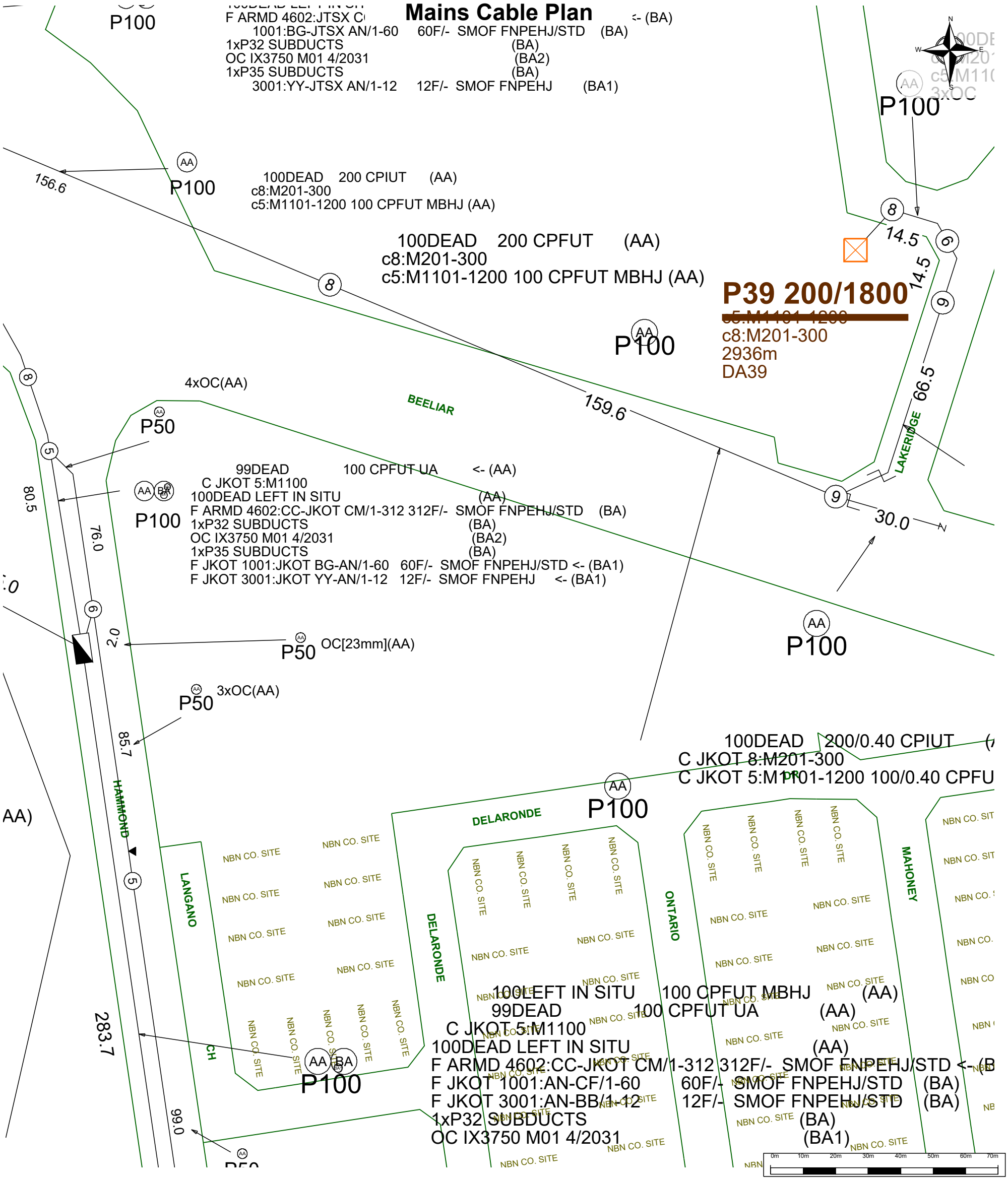
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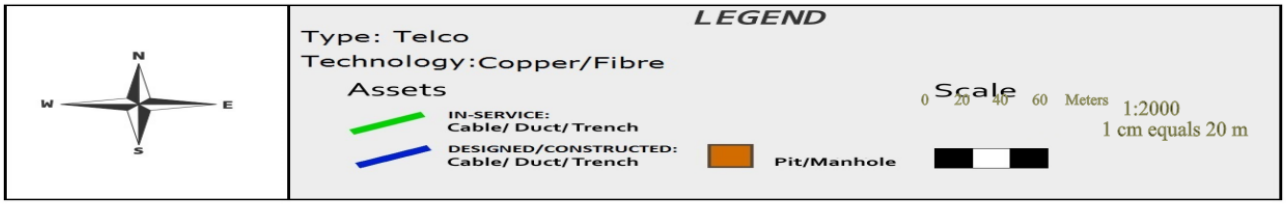
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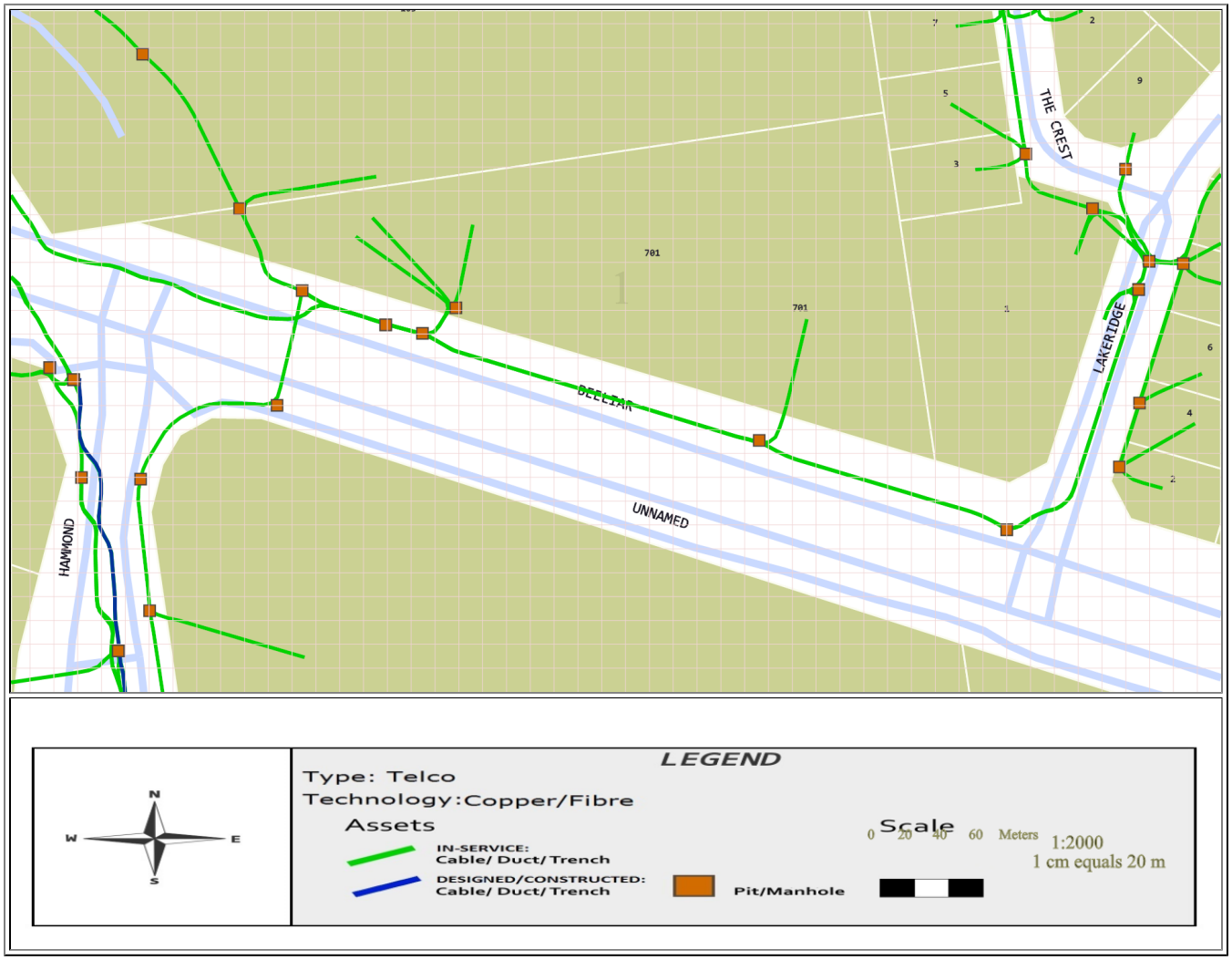
Issue Date:	08/06/2018
Location:	Hammond Road,Success,WA-6164

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Emergency Contacts

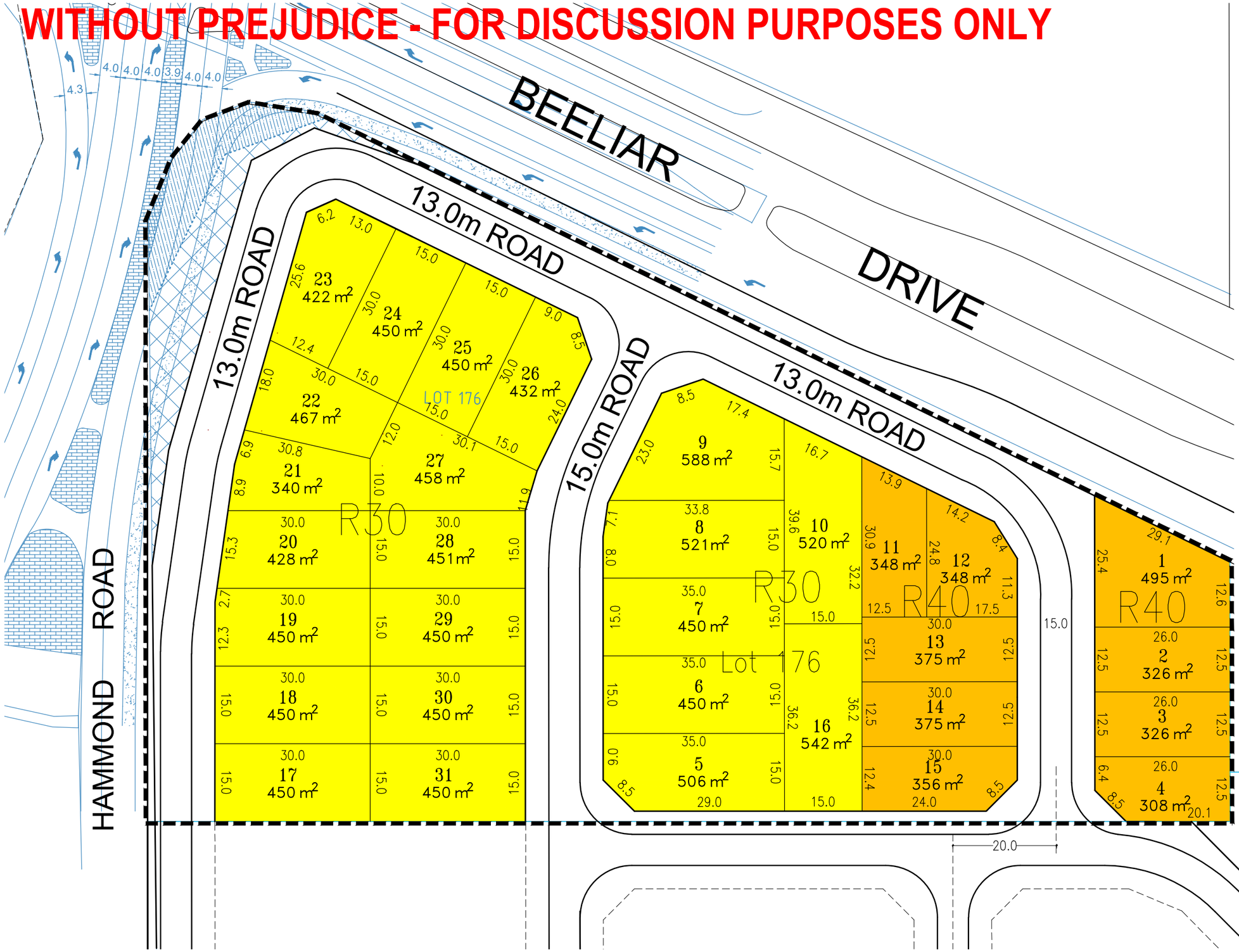
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APPENDIX 2

Plan of Subdivision

WITHOUT PREJUDICE - FOR DISCUSSION PURPOSES ONLY



LEGEND

- Subject Site
- 100 Existing Lot Number
- Existing Lot Boundary
- Proposed Lot Boundary
- Existing MRS Reservation (352m²)
- Proposed MRS Reservation (563m²)

SUBDIVISION SUMMARY

Subject Site (m²)	2.0823ha
No of Exisitng Lots	1
Lot Yield	31

R30 DENSITY CODE

	R30	Provided
Minimum Lot Size	260m²	340m²
Average Lot Size	300m²	467m²

R40 DENSITY CODE

	R40	Provided
Minimum Lot Size	180m²	308m²
Average Lot Size	220m²	362m²

CONCEPT PLAN NOTES

1. Concept plan subject to detailed input and advice from co-consultant team and authorities. Concept plan may be refined or amended upon input.
2. No POS has been provided. Design assumes 10% cash-in-lieu contribution being paid, as considered acceptable by the City of Cockburn / WAPC.
3. Acoustic assessment for road noise may be required.

PLANNING SOLUTIONS | PS
URBAN & REGIONAL PLANNING

SCALE	1: 750 @ A3
DATE	19 March2017
FILE	180319 4900 Concept Plan.dwg
REVISION	1/DR/First Draft/18.09.2017

SUBDIVISION CONCEPT PLAN

LOT 176 (119) HAMMOND ROAD,
SUCCESS, WA

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