Muchea Industrial Area – Precinct 2A

Request for Amendment to the Shire of Chittering *Local Planning Scheme No. 6*

Prepared for Tallangatta Beef Pty Ltd
Prepared by Taylor Burrell Barnett
February 2023

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Document History & Status

Muchea Industrial Area – Precinct 2A

Request for Amendment to the Shire of Chittering Local Planning Scheme No. 6

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Revision	Reviewer	Date Issued
20~034-0	JR	17 November 2021
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1.0

Introduction

1.0 Introduction

1.1 Request for Amendment

This report constitutes a formal request to the Shire of Chittering from Tallangatta Beef Pty Ltd to initiate an amendment to *Local Planning Scheme No. 6* (LPS 6) which aims to facilitate the development of an area known as the Muchea Industrial Area Precinct 2A.

The report outlines the justification, including the policy and legislative framework, environmental conditions, service infrastructure availability and traffic and transport considerations relevant to the zoning and Scheme provisions for the area.

1.2 The Proponent

The proponent for this application is Tallangatta Beef Pty Ltd, who own the land subject to the scheme amendment request.

The proponent has engaged a highly qualified and experienced team to assist them in facilitating the industrial development of the precinct to a high standard, as outlined in **Table 1** below.

Table 1 Project Team

Project Team Member	Project Team Role
iParks Pty Ltd	Project Manager
Taylor Burrell Barnett	Town Planning
Peritas	Civil Engineering
Bayley Environmental Services	Environmental Analysis
Eco Logical Australia	Bushfire Management
Transcore	Transport Analysis

1.3 Subject Land

The subject land comprises of a total of two individual parcels of land, equating to a total area of approximately 212.1525 hectares, which are situated within the suburb of Muchea as shown in **Figure 1**. The site is located on the corner of Muchea Road East and Great Northern Highway, and is bordered by Muchea East Road to the north, Lot M1326 to the east, Lots 204 and 205 to the south, and Great Northern Highway to the west.

The subject land is wholly within the ownership of Tallangatta Beef Pty Ltd, as outlined in **Table 2** and copies of the Certificates of Title are provided in **Appendix B.**

Table 2 Land Details

Lot on Plan	Certificate of Title	Area (ha)	Owner
Lot M1456 on Diagram 6680	1255/577	190.5645	TALLANGATTA BEEF PTY LTD
Lot 50 on Diagram 12338	1255/578	21.5880	TALLANGATTA BEEF PTY LTD

1.4 Site Description & Existing Land Use

The subject site, commonly known as Tallangatta Farm, is generally cleared and has been used for grazing purposes since before 1965, and continues to be used for this purpose today. The site contains a homestead and structures associated with the agricultural operations of the farm, close to the centre of the site.

The site is relatively flat with a general gradient of approximately 2.5% from east to west. The site slopes westward from a high point of 93m AHD to 53m AHD.

Watercourses traverse the site in the north and south, generally flowing in an east-westerly direction.

An air-strip and associated hanger is located on the western edge of the site, and although listed on the Shire's Municipal Heritage Inventory as a category 5 place, it has been agreed with the Shire that identification and recognition is a more appropriate method of respecting the heritage status.

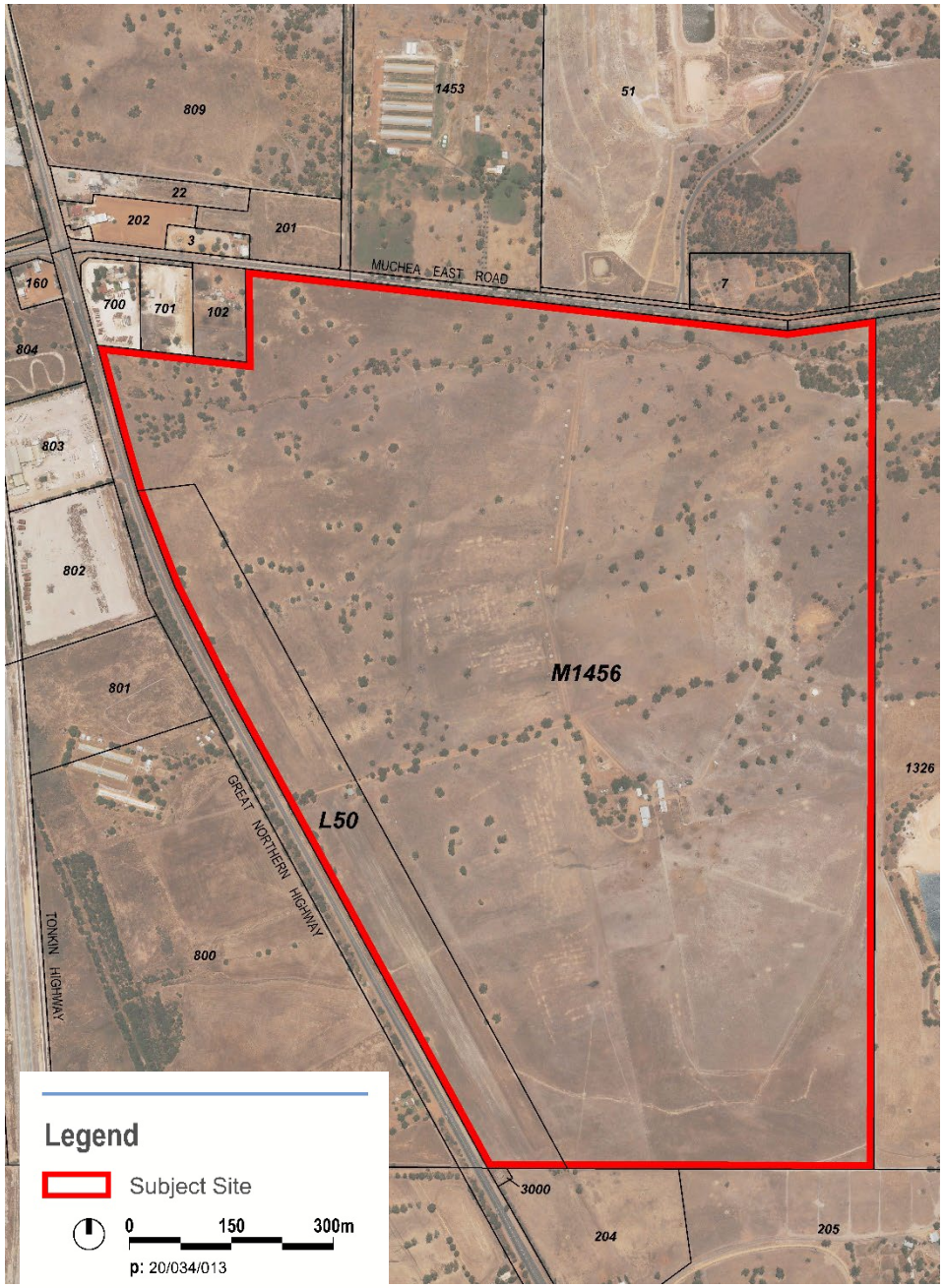


Figure 1 Subject Site

1.5 Planning Framework Preparation Timeframes

In order to maintain the momentum of the project and realise the opportunity to coordinate the development, the proponent is seeking to streamline the planning processes wherever possible.

In this regard, we are lodging this Scheme amendment request with the expectation that it will be considered for initiation by the Council at its meeting in March 2023.

The structure plan for the subject site has been prepared and lodged concurrent with the Scheme amendment proposal to assist in expediting the planning framework and informing the consideration of this Scheme amendment (refer **Appendix A**).

1.6 Context

The subject site is located within the municipality of the Shire of Chittering, outside the Perth Metropolitan Area. The subject site forms the northern portion of Precinct 2 within the Muchea Industrial Park, and is located approximately:

- 2 kilometres east of the Muchea Townsite;
- 7.5 kilometres north of the RAAF Military Airforce Base;
- 9.0 kilometres north of the Bullsbrook Town Centre;
- 21 kilometres north of the Ellenbrook Town Centre;
- 32 kilometres north of the Midland City Centre; and
- 42 kilometres north east of the Perth Central Business District.

The site is located approximately 1.5m south of the Brand Highway interchange, which was recently constructed as part of the Northlink Project to provide a non-stop transport route between Morley and Muchea, and provides an alternative freight route, taking about 80% of trucks off Great Northern Highway (refer **Figure 2**).

The Northlink connection also provides the site with efficient heavy vehicle access to the Port of Fremantle, the Perth International Airport, and the Kewdale/Welshpool industrial area (refer **Figure 3**).

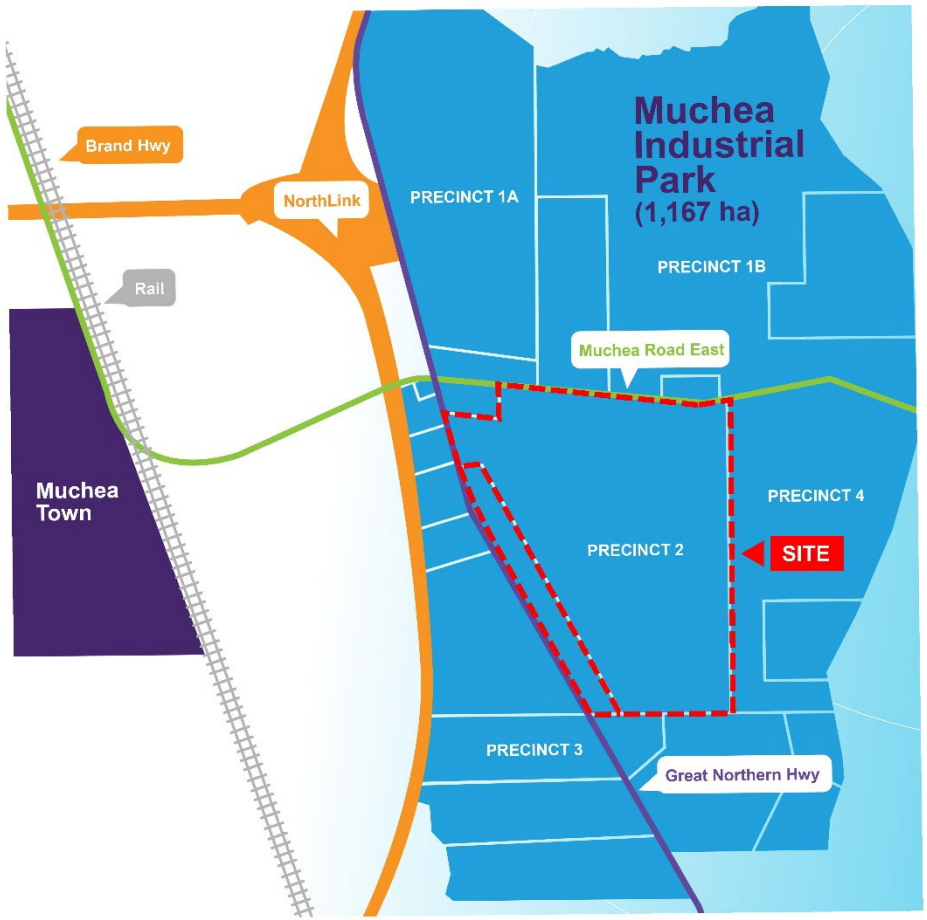
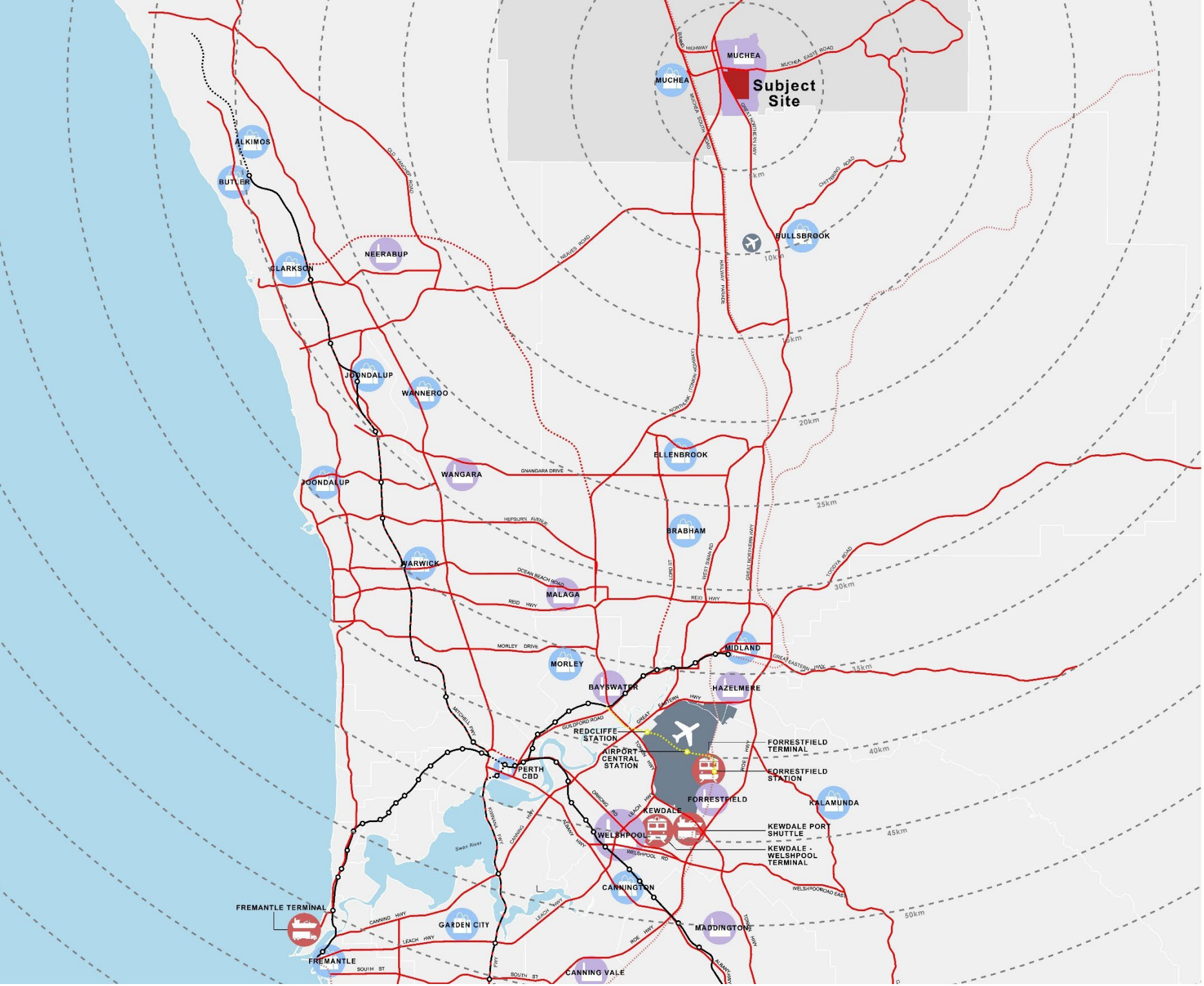


Figure 2 Local Context



Legend

- Perth Airport (Specialised Activity Centre)
- RAAF Base
- Primary Road
- Freight Rail
- Freight Terminal
- Existing Passenger Railway and Stations
- Forrestfield Airport Link
- Major Industry
  - Welshpool
  - Hazelmere
  - Forrestfield
  - Canning Vale
  - Maddington
  - Spearwood
  - Latitude 32
- Specialised Activity Centre
  - University Of WA / QEII
  - Curtin University / Bentley Technology
  - Murdoch University
- Activity Centre
  - Perth CBD
  - Fremantle
  - Morley
  - Midland
  - Cannington
  - Garden City

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Figure 3 Regional Context

Section

2.0

Planning Framework

2.0 Planning Framework

2.1 Region Scheme

The subject site is outside the boundary of the Metropolitan Region Scheme and does not fall within the jurisdiction of any other region scheme.

2.2 Shire of Chittering Local Planning Scheme No. 6

2.2.1 Zoning and Reservations

The subject site is currently zoned 'Agricultural Resource' under LPS 6 (**Figure 4**). The Agricultural Resource Zone is intended to:

a) *preserve productive land suitable for grazing, cropping and intensive horticulture and other compatible productive rural uses in a sustainable manner;*

b) *protect the landform and landscape values of the district against despoliation and land degradation;*

c) *encourage intensive agriculture and associated tourist facilities, where appropriate;*

d) *allow for the extraction of basic raw materials where it is environmentally and socially acceptable*

The adjacent areas are also predominantly zoned 'Agricultural Resource' with the following exceptions:

- An area to the north, representing Precinct 1A of Muchea Industrial Area, is zoned 'Industrial Development';
- Small parcels of land to the north and north-west are zoned 'General Industry' and 'Light Industrial' respectively;
- The Great Northern Highway is reserved for the purposes of 'Highway';
- Muchea Road East is reserved for the purpose of 'Major Road'; and
- A portion of land to the north-east of the site is reserved for 'Parks and Recreation'.

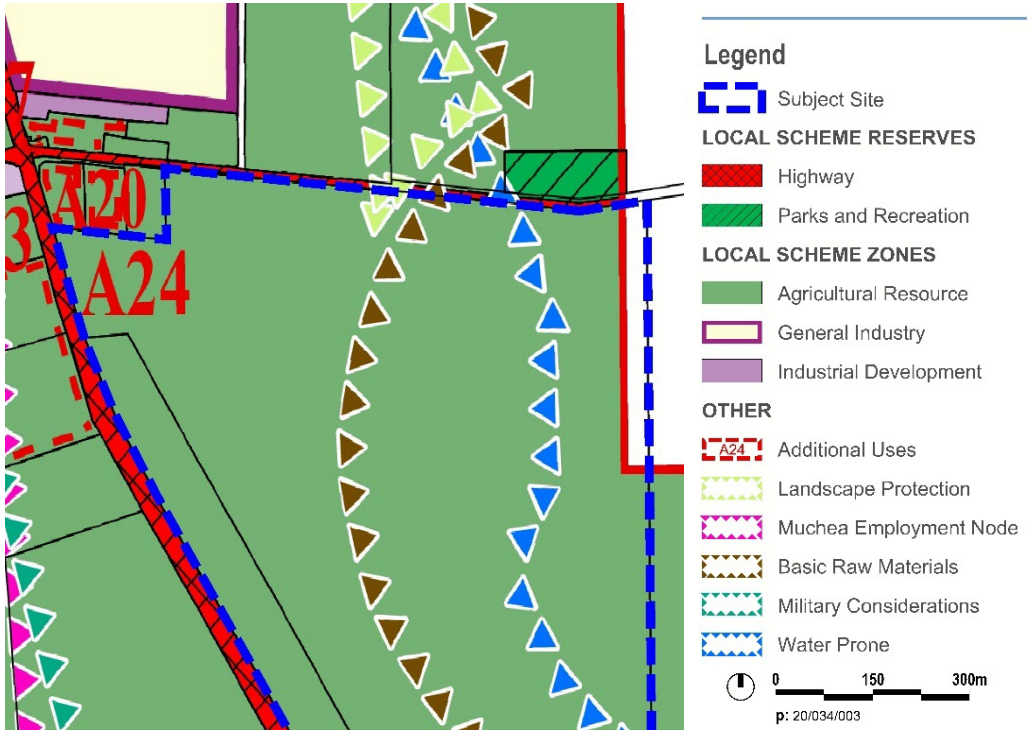


Figure 4 Shire of Chittering Local Planning Scheme No. 6 Extract

2.2.2 Special Control Areas

Portions of the subject site are affected by Special Control Areas as outlined within **Figure 4**. The provisions of LPS 6 relating to Special Control Areas are outlined within Part 5 of LPS 6, and include the purpose, planning requirements, relevant considerations and requirements for referral for each. The relevance of each of these areas is summarised as follows:

a) The **Muchea Employment Node Special Control Area** which is addressed by Clause 5.7 of LPS 6. The purpose of the SCA is to provide a basis for the zoning and development of the Muchea Employment Node as an industrial estate in accordance with the Muchea Employment Node Structure Plan. Of specific relevance to this application is Clause 5.7.2.2 which outlines the requirements for zoning proposals within the SCA, which are briefly summarised as follows:

- Details of the stormwater and wastewater management in an environmentally sustainable manner;
- Consideration of impacts on flora and fauna;
- Details of the potential impacts and buffers from waterways and wetlands;
- Demonstration of the land capability to accommodate the uses proposed;
- Desktop review of the Aboriginal heritage significance; and
- Review of other relevant matters, including access and egress to basic raw materials.

Also of relevance is Clause 5.7.2.3, which outlines that zoning proposals are to be assessed for suitability on the basis of:

a) Their location relative to sensitive land uses;

b) The environmental suitability of the site; and

c) The potential impact of proposed drainage and wastewater treatment and disposal systems on the environment.

These matters have been addressed within the Scheme Amendment Request, in the following sections:

- Stormwater Management – refer **Section 3.10.2.**
- Flora and Fauna – refer **Sections 3.1.3** and **3.1.4.**
- Land Capability – refer **Section 3.2.5**.
- Aboriginal Heritage – refer **Section 3.4**.
- Basic Raw Materials – refer **Section 2.5.1**.
- Location relative to Sensitive Land Uses – **Sections 3.5**, **3.6** and **3.7**.
- Environmental Suitability of the Site – **Section 3.1**.

b) The **Basic Raw Materials Special Control Area** which is addressed by Clause 5.4 of LPS 6. Of specific relevance to this application is Clause 5.4.4 which identifies that a key consideration of the Shire will be whether development within the buffer area of an identified basic raw material site will affect future extractive industry operations.

c) The **Water Prone Special Control Area** which is addressed by Clause 5.3 of LPS 6. Though the majority of the provisions relate to development applications rather than Scheme amendment proposals, the potential limitations on development of land subject to inundation or flooding.

d) The **Landscape Protection Area** Special Control Area which is addressed in clause 5.2 of LPS 6. The purpose of the SCA is to ensure the protection of the Brockman River Catchment, its biodiversity and the drainage pattern and land degradation problems. It is noted that the provisions relate to development applications rather than Scheme amendments, however the protection of the Brockman River catchment has been considered through the proposed drainage strategy, as outlined in **Sections 3.10.2** and **Appendix D**.

e) The **Military Considerations Special Control Area** which is addressed by Clause 5.5 of LPS 6. The provisions relate to development applications, and primarily relate to residential development. Given industrial development is intended on the subject site, there are no implications for the Scheme Amendment, unless any structures are proposed which would constitute a hazard or interference to aircraft flying in the area, which would be addressed at the Development Application stage.

2.3 District Structure Planning

2.3.1 Muchea Employment Node Structure Plan (August 2011)

The Muchea Employment Node Structure Plan was endorsed by the WAPC in August 2011 and provides comprehensive district level structure planning for the entire Muchea Employment Node precinct, which is proposed to be developed for *'service-based uses such as transport, livestock, fabrication, warehousing, wholesaling and general commercial use'*. The Structure Plan is intended to provide a 20-year land use planning framework, with a focus on providing employment opportunities for people living in and around the Shire of Chittering.

The Structure Plan area comprises of 1,113 hectares of land abutting Great Northern Highway and Muchea East, and is divided into four precincts as outlined in **Figure 5.**

The subject site is included within Precinct 2 (south), and identified for proposed industrial development. The site is also impacted by the following:

- 500m land use buffer (from feed lots located on the subject site, as well as a horse stud located south of the subject site);
- 500m poultry buffer (from various poultry farms located in proximity to the subject site);
- 1000m WAMIA buffer (from the WAMIA site located north of the subject site);
- Priority resource boundary;
- Minor waterways, included within reserves for conservation, recreation, foreshore management or regional open space; and
- Proposed local distributor / industrial (loop road) running north-south through the site, providing a connection north of Muchea East Road to Precinct 1.

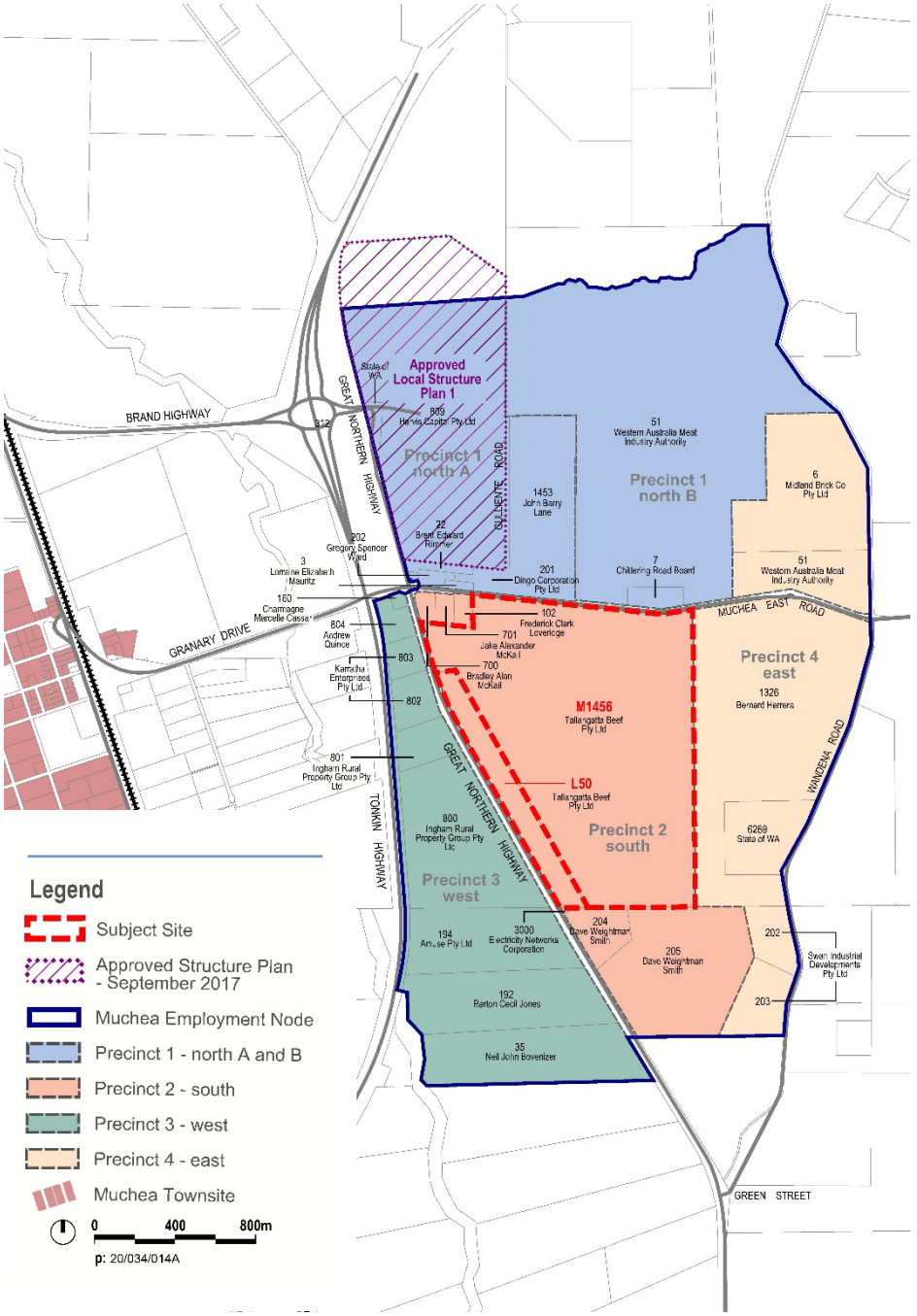


Figure 5 Muchea Employment Node Structure Plan

The report provides a range of guidance for landowners and developers, including:

- Guidance on desired land use structure of the area, with a focus on industrial development which is complementary to the surrounding rural environment and uses that generate significant employment for the region;
- A Water Management Strategy prepared to guide proponents on potable and non-potable water use, wastewater treatment and drainage and groundwater management;
- Environmental analysis outlining the relevant environmental considerations to guide future industrial development;
- Traffic and transport considerations, and in particular the (at that time) proposed upgrades to the regional road network and potential for an inter-modal facility to facilitate greater efficiency of freight movements; and
- Servicing considerations, noting in particular:
    - the lack of reticulated sewerage within the region, and the likely requirement for ATU provision to treat wastewater to a high standard due to the proximity of the site to the Ellen Brook catchment; and
    - The lack of reticulated water supply within the region, and the reliance on groundwater extraction licences and rainwater tanks unless reticulation is extended in the future.

2.3.1.1 Land Use

The MENSP identifies a range of land uses that are permitted within the Structure Plan area including general, light, rural and service industry uses, consistent with the proposed Scheme amendment.

2.3.1.2 Policy Provisions

The MENSP also includes the following policy provisions in relation to Precinct 2 (south):

1. A landscape buffer of at least 50 metres shall be continued along the southern frontage of the Muchea East Road and shall incorporate wetlands and areas of remnant vegetation.
2. Muchea East Road east of the loop road is to be offset by 90 metres.
3. Lot 50 on Great Northern Highway contains a heritage listed war-time airstrip. The landholder has consulted with the Shire of Chittering and confirmed that the site does not require retention, and is capable of removal as a component of development or subdivision works provided that the heritage status is identified and recognised through this process.
4. The district distributor A loop road shall be designed with provision for potential use as a high wide load route (to MRWA standards). The road shall be constructed as a median separated two-lane road, with an appropriate road reserve to provide for a future four-lane dual carriage way:
    - The design vehicle shall be an A-triple road train;
    - The design shall be for an operating speed of 60 km/hr; and
    - Drainage of the road shall be through the use of swales.
5. The developer shall construct appropriate access roads which tie into the loop road, and suit the lot size and layout of the development.
6. Low water use type industries with a minimum lot size of 10,000m^2 may be established in this area unless the developer can demonstrate, that wastewater generated can be adequately managed as per the requirements outlined in the water management strategy or a more detailed local water management strategy.
7. For lots that do not require subdivision prior to development occurring, primary wastewater treatment shall be via aerobic treatment units followed by secondary treatment in evaporation ponds due to high groundwater levels.
8. Structures higher than 45 m on Lot 8 Great Northern Highway and 90 m in the rest of the precinct require referral to the RAAF.

These provisions are addressed in the following sections of this report:

- Landscaping – refer **Section 2.7.2.2** and **Appendix H**;
- Moving and access – refer **Section 3.9**; and
- Servicing – refer **Section 3.10**.

2.3.1.3 Sensitive Land Use Buffers

In relation to the various land use buffers identified over the subject site, the Muchea Employment Node Structure Plan notes that these buffers should be noted, and they do not impose any restriction on the future industrial development of the land.

2.3.1.4 Development Contribution Plan

The MENSP notes that a Development Contribution Plan (DCP) is intended to be prepared to require developers to provide contributions to district and local level infrastructure. It is understood that the Shire has decided not to prepare a DCP, and as such if there is any infrastructure which requires cost sharing, it will need to be addressed by private landowner agreements in accordance with State Planning Policy 3.6 *Infrastructure Contributions*.

2.3.1.5 Zoning

The MENSP proposes a 'Future Industry Zone' over the subject site, which would be a new zone in LPS 6, and require Scheme Amendments to be prepared to introduce the zone and facilitate the rezoning.

Following liaison with the DPLH and Shire of Chittering, it is requested the subject site is zoned 'General Industry' under LPS 6, consistent with the *Planning and Development (Local Planning Schemes) Regulations 2015.*

2.3.2 Muchea Industrial Park Structure Plan (April 2022)

The Muchea Industrial Park Structure Plan has been approved by the WAPC as an update to the 2011 Muchea Employment Node Structure Plan in response to:

- the early arrival of Northlink which provides direct interchange access into the industrial park;
- changes to State policy, particularly regarding catchment management and environmental assets;
- the planned relocation of triple road train assembly facilities from Wubin (235km north) to Muchea and upgrades to Great Northern Highway;
- a need to review economic drivers and assumptions made in the 2011 plan; and
- a need to set better direction for essential services, where there is no existing water or wastewater servicing.

The subject site is identified as General Industry, with a possible Future RAV 10 road providing an east-west connection through the site from the Great Northern Highway to Precinct 4. An indicative RAV 10 loop road is also identified over the site, connecting the Structure Plan area with Northlink, intended to perform a distributive function to open up land for industry with RAV 10 access across the industrial park.

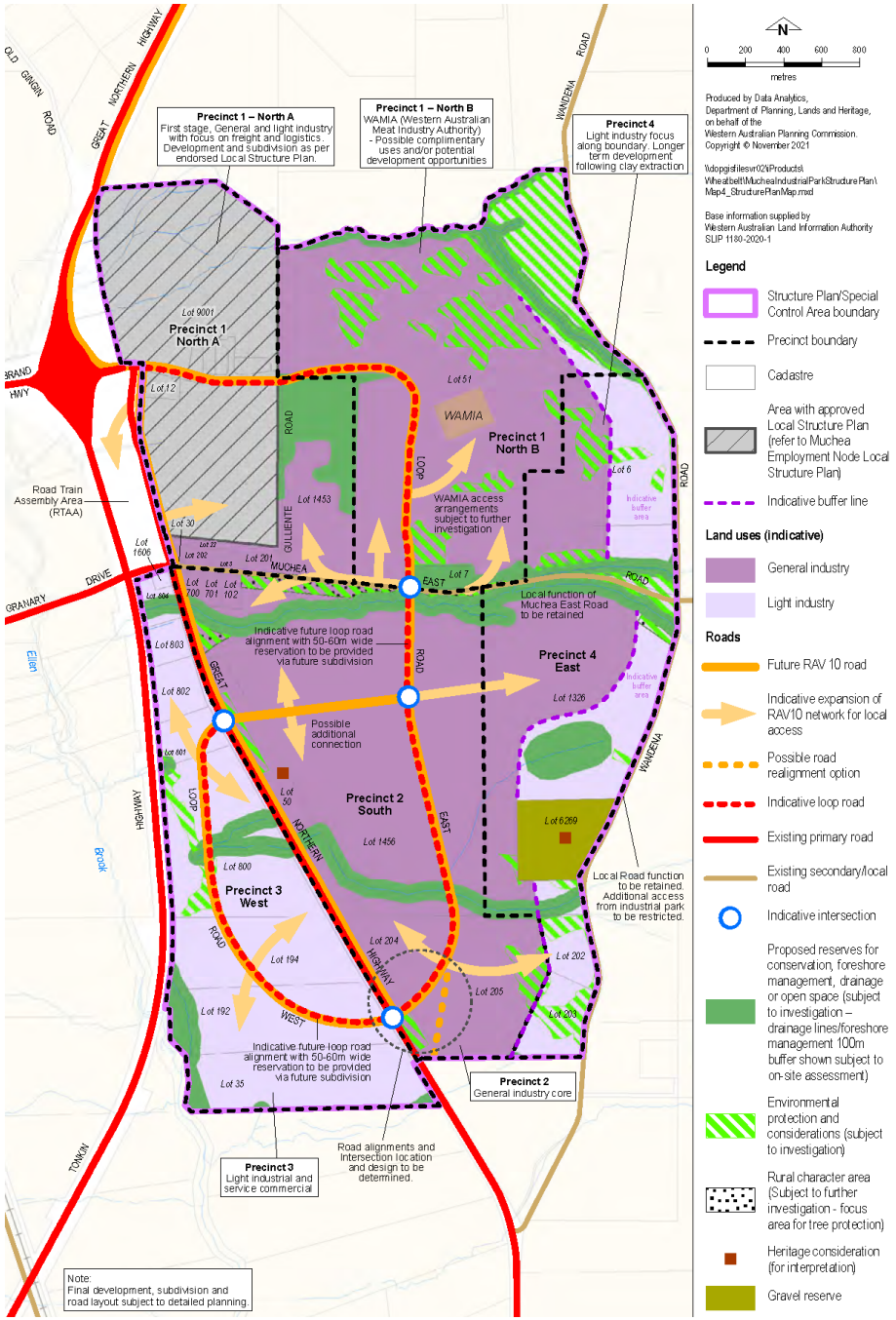


Figure 6 Muchea Industrial Park Structure Plan

2.3.3 Bullsbrook Freight and Industrial District Structure Plan

The DPLH are currently preparing the Bullsbrook Freight and Industrial District Structure Plan over the portion of land south of the subject site. The purpose of the Structure Plan is to provide a clear strategic vision for future development of the industrial land, service infrastructure and transport requirement to support the Bullsbrook intermodal terminal, and provide for long term employment opportunities.

The Structure Plan will enable greater accessibility to the subject site, and support the development envisaged under the Scheme Amendment.

2.4 Planning Strategies

2.4.1 State Planning Strategy 2050 (2014)

The *State Planning Strategy* outlines strategic goals and State strategic directions for the future land-use planning and development of Western Australia. The *Strategy* recognises land suitable for strategic industrial areas is limited, and aspires to ensuring project-ready industrial land is secured given its strategic importance to the State. The proposed Scheme amendment is consistent with the State's objectives outlined in the *State Planning Strategy*.

2.4.2 Perth and Peel @ 3.5 million (2018)

The subject site is located outside of the *Perth and Peel @ 3.5 million* area, although the *North-East sub-Regional Planning Framework* recognises Muchea as an employment node, which will be developed for service-based land uses such as transport, livestock, fabrication, warehousing, wholesaling and general commercial uses, and provide employment opportunities for people living within the north-east sub-region.

It is also worth noting that the nearby Bullsbrook townsite is identified in the document as a centre for expansion for the north-east sub-region. The document also identifies the intermodal terminal at Bullsbrook, which will enable greater accessibility to the subject site, and promote Muchea as an emerging employment node for the expanded Bullsbrook townsite and surrounding areas.

2.4.3 Wheatbelt Regional Planning and Infrastructure Framework (2015)

The *Wheatbelt Regional Planning and Infrastructure Framework* provides an overview of regional planning issues and a basis for ongoing planning and development.

The *Framework* acknowledges the large Employment Node at Muchea, and recognises the importance of serviced industrial land as a regional asset that can provide opportunities in the short and long-term for the establishment of new industries in, and relocation of existing industries, to the Wheatbelt.

The proposed Scheme Amendment is consistent with the intent of the *Framework*.

2.4.4 Shire of Chittering Local Planning Strategy (2019)

The *Shire of Chittering Local Planning Strategy* establishes direction for future population growth and sets our broad strategies and actions for housing, industrial and business uses.

The *Strategy* identifies the Shire's intention is to direct industrial uses to the Muchea Industrial Park, and promote a variety of land uses that are related to, and compatible with, primary production. In order to support development of the Muchea Industrial Park, the *Strategy* seeks to limit the introduction of further sensitive land uses within one kilometre of the Muchea Industrial Park, to allow the area to be developed with a range of industrial uses, and to ensure that any amenity impacts from the industrial area do not affect sensitive land uses.

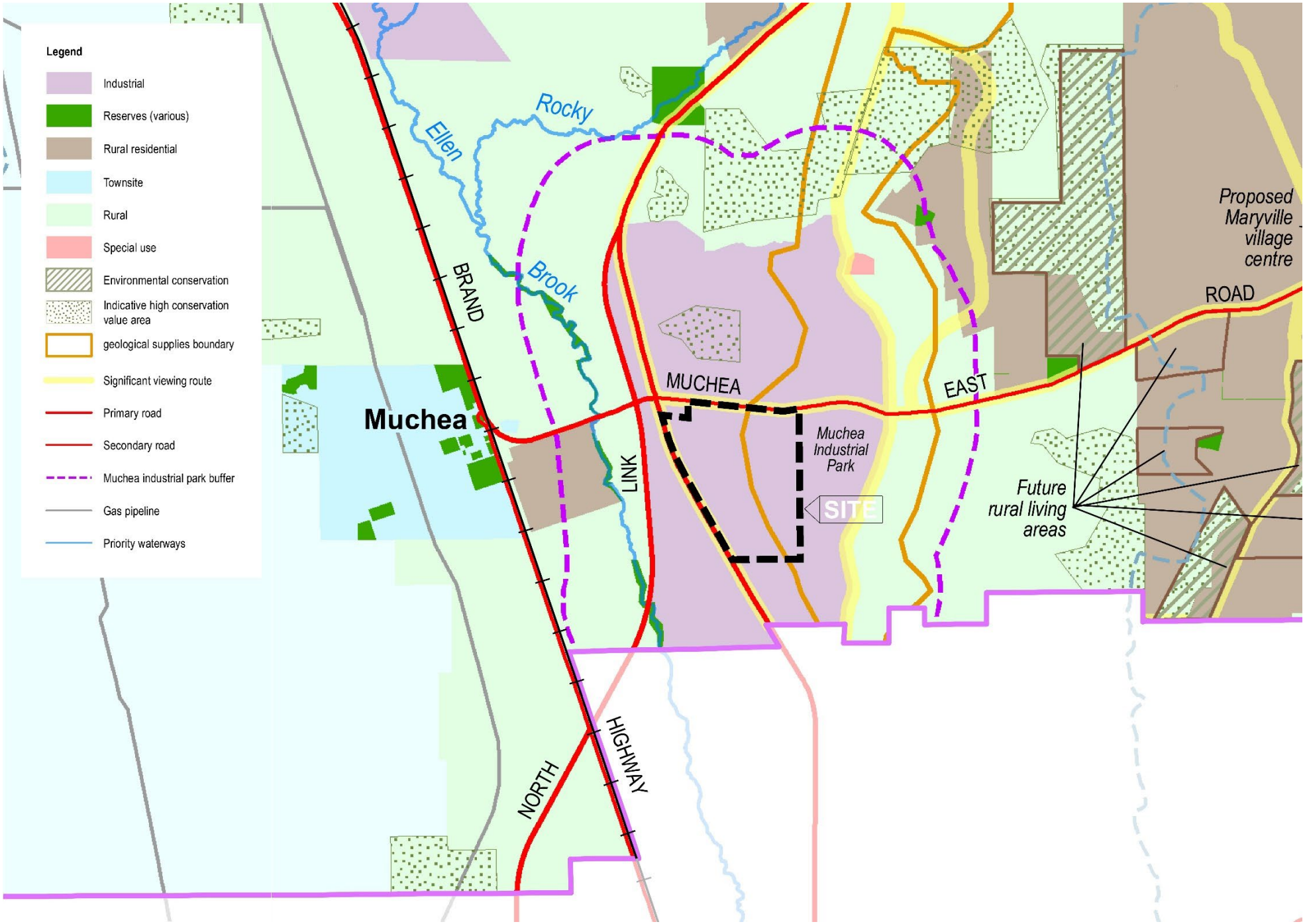


Figure 7 Shire of Chittering Local Planning Strategy Extract

2.5 State Planning Polices

2.5.1 State Planning Policy 2.4 Planning for Basic Raw Materials (July 2021)

The WAPC released an updated version of State Planning Policy 2.4 *Planning for Basic Raw Materials* (SPP 2.4) in July 2021. The key objective of SPP 2.4 is to enable the responsible extraction of basic raw materials used in building and development, while ensuring the protection of people and the environment.

The policy recognises BRM is a finite source and promotes the importance of ensuring a continuing supply of BRM for extraction in support of regional development and agriculture.

Importantly, the policy recognises that identified BRM sites does not presume that extraction would have acceptable community amenity, health of environmental impacts, not that approval of extraction would be guaranteed.

The policy differentiates basic raw material areas into three categories as follows:

- Significant Geological Supply (SGS) areas
- known, proposed, approved or operating extraction sites (ES)
- exclusion areas – known or proposed sites excluded from BRM extraction due to environmental values, resource conflicts or for land use planning reasons.

The subject area partially falls within an identified Significant Geological Supply (SGS) area as shown in **Figure 10.** This is not considered to constrain the proposed industrial development of the precinct, and is further outlined in **Section 5.1.3.5**.

2.5.2 State Planning Policy 3.7 Planning in Bushfire Prone Areas

State Planning Policy 3.7 *Planning in Bushfire Prone Areas* (SPP 3.7) assists in reducing the risk of bushfire to people, property and infrastructure by encourage a conservative approach to strategic planning, subdivision, development and other planning decisions proposed in bushfire prone areas. SPP 3.7 applies to all land which has been designated as bushfire prone by the Fire and Emergency Services Commissioner as identified on the Map of Bushfire Prone Areas.

The subject site is identified as bushfire prone, and accordingly a Bushfire Management Plan (BMP) has been prepared and has informed the Development Concept Plan design. The BMP details how SPP 3.7 and the bushfire protection criteria outlined within the *Guidelines for Planning in Bushfire Prone Areas* can be satisfied, and includes a Bushfire Attack Level (BAL) assessment.

A copy of the BMP is included in **Appendix E** and discussed further in **Section 3.3**.

2.5.3 State Planning Policy 4.1 Industrial Interface

The purpose of State Planning Policy 4.1 *Industrial Interface* (SPP 4.1) is to protect industry and infrastructure facilities from the encroachment of incompatible land uses and ensure that planning decisions consider the locational constraints of these land uses, the significant investment they represent and their current and future benefits and costs to the community when considering the most appropriate land uses for the surrounding land.

The policy requires that new industry be located to adequately separate industrial land uses from incompatible land uses.

The subject site is surrounded by rural land zoned ‘Agricultural Resource’ to the north, east, south and west, with a pocket of industrial land zoned ‘Industrial Development’, ‘General Industry’ and ‘Light Industry’, located north of Muchea East Road. As such, there are a limited number of ‘sensitive land uses’ located in proximity to the subject site, comprising a small number of residential dwellings.

2.6 Local Structure Planning Context

2.6.1 Precinct 1A

The Muchea Employment Node – Lot 102 Great Northern Highway Structure Plan was approved by the WAPC in October 2017, and covers Precinct 1A of the Muchea Industrial Park, being a 149ha parcel of land to the north of the subject site (refer **Figure 8**).

The Structure Plan provides for the development of the first stage of the Muchea industrial precinct, and serves as a catalyst for further industrial development within the Muchea Employment Node. The Structure Plan identifies the majority of the land as 'General Industrial', with the corresponding objectives, land use permissibility and development standards prescribed for the zone under LPS 6 applicable.

2.6.2 Precinct 3

The Precinct 3 Muchea Industrial Park Structure Plan was prepared in October 2019 over Precinct 3 of the Muchea Industrial Park, being the 185ha area of land west of the subject site (refer **Figure 8**).

The Structure Plan provides the detailed planning framework to deliver the industrial area in and timely and coordinated manner, in a form that will facilitate flexibility in lot size and layout; and enable access and manoeuvrability within the estate for industrial vehicles.

The Structure Plan provides for approximately 51 lots of approximately 1.3ha to 7.6ha, providing flexibility for a range of industrial uses, expected to be primarily transport logistics related.

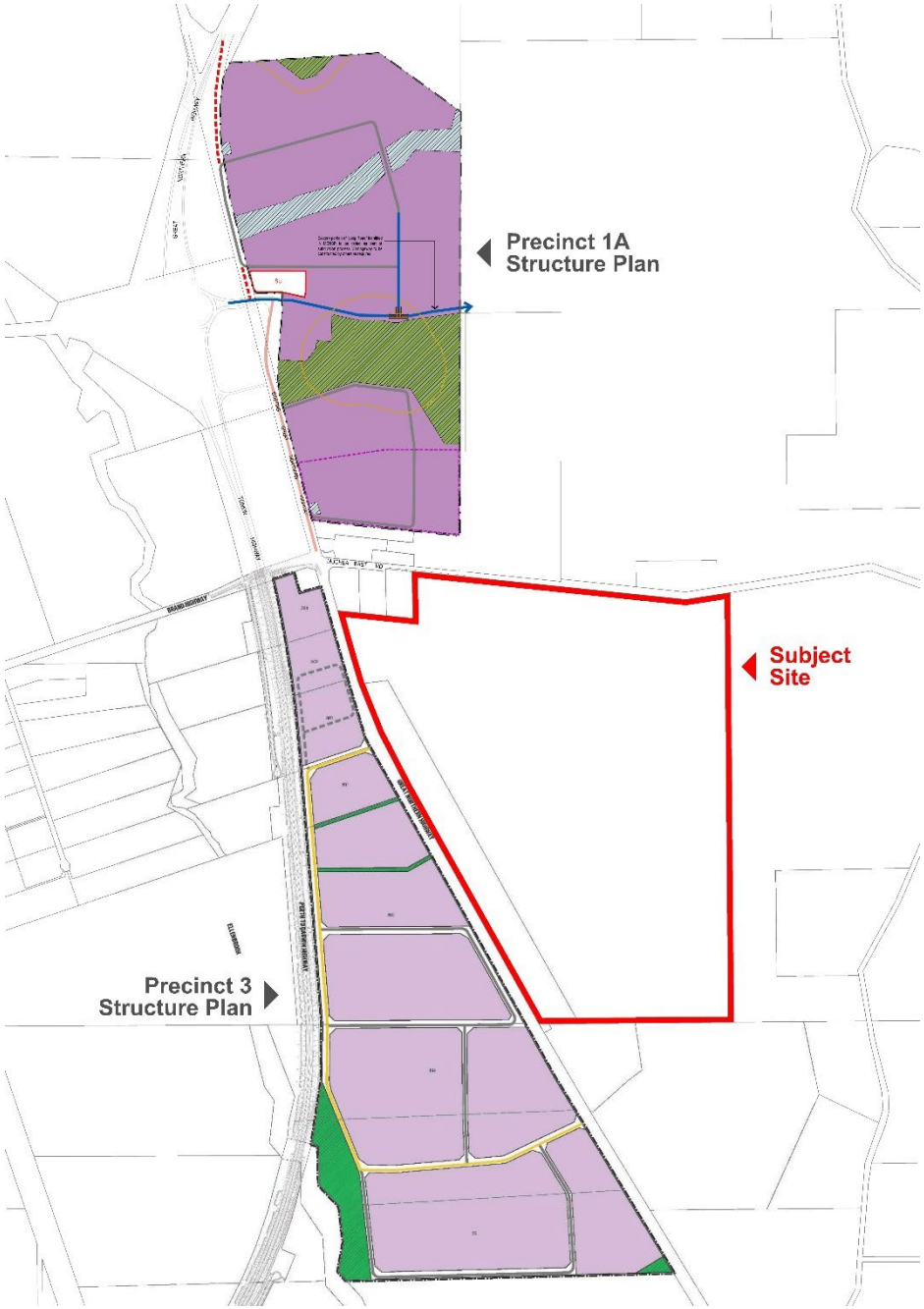


Figure 8 Local Structure Planning Context

2.7 Local Planning Policy Framework

2.7.1 Local Planning Policy No. 6 – Water Supply and Drainage

The Shire's Local Planning Policy No. 6 – Water Supply and Drainage (LPP 6) provides guidance on the provisions relating to water courses, water supply and drainage works under Clauses 5.8, 6.3, 8.2 and 9.2 of LPS 6.

The following objectives of the LPP have been addressed in the Local Water Management Strategy included in **Appendix D**:

- To ensure safe and healthy water supply and drainage;
- To minimise environmental impact on water resources and associated vegetation;
- To avoid visual or aesthetic impact on landscape values from water works/development;
- To prevent future land and water use conflicts;
- To place minimal restrictions on farmers;
- To clearly identify responsibilities for construction and use of water infrastructure.

The proposed Scheme Amendment will enable the specific provisions of LPP 6 to be addressed through future subdivision and development application stages over the subject site.

2.7.2 Local Planning Policy No. 33 – Muchea Industrial Park Design Guidelines

The Shire of Chittering's Local Planning Policy No. 33 - Muchea Industrial Park Design Guidelines (Design Guidelines) have been prepared to guide landowners and assist the Shire in achieving a high standard of development within the Muchea Employment Node Special Control Area.

The Design Guidelines provides a range of guidance for landowners and developers, including:

- Land Use and Industrial Design; and
- Site Planning and Building Design.

2.7.2.1 Land Use and Industrial Design

The Design Guidelines identify land use permissibility shall be in accordance with LPS 6, having due regard to any approved Structure Plans applicable to the area, with the design of industrial buildings to be guided by the proposed land use.

Reticulated water service is required for general industrial land uses, however in the event a licenced reticulated water scheme is not provided and connected to the MIP reticulated system, permissible land uses will be limited.

2.7.2.2 Site Planning

The Design Guidelines includes provisions relating to site planning which have been addressed / will be addressed in future planning stages as follows:

- **Site cover** – requires development to contribute to the desired streetscape in order to create attractive, high-quality built from within the MIP.

  The Scheme Amendment will facilitate the subdivision and development of industrial land uses, which will have regard to the site cover including existing vegetation, suitable lot sizes, and the soil conditions of the site, which can be achieved as demonstrated on the Development Concept Plan included in ***Figure 12.***

- **Streetscape** – requires development to address and activate the street in order to create an attractive and safe environment within the MIP.

  Future development will be required to achieve the minimum street setbacks specified in the Design Guidelines to ensure an attractive and safe streetscape is accommodated.

- **Stormwater management -** Stormwater is required to be managed appropriately and in accordance with an approved Urban Water Management Plan, to minimise stormwater runoff and impacts on the surrounding land.

  Stormwater has been designed in accordance with the LWMS contained in ***Appendix D****, and will be subject to a UWMP at the subdivision stage.*

- **Effluent disposal** – is required to be managed in accordance with Scheme requirements to ensure no adverse environmental or health impacts within the MIP or surrounding land, and in accordance with the draft Government Sewerage Policy 2016.

A Land Capability Assessment has been completed for the site to determine the suitability for on-site effluent disposal. The assessment details that all effluent generated on site can be treated and disposed by means of individual on-site effluent disposal systems, with different treatment systems required on each lot depending on soil profile, groundwater depth and expected site population. Site testing on each lot prior to development will be required to determine the optimum location and type of disposal system.

- **Road design** – the road network is required to ensure safe and efficient movement of traffic, permit RAV access and egress, and consider the dual use/ shared pathways to ensure safety of pedestrians and cyclists.

  *The Transport Impact Assessment contained in **Appendix F,** demonstrates the road network intended through the Scheme Amendment as illustrated on the Development Concept Plan (**Figure 12**), has been established in line with the MIPSP with controlled access through an internal road system with a limited number of access points to the Great Northern Highway to ensure safe vehicular movement.*

  A loop road is also identified which connects to the Great Northern Highway, north and south of the Muchea East Road intersection and loops the northern and southern precincts intersecting with Muchea East Road, reducing traffic on the Great Northern Highway.

  The road network will accommodate RAV 10 vehicles, which integrates with the MIPSP RAV 10 road network.

  Additional traffic modelling and analysis undertaken at the subdivision stage will inform the accurate design and cross sections of key roads, which aligns with this requirement of the Design Guidelines.

- **Earthworks** – all earthworks are required to be completed in a manner that supports and implements an approved urban water management plan and stormwater management plan, having regard to streetscape objectives of the MIP.

  *The Geotechnical Report contained in **Appendix I** provides guidance for the likely earthwork requirements for the site, which will be used to inform he earthworks strategy at the subdivision stage, to address this requirement of the Design Guidelines.*

- **Fencing** – is to promote passive surveillance of the public realm and ensure safe, attractive and coordinated streetscapes.

  Any fencing proposed at the development stage will address this requirement as part of a development application.

- **Landscaping** – development is to incorporate quality native landscaping that performs on a function, aesthetic and sustainable level, with landscaped areas maintained and managed to ensure survival.

  *A Landscape Masterplan contained in **Appendix H**, has been prepared which reflects the requirements of this provision. Detailed landscaping plans will also be provided at the development application stage.*

- **Signage** – is required to be sensitively designed and located to not detract from the façade or streetscape, and not be excessive in scale or quantity.

  Signage will be addressed as part of future development applications to address this requirement.

- **Entry statements** – should use natural material with local themes.

  Entry statements will be subject to future development applications, and will address this requirement of the Design Guidelines.

- **Parking and service access** – Developments are to incorporate sufficient on-site car parking to be designed and located to minimise any adverse impacts on the streetscape. The design and location of vehicle access points to meet the needs of businesses whilst not compromising safety, building design or drainage swale functionality.

  Parking to be addressed as part of future development applications in accordance with the provisions of the Design Guidelines.

- **Storage areas** – Storage and hard stand areas are to be located and constructed to minimise any adverse visual impacts and to protect the amenity of the MIP from dust, run off and contamination.

  Storage and hardstand to be addressed as part of future development applications in accordance with this provision of the Design Guidelines.

- **Setbacks to Ellen Brook and Buffers to Sensitive Land Uses** – To protect designated conservation areas, including Environmentally Sensitive Areas, Conservation Category Wetlands and vegetation protection areas from inappropriate impacts associated with adjacent development.

*The Development Concept Plan contained in **Figure 12** demonstrates protection of the watercourse along the northern edge of the site through a 60m wide foreshore buffer, as well as protection of vegetation along the frontage to Great Northern Highway through an Environment and Rural Character Protection area. These elements will be adopted through the Structure Plan for the subject site.*

- **Conservation Area Interface** – To provide a suitable interface between industrial development and conservation areas which protects environmental assets from encroachment by industrial uses and provides effective access for fire management and maintenance purposes

  *The Development Concept Plan contained in **Figure 12** demonstrates protection of the watercourse along the northern edge of the site through a 60m wide foreshore buffer, which will be adopted through the Structure Plan for the subject site.*

- **Bushfire Management** – development required to take into account fire protection requirements and ensure adequate protection measures achieved to avoid increase in threat of bushfire to people, property and infrastructure.

  *The BMP contained in **Appendix E** details the bushfire protection requirements required to provide an adequate standard of bushfire protection for the proposed rezoning.*

2.7.2.3 Building Design

The Design Guidelines contain criteria relating to building and sustainable design, which will be addressed through future development applications upon completion of the Scheme Amendment.

Section

3.0

Site Conditions

3.0 Site Conditions

3.1 Environment

A review of the environmental attributes of the site, as well as site specific investigations were undertaken by Bayley Environmental Services in support of this Scheme Amendment. The Environmental Assessment and Management Strategy (EAMS) is included in **Appendix C.**

3.1.1 Topography

Tallangatta is located on the western footslopes of the Gingin Scarp, just west of the Darling Fault. The site slopes generally westward from a high point of 93m AHD in the north-east to a low of 53m AHD at the north-west corner. The gradient averages about 2.5%. The steepest slopes are in the north-east, reaching up to 10% in places.

3.1.2 Geology and Soils

The geological map for the area indicates the majority of the site to be underlain by the Guildford Formation consisting of clay, sand, silt and gravels. Quartz sand is noted in the centre and along the eastern boundary, with lateritic gravels towards the north eastern corner.

3.1.2.1 Acid Sulphate Soils

The DBCA maps the site as Low to Nil risk of Acid Sulphate Soils (ASS). Bore sampling undertaken in August 2017 found no indicators of potential or actual ASS in the groundwater. No further investigation of ASS is considered necessary.

3.1.2.2 Contamination

The DWER Contaminated Sites Database shows no records of contamination on the subject site. A desktop study carried out for the Muchea Employment Node Structure Plan identified a number of sites of possible contamination in the greater Employment Node; however, it was unknown whether any of these sites were on the subject site. As such, it is recommended that a detailed contamination study be undertaken to determine if there is any contamination on the subject site. However, based on the previous land uses on the subject site, it is expected that any contamination found will be low-level, localised and readily remediated to a level suitable for industrial use.

3.1.3 Flora and Vegetation

The subject site is cleared except for a number of scattered paddock trees, and a small group of denser trees around the creekline in the north-eastern corner. The paddock trees are mostly mature Marri and Wandoo with a few Jarrah.

Flooded gums are present near the creekline in the north-east corner of the subject site.

No Threatened Flora pursuant to the *Biodiversity Conservation Act 2016* or the *EPBC Act 1999* were recorded on the subject site during the site surveys. Given the degree of clearing, it is unlikely that any rare or threatened species or communities would be present.

3.1.4 Fauna

The largely cleared subject site offers little habitat for native fauna, apart from disturbance-tolerant species such as kangaroos and birds which might nest in some trees.

3.1.4.1 Significant Fauna

A search of the relevant databases was undertaken, which produced an extensive list of Threatened Fauna species, Priority Fauna species, and otherwise significant species from the search area.

A review of the significant fauna which may exist determined the majority of these species would be unlikely to be present based on the vegetation and habitats.

3.1.4.2 Black Cockatoo Habitat

The subject site contains vegetation types that are potential food and habitat sources for the black cockatoos, and therefore a Black Cockatoo Habitat Assessment was undertaken.

Feeding habitat

Although the subject site contains vegetation which may provide food resources for black cockatoos, no direct or indirect evidence of feeding was observed on the subject site.

Roosting habitat

The assessment found that it is unlikely that black cockatoos would roost in the subject area based on the lack of feeding habitat and nature of vegetation in the subject site.

Breeding habitat

The assessment found 39 potential cockatoo breeding hollows within trees on the subject site, however an inspection of the hollows found no evidence of current or previous black cockatoo nesting was found.

Therefore, there is no evidence of black cockatoos on the subject site, or particular trees which are required to be protected.

3.2 Hydrology

A Local Water Management Strategy (LWMS) has been prepared for the site by Bayley Environmental Services to support the Scheme Amendment (refer **Appendix D**). Key aspects of the existing hydrology of the site are listed below.

3.2.1 Surface Water

A significant creek flows from east to west along the northern edge of the subject site. Two smaller drains flow across the site near the southern boundary. The remainder of the subject site would drain by sheet flow during heavy rainfall.

All drainage from the site flows eventually into Ellen Brook, the major drainage feature of the region.

Flow calculations demonstrate some protection works (such as revegetation) may be necessary on the north creek line to reduce the risk of flooding under a 100-year storm event occurring.

Capture of surface water, while possibly feasible in particular circumstances, is unlikely to be a viable water supply option for the whole estate.

3.2.2 Groundwater

Groundwater flows from east to west beneath the site, at a gradient of between 0.01 and 0.02. Regional mapping by DWER shows superficial groundwater present at minimum elevations of 48m to 55m AHD.

Groundwater measurements have also been undertaken, enabling the Average Annual Maximum (AAMGL) and Maximum (MGL) groundwater levels at the site to be calculated. The calculations demonstrate that the AAMGL is within one metre of the ground surface in parts of the west, south and north-west of the site. The AAMGL is predicted to intersect the ground surface in small areas in the west, south and north-east.

Filling and/or subsoil drainage is likely to be necessary in areas of the site where the depth to groundwater is less than 1.5m in order to provide groundwater clearance for roads, buildings and effluent disposal.

3.2.3 Groundwater Resources

The subject site is within the Gingin Groundwater Area (GWA) for the superficial and surficial aquifers, the Southern Scarp sub-area for the semi-confined (Mirrabooka) aquifer, the Cowalla sub-area for the confined Leederville-Parmelia aquifer and the Chandala sub-area for the Yarragadee aquifer

The DWER has advised that the superficial aquifer resource is fully allocated but 1,600 ML/a is available for allocation in the surficial aquifer. In the deeper confined aquifers, the Leederville aquifer (Cowalla Subarea) has a total of 17,617 ML/a, which is fully allocated, and the Yarragadee aquifer (Chandala Subarea) has 1,050 ML/a, of which 194 ML/a is available for allocation.

3.2.4 Wetlands

The north-west and north-east corners of the subject site are mapped as Multiple Use Wetlands by the DBCA. Multiple Use Wetlands are degraded and regarded by the DBCA as developable, provide that the hydrological functions of the wetland are maintained.

3.2.5 Land Capability

As part of the LWMS, a Land Capability Assessment was undertaken to determine the suitability for on-site effluent disposal. The assessment concludes on-site effluent disposal can be accommodated on the site, with different effluent disposal requirements for each lot depending on the soil profile, groundwater depth and expected site population. Site testing on each lot prior to development will be required to determine the optimum location and type of effluent disposal system.

3.3 Bushfire Management

The entire site is designated as a "bushfire prone area" in the state Map of Bush Fire Prone Areas (DFES 2019), and accordingly bushfire hazards are required to be considered in accordance with SPP 3.7.

A Bushfire Management Plan (BMP) has been prepared by Eco Logical Australia to support the Scheme Amendment and considers the potential mitigation and management of bushfire in accordance with SPP 3.7 (refer **Appendix E**).

As part of the preparation of this document, a Bushfire Hazard Level (BHL) Assessment has been prepared which provides an indication of potential bushfire impact on the subject site by providing a likely intensity based on the classified vegetation, which demonstrate the vegetation has a moderate to extreme BHL rating.

A post-development BHL is also provided, which takes into the account the assumption that the entire subject site will be managed in a low threat state as per the Guidelines and AS3959-2018.

As demonstrated in the Development Concept Plan, there are areas of revegetation along the creekline in the north of the site, and minor drainage swales within the road reserves which are proposed to be revegetated with shrubs and have been considered in the post-development BHL assessment.

The BMP considers that the current on-site vegetation is not considered to be a bushfire hazard 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.

On this basis, the BMP concludes the bushfire protection requirements listed in this assessment provide an adequate standard of bushfire protection for the proposed rezoning. As such, the proposed rezoning is consistent with the aim and objectives of SPP 3.7 and Guidelines.

3.4 Heritage

The DPLH online database contains two registered Aboriginal heritage sites on or near the subject site:

- DAA 3525: Ellenbrook – Upper Swan (mythological); and
- DAA 20008: Gingin Brook Waugal Site (mythological, camping, hunting, plant resource, water source).

The DPLH has advised the gazetted boundary of Site DAA 3525 intersects with the northern boundary of the subject site.

As such, an application under Section 18 of the *Aboriginal Cultural Heritage Act 1972* (as amended) will be required before any ground-disturbing development work is undertaken in the affected area.

3.5 Odour

Two poultry farms are located approximately 200m west of the subject site, and another located about 300m to the north. The Muchea landfill is located 1.5km to the north-east.

The EPA recommends a buffer of 300-1000m between poultry farms and sensitive land uses, and a 1000m buffer for putrescible landfills. The term "sensitive land uses" is most often applied to residential uses, but in some instances may also be applied to some commercial and light industrial uses requiring a high level of public amenity.

The presence of the existing poultry farms may constrain high-amenity uses such as retail from areas in the south west of the subject site, however given the relatively small size of the poultry farms, the required buffers are likely to be at the lower end of the EPA's recommended range.

Industrial uses within the subject site that produce odour or other emissions may require buffering from sensitive land uses outside the site. This is unlikely to be a significant constraint to the property for industrial uses, with land use allocation to be established through the Structure Plan, taking these considerations into account.

3.6 Noise

The westerns side of the subject site currently experiences high levels of noise from the Great Northern Highway; however, the level of noise has diminished significantly since the opening of the new Tonkin Highway which reduced the volume of traffic on this part of the Northern Highway.

Noise sensitive premises (residences) are located in Muchea, 1,200 metres west of the subject site, and isolated residences are located west of the Great Northern Highway, north and south of Muchea East Road.

Other noise sources include an active clay quarry 100m east of the site, and air traffic from Pearce RAAF Base approximately 7km to the south. Future noise sources will include industry to the north, south, east and west of the site as part of the Muchea Industrial Park.

Active management of noise within and from the subject site will not generally be required. Any industries with high noise emissions may be restricted to certain areas of the Structure Plan, and may require technical analysis to determine separation requirements at the Development Application stage.

3.7 Dust

Future industrial land uses may generate significant amounts of dust depending on the nature of the activities carried out and the ground surface. Individual landholdings within the subject site will be required to manage dust generation determined at the development application stage, and will require to hold a DWER licence which will specify the dust limits and monitoring requirements.

3.8 Existing Movement Network

A Transport Impact Assessment has been undertaken by Transcore to determine the extent of constraints to evaluate traffic flows that would be generated by the development intended under the proposed Scheme Amendment, and determine the ability for the additional traffic to be accommodated in the future regional road network in the area.

The following provides a summary of the main findings of Transcore's transport impact assessment, with a full copy included in **Appendix F.**

3.8.1 Road Network and Access

The Muchea Industrial Park, including the subject site is located at the junction of three primary distributor roads being the Great Northern Highway, Brand Highway and Tonkin Highway (North Link). Muchea East Road is a regional distributor, and Wandena Road, to the east of the industrial park, is a local distributor.

3.8.2 Great Northern Highway

Great Northern Highway runs north-south connecting Midland with the far north regions of WA, passing through a number of major agricultural and resource industry nodes. It is a Primary Distributor Road under the care and control of Main Roads WA, and is generally a two-lane, single carriageway road with a speed limit of 110km/h in the vicinity of the subject site.

The recently constructed North Link is expected to take significant volumes of regional traffic, particularly heavy vehicles, away from the Great Northern Highway.

Great Northern Highway is classified as Restricted Vehicle Access 7 (RAV 7), and is planned to be upgraded to RAV 10.

3.8.3 Muchea East Road

Muchea East Road extends eastwards of Brand Highway, providing an important east-west link to Chittering Road to the east. It is classified as a Regional Distributor Road, under the control of the Local Government. It is currently constructed as a single carriageway two-lane road.

Muchea East Road is classified as RAV 7 in the vicinity of the subject site.

3.8.4 Changes to Surrounding Network

The major changes to the surrounding road network are in accordance with the Muchea Industrial Park Structure Plan, are the completion of the Northlink project, including an interchange directly adjoining the industrial park, and planned RAV 10 upgrades of portions of the Great Northern Highway.

Planned changes also include the proposed loop road which will run through the subject site and have two intersections on Great Northern Highway, resulting in access to the subject site being shifted to the loop road instead of Muchea East Road. The loop road is intended to provide high-capacity freight route and access opportunities for future development within the Muchea Industrial Park, with capacity for RAV 10 vehicles.

3.8.5 Public Transport

There are currently no bus services to the subject site. The Midland to Geraldton railway line is located west of the subject site. The large scale industrial land uses proposed for the site would make the feasible provision of public transport difficult to achieve.

3.8.6 Pedestrian and Cyclist Facilities

There are currently no pedestrian and cyclist facilities surrounding the subject site. As noted in the Muchea Employment Node Structure Plan, the industrial nature of the area would make the provision of a pedestrian network difficult.

3.9 Proposed Movement Network

The proposed internal road network will be in line with the WAPC's Development Control Policy 4.1 Industrial Subdivision (DC 4.1) for Industrial Estates, Muchea Employment Node Structure Plan, and Muchea Industrial Park Structure Plan. All roads and intersection accommodating RAV 10 vehicles will need to be designed to safely accommodate RAV 10 vehicles in accordance with MRWA specifications.

The loop road will be designed as a single carriageway standard road with a 40m road reserve. The internal roads are not expected to carry more than 5,000vpd, and therefore 20m road reserves with 10m traffic lanes are considered to be sufficient for all internal roads.

More detailed modelling and analysis would be required during the subdivision stages to inform the accurate design.

3.9.1 Traffic generation

The proposed land uses for the subject site are predominantly general industry uses, which have a trip rate of 5vpd per 100sqm of Gross Floor Area (GFA).

Assuming the GFA would be about 20% of the total efficient land area, it is anticipated the total trip generation for the site is estimated to be 16,840 vpd.

3.9.2 Intersection Analysis

The proposed intersection controls include:

- Roundabouts at the intersection of the loop road with Great Northern Highway; and
- Left-in, left-out intersection between the roundabouts on Great Northern Highway to improve the traffic operations and safety.

The details of the subject site layout and internal and external intersection will be confirmed through further detailed traffic modelling and analysis during subdivision stages of the project.

Intersection analysis undertaken indicates satisfactory traffic operation of the existing signalised intersection of the Great Northern Highway and Muchea Road East during the AM/PM peak hours, assuming full development of the subject site.

3.10 Servicing Considerations

Peritas has prepared an engineering servicing report for the subject site. The following is a high-level summary of the report in support of the Scheme Amendment. A copy of the report is included in **Appendix G**.

3.10.1 Road Network

The subject site can be accessed via the Great Northern Highway or the new North Link extension.

Once the proposed Loop Road is provided, access will be available to the north, south and west between Precincts, 1, 2 and 3. Until such time as the connection of the Loop Road is facilitated and completed, however, a series of temporary road connections or other arrangements will be required.

3.10.2 Drainage

The drainage system will be designed to maintain surface flow rates and volumes within and from the developed site at their pre-development levels, and include the following elements:

- **Through drainage**: the existing creekline at the north-east of the site will be retained and protected within a POS reserve. The two artificial drainage lines that enter towards the south-east corner of the site will be realigned into roadside bioretention swales, sized to accommodate the 100-year ARI. A series of weirs within the swales will capture and infiltrate the 1-year ARI.

  The swales will be converted to living streams and densely planted with sedges and shrubs to slow the water flow and help remove sediments and nutrients from the water.

- **Lot drainage**: Runoff from roofs, paved surfaces and hardstand areas within private lots from storms to 1-year ARI will be retained and infiltrated within each lot in soakwells, swales, basins and/or landscaped areas. The excess runoff from each lot will be accommodated in roadside swales.
- **Internal road drainage**: Runoff from public roads up to the 1-year ARI will be retained and infiltrated in roadside bioretention swales.
- **Major storm drainage**: Road runoff and lot overflows from larger storms will flow along the swales and enter roadside drains and culverts in Great Northern Highway.

3.10.3 Water Supply

The subject site is beyond the Water Corporation's reticulation area, with the nearest Water Corporation asset located approximately 11km south-east of Muchea. Due to restricted potable water, fit for purpose water supply will be critical.

The Leederville aquifer is likely to be the preferred source for potable water supply due to its generally higher quality and lower risk of contamination. Potable water will be supplied by a licensed water provider (likely to be Muchea Water (Aqua Ferre)).

Non-potable groundwater demand is likely to be limited to landscape irrigation. Purchase of water entitlements from existing licensed users within or outside of the project area is likely to be necessary.

The landowner will liaise with existing license holders with a view to purchasing an existing groundwater allocation, and will submit a groundwater licence application to DWER in due course.

3.10.3.1 Waste-Water

The recommended waste-water management approach is by on-site treatment using an Aerobic Treatment Units (ATU), which has been confirmed to be suitable for the subject site as detailed in the Land Capability Assessment included in the LWMS in **Appendix D.**

3.10.4 Gas

There are not currently any gas services within the vicinity. Future landholdings will be required to install their own gas storage tank if gas supply is required.

3.10.5 Power

A 3 phase 1kV-33kV overheard High Voltage (HV) distribution line is located along Great Northern Highway, which appears to be located within the subject site. The Western Power Network Capacity Forecast 2026 indicate up to 30MVA remaining capacity in 2026, which is more than adequate to service the entire subject site.

Given future industrial land uses will have different power requirements, it is difficult to forecast the power requirements for the Precinct. As such, an application will be made to Western Power to confirm connection location and capacity at the detailed design stage for each lot.

3.10.6 Communication

Telstra fibre optics are located along the western verge of the Great Northern Highway.

The NBN network is also scheduled to be provided to the area.

4.0 Opportunities and Issues

Having regard to the previously discussed background and consideration, an opportunities and issues plan has been prepared for the subject site (refer **Figure 9** and **Figure 10**). The Development Concept Plan contained in **Figure 12** has been prepared to give rationale and justification to its considerations to be rezoned (refer **Section 5.1.1**).

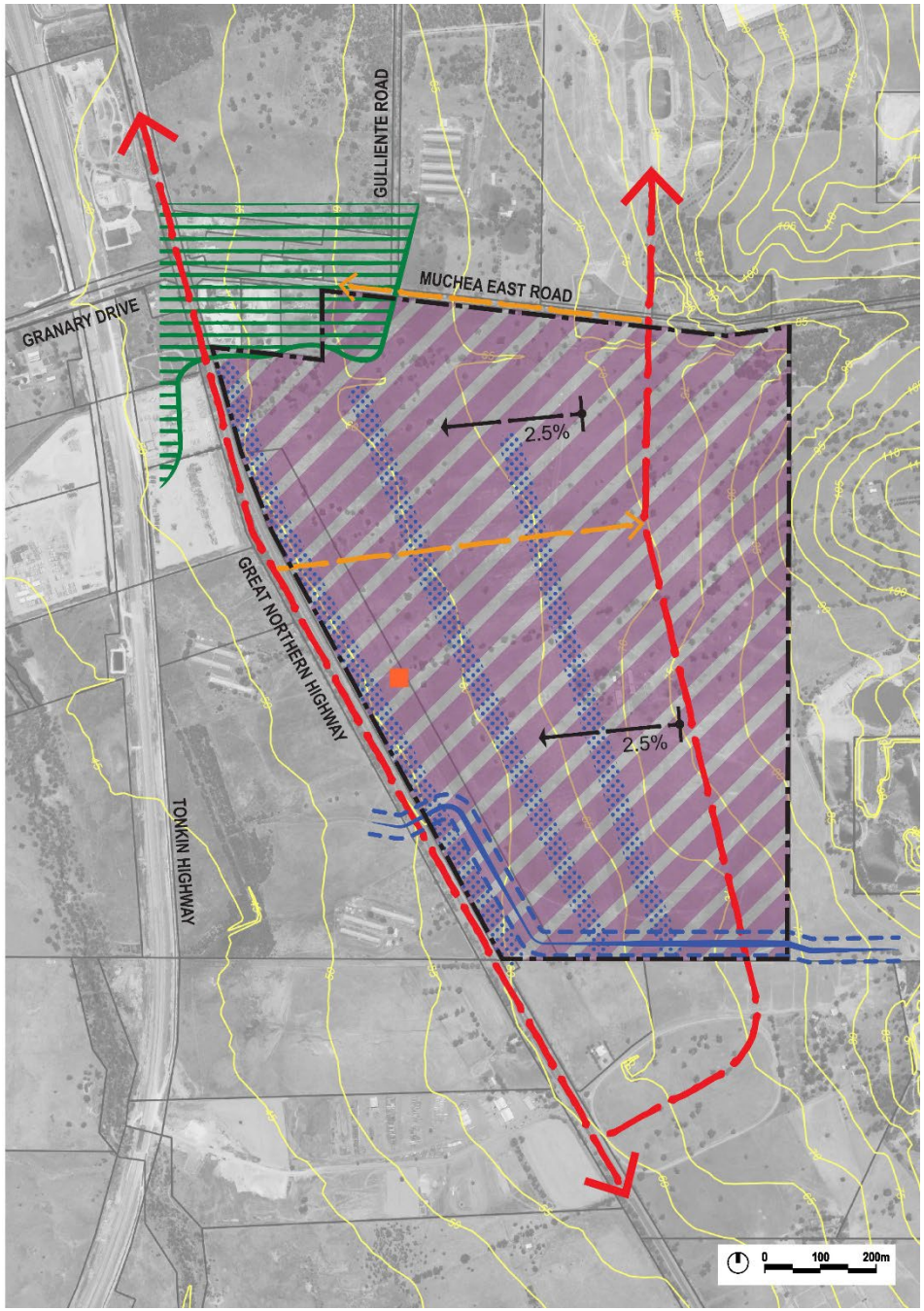


Figure 10 Site Opportunities

Subject Site

Key Opportunities

Land Use:

Zoning – Proposed General Industrial zoning provides for diversity of land uses, lot size's and configuration; consider any additional convenience uses/locations to support industrial enterprises

Heritage – Potential to interpret past land use activities and incorporate as place theming for estate

Engineering:

Topography – Moderate 2.5% gradient over site offers flexibility for engineering response – site fall from east to west

NOTE **Groundwater –** Mitigate quantity of site-filling required to achieve groundwater separation by providing larger lots and specific land uses to the western extent of the site

Drainage Management – Co-locate bio-retention swales with future roads (determine widths) for development efficiencies;

Staging considerations for temporary drainage areas and/or connectivity to culverts/treatment areas

Environmental:

Wetlands – Multiple Use Wetland located in north-west of the site – degraded and regarded by DPAW as developable

Watercourses - Opportunity to realign southern drainage line with introduced road structure (consider culvert locations at Great Northern Highway).

NOTE **Vegetation** – DPAW – no recorded rare or priority flora

Movement:

RAV10 Network – Proposed loop configuration provides direct access through site

Expansion opportunities to future RAV 10 network

NOTE **Staging** – Consider implementation pragmatics for proposed subdivision structure – i.e. temporary turning movement for RAV10

Subject Site

Key Issues

Land Use:

Heritage Site – Identified heritage considerations adjacent Great Northern Highway *(Source: Draft Muchea Industrial Park Structure Plan [Context Plan])* – further evaluation required

Basic Raw Materials – Clay – extent and quality to be assessed for appropriate response *(Source: https://catalogue.data.wa.gov.au/dataset/regionally-significant-basic-raw-materials-1-100-000/resource/4ad2a91d-6d9c-4248-9d3e-a31252cad766?view_id=3bd074a3-2f83-439a-922c-a720248c7852)*

Environmental:

Watercourse(s) - Ephemeral northern natural creek 5-10m wide, depth of 1m east and 0.5m west – drains an upstream catchment of 360ha and 250ha within the property. Southern constructed drainage line – 4-8m wide, 0.5m deep – drains upstream catchment of 117ha and 3ha within the property

Flooding – Seasonal overtopping - approximately 15m either side of northern natural creek at western extent; Southern drain – nonapplicable

Fauna – Carnaby's and Forest Red-tailed Black Cockatoos potentially occur at site – extent and response to be determined. Scattered paddock trees, some large and potential for feeding/roosting or nesting

Wetlands – Multiple use wetland located in north-west of the site – degraded and regarded by DPAW as developable

Vegetation – Locations to be considered in future development. North east location of denser trees along creek line – possibly flooded gums with potential for retention in creek floodway buffer

NOTE **Fire Management –** Potential implications of foreshore location to be considered

NOTE **Aboriginal Heritage Site –** DAA 3525 potentially intersects northern site boundary – section 18 may be required

Environmental (cont.)

Odour – Consideration of adjacent existing poultry farm effective EPA buffers 300-1000m – implications on sensitive land use locations to the west/south. Note: future Industrial uses that produce odour must be located to limit impact on existing isolated properties

Engineering:

Topography – Generally moderate 2.5% gradient over site increases to 10% for north-east location – site fall from east to west

Groundwater – Superficial groundwater at minimum elevations of 48-55m or 50-60m seasonally varied | filling and/or subsoil drainage will be required below 70mAHD

Drainage Management – Requirement for bio-retention solution within site – locations and configuration to be considered

Culvert locations – Regard sites for future road/drainage alignments within subdivision pattern

Movement:

RAV10 – Identified access locations *(Source: Draft Muchea Industrial Park Structure Plan [Context Plan])* – for further evaluation.

NOTE Consider cross section detail required for RAV10 loop road; Evaluate probability of road widening to Great Northern Highway to achieve upgrade to RAV10 – impact on site area

NOTE Consider Intersection design and landtake at Muchea East Road

Access – Direct lot vehicle access restricted from Great Northern Highway

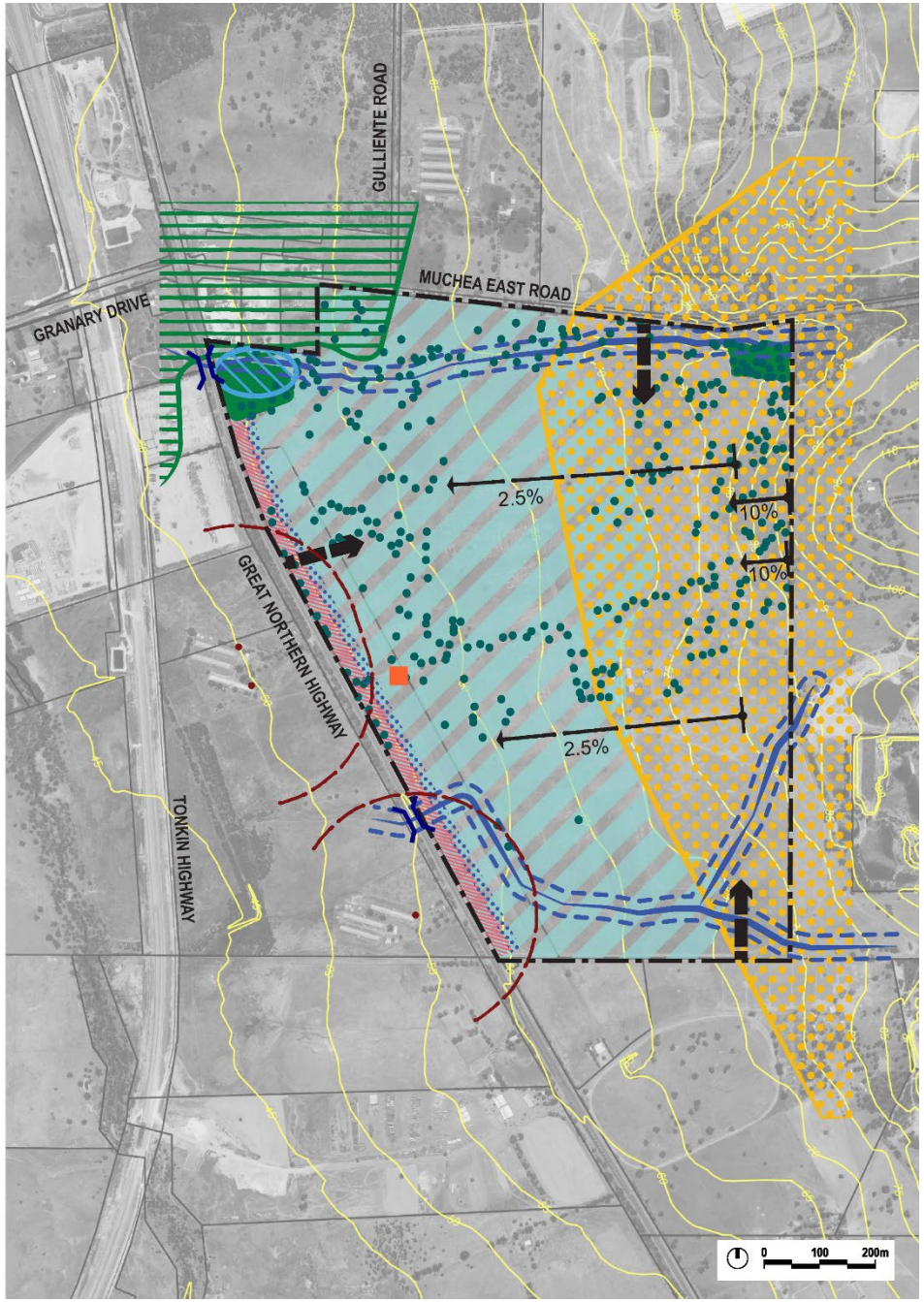


Figure 11 Site Issues

Section

4.0

Proposed Amendment

5.0 Proposed Amendment

5.1 Rezoning of Subject Area

The land subject of this Scheme Amendment is proposed to be zoned General Industry under LPS 6.

The intent is for the amendment to accommodate a range of industrial uses on the subject site such as livestock, fabrication, warehousing, wholesaling and general commercial uses, which will not detrimentally impact upon residential and other sensitive land uses outside of the General Industry zone, noting that:

a) A minor modification is proposed to the use permissibility to accommodate the integration of a small commercial precinct which supports the broader industrial estate. This precinct is envisioned to potentially accommodate a Service Station or Roadhouse (existing P uses). The Scheme Amendment proposes two additional uses: Tavern (as a D use); and Restaurant (as a D use).

b) Clarifying provisions are to be included in Schedule 11 to outline the extent of management plans and analysis required at structure planning, subdivision and development application stages.

5.1.1 Rationale for Proposal

The proposed amendment is considered suitable for initiation by the Shire of Chittering based on the following rationale:

a) Consistent with Long Term Strategic Planning

The proposed amendment is consistent with the State and Regional objectives of diversifying the regional economy within the Chittering area and contributing to the sustainability and self-sufficiency of the regional economy.

The proposal is wholly consistent with the WAPC's Muchea Employment Area Structure Plan (2022) as it reflects the expectation that the subject area is largely unconstrained and subject to detailed planning is suitable to accommodate general industrial uses.

It is also wholly consistent with the Shire of Chittering's strategic planning framework, and particularly with draft Shire of Chittering's *Local Planning Strategy* (2020) and Shire's industrial design guidelines.

b) Consistent with Scheme Requirements

This amendment report addresses each of the criteria outlined within the Scheme to facilitate the Shire's support for an amendment within the Muchea precinct.

Of specific relevance to this application is Clause 5.7.2.2 which outlines the requirements for zoning proposals within the SCA, which are briefly summarised as follows:

- Details of the stormwater and wastewater management in an environmentally sustainable manner, which has been addressed in **Section 3.10.2** and **Appendix D**;
- Consideration of impacts on flora and fauna, which has been addressed in **Sections 3.1.3, 3.1.4** and **Appendix C**;
- Details of the potential impacts and buffers from waterways and wetlands, which has been addressed in **Sections 3.1.3, 3.1.4** and **Appendix C**;
- Demonstration of the land capability to accommodate the uses proposed, which has been addressed in **Section 3.2.5 and Appendix C**;
- Desktop review of the Aboriginal heritage significance, which has been addressed in **Section 3.4** and **Appendix C**; and
- Review of other relevant matters, including access and egress to basic raw materials, which are addressed throughout the report.

On the basis of the rationale outlined it is considered appropriate for the Shire of Chittering to initiate the amendment as proposed and progress the document to public advertising following referral to the Environmental Protection Authority.

5.1.2 Proposed Council Resolution

It is proposed that the Shire of Chittering resolve to amend Local Planning Scheme No. 6 by:

1. Rezoning Lots M1456 and Lot 50 Great Northern Highway, Muchea from 'Agricultural Resource' zone to the 'General Industry' zone and amending the scheme map accordingly (refer **Figure 11**);
2. Amending Schedule 11 – Muchea Employment Node Special Control Area by including provisions for Precinct 2A of the Muchea Industrial Precinct as follows:

No	Description of Land	Conditions
3	Precinct 2A (P2A) of the Muchea Industrial Park – Lot M1456 (3488) and Lot 50 Great Northern Highway, Muchea	General planning matters applicable to the Muchea Industrial Park are set out in clauses 4.9, 4.20 and 5.7 of the Scheme. The purpose of this schedule is to identify more detailed planning matters relevant to this precinct. **1. Structure Plan** 1.1. Prior to the subdivision and development of the land, a structure plan is to be prepared and approved in accordance with Schedule 2 of the *Planning and Development (Local Planning Schemes) Regulations 2015* and the relevant Scheme requirements. 1.2. Part 1 of the Structure Plan is to make provision for – i. A centrally aligned loop road designed to carry Class 10 Restricted Access Vehicles (RAV 10), having regard to the general requirements of the Muchea Industrial Park Structure Plan. ii. A functional movement network, providing for: a. suitable road reserve widths for accommodating road, footpath and verge drainage infrastructure in a manner consistent with project traffic volumes, functionality and integration with the broader road (RAV 10) network; b. limited number of access points to Great Northern Highway and the loop road; and c. an indicative lot layout that demonstrates capability to accommodate efficient RAV 10 access to all General Industry lots within the precinct. iii. Staging details to facilitate orderly development within the precinct. Details to address temporary access arrangements, road upgrades, construction of an appropriate footpath network, intersection treatments, public land requirements and cost sharing responsibilities. iv. Identification of reserves for conservation, foreshore management, drainage and/or public open space. v. The identification of any significant features and management strategies to retain features and/or respond to how potential impacts are to be avoided or managed within acceptable limits, to the satisfaction of the local government and in consultation with relevant agencies. These features may include, but not limited to: a. Environmental features; b. Aboriginal heritage; and/or c. Heritage listed sites. vi. Servicing strategy to include concept earthworks and design fill levels; vii. Reasonable and sustainable fill requirements for anticipated industrial uses and development, and details for timing, implementation and responsibility. viii. A Landscape Master Plan to be prepared and submitted to provide the landscaping strategy, species selection and plan density for:

No	Description of Land	Conditions
		a. Preservation of rural character including large original trees in prominent locations along Great Northern Highway and Muchea East Road, where identified as contributing to visual landscape character; b. Conservation, foreshore management and/or public open space reserves; c. Swales and basins based on the recommendations in the Vegetation Guidelines for Stormwater Biofilters in the South-West of Western Australia; d. Effluent irrigation areas; and e. On-site landscaped areas. ix. A Local Water Management Strategy providing additional detail for the structure plan, to ensure that surface and ground water is managed in accordance with State Planning Policy, *Better Urban Water Management*, *Government Sewerage Policy*, the *Muchea Industrial Structure Plan* and its *Regional Water Management Strategy*. The Local Water Management Strategy shall provide, but not limited to, details of: a. Water supply and water efficiency measures for land uses; b. Land capability for on-site effluent treatment with nutrient retention and disposal, having regard to the *Government Sewerage Policy*; c. Stormwater management strategy that identifies sub-catchments and land requirements (including within road reserves and swales) for drainage, bioretention and infiltration, in accordance with water sensitive urban design principles; d. Groundwater management strategy including information about pollutant and nutrient management; and e. Landscaping strategy.

No	Description of Land	Conditions
		2. Subdivision requirements 2.1. Plans and information, including but not limited to the following, are to be prepared in accordance with the following conditions: i. A Site and Soil Evaluation demonstrating appropriate site level requirements and wastewater disposal in accordance with the *Government Sewerage Policy* and Local Water Management Strategy. ii. A Transport Impact Statement (TIS) or Transport Impact Assessment (TIA) to be prepared and submitted as a component of a subdivision application. The Western Australian Planning Commission's *Transport Impact Assessment Guidelines* be used to determine the level of assessment required. The TIA/TIS shall identify the extent and suitability of road network modifications to accommodate the creation of the proposed lots as a component of a subdivision application. iii. An Urban Water Management Plan (UWMP) be prepared and approved prior to the commencement of subdivision works. iv. A Bushfire Management Plan. 2.2. A reticulated water and power supply, operated by licensed operators, shall be provided at the first stage of subdivision. **3. Development** 3.1. Development shall be in accordance with any restrictions and notifications, if applicable, to the lot. 3.2. Development applications to provide details of any emissions and mitigation. 3.3. Development footprints and effluent disposal areas shall be filled in accordance with the relevant Site and Soil Evaluation and Urban Water Management Plan.

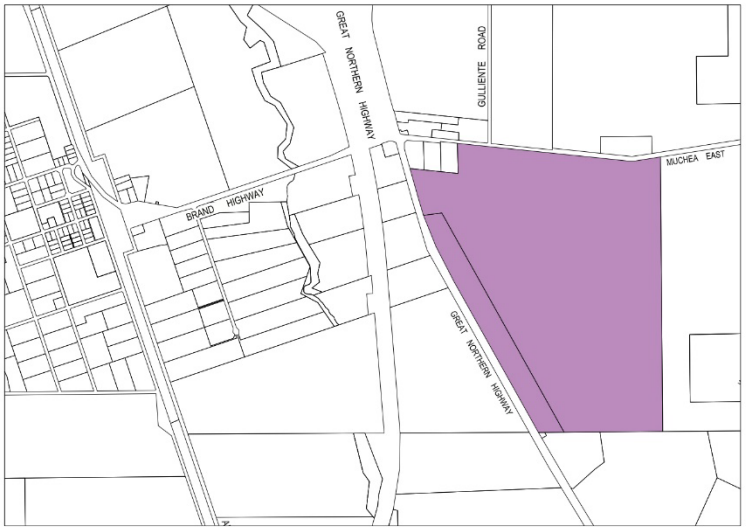
No	Description of Land	Conditions
		4. Additional Uses 4.1. The following are additional uses in Precinct 2A: • Restaurant – D use • Tavern – D use 4.2. Development to be generally in accordance with the Scheme and approved Structure Plan for Precinct 2A of the Muchea Industrial Park. 4.3. The location and suitability of land use and development shall not interfere with: i. Establishment and operation of general industry land uses in Precinct 2A of the Muchea Industrial Park; and/or ii. Safe operation and function of the existing or proposed road network which prioritises RAV 10 vehicle movements.
		5. Conditions 5.1. Pursuant to Clause 34 of *Planning and Development (Local Planning Schemes) Regulations 2015* where reserves for roads, conservation, foreshore management, drainage and/or public open space have been ceded, these may be incorporated onto the Scheme Map as local scheme reserves by means of a basic amendment to the Scheme.

3. Amending the 'List of Contents' and undertaking any other necessary formatting and administrative edits accordingly.
4. Pursuant to Regulation 35 of the *Planning and Development (Local Planning Schemes) Regulations 2015*, determined that the amendment is a 'Standard Amendment' for the following reasons:
   a. The amendment is consistent with the Muchea Industrial Park Structure Plan (April 2022); and
   b. The Amendment is consistent with the Shire of Chittering Local Planning Strategy (October 2019) that has been endorsed by the Commission.

SHIRE OF CHITTERING
Local Planning Scheme No.6
Amendment No. 74

EXISTING

PROPOSED



LEGEND

LOCAL SCHEME RESERVES
- ENVIRONMENTAL CONSERVATION
- HIGHWAY
- MAJOR ROAD
- PARKS AND RECREATION
- RAILWAY
- WATER SUPPLY

LOCAL SCHEME ZONES
- AGRICULTURAL RESOURCE
- INDUSTRIAL DEVELOPMENT
- RURAL RESIDENTIAL
- LIGHT INDUSTRY
- TOWNSITE

OTHER
- A24 ADDITIONAL USES
- LANDSCAPE PROTECTION
- MUCHEA EMPLOYMENT NODE
- BASIC RAW MATERIALS
- MILITARY CONSIDERATIONS
- WATER PRONE
- WATER SUPPLY

LEGEND

LOCAL SCHEME ZONES
- GENERAL INDUSTRY

scale: 1:40,000@A4 | 1:20,000@A2
plan: 20/034/001C
0 250 500 750m
date: 16/12/2022

Figure 12 Scheme Amendment Plan

5.1.3 Planning Considerations for Future Stages

5.1.3.1 Environmental Management

The Environmental Assessment and Management Strategy prepared and included as **Appendix C** is considered suitable both for the progression of the Scheme amendment and a Structure Plan, and has identified that there are minimal environmental issues to be managed, and that each can be managed in accordance with government policy.

More detailed analysis and management plans may be required as conditions of subdivision approval, and these will be considered separately as the staging of development progresses.

5.1.3.2 Stormwater Management

The Local Water Management Strategy prepared and included as **Appendix D** is considered suitable both for the progression of the Scheme amendment and a Structure Plan, and has identified that the subject area can be developed for industrial purposes with a drainage regime consistent with the expectations and guidance provided by *Better Urban Water Management* (DoW 2008).

More detailed analysis and engineering designs will be required as conditions of subdivision and/or development approval, and these will be considered separately as the staging of development progresses.

5.1.3.3 Site Servicing

The Site Servicing report prepared and included as **Appendix G** is considered suitable both for the progression of the Scheme amendment and a Structure Plan, and has identified that the subject area can be developed for industrial purposes subject to the integration of utility service infrastructure as staging progresses.

Of critical importance at the subdivision and development stages will be securing a source of potable water for reticulation throughout the Estate, and the design and management of wastewater disposal dependent on both the land uses nominated and the design of individual sites.

More detailed analysis and engineering designs will be required as conditions of subdivision and/or development approval, and these will be considered separately as the staging of development progresses.

5.1.3.4 Traffic Management

The Traffic Impact Assessment prepared and included as **Appendix F** is considered suitable both for the progression of the Scheme amendment and a Structure Plan, and has identified that the subject area can be developed for industrial purposes consistent with the proposed road network under the WAPC Muchea Industrial Park Structure Plan.

Critical to the implementation to this will be the agreement on staging and funding of key shared infrastructure items with respect to the proposed RAV 10 Loop Road network, and the design requirements of the road network based on the traffic generation created by the subdivision proposed.

More detailed analysis and engineering designs will be required as conditions of subdivision and/or development approval, and these will be considered separately as the staging of development progresses.

5.1.3.5 Basic Raw Materials

Whilst the subject site falls partially within a Significant Geological Supply area under State Planning Policy 2.4 (Planning for Basic Raw Materials) the nature of the zoning and uses proposed are not considered to conflict with the extraction of raw materials on the adjacent site to the east.

The quality of the clay deposit within the subject site has been investigated through the preparation of a Geotechnical Investigation contained in **Appendix I**. It is considered unlikely that the deposit will be viable for extraction into the future, and as such it is anticipated that subdivision and development may progress over this area without conflict with the provisions of SPP 2.4.

More detailed analysis and engineering designs will be required as pre-requisites and/or conditions of subdivision and/or development approval, and these will be considered separately as the staging of development progresses.

5.1.3.6 Development Concept Plan

A Development Concept Plan has been prepared to demonstrate how the opportunities and constraints and issues affecting the land might be addressed through the future planning and design for the land at the structure planning and detailed design level. The Development Concept Plan and a description of its key elements is contained in **Figure 12.**

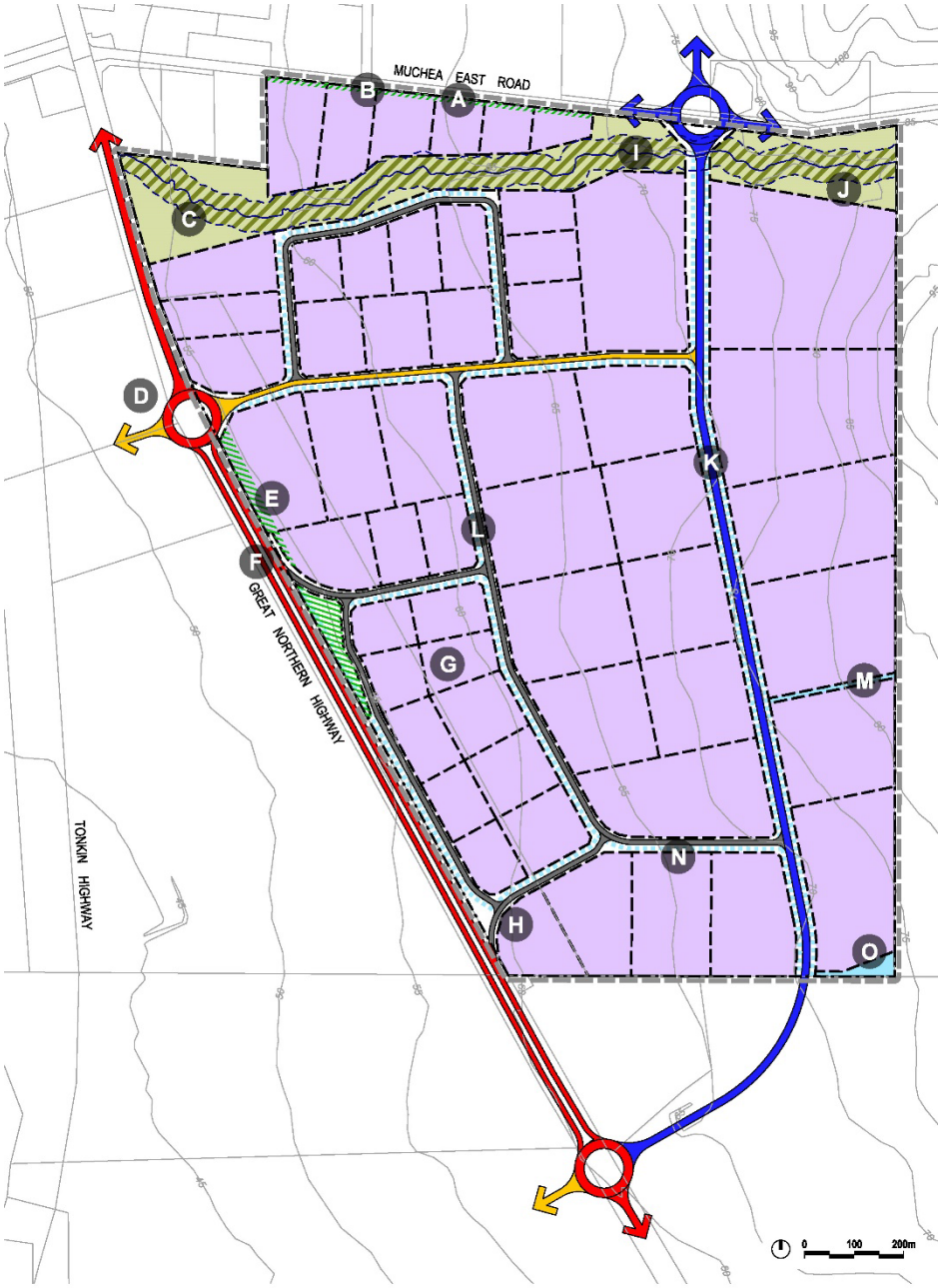


Figure 13 Development Concept Plan

Legend

ZONES

- General Industry

LOCAL RESERVES

- Conservation/Foreshore Management Reserve
- Drainage reserve
- Foreshore buffer (60m width)
- Environmental and Rural Character Protection (tree retention)

OTHER

- Precinct 2 Structure Plan boundary
- Roadside Bio-Retention Swales
- RAV10 Primary Distributor Road
- RAV10 District Distributor Road
- RAV10 Local Distributor Road
- RAV10 Local Access Road

NOTES

A **Maintain Visual landscape character** - preservation of Muchea East Road verge trees

B Development with coordinated **landscaped frontages** as recommendation to achieve rural character in this location

C Configuration provides for retention of existing trees and treatment of local drainage

D Intersection located to align with proposed Precinct 3 to form four-way as per DMIPSP (Roundabout specifications to be confirmed indicated at 40m internal radius and 18.8m carriageway)

E Investigate potential for tree retention on-lot for visual landscape character

F Introduce a **left-in intersection** for local access to improve accessibility for moderate sized lots (non RAV10 vehicles).

G **Lot size diversity** promoted to take advantage of Great Northern Highway exposure with smaller lots located in this area and predominently larger lots adjoining the loop road(s)

H Introduce a **left-out intersection** to aid connectivity for non RAV10 vehicles and independence from delivery of the southern loop road connection by southern land holders. Egress will be limited to light vehicles only

I Proposed drainage and landscaped **foreshore reserve** configured along watercourse as an indicated 60m wide buffer. Incorporate localised flooding at western location

J **Rural character** preserved in proximity of Muchea East Road and creekline through retention of existing trees

K **RAV10** loop road alignment and peripheral intersection locations are consistent with Draft Muchea Industrial Park Structure Plan (DMIPSP)

L **Staging** - RAV10 internal alignment achieves a functional loop without reliance on the northern and southern external connections in the short-medium term

M Drainage Reserve to accommodate overland flows from adjoining site (east to west)

N **Overland drainage** network incorporated within a 10m wide roadside bio-retention swale(s)

O Drainage Reserve to accommodate overland flows from adjoining site (east to west)

6.0 Conclusion

This report outlines that there is substantial rationale and justification for the subject land to be included within the 'General Industry' zone under the Shire of Chittering's Local Planning Scheme No. 6.

The request to amend LPS 6 to rezone the subject land from 'Agricultural Resource' to 'General Industry' to facilitate industrial development is required to accommodate a range of industrial uses on the subject site such as livestock, fabrication, warehousing, wholesaling and general commercial uses, in accordance with the State and local planning framework.

The proposed amendment is considered consistent with the orderly and proper planning for the area for the following reasons:

- The proposed amendment is consistent with the strategic planning framework for the site, including the MENSP and the Muchea Industrial Park Structure Plan;
- The subject land is suitable for being developed for industrial purposes;
- The environmental considerations of the subject site including the existing flora, fauna and wetlands do not pose a significant constraint to development, and can be incorporated into future plans during the Structure Planning and Subdivision phases.
- The subject land is able to be suitably serviced to accommodate the types of land uses which will be accommodated under the proposed General Industry zoning.

Having regard to the content of this request, it is respectfully requested that the Shire of Chittering proceed to initiate an amendment to the LPS 6 to rezone the subject site from 'Agricultural Resource' to 'General Industry', supported by the preparation of a Structure Plan prepared in accordance with the *Planning and Development (Local Planning Scheme) Regulations 2015.*

APPENDIX A

Scheme Amendment

Shire of Chittering
Local Planning Scheme No. 6

Amendment No. 74

Rezoning Lot M1456 and Lot 50 Great Northern Highway, Muchea to 'General Industry'

FORM 2A

Planning and Development Act 2005
Resolution Deciding to Adopt Amendment to Local Planning Scheme
Shire of Chittering
Local Planning Scheme No.6
Amendment No.74

Resolved that the Local Government pursuant to Section 75 of the *Planning and Development Act 2005*, amend the above Local Planning Scheme by:

1. Rezoning Lots M1456 (3488) and Lot 50 Great Northern Highway, Muchea from the 'Agricultural Resource' zone to the 'General Industry' zone, and amending the scheme map accordingly;

2. Amending Schedule 11 – Muchea Employment Node Special Control Area by including provisions for Precinct 2A of the Muchea Industrial Precinct as follows:

NO	DESCRIPTION OF LAND	CONDITIONS
3	Precinct 2A (P2A) of the Muchea Industrial Park – Lot M1456 (3488) and Lot 50 Great Northern Highway, Muchea	General planning matters applicable to the Muchea Industrial Park are set out in clauses 4.9, 4.20 and 5.7 of the Scheme. The purpose of this schedule is to identify more detailed planning matters relevant to this precinct. **1. Structure Plan** 1.1 Prior to the subdivision and development of the land, a structure plan is to be prepared and approved in accordance with Schedule 2 of the *Planning and Development (Local Planning Schemes) Regulations 2015* and relevant Scheme requirements. 1.2 Part 1 of the Structure Plan is to make provision for – i. A centrally aligned loop road designed to carry Class 10 Restricted Access Vehicles (RAV10), having regard to the general requirements of the Muchea Industrial Park Structure Plan. ii. A functional movement network providing for: a. suitable road reserve widths for accommodating road, footpath and verge drainage infrastructure in a manner consistent with projected traffic volumes, functionality and integration with the broader road (RAV10) network; b. limited number of access points to Great Northern Highway and the loop road; and c. an indicative lot layout that demonstrates capability to accommodate efficient RAV10 access to all General Industry lots within the precinct. iii. Staging details to facilitate orderly development within the precinct. Details to address temporary access arrangements, road upgrades, construction of an appropriate footpath network, intersection treatments, public land requirements and cost sharing responsibilities. iv. Identification of reserves for conservation, foreshore management, drainage and/or public open space. v. The identification of any significant features and management strategies to retain features and/or respond to how potential impacts are to be avoided or managed within acceptable limits, to the satisfaction of the local government and in consultation

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3. Amending the ‘List of Contents’ and undertaking any other necessary formatting and administrative edits accordingly.
4. Pursuant to Regulation 35 of the *Planning and Development (Local Planning Schemes) Regulations 2015*, determined that the amendment is a ‘Standard Amendment’ for the following reasons:
    a) The Amendment is consistent with the Muchea Industrial Park Structure Plan (April 2022); and
    b) The Amendment is consistent with the Shire of Chittering Local Planning Strategy (October 2019) that has been endorsed by the Commission.

Dated this …….. day of …… 20……..

……..……..

CHIEF EXECUTIVE OFFICER

Planning and Development Act 2005

RESOLUTION TO AMEND LOCAL PLANNING SCHEME

Shire of Chittering Local Planning Scheme No.6
Amendment No.74

Resolved that the Local Government pursuant to section 75 of the *Planning and Development Act 2005*, amend the above Local Planning Scheme by:

1. Rezoning Lots M1456 (3488) and Lot 50 Great Northern Highway, Muchea from the 'Agricultural Resource' zone to the 'General Industry' zone, and amending the scheme map accordingly;

2. Amending Schedule 11 – Muchea Employment Node Special Control Area by including provisions for Precinct 2A of the Muchea Industrial Precinct as follows:

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SHIRE OF CHITTERING
Local Planning Scheme No.6
Amendment No. 74

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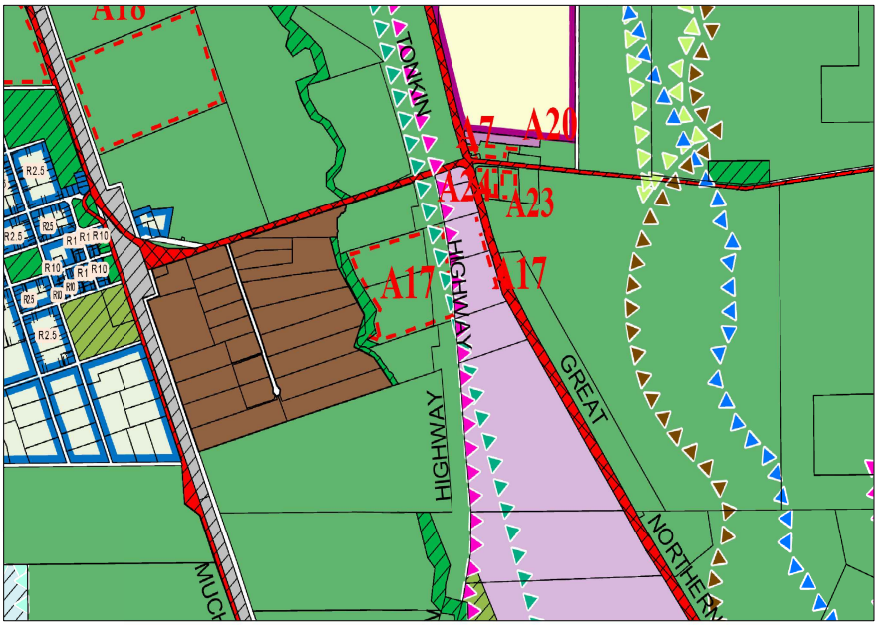

LEGEND

LOCAL SCHEME RESERVES

- ENVIRONMENTAL CONSERVATION
- HIGHWAY
- MAJOR ROAD
- PARKS AND RECREATION
- RAILWAY
- WATER SUPPLY

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- BASIC RAW MATERIALS
- MILITARY CONSIDERATIONS
- WATER PRONE
- WATER SUPPLY

PROPOSED

LEGEND

LOCAL SCHEME ZONES

- GENERAL INDUSTRY

scale: 1:40,000@A4 | 1:20,000@A2

plan: 20/034/001C

0 250 500 750m

date: 16/12/2022

FORM 6A

COUNCIL ADOPTION

This Standard Amendment was adopted by resolution of the Council of the Shire of Chittering at the Ordinary Meeting of the Council held on the ____ day of _____, 20___.

.....
SHIRE PRESIDENT
.....
CHIEF EXECUTIVE OFFICER

COUNCIL RESOLUTION TO ADVERTISE

by resolution of the Council of the Shire of Chittering at the Ordinary Meeting of the Council held on the ____ day of _____, 20___, proceed to advertise this Amendment.

.....
SHIRE PRESIDENT
.....
CHIEF EXECUTIVE OFFICER

COUNCIL RECOMMENDATION

This Amendment is recommended _____ by resolution of the Shire of Chittering at the Ordinary Meeting of the Council held on the ____ day of _____, 20___ and the Common Seal of the Shire of Chittering was hereunto affixed by the authority of a resolution of the Council in the presence of:

.....
SHIRE PRESIDENT

.....
CHIEF EXECUTIVE OFFICER

WAPC ENDORSEMENT (r.63)

.....
DELEGATED UNDER S.16 OF THE P&D ACT 2005

DATE.....

APPROVAL GRANTED

.....
MINISTER FOR PLANNING

DATE.....

APPENDIX B

Certificate of Title

WESTERN AUSTRALIA

REGISTER NUMBER	
M 1456/D6680	
DUPLICATE EDITION **5**	DATE DUPLICATE ISSUED **26/2/2020**

VOLUME **1255** FOLIO **577**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

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

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT M 1456 ON DIAGRAM 6680

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

TALLANGATTA BEEF PTY LTD OF 38 MANDURAH ROAD KWINANA BEACH WA 6167
(T O348995) REGISTERED 19/2/2020

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

1. EXCEPT AND RESERVING METALS, MINERALS, GEMS AND MINERAL OIL SPECIFIED IN TRANSFER 8396/1944.
2. THE LAND THE SUBJECT OF THIS CERTIFICATE OF TITLE EXCLUDES ALL PORTIONS OF THE LOT DESCRIBED ABOVE EXCEPT THAT PORTION SHOWN IN THE SKETCH OF THE SUPERSEDED PAPER VERSION OF THIS TITLE. VOL 1255 FOL 577.
3. *E797718 CAVEAT BY MIDLAND BRICK COMPANY PTY LTD LODGED 13/2/1992.
4. F420749 LEASE TO COMMONWEALTH OF AUSTRALIA OF CARE OF STATE MANAGER, AUSTRALIA PROPERTY GROUP DEPARTMENT OF ADMINISTRATIVE SERVICES, 12-14 ST GEORGE'S TERRACE, PERTH EXPIRES: SEE LEASE. AS TO PORTION ONLY. REGISTERED 12/1/1994.

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: 1255-577 (M 1456/D6680)
PREVIOUS TITLE: 1151-467
PROPERTY STREET ADDRESS: 3488 GREAT NORTHERN HWY, MUCHEA.
LOCAL GOVERNMENT AUTHORITY: SHIRE OF CHITTERING

NOTE 1: O280313 SECTION 138D TLA APPLIES TO CAVEAT M971421

WESTERN AUSTRALIA

REGISTER NUMBER	
50/D12338	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
4	26/2/2020

VOLUME 1255 FOLIO 578

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

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

BGRoberts

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 50 ON DIAGRAM 12338

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

TALLANGATTA BEEF PTY LTD OF 38 MANDURAH ROAD KWINANA BEACH WA 6167
(T O348995) REGISTERED 19/2/2020

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

1. T10184/1948 SUBJECT TO CERTAIN MINERAL AND OTHER RESERVATIONS AS SET OUT IN TRANSFER 10184/1948 WHICH ARE IN ADDITION TO THOSE RESERVATIONS TO THE CROWN CONTAINED IN THE ORIGINAL GRANT. REGISTERED 10/8/1948.
2. TITLE EXCLUDES THE LAND SHOWN ON DEPOSITED PLAN 214326
3. *E797719 CAVEAT BY MIDLAND BRICK COMPANY PTY LTD LODGED 30/1/1992.

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:	D12338
PREVIOUS TITLE:	1111-933
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AUTHORITY:	SHIRE OF CHITTERING

NOTE 1: O280313 SECTION 138D TLA APPLIES TO CAVEAT M971421

APPENDIX C

Environmental Assessment and Management Strategy

TALLANGATTA FARM
LOTS 50 AND 1456 GREAT NORTHERN HIGHWAY, MUCHEA

ENVIRONMENTAL ASSESSMENT AND MANAGEMENT STRATEGY

Prepared for

Tallangatta Beef Pty Ltd
c/- iParks Property Group Pty Ltd
38 Mandurah Rd
KWINANA BEACH WA 6167

Draft Report No. J20008a
11 March 2021

BAYLEY ENVIRONMENTAL SERVICES
30 Thomas Street
SOUTH FREMANTLE WA 6162

Sundowner Nominees Pty Ltd as trustee for the Bayley Cook Family Trust ABN 20 822 598 897
trading as Bayley Environmental Services

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1.0 INTRODUCTION

1.1 Background

Tallangatta Farm (Lots 50 and 1456 Great Northern Highway, Muchea) is located on the corner of Muchea East Road and Great Northern Highway, Muchea. Tallangatta Beef Pty Ltd, the owner of Tallangatta Farm, has applied to the Shire of Chittering for the property to be rezoned from Agricultural Resource to General Industry. The *Muchea Industrial Park Structure Plan* (MIPSP) shows Tallangatta as part of Precinct 2 (General Industry Core) of the Muchea Industrial Park. Figure 1 shows the location of the site within the draft Muchea Industrial Park Structure Plan area.

The total area of Tallangatta is 213 hectares. Figure 2 shows the boundaries of the site. Figure 3 shows a preliminary conceptual plan of subdivision.

The Local Structure Plan for Tallangatta has been submitted to the Department of Planning, Lands & Heritage and the Shire of Chittering, and is currently being considered by these agencies.

1.2 Scope of the EAMS

The scope of this Environmental Assessment & Management Strategy (EAMS) is to:

- document the existing environment of the site;
- briefly describe the proposed development;
- examine the potential impacts of development;
- propose management strategies to avoid or mitigate impacts; and
- outline a proposed monitoring program.

This EAMS is accompanied by a Local Water Management Strategy (LWMS), which deals specifically with water-related matters including water supply, drainage, groundwater management and wastewater disposal.

1.3 Relevant Guidelines and Policies

1.3.1 Better Urban Water Management

Better Urban Water Management (WAPC, 2008) sets out the following objectives for water sensitive urban design:

Water Conservation

- Consumption of 100kL/pp/yr including less than 40-60 kL/p/yr scheme water.

Water Quantity

- Ecological Protection – Maintain pre-development flow rates and volumes for the 1 year ARI event. Maintain or restore desirable environmental flows and/or hydrological cycles.

- Flood Management – Maintain pre-development flow rates and volumes for the 100 year ARI event.

Water Quality

- Maintain pre-development nutrient outputs (if known) or meet relevant water quality guidelines (e.g. ANZECC & ARMCANZ, 2000).

- Treat all runoff in the drainage network prior to discharge consistent with the Stormwater Management Manual.

- As compared to a development that does not actively manage stormwater quality, achieve:

    - at least 80% reduction of Total Suspended Solids;
    - at least 60% reduction of Total Phosphorus;
    - at least 45% reduction of Total Nitrogen; and
    - at least 70% reduction of gross pollutants.

Mosquitoes and Midges

- Design detention structures so that, between the months of November and May, stormwater is fully infiltrated within 96 hours.

- Design permanent water bodies (where accepted by DWER) to maximise predation of mosquito larvae by native fauna.

1.3.2 Shire of Chittering Local Planning Scheme No. 6

"The following development requirements shall apply to the development and subdivision of land within industrial zones and to industrial land uses –

(a) the effect on the environment by means of discharge of pollutants or contaminants into the air, ground and water be avoided, or managed within acceptable limits;

(b) where an on-site wastewater disposal system is proposed –

    i. land capability assessment may be required to demonstrate the capability of the site to manage wastewater and the suitability of the proposed system;
    ii. the use of fill and drains to achieve the required separation from groundwater is to be limited; and

iii. a suitable and unencumbered land application area is to be set aside to distribute treated sewage, where required;

(c) within sewerage sensitive areas secondary treatment systems with nutrient removal are to be utilised;

(d) notwithstanding any other provisions of this scheme, industrial development not connected to reticulated sewerage (for treatment on-site or off-site) is to be restricted to 'dry industry' being land uses that intend to dispose of wastewater on site to the environment of a kind and volume ordinarily discharged from a habitable building at a daily volume of less than 540 litres per 1,000m^2 of the site area [R10 equivalent];

(e) where trade waste is to be managed and/or disposed of on-site or off-site the associated risks must be identified and addressed, including the vulnerability of the receiving environment where relevant;

(f) where a caretaker's dwelling is a discretionary use –

i. only one dwelling be permitted on each lot;
ii. the dwelling is to have a maximum floor area of 100m^2;
iii. the dwelling is to be incidental to the industrial land use;
iv. subdivision of the dwelling from the parent lot will not be permitted;
v. the use of notifications on title may be considered to advise prospective purchasers of potential impacts from noise, dust, odour or amenity that may arise from the location of a residential land use within the zone;
vi. the local government will not consider applications for caretakers' dwellings prior to the primary site activity being either approved or constructed;
vii. where simultaneous approval has been granted by local government for both a caretaker's dwelling and the main activity on the same lot, the main activity must be developed and operational prior to occupation of the dwelling; and
viii. caretaker's dwellings are to be carefully sited and constructed so the potential site (or estate) impacts from noise, dust, odour or amenity are minimised;

(g) in considering rezoning proposals for industrial zones, the local government may require the preparation of a structure plan, and any information relevant to the site conditions, in keeping with the matters listed in clause 67 of the deemed provisions and clause 5.7 of the scheme; and

(h) any other requirement as included in a Local Planning Policy adopted by the local government."

The Scheme shows most of Tallaangatta as part of a Water Prone Area (Ellen Brook Palusplain), within which the following special provisions apply:

"5.3.3 Planning Requirements

The local government will impose conditions on any Development approval relating to -

a) the construction and occupation of any dwelling or outbuilding;

b) the type of effluent disposal system used in this area shall be high performance with bacterial and nutrient stripping capabilities to the specifications of local government and the Health Department and shall be located in a position determined by local government.;

c) minimum floor levels for any building above the highest known water levels;

d) any land use that may contribute to the degradation of the surface or sub-surface water quality.

e) no development other than for conservation purposes will be permitted within 30 metres of any natural water body; AMD 21 GG 3/4/09

f) damming, draining or other developments which may alter the natural flow of surface water will not be permitted unless such works are part of an approved Catchment Management Plan."

Schedule 11 of the Scheme contains the following provisions that apply to the Muchea Industrial Park:

"2.2 Environmental Management Plans

The following Environmental Management Plans shall be prepared and used to inform the design and proposed subdivision and development within the Structure Plan area. They shall be submitted as an additional detail of a Structure Plan unless otherwise determined by the Western Australian Planning Commission.

2.2.1 Local Water Management Strategy

The developer shall submit to the Local Authority a Local Water Management Strategy (LWMS) for approval as an additional detail of a Structure Plan pursuant to clause 5.19 in order to ensure that surface and ground waters are managed with the aim of maintaining the natural water balance. The Local Authority must notify and consult with the authority responsible for water and the environment on the proposed strategy in advertising the Local Structure Plan(s) pursuant to Part 4 of the deemed provisions.

The LWMS shall be prepared in accordance with Better Urban Water Management or its successor document.

The Structure Plan design shall respond to the LWMS required by 2.2.1 and shall be implemented to the satisfaction of the Local Authority, having regard to any advice from the Department of Water.

2.2.2 Environmental Assessment and Management Strategy

The developer shall submit to the Local Authority an Environmental Assessment and Management Strategy for approval as an additional detail of a Local Structure Plan pursuant to Part 4 of the deemed provisions in order to ensure the local structure plan provides a comprehensive and coordinated response to all environmental features within the Structure Plan area and in accordance with the Muchea Industrial Park Structure Plan.

The Environmental Assessment and Management Strategy is to include the following:

- Identification of significant environmental features within the local structure plan area including flora, vegetation, fauna, wetlands and waterways.

- Identification of appropriate management strategies, consistent with industry best practice, to ensure that the local structure plan responds appropriately to these environmental features. Appropriate management strategies might include identification of buffers / setbacks, potential areas of revegetation / rehabilitation, public open space and fauna relocation.

- Consideration of Acid Sulphate Soils (if present) and identification of the likely requirement for ASS management during future planning stages.

- Identification of, and the means for retention and protection of, key cockatoo habitat trees / locations.

- Identification of measures to retain the rural character of views of the Structure Plan area from roads within, adjoining, or in the vicinity of the Structure Plan area, by providing details of vegetation screen planting, as well as the details for the siting and design of structure and major earthworks within the Structure Plan area.

The Local Authority must consult with the relevant environmental agencies regarding the proposed strategy in advertising the Local Structure Plan pursuant to clause 5.19.

The Environmental Assessment and Management Strategy shall be consistent with the EPA's current Guidance Statement No. 33 Environmental Guidance for Planning and Development, or any successor Guidance Statement.

The Environmental Assessment and Management Strategy required by 2.2.2 shall be implemented to the satisfaction of the Local Authority on the advice of the applicable environmental agencies."

This Environmental Assessment and Management Strategy (EAMS) has been prepared to satisfy the requirements of Clause 2.2.2 of Schedule 11.

1.3.3 Government Sewerage Policy

The Government Sewerage Policy (2019) requires that all new subdivision and development should be deep-sewered unless it is exempt for one of several reasons. For exempt developments, the policy establishes minimum site capability requirements and, where appropriate, density limits. In these cases, on-site effluent disposal may be approved where the responsible authority is satisfied that:

- each lot is capable of accommodating on-site sewage disposal without endangering public health or the environment; and
- the minimum site requirements for on-site sewage disposal as set out in the Policy can be met.

The Policy designates certain areas as Sewage Sensitive Areas (SSAs), including land:

- within the coastal catchment of the Swan Estuary; and
- within 1km upgradient or 250m downgradient (or overall 1km where the groundwater gradient is unknown) of a significant wetland.

Additional restrictions and requirements apply to on-site effluent disposal in SSAs, including:

- a minimum lot size of one hectare (unless exempted on a case-by-case basis);
- minimum vertical separation of 1.5m from the discharge point of effluent disposal systems to the highest groundwater table level; and
- secondary effluent treatment systems with nutrient removal.

The Policy shows all of Tallangatta except for about 6ha in the north-east corner within an SSA associated with the Ellen Brook catchment. The remaining 6ha is shown within an SSA associated with a significant wetland. Figure 3 shows the mapped SSAs.

The SSA mapping associated with the wetland is considered to be erroneous. The wetland in question (a Conservation category dampland) is located more than 300m upgradient of the site and is maintained by surface flow and/or locally perched groundwater (the mapped permanent groundwater table is 45-50m below the ground surface), so there is no possibility of groundwater flow from the site to the wetland. This matter is examined further in the LWMS (Appendix A).

2.0 EXISTING ENVIRONMENT

2.1 Rainfall

Muchea, like the rest of the greater Perth region, has a strongly seasonal rainfall, with most of the annual rain falling between May and September in association with winter cold fronts. Occasional heavy falls may occur from summer thunderstorms. The long-term average annual rainfall for Pearce RAAF Base (located 6.5km south of the site) is 679.7mm, of which 77% falls between the months of May and September.

Figure 4 shows a rainfall occurrence chart for Pearce RAAF.

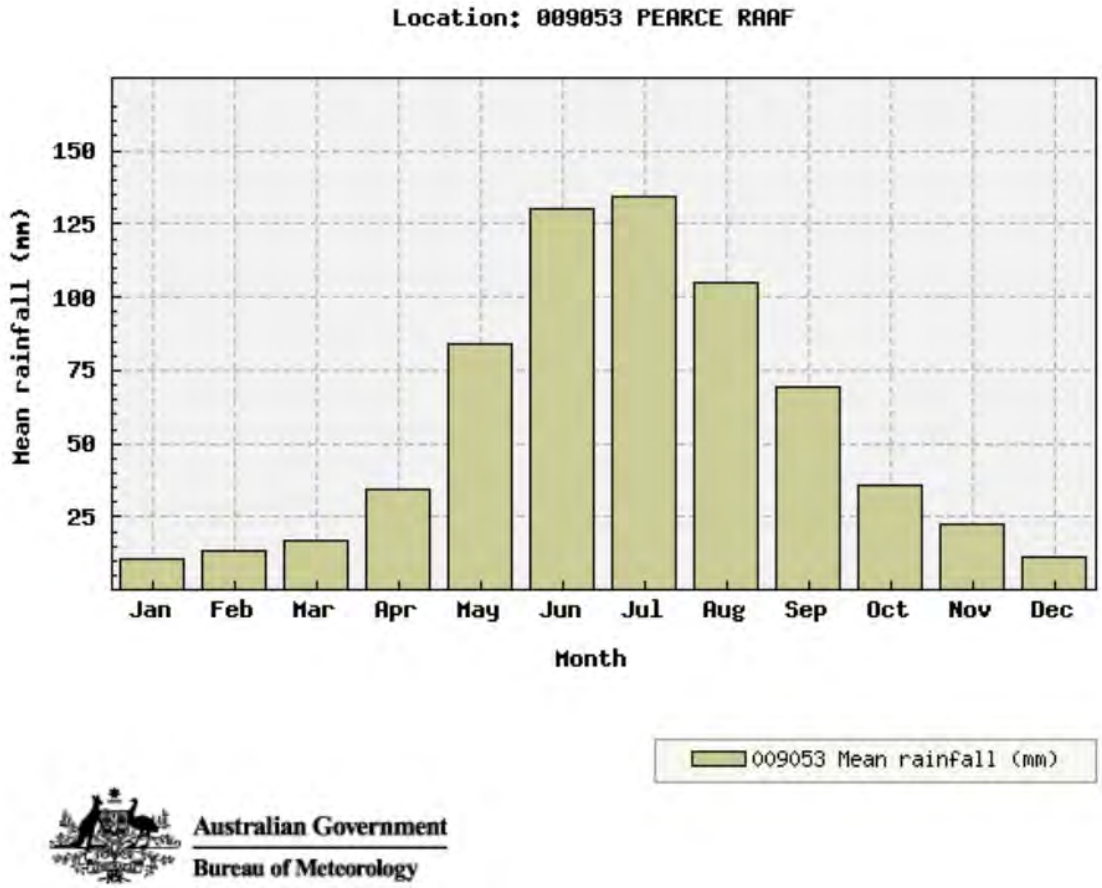

Figure 4 Pearce RAAF Mean Rainfall

2.2 Physiography

2.2.1 Topography

Tallangatta is located on the western footslopes of the Gingin Scarp, just west of the Darling Fault. The site slopes generally westward from a high point of 93m AHD in the north-east to a low of 53m AHD at the north-west corner. The gradient averages about 2.5%. The

steepest slopes are in the north-east, reaching up to 10% in places. Figure 5 shows the topography.

2.2.2 Geology, Landforms and Soils

Most of Tallangatta is mapped by the GSWA (Gozzard, 1982) as Guildford Formation (Qpa), with soils consisting of pebbly silt (Mgs_1). This unit is described as having generally low permeability and shallow groundwater, with a low to moderate capability for effluent and drainage disposal. The foundation stability may vary, with differential settling possible in clayey areas. Sand pads are generally necessary for foundations.

The eastern part of the property is mapped as Colluvium (Qc), with soils of medium to coarse grained brown sand (S_5) and sandy silt (Msg). The S_5 soil type has high permeability and generally high capability for drainage and effluent disposal. The Msg type has low permeability and consequently low suitability for effluent disposal. Both soil types provide good foundations when compacted.

A small area in the north-east of the property is mapped as Leederville Formation (Klb), with soils derived from siltstone (ST_1). This unit is described as moderately stable but prone to weathering when disturbed, with low permeability making it of low suitability for drainage or effluent disposal.

Figure 5 shows the GSWA mapping. Drilling at nine locations across the site in June 2017 (Figure 5) generally confirmed the GSWA mapping. Soil logs from the drilling are attached in the Local Water Management Strategy (Appendix A).

2.2.3 Soil Permeability

The permeability of the site soils will vary depending on the clay content. Test pumping during sampling of the on-site bores indicated hydraulic conductivities in the subsoil (1–5 m bgl) ranging from about 0.06 to 0.42 m/day. The permeability of the top 2m of the soil profile is expected to be higher.

Brown Geotechnical carried out falling-head permeability tests between 0.5m and 1m depth at three locations across the property (Figure 5) in 2020. The tests returned estimated permeabilities ranging from $8.5x10^{-5}$ m/day in dense gravelly sandy clay to 53 m/day in sandy gravel.

For preliminary drainage and effluent design purposes, a permeability of 1 m/day has been assumed. Constant-head permeability tests in accordance with the method set out in Australian Standard AS1547:2012: – *On-site Domestic Wastewater Management* will be undertaken prior to subdivision.

2.2.4 Acid Sulphate Soils

The DBCA maps the site as Low to Nil risk of Acid Sulphate Soils (ASS). The nearest mapped High ASS risk area is a palusplain about 1.6km to the south.

Bore sampling in August 2017 found no indicators of potential or actual ASS in the groundwater. No further investigation of ASS is considered necessary.

2.2.5 Phosphorus Retention Index

Previous experience has shown that the gravelly and silty clay soils of the Guildford Formation and other alluvial and colluvial soils generally have moderate to high PRI.

PRI is a measure of the ability of a soil to adsorb and retain phosphorus from solution. A high PRI indicates that a soil is unlikely to leach phosphorus to the water table. Typical ranges for PRI values in soils are as follows:

PRI Range	*Rating*	*Typical soils*
0 – 0.5	Very Low	Bassendean Sand
2 – 4	Low – Moderate	Karrakatta Sands
5 – 12	Moderate – High	Cottesloe Sands
12 – 20	High	Crushed Limestone, Limesand
20 – 1000+	Very High	Clay

The DWER recommends a minimum PRI of 15 for soils beneath infiltration basins and swales. The site soils are expected to meet or exceed this requirement. PRI testing of soils beneath proposed infiltration basins will be undertaken before subdivision.

2.3 Hydrology

2.3.1 Groundwater

Groundwater flows from east to west beneath the site at a gradient of between 0.01 and 0.02. The low permeability of the soil profile means that groundwater throughflow would be very low.

Regional mapping by the DWER shows superficial groundwater present at minimum elevations of 48m to 55m AHD. Figure 6 shows the DWER contours.

Groundwater measurements in nine bores in and around the site on 21 August 2020 (Figure 6), during a drier than average winter, gave the water depths and levels shown in Table 2.1. Groundwater measurements collected from the site since 2017 are detailed in the LWMS.

Simultaneous measurements of DWER bores located 1,400m south (Swan GWA 2-98) and 40m north (Gnangara Monitoring GD20) enabled Average Annual Maximum (AAMGL) and

Maximum (MGL) groundwater levels at the site to be calculated. Figure 6 shows the calculated AAMGL and depth to AAMGL contours across the site. Figure 7 shows the hydrographs of the DWER bores.

Table 2.1 shows that the groundwater levels measured in August 2020 were about 0.4m below the AAMGL. The winter of 2020 was drier than average, and the levels measured on 21 August are considered to approximate the peak for the year.

Figure 6 shows that the AAMGL is within one metre of the ground surface in parts of the west, south and north-west of the site. The AAMGL is predicted to intersect the ground surface in small areas in the west, south and north-east.

Filling and/or subsoil drainage is likely to be necessary in areas of the site where the depth to groundwater is less than 1.5m in order to provide groundwater clearance for roads, buildings and effluent disposal. The requirement for filling will depend on the size of the lots and the uses to which they are put. Most of the site has sufficient slope and depth to groundwater that subsoil drainage alone may be sufficient to create the necessary groundwater clearance for building, effluent disposal and drainage.

Table 2.1 Groundwater Depths and Levels 21 August 2020

Bore (Figure 6)	*Depth (mbgl)*	*Level (m AHD)*	*AAMGL (m AHD)*	*MGL (m AHD)*	*Depth to AAMGL (m)*	*Depth to MGL (m)*
TB1	4.64	60.61	61.037	61.617	4.213	3.633
TB2	2.95	82.05	82.477	83.057	2.523	1.943
TB3	0.7	79.85	80.277	80.857	0.273	-0.307
TB4	0.41	54.39	54.817	55.397	-0.017	-0.597
TB5	>3.45	<63.55				
TB6	0.37	53.63	54.057	54.637	-0.057	-0.637
TB7	1.14	57.26	57.687	58.267	0.713	0.133
TB8	1.11	64.14	64.567	65.147	0.683	0.103
TB9	0.56	74.24	74.667	75.247	0.133	-0.447
MB1	0.285	51.305	51.732	52.312	-0.142	-0.722
MB3	1.59	50.99	51.417	51.997	1.163	0.583
MB5	0.77	56.02	56.447	57.027	0.343	-0.237
WB2	>4.98	<65.89				
GD20	0.88	60.6	59.85	61.35	1.63	0.13
2-98	2.117	56.173	56.6	57.18	1.69	1.11

2.3.2 Surface Water

A significant creek flows from east to west along the northern edge of the property. Two smaller drains flow across the site near the southern boundary. All of the watercourses are seasonal or ephemeral. The remainder of the property would drain by sheet flow during heavy rainfall. Figure 8 shows the drainage lines and their catchments.

The northern creekline is a natural waterway, incised at the eastern side of the property but flatter and shallower at the western side. The depth of the creek channel is estimated at 1m in the east and 0.5m at the west, with a width of 5-10m. The creek drains an upstream catchment of about 360ha and an additional catchment of 250ha within the property.

Historical Landgate aerial photography shows that the middle drainage line is an artificial drain, constructed between 1965 and 1977. It is shallow and slightly incised, about 0.5m deep and 8-10m wide. It has an upstream catchment of about 38ha and an internal catchment of another 30ha.

The southernmost drainage line is also a constructed drain, dating from between 1977 and 1979. It is slightly incised, about 0.5m deep with a width ranging from 4-8m in the east to 12m in the west. It drains an upstream catchment of about 117ha and an internal catchment of another 3ha.

All drainage from the site flows eventually into Ellen Brook, the major drainage feature of the region. The Ellen Brook catchment is the largest sub-catchment of the Swan-Canning River system, contributing 6% of the total annual flow, and is the largest single contributor of nutrients to the system (WA Govt, 2011).

Ellen Brook has a surface catchment of 715km^2 (WRC, 2012). The Brook rises as Chandala Brook about 22km north-northwest of the site. The Brook is seasonal, flowing between May and November with an annual flow ranging from 2.1 to 48.6 GL (SRT, 2009).

Table 2.2 summarises estimated 100-year ARI (average recurrence interval) flows under current conditions in the three drainage lines, calculated using the Rational Method (Institute of Engineers Australia, 1987). A runoff coefficient of 0.3 for the 100-year storm was assumed for all catchments. Table 2.2 also shows estimated water depths, widths and flow velocities in the watercourses at the upstream and downstream ends of the site, calculated using Manning's open channel flow formula (Fang, 2002), using a roughness coefficient (Manning's *n*) of 0.03.

Table 2.2 100-year ARI Flows

Drainage Line		*North*	*Middle*	*South*
Upstream Catchment (ha)		360	38	117
100-yr ARI Flow (m^3/sec)		7.04	1.21	3.9
Water Depth (m)	*Upstream*	0.7	0.2	0.5
	Mid-point	0.8	-	-
	Downstream	0.4	0.2	0.5
Top Water Width (m)	*Upstream*	4.6	9.4	8.2
	Mid-point	6.9	-	-
	Downstream	28	11	11
Flow Velocity (m/sec)	*Upstream*	3.5	1.0	1.5
	Mid-point	2.0	-	-
	Downstream	1.1	1.1	1.1

The flow calculations in Table 2.2 suggest that the northern creek is likely to overtop its banks at its western end during a 100-year storm, creating flooding to about 15m each side of the creek. The eastern part of the northern creek, and the two southern drainage lines, appear unlikely to overtop in a 100-year storm.

The flow velocity in the eastern part of the northern creek is relatively high and may cause scouring of the creek bed in a 100-year storm. Given that a storm of this size may not have occurred since the creekline and its catchment were cleared for farming, such an event may significantly alter the shape of the watercourse. Some protection works (such as revegetation, riffling and barriers) may be necessary to reduce the risk of this occurring.

The calculations shown in Table 2.2 are preliminary and based on desktop estimates of channel morphology and catchment characteristics. They are not for design purposes.

2.4 Water Quality

2.4.1 Groundwater

Groundwater samples were collected from the nine on-site bores in August 2017. Table 2.3 shows the groundwater quality data from August 2017. The samples show that the groundwater quality across the site is generally moderate, with some notable features:

- Nitrogen (both total and NO_X) levels were elevated across most of the site, particularly in Bore TB1 in the centre of the property. This is probably due largely to the high density of cattle then being stocked on the property. Nitrogen levels are expected to decline once cattle are removed from the property.

- Bore TB3 is quite saline (Conductivity 12 mS/cm = 7,200 mg/L) as well as being very acidic (ph 3.7, Total Acidity 96) and high in some metals (aluminium, potassium, iron, lead and zinc). These are consistent with its origin as seepage from clay and siltstone. The sulphate level is also elevated, although the low sulphate/chloride ratio (0.09) and the elevation and soil type suggests that these characteristics are not indicative of the presence of ASS.

- Dissolved phosphorus levels were low across the site.

2.4.2 Surface Water

Surface water samples were collected from six locations (three inflowing, three outflowing) in August 2017 (Figure 8). The results show that the surface flows into and out of the site are generally of similar and moderate quality. The water in the northern creek has elevated salinity, but shows little of the high acidity found in the adjacent Bore TB3. Water flowing from the east in the vicinity of the Midland Brick quarry had very low pH but only moderate acidity. Table 2.4 shows the surface water data from August 2017.

Table 2.3 Groundwater Quality 17/8/2017
(see Figure 6 for bore locations)

	Parameter	Unit	Aquatic Ecosystems[a]	Irrigation Water[b]	*TB1*	*TB2*	*TB3*	*TB4*	*TB5*	*TB6*	*TB7*	*TB8*	*TB9*
Nutrients	Total Nitrogen	mg/L	1.2	5	**19**	0.9	**9.5**	**5.3**	**2**	**2.3**	0.6	1.2	**6.2**
	NOx	mg/L	0.15	ng	**19**	**0.72**	0.15	**3.7**	**1.4**	**1.2**	**0.18**	**0.25**	**3.8**
	Total Kjeldahl Nitrogen	mg/L	ng	ng	<0.2	0.2	9.4	1.6	0.6	1.1	0.4	1	2.4
	Total Phosphorus	mg/L	0.065	0.05	**0.89**	**0.09**	**0.54**	**0.49**	**0.43**	**0.48**	0.04	**0.3**	**3.5**
	Reactive Phosphorus	mg/L	0.04	ng	0.01	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Physical	pH		6.5-8.0	6-8.5	**5.9**	6.8	**3.7**	6.8	6.5	7.3	6.6	7	7.4
	Conductivity	mS/cm	0.12-0.3	1.3	**1**	**0.53**	**12**	**2.2**	0.29	**0.7**	**0.49**	**0.55**	**0.63**
	Salinity (from EC)	mg/L	72-180	780	**600**	**318**	**7200**	**1320**	174	**420**	**294**	**330**	**378**
	Acidity	mg/L	40[c]	ng	19	5	**96**	<5	13	9	19	7	7
	Alkalinity	mg/L	ng	ng	10	28	<5	21	22	100	50	38	67
	Acidity:Alkalinity Ratio		1[c]	ng	**1.90**	0.18	**>19.2**	<0.24	0.59	0.09	0.38	0.18	0.10
	Hardness	mg/L	ng	60-350	95	64	1310	208	27	56	59	63	48
	Sulphate	mg/L	ng	ng	60	26	310	29	18	66	17	40	23
	Chloride	mg/L	ng	350	240	150	3600	690	94	110	100	110	130
	SO_4:Cl Ratio		0.5	ng	0.25	0.17	0.09	0.04	0.19	**0.60**	0.17	0.36	0.18
Major Ions	Calcium	mg/L	ng	ng	5	6	30	9	4.2	5.8	5.6	9.1	7.2
	Sodium	mg/L	ng	230	130	61	2100	350	36	110	54	60	80
	Potassium	mg/L	ng	ng	0.2	0.4	60	0.6	1.2	<0.1	0.9	3.8	6.6
	Magnesium	mg/L	ng	ng	20	12	300	45	4	10	11	9.9	7.2
	Iron	mg/L	ng	10	0.26	0.09	2.4	0.3	0.07	0.36	0.04	0.02	0.16

Notes

ng denotes "no guideline". na denotes "not analysed"
a. ANZECC (2000) Aquatic Ecosystem trigger values (Nutrient, pH and Conductivity are for lowland rivers; Dissolved Metals are for freshwater ecosystems 90% species protection)
b. ANZECC (2000) Irrigation trigger values (long-term irrigation up to 100 years)
c. DEC(20__) oxidation indicator triggers for ASS-affected groundwater.
d. ANZECC (2000) Irrigation trigger values for pasture and fodder for grazing animals except pigs and dairy animals.

Dissolved Metals	Aluminium	mg/L	0.08	5	**1.7**	**0.3**	**9.2**	**1.1**	**0.2**	**0.8**	<0.1	<0.1	**0.3**	
	Arsenic (III & V)	mg/L	0.136	0.1	<0.002	<0.002	0.002	0.001	<0.002	0.001	<0.002	<0.002	<0.002	
	Cadmium	mg/L	0.0004	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	
	Chromium (VI)	mg/L	0.006	0.1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	
	Copper	mg/L	0.0018	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
	Mercury	mg/L	0.0019	0.002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	
	Nickel	mg/L	0.013	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
	Lead	mg/L	0.0056	2	<0.01	<0.01	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
	Zinc	mg/L	0.015	2	**0.08**	<0.01	**0.04**	**0.02**	<0.01	0.01	0.01	<0.01	<0.01	

Table 2.4 Surface Water Quality 17/8/2017
(see Figure 8 for sample locations)

	Parameter	Unit	Aquatic Ecosystems[a]	Irrigation Water[b]	*TS1 (inflow)*	*TS2 (outflow)*	*TS4 (outflow)*	*TS5 (outflow)*	*TS6 (inflow)*	*TS7 (inflow)*
Nutrients	Total Nitrogen	mg/L	1.2	5	0.8	0.9	**3.5**	1.1	**3.8**	0.2
	NOx	mg/L	0.15	ng	0.01	0.1	**0.81**	<0.01	**0.93**	<0.01
	Total Kjeldahl Nitrogen	mg/L	ng	ng	0.8	0.8	2.7	1.1	2.9	0.2
	Total Phosphorus	mg/L	0.065	0.05	**0.09**	**0.1**	**0.16**	**0.08**	**0.08**	**0.09**
	Reactive Phosphorus	mg/L	0.04	ng	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Physical	pH		6.5-8.0	6-8.5	**6.3**	**6.1**	**9.3**	7.5	**10.4**	**3.8**
	Conductivity	mS/cm	0.12-0.3	1.3	**3.2**	**3.3**	**0.95**	**1**	**1**	**2.2**
	Salinity (from EC)	mg/L	72-180	780	**1920**	**1980**	**570**	**600**	**600**	**1320**
	Acidity	mg/L	40[c]	ng	6	<5	<5	<5	<5	27
	Alkalinity	mg/L	ng	ng	10	<5	100	11	130	<5
	Acidity:Alkalinity Ratio		1[c]	ng	0.60	-	<0.02	<0.45	<0.04	**>5.4**
	Hardness	mg/L	ng	60-350	353	382	94	90	76	145
	Sulphate	mg/L	ng	ng	52	62	98	55	110	170
	Chloride	mg/L	ng	350	890	980	190	290	220	570
	SO_4:Cl Ratio		0.5	ng	0.06	0.06	**0.52**	0.19	0.50	0.30
Major Ions	Calcium	mg/L	ng	ng	16	16	28	8.2	24	3.8
	Sodium	mg/L	ng	230	540	630	110	120	120	330
	Potassium	mg/L	ng	ng	14	16	27	7.4	28	5.6
	Magnesium	mg/L	ng	ng	76	83	5.9	17	4	33
	Iron	mg/L	ng	10	0.1	0.1	0.07	0.05	<0.01	2.8

Notes

ng denotes "no guideline". na denotes "not analysed"
a. ANZECC (2000) Aquatic Ecosystem trigger values (Nutrient, pH and Conductivity are for lowland rivers; Dissolved Metals are for freshwater ecosystems 90% species protection)
b. ANZECC (2000) Irrigation trigger values (long-term irrigation up to 100 years)
c. DEC(20__) oxidation indicator triggers for ASS-affected groundwater.
d. ANZECC (2000) Irrigation trigger values for pasture and fodder for grazing animals except pigs and dairy animals.

Dissolved Metals	Aluminium	mg/L	0.08	5	<0.1	<0.1	<0.1	<0.1	<0.1	**1.2**	
	Arsenic (III & V)	mg/L	0.136	0.1	0.002	0.002	0.002	<0.002	0.002	<0.002	
	Cadmium	mg/L	0.0004	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	
	Chromium (VI)	mg/L	0.006	0.1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	
	Copper	mg/L	0.0018	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
	Mercury	mg/L	0.0019	0.002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	
	Nickel	mg/L	0.013	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	**0.02**	
	Lead	mg/L	0.0056	2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
	Zinc	mg/L	0.015	2	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	

2.5 Wetlands

The north-west and north-east corners of Tallangatta are mapped as Multiple Use palusplain (seasonally waterlogged plain) by the DBCA. Palusplain also covers an extensive area west of the property in the floodplain of Ellen Brook. Figure 8 shows the mapped wetlands.

Multiple Use category wetlands are degraded and are regarded by the DBCA as developable, provided that the hydrological functions (mainly drainage) of the wetland are maintained or replicated.

No other wetlands are present on or immediately downstream of the property.

2.6 Vegetation

2.6.1 Vegetation Type and Condition

Tallangatta is cleared except for a number of scattered paddock trees (some apparently planted) and a small group of denser trees around the creekline in the north-east corner. The paddock trees are mostly located in the northern two-thirds of the property, with the southern third being almost entirely cleared.

The paddock trees are mostly mature Marri and Wandoo with a few Jarrah, with some large specimens up to 15-20m tall. Flooded Gums are present near the creekline in the north-east corner of the property.

2.6.2 Vegetation Complexes

Most of Tallangatta is mapped as Coonambidgee Complex, described by Heddle *et al.* (1980) as ranging from a low open forest and low woodland of pricklybark-banksia (*E. todtiana - B. attenuata - B. menziesii – B. ilicifolia*) with local admixtures of *B. prionotes*, to an open woodland of marri-banksia.

A narrow band on the western side of the property is mapped as Yanga Complex, which Heddle *et al.* (1980) described as a mixture of low open forest of banksia-pricklybark on the higher areas and an open woodland of marri-banksia in the moister low-lying areas.

The more elevated eastern side is mapped as Reagan Complex, described as ranging from low open woodland of *B. attenuata – B. menziesii – E. todtiana* to closed heath, depending on the depth of soil.

Figure 9 shows the mapped vegetation complexes. None of these vegetation complexes survives in identifiable form on the property.

2.6.3 Rare and Significant Flora

The DBCA's Naturemap and Commonwealth databases of Threatened and Priority Flora list 42 plant taxa with the potential to occur within the site (Table 2.5). Of these, 19 are listed as Threatened under the *Biodiversity Conservation Act 2016*. Two species are listed as Priority 1, six as Priority 2, 11 as Priority 3 and six as Priority 4. One Priority 4 species (*Centrolepis caespitosa*) is also listed as Threatened under the EPBC Act. Table 2.5 summarises the likelihood of occurrence of these species at the site.

No Threatened Flora pursuant to the *Biodiversity Conservation Act* 2016 or the *EPBC Act* 1999 were recorded during the site surveys. Given the degree of clearing, it is unlikely that any rare or threatened species or communities would be present.

2.6.4 Floristic Communities

Owing to the state of clearing and degradation of the vegetation on Tallangatta, it is not possible to assign the vegetation to any floristic community type. No identifiable Threatened or Priority Floristic Communities pursuant to State or Commonwealth legislation are present at the site.

Table 2.5 Significant Flora Potentially Occurring Within the Site

Taxon	*DBCA Cons Code*	*EPBC Cons Code*	*Recorded Habitat(s)*	*Closest Record*	*Likelihood of Occurrence*
Acacia anomala	DRF	VU	Western slopes of the Darling Range east of Perth, on shallow grey sands over laterite.	4km	Unlikely
Acacia drummondii ssp. affinis	P3		Lateritic gravelly soils.	5km	Unlikely
Adenanthos cygnorum ssp. *chamaephyton*	P3		Grey sand, lateritic gravel.	2km	Unlikely
Andersonia gracilis	DRF	EN	Known from the Badgingarra, Dandaragan and Kenwick areas. Seasonally damp, black sandy clay flats near swamps.	111km	Unlikely
Anigozanthos viridis ssp. *terraspectans*	DRF	VU	Winter-wet depressions on grey sandy clay loam or grey sand in low heath that is regenerating after fire.	111km	Unlikely
Anthocercis gracilis		VU	Sandy or loamy soils. Granite outcrops.	31km	Unlikely
Caladenia huegelii	DRF	EN	Mixed woodland of Jarrah, Banksia, Sheoak, marri from just north of Perth to Busselton, usually within 20m of the coast. Mostly deep grey-white sand of the Bassendean dune system.	16km	Unlikely
Centrolepis caespitosa	P4	EN	Winter-wet claypans dominated by low shrubs and sedges.	8km	Unlikely
Chamaescilla gibsonii	P3		Clay to sandy clay. Winter-wet flats, shallow water-filled claypans.	4km	Unlikely
Chamelaucium sp. *Gingin* (N.G. Marchant 6)	DRF	EN	White/yellow sand in woodland with *Eucalyptus todtiana*, *Banksia attenuata* and *Hibbertia* sp.	13km	Unlikely
Conospermum densiflorum ssp. *unicephalatum*	DRF	EN	Low-lying sandy clay soils with surface gravel, over 10km between Gingin and Moora.	75km	Unlikely
Cyathochaeta teretifolia	P3		Grey sand, sandy clay in swamps and creek edges.	3km	Unlikely
Darwinia foetida	DRF	CE	Grey-white sand on swampy, seasonally wet sites.	1.6km	Unlikely
Diplolaena andrewsii	DRF	EN	Loam, clay. Granite outcrops and hillsides.	17km	Unlikely
Diuris micrantha	DRF	VU	Seasonally wet flats among sedges and scattered shrubs.	73km	Unlikely

Diuris purdei	DRF	EN	Under dense shrubs in seasonally-wet swamps and drainage lines.	55km	Unlikely
Drakaea elastica	DRF	EN	Bare patches of grey-white sand in low-lying areas alongside winter-wet swamps, typically in banksia woodland or spearwood thicket.	32km	Unlikely
Drosera occidentalis ssp*. occidentalis*	P4		Sandy and clayey soils. Swamps and wet depressions.	1.2km	Unlikely
Drosera sewelliae	P1		Laterite and silica sand soils.	6km	Unlikely
Eryngium pinnatifidum ssp. *Palustre* (G.J. Keighery 13459)	P3		Winter-wet areas, damplands and claypans.	2km	Unlikely
Eleocharis keigheryi	DRF	VU	Clay, sandy loam. Emergent in freshwater: creeks, claypans.	10km	Unlikely
Eucalyptus balanites	DRF	EN	Gently sloping heathlands on light-coloured sandy soils over laterite.	64km	Unlikely
Eucalyptus leprophloia	DRF	EN	Known over 90km range from north of Badgingarra to the Mt Adams area. Range of habitats including slopes of hills in brown loam over laterite.	154km	Unlikely
Grevillea althoferorum ssp*. fragilis*	DRF	EN	Base of the Darling Scarp on greyish-yellow colluvial sand, in banksia woodland.	2.7km	Unlikely
Grevillea christinae	DRF	EN	Clay loam, sandy clay, often moist.	76km	Unlikely
Grevillea corrugata	DRF	EN	Known from two locations 10km south of Bindoon, on gravelly loam in partially-cleared eucalyptus woodland on roadsides.	16km	Unlikely
Grevillea curviloba ssp*. curviloba*	DRF	EN	Winter wet, deep peaty grey sands over limestone.	4km	Unlikely
Grevillea curviloba ssp. *incurva*	DRF	EN	Open heath in winter-wet areas on sand over limestone or ironstone.	2km	Unlikely
Guichenotia tuberculata	P3		Sandy clay over laterite, sand.	69km	Unlikely
Haemodorum loratum	P3		Grey or yellow sand, gravel.	63km	Unlikely
Hibbertia glomerata ssp*. ginginensis*	P1		Sand, brown clay, laterite and near roadsides.	30km	Unlikely
Oxymyrrhine coronata	P4		Slopes and flats with dry gravel over laterite.	4km	Unlikely
Persoonia rudis	P3		White, grey or yellow sand, often over laterite.	4km	Unlikely
Platysace ramosissima	P3		Sandy soils.	2km	Unlikely

Schoenus sp. Bullsbrook (J.J. Alford 915)	P2		Grey peaty sand, low-lying flats.	13km	Unlikely
Stenanthemum sublineare	P2		Littered white sand on the Swan Coastal Plain.	13km	Unlikely
Stylidium aceratum	P2		Sandy soils, swamp heathland.	3km	Unlikely
Stylidium longitubum	P3		Sandy clay, clay. Seasonal wetlands.	14km	Unlikely
Stylidium paludicola	P3		Peaty sand over clay. Winter-wet habitats. Marri and melaleuca woodlands.	14km	Unlikely
Stylidium squamellosum			Brown to red-brown clay loam. Winter-wet depressions. Open woodland, shrubland.	2km	Unlikely
Synaphea grandis	P4		Laterite.	1km	Unlikely
Tetraria sp. Chandala (G.J. Keighery 17055)	P2		Mound springs, wetlands and peaty sands.	14km	Unlikely
Thelymitra manginii K. Dixon & Batty ms (*Thelymitra dedmaniarum*)	DRF	EN	Open wandoo woodlands on red-brown sandy loam associated with dolerite and granite outcrops.	18km	Unlikely
Thelymitra stellata	DRF	EN	Low heath and scrub in jarrah and wandoo woodland on ridges and slopes, also on river banks and breakaways, on red, brown, yellow or grey sandy loams, clay or gravel over laterite or gravel.	5km	Unlikely
Trichocline sp. Treeton (B.J. Keighery & N. Gibson 564)	P2		Sand over limestone, sandy clay over ironstone. Seasonally wet flats.	8km	Unlikely
Verticordia lindleyi ssp*. lindleyi*	P4		Sand, sandy clay. Winter-wet depressions.	5km	Unlikely
Verticordia serrata var*. linearis*	P4		White sand, gravel. Open woodland.	3km	Unlikely

2.7 Fauna

2.7.1 Species and Habitats

The largely cleared project area offers little habitat for native fauna, apart from disturbance-tolerant species such as kangaroos (which may graze in the paddocks from refuges to the east) and birds which might nest in some trees.

2.7.2 Significant Fauna

A search was made of relevant databases for the area surrounding the project area. The databases searched included:

- DBCA Naturemap (15km radius including the project area);
- DBCA Threatened Fauna Database (15km radius including the project area);
- EPBC Protected Matters Search Tool (10km radius including the project area); and
- Birds Australia Birdata database (1 degree/60nm square including the project area).

The searches produced an extensive list of Threatened Fauna species, Priority Fauna species and otherwise significant species from the search area. Many of those were marine or aquatic species for which no habitat exists in the project area. Species that might occur in the project area or its surrounds are summarised, and their likelihood of occurrence in the project area assessed, below:

- Carnaby's Black Cockatoo *Calyptorhynchus latirostris* (S1, EN) – Feeds and breeds in eucalypt and Banksia woodland from the lower Murchison to the lower south-west. Numerous records of occurrence near the project area. A flock of about 30 birds was observed overflying the project area in June 2017. The project area contains food resources including Marri trees and potential nesting sites. No direct or indirect signs of feeding (e.g. chewed nuts) were observed during the site inspections in 2020, although feeding evidence has been observed in surrounding areas.

- Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* (S1, VU) - Feeds and breeds in eucalypt and Banksia woodland from Gingin to the lower south-west. One individual was observed overflying the project area in June 2017. The project area contains food resources including Marri trees and potential nesting sites.

- Black-striped Snake *Neelaps calonotos* (P3) - Inhabits dense leaf litter in Banksia and eucalypt woodlands with sandy soil from Lancelin south to Mandurah. Unlikely to be present in the project area due to the absence of dense vegetation or leaf litter.

- Black-flanked Rock Wallaby *Petrogale lateralis* subsp. *lateralis* (T, EN) – Restricted to parts of Cape Range, Little Sandy Desert, granite rocks in the Avon Wheatbelt, Kalbarri National Park and Barrow and Salisbury Islands. Occurs on rocky habitats with a preference for complex caves and crevices. Unlikely to be present in the project area due to the absence of suitable habitat.

- Woylie *Bettongia penicillata ogilbyi* (T, EN) - Formerly widespread species now restricted to six known sites in the south-west. Inhabits open eucalypt forest, open mallee woodlands and shrublands. Unlikely to be present in the vicinity due to absence of suitable habitat and predation by foxes and cats.

- Douglas' Broad-headed Bee *Hesperocolletes douglasi* (T, CR) – Recently rediscovered in Banksia woodland at Pinjar in 2019 after being presumed extinct. Only previous sighting was on Rottnest Island in 1938. Unlikely to be present in the project area.

- Chuditch *Dasyurus geoffroii* (S3, VU) - Occurs in a wide range of habitats including woodlands, dry sclerophyll forests and riparian vegetation. The project area provides little or no suitable foraging habitat although the species may be an occasional visitor.

- Peregrine Falcon *Falco peregrinus* (S4) - A wide-ranging species that prefers nesting in cliff faces. Likely to overfly the project area but would not be resident.

- Rainbow Bee-eater *Merops ornatus* (S3, MI) - A common and widespread migratory species that utilises a wide range of habitats, with a preference for nesting in open sandy ground. The project area has few open sandy areas and is unlikely to provide habitat for the species.

- Fork-tailed Swift *Apus pacificus* (S3, MI) - A widespread and almost entirely aerial species. Likely to overfly the project area but would not be resident or dependent upon it.

- A short-tongued bee *Leioproctus douglasiellus* (CR) - Known from only three locations within the Perth metropolitan area in association with two plant species: *Goodenia filiformis* and *Anthotia junciforme*, neither of which are present at the site.

- Brush-tailed Phascogale *Phascogale tapoatafa* (P3) - Inhabits dry sclerophyll forests and open woodlands with hollow-bearing trees and sparse ground cover between Perth and Albany. Unlikely to be present at the site due to its scarcity and the absence of its preferred habitat.

- Graceful Sunmoth *Synemon gratiosa* (P4) - Inhabits coastal heathland on Quindalup dunes and banksia woodland on Spearwood and Bassendean dunes in association with two species of mat-rush, *Lomandra maritima* and *L. hermaphrodita.* Neither plant species was found in the project area so the moth is unlikely to be present.

- Inornate Trapdoor Spider *Euoplos inornatus* (northern Jarrah Forest) (P3) – Known from several locations in the northern Jarrah forest, the closest 6.5km south-east of the site. Unlikely to be present at the site due to the absence of undisturbed leaf litter.

- A short-tongued Bee *Leioproctus contrarius* (P3) – Occurs on the Swan Coastal Plain in association with *Scaevola repens* var. *repens* and *Lechenaultia* spp, neither of which are present at the site.

- Quenda *Isoodon obesulus fusciventer* (P4) - Inhabits dense ground cover in forests, woodlands and heaths, preferring areas around wetlands and damplands. Unlikely to be present at the site due to the absence of cover.

- Grey Wagtail *Motacilla cinerea* (MI) – Breeds in northern Europe and migrates to the southern hemisphere, mostly Africa and Asia. Two Western Australian records from near Pemberton and Northcliffe. Unlikely to be present at the site.

2.7.3 Black Cockatoo Habitat Assessment

Feeding Habitat
The project area contains two species recorded by Valentine & Stock (2008) as food resource species for Carnaby's Cockatoo: *Corymbia calophylla* and *Eucalyptus marginata.* These species are present at low density, so the site offers limited food resources for black cockatoos. The large Marri trees in the cleared areas would be expected to provide food for black cockatoos. However, no direct or indirect evidence of feeding by black cockatoos was observed.

Roosting Habitat
The EPBC Act Referral Guidelines for Black Cockatoos (DSEWPC, 2012) define black cockatoo roosting sites as tall trees or groups of tall trees, usually close to an important water source and within an area of quality feeding habitat.

Water sources exist east of the project area in the form of ponds and sumps within the Midland Brick quarry, although given the level of disturbance and activity in the quarry it is questionable whether this would be used by cockatoos. The project area contains little feeding habitat. It is therefore unlikely that black cockatoos will roost in the project area.

Breeding Habitat
The DSEWPC (2012) defines black cockatoo breeding habitat as follows:

- Current breeding habitat - Trees of suitable species (including Marri, Jarrah and Wandoo) with suitably-sized hollows (generally minimum 140mm opening, 200mm internal width, 450mm depth).

- Potential breeding habitat - Trees of suitable species of size at least 500mm diameter at breast height (dbh) (or 300mm for Wandoo).

A tree survey in August 2020 found 383 trees with diameter at breast height (dbh) greater than 0.5m (0.3m for Wandoo), which are considered large enough to contain breeding hollows now or in the future. Of these, 39 contained potential cockatoo breeding hollows (possible openings 120mm or larger in diameter).

BES inspected all potential hollows in October 2020 with a pole-mounted camera (Cocky Cam) supplied by Birdlife Australia. The inspection found five hollows in use by Corellas and two by Australian Kestrels. No evidence of current or previous black cockatoo nesting was

found. Nineteen potential hollows were found to be unusable (either not hollow, too shallow, too large or without floors), while another nine apparently usable hollows showed no sign of usage. A significant number of hollows (seven of 35 examined) contained feral bee hives.

Figure 9 shows a consolidated map of all potential nesting trees identified by BES (2020). The full findings of the tree survey are reported in Appendix B.

2.8 Aboriginal Heritage Sites

The DPLH online database shows two registered Aboriginal heritage sites on or near Tallangatta:

- DAA 3525: Ellenbrook - Upper Swan (mythological); and
- DAA 20008: Gingin Brook Waugal Site (mythological, camping, hunting, plant resource, water source).

The DPLH has advised that the gazetted boundary of site DAA 3525 intersects the northern end of the Tallangatta property. The results of the database search and the DPLH advice are attached in Appendix C.

Under Section 18 of the *Aboriginal Heritage Act 1972*, permission from the Minister for Aboriginal Affairs is required for any disturbance of a registered Aboriginal site. An application under Section 18 will be required before any ground-disturbing development work is undertaken in the affected area.

2.9 Land Uses and Potential Contamination

Historical Landgate aerial photography shows that Tallangatta has been cleared and used primarily for broadacre farming since before 1965. The photographs show stock pens (possibly for pigs or poultry) near the farmhouse in the centre of the property between 1965 and about 2000; however, this use appears to have been small-scale and essentially domestic. Residual contamination from pesticides such as dieldrin could be present around the site of the stock pens.

Between 2004 and 2011 the property was used as an intensive live cattle export depot. Between about 2006 and 2010, manure from the feedlot operation was stockpiled in windrows about 250m east of the cattle handling sheds in the middle of the property. When the feedlot operation ended the stockpiled compost was removed from the site.

Intensive agriculture is regarded as a potentially contaminating land use by the Department of Environmental Regulation (DER, 2004); however, the agricultural chemicals available for use since 2004 do not include many of the chemicals often responsible for persistent soil contamination, such as organochlorine pesticides.

Feedlots are potential sources of soil and groundwater contamination by nutrients (nitrogen and phosphorus), organic matter and pathogens (particularly faecal bacteria). All of these contaminants are mobile and/or short-lived, and are not likely to result in persistent soil or groundwater contamination or to pose a long-term risk to health.

The DWER Contaminated Sites Database shows no records of contamination on or near Tallangatta. A desktop study carried out by Connell Wagner in 2007 for the Muchea Employment Node Structure Plan identified a number of sites of possible contamination in the greater Employment Node; it is unknown whether any of these were in Tallangatta. The Structure Plan recommended that a detailed contamination study, involving a site history and possibly soil sampling, be undertaken to investigate the sites identified by Connell Wagner and any others subsequently identified.

Given the previous land uses on Tallangatta, it is expected that any contamination found by the detailed study will be low-level, localised and readily remediated to a level suitable for industrial use.

2.10 Odour

Two poultry farms are present about 200m west of Tallangatta and another is located about 300m to the north. The Muchea landfill is located 1.5km to the north-east.

The EPA (2015) recommends a buffer of 300-1000m between poultry farms and sensitive land uses, and a 1000m buffer for putrescible landfills. The EPA defines “sensitive land uses” as “…places where people live or regularly spend time and which are therefore sensitive to emissions from industry”. The term is most often applied to residential uses but previous advice from the EPA indicates that it may also be applied to some commercial and even light industrial uses requiring a high level of public amenity, such as retail warehouses and display centres.

The existing poultry farms may constrain high-amenity uses such as retail from areas in the south-west of Tallangatta close to Great Northern Highway. Given the relatively small size of the poultry farms, the required buffers are likely to be at the lower end of the EPA’s recommended range.

Industrial land uses within Tallangatta that produce odour or other emissions may require buffering from sensitive land uses outside the estate. The Muchea townsite is located about 1km to the west; isolated residences are located immediately to the north-west and 230m south-west of the property. Allocation of land uses within the estate will need to take account of these external land uses and allow for adequate separation distances where necessary. This is unlikely to be a significant constraint on the development of the property for industry.

2.11 Landscape

Tallangatta is visible from Great Northern Highway and Muchea East Road, from where it presents a view of open grazing paddocks with scattered trees. The view is mostly unobstructed by the few trees and shrubs present in the road verge. Figure 10 shows views of the site from the adjoining roads.

3.0 ENVIRONMENTAL IMPACTS AND MANAGEMENT

3.1 Surface Water Protection

The project area drains to Ellen Brook via culverts beneath Great Northern Highway and small drainage lines within and adjacent to the site.

Ellen Brook is a major tributary of the Swan-Canning River system and the largest contributor of nutrients, mostly from agriculture on the grey sandy soils west of the Brook. Small creeks and drainage lines are important contributors to the flow and water quality of Ellen Brook.

Industrial development has the potential to affect the volume, rate and quality of water flows in the drainage lines and Ellen Brook. The Structure Plan recognises the project area's sensitivity with respect to its proximity to Ellen Brook by restricting future land uses within Precinct 2 to industries with low water requirements that do not produce large amounts of industrial waste water. Water outputs will be limited to stormwater, groundwater and minor process water (such as washdown water). In addition, the limited availability of water (groundwater or scheme) will mitigate against the establishment of industry with high water requirements.

The Structure Plan has been laid out in order to provide physical protection to the northern creek line that crosses the project area.

Management
The aim of surface water protection is to improve the quality of surface water leaving the project area. Given the site's current use for agriculture, this is considered achievable.

The contaminant of major concern in Ellen Brook and the Swan-Canning River system is phosphorus. Monitoring in September 2018 (BES, 2019) showed that Ellen Brook carries very heavy phosphorus loads. Phosphorus is a major contaminant in agricultural runoff but a minor component in runoff from industrial areas.

Management strategies to be implemented include:

- In accordance with the Shire of Chittering Town Planning Scheme No. 4, industries permitted will be those that dispose of domestic-quality wastewater at a rate less than 5,400 litres per hectare per day (R10 equivalent).

- Wastewater from toilets and bathrooms will be treated by nutrient-removing systems (e.g. ATU or modified leach drains) in accordance with Health Department requirements. An analysis of the capability of the site to support on-site effluent disposal is presented in the Local Water Management Strategy (Appendix A).

- Existing drainage lines crossing the project area will be retained and protected within vegetated streamlines or swales (see LWMS and Landscape Master Plan).

- All road runoff will be captured and infiltrated (up to 1-year ARI 1-hour storm) or detained (up to critical 100-yr storm) in bioretention swales in accordance with DWER guidelines. Stormwater management is detailed in the LWMS. Figure 11 shows an overview of the stormwater management system.

- Any process wastewater generated by industries will be treated on-site to a standard suitable for discharge or disposed offsite.

- All lot drainage from storms up to 1-year ARI will be retained and infiltrated within individual lots. Runoff from critical storms up to 100-year ARI will be detained within lots and released at a rate no greater than the pre-development rate.

- A monitoring program for stormwater outflows from the site will be implemented as detailed in the LWMS.

- Temporary drainage controls will be implemented during the construction period (see Section 3.5).

3.2 Groundwater Protection

Groundwater is an important contributor to water flow and quality in Ellen Brook. Given the silty clay soils of the project area, groundwater throughflow and discharge will be relatively low.

Groundwater approaches close to the ground surface in the south, north-west and north-east of the project area in very wet winters, possibly leading to groundwater discharge to surface drains.

Bore samples collected in August 2020 show that the quality of groundwater is generally moderate, with low concentrations of phosphorus but elevated nitrogen levels.

The Structure Plan aims to maintain groundwater levels, discharge volumes and quality at their pre-development levels. With the removal of horse and cattle grazing, the quality of groundwater is expected to gradually improve.

Management
Groundwater protection measures are detailed in the LWMS and will include:

- Development will be restricted to those industries with low water use and minimal or no waste water (see Structure Plan report).

- Subsoil drains, if required, will be set at or above the pre-existing Average Annual Maximum Groundwater Level (AAMGL).

- Subsoil and stormwater drains will discharge via free-draining outlets to vegetated swales with PRI of at least 15 (see LWMS).

3.3 Noise

Industrial land use is inherently noisy. Noise sources include traffic, machinery, power tools, ventilators and impacts.

The western side of the project area currently experiences high levels of noise from Great Northern Highway. The volume of traffic and hence the noise level on this part of Great Northern Highway has diminished significantly with the opening of the new Tonkin Highway.

Noise-sensitive premises (residences) are located in Muchea, 1,200 metres west of the project area. Isolated residences are also located west of Great Northern Highway (70m west of the project area), north and south of Muchea East Road (20-25m north of the project area), and about 200m to the east and south.

Other noise sources include an active clay quarry located 100m east and air traffic (including jets) from Pearce RAAF Base located 7km south. The project area is in line with the main runway at Pearce.

Future noise sources will include industry to the north, south, east and west as part of the Muchea Industrial Park.

Management
Active management of noise within and from the Structure Plan area will not generally be required. Industries with high noise emissions may be required to undertake technical analyses to determine separation requirements. These industries may be restricted to certain parts of the Structure Plan area where suitable separations are available.

3.4 Dust

Industrial land uses may generate significant amounts of dust, depending on the activities carried out and the condition of the ground surface. Potential dust sources include processing (materials handling), unsealed roads and exposed soil surfaces.

The silty soils of the project area are susceptible to dust generation when disturbed. The main dust risk will be during construction work. Management of construction impacts is detailed in Section 3.5.

Sensitive dust receptors are the same as those for noise: the town of Muchea and residences located north, south, east and west of the project area.

Management
Individual lot holders within the project area will be required to manage dust generation so as to prevent dust escape beyond their boundaries. Industries that generate appreciable process dust will be required to hold a DWER licence, which will specify dust limits and monitoring requirements.

3.5 Construction Impacts

Construction of the project may be carried out at various times, in accordance with the land owner's preferences. Construction of roads, drainage and other services will be undertaken by the owner as part of each stage of subdivision.

Construction-stage impacts relate mainly to the movement of machinery and the presence of areas of exposed soil, and include noise, vibration, dust, erosion and sedimentation.

Management
Management of construction impacts will be the subject of conditions attached to subdivision approvals, works approvals and development approvals.

In general, control of construction impacts will be the responsibility of the construction contractor. The contractor will implement a Construction Management Plan for the development dealing with dust management, erosion and sediment control, containment of environmentally hazardous materials (chiefly fuel and oils) and spill response. The key elements of the Construction Management Plan will include the following:

Dust Minimisation
- No topsoil stripping will be undertaken in dry conditions when the wind speed is greater than 25km/h unless appropriate dust control watering is undertaken prior to and during disturbance..
- No earthworks will be undertaken in dry conditions when the wind speed is greater than 40km/h unless appropriate dust control watering is undertaken prior to and during disturbance.
- Dust will be suppressed on open ground and stockpiles by regular watering, hydromulching, wind fencing and/or covering.
- An adequate supply of water for dust suppression will be kept on site at all times.
- Soil stockpiles will be limited to a height of 2.5m to minimise dust generation and to facilitate watering.
- Other dust minimisation measures will include minimising areas of disturbance, limiting volume and speed of construction traffic and instructing site workers in dust minimisation.

Erosion and Sedimentation
- Drains and bunds will be constructed at the beginning of site disturbance as necessary to capture and direct all runoff from disturbed areas into settling ponds. Drains, bunds and ponds will be appropriately designed and sized to provide adequate settling of sediments from drained water before release.

- Vehicles and machinery will be kept to designated roads, tracks and work areas.

Water Conservation

- Water consumption during construction will be minimised by:
  - limiting dust suppression watering to prevent ponding and runoff; and
  - use of non-water dust control methods such as wind fencing and hydromulching where appropriate.

Hazardous Materials

- All environmentally hazardous materials will be stored in their original labelled containers (or labelled jerrycans or drums in the case of petroleum fuels) in a ventilated enclosure equipped with appropriate signage, fire extinguishers and a spill response kit.
- Petroleum products will be held in a bunded enclosure.
- Material Safety Data Sheets (MSDS) and a chemical register for all hazardous materials on the site will be maintained by the site supervisor in the site office.

Complaints Register

- The site supervisor will maintain a record of any public complaints and the actions taken in response.

3.6 Vegetation and Flora

The native vegetation over most of the project area consists of scattered mature paddock trees and rows of planted trees.

Remnant trees within the development area will be preserved where possible. No remnant trees may be cleared without a Development Approval from the Shire of Chittering and/or a clearing permit from the DWER.

Landscaping within private lots and public areas (e.g. road reserves and drainage swales/basins) will be carried out using local native species.

3.7 Fauna

No significant fauna habitat will be cleared in the development of Tallangatta.

Fauna habitat will be created in the revegetation of drainage swales and basins. Street trees planted within the project area will focus on native tree species that provide habitat for nectar-eating and seed-eating birds.

3.8 Landscape

3.8.1 Overview

Development in accordance with the Structure Plan will change the landscape of the project area from predominantly rural to industrial, in keeping with the industrial landscape of the overall Muchea Industrial Park.

The objective of landscaping will be not to hide the industry from view but to provide vegetation features that "soften" and break up the industrial landscape. This will include plantings within lots along the interface of Great Northern Highway and Muchea East Road, bioretention swales and basins, vegetated creek lines, verge trees within the developed areas and landscape buffers within lots.

3.8.2 Landscape Plantings

The Shire of Chittering Town Planning Scheme imposes a general requirement that all non-residential lots should provide landscaping with approved species to a minimum of 10% of the total site area, including a minimum of one shade tree per four car parking bays.

The Shire of Chittering's *Muchea Industrial Park Design Guidelines* (2018) set out the Council's requirements and recommendations for development layout within lots, streetscaping, landscaping, bushfire management, fencing, signage and building design. The Guidelines require:

- a minimum 2m wide landscape buffer on the primary road frontage;
- a minimum 1m wide landscape buffer on secondary road interface and side boundaries extending to the building setback line;
- one shade tree per four car parking bays; and
- one tree per 10m of road frontage.

The landscape plantings within lots will be of a mix of native trees, shrubs and ground covers. The 1-year ARI 1-hour bioretention swales within each lot will be densely planted with native sedges and low shrubs. This will form part of the 10% landscaping requirement for each lot.

3.8.3 Streamline Revegetation

Roadside bioretention swales and through-drainage swales will be densely planted with native sedges and low shrubs to stabilise the beds and banks of the swales, slow water flows and promote the uptake of sediments and nutrients from the water. The northern creekline will be retained and protected within a vegetated foreshore and POS reserve that extends at least 30m and up to 150m from the creekline. The areas to be planted, species and planting densities are described in more detail in the Landscape Master Plan (BES, 2021).

Plantings within the swales will be kept to a height that meets the definition of Shrubland in the Bushfire Hazard Assessment (Eco Logical Australia, 2020) so as not to create an unacceptable fire hazard.

4.0 MONITORING

Baseline water quality results for the project area are shown in Tables 2.3 and 2.4. Groundwater levels and quality will continue to be monitored and compared against baseline levels and relevant guidelines. Surface water quality in drainage lines upstream and downstream of the project area will be monitored to determine what (if any) impacts the development may be having on surface water quality.

The developer of each stage of subdivision will be responsible for monitoring water quality in bores and drainage swales within that stage.

Water quality sampling will be conducted nominally once a year in late winter. Detailed water monitoring and response procedures will be developed as part of the Urban Water Management Plans to be prepared for each stage of subdivision.

5.0 IMPLEMENTATION AND FURTHER MANAGEMENT PLANS

Subdivision and development in the project area will be undertaken in accordance with the Structure Plan, this EAMS and the attached LWMS.

Development may occur in accordance with a subdivision approval or, in the absence of subdivision, a Development Approval. Subdivision approvals will include a requirement for an Urban Water Management Plan (UWMP). If development occurs without a subdivision, a Local Water Management Plan (LWMP) may be required to set out drainage design for the development.

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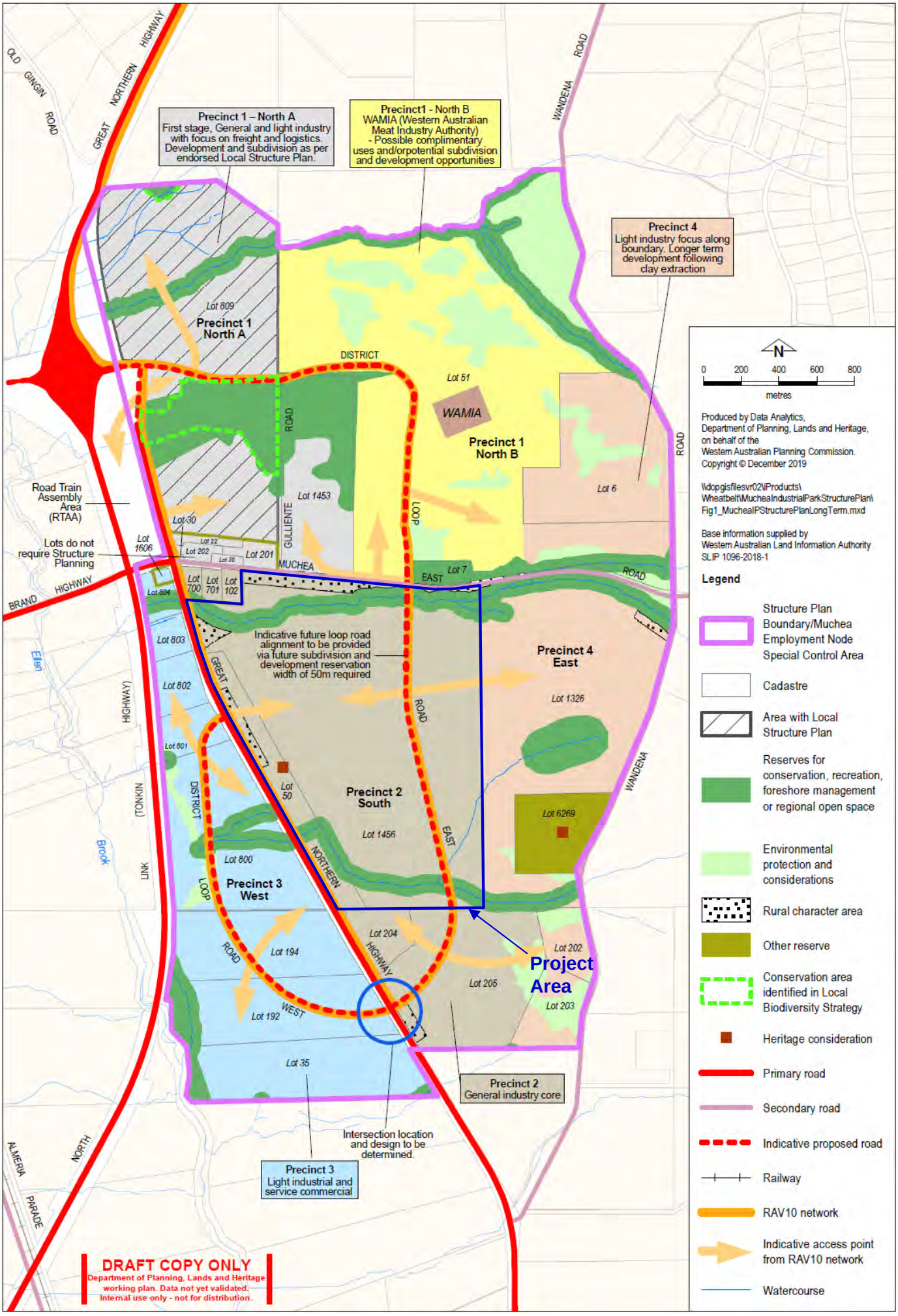
Figures



Source: WAPC, 2019

Figure 1

DRAFT MUCHEA INDUSTRIAL PARK STRUCTURE PLAN

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Figure 2

THE SITE AND SURROUNDINGS

Image source: Google 2018

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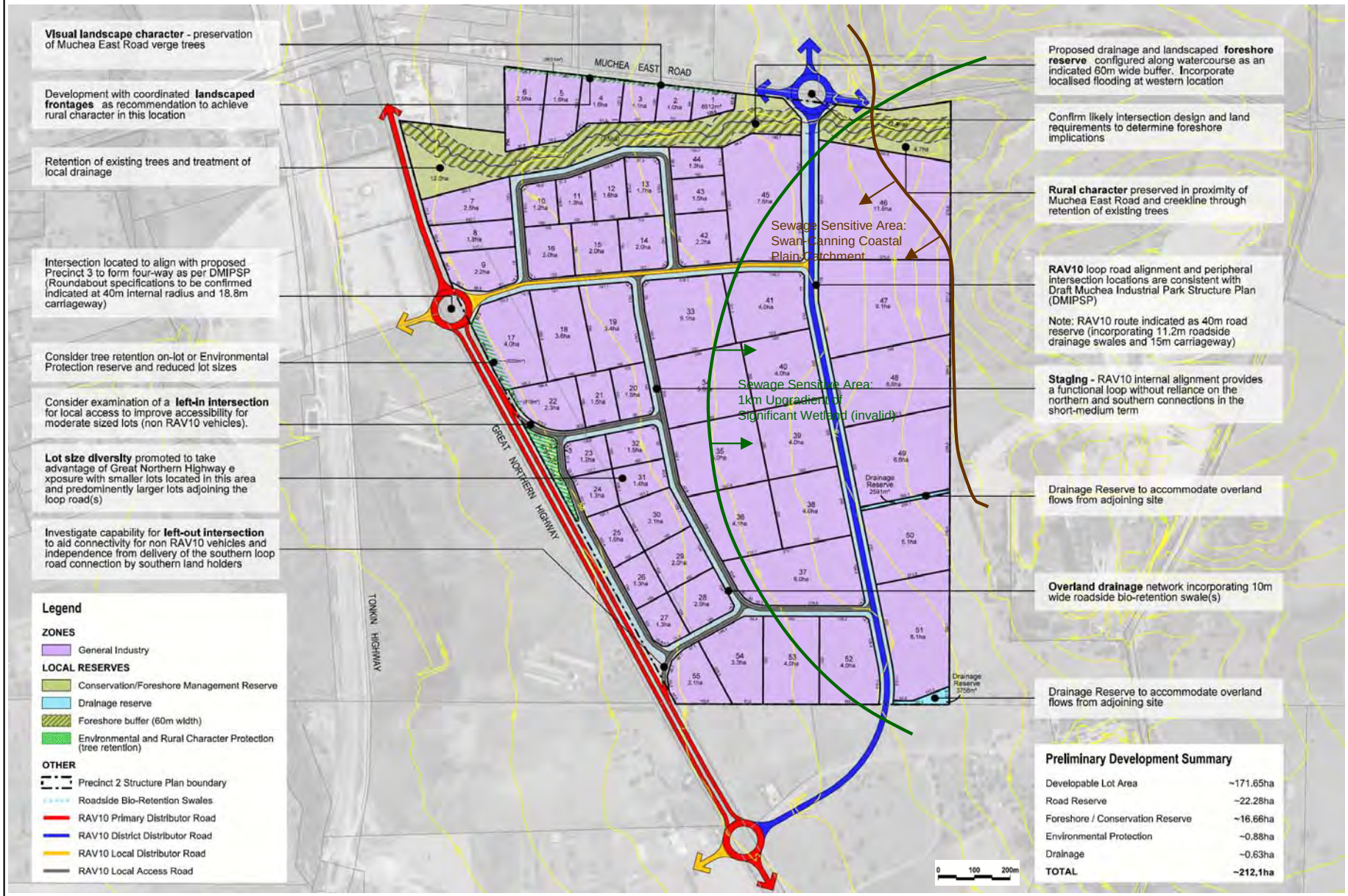

Figure 3

PROPOSED PLAN OF SUBDIVISION

Taylor Burrell Barnett

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Figure 5

PHYSIOGRAPHY

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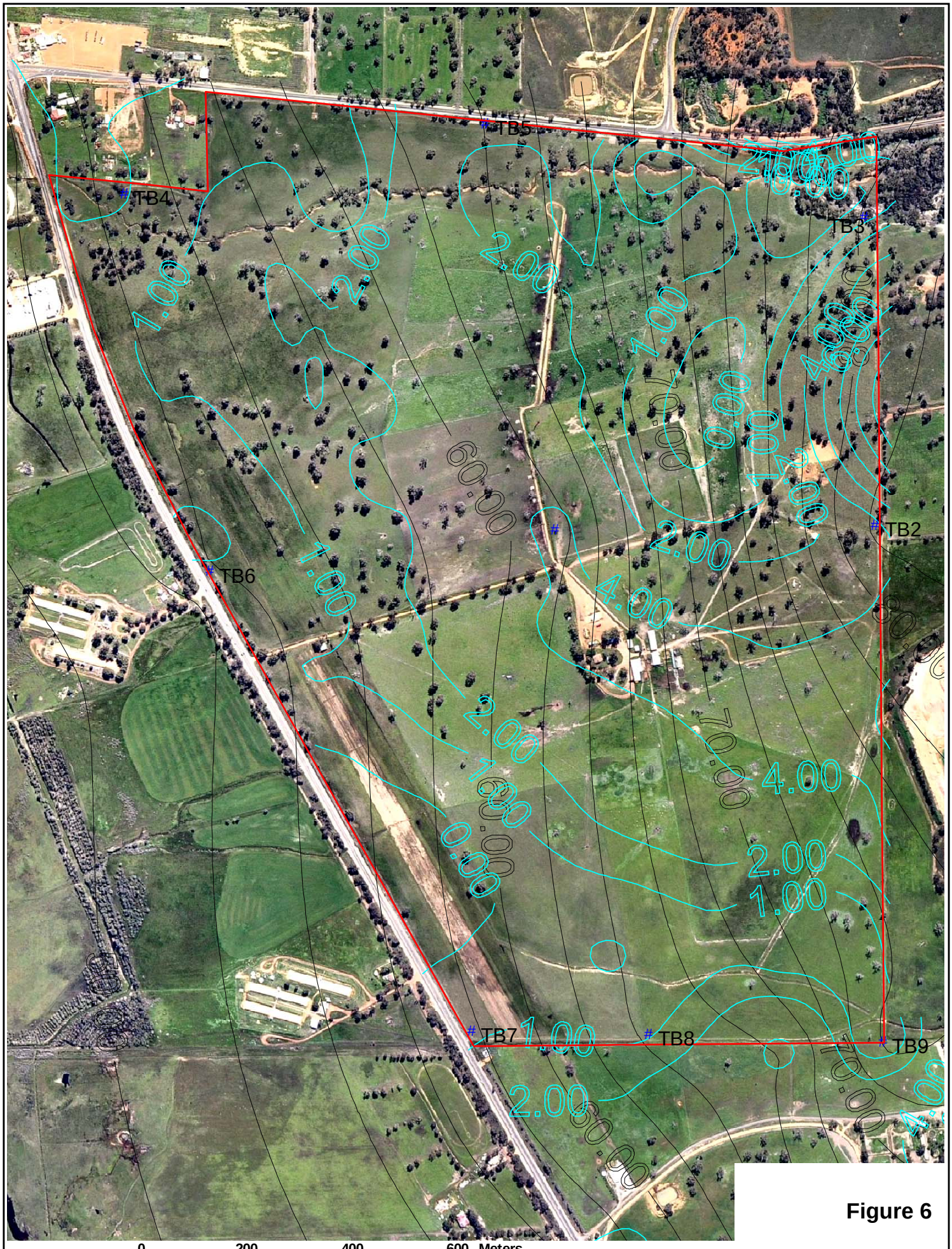

Figure 6

GROUNDWATER HYDROLOGY

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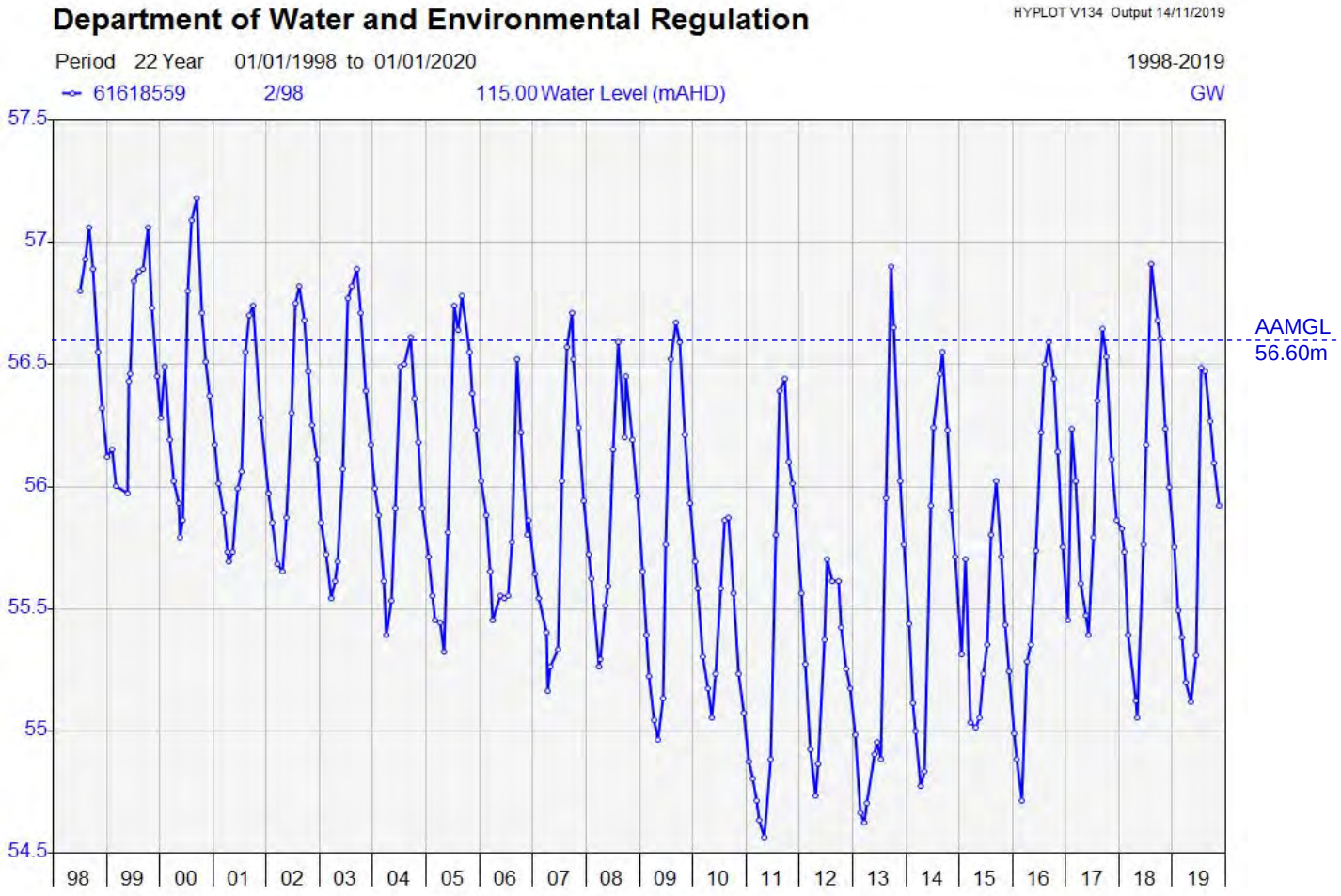

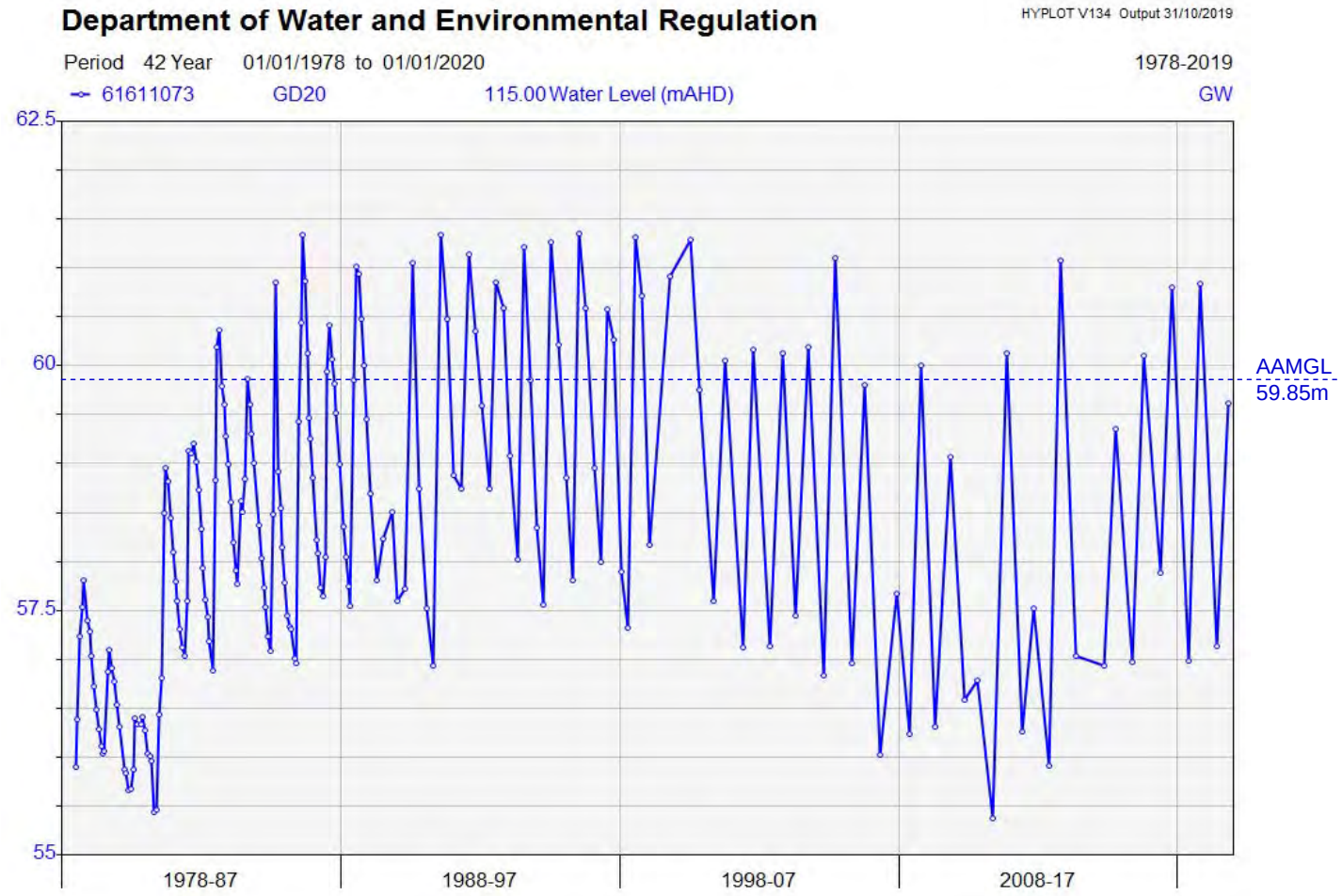

Figure 7

DWER BORE HYDROGRAPHS

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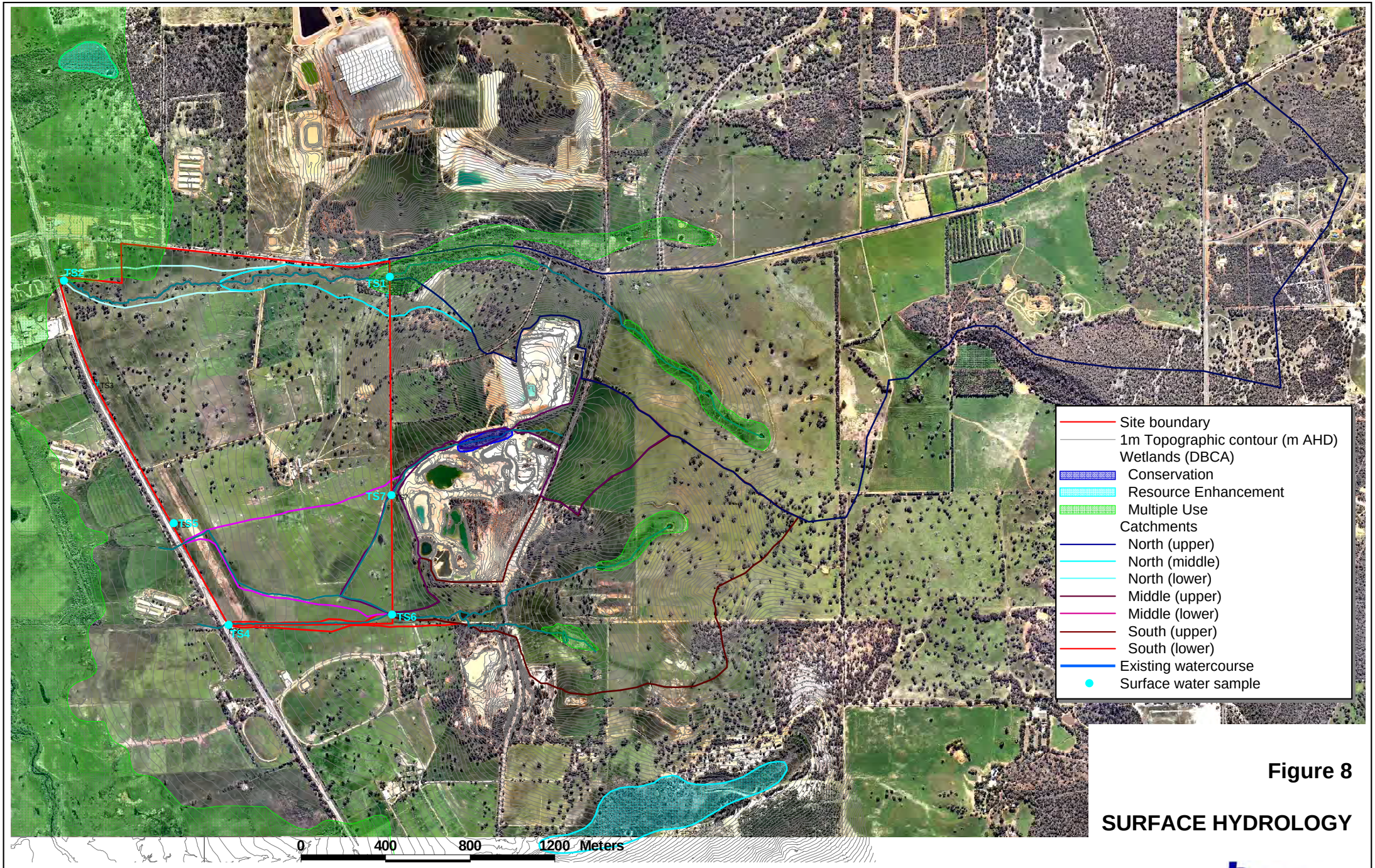

Figure 8

SURFACE HYDROLOGY

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Figure 9

VEGETATION AND FAUNA

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1 Great Northern Highway looking north-east

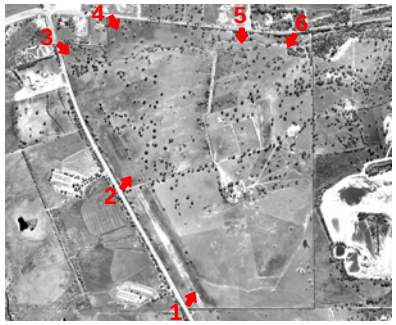
2 Great Northern Highway looking north-east

3 Great Northern Highway looking south-east

4 Muchea East Road looking south-east

5 Muchea East Road looking south

6 Muchea East Road looking south-west



Images: Google (2018)

Figure 10

VIEWS FROM GREAT NORTHERN HIGHWAY AND MUCHEA EAST ROAD

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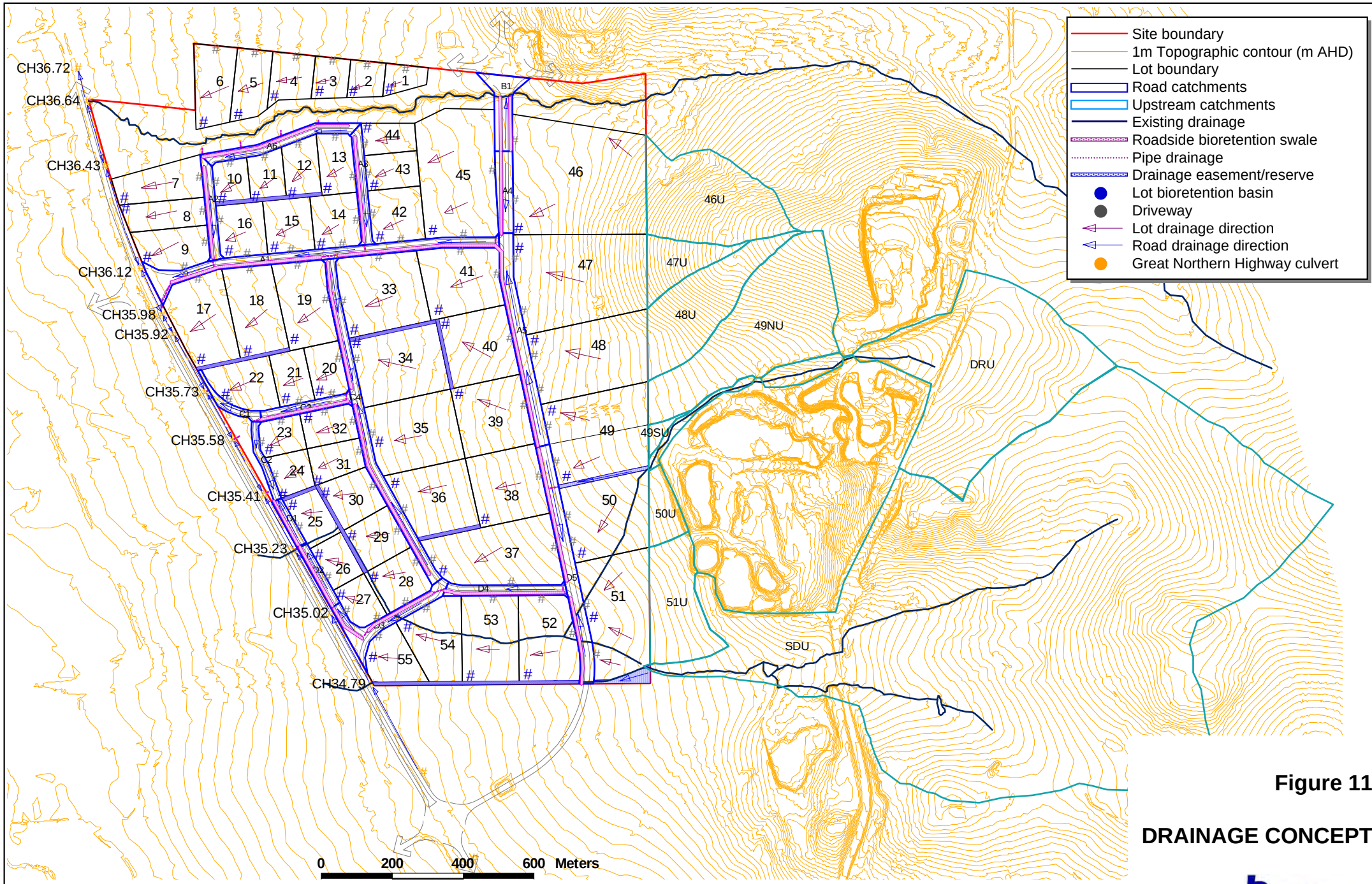

Figure 11

DRAINAGE CONCEPT

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Appendix A

Local Water Management Strategy

Appendix B

Tree Survey Results

Talangatta Tree Survey

List of Trees over 0.5m dbh

Wpt	*Easting*	*Northing*	*Species*	*DBH (m)*	*Height (m)*	*Description*	*Hollow Inspection 261020*
621	406296	6504203	uk	1	20	Dead stag, possibly Marri, several possible hollows, nothing large	No usable hollow.
622	406303	6504210	uk	1	15	Several possible hollows inc 2 large openings @ 5-8m	2 ok looking hollows, no sign of use.
623	406356	6504213	uk	0.9	15	Dead stage, several potential hollows & spouts	Corella chick in 1 hollow.
624	406369	6504916	uk	0.7	5	Dead stag, snapped at 5m no hollows	
625	405595	6504489	Wandoo	0.8	8	Healthy, spreading, no hollows	
626	405616	6504496	Marri	1	8	Bifurcated at 1m, spreading, no hollows	
627	405589	6504548	Marri	1.1	15	Spreading, no hollows	
628	405472	6504453	Wandoo	0.9	15	Spreading, no hollows	
629	405290	6504767	Wandoo	0.9	15	Healthy, spreading, no hollows	
630	405291	6504785	Wandoo	0.7	18	Straight, no hollows, stick nest up high	
631	405280	6504792	Wandoo	0.6	18	Straight, no hollows	
632	405263	6504837	Marri	0.8	10	Old, spreading, sparse foliage, no hollows	
633	405248	6504860	Marri	0.8	15	Spreading, no hollows	
634	405215	6504893	Wandoo	0.7	15	Few possible small hollows, none cocky size	
635	405211	6504901	Wandoo	0.7	4	Snapped off at 4m, dead branches, no hollows	
636	405243	6504937	Marri	0.7	10	Spreading, no hollows	
637	405387	6504937	Marri	0.8	12	Healthy, spreading, no hollows	
638	405450	6504823	Marri	0.8	15	Healthy, no hollows	
639	405546	6504791	Marri	0.9	15	Senescent, dead limbs, poss small hollows, none cocky sized	
640	405520	6504834	Marri	0.7	15	Spreading, healthy, no hollows	
641	405520	6504846	Marri	0.7	12	Spreading, healthy, no hollows	
642	405527	6504880	Marri	1	15	Spreading, healthy, no hollows	
643	405495	6504952	Marri	0.9	18	Healthy, 1 small hollow, not cocky sized	
644	405599	6504892	Marri	1	12	Healthy, spreading, no hollows	
645	405627	6504856	Marri	0.8	12	Spreading, no hollows	
646	405614	6504831	Marri	0.6	8	Many dead terminal branches, no hollows	
647	405807	6504920	Flooded gum	0.7	18	Possible ES euc, heavily branched, no hollows	
648	405790	6504950	Marri	0.9	12	Spreading, v senescent, no hollows	
649	405782	6505023	Wandoo	0.6	15	Possible ES euc, spreading, no hollows	
650	405877	6504976	Flooded gum	1.8	25	Probably ES euc, heavily branched at 2m, 1 stick nest, no hollows	
651	405845	6504974	Wandoo	0.9	20	Probably BG, no hollows	
652	405903	6504984	Flooded gum	1	20	Probably ES euc, no hollows	
653	405873	6504942	Wandoo	0.8	18	Sparse foliage, no hollows	
654	405891	6504904	Wandoo	0.7	15	Possible Wandoo, no hollows	
655	406047	6504922	Marri	0.7	8	Spreading, no hollows	
656	406066	6504948	Marri	0.7	10	Spreading, no hollows	
657	406077	6504920	Marri	0.6	12	Bifurcated at GL, senescent, no hollows	
658	406110	6505013	Marri	0.9	18	Healthy, no hollows	
659	406080	6505072	Marri	0.5	8	Sparse branches, no hollows	
660	406098	6505108	Marri	1	15	Old, senescent, no hollows	
661	406110	6505058	Marri	0.8	18	Spreading, no hollows	
662	406146	6505017	Marri	0.6	8	Spreading, no hollows	
663	406166	6505021	Marri	0.8	12	No hollows	
664	406183	6504956	Marri	0.7	8	No hollows	
665	406219	6504970	Marri	0.5	8	Slender, 1 sided, no hollows	
666	406202	6505040	Marri	0.6	10	No hollows	
667	406152	6505089	Jarrah	0.7	15	Bifurcated at GL, healthy, no hollows	
668	406164	6505116	Marri	0.7	12	Healthy, spreading, no hollows	
669	406130	6505149	Jarrah	0.8	8	Leaning, spreading, healthy, no hollows	
670	406165	6505143	Jarrah	0.7	5	Heavily senescent, leaning, poor health, no hollows	
671	406219	6505104	Marri	0.8	12	Healthy, spreading, no hollows	
672	406270	6505104	Marri	0.7	12	Spreading, healthy, no hollows	

673	406225	6505149	Marri	0.9	10	Senescent, dead limbs, possible hollows/spouts	
674	406171	6505232	Marri	1	20	Spreading, no hollows	
675	406162	6505265	Marri	1	18	Spreading, no hollows	
676	406203	6505269	Marri	0.8	12	No hollows	
677	406245	6505355	Wandoo	0.5	8	Bifurcated at 1m, no hollows	
678	406322	6505333	Wandoo	0.8	15	2 large dead sections, Corellas, 1 or 2 potential large spouts at 4 & 6 m	
679	406313	6505327	Wandoo	1	15	Most trunk dead (1 side), 2 possible hollows/spouts, 28s & Corellas squabbling	
680	406301	6505312	Wandoo	0.7	8	No hollows	
681	406293	6505297	Wandoo	0.7	5	Snapped off at 2.5m, no hollows	
682	406258	6505273	Marri	0.7	10	Top 3-4m dead, 1 small hollow occupied by 28s	
683	406260	6505226	Marri	0.5	6	No hollows	
684	406249	6505218	Marri	0.6	10	No branches below 6m, no hollows	
685	406234	6505213	Marri	0.7	15	no branches below 6m, stick nests in top, no hollows	
686	406240	6505186	Marri	0.5	6	Spreading, no hollows	
687	406324	6505350	Wandoo	0.5	5	Bfirucated at 1m, no hollows	
688	406298	6505375	Wandoo	0.5	8	1-2 small hollows, not cocky sized	
689	406257	6505355	Wandoo	0.5	10	No hollows	
690	406274	6505346	Wandoo	0.5	8	Heavily branched, no hollows	
691	406357	6505377	Wandoo	0.6	10	No hollows	
692	406366	6505351	Wandoo	0.9	15	Dead sections of trunk & branches, 1 possible cocky hollow	
693	406349	6505137	Marri	0.6	10	No hollows	
694	406322	6505160	Marri	0.6	12	Twin marris, spreading, no hollows	
695	406318	6505161	Marri	0.5	5	No hollows	
696	406316	6505165	Marri	0.7	7	No hollows	
697	406314	6505152	Marri	0.7	10	Spreading, no hollows	
698	406308	6505137	Marri	0.8	10	Spreading, no hollows	
699	406366	6505023	Marri	1	6	Strongly leaning, senescent, hollow at 2m with beehive	
700	406359	6505583	Wandoo	0.6	6	Heavily branched, spreading, no hollows	
701	406352	6505576	Wandoo	0.5	6	Branching, no hollows	
702	406332	6505581	Wandoo	0.5	10	Spreading, no hollows	
703	406307	6505575	Wandoo	0.7	8	2 Wandoos, no hollows	
704	406280	6505537	Wandoo	0.7	15	Spreading, 1 sided, no hollows	
705	406281	6505518	Wandoo	1.1	8	Snapped off at 6m, possible large spout in top	
706	406264	6505541	Wandoo	0.7	10	No hollows	
707	406185	6505489	Marri	0.7	8	No hollows	
708	406168	6505464	Wandoo	0.7	15	Healthy, no hollows	
709	406203	6505414	Wandoo	0.6	15	No hollows	
710	406245	6505451	Wandoo	0.6	15	No hollows	
711	406279	6505453	Wandoo	0.7	15	2 or 3 small hollows up high, none cocky sized	
712	406302	6505481	Wandoo	0.6	15	Spreading, no hollows	
713	406177	6505395	Jarrah	0.8	12	Spreading, leaning, no hollows	
714	406124	6505374	Marri	0.8	15	No hollows	
715	406121	6505346	Marri	0.8	18	Healthy, spreading, no hollows	
741	405456	6505041	Wandoo	0.7	12	Healthy, no hollows	
742	405449	6505030	Wandoo	0.8	15	Healthy, spreading, several potential large and small hollows	2 hollows, 1 obstructed, other messy, no use.
743	405428	6505043	Wandoo	0.7	15	Spreading, one hollow at 3m another at 6m, 2 other potentials	No usable hollow.
744	405360	6505004	Wandoo	0.9	12	1 small hollow at 5m, possibly other small ones towards top	No usable hollow.
745	405399	6505065	Marri	1	10	No hollows	
746	405394	6505094	Wandoo	0.9	12	1 hollow at 8m with beehive, 2 other small potentials	1 hollow 0.5m deep with bees.
747	405395	6505110	Marri	1	8	1 potential large hollow at 3m	No usable hollow.
748	405343	6505115	Marri	0.9	15	Spreading, dead upper branches, no hollows	
749	405316	6505132	Marri	0.8	12	1 small hollow at 3m	No usable hollow.
750	405337	6505177	Marri	1.1	15	Spreading, no hollows	
751	405345	6505219	Marri	0.8	10	No hollows	
752	405345	6505219	Marri	0.7	8	No hollows	
753	405378	6505217	Marri	0.6	6	No hollows	
754	405394	6505211	Marri	1	10	Lots of carellas, no hollows	

755	405393	6505264	Marri	0.7	12	No hollows	
756	405389	6505272	Marri	0.8	12	No hollows	
757	405389	6505302	Marri	0.8	10	Spreading, no hollows	
758	405394	6505343	Marri	0.7	10	Spreading, sparse foliage, possibly poor health, no hollows	
759	405390	6505456	Marri	0.7	15	No hollows	
760	405359	6505457	Marri	0.7	10	No hollows	
761	405402	6505482	Marri	0.8	10	No hollows	
762	405438	6505530	Marri	0.6	10	Senescent, scrappy looking, no hollows	
763	405401	6505642	Marri	0.9	10	Spreading, no hollows	
764	405353	6505702	Marri	0.8	10	Everything above 3m dead, senscent, hollow at 3-4m mark with a beehive near	Decent hollow, beehive next to it.
765	405358	6505726	Marri	1	10	Spreading, no hollows	
766	405322	6505688	Marri	0.6	10	No hollows	
767	405339	6505627	Marri	0.9	15	Straight, clean, no hollows	
768	405226	6505585	Wandoo	0.6	12	Straight, no hollows	
769	405272	6505482	Wandoo	0.6	15	Straight, clean, no hollows	
770	405290	6505490	Wandoo	0.6	15	2 possible small hollows at 5 and 7m	1 hollow with 2 corellas
771	405328	6505482	Marri	0.9	18	Spreading, no hollows	
772	405210	6505405	Marri	0.7	12	No hollows	
773	405231	6505376	Wandoo	0.7	12	No hollows	
774	405255	6505359	Wandoo	0.6	8	No hollows	
775	405311	6505387	Marri	0.9	8	Spreading, no hollows	
776	405325	6505405	Wandoo			Recently deceased, no hollows	
777	405324	6505336	Marri	0.6	6	No hollows	
778	405326	6505336	Marri	0.5	5	No hollows	
779	405335	6505326	Marri	1	15	Senescent, aggressive hive at base, 1 large hollow at 5m with possible traffic marks	Large hollow 0.5m deep, no use.
780	405322	6505314	Marri	0.5	8	No hollows	
781	405300	6505311	Marri	0.5	8	Heavily laden with nuts, no hollows	
782	405267	6505327	Marri	0.7	10	No hollows	
783	405244	6505333	Wandoo	0.8	8	1 large gap from 2m, 2 small hollows at 4-5m - not cocky sized	
784	405298	6505295	Marri	0.7	15	No hollows	
785	405305	6505276	Marri	0.8	12	1 possible large hollow at 6m, white feather stuck to outside	No usable hollow.
786	405310	6505004	Wandoo	1	15	Very senscent, basically dead 3m up, dead branches, several possible hollows (1 lrg)	1 hollow with kestrel on eggs.
787	405296	6504995	Wandoo	0.6	8	No hollows	
788	405181	6504954	Marri	0.9	15	One sided to east, trimmed off from powerline, no hollows	
789	405174	6504977	Marri	0.7	8	No hollows	
790	405159	6504991	Marri	0.8	10	One sided, no hollows	
791	405123	6505056	Marri	0.7	10	No hollows	
792	405118	6505068	Marri	1.3	15	One sided, no hollows	
793	405092	6505107	Marri	1	10	Cut away from powerline, 1 v small hollow at 8m	
794	405069	6505179	Wandoo	1	10	No hollows	
795	405045	6505201	Wandoo	0.6	8	Bifurcated at 0.5m, larger is 0.6, no hollows	
796	405032	6505247	Marri	1	8	Spreading, no hollows	
797	405010	6505279	Wandoo	0.7	10	No hollows	
798	405009	6505285	Wandoo	0.8	10	Possibly one hollow forming	No usable hollow - perhaps future.
799	404977	6505363	Marri	0.7	10	No hollows	
800	404964	6505353	Stag	0.9	4	Cut off at top, no hollows	
801	404971	6505372	Marri	0.9	10	Spreading, no hollows	
802	404976	6505388	Marri	0.9	10	Spreading, no hollows	
803	405052	6505467	Marri	0.9	8	No hollows	
804	405064	6505447	Marri	0.9	10	No hollows	
805	405082	6505378	Marri	0.8	6	Old, no hollows	
806	405090	6505367	Marri	0.7	6	No hollows	
807	405106	6505391	Wandoo	0.8	15	No hollows	
808	405133	6505417	Wandoo	0.7	12	No hollows	
809	405154	6505409	Wandoo	0.7	10	No hollows	
810	405187	6505391	Wandoo	0.9	10	Big dead chunk on trunk, one **very** large hollow at 3.5m	Big spout, no occupancy.
811	405207	6505340	Wandoo	0.7	10	Bifurcated at 1m, larger is dead, spout at 3m	No usable hollow.

812		405170	6505318	Marri	0.8	12	Old, senescent, few potential hollows, none current
813		405158	6505324	Marri	0.6	8	Spreading, no hollows
814		405147	6505307	Marri	0.7	8	Largest of 3 next to each other by combining 2 trunks, sensecent, no hollows
815		405218	6505190	Marri	0.7	8	Spreading, no hollows
816		405070	6505596	Wandoo	0.6	6	Trifurcated at 0.5, no hollows
817		405088	6505672	Wandoo	0.9	15	No hollows
818		405016	6505698	Wandoo	0.6	10	No hollows
819		405009	6505704	Wandoo	0.7	10	Spreading, no hollows
820		404968	6505706	Wandoo	0.5	15	No hollows
821		404982	6505730	Wandoo	0.6	15	No hollows
822		404887	6505670	Wandoo	0.5	10	No hollows
823		404942	6505656	Wandoo	0.5	10	No hollows
824		405117	6505713	Dead Stag - Wandoo	0.7	10	No hollows
825		405164	6505672	Wandoo	0.7	15	2 small hollows, none cocky sized, 1 stick nest 5m
826		405171	6505674	Marri	0.7	10	Double trunk, larger dead, no hollows
827		405200	6505665	Wandoo	0.7	8	Triple trunked, 1 small hollow, nothing cocky sized
828		405205	6505647	Marri	0.7	8	Spreading, no hollows
829		405185	6505641	Marri	0.7	8	No hollows
830		405204	6505625	Wandoo	0.6	8	No hollows
831		405216	6505730	Marri	0.7	8	No hollows
832		405299	6505750	Marri	0.5	10	No hollows
833		405312	6505764	Marri	0.6	8	Several trunks, no hollows
834		405337	6505767	Marri	0.6	8	No hollows
835		405345	6505766	Marri	0.8	10	Almost entirely dead, no hollows
836		405356	6505746	Marri	0.8	15	Mostly dead, 1 low potential cocky hollow 5m
837		405363	6505799	Marri	0.6	12	No hollows
838		405366	6505799	Marri	0.6	10	1m east of 837, no hollows
839		405379	6505801	Marri	0.6	10	No hollows
840		405387	6505795	Marri	0.5	10	Recently dead, no hollows
841		405403	6505801	Wandoo	0.6	8	No hollows
842		405444	6505806	Wandoo	0.6	8	No hollows
843		405513	6505799	Wandoo	0.5	6	1 very small hollow 3m
844		405563	6505794	Marri	0.7	10	No hollow, 1 possible forming 3m
845		405630	6505807	Marri	0.7	8	Recently deceased, spreading, no hollows
846		405680	6505787	Marri	0.6	8	No hollows
847		405715	6505771	Marri	0.5	12	No hollows
848		404844	6505779	Wandoo	0.6	5	No hollows
849		404839	6505793	Marri	1	15	"Large impressive specimen", no hollows
850		404819	6505813	Marri	0.7	8	Spreading, no hollows
850 (2)		405506	6505061	Wandoo	0.9	20	Small dead branches&twigs, otherwise healthy, spout and beehive possible at 10, 5m
851		405508	6505079	Wandoo	0.5	10	No hollows
852		405493	6505099	Wandoo	0.7	10	Lots of dead small upper branches, no hollows
853		405553	6505191	Marri	0.9	12	Large dead sections, 2 possible future hollows
854		405508	6505299	Marri	0.8	6	Major bifurcation 1.5m, one side mostly dead, hollow 4m with carella, another small at 6
855		405489	6505240	Marri	0.7	10	Dead branches, no hollows
856		405611	6505542	Marri	0.8	10	Spreading, no hollows
857		405867	6505825	Jarrah	0.9	8	Senescent, spreading, dead branches, 3 small/potentia hollows, none cocky sized
858		405937	6505814	Marri	0.7	7	Senescent, dead branches, no hollows
859		406008	6505816	Marri	0.9	10	Old, 1 hollow homing a 28
860		406018	6505824	Marri	0.8	12	No hollows, 1 magpie nest up high
861		406358	6505753	Dead Stag - Wandoo	0.6	10	No hollows
862		406360	6505721	Marri	0.7	18	Healthy, no hollows
863		406362	6505712	Marri	0.5	8	No hollows
864		406323	6505698	Marri	0.7	15	No hollows
865		406311	6505707	Marri	0.6	18	No hollows
866		406276	6505707	Marri	1	20	1 possible large spot at 6m, 1 very large hollow at 12m, may or may not be habitable
867		406243	6505671	Marri	0.7	12	Senescent, no hollows

2 hollows, 1 possbly with corellas, other with 2-3 kestrel chicks.
Decent hollow, no usage.
1 good hollow with corellas.
Decent hollow, no occupant.
No usable hollow.

868	406307	6505672	Marri	0.7	15	No hollows	
869	406324	6505680	Marri	0.7	12	No hollows	
870	406340	6505676	Marri	0.6	6	Old, spreading, no hollows	
871	406343	6505661	Marri	0.6	8	Spreading, no hollows	
872	406359	6505646	Marri	0.6	8	Senescent, no hollows	
873	406356	6505619	Wandoo	0.5	8	No hollows	
874	406314	6505609	Marri	0.7	20	No hollows	
875	406301	6505627	Marri	0.9	15	Bifurcated at 2m, no hollows	
876	406275	6505610	Marri	0.9	18	No hollows	
877	406284	6505595	Marri	0.6	15	No hollows	
878	406301	6505600	Wandoo	0.5	10	No hollows	
879	406312	6505609	Marri	0.8	18	No hollows	
880	406300	6505594	Marri	0.7	10	Dead, No hollows	
881	406273	6505567	Wandoo	0.5	8	No hollows	
882	406264	6505583	Marri	0.5	15	1 Stick nest at 10m, no hollows	
883	406215	6505575	Marri	0.7	20	No hollows	
884	406210	6505548	Marri	0.7	18	Trifurcated at 1.5m, spreading, senescent, no hollows	
885	406233	6505535	Wandoo	0.8	20	No hollows	
886	406214	6505525	Wandoo	0.7	8	Top 3m dead, no hollows	
887	406169	6505534	Marri	0.5	8	1 large dead upright but no visible hollow, possible future spout	
888	406154	6505561	Marri	0.7	15	Bifurcated at 0.5m, no hollows	
889	406166	6505590	Marri	0.7	15	No hollows	
890	406043	6505515	Marri	0.6	8	No hollows, 1 28 at top	
891	406029	6505508	Marri	0.5	8	Sparse, no hollows	
892	406000	6505508	Marri	0.8	20	1 small hollow at 5m, not cocky sized	
893	405976	6505512	Marri	0.6	18	No hollows	
894	405932	6505485	Marri	0.9	18	Spreading, no hollows	
895	405844	6505488	Marri	0.7	12	Almost dead, no hollows	
896	405773	6505474	Marri	0.6	8	No hollows	
897	405756	6505628	Marri	0.6	6	Old, no hollows	
898	405785	6505643	Marri	0.7	10	No hollows	
899	405852	6505670	Marri	0.7	10	Senescent, lots of dead branches, no hollows	
900	405851	6505710	Marri	0.8	8	No hollows	
901	405863	6505714	Marri	0.7	8	No hollows	
902	405897	6505728	Marri	0.7	15	No hollows	
903	405956	6505700	Marri	0.8	8	No hollows	
904	405964	6505712	Marri	0.7	12	Mostly dead, 1 small hollow 5m, not cocky sized	
905	405978	6505713	Marri	0.6	12	No hollows	
906	406008	6505737	Marri	0.8	20	No hollows	
907	406029	6505763	Marri	0.8	20	Fairly sparse, no hollows, 1 magpie	
908	406074	6505758	Marri	0.9	20	Beehive at base and another at 4m, hollows at 6 and 10m - not cocky sized	
909	406080	6505717	Marri	0.6	12	No hollows	
910	406088	6505718	Marri	0.7	15	Partly dead, 2 very small hollows	
911	406096	6505723	Marri	0.7	12	No hollows	
912	406102	6505713	Marri			Dead branch low down, higher up is healthy, no hollows	
913	406125	6505751	Marri			Mostly dead, one small hollow 3m	
914	406133	6505753	Marri	0.6	15	No hollows	
915	406139	6505735	Marri	0.8	18	No hollows	
916	406157	6505748	Marri	0.6	15	No hollows	
917	406175	6505758	Marri	0.7	10	No hollows	
918	406190	6505731	Marri	0.7	12	No hollows	
919	406167	6505691	Marri	0.7	15	Leaning, no hollows	
920	406139	6505694	Marri	0.9	20	Large possible spout 10m, another slightly higher	Big deep hollow, no sign of use.
921	406128	6505661	Marri	0.6	10	No hollows	
922	406042	6505643	Marri	0.7	15	No hollows	
923	406033	6505551	Marri	0.7	15	No hollows	
924	406006	6505576	Marri	0.6	8	No hollows	

925	405960	6505634	Marri	0.8	12	Lots of dead branches, quite senescent, 1 hollow 8m with beehive	
926	405965	6505667	Marri	0.7	12	No hollows	
927	404877	6505827	Wandoo	0.6	15	No hollows, stick nest at 12m	
928	404896	6505814	Wandoo	0.5	10	1 of a group, 1 small hollow 4m - not cocky sized	
929	404920	6505808	Wandoo	0.6	8	4 trunks, bushy, spreading, no hollows	
930	404938	6505841	Wandoo	0.6	8	Bushy, spreading, no hollows	
931	405072	6505810	Marri	0.6	8	No hollows	
932	405096	6505795	Wandoo	0.6	8	No hollows	
933	405090	6505794	Wandoo	0.6	6	No hollows	
934	405089	6505790	Wandoo	0.6	8	No hollows	
935	405078	6505772	Wandoo	0.5	8	No hollows	
936	405074	6505770	Wandoo	0.5	8	No hollows	
937	405080	6505766	Wandoo	0.7	10	4 trunks, no hollows	
938	405087	6505745	Wandoo	0.5	10	2 trunks, no hollows	
939	405133	6505861	Wandoo	1	20	1 possible hollow 5m	2 hollows, 1 too shallow, other had beehive.
940	405101	6505929	Wandoo	1	20	Trunk snapped at 4m, possible very large spout at top	Huge chimney in top, too big for nest.
941	405106	6505955	Wandoo	0.6	8	No hollows	
942	405130	6505996	Dead stag - Marri	0.6	8	No hollows	
943	405135	6505996	Marri	0.8	15	2 hollows, both with beehive	
944	405142	6505989	Wandoo	0.9	15	No hollows	
945	405160	6505988	Wandoo	0.7	18	No hollows	
946	405195	6505954	Marri	1.1	20	Very broad base - 2m+, no hollows	
947	405214	6505943	Marri	0.7	15	No hollows	
948	405203	6505916	Marri	0.7	15	No hollows	
949	405211	6505882	Marri	0.6	10	Double trunk, no hollows	
950	405265	6505892	Marri	0.6	12	1 possible hollow 10m	No usable hollow.
951	405239	6505990	Marri	0.9	20	Next to powerline, no hollows	
952	405282	6505835	Marri	0.7	7	Snapped off at 4m, huge spout in snapped part, probably not hollow	Big deep spout, no sign of use.
953	405267	6505825	Marri	0.7	10	1 hollow with beehive	
954	405257	6505787	Marri	0.6	15	No hollows	
955	405217	6505759	Wandoo	0.7	15	No hollows	
956	405264	6505767	Marri	0.8	18	No hollows	
957	405254	6505782	Marri	0.6	10	No hollows	
958	405309	6505856	Marri	0.8	18	No hollows	
959	405351	6505818	Marri	0.6	15	No hollows	
960	405395	6505838	Marri	0.7	15	No hollows	
961	405401	6505828	Stag - Marri	0.6	6	No hollows	
962	405420	6505840	Marri	1	15	1 small hollow at 3m	
963	405436	6505825	Marri	0.8	18	No hollows	
964	405474	6505821	Marri	0.6	10	No hollows	
965	405482	6505824	Wandoo	0.9	20	1 possible future hollow at 8m	
966	405523	6505887	Marri	1	15	No hollows	
967	405561	6505827	Wandoo	0.9	20	Beehive in very small hollow 3.5m, large hollow right next to it, another possible 10m	No usable hollows.
968	405586	6505862	Marri	0.9	18	Very spreading, no hollows	
969	405628	6505913	Marri	0.8	15	No hollows	
970	405637	6505943	Marri	0.7	18	2 trunks from 0.5m, no hollows	
971	405626	6505848	Marri	0.7	15	No hollows	
972	405673	6505867	Marri	0.7	15	top half dead, no hollows	
973	405687	6505895	Marri	0.6	15	Recently dead, no hollows	
974	405695	6505909	Marri	0.7	18	Split at 0.5m, no hollows	
975	405700	6505936	Marri	0.8	15	Large hollow 5m	Decent hollow, occupied by ants nest.
976	405732	6505935	Marri	0.7	12	No hollows	
977	405763	6505930	Stag - Marri	0.6	10	No hollows	
978	405754	6505899	Marri	0.6	10	Most of main trunk dead, possible spout 4m	No usable hollow.
979	405756	6505879	Marri	0.7	15	Mostly recently dead, no hollows	
980	405759	6505860	Marri	0.8	15	No hollows	
981	405745	6505862	Stag	0.7	5	No hollows	

982	405794	6505891	Marri	0.7	15	1 Stick nest at 15m, no hollows	
983	405798	6505872	Marri	0.6	8	No hollows	
984	405858	6505864	Marri	0.8	15	No hollows	
985	405851	6505863	Marri	0.6	8	3m south of 984, no hollows	
986	405878	6505883	Marri	0.7	15	3 trunks, 1 possible small hollow 4m - not cocky sized	
987	405987	6505877	Marri	0.8	20	Spreading, no hollows	
988	406052	6505897	Stag - Marri	1	8	2 possible spouts at ends of branches, nothing visible	
989	406086	6505832	Marri	0.6	15	No hollows	
990	406104	6505840	Marri	0.6	15	No hollows	
991	406159	6505863	Wandoo	0.7	15	1 possible hollow at 10m, substantial stick nest 12m	Beehive in hollow.
992	406171	6505862	Wandoo	0.6	8	No hollows	
993	406220	6505857	Marri	0.8	20	Top 5m mostly dead, possible spout 18m	No usable hollow.
994	406245	6505853	Marri	0.6	8	No hollows	
995	406207	6505890	Wandoo	0.5	8	No hollows	
996	406317	6505904	Stag	0.8	15	No hollows	
997	406340	6505854	Marri	0.6	15	Split at 0.5m, no hollows	
998	406330	6505853	Marri	0.6	6	Old, no hollows	
999	406288	6505851	Marri	0.6	10	No hollows	
1001	406286	6505845	Marri	0.6	12	3 trunks from 0.5m, no hollows	
1002	406295	6505853	Marri	0.9	6	Fallen, no hollows	
1003	405084	6505767	Wandoo	0.6	12	3-4 trunks from ground level, no hollows	
1004	405076	6505768	Wandoo	0.5	10	No hollows	
1005	405052	6505731	Marri	0.5	12	No hollows	
1006	405048	6505736	Marri	0.7	15	Trifurcated at 0.5m, no hollows	
1007	405004	6505759	Wandoo	0.7	6	No hollows	
1008	405000	6505746	Wandoo	0.7	12	No hollows	
1009	404979	6505752	Wandoo	0.5	8	No hollows	
1011	405832	6505351	Marri	0.5	8	Senescent, dead tips, no hollows	
1012	405840	6505407	Marri	0.95	20	Old, healthy looking, 1 likely hollow at 8-9m - not cocky sized but inhabited	
1013	405843	6505412	Marri	0.6	7	2m NE of 1012, no hollows	
1014	405866	6505382	Marri	0.6	7	Senescent, no hollows	
1015	405903	6505370	Marri	0.8	18	Spreading, no hollows	
1016	405893	6505435	Marri	1	15	Spreading, no hollows	
1017	405942	6505404	Marri	0.8	15	No hollows	
1018	405997	6505413	Marri	0.7	15	No hollows	
1019	405975	6505395	Marri	0.7	12	No hollows	
1020	406028	6505367	Jarrah	0.9	5	Almost entirely dead, burnt out at base, 2 potential huge spouts at 4m	2 very large hollows, no usage.
1021	405933	6505319	Marri	0.7	10	Almost dead, probably dying possible 20cm hollow 5m, another smaller one 6m	1 hollow with corellas, 1 other smaller, no use.
1022	405047	6505798	Wandoo	0.4	6	No hollows	
1023	405033	6505797	Wandoo	0.5	8	No hollows	
1024	404935	6505820	Wandoo	0.4	8	Double trunk, no hollows	
1025	404894	6505706	Wandoo	0.4	8	Triple trunked, no hollows	
1026	404922	6505742	Wandoo	0.5	5	Double trunked, 1 very small hollow 3m - not cocky sized	
1027	404912	6505757	Wandoo	0.5	6	Lots of dead foliage at top, no hollows	
1028	404945	6505677	Wandoo	0.4	7	Spreading, no hollows	
1029	404883	6505661	Wandoo	0.5	8	Triple trunked, no hollows	

Appendix C

Aboriginal Sites Search Report and DPLH Advice

Search Criteria

2 Registered Aboriginal Sites in Coordinates search area; 404797.00mE, 6505844.00mN z50 (MGA94) : 405094.00mE, 6505817.00mN z50 (MGA94) : 405094.00mE, 6506005.00mN z50 (MGA94) : 406180.00mE, 6505893.00mN z50 (MGA94) : 406368.00mE, 6505923.00mN z50 (MGA94) : 406376.00mE, 6504206.00mN z50 (MGA94) : 405598.00mE, 6504197.00mN z50 (MGA94) : 404958.00mE, 6505368.00mN z50 (MGA94)

Disclaimer

The *Aboriginal Heritage Act 1972* preserves all Aboriginal sites in Western Australia whether or not they are registered. Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist.

The information provided is made available in good faith and is predominately based on the information provided to the Department of Aboriginal Affairs by third parties. The information is provided solely on the basis that readers will be responsible for making their own assessment as to the accuracy of the information. If you find any errors or omissions in our records, including our maps, it would be appreciated if you email the details to the Department at heritageenquiries@daa.wa.gov.au and we will make every effort to rectify it as soon as possible.

South West Settlement ILUA Disclaimer

Your heritage enquiry is on land **within or adjacent to** the following Indigenous Land Use Agreement(s): Whadjuk People ILUA

On 8 June 2015, six identical Indigenous Land Use Agreements (ILUAs) were executed across the South West by the Western Australian Government and, respectively, the Yued, Whadjuk People, Gnaala Karla Booja, Ballardong People, South West Boojarah #2 and Wagyl Kaip & Southern Noongar groups, and the South West Aboriginal Land and Sea Council (SWALSC).

The ILUAs bind the parties (including 'the State', which encompasses all State Government Departments and certain State Government agencies) to enter into a Noongar Standard Heritage Agreement (NSHA) when conducting Aboriginal Heritage Surveys in the ILUA areas, unless they have an existing heritage agreement. It is also intended that other State agencies and instrumentalities enter into the NSHA when conducting Aboriginal Heritage Surveys in the ILUA areas. It is recommended a NSHA is entered into, and an 'Activity Notice' issued under the NSHA, if there is a risk that an activity will 'impact' (i.e. by excavating, damaging, destroying or altering in any way) an Aboriginal heritage site. The Aboriginal Heritage Due Diligence Guidelines, which are referenced by the NSHA, provide guidance on how to assess the potential risk to Aboriginal heritage.

Likewise, from 8 June 2015 the Department of Mines and Petroleum (DMP) in granting Mineral, Petroleum and related Access Authority tenures within the South West Settlement ILUA areas, will place a condition on these tenures requiring a heritage agreement or a NSHA before any rights can be exercised.

If you are a State Government Department, Agency or Instrumentality, or have a heritage condition placed on your mineral or petroleum title by DMP, you should seek advice as to the requirement to use the NSHA for your proposed activity. The full ILUA documents, maps of the ILUA areas and the NSHA template can be found at https://www.dpc.wa.gov.au/lantu/Claims/Pages/SouthWestSettlement.aspx.

Further advice can also be sought from the Department of Aboriginal Affairs (DAA) at heritageenquiries@daa.wa.gov.au.

Coordinate Accuracy
Accuracy is shown as a code in brackets following the coordinates. Map coordinates (Latitude/Longitude and Easting/Northing) are based on the GDA 94 Datum. The Easting/Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '500000mE:Z50' means Easting=500000, Zone=50.

Terminology (NB that some terminology has varied over the life of the legislation)
Place ID/Site ID: This a unique ID assigned by the Department of Aboriginal Affairs to the place
Status:
- **Registered Site**: The place has been assessed as meeting Section 5 of the *Aboriginal Heritage Act 1972*
- **Other Heritage Place which includes:**
  - **Stored Data / Not a Site:** The place has been assessed as not meeting Section 5 of the *Aboriginal Heritage Act 1972*
  - **Lodged:** Information has been received in relation to the place, but an assessment has not been completed at this stage to determine if it meets Section 5 of the *Aboriginal Heritage Act 1972*

Status Reason: e.g. Exclusion - Relates to a portion of an Aboriginal site or heritage place as assessed by the Aboriginal Cultural Material Committee (ACMC). e.g. such as the land subject to a section 18 notice.
Origin Place ID: Used in conjuction with Status Reason to indicate which Registered Site this Place originates from.
Access and Restrictions:
- **File Restricted = No:** Availability of information (other than boundary) that the Department of Aboriginal Affairs holds in relation to the place is not restricted in any way.
- **File Restricted = Yes:** Some of the information that the Department of Aboriginal Affairs holds in relation to the place is restricted if it is considered culturally sensitive. This information will only be made available if the Department of Aboriginal Affairs receives written approval from the informants who provided the information. Download the Request to Access Restricted Information letter and form.
- **Boundary Restricted = No:** place location is shown as accurately as the information lodged with the Registrar allows.
- **Boundary Restricted = Yes:** To preserve confidentiality the exact location and extent of the place is not displayed on the map. However, the shaded region (generally with an area of at least 4km²) provides a general indication of where the place is located. If you are a landowner and wish to find out more about the exact location of the place, please contact DAA.
- **Restrictions:**
  - **No Restrictions:** Anyone can view the information.
  - **Male Access Only:** Only males can view restricted information.
  - **Female Access Only:** Only females can view restricted information

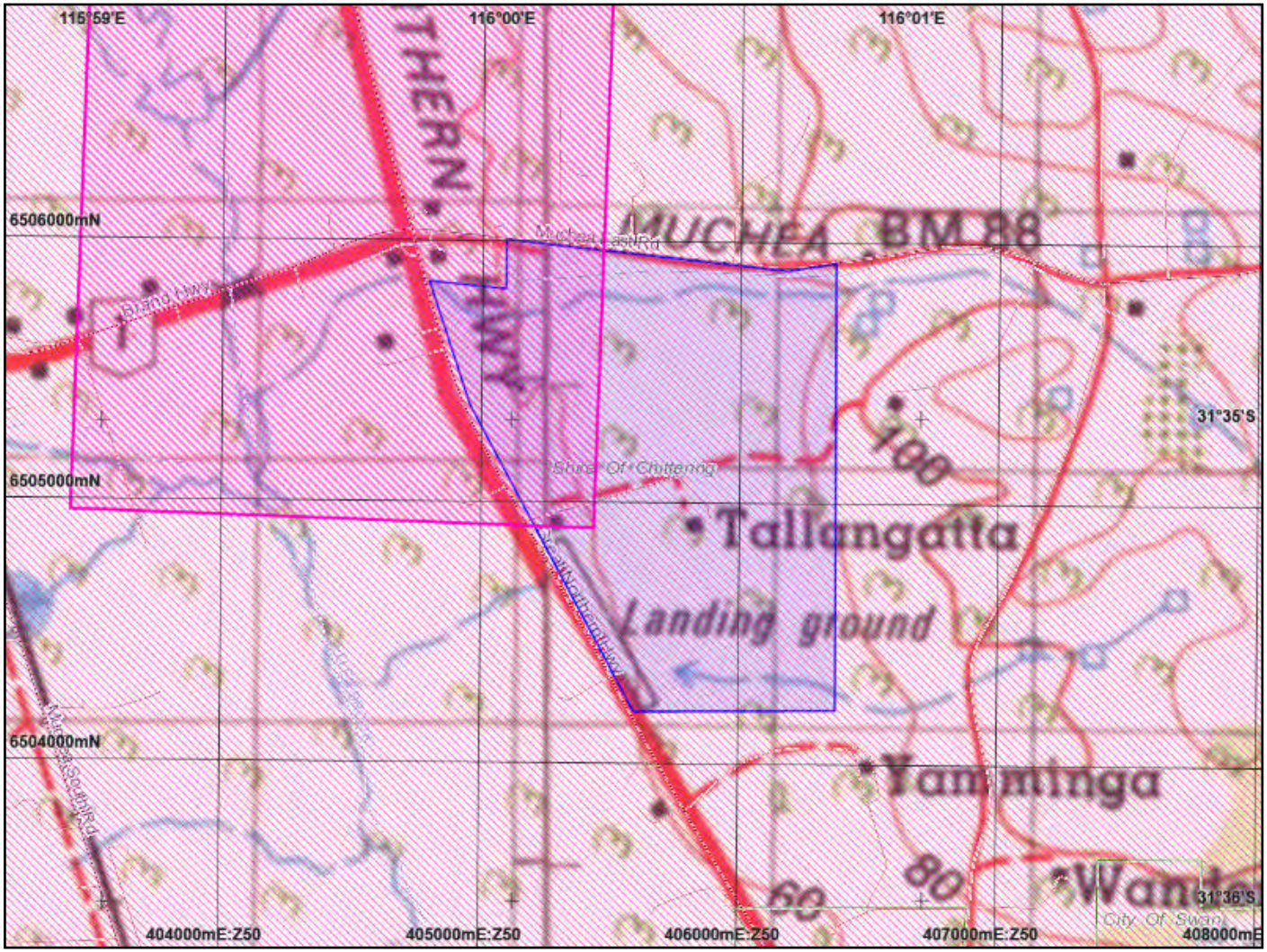
Legacy ID: This is the former unique number that the former Department of Aboriginal Sites assigned to the place. This has been replaced by the Place ID / Site ID.

List of Registered Aboriginal Sites with Map

Site ID	Site Name	File Restricted	Boundary Restricted	Restrictions	Status	Status Reason	Origin Place ID	Site Type	Knowledge Holders	Coordinates	Legacy ID
3525	ELLEN BROOK: UPPER SWAN	Yes	Yes	No Gender Restrictions	Registered Site			Mythological	*Registered Knowledge Holder names available from DAA	Not available when location is restricted	S02516
20008	Gingin Brook Waggyl Site	Yes	Yes	No Gender Restrictions	Registered Site			Historical, Mythological, Camp, Hunting Place, Plant Resource, Water Source	*Registered Knowledge Holder names available from DAA	Not available when location is restricted	

Aboriginal Heritage Inquiry System

Aboriginal Sites Database



Legend

Selected Heritage Sites

- Registered Sites
- Aboriginal Community Occupied
- Aboriginal Community Unoccupied
- Town
- Search Area

Government of **Western Australia**
Department of **Aboriginal Affairs**

ENQUIRIES: Heritage Enquiries- Ph 6551 8000

OUR REF: 2017/0048-01

Mr Phil Bayley
Bayley Environmental Services

via Email: bayley@iinet.net.au

Dear Mr Bayley

ABORIGINAL HERITAGE INQUIRY MUCHEA

Thank you for your email dated 7 April 2017 regarding Muchea East Road and Great Northern Highway, Muchea.

A review of the Register of Places and Objects as well as the Department of Aboriginal Affairs (DAA) Aboriginal Heritage Database concludes that DAA 3525 (Ellen Brook: Upper Swan) intersects within the northern portion of the study area.

Please note that while DAA 4299 (Upper Swan Bridge) and DAA 27868 (Upper Swan Lot 39 Artefact Scatter) intersects within the study area the actual boundary as administered by DAA is not within the study area and no approvals under the *Aboriginal Heritage Act 1972 (*AHA) are required.

DAA suggests that as there is a registered Aboriginal site within the study area that before any development is undertaken that contact be made to DAA with regards to whether any application under the AHA will be necessary.

If you have any questions regarding the above, please contact Heritage Enquiries on 6551 or email heritageenquiries@daa.wa.gov.au.

Yours sincerely

Tanya Butler
DIRECTOR HERITAGE OPERATIONS

12 April 2017

Ground Floor, 151 Royal Street, EAST PERTH, Western Australia, 6004
PO Box 3153, EAST PERTH, Western Australia, 6892
Telephone 1300 651 077 Facsimile (08) 6551 8088
www.daa.wa.gov.au

APPENDIX D

Local Water Management Strategy

TALLANGATTA FARM
LOTS 50 AND 1456 GREAT NORTHERN HIGHWAY, MUCHEA

LOCAL WATER MANAGEMENT STRATEGY

Prepared for

Tallangatta Beef Pty Ltd
c/- iParks Property Group Pty Ltd
38 Mandurah Rd
KWINANA BEACH WA 6167

Draft Report No. J20008b
11 March 2021

BAYLEY ENVIRONMENTAL SERVICES
30 Thomas Street
SOUTH FREMANTLE WA 6162

Sundowner Nominees Pty Ltd as trustee for the Bayley Cook Family Trust ABN 20 822 598 897
trading as Bayley Environmental Services

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1.0 INTRODUCTION

1.1 Background

Tallangatta Farm (Lots 50 and 1456 Great Northern Highway, Muchea) is located on the corner of Muchea East Road and Great Northern Highway, Muchea. Tallangatta Beef Pty Ltd, the owner of Tallangatta Farm), has applied to the Shire of Chittering for the property to be rezoned from Agricultural Resource to General Industry. The *Muchea Industrial Park Structure Plan* (MIPSP) shows Tallangatta as part of Precinct 2 (General Industry Core) of the Muchea Industrial Park. Figure 1 shows the location of the site within the draft Muchea Industrial Park Structure Plan area.

The total area of Tallangatta is 213 hectares. Figure 2 shows the boundaries of the site. Figure 3 shows a preliminary conceptual plan of subdivision.

The Local Structure Plan for Tallangatta has been submitted to the Department of Planning, Lands & Heritage and the Shire of Chittering, and is currently being considered by these agencies.

1.2 Previous Studies

1.2.1 Water Management Strategy – Muchea Employment Node

A Water Management Strategy (WMS) was prepared by Connell Wagner in 2008 in support of the District Structure Plan for the Muchea Employment Node. The WMS documented the existing environment of the MEN in broad terms, including soils and geology, topography, hydrology, vegetation and land uses. The WMS examined:

- the possible impacts of development on surface water and groundwater
- water demand and supply options;
- wastewater treatment and disposal, including leach drains, evaporation ponds and reuse.

The WMS recommended, among other things:

- Groundwater monitoring over at least two winter seasons should be undertaken to provide information on groundwater levels and quality.

- The preferred method of effluent disposal, based on desktop studies, was treatment by Aerobic Treatment Units (ATU) followed by disposal in evaporation ponds.

- Development should be set back from waterways in accordance with Water and Rivers Commission Note 23: *Determining Foreshore Reserves* (2001), with a default minimum setback of 30m.

- Stormwater runoff from lots and roads should be managed by infiltration and detention so that the runoff from a 1-year 1-hour storm is retained and infiltrated, and that peak flows from critical storms up to 100-year ARI are limited to pre-development rates.

- Water sensitive urban design measures should be implemented to meet catchment water quality targets as set out in the Swan-Canning Water Quality Improvement Plan (2009).

1.2.2 Regional Water Management Strategy – Muchea

The Muchea Regional Water Management Strategy (RWMS) was prepared by Emerge Associates for the Department of Planning, Lands & Heritage in 2019. The RWMS deals with the entire Muchea Employment Node, covering an area of 6,580 hectares.

The RWMS identifies environmental values, documents the hydrological regime and identifies requirements for wastewater management. The RWMS recommends further assessments prior to development including geotechnical, flora and fauna, wetlands, waterways, land capability and flooding.

1.3 Relevant Guidelines and Policies

1.3.1 State Planning Policy 2.9

State Planning Policy 2.9: *Water Resources* (WAPC, 2006) lists the following key principles for total water cycle management:

- Consideration of all water sources (including wastewater) in water planning, maximising the value of water resources.

- Integration of water and land use planning.

- Sustainable and equitable use of all water sources, having consideration of the needs of all water users including the community, industry and the environment.

- Integration of water use and natural water processes.

- A whole-of-catchment integration of natural resource use and management.

SPP 2.9 also lists the following general objectives for water-sensitive urban design:

- to manage a water regime;

- to maintain and, where possible, enhance water quality;

- to encourage water conservation;

- to enhance water-related environmental values; and

- to enhance water-related recreational and cultural values.

Element 5 of *Liveable Neighbourhoods* Edition 3 (WAPC, 2004) identifies specific objectives and requirements for Urban Water Management. These are based on Best Planning Practices which are defined as the best practical approach for achieving water resource management objectives within an urban framework.

1.3.2 Better Urban Water Management

Better Urban Water Management (WAPC, 2008) sets out the following objectives for water sensitive urban design:

Water Conservation

- Consumption of 100kL/pp/yr including less than 40-60 kL/p/yr scheme water.

Water Quantity

- Ecological Protection – Maintain pre-development flow rates and volumes for the 1 year ARI event. Maintain or restore desirable environmental flows and/or hydrological cycles.

- Flood Management – Maintain pre-development flow rates and volumes for the 100 year ARI event.

Water Quality

- Maintain pre-development nutrient outputs (if known) or meet relevant water quality guidelines (e.g. ANZECC & ARMCANZ, 2000).

- Treat all runoff in the drainage network prior to discharge consistent with the Stormwater Management Manual.

- As compared to a development that does not actively manage stormwater quality, achieve:

  - at least 80% reduction of Total Suspended Solids;
  - at least 60% reduction of Total Phosphorus;
  - at least 45% reduction of Total Nitrogen; and
  - at least 70% reduction of gross pollutants.

Mosquitoes and Midges

- Design detention structures so that, between the months of November and May, stormwater is fully infiltrated within 96 hours.

- Design permanent water bodies (where accepted by DWER) to maximise predation of mosquito larvae by native fauna.

1.3.3 Shire of Chittering Local Planning Scheme No. 6

"The following development requirements shall apply to the development and subdivision of land within industrial zones and to industrial land uses –

(a) the effect on the environment by means of discharge of pollutants or contaminants into the air, ground and water be avoided, or managed within acceptable limits;

(b) where an on-site wastewater disposal system is proposed –

i. land capability assessment may be required to demonstrate the capability of the site to manage wastewater and the suitability of the proposed system;
ii. the use of fill and drains to achieve the required separation from groundwater is to be limited; and
iii. a suitable and unencumbered land application area is to be set aside to distribute treated sewage, where required;

(c) within sewerage sensitive areas secondary treatment systems with nutrient removal are to be utilised;

(d) notwithstanding any other provisions of this scheme, industrial development not connected to reticulated sewerage (for treatment on-site or off-site) is to be restricted to 'dry industry' being land uses that intend to dispose of wastewater on site to the environment of a kind and volume ordinarily discharged from a habitable building at a daily volume of less than 540 litres per 1,000m^2 of the site area [R10 equivalent];

(e) where trade waste is to be managed and/or disposed of on-site or off-site the associated risks must be identified and addressed, including the vulnerability of the receiving environment where relevant;

The Scheme shows Tallangatta as part of a Water Prone Area (Ellen Brook Palusplain), within which the following special provisions apply:

"5.3.3 Planning Requirements

The local government will impose conditions on any Development approval relating to -

a) the construction and occupation of any dwelling or outbuilding;

b) the type of effluent disposal system used in this area shall be high performance with bacterial and nutrient stripping capabilities to the specifications of local government and the Health Department and shall be located in a position determined by local government.;

c) minimum floor levels for any building above the highest known water levels;

d) any land use that may contribute to the degradation of the surface or sub-surface water quality.

e) no development other than for conservation purposes will be permitted within 30 metres of any natural water body; AMD 21 GG 3/4/09

f) damming, draining or other developments which may alter the natural flow of surface water will not be permitted unless such works are part of an approved Catchment Management Plan."

Schedule 11 of the Scheme contains the following provisions that apply to the Muchea Industrial Park:

"2.2 Environmental Management Plans

The following Environmental Management Plans shall be prepared and used to inform the design and proposed subdivision and development within the Structure Plan area. They shall be submitted as an additional detail of a Structure Plan unless otherwise determined by the Western Australian Planning Commission.

2.2.1 Local Water Management Strategy

The developer shall submit to the Local Authority a Local Water Management Strategy (LWMS) for approval as an additional detail of a Structure Plan pursuant to clause 5.19 in order to ensure that surface and ground waters are managed with the aim of maintaining the natural water balance. The Local Authority must notify and consult with the authority responsible for water and the environment on the proposed strategy in advertising the Local Structure Plan(s) pursuant to Part 4 of the deemed provisions.

The LWMS shall be prepared in accordance with Better Urban Water Management or its successor document.

The Structure Plan design shall respond to the LWMS required by 2.2.1 and shall be implemented to the satisfaction of the Local Authority, having regard to any advice from the Department of Water."

1.3.4 Government Sewerage Policy

The Government Sewerage Policy (2019) requires that all new subdivision and development should be deep-sewered unless it is exempt for one of several reasons. For exempt developments, the policy establishes minimum site capability requirements and, where appropriate, density limits. In these cases, on-site effluent disposal may be approved where the responsible authority is satisfied that:

- each lot is capable of accommodating on-site sewage disposal without endangering public health or the environment; and
- the minimum site requirements for on-site sewage disposal as set out in the Policy can be met.

The Policy designates certain areas as Sewage Sensitive Areas (SSAs), including land:

- within the coastal catchment of the Swan Estuary; and
- within 1km upgradient or 250m downgradient (or overall 1km where the groundwater gradient is unknown) of a significant wetland.

Additional restrictions and requirements apply to on-site effluent disposal in SSAs, including:

- a minimum lot size of one hectare (unless exempted on a case-by-case basis);
- minimum vertical separation of 1.5m from the discharge point of effluent disposal systems to the highest groundwater table level; and
- secondary effluent treatment systems with nutrient removal.

The Policy shows all of Tallangatta except for about 6ha in the north-east corner within an SSA associated with the Ellen Brook catchment. The remaining 6ha is shown within an SSA associated with a significant wetland. Figure 3 shows the mapped SSAs.

The SSA mapping associated with the wetland is considered to be erroneous. The wetland in question (a Conservation category dampland) is located more than 300m upgradient of the site and is maintained by surface flow and/or locally perched groundwater (the mapped permanent groundwater table is 45-50m below the ground surface), so there is no possibility of groundwater flow from the site to the wetland. This matter is examined further in Section 4.1.

1.3.5 DoW Operational Policy 4.3: Identifying and Establishing Waterways Foreshore Areas

DoW Operational Policy 4.3 was published in 2012 and sets out the Department of Water's policy on defining and protecting foreshore reserves. It is intended to apply to all natural waterways within development areas. The policy sets out procedures for identifying, delineating and protecting foreshore areas.

The procedure may vary depending on the size and nature of the waterway and the nature of the proposed adjacent development. The policy provides for standard or nominal foreshore widths to be employed in some cases, such as small subdivisions and/or minor tributary creeks where the waterway is adequately protected and the proposed development poses an insignificant additional risk to the waterway.

1.3.6 DoW Interim Guideline: Developing a Local Water Management Strategy

The DoW LWMS guideline was published in 2008 and sets out the DoW's preferred format and content for LWMS documents. The guideline expands on the LWMS guidance provided in *Better Urban Water Management* (2008).

This LWMS has been prepared in accordance with the principles set out in the DoW guideline. Appendix A shows a completed checklist from the DWER guideline.

1.4 Scope of the LWMS

The scope of this LWMS is to:

- Document the existing environment on the site, in relation to soils, drainage, erosion, watercourses, groundwater and water-dependent ecosystems.
- Briefly describe the proposed development in relation to water management.
- Examine the capability of the site for on-site effluent disposal.
- Address relevant regulatory requirements and design criteria for water harvesting, setbacks to watercourses, groundwater management and drainage.
- Describe the strategies to be implemented for water conservation, watercourse protection, groundwater management and stormwater drainage.
- Outline the proposed monitoring program.
- Outline what is to be addressed in future Urban Water Management Plans.

1.5 Design Objectives

Table 1.1 summarises the water-related design objectives for Tallangatta and the means by which they will be achieved in the LWMS and subsequent management plans.

Table 1.1 Design Objectives

Design Aspect	*Design Objective*	*How Objective is to be Achieved*
Water Conservation	Ensure efficient and sustainable use of water resources	Only low water use industries permitted in Precinct 2. Use water efficient fixtures. Limit wastewater generation to 5.4 KL/ha/day. Use non-potable water for irrigation. Purchase groundwater licence(s) from existing holders within or outside the project area. Use water-efficient native species for landscaping. Irrigate landscape plantings only for 2 years.
Groundwater Management	Minimise impacts on groundwater level and flows Minimise impacts on groundwater quality	Subsoil drains set at or above pre-existing AAMGL, with fill used to provide additional clearance if required. Finished floor levels of habitable buildings set at least 0.5m above controlled groundwater level. Treat runoff from minor storms in bioretention basins and swales. Minimise fertiliser and chemical use in landscaping areas. Use nutrient-removing alternative secondary systems for effluent disposal.
Surface Water Management	Minimise impacts on surface water flow rates, volumes and quality	Retain and infiltrate runoff from 1-year ARI 1-hour storms in bioretention basins and swales. Detain runoff from larger storms and control release from lots and overall site to pre-development flow rates. Convey existing flows through the site in stream reserves or roadside swales at pre-development rates. Set effluent disposal facilities at least 100m back from natural waterways. Sweep streets regularly to remove accumulated contaminants.

2.0 EXISTING ENVIRONMENT

2.1 Rainfall

Muchea, like the rest of the greater Perth region, has a strongly seasonal rainfall, with most of the annual rain falling between May and September in association with winter cold fronts. Occasional heavy falls may occur from summer thunderstorms. The long-term average annual rainfall for Pearce RAAF Base (located 6.5km south of the site) is 679.7mm, of which 77% falls between the months of May and September.

Figure 4 shows a rainfall occurrence chart for Pearce RAAF. Table 2.1 shows rainfall intensity, frequency and duration for Muchea.

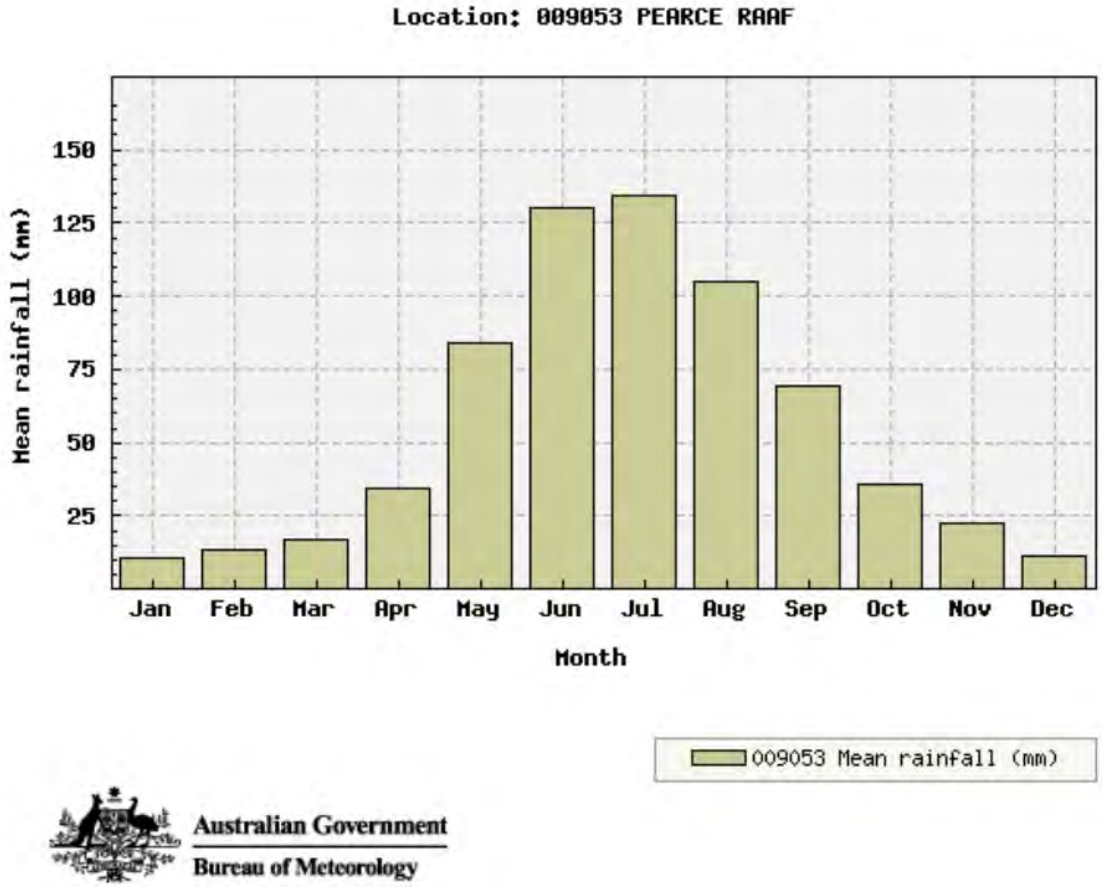

Figure 4 Pearce RAAF Mean Rainfall

IFD Design Rainfall Depth (mm) Issued: 31 October 2018

Rainfall depth for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).
FAQ for New ARR probability terminology

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	1.51	1.68	2.26	2.69	3.14	3.77	4.29
2 min	2.61	2.89	3.82	4.49	5.18	6.18	7.00
3 min	3.52	3.90	5.17	6.11	7.07	8.47	9.62
4 min	4.28	4.75	6.34	7.50	8.72	10.5	11.9
5 min	4.92	5.48	7.34	8.71	10.1	12.2	13.9
10 min	7.23	8.07	10.9	13.0	15.2	18.2	20.8
15 min	8.75	9.76	13.2	15.7	18.3	22.0	25.1
20 min	9.90	11.0	14.9	17.7	20.6	24.8	28.2
25 min	10.8	12.1	16.2	19.3	22.5	27.0	30.7
30 min	11.6	13.0	17.4	20.7	24.0	28.8	32.8
45 min	13.6	15.1	20.1	23.9	27.7	33.3	37.9
1 hour	15.1	16.7	22.2	26.4	30.7	36.9	42.1
1.5 hour	17.4	19.3	25.6	30.4	35.4	42.8	49.1
2 hour	19.3	21.3	28.3	33.6	39.4	47.8	55.1
3 hour	22.3	24.6	32.7	39.0	45.9	56.3	65.2
4.5 hour	25.8	28.5	37.9	45.4	53.8	66.4	77.6
6 hour	28.7	31.6	42.1	50.6	60.1	74.7	87.7
9 hour	33.1	36.5	48.7	58.7	70.0	87.5	103
12 hour	36.6	40.3	53.9	65.0	77.5	96.9	114
18 hour	42.0	46.3	61.7	74.2	88.1	110	129
24 hour	46.1	50.8	67.5	80.8	95.3	118	138
30 hour	49.5	54.5	72.1	85.8	101	124	143
36 hour	52.4	57.7	75.9	89.8	105	128	147
48 hour	57.2	62.9	82.1	96.1	111	133	152
72 hour	64.9	71.2	91.5	106	120	141	158
96 hour	71.4	78.2	99.4	114	128	148	164
120 hour	77.4	84.6	107	122	136	157	173
144 hour	83.4	91.0	115	131	146	168	185
168 hour	89.4	97.3	123	140	157	181	200

Note:
The 50% AEP IFD **does not** correspond to the 2 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 1.44 ARI.
* The 20% AEP IFD **does not** correspond to the 5 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 4.48 ARI.

Table 2.1 Rainfall Intensity for Muchea

2.2 Physiography

2.2.1 Topography

Tallangatta is located on the western footslopes of the Gingin Scarp, just west of the Darling Fault. The site slopes generally westward from a high point of 93m AHD in the north-east to a low of 53m AHD at the north-west corner. The gradient averages about 2.5%. The steepest slopes are in the north-east, reaching up to 10% in places. Figure 5 shows the topography.

2.2.2 Geology, Landforms and Soils

Most of Tallangatta is mapped by the GSWA (Gozzard, 1982) as Guildford Formation (Qpa), with soils consisting of pebbly silt (Mgs_1). This unit is described as having generally low permeability and shallow groundwater, with a low to moderate capability for effluent and drainage disposal. The foundation stability may vary, with differential settling possible in clayey areas. Sand pads are generally necessary for foundations.

The eastern part of the property is mapped as Colluvium (Qc), with soils of medium to coarse grained brown sand (S_5) and sandy silt (Msg). The S_5 soil type has high permeability and generally high capability for drainage and effluent disposal. The Msg type has low permeability and consequently low suitability for effluent disposal. Both soil types provide good foundations when compacted.

A small area in the north-east of the property is mapped as Leederville Formation (Klb), with soils derived from siltstone (ST_1). This unit is described as moderately stable but prone to weathering when disturbed, with low permeability making it of low suitability for drainage or effluent disposal.

Figure 5 shows the GSWA mapping. Drilling at nine locations across the site in June 2017 (Figure 5) generally confirmed the GSWA mapping. Soil logs from the drilling are attached in Appendix B.

2.2.3 Soil Permeability

The permeability of the site soils will vary depending on the clay content. Test pumping during sampling of the on-site bores indicated hydraulic conductivities in the subsoil (1-5 m bgl) ranging from about 0.06 m/day to 0.42 m/day. The permeability of the top 2m of the soil profile is expected to be higher.

Brown Geotechnical carried out falling-head permeability tests at three locations at 0.5-1m depth across the property (Figure 5) in 2020. The tests returned estimated permeabilities ranging from $8.5x10^{-5}$ m/day in dense gravelly sandy clay to 53 m/day in sandy gravel. The geotechnical report is attached in Appendix C.

For preliminary drainage and effluent design purposes, a conservative permeability of 1 m/day has been assumed. Constant-head permeability tests in accordance with the method set out in Australian Standard AS1547:2012: – *On-site Domestic Wastewater Management* will be undertaken prior to subdivision.

2.2.4 Acid Sulphate Soils

The DBCA maps the site as Low to Nil risk of Acid Sulphate Soils (ASS). The nearest mapped High ASS risk area is a palusplain about 1.6km to the south.

Bore sampling in August 2020 found no indicators of potential or actual ASS in the groundwater. No further investigation of ASS is considered to be necessary.

2.2.5 Phosphorus Retention Index

Previous experience has shown that the gravelly and silty clay soils of the Guildford Formation and other alluvial and colluvial soils generally have moderate to high PRI.

PRI is a measure of the ability of a soil to adsorb and retain phosphorus from solution. A high PRI indicates that a soil is unlikely to leach phosphorus to the water table. Typical ranges for PRI values in soils are as follows:

PRI Range	*Rating*	*Typical soils*
0 – 0.5	Very Low	Bassendean Sand
2 – 4	Low – Moderate	Karrakatta Sands
5 – 12	Moderate – High	Cottesloe Sands
12 – 20	High	Crushed Limestone, Limesand
20 – 1000+	Very High	Clay

The DWER recommends a minimum PRI of 15 for soils beneath infiltration basins and swales. The site soils are expected to meet or exceed this requirement. PRI testing of soils beneath proposed infiltration basins will be undertaken before subdivision.

2.3 Hydrology

2.3.1 Groundwater

Groundwater flows from east to west beneath the site at a gradient of between 0.01 and 0.02. The low permeability of the soil profile means that groundwater throughflow would be very low.

Regional mapping by the DWER shows superficial groundwater present at minimum elevations of 48m to 55m AHD. Figure 6 shows the DWER contours.

Groundwater measurements in nine bores in and around the site on 21 August 2020 (Figure 6), during a drier than average winter, gave the water depths and levels shown in Table 2.2. Groundwater measurements collected from the site since 2017 are detailed in Appendix D.

Simultaneous measurements of DWER bores located 1,400m south (Swan GWA 2-98) and 40m north (Gnangara Monitoring GD20) enabled Average Annual Maximum (AAMGL) and Maximum (MGL) groundwater levels at the site to be calculated. Figure 6 shows the calculated AAMGL and depth to AAMGL contours across the site. Figure 7 shows the hydrographs of the DWER bores.

Table 2.2 shows that the groundwater levels measured in August 2020 were about 0.4m below the AAMGL. The winter of 2020 was drier than average, and the levels measured on 21 August are considered to approximate the peak for the year.

Figure 6 shows that the AAMGL is within one metre of the ground surface in parts of the west, south and north-west of the site. The AAMGL is predicted to intersect the ground surface in small areas in the west, south and north-east.

Filling and/or subsoil drainage is likely to be necessary in areas of the site where the depth to groundwater is less than 1.5m in order to provide groundwater clearance for roads, buildings and effluent disposal. The requirement for filling will depend on the size of the lots and the uses to which they are put. Most of the site has sufficient slope and depth to groundwater that subsoil drainage alone may be sufficient to create the necessary groundwater clearance for building, effluent disposal and drainage.

Table 2.2 Groundwater Depths and Levels 21 August 2020

Bore (Figure 6)	*Depth (mbgl)*	*Level (m AHD)*	*AAMGL (m AHD)*	*MGL (m AHD)*	*Depth to AAMGL (m)*	*Depth to MGL (m)*
TB1	4.64	60.61	61.037	61.617	4.213	3.633
TB2	2.95	82.05	82.477	83.057	2.523	1.943
TB3	0.7	79.85	80.277	80.857	0.273	-0.307
TB4	0.41	54.39	54.817	55.397	-0.017	-0.597
TB5	>3.45	<63.55				
TB6	0.37	53.63	54.057	54.637	-0.057	-0.637
TB7	1.14	57.26	57.687	58.267	0.713	0.133
TB8	1.11	64.14	64.567	65.147	0.683	0.103
TB9	0.56	74.24	74.667	75.247	0.133	-0.447
MB1	0.285	51.305	51.732	52.312	-0.142	-0.722
MB3	1.59	50.99	51.417	51.997	1.163	0.583
MB5	0.77	56.02	56.447	57.027	0.343	-0.237
WB2	>4.98	<65.89				
GD20	0.88	60.6	59.85	61.35	1.63	0.13
2-98	2.117	56.173	56.6	57.18	1.69	1.11

2.3.2 Surface Water

A significant creek flows from east to west along the northern edge of the property. Two smaller drains flow across the site near the southern boundary. All of the watercourses are seasonal or ephemeral. The remainder of the property would drain by sheet flow during heavy rainfall. Figure 8 shows the drainage lines and their catchments.

The northern creekline is a natural waterway, incised at the eastern side of the property but flatter and shallower at the western side. The depth of the creek channel is estimated at 1m in the east and 0.5m at the west, with a width of 5-10m. The creek drains an upstream catchment of about 360ha and an additional catchment of 250ha within the property.

Historical Landgate aerial photography shows that the middle drainage line is an artificial drain, constructed between 1965 and 1977. It is shallow and slightly incised, about 0.5m deep and 8-10m wide. It has an upstream catchment of about 38ha and an internal catchment of another 30ha.

The southernmost drainage line is also a constructed drain, dating from between 1977 and 1979. It is slightly incised, about 0.5m deep with a width ranging from 4-8m in the east to 12m in the west. It drains an upstream catchment of about 117ha and an internal catchment of another 3ha.

All drainage from the site flows eventually into Ellen Brook, the major drainage feature of the region. The Ellen Brook catchment is the largest sub-catchment of the Swan-Canning River system, contributing 6% of the total annual flow, and is the largest single contributor of nutrients to the system (WA Govt, 2011).

Ellen Brook has a surface catchment of 715km^2 (WRC, 2012). The Brook rises as Chandala Brook about 22km north-northwest of the site. The Brook is seasonal, flowing generally between May and November with an annual flow ranging from 2.1 to 48.6 GL (SRT, 2009).

Table 2.3 summarises estimated 100-year ARI (average recurrence interval) flows under current conditions in the three drainage lines, calculated using the Rational Method (Institute of Engineers Australia, 1987). A runoff coefficient of 0.3 for the 100-year storm was assumed for all catchments. Table 2.3 also shows estimated water depths, widths and flow velocities in the watercourses at the upstream and downstream ends of the site, calculated with Manning's open channel flow formula (Fang, 2002), using a roughness coefficient (Manning's *n*) of 0.03.

Table 2.3 100-year ARI Flows in Existing Watercourses

Drainage Line		*North*	*Middle*	*South*
Upstream Catchment (ha)		360	38	117
100-yr ARI Flow (m^3/sec)		7.04	1.21	3.9
Water Depth (m)	*Upstream*	0.7	0.2	0.5
	Mid-point	0.8	-	-
	Downstream	0.4	0.2	0.5
Top Water Width (m)	*Upstream*	4.6	9.4	8.2
	Mid-point	6.9	-	-
	Downstream	28	11	11
Flow Velocity (m/sec)	*Upstream*	3.5	1.0	1.5
	Mid-point	2.0	-	-
	Downstream	1.1	1.1	1.1

The flow calculations in Table 2.3 suggest that the northern creek is likely to overtop its banks at its western end during a 100-year storm, creating flooding to about 15m each side

of the creek. The eastern part of the northern creek, and the two southern drainage lines, appear unlikely to overtop in a 100-year storm.

The flow velocity in the eastern part of the northern creek is relatively high and may cause scouring of the creek bed in a 100-year storm. Given that a storm of this size may not have occurred since the creekline and its catchment were cleared for farming, such an event may alter the shape of the watercourse. Some protection works (such as revegetation, riffling and barriers) may be necessary to reduce the risk of this occurring. Given the relatively steep topography in the vicinity of the creekline, any scouring is likely to result in minor straightening of the watercourse rather than any major change in its alignment.

The calculations shown in Table 2.3 are preliminary and based on desktop estimates of channel morphology and catchment characteristics. They should not be used for design purposes.

2.4 Water Resources

2.4.1 Groundwater

Tallangatta is within the Eclipse Hill Subarea of the Gingin Groundwater Area (GWA) for the superficial and surficial aquifers, the Southern Scarp sub-area for the semi-confined (Mirrabooka) aquifer, the Cowalla sub-area for the confined Leederville-Parmelia aquifer and the Chandala sub-area for the Yarragadee aquifer. Groundwater allocations within the GWA are managed under the Gingin Groundwater Areas Allocation Plan (DoW, 2015).

Under the plan (as of 2015), the Eclipse Hill (superficial), Southern Scarp (Mirrabooka) and Cowalla (Leederville) sub-areas are over-allocated and no new allocations are available.

The Gingin Groundwater Allocation Plan shows that the Eclipse Hill Subarea has a total allocable resource of 1,050 ML/a in the superficial and 3,000 ML/a in the surficial aquifer. The DWER has advised (M. Ong, 2017 pers. comm.) that the superficial aquifer resource is fully allocated but 1,600 ML/a is available for allocation in the surficial aquifer.

In the deeper confined aquifers, the Leederville aquifer (Cowalla Subarea) has a total of 17,617 ML/a, which is fully allocated, and the Yarragadee aquifer (Chandala Subarea) has 1,050 ML/a, of which 194 ML/a is available for allocation.

2.4.2 Surface Water

The three drainage lines that flow across Tallangatta have a combined upstream catchment of approximately 515 hectares. Using the average annual rainfall of 653mm for Pearce RAAF Base (BoM, 2017) and an overall catchment runoff coefficient of 5% (CSIRO, 2009), it can be estimated that an average of approximately 168 ML/a of surface flow may be available for capture and use.

This may be augmented by the capture and storage of stormwater from within the developed industrial area. Using the same average rainfall and an overall post-development runoff coefficient of 20%, the industrial area could yield approximately another 278 ML/a.

Capture and storage of surface runoff at this scale is problematic for several reasons:

- The quantity available is variable, with annual rainfall at Pearce RAAF having been recorded as low as 50% of the mean.
- Storage of the water would require deep ponds covering several hectares.
- Unless the ponds were covered, a substantial portion (average 2m depth each year) of the stored water would be lost to evaporation.
- Captured surface water, particularly stormwater from streets, would be unsuitable for potable use.

For these reasons, capture of surface water, while possibly feasible in particular circumstances, is unlikely to be a viable water supply option for the whole estate.

2.5 Water Quality

2.5.1 Groundwater

Groundwater samples were collected from the nine on-site bores in August 2017. The samples show that the groundwater quality across the site is generally moderate, with some notable features:

- Nitrogen (both total and NO_X) levels were elevated across most of the site, particularly in Bore TB1 in the centre of the property. This is probably due largely to the high density of cattle then being stocked on the property. Nitrogen levels are expected to decline once cattle are removed from the property.
- Bore TB3 is quite saline (Conductivity 12 mS/cm = 7,200 mg/L) as well as being very acidic (ph 3.7, Total Acidity 96) and high in some metals (aluminium, potassium, iron, lead and zinc). These are consistent with its origin as seepage from clay and siltstone. The sulphate level is also elevated, although the low sulphate/chloride ratio (0.09) and the elevation and soil type suggests that these characteristics are not indicative of the presence of ASS.
- Dissolved phosphorus levels were low across the site.

Table 2.4 shows the groundwater quality data from August 2017.

2.5.2 Surface Water

Surface water samples were collected from six locations (three inflowing, three outflowing) in August 2017 (Figure 8). The results show that the surface flows into and out of the site are generally of similar and moderate quality. The water in the northern creek has elevated salinity, but shows little of the high acidity found in the adjacent Bore TB3. Water flowing from the east in the vicinity of the Midland Brick quarry had very low pH but only moderate acidity.

Table 2.5 shows the surface water data from August 2017.

Table 2.4 Groundwater Quality 17/8/2017
(see Figure 6 for bore locations)

	Parameter	Unit	Aquatic Ecosystems[a]	Irrigation Water[b]	*TB1*	*TB2*	*TB3*	*TB4*	*TB5*	*TB6*	*TB7*	*TB8*	*TB9*
Nutrients	Total Nitrogen	mg/L	1.2	5	**19**	0.9	**9.5**	**5.3**	**2**	**2.3**	0.6	1.2	**6.2**
	NOx	mg/L	0.15	ng	**19**	**0.72**	0.15	**3.7**	**1.4**	**1.2**	**0.18**	**0.25**	**3.8**
	Total Kjeldahl Nitrogen	mg/L	ng	ng	<0.2	0.2	9.4	1.6	0.6	1.1	0.4	1	2.4
	Total Phosphorus	mg/L	0.065	0.05	**0.89**	**0.09**	**0.54**	**0.49**	**0.43**	**0.48**	0.04	**0.3**	**3.5**
	Reactive Phosphorus	mg/L	0.04	ng	0.01	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Physical	pH		6.5-8.0	6-8.5	**5.9**	6.8	**3.7**	6.8	6.5	7.3	6.6	7	7.4
	Conductivity	mS/cm	0.12-0.3	1.3	**1**	**0.53**	**12**	**2.2**	0.29	**0.7**	**0.49**	**0.55**	**0.63**
	Salinity (from EC)	mg/L	72-180	780	**600**	**318**	**7200**	**1320**	174	**420**	**294**	**330**	**378**
	Acidity	mg/L	40[c]	ng	19	5	**96**	<5	13	9	19	7	7
	Alkalinity	mg/L	ng	ng	10	28	<5	21	22	100	50	38	67
	Acidity:Alkalinity Ratio		1[c]	ng	**1.90**	0.18	**>19.2**	<0.24	0.59	0.09	0.38	0.18	0.10
	Hardness	mg/L	ng	60-350	95	64	1310	208	27	56	59	63	48
	Sulphate	mg/L	ng	ng	60	26	310	29	18	66	17	40	23
	Chloride	mg/L	ng	350	240	150	3600	690	94	110	100	110	130
	SO_4:Cl Ratio		0.5	ng	0.25	0.17	0.09	0.04	0.19	**0.60**	0.17	0.36	0.18
Major Ions	Calcium	mg/L	ng	ng	5	6	30	9	4.2	5.8	5.6	9.1	7.2
	Sodium	mg/L	ng	230	130	61	2100	350	36	110	54	60	80
	Potassium	mg/L	ng	ng	0.2	0.4	60	0.6	1.2	<0.1	0.9	3.8	6.6
	Magnesium	mg/L	ng	ng	20	12	300	45	4	10	11	9.9	7.2
	Iron	mg/L	ng	10	0.26	0.09	2.4	0.3	0.07	0.36	0.04	0.02	0.16

Notes

ng denotes "no guideline". na denotes "not analysed"
a. ANZECC (2000) Aquatic Ecosystem trigger values (Nutrient, pH and Conductivity are for lowland rivers; Dissolved Metals are for freshwater ecosystems 90% species protection)
b. ANZECC (2000) Irrigation trigger values (long-term irrigation up to 100 years)
c. DEC(20__) oxidation indicator triggers for ASS-affected groundwater.
d. ANZECC (2000) Irrigation trigger values for pasture and fodder for grazing animals except pigs and dairy animals.

Dissolved Metals	Aluminium	mg/L	0.08	5	**1.7**	**0.3**	**9.2**	**1.1**	**0.2**	**0.8**	<0.1	<0.1	**0.3**	
	Arsenic (III & V)	mg/L	0.136	0.1	<0.002	<0.002	0.002	0.001	<0.002	0.001	<0.002	<0.002	<0.002	
	Cadmium	mg/L	0.0004	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	
	Chromium (VI)	mg/L	0.006	0.1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	
	Copper	mg/L	0.0018	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
	Mercury	mg/L	0.0019	0.002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	
	Nickel	mg/L	0.013	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
	Lead	mg/L	0.0056	2	<0.01	<0.01	**0.02**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
	Zinc	mg/L	0.015	2	**0.08**	<0.01	**0.04**	**0.02**	<0.01	0.01	0.01	<0.01	<0.01	

Table 2.5 Surface Water Quality 17/8/2017
(see Figure 8 for sample locations)

	Parameter	Unit	Aquatic Ecosystems[a]	Irrigation Water[b]	*TS1 (inflow)*	*TS2 (outflow)*	*TS4 (outflow)*	*TS5 (outflow)*	*TS6 (inflow)*	*TS7 (inflow)*
Nutrients	Total Nitrogen	mg/L	1.2	5	0.8	0.9	**3.5**	1.1	**3.8**	0.2
	NOx	mg/L	0.15	ng	0.01	0.1	**0.81**	<0.01	**0.93**	<0.01
	Total Kjeldahl Nitrogen	mg/L	ng	ng	0.8	0.8	2.7	1.1	2.9	0.2
	Total Phosphorus	mg/L	0.065	0.05	**0.09**	**0.1**	**0.16**	**0.08**	**0.08**	**0.09**
	Reactive Phosphorus	mg/L	0.04	ng	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Physical	pH		6.5-8.0	6-8.5	**6.3**	**6.1**	**9.3**	7.5	**10.4**	**3.8**
	Conductivity	mS/cm	0.12-0.3	1.3	**3.2**	**3.3**	**0.95**	**1**	**1**	**2.2**
	Salinity (from EC)	mg/L	72-180	780	**1920**	**1980**	**570**	**600**	**600**	**1320**
	Acidity	mg/L	40[c]	ng	6	<5	<5	<5	<5	27
	Alkalinity	mg/L	ng	ng	10	<5	100	11	130	<5
	Acidity:Alkalinity Ratio		1[c]	ng	0.60	-	<0.02	<0.45	<0.04	**>5.4**
	Hardness	mg/L	ng	60-350	353	382	94	90	76	145
	Sulphate	mg/L	ng	ng	52	62	98	55	110	170
	Chloride	mg/L	ng	350	890	980	190	290	220	570
	SO_4:Cl Ratio		0.5	ng	0.06	0.06	**0.52**	0.19	0.50	0.30
Major Ions	Calcium	mg/L	ng	ng	16	16	28	8.2	24	3.8
	Sodium	mg/L	ng	230	540	630	110	120	120	330
	Potassium	mg/L	ng	ng	14	16	27	7.4	28	5.6
	Magnesium	mg/L	ng	ng	76	83	5.9	17	4	33
	Iron	mg/L	ng	10	0.1	0.1	0.07	0.05	<0.01	2.8

Notes

ng denotes "no guideline". na denotes "not analysed"
a. ANZECC (2000) Aquatic Ecosystem trigger values (Nutrient, pH and Conductivity are for lowland rivers; Dissolved Metals are for freshwater ecosystems 90% species protection)
b. ANZECC (2000) Irrigation trigger values (long-term irrigation up to 100 years)
c. DEC(20__) oxidation indicator triggers for ASS-affected groundwater.
d. ANZECC (2000) Irrigation trigger values for pasture and fodder for grazing animals except pigs and dairy animals.

Dissolved Metals	Aluminium	mg/L	0.08	5	<0.1	<0.1	<0.1	<0.1	<0.1	**1.2**	
	Arsenic (III & V)	mg/L	0.136	0.1	0.002	0.002	0.002	<0.002	0.002	<0.002	
	Cadmium	mg/L	0.0004	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	
	Chromium (VI)	mg/L	0.006	0.1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	
	Copper	mg/L	0.0018	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
	Mercury	mg/L	0.0019	0.002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	
	Nickel	mg/L	0.013	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	**0.02**	
	Lead	mg/L	0.0056	2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
	Zinc	mg/L	0.015	2	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	

2.6 Wetlands

The north-west and north-east corners of Tallangatta are mapped as Multiple Use palusplain (seasonally waterlogged plain) by the DBCA. Palusplain also covers an extensive area west of the property in the floodplain of Ellen Brook. Figure 8 shows the mapped wetlands.

Multiple Use category wetlands are degraded and are regarded by the DBCA as developable, provided that the hydrological functions (mainly drainage) of the wetland are maintained or replicated.

No other wetlands are present on or immediately downstream of the property.

2.7 Vegetation

Tallangatta is cleared except for a number of scattered paddock trees (some apparently planted) and a small group of denser trees around the creekline in the north-east corner. The paddock trees are mostly located in the northern two-thirds of the property, with the southern third being almost entirely cleared.

The paddock trees appear to be mostly mature Marri and Wandoo, with some large specimens up to 15-20 tall. Flooded Gums are present near the creekline in the north-east corner of the property.

The DPAW database show no recorded rare or priority flora or threatened ecological communities on the property. Given the degree of clearing, it is unlikely that any rare or threatened species or communities would be present.

There is no riverine, riparian or wetland-dependent vegetation present on the property.

2.8 Fauna

The largely cleared project area offers little habitat for native fauna, apart from disturbance-tolerant species such as kangaroos (which may graze in the paddocks from refuges to the east) and birds which might nest in some trees.

There are no riverine, riparian or wetland habitats present on the property.

2.9 Land Uses and Potential Contamination

Historical Landgate aerial photography shows that Tallangatta has been cleared and used primarily for broadacre farming since before 1965. The photographs show stock pens

(possibly for pigs or poultry) near the farmhouse in the centre of the property between 1965 and about 2000; however this use appears to have been small-scale and essentially domestic. Residual contamination from pesticides such as dieldrin could be present around the site of the stock pens.

Between 2004 and 2011 the property was used as an intensive live cattle export depot. Between about 2006 and 2010, manure from the feedlot operation was stockpiled in windrows about 250m east of the cattle handling sheds in the middle of the property. When the feedlot operation ended the stockpiled compost was removed from the site.

Intensive agriculture is regarded as a potentially contaminating land use by the Department of Environmental Regulation (DER, 2004); however, the agricultural chemicals available for use since 2004 do not include many of the chemicals often responsible for persistent soil contamination, such as organochlorine pesticides.

Feedlots are potential sources of soil and groundwater contamination by nutrients (nitrogen and phosphorus), organic matter and pathogens (particularly faecal bacteria). All of these contaminants are mobile and/or short-lived, and are not likely to result in persistent soil or groundwater contamination or to pose a long-term risk to health.

The DWER Contaminated Sites Database shows no records of contamination on or near Tallangatta. A desktop study carried out by Connell Wagner in 2007 for the Muchea Employment Node Structure Plan identified a number of sites of possible contamination in the greater Employment Node; it is unknown whether any of these were in Tallangatta. The Structure Plan recommended that a detailed contamination study, involving a site history and possibly soil sampling, be undertaken to investigate the sites identified by Connell Wagner and any others subsequently identified.

Given the previous land uses on Tallangatta, it is expected that any contamination found by the detailed study will be low-level, localised and readily remediated to a level suitable for industrial use.

3.0 WATER USE SUSTAINABILITY

3.1 Water Supply

Water will be required for both potable and non-potable purposes. The water requirement for the fully developed project area is unknown. Calculations based on a study carried out by GHD for the Karratha Gap Industrial Estate suggest that approximately 4 KL/ha/day will be required for both potable and non-potable uses. Over the 213ha of the site (assuming 80% developable land), this equates to a total water demand of approximately 250ML/yr. This is less than the volume available in the surficial aquifer, but water from this source is unlikely to be suitable for potable use and the available yield may vary from place to place. The presence of existing bores and windmills on Tallangatta indicates that water is available in at least some parts of the property.

The Leederville aquifer is likely to be the preferred source for potable supply due to its generally higher quality and lower risk of contamination. Non-potable groundwater demand is likely to be limited to landscape irrigation, as industries within this precinct will be restricted to those with low water usage.

Potable water will be supplied to the project area by a licensed water provider. A proposed water project for the Lower Chittering Valley is currently in development by Aqua Ferre Pty Ltd, which includes construction of a water treatment facility on Lot 2 Reserve Rd, Chittering. Aqua Ferre is in the process of applying for a Water Service Provider's Licence from the Economic Regulation Authority (ERA). Aqua Ferre has confirmed that it has the capacity within its proposed licence to supply Muchea Industrial Park with potable water. Discussions with Aqua Ferre are ongoing. A letter from Aqua Ferre confirming this understanding is attached in Appendix E.

For non-potable uses, purchase of water entitlements from existing licensed users within or outside of the project area is likely to be necessary. The landowners will negotiate with existing licence holders within and outside of the project area with a view to purchasing an existing groundwater allocation, and will submit a groundwater licence application to the DWER in due course.

3.2 Water Efficiency Measures

Precinct 2 of the MIP will be designed as a low-water-use precinct. Only industries with low water consumption will be permitted in this precinct. This is driven largely by the hydrology of the site and its proximity to Ellen Brook, which demands that wastewater disposal be minimised.

Potable water use within the project area will be limited to consumption for domestic use in toilets, bathrooms and kitchens. The Shire of Chittering Town Planning Scheme No. 6 limits wastewater generation in industrial zones to 5,400 litres per hectare per day.

Groundwater will be used mainly for irrigation of landscape plantings and swales. These areas will be irrigated only during the establishment stage (one or two years). The Landscape Master Plan estimates total plantings of 40ha of sedges, shrubs and trees within the project area.

The water demand for irrigation in a given year will depend on the staging of subdivision and development. If the project area were developed over ten years, the demand for irrigation water (at the DWER's default rate of 4,500 KL/ha/yr) over that ten year period would be in the order of 18 ML/yr, decreasing in subsequent years.

4.0 LAND CAPABILITY FOR ON-SITE EFFLUENT DISPOSAL

4.1 Published Land Capability Ratings and Constraints

Extrapolation of mapping by the Department of Agriculture (King & Wells, 1990) suggests that the western part of Tallangatta would be mapped as Guildford Formation (Gf2): "Plain with imperfectly drained yellow duplex soils with sand to sandy loam topsoil", and the eastern part as Reagan (Re2): "Gentle slopes with deep, well drained brownish or earthy sands situated below Re1". King & Wells (1990) rated the capability of these landform types for on-site effluent disposal as follows:

Landform	*Capability*	*Limiting Factor(s)*
Gf2	Fair	Microbial purification ability, soil absorption ability
Re2	High	None

The limitations on the capability of the Gf2 landform unit relate to the imperfect drainage of the unit due to its silty soils and sometimes occurrence of clay horizons. The drilling carried out in June 2017 showed that the soils on the site possessed a sandy or gravelly loam profile to at least 1.5m depth, suggesting that they were well drained. Permeability measurements by Bayley Environmental Services in 2017 and Brown Geotechnical in 2020 returned permeabilities in the top 5m of the soil profile between $8.6x10^{-4}$ and 53 m/day. These results suggest that the permeability of the Gf2 soils on the site poses no significant constraint to effluent disposal.

The Government Sewerage Policy maps most of the project area as being within a Sewage Sensitive Area (SSA) due to its location within the catchment of the Swan-Canning Estuary and/or within 1km of significant wetlands. The Policy places additional site requirements in terms of groundwater clearance and lot density on effluent disposal within SSAs, including a lower lot size limit of 1ha. Figure 3 shows the SSA boundaries over the subject land.

The north-eastern part of Tallangatta is mapped as SSA by the GSP under the category of land "…within one kilometre up-groundwater-gradient and 250 metres down-groundwater-gradient of a significant wetland; or where the groundwater gradient is unknown or seasonably variable within one kilometre of the significant wetland…". Closer inspection shows that the wetland in question in this case, a Conservation Category dampland located 315m east of the project area, is upgradient of the site and maintained by surface water inflow from further upgradient. There appears to be no way that effluent disposal at the site could affect this dampland, and therefore the SSA mapping in this case is considered invalid. The GSP allows for SSA mapping to be refined through site-specific investigations as in this case.

4.2 Soil Permeability

Australian Standard AS1947:2012 recommends a minimum hydraulic conductivity of 0.06m/day for on-site effluent disposal without special design. The testing method set out in the *Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974* implies a minimum conductivity of 0.11m/day without specific approval by the Director-General of Public Health. Permeabilities of this order are generally found in weakly structured or massive clays.

Permeability measurements by Bayley Environmental Services in 2017 and Brown Geotechnical in 2020 returned permeabilities in the top 5m of the soil profile of $8.6x10^{-4}$ to 53 m/day.

Constant-head permeability tests in accordance with the method set out in Australian Standard AS1547:2012: – *On-site Domestic Wastewater Management* will be undertaken prior to subdivision.

4.3 Phosphorus Retention Index

The Health Department's draft *Code of Practice for Onsite Sewage Management* (2012) recommends a PRI of at least 20 for soils beneath effluent irrigation areas.

Previous experience has shown that the gravelly and silty clay soils of the Guildford Formation and other alluvial and colluvial soils generally have moderate to high PRI.

PRI testing of soils beneath proposed infiltration basins will be undertaken before subdivision. The soils will be modified by the importation of high-PRI fill if necessary to achieve an overall PRI of at least 20, in line with the Health Department's draft Code of Practice (2012).

4.4 Depth to Groundwater

The Government Sewerage Policy (GSP) (WA Govt, 2019) requires that land used for effluent disposal in sewage sensitive areas must have a minimum clearance of 1.5m from the effluent discharge point (e.g. base of leach drain or ATU drip lines) to the highest groundwater level. Under the Policy, the required clearance can be achieved by filling but not by drainage. Outside of sewage sensitive areas, the minimum groundwater clearance requirement for loams and heavy soils is 0.6m.

The groundwater measurements and modelling carried out in August 2020 indicate that the average annual maximum groundwater level (AAMGL) is within 1.5m of the ground surface in the south, west and north-east of the project area (Figure 6). Filling of effluent disposal

sites will be required in these areas to permit on-site effluent disposal in accordance with the GSP.

Where filling is used to achieve the necessary groundwater clearance, subsoil drains will be installed at the AAMGL to minimise groundwater rise into the fill. Because drainage is not being used to create the required clearance, this is believed to comply with the GSP.

4.5 Slope

The Government Sewerage Policy prohibits on-site effluent disposal on land with a slope of more than 1 in 5 (20%), in order to prevent runoff of effluent.

The slope of the subject land is mostly less than 5% and does exceed 10%. Effluent disposal on the site is therefore unconstrained by slope.

4.6 Watercourse Setbacks

The Department of Water & Environmental Regulation (DWER, 2016) recommends that effluent disposal systems should be located at least 100m from waterways and wetlands. The Government Sewerage Policy requires a 100m setback from waterways, significant wetlands and drains discharging directly into waterways or significant wetlands without treatment.

For the purposes of these requirements, “waterway” is defined as a natural watercourse as defined in the *Rights in Water and Irrigation Act 1914*. Based on site inspections and historical aerial photography as described in Section 2.3.2, the northern creekline is a natural waterway, while the middle and southernmost drainage lines are artificial drains.

Under the structure plan for Tallangatta, the northern creekline will be retained in its current alignment within a POS reserve that extends between 30m and 150m from the creekline. All effluent disposal areas will be set back at least 100m from this creekline.

The middle and southern existing drainage lines will be realigned into roadside bioretention swales, where dense vegetation will treat the water flowing down the drains to reduce flow velocities and remove suspended sediments, nutrients and other contaminants.

The Government Sewerage Policy provides that reduced setbacks from drains may be allowed where it can be demonstrated that the reduced setbacks will not have a significant impact on the environment or public health. In this case, setbacks of less than 100m from bioretention swales are considered acceptable and necessary because:

- all effluent disposal will be by means of alternative effluent disposal systems with nutrient removal capability (Section 4.7);

- the clayey soils and high PRI of the site (Section 2.2.5) mean that leachate emanating from the effluent disposal systems will be of high quality;
- the water in the roadside swales will be treated by infiltration, vegetation uptake and soil adsorption before it reaches any downstream water body; and
- imposing a requirement for 100m setbacks would severely constrain and in some cases prevent the siting of effluent disposal systems on lots

A setback of 6m from subsoil drains is considered necessary and justified because:

- the subsoil drains will be located upslope of the effluent disposal fields (Section 4.8) and will drain only clean groundwater that has been filtered through the soil profile;
- all effluent disposal will be by means of alternative effluent disposal systems with nutrient removal capability (Section 4.7);
- the drained water will be treated by infiltration and vegetation uptake within the roadside swales before being released to downstream watercourses (Section 5.5.2);
- a greater separation would reduce the effectiveness of the subsoil drains in limiting groundwater rise within the effluent disposal areas; and
- the clayey soils and high PRI of the site (Section 2.2.5) mean that the drained water will be of high quality.

The differing sized lots within the subject site will offer a range of options for siting of development elements and effluent disposal systems within each lot. At the time of subdivision and development approval, the siting of individual effluent disposal systems will be subject to review and approval by the Shire of Chittering and other agencies.

It is concluded that the proposed system of effluent disposal in the project area will pose minimal risk to the environment or public health and will meet all setback requirements set out in current government policies.

4.7 System Selection and Location

All effluent generated within the subdivision will be treated and disposed by means of individual on-site effluent disposal systems. All lots in low-lying areas where the AAMGL is less than 1.5m below the natural ground surface will be required to employ nutrient-attenuating secondary treatment systems such as aerobic treatment units (ATUs) with high-PRI irrigation areas or modified leach drain systems (e.g. Filtrex). Lots in higher areas or with deeper groundwater may employ conventional septic systems and leach drains.

ATU irrigation areas will be filled to approximately 2m above the AAMGL in order to provide 1.5m clearance from the AAMGL to the effluent drip lines as required under the Government Sewerage Policy (2019), allowing for 0.3m groundwater mounding and 0.2m soil cover over the drip lines. Fill used for this purpose will be either sourced from on site or imported. The soil will be tested and modified if necessary to confirm a PRI of at least 20.

The ATU irrigation area or leach drain length on each lot will be sized to suit the expected population of the lot. As a rough rule of thumb, each full-time employee on site will require approximately 23m^2 of effluent irrigation area or 4.4m of leach drain. Treated ATU effluent may be disposed of via leach drains, which may reduce the area required for disposal by up to two thirds at the cost of a greater height of fill.

The effluent disposal requirements of each lot will vary depending on the soil profile, groundwater depth and expected site population. Site testing on each lot prior to development will be required to determine the optimum location and type of effluent disposal system.

4.8 Subsoil Drainage

Where fill is used to raise pads for effluent disposal, subsoil drains will be placed upslope of the filled pad to prevent groundwater rise into the fill. The drains will be placed at least 6m upslope from the drip lines or leach drains. The drains will be set with their inverts at or above the AAMGL and will discharge via free-draining outlets into the roadside swales, where the water will be further treated by infiltration and vegetation uptake within the swales. Because the water will be draining from high-PRI soil (see Section 2.2.5), it will be of high quality.

5.0 STORMWATER MANAGEMENT STRATEGY

5.1 Principles and Objectives

The stormwater management strategy aims to comply with the principles and objectives for stormwater management identified in the *Stormwater Management Manual for WA* (DoW, 2004) and *Better Urban Water Management* (WAPC, 2008).

Nutrient concentrations and loads in water leaving the site will be managed to comply with the targets of the draft *Swan Canning Water Quality Improvement Plan* (SRT, 2009) for the Ellen Brook catchment, as follows:

- Winter median TP concentration: 0.1 mg/L
- Winter median TN concentration: 1.0 mg/L
- Annual TP yield: 0.03 kg/ha
- Annual TN yield: 0.31 kg/ha.

5.2 Drainage Management System

The drainage system will be designed to maintain surface flow rates and volumes within and from the developed site at their pre-development levels. The drainage design presented here is conceptual and will be refined in the detailed subdivision designs. Figure 9 shows an overview of the conceptual drainage design.

The priorities for managing the various sizes of storm event will be:

- 1 year ARI Infiltrate all flows as close to the source as possible. Maintain pre-development flow rates and volumes. Minimise export of nutrients and sediments.

- 5 year ARI Detain water prior to discharge. Maintain pre-development flow rates and volumes. Maintain amenity and serviceability. Prevent scouring and damage.

- 100 year ARI Maintain pre-development flow rates and volumes. Prevent flooding and damage.

5.2.1 Through Drainage

The existing creekline entering at the north-east of the property will be retained in its current alignment and protected within a POS reserve. The two artificial drainage lines that enter towards the south-east corner of the property will be realigned into roadside bioretention swales.

The swales will be sized to accommodate the flow from a 100-year ARI critical storm from both the upstream and internal catchments. A series of low weirs within the swales will capture and infiltrate road runoff from storms up to 1-year ARI 1-hour. The inverts of the swales will be at or above the AAMGL.

The swales will be configured as living streams and densely planted with sedges and shrubs to slow the water flow and help to remove sediments and nutrients from the water.

5.2.2 Lot Drainage

Runoff from roofs, paved surfaces and hardstand areas within private lots from storms up to 1-year ARI 1-hour duration (about 15mm) will be retained and infiltrated within each lot in soakwells, swales, basins and/or landscaping areas. For preliminary design purposes it has been assumed that all parts of the lots except for landscaping and effluent irrigation areas will be developed to hardstand, internal roads or buildings. These will be subject to detailed design on individual lots.

The in-lot drainage structures will also be sized to capture the excess runoff from roofs, paved surfaces and hardstand areas from critical storms up to 100-year ARI. In most cases the critical storm (that producing the highest flow rate) will be of less than fifteen minutes' duration, and the volume of flow will be less than that from the 1-year 1-hour storm.

All runoff from within each lot will be directed to the bioretention/detention basin. Overflows from the basins will run into the roadside bioretention swales, either directly or, for those lots that do not have a downslope road frontage, via drainage easements.

The management of excess runoff from each lot will vary depending on the situation of the lot. In general:

- On lots that front a public road on the downslope side, the part of the lot near the road will be filled as necessary to raise its level above the outer embankment of the roadside swale and allow overflow drainage to flow into the roadside swale. The height of filling will generally be between 0m and 0.8m. Depending on the slope of the lot, the filling will extend between about 10m and 90m from the lot boundary. This filling will be carried out by the subdivider/developer during the construction of the roads.

  The internal basin will be located in the fill and will capture the 1-year 1-hour storm runoff and excess flow from critical storms up to 100-year ARI, and will overflow into the roadside swale.

  Figure 10 shows a conceptual layout and profile of a typical lot in this situation.

- On lots that adjoin another lot on the downslope side (i.e. that do not have a downslope road frontage), the in-lot basin will overflow via a bund or swale along the downslope lot boundaries to the nearest roadside swale. Where the flow needs to cross another lot

before reaching the road reserve, an easement nominally 10m wide will be created in favour of the Shire of Chittering. Swales and/or bunds may be created within the easements as necessary to direct the overflow. These swales and bunds will be constructed by the developer at the time of creation of the lots. Figure 9 shows the conceptual layout of the drainage easements. Figure 10 shows a conceptual layout of a typical lot of this type.

5.2.3 Internal Road Drainage

Runoff from public roads from up to the 1-year ARI 1-hour storm will be retained and infiltrated in roadside bioretention swales. The inverts of the swales will be at or above the AAMGL. Figure 9 shows the preliminary layout of the roadside swale network.

The swales will be constructed with low internal weirs set at a height that captures the 1-year 1-hour storm. In preliminary drainage calculations (Appendix F), the swales have been set at 0.5m to 0.8m deep with base width of 3m to 5m, side slopes of 1 in 3 and with 0.3m high internal weirs. The weirs may incorporate underdrains to promote infiltration of the 1-year flows.

The configuration of the swales and internal weirs will be subject to detailed design prior to subdivision, including:

- the height of the swale inverts at or above the AAMGL;
- the depth and width of the swales;
- the height of the internal weirs;
- the composition of the swale floors, designed to maximise nutrient uptake;
- planting of the swales with dense sedges and shrubs to maximise nutrient uptake; and
- the possible inclusion of underdrains within the swales to promote infiltration of 1-year ARI flows.

Figure 11 shows conceptual profiles of the roadside swales.

5.2.4 Major Storm Drainage

Road runoff and lot overflows from larger storms will overtop the weirs and flow along the swales to the western boundary, where it will enter the roadside drains and culverts on Great Northern Highway. The peak flow rate of drainage out of the site will be controlled to be no greater than that existing before development.

Figure 9 shows the overall drainage layout and the 100-year ARI flow paths. Table 5.1 summarises the 100-year flows in the swales. The flow calculations are detailed in Appendix F.

The drainage from the site flows beneath Great Northern Highway via eleven culverts, as shown on Figure 9. These were constructed in the context of a rural setting, in which

culverts may be designed to allow some ponding upstream on adjacent land during major storms.

Survey of the culverts adjacent to the site, coupled with data provided by Main Roads WA from its IRIS database, enabled the flow capacities of the culverts to be calculated using Manning's Open Channel Flow Formula. The calculations show that, assuming overall peak flow rates following development are controlled to be no greater than the pre-development flows, the combined capacity of the culverts is more than double the expected 100-year peak flow from the project area and upstream.

In the centre of the site (culverts CH35.41 to CH36.12), the predicted peak flow rate exceeds the instantaneous capacity of the culverts by approximately 40%. In this section, the existing roadside drain on Great Northern Highway appears to sufficient capacity to store the excess flow without backing up into the project area. If further detailed design calculations show that additional storage is necessary, the Public Open Space area adjacent to the boundary, measuring approximately 0.87ha, may be configured as a flood storage area. Table 5.2 shows the culvert flow calculations.

Table 5.1 Preliminary Swale Sizing – 100 yr ARI Critical Storm

Swale Segment (Figure 9)	*Contributing Segments*	*Contributing Lots*	*Contributing Upstream Catchments*	*Total Cumulative Peak Flow (L/s)*[1]	*Long Slope*[2]	*Swale Base Width (m)*	*Swale Depth (m)*	*Height Over 0.3m Weir (m)*[4]
A1	A1-A5	10-16, 42-49n	46U,47U,49U,49NU	2892.34	0.0179	5	0.6	0.28
A2	A2	10-13		501.31	0.0066	4	0.5	0.15
A3	A3	43		273.18	0.0044	3	0.5	0.13
A4	A4	46	46U	1230.24	0.0140	2	0.6	0.25
A5	A5	47-49N	46U,47U,48U,49NU	1748.01	0.0086	3.5	0.6	0.30
A6	A6			245.51	0.0190	4	0.5	0.07
B1	B1			163.29	0.0182	2	0.5	0.07
C1	C1	22		1946.20	0.0185	3	0.6	0.27
C2	C2	23,24		2121.04	0.0016	4.5	0.8	0.48
C3	C3,C4	20,21,32-41		1610.66	0.0071	3.5	0.6	0.30
C4	C4	33-41		1415.40	0.0079	3	0.6	0.29
D1	D1-D5	25-30,49S-51,54,55	49SU,50U,51U,DRU	1430.40	0.0172	3	0.6	0.26
D2	D2-D5	26,27,49S-51,54,55	49SU,50U,51U,DRU	1390.13	0.0209	4	0.5	0.20
D3	D3-D5	49S-51,54,55	49SU,50U,51U,DRU	1600.45	0.0080	3.5	0.6	0.29
D4	D4,D5	49S-51	49SU,50U,51U,DRU	2892.34	0.0179	5	0.6	0.28
D5	D5	49S-51	49SU,50U,51U,DRU	501.31	0.0066	4	0.5	0.15

1. Based on runoff coefficient for the 100-year ARI storm of 0.85 and 100% development of lots to hardstand.
2. Based on existing topography; this may change with filling and levelling of lots and road reserves.
3. Calculated using Manning's Open Channel Flow Formula (Fang, 2000) for a trapezoidal channel with 1:3 side slopes and Manning's *n* of 0.04.

Table 5.2 100yr ARI Culvert Flows

Culvert(s) Figure 9)	*No. & Size*	*Length (m)*	*Slope*	*Total Capacity (m^3/s)[1]*	*100 yr Flow (m^3/s)[2]*	*Storage Required (m^3)[3]*	*GNH Drain Volume (m^3)[4]*
CH36.64	5 x 1.2 x 0.5	17.3	0.0068	7618	6788	0	1089
CH36.43	1 x 0.9 x 0.45	14.8	0.0142				
CH36.12	1 x 0.6	17.2	0.0152	3584	4986	1893	2750
CH35.98	2 x 0.5	14.8	0.0172				
CH35.92	1 x 0.6	14.8	0.0110				
CH35.73	1 x 0.9 x 0.6	16	0.0086				
CH35.58	1 x 0.45	16	0.0088				
CH35.41	1 x 0.45	16	0.0025				
CH35.23	5 x 1.2 x 0.75	20.8	0.0057	12898	1630	0	1191
CH35.02	2 x 1.2 x 0.45	25.6	0.0092				
CH34.79	4 x 1.2 x 0.75	25.6	0.0094	10487	3630	0	30

1. Calculated by Manning's Open Channel Flow Equation as set out in Fang (2000) using pipe roughness coefficient of 0.016 (wet-cast concrete).
2. Calculated by Rational Method using runoff coefficients of 0.85 for road reserves and lots, 0.35 for upstream catchments and POS.
3. Calculated by modified COPAS Equation.
4. Calculated from length of drain within segment, 4m base width and 1:3 side slopes.

5.3 Surface Water Quality Management

The drainage system will be designed to maximise on-site retention of nitrogen, phosphorus, sediments and other contaminants. This will be achieved by:

- Retaining and infiltrating all lot runoff from storms up to 1-year ARI in bioretention basins within the lots.

- Retaining and infiltrating all road runoff from storms up to 1-year ARI 1-hour duration (estimated by the DWER to carry more than 99% of total flows and nutrients) in vegetated bioretention swales with a minimum soil PRI of 15.

- Conveying all runoff from storms between 1-year and 100-year ARI in densely vegetated bioretention swales to allow suspended particles to be filtered out.

5.4 Maintenance

The drainage system has been designed to require minimal maintenance. The following will be required to ensure that the system continues to function as designed:

- Regular cleaning of side entry and junction pits, inlet pits and small culverts. More frequent (perhaps annual)cleaning may be required during the construction phase.

- Tending and maintenance of swales and other vegetated drainage features to remove litter, control weeds and encourage the growth of native species.

- Pruning, mulching or removal of vegetation in swales as necessary to maintain ground fuel loads below 8 tonnes/ha.

6.0 GROUNDWATER MANAGEMENT STRATEGY

6.1 Groundwater Levels

The drainage system for the site is designed to minimise changes to the existing groundwater regime. Roadside swales and subsoil drains will be set with their inverts at or above the AAMGL. Subsoil drainage within lots will be limited to filled areas used for buildings or effluent disposal.

6.2 Subsoil Drainage

Subsoil drainage will be employed within some lots where necessary to maintain existing maximum groundwater levels beneath building pads and effluent disposal areas. Subsoil drains may also be employed within road reserves to prevent groundwater rise from damaging the road base and pavement.

All subsoil drains will be set with their invert at or above the AAMGL. Therefore, changes to the groundwater hydrology of the site will be minimal. The subsoil drains will discharge into roadside swales via free-draining outlets.

6.3 Groundwater Quality

The sampling undertaken to date indicates that the groundwater beneath the site contains low to moderate concentrations phosphorus but elevated levels of nitrogen. This is to be expected given the nature of the soils and the land use history of the site.

The relationship between nutrient inputs and exports is complex, especially in the case of phosphorus, which travels through the soil profile as a “front” in a complex series of adsorption and desorption reactions. Nitrogen is subject to denitrification and mineralisation in the soil and groundwater. As a result, nutrient exports from the site at present will be a reflection of nutrient inputs over the last several decades, modified by soil hydrology and nutrient retention capacity.

The aim of nutrient management will be to limit nutrient inputs to the site so that nutrient outputs are minimised. As an industrial precinct, the area of fertilised gardens and lawns will be small. Landscaping areas including street trees, swales and vegetation buffers will be established with minimal fertilisers and irrigation.

Measures available to minimise nutrient inputs and exports in the development will include:

- regular street sweeping to remove accumulated contaminants; and
- selection of native species with low water and fertiliser requirements for public open space and landscape areas.

7.0 LANDSCAPING STRATEGY

Landscaping of the site will focus on the use of species with low water demand. Planting areas will include bioretention swales and basins, landscape buffers (to a minimum of 10% of the area of each lot) and street trees. The plantings will not be irrigated after the establishment phase. No turf grass will be planted.

The plantings in swales, basins and effluent irrigation areas will include a high proportion of species recommended in the Monash University (2014) *Vegetation Guidelines for Stormwater Biofilters in the South-West of Western Australia*.

Fertiliser use will be minimal. New tube stock plantings will be fertilised with slow-release nitrogen and phosphorus tablets on establishment and thereafter will be unfertilised.

The bioretention basins and swales will be densely planted with inundation-tolerant species including sedges and low shrubs in order to stabilise the basins and maximise their ability to take up nitrogen from the water.

The total area to be planted is approximately 40 hectares. If all of this area were planted simultaneously during the establishment phase, approximately 180 ML of water would be required to irrigate the new plantings for the first year. As the project area is likely to be developed in a number of stages, the requirement for irrigation water is likely to be spread out over a number of years, with only a small part of the total demand being required in any one year.

The density of planting will be controlled to keep flammable ground fuel loads below 8 tonnes/ha, in accordance with the Bushfire Hazard Assessment (Eco logical Australia, 2020).

Figure 12 shows the conceptual landscaping strategy. The landscaping strategy is described in more detail in the Landscape Master Plan (BES, 2021).

8.0 MONITORING

Baseline water quality results for the site are shown in Tables 2.4 and 2.5. Groundwater levels and quality will continue to be monitored and compared against baseline levels and relevant guidelines. Water quality in surface drains will be monitored upstream and downstream of the project area to determine what (if any) impacts the development may be having on the watercourses.

Water quality sampling will be conducted nominally once a year in late winter. Detailed water monitoring and response procedures will be developed as part of the Urban Water Management Plans to be prepared for each stage of subdivision.

9.0 IMPLEMENTATION AND FURTHER MANAGEMENT PLANS

Further planning and subdivision of the subject land will be carried out in accordance with the general water management principles set out in this LWMS. Subdivision of lots in the structure plan area may be carried out by individual owners as they see fit, in accordance with the framework of the LWMS.

An Urban Water Management Plan (UWMP) will be prepared as a condition of subdivision approval for each stage of subdivision. The UWMP will present the detailed design of the stormwater drainage system within that stage.

The developer of each stage of subdivision will maintain the drainage system, landscaped areas and water monitoring program within that stage until two years after that stage of subdivision is completed. At the end of that time the responsibility for monitoring and management will be handed over to the Shire of Chittering.

10.0 REFERENCES

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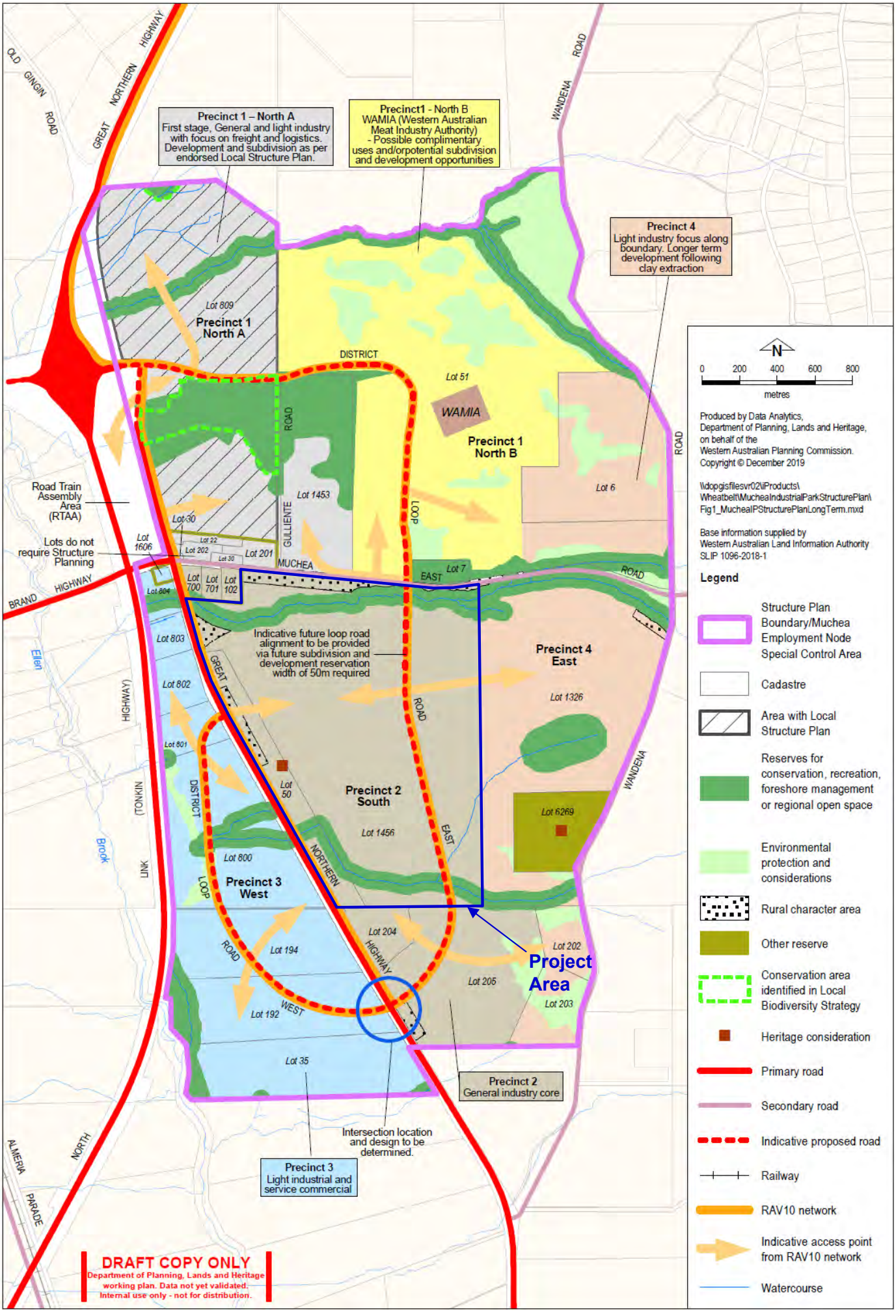
Figures



Source: WAPC, 2019

Figure 1

DRAFT MUCHEA INDUSTRIAL PARK STRUCTURE PLAN

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Figure 2

THE SITE AND SURROUNDINGS

Image source: Google 2018

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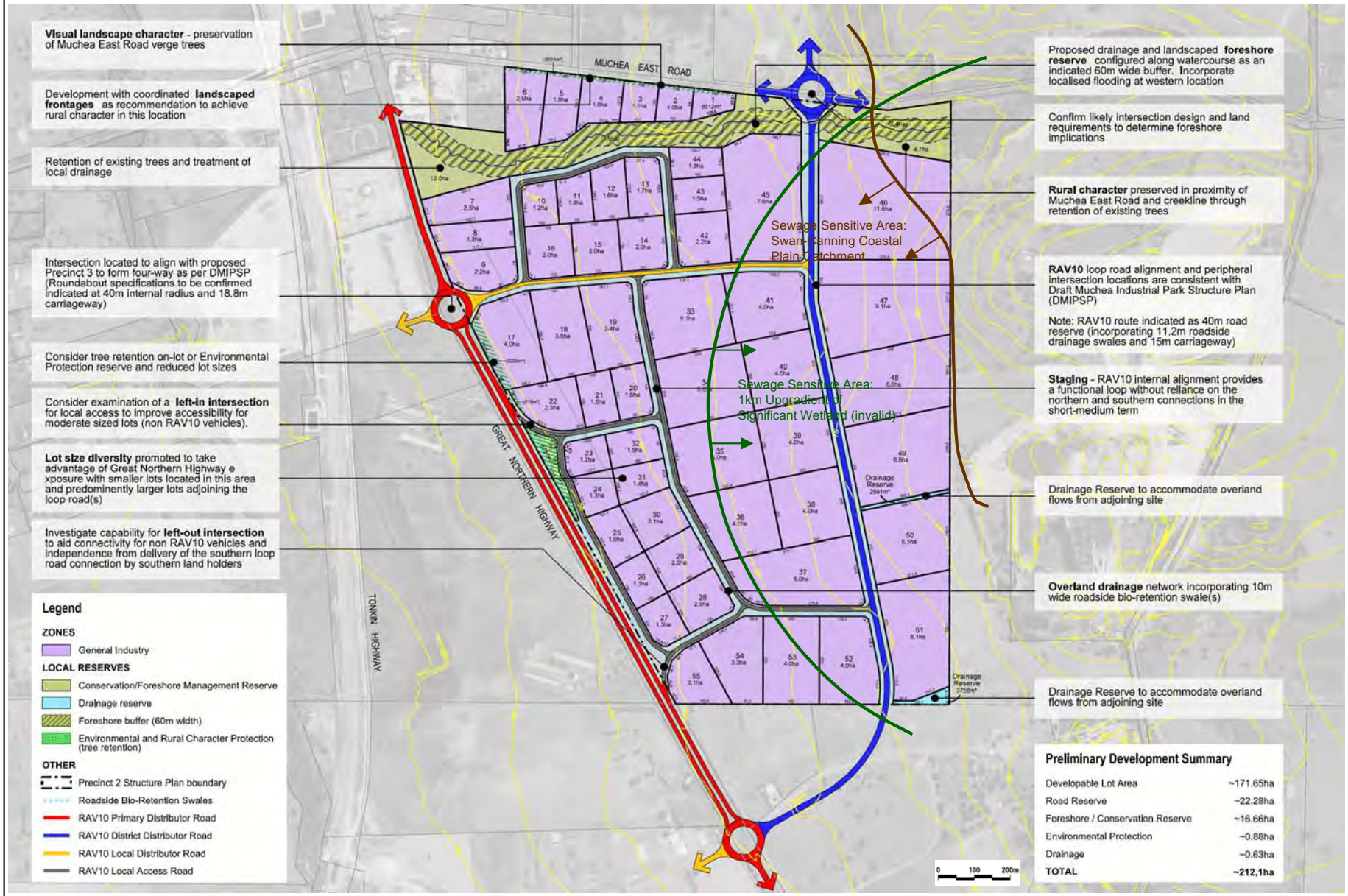

Figure 3

PROPOSED PLAN OF SUBDIVISION

Taylor Burrell Barnett

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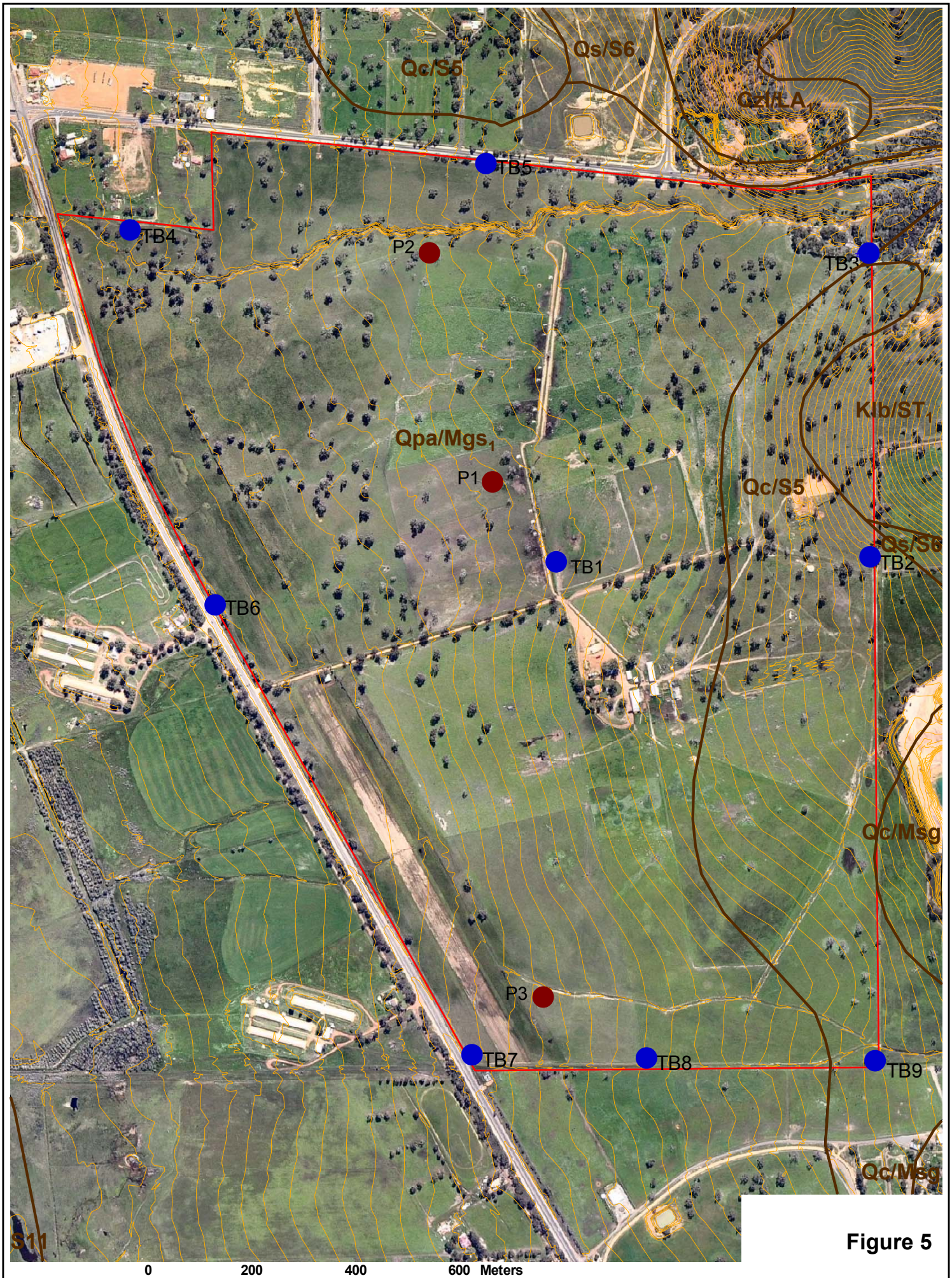

Figure 5

PHYSIOGRAPHY

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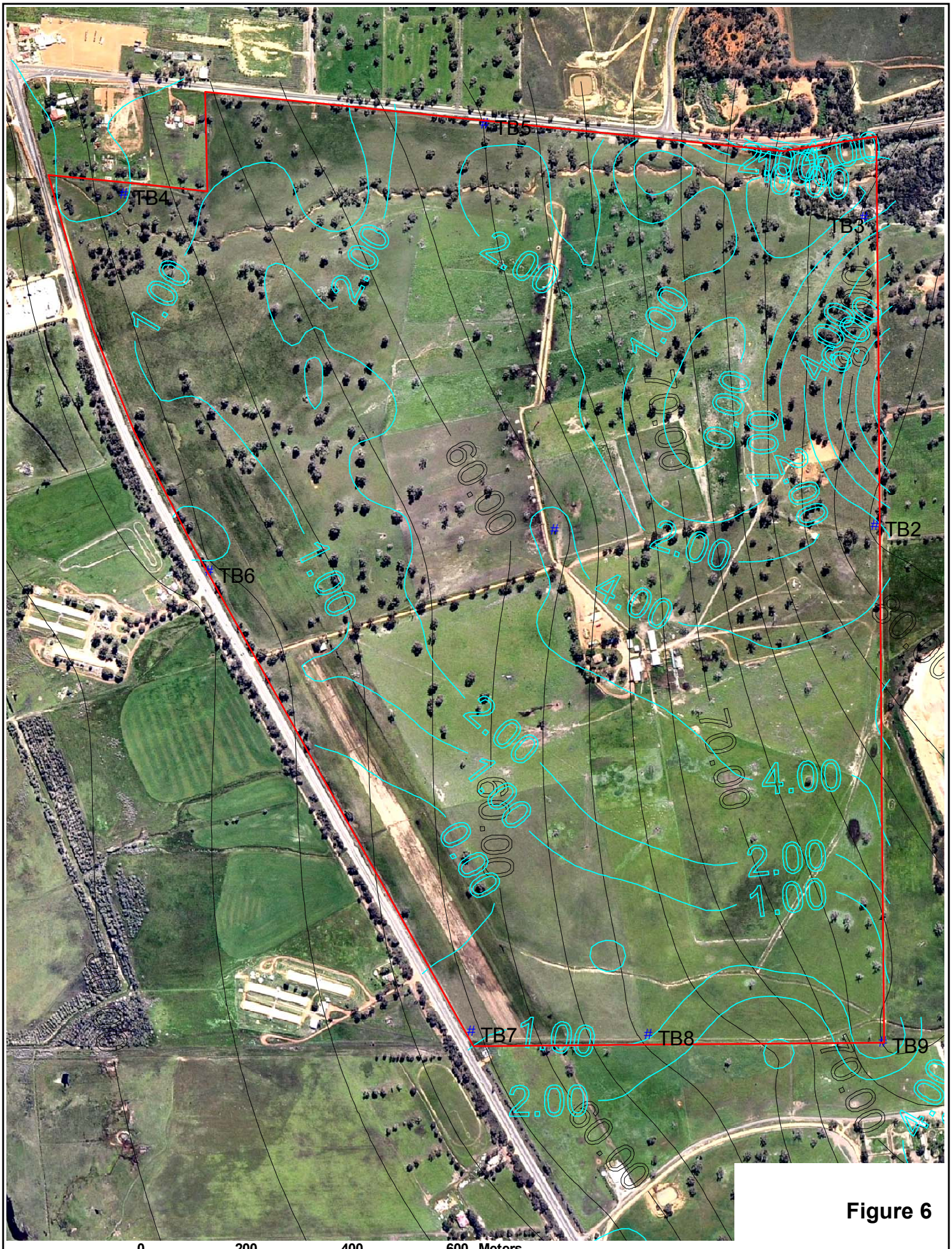

Figure 6

GROUNDWATER HYDROLOGY

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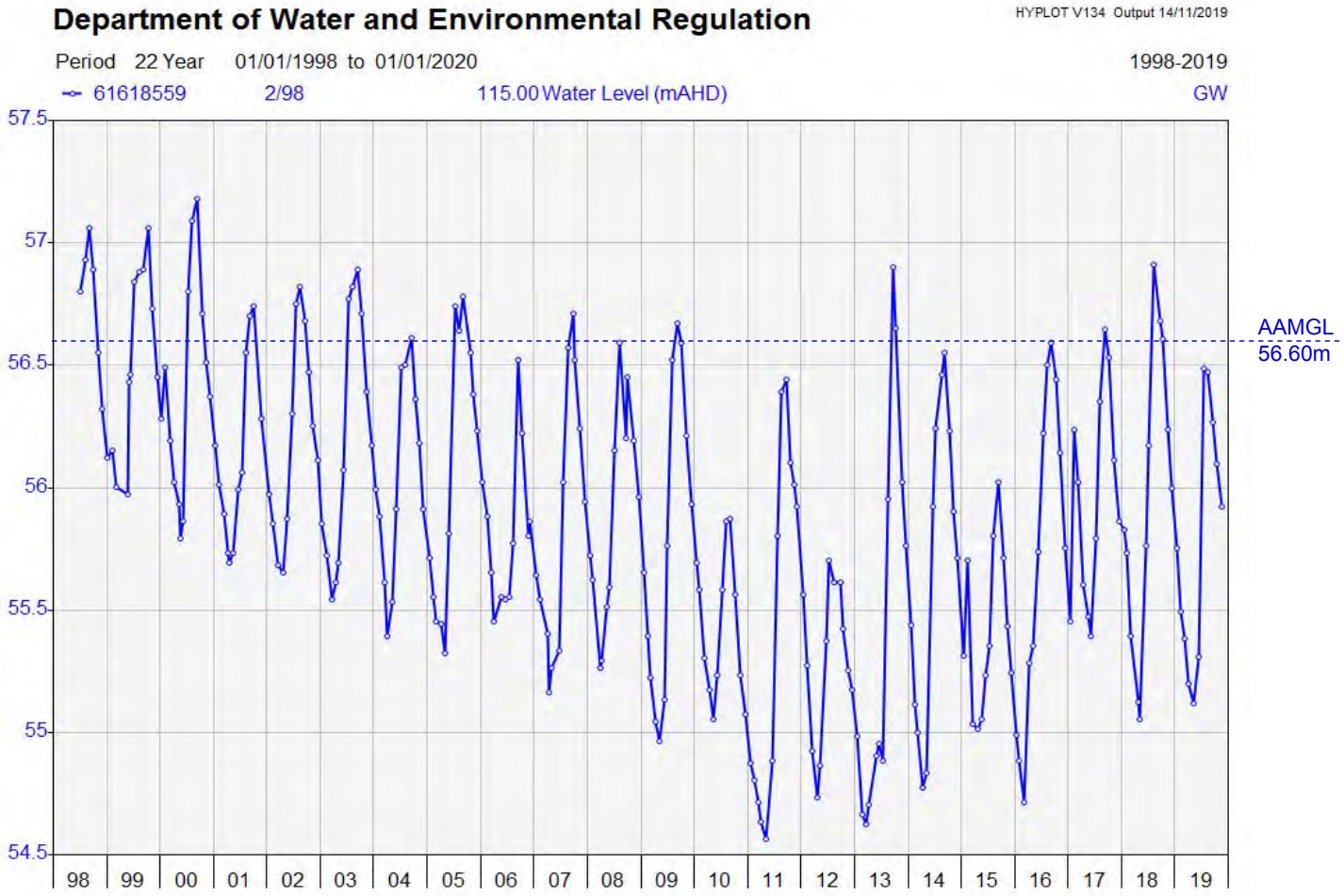

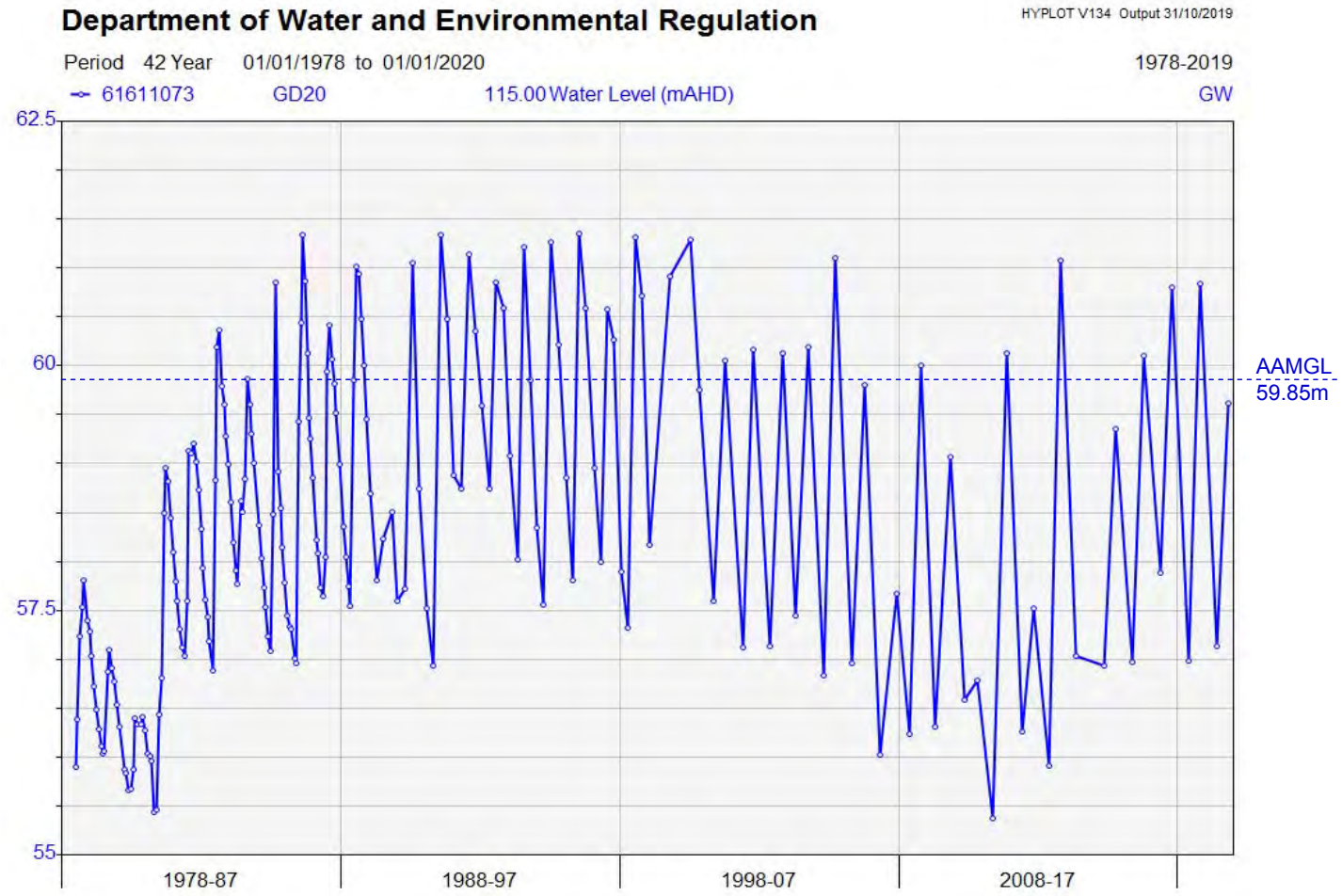

Figure 7

DWER BORE HYDROGRAPHS

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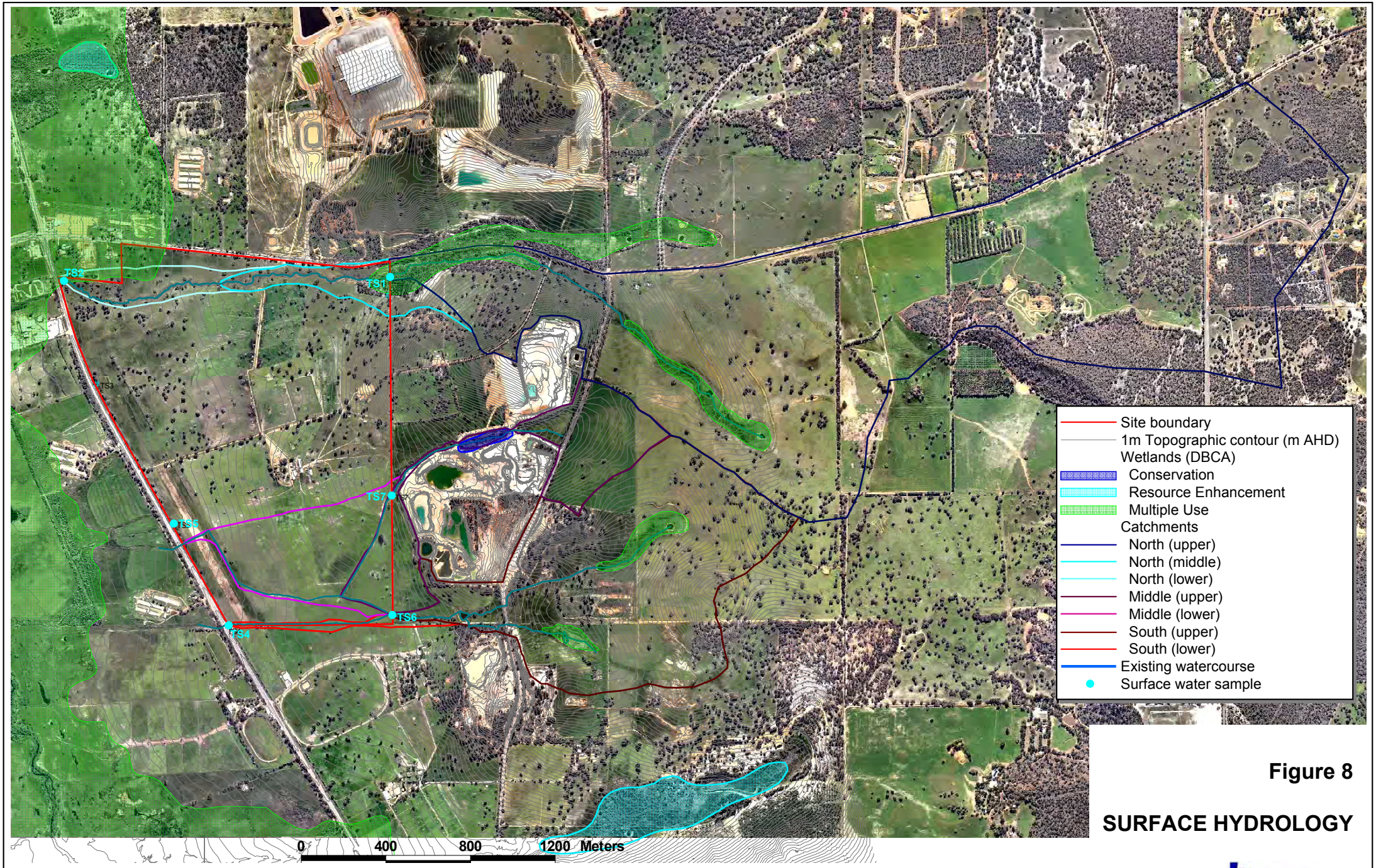

Figure 8

SURFACE HYDROLOGY

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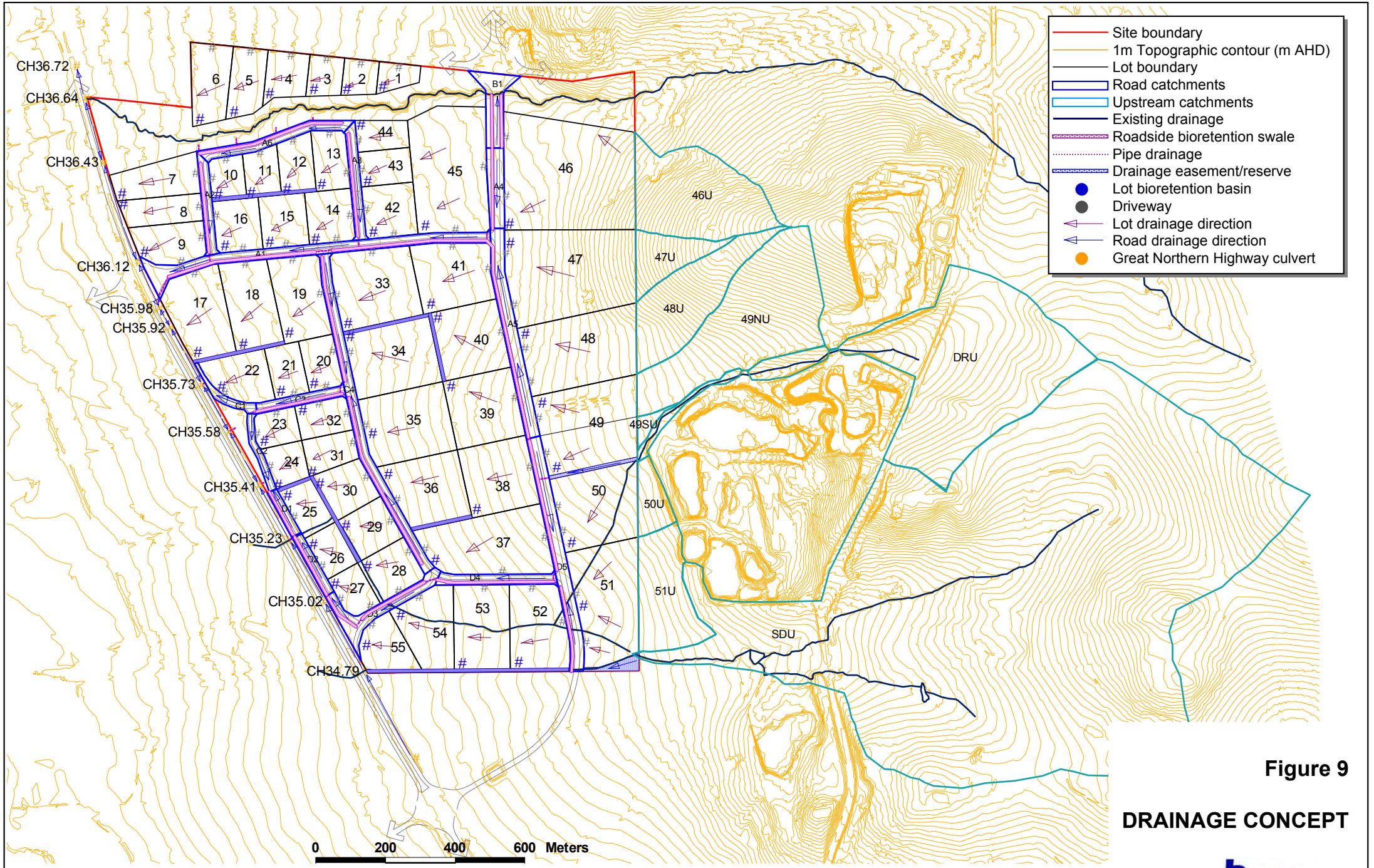

Figure 9

DRAINAGE CONCEPT

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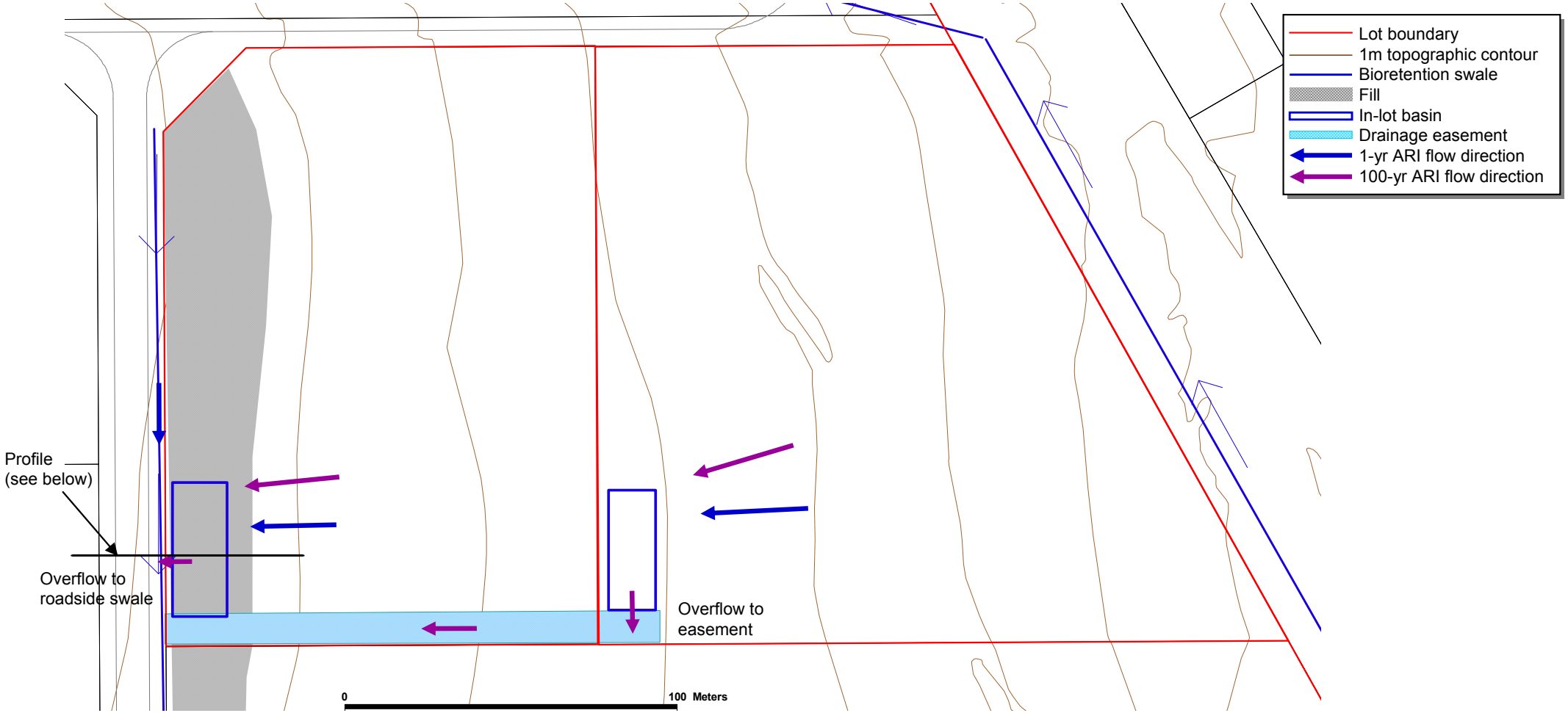

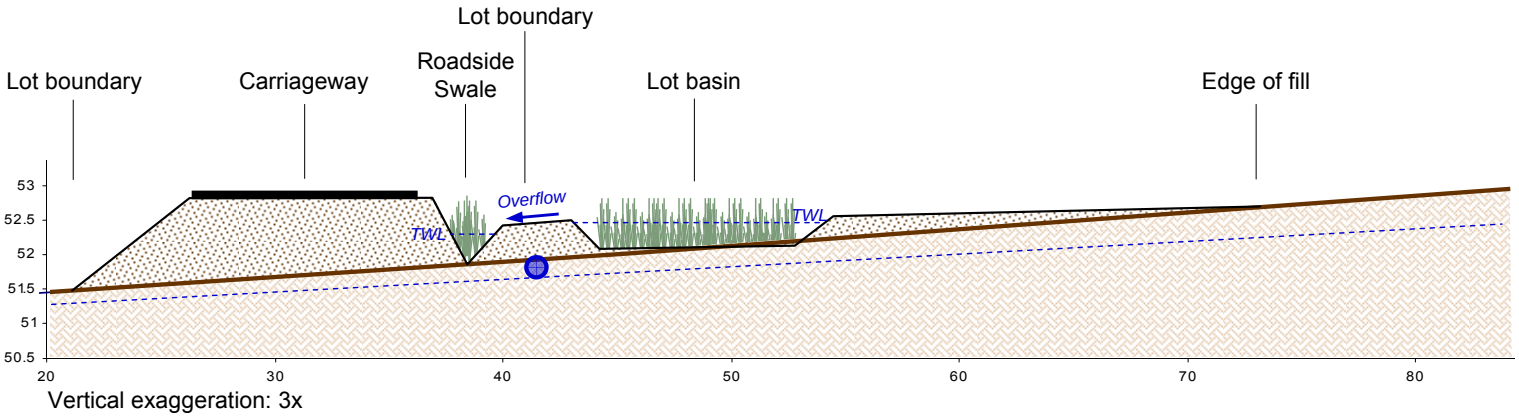

Figure 10

LOT DRAINAGE EXAMPLES

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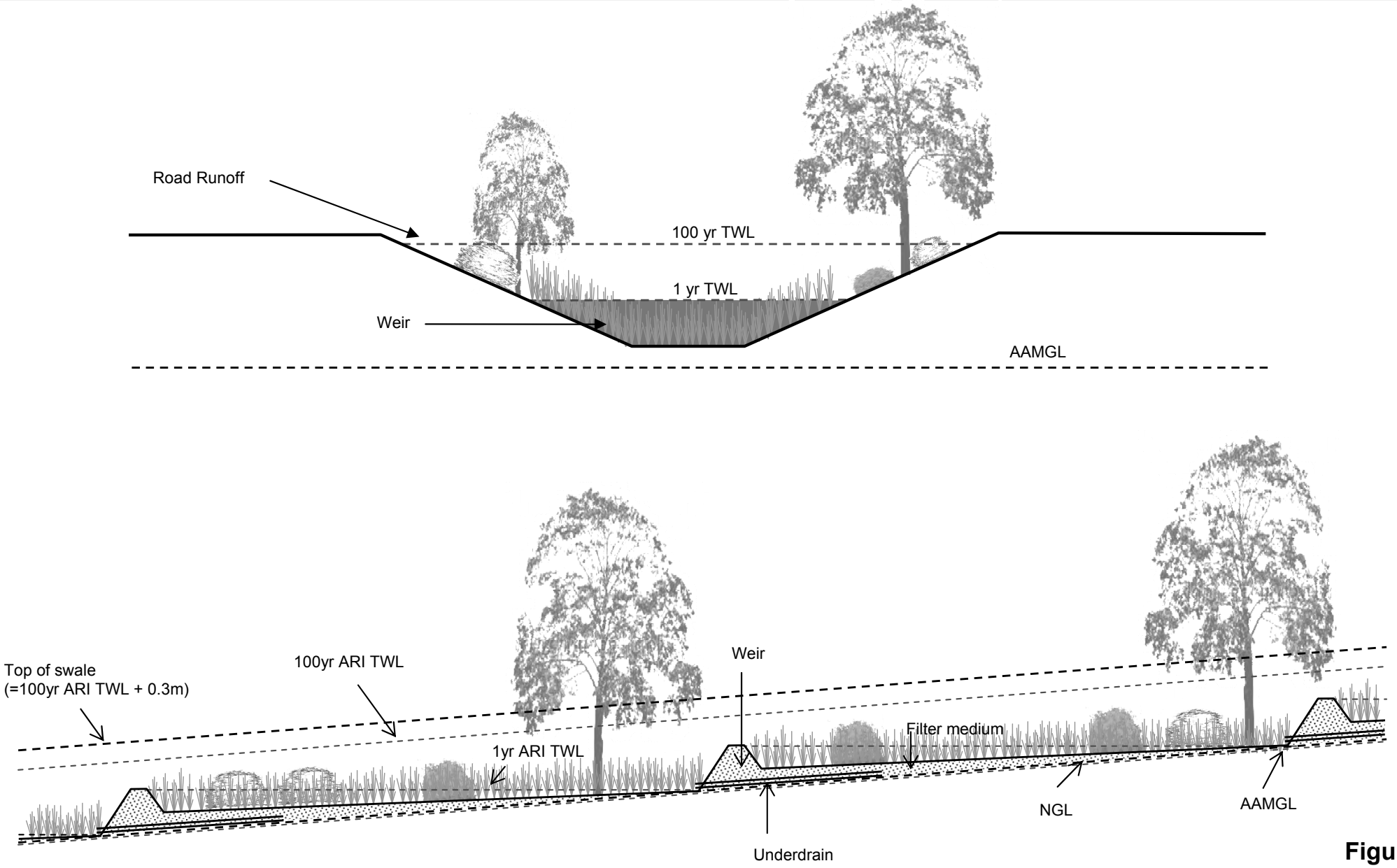

Figure 11

CONCEPTUAL SWALE PROFILES

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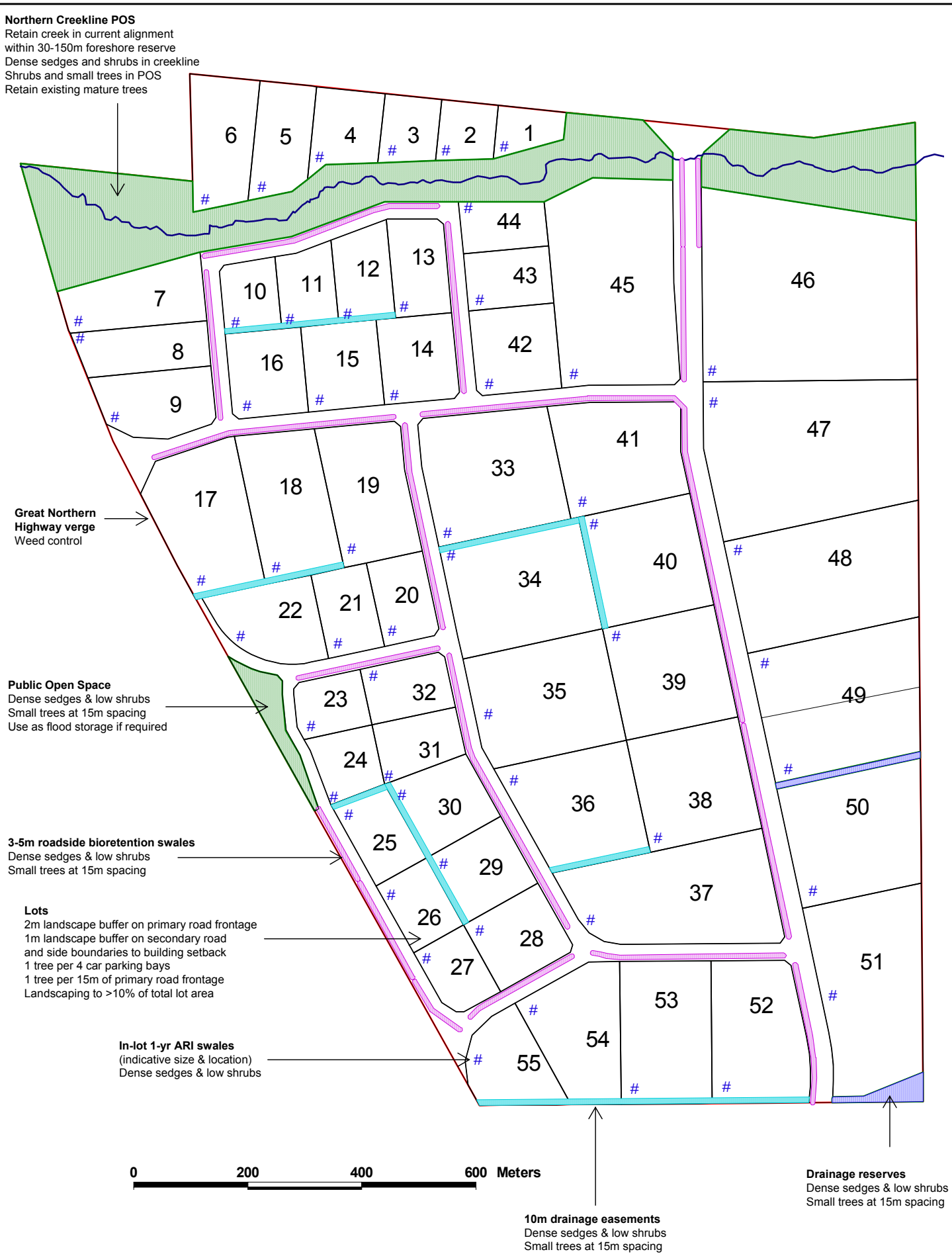

Figure 12

LANDSCAPE MASTER PLAN

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Appendix A

DWER LWMS Checklist

Appendix 2 Local water management strategy checklist

Local water management strategy item	Deliverable	☑	Notes
Executive summary			
Summary of the development design strategy, outlining how the design objectives are proposed to be met	Table 1: Design elements and requirements for best management practices and critical control points	☑	Page 8
Introduction			
Total water-cycle management – principles and objectives Planning background Previous studies		☑	Section 1
Proposed development			
Structure plan, zoning and land use Key landscape features Previous land use	Site context plan Structure plan	☑ ☑	Figures 1-3 Section 2
Landscape – proposed public open space areas, public open space credits, water source, bore(s), lake details, irrigation areas (if applicable)	Landscape plan	☑	Sections 3, 7
Design criteria			
Agreed design objectives and source of objectives		☑	Section 1.5 Table 1.1
Pre-development environment			
Existing information and more detailed assessments (monitoring). How do the site characteristics affect the design?		☑	Section 2
Site conditions – existing topography/contours, aerial photo underlay, major physical features	Site condition plan	☑	Section 2
Geotechnical – topography, soils including acid sulfate soils and infiltration capacity, test pit locations	Geotechnical plan	☑	Section 2 Appendix C
Environmental – areas of significant flora and fauna, wetlands and buffers, waterways and buffers, contaminated sites	Environmental plan plus supporting data where appropriate	☑	Section 2
Surface water – topography, 100-year floodways and flood fringe areas, water quality of flows entering and leaving (if applicable)	Surface-water plan	☑	Section 2
Groundwater – topography, pre-development groundwater levels and water quality, test bore locations	Groundwater plan plus site investigations	☑	Section 2

Local water management strategy item	Deliverable	☑	Notes
Water sustainability initiatives			
Water efficiency measures – private and public open spaces including method of enforcement		☑	Section 3
Water supply (fit-for-purpose) strategy, agreed actions and implementation		☑	Section 3
Wastewater management		☑	Section 4
Stormwater management strategy			
Flood protection – peak flow rates, volumes and top water levels at control points, 100-year flowpaths and100-year detention storage areas	100-year-event plan Long section of critical points	☑ ☑	Section 5
Manage serviceability – storage and retention required for the critical 5-year ARI storm events Minor roads should be passable in the 5-year ARI event	5-year-event plan	☑	Section 5
Protect ecology – detention areas for the 1-year 1-hour ARI event, areas for water quality treatment and types of agreed structural and non-structural best management practices and treatment trains (including indicative locations). Protection of waterways, wetlands (and their buffers), remnant vegetation and ecological linkages	1-year-event plan Typical cross sections	☑ ☑	Section 5
Groundwater management strategy			
Post-development groundwater levels, existing and likely final surface levels, outlet controls, and subsoil drain areas/exclusion zones	Groundwater/subsoil plan	☑	Section 6
Actions to address acid sulfate soils or contamination		☑	Sections 2.2.4 and 2.9
The next stage – subdivision and urban water management plans			
Content and coverage of future urban water management plans to be completed at subdivision. Include areas where further investigations are required before detailed design.		☑	Section 9
Monitoring			
Recommended future monitoring plan including timing, frequency, locations and parameters, together with arrangements for ongoing actions		☑	Section 8
Implementation			
Developer commitments		☑	Section 9
Roles, responsibilities, funding for		☑	Section 9

Local water management strategy item	Deliverable	☑	Notes
implementation			
Review		☑	Section 9

Appendix B

Soil Logs

SOIL PROFILE LOG

PROJECT NUMBER:	J20008
SITE ID:	TB1
EASTING:	405754
NORTHING:	6505172
METHOD:	Auger rig
TOTAL DEPTH (mbgl):	6
REFUSAL (Y/N):	N
DATE:	13/06/2017
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0.5	Brown gravelly sand		
1 - 1.5	Orange gravelly loam		
2	Orange-brown clay-loam		
2.5	Orange-brown loamy clay		
3	Red-brown loamy clay		
3.5 - 5	Pink clay		
5.5 - 6	Red clay		

SOIL PROFILE LOG

PROJECT NUMBER:	J20008
SITE ID:	TB2
EASTING:	406361
NORTHING:	6505180
METHOD:	Auger rig
TOTAL DEPTH (mbgl):	6
REFUSAL (Y/N):	N
DATE:	13/06/2017
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0.5 - 2	Orange slightly clayey sand		
2.5	Orange-brown gravelly loam		
3	Orange-brown gravelly clay-loam		
3.5 - 4	Red-brown loamy clay		
4.5	Red gravelly loamy clay		
5-Jun	Red loamy clay		

SOIL PROFILE LOG

PROJECT NUMBER:	J20008
SITE ID:	TB3
EASTING:	406340
NORTHING:	6505764
METHOD:	Auger rig
TOTAL DEPTH (mbgl):	2
REFUSAL (Y/N):	Y
DATE:	13/06/2017
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0.5	Grey sand		
1	Grey-brown sand, damp		
1.5	Brown slightly gravelly sand, damp		
2	Red-brown gravelly clay		
2.4	Refusal on granite(?)		

SOIL PROFILE LOG

PROJECT NUMBER:	J20008
SITE ID:	TB4
EASTING:	404938
NORTHING:	6505808
METHOD:	Auger rig
TOTAL DEPTH (mbgl):	4
REFUSAL (Y/N):	n
DATE:	13/06/2017
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0.5	Grey-brown gravelly sand		
1	Orange gravelly sand		
1.5	Orange gravelly loamy sand		
2	Orange loamy clay		
2.5 - 3	Orange-brown/grey mottled well structured clay		
3.5	Pink-brown hard clay, dry		
4	Pink hard clay, dry		

SOIL PROFILE LOG

PROJECT NUMBER:	J20008
SITE ID:	TB5
EASTING:	405623
NORTHING:	6505941
METHOD:	Auger rig
TOTAL DEPTH (mbgl):	4
REFUSAL (Y/N):	N
DATE:	13/06/2017
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0.5	Brown gravelly sand		
1	Orange-brown sandy gravel		
1.5	Orange-yellow gravelly loamy sand		
2 - 2.5	Orange-yellow sandy clay		
3	Orange-brown sandy clay		
3.5 - 4	Yellow-brown sandy clay		

SOIL PROFILE LOG

PROJECT NUMBER:	J20008
SITE ID:	TB6
EASTING:	405100
NORTHING:	6505093
METHOD:	Auger rig
TOTAL DEPTH (mbgl):	4
REFUSAL (Y/N):	N
DATE:	13/06/2017
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0.5	Brown gravelly sand		
1 - 1.5	Orange-brown gravelly loam		
2	Orange-brown gravelly loamy clay		
2.5	Red-brown moderately structured gravelly clay		
3	Red-yellow-brown well structured gravelly clay, damp		
3.5	Red-brown/grey mottled clay		
4	Red clay, dry		

SOIL PROFILE LOG

PROJECT NUMBER:	J20008
SITE ID:	TB7
EASTING:	405596
NORTHING:	6504222
METHOD:	Auger rig
TOTAL DEPTH (mbgl):	4
REFUSAL (Y/N):	N
DATE:	13/06/2017
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0.5	Pale brown gravelly sand		
1	Yellow-brown gravelly sandy loam		
1.5	Yellow-brown gravelly loamy clay		
2	Brown gravelly loamy clay		
2.5 - 3	Red-brown slightly mottled gravelly clay		
3.5 - 4	Red/orange/grey slightly mottled gritty clay		

SOIL PROFILE LOG

PROJECT NUMBER:	J20008
SITE ID:	TB8
EASTING:	405932
NORTHING:	6504216
METHOD:	Auger rig
TOTAL DEPTH (mbgl):	4
REFUSAL (Y/N):	N
DATE:	13/06/2017
DEPTH TO WATER (mbgl)	_

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0.5 - 1	Yellow-brown gravelly sand		
1.5	Orange-brown gravelly loam		
2	Orange-brown gravelly clay-loam		
2.5 - 4	Red-brown sandy loamy clay		

SOIL PROFILE LOG

PROJECT NUMBER:	J20008
SITE ID:	TB9
EASTING:	406375
NORTHING:	6504202
METHOD:	Auger rig
TOTAL DEPTH (mbgl):	3
REFUSAL (Y/N):	N
DATE:	13/06/2017
DEPTH TO WATER (mbgl)	-

SOIL PROFILE		SAMPLE DATA	
DEPTH (m)	SOIL DESCRIPTION	SAMPLE ID	INTERVAL (m)
0.5	Yellow-brown slightly gravelly silty sand		
1 - 1.5	Yellow-brown sandy loam with occasional gravel		
2	Brown slightly gravelly clay-loam		
2.5 - 3	Red-brown silty clay, dry & very hard		

Appendix C

Geotechnical Report
(Brown Geotechnical, 2021)

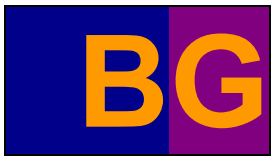
PRELIMINARY GEOTECHNICAL INVESTIGATION

For Local Structure Plan

LOTS 50 and M1456
GREAT NORTHERN HIGHWAY
MUCHEA
WESTERN AUSTRALIA

DECEMBER 2020
Ref: 20049

FOR
Tallangatta Beef Pty Ltd
c/- iParks Property Group Pty



Brown Geotechnical

CONDITIONS RELATING TO THIS REPORT

1. This report has been prepared for the sole use of Tallangatta Beef Pty Ltd. 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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1 Introduction

In November 2020 Brown Geotechnical was commissioned by iParks Property Group on behalf of the client – Tallangatta Beef Pty Ltd to undertake a preliminary geotechnical investigation for the development of a Local Structure Plan at Lots 50 and M1456 Great Northern Highway, Muchea (the site), refer Figure 1. This report presents the results of the investigation conducted at the site. The fieldwork was carried out over the 19th and 20th November 2020. Details of the site were supplied by planners iParks Property Group Pty.

Note: It should be noted that this is a preliminary geotechnical investigation for the development of a Local Structure Plan. In portions of the site where soils are non-homogenous, or where boundaries lines are drawn on Figures, for example between zones of different soil types or site classification, additional investigation should be undertaken. The conclusions in this report are based on limited sampling and testing, and should be used as starting point for further detailed investigations as the project proceeds.

2 Brief

The brief discussed with the planners required the report to address:

- Subsurface conditions.
- An estimate of existing soil classification in accordance with AS2870 (2011).
- Any earthworks required to obtain a classification suitable for development including estimated additional fill thickness requirements.
- The presents of uncontrolled fill.
- Estimated CBR for road pavement design.
- Suitability of existing soils for use in the development.
- An assessment of acid sulphate soil issues
- Estimated site permeability and likely drainage issues.

3 Desk Studies

The site covers approximately 213ha and consists of large fenced paddocks. The paddocks are mostly grass covered with some areas of trees. A small creek runs east west across the north of the site. The depth varies from 0.5m to 1m.

The geological map for the area indicates the majority of the site to be underlain by the Guildford Formation consisting of clay, sand, silt and gravels. Quartz sand is noted in the centre and along the eastern boundary, with lateritic gravels towards the north eastern corner.

The Perth Groundwater Map indicates the historical maximum groundwater level to be about 50m AHD, approximately 8m below ground level. It is understood that pre-development groundwater monitoring is to be carried out on the site by others.

The acid sulphate soil risk map for the area, indicates soils to be in the No Known Risk category.

The site rises eastwards from approx. 50m along the Great Northern Highway to 93m AHD in the north east. Some steeper slopes rise in the north east, likely associated with the outcropping laterite deposits noted on the geological map.

4 Fieldwork and Laboratory Testing

4.1 Scope of Work

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

- A desk study to determine likely soil types below the site.
- Follow-up fieldwork including a walk-over survey to determine any obvious geological features, hazards and ASS indicators.
- Test holes excavated at approximate 200m centres to confirm soil type identified in the desk study. Some areas allowed limited access, however enough information was collected for the preliminary report.
- Limited soil sampling was carried out for laboratory analysis to determine soil classification and geotechnical properties.
- Laboratory testing included: particle size distribution, Atterberg Limits, percent fines content and organic content.
- In the absence of any high-risk ASS indicators, no preliminary acid sulphate soil testing was required as initially indicated in the proposal.
- Organic content determination was carried out for potential blending ratios of topsoil with clean sand fill for use in the future development.
- Permeability testing was carried out typical soil types encountered for site drainage information.

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

4.2 Laboratory Testing

Soil samples were delivered to the NATA accredited Western Geotechnical Laboratory Services 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 and inferred from laboratory test results and PSP plots are described as follows:

5.1.1 Topsoil and Fill

Test holes encountered topsoil consisting of grey silty sand with organics, locally with rootlets. The topsoil varied in thickness from 0.1m to 0.15m, the average across the site being 0.1m.

No uncontrolled fill was encountered in test holes and there were no obvious signs of old structures, foundations or infill areas within the paddocks.

5.1.2 Sand with Silt

Fine to medium grained, sand with low to moderate silt content was encountered in all test holes below the topsoil in the central and north western portion of the site (refer Figure 2). Penetrometer tests show the material to be medium dense. The thickness varied from approximately 0.3m to 0.5m.

The sand extends to greater depths in the north eastern portion of the site, locally >2m and at one locality on the western boundary (refer Figure 2).

5.1.3 Sandy Gravel

Fine to medium grained, gravel with sand was encountered in all test holes below the topsoil in the southern portion of the site (refer Figure 2). Penetrometer tests show the material to be medium dense to dense. The thickness varied from approximately 0.1m to 0.55m.

5.1.4 Laterite (Cemented Sandy Gravel)

A very dense, often cemented, sandy gravel or Laterite was encountered at the surface in TH15 and TH16 on the eastern boundary. The excavator refused in the material at about 0.6m.

5.1.5 Gravelly Sand with Clay

Very dense, fine to medium grained sandy gravel with clay was encountered below the silty sand and sandy gravel areas of the site. The material was occasionally present at the surface in the center of the site in the vicinity of TH7, 11 and 12. Test results show the material to have a moderate fines content, intermediate to low plasticity with a low expansive nature. The material often became hard after about 1m due to pockets of iron rich cementation resulting in slow excavation and often caused refusal of the 5 tonne excavator.

5.1.6 Groundwater

No groundwater was not encountered in test holes. The Perth Groundwater Map indicates the historical maximum groundwater levels to be about 50m AHD, approximately 8m below ground level.

5.2 Laboratory Test Results

Laboratory test results are summarized in Table 1

Table 1 – Classification Test Results

Test Hole No.	Depth (m)	LL (%)	PL (%)	PI (%)	Particle Size Distribution			Organic (%)
					Fines (%)	Sand (%)	Gravel(%)	
TH01	0.2-0.5	NP	NP	NP	13	79	8	
TH06	1.5-2.0	31	13	21	27			
TH14	0.1							5.8
TH14	1.0-1.5	NP	NP	NP	22	71	7	
TH19	0.3-0.8				4	26	70	
TH19	1.0-1.5	28	14	14	19			
TH21	1.5-1.9	35	16	19	24			
TH29	0.1-0.5	NP	NP	NP	5	27	68	
TH29	0.5-1.1	23	17	6				
TH37	1.2-1.6	31	14	17	21			

*Non-plastic

5.3 Soil Permeability

Permeability test results are summarized in Table 2.

Table 2 – Permeability Test Results

Test Location	Testing Material	In-situ Permeability Test Result (m/s)	Drainage Characteristics
P1 (TH12)	Very dense gravelly sand with clay	*$1x10^{-9}$m/s	Poor
P2 (TH01)	Medium dense sand with silt	$5x10^{-4}$m/s	Moderate to Good
P3 (TH19)	Medium dense sandy gravel with silt	$6x10^{-4}$m/s	Moderate to Good

*Estimated: Minimal Soakage

6 Analysis and Conclusions

6.1 Subsurface Conditions (refer Figure 2)

The topsoil has an average thickness of 0.1m. Once the grass and roots are removed the topsoil will be relatively low in organic content. Testing a typical sample gave an organic content of 5.8%. It should be suitable for use as engineering fill when screened and blended with clean sand fill at a ratio of approximately 1:3 (screened topsoil : clean sand). Further testing following screening could bring the ratio down to 1:2 or 1:1 for some portions of the site.

Below the topsoil, much of the site is covered by 0.3-0.5m of granular soils with a moderate silt content (sand and gravels). These soils are non-cohesive, relatively free draining with moderate to good drainage characteristics.

These sand and gravels are underlain by a clayey subgrade across the majority of the site, except for the north east area. The soil is a very dense gravel with clay. The clayey subgrade extends to at least 2.0m. The soils have a moderate to low plastic fines content, an intermediate to low plasticity and a low expansive nature. The drainage in the clayey soil is poor. The material often becomes hard with iron cementation below about 1m which caused refusal of the 5 tonne excavator in most holes.

The north eastern area consists of deeper sands, with hard lateritic soils on the eastern boundary which caused refusal of the 5 tonne excavator close to the surface.

No uncontrolled fill was encountered in test holes.

With respect to the desk study and geological information obtained prior to the fieldwork, it appears that the sands discussed are not as extensive as anticipated, confined only to the north east area. The remainder of the site is underlain by the Guildford Formation as suggested, with the laterite deposits to the east.

6.2 Groundwater

No groundwater was not encountered in test holes. The Perth Groundwater Map indicates the historical maximum groundwater levels to be about 50m AHD, approximately 8m below ground level. It is likely that in times of heavy rainfall, the granular soils above of the clayey subgrade will saturate resulting in a perched water table. The soils would then likely drain towards the creek; or the deeper sand deposits from the raised lateritic area.

6.3 Site Classification and Fill Requirements

Based on this preliminary geotechnical investigation, test hole spacing and limited testing, the classification for the site in accordance with AS 2870 – 2011 can be divided in to two classes. The portion underlain by a clayey subgrade with moderate to low plastic fines content, low plasticity and low expansive nature has an existing classification of Class ‘S’. The portion underlain by deeper sand and laterite has an existing classification of Class ‘A’ (refer Figure 2 and Table 3).

To obtain a site classification of Class 'A' in all areas, additional sand fill will be required. A total of 1.8m of granular material will be required above the clayey subgrade. The approximate thickness of additional fill varies from 0.2m to 1.8m and is shown on Figure 2.

Further investigation will be required to determine the exact boundaries between the site classification zones for specific Lots, and the amount of sand fill required could vary.

Table 3 – 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”. This section should act as a guide to likely earthwork requirements for the site, pending a detailed investigation.

6.4.2 Topsoil and Fill Management

A thin layer of topsoil is present across the site. It is not suitable for foundation support and should be removed along with trees and roots then replaced with clean sand fill. The topsoil may be used in landscaping following the removal of any tree roots, unless screened and blended as described below. A geotechnical inspection will be required to confirm topsoil stripping.

6.4.1 Blending of Topsoil for use as Engineering Fill

Topsoil in most areas of the site appears to be of lower quality i.e. lower in organic and fines content. An option would be to blend the screened topsoil with clean sand fill to reduce the organic and fines content to acceptable levels for use in residential or commercial development. Limited testing on non-screened topsoil, but with grass and roots removed, suggest a ratio of approximately 1:3 (screened topsoil : clean sand) to be appropriate. Further testing following screening could bring the ration down to 1:2 or 1:1 for portions of the site.

Ongoing tests for organic and fines content would be required post screening and on the blended soil to confirm suitability for use in the development.

6.4.2 Proof Rolling

Following the removal of topsoil, prior to footing placement or placing any additional fill on site, the surface should be proof rolled to achieve at least 95% SMDD for residential and 98% SMDD for commercial developments.

6.4.3 Imported Fill Material

Any sand fill imported to obtain site formation levels should be compacted in layers not more than 300mm thick to at least 95% SMDD for residential and 98% SMDD for commercial developments. In-situ density tests should be carried out to calibrate a PSP to specific densities of the compacted material to check fill compaction. 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 maintain good drainage conditions.

Following excavation for foundations, the bases of pad and strip footings should also be compacted to achieve at least 95% SMDD for residential and 98% SMDD for commercial developments.

6.4.4 Earthwork Inspections

A geotechnical engineer should inspect the site following the removal of vegetation, trees, roots and unsuitable materials, and to confirm the compaction of the subsurface following proof rolling. Inspections and auditing of the earthworks should be carried out by the geotechnical engineer to enable confirmation of the final site classification.

6.5 Suitability of In-situ Soils as Engineering Fill

The majority of the in-situ sands, particularly in the central and north area, contain a moderate fines content but zero plasticity. The soils will be suitable for use as engineering fill in the future development but have a reduced permeability due to the raised silt content. Blending with clean sand fill would reduce the fines content and increase drainage potential.

The sandy gravel with clay could also be blended with clean sand to reduce the fines. The material may be appropriate as a base layer above the existing clayey subgrade if major earthworks are required and removal of the existing granular soils is necessary.

6.6 Design CBR

Assuming the subgrade material below the road pavement or car park areas will be the natural in-situ near surface sand, a design CBR of 20 is suitable pavement design. Pavements founded on the sandy gravels could have a higher CBR of at least 30. Pavements founded within imported sand fill will require CBR testing during earthworks.

6.7 Retaining Wall Parameters

The site is gently sloping to the west and some retaining maybe required in the development. The following retaining wall parameters have been based on a compacted dense sand soil with ϕ=40^o.

γ=19 kN/m^3
Ko=0.36
Ka=0.22
Kp=4.6

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

6.8 Acid Sulphate Soils

The acid sulphate soil risk map for the area indicate soils below the site to be in the No Known Risk category. The walkover survey and descriptions from test holes indicated no soils associated with high-risk ASS.

6.9 Site Permeability and Drainage Recommendations

The near surface sand and gravels contain moderate fines, zero plasticity and are free draining. The drainage condition within the sands prior to proof rolling is moderate to good. Permeability of approx. 5x10^{-4}m/s was recorded. Permeability of the underlying clayey subgrade was poor.

For soakwell installation, additional sand fill may be required in some areas, especially where the clayey subgrade approaches the existing surface. A suitably designed drainage system would allow for the use of soakwells if sufficient height, say at least 1.2m, is obtained above the clayey subgrade and the groundwater. Further permeability testing and groundwater monitoring is recommended as part of the detailed geotechnical investigation to refine these observations.

If clean fill sand is to be imported on to the site to raise site formation levels, permeability can vary depending on the source, and could vary between 1x10^{-3} and a 1x10^{-5} m/s based on observed results on typical Perth fill sands.

Permeability and drainage conditions may be reduced during earthworks due to compaction of in-situ and imported sands. Over compaction during earthworks can seriously reduce soil permeability. It is recommended that further permeability testing be carried out following earthworks to confirm parameters used during drainage design.

BROWN GEOTECHNICAL

Ferry Haryono
Senior Geotechnical Engineer

Reviewed by
Ken Brown
Senior Geotechnical Engineer

REFERENCES

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

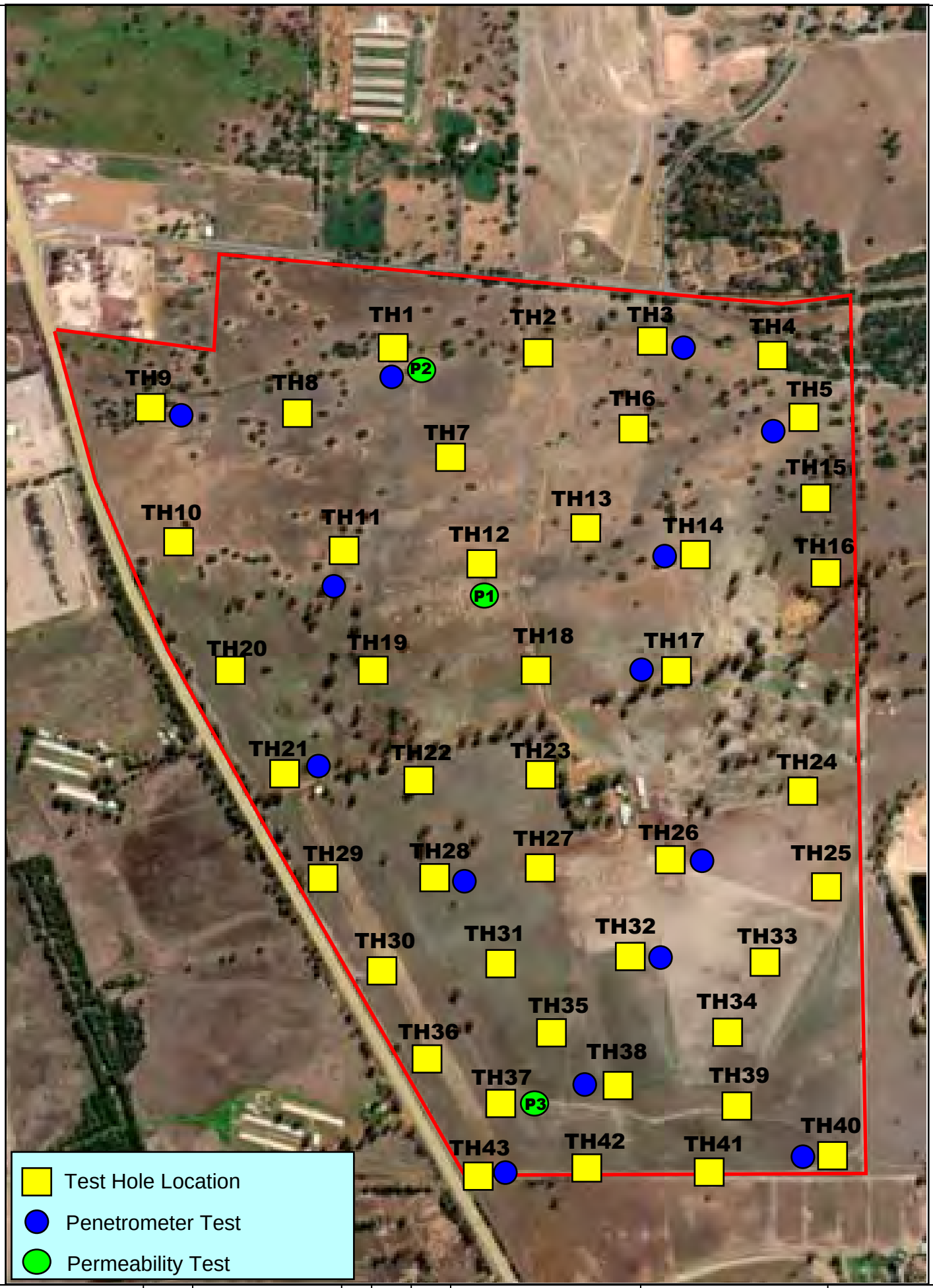
2. Geological Survey of Western Australia. 1:50,000 Environmental Geology Series, Perth.

3. Department of Water. *Perth Groundwater Map*

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
21.11.2020	Test Location Plan	kb	fh	kb

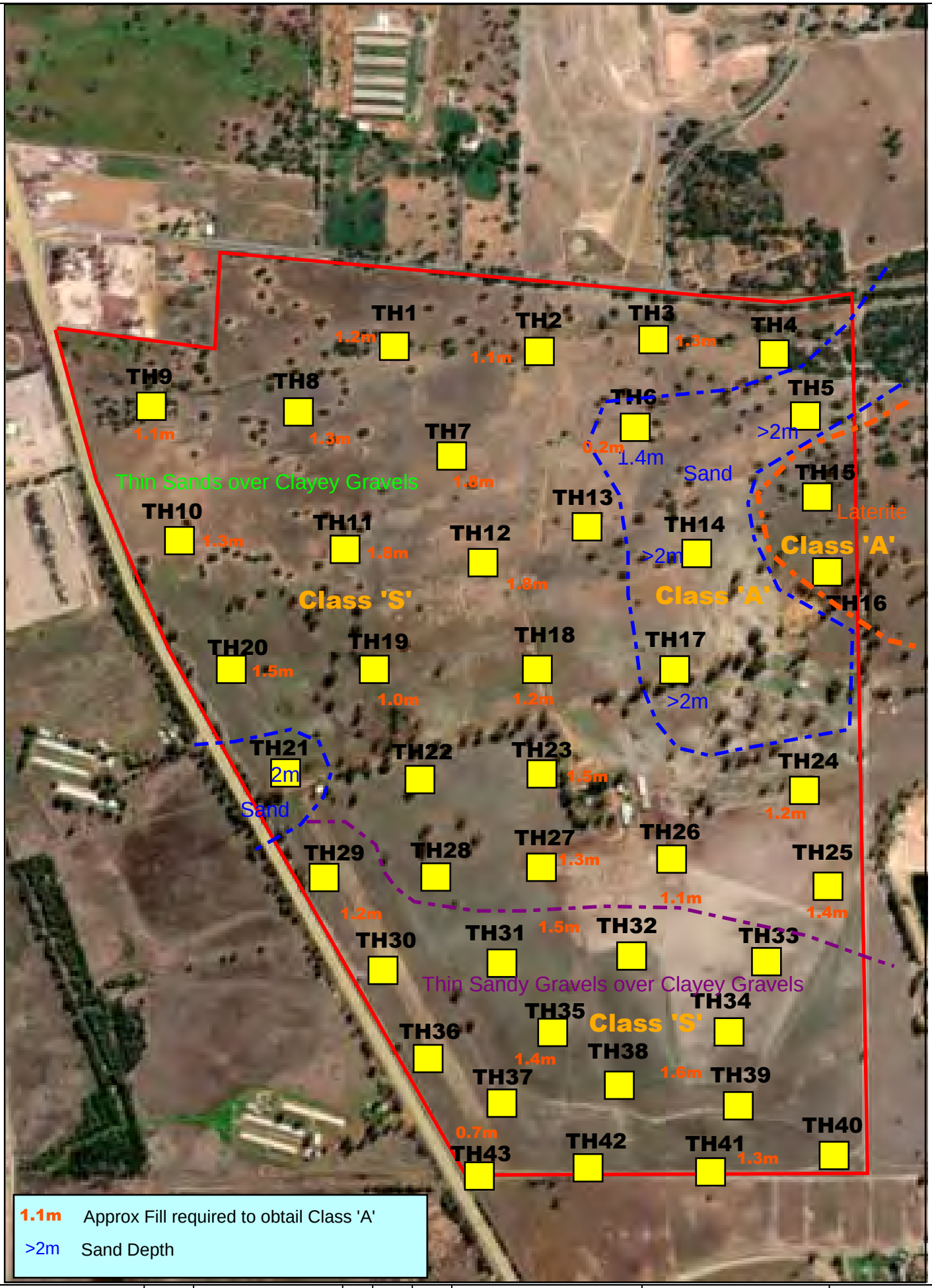
TEST LOCATION PLAN

LOTS 50 AND M1456
GREAT NORTHERN HIGHWAY
MUCHEA

CLIENT

Tallangatta Beef Pty Ltd

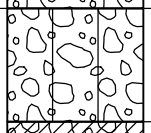
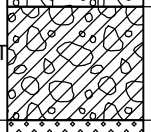
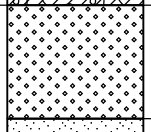
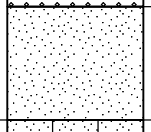
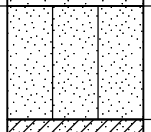
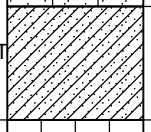
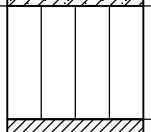
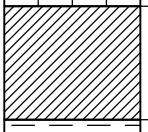
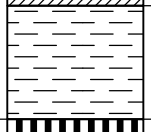
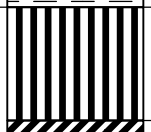
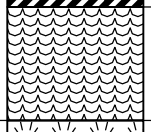
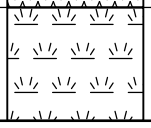
Drawing No. 20049 Fig1
Scale: NTS
Sheet Size: A4
Job No. 20049
FIGURE 1



BG Brown Geotechnical	Date	Description	Drawn	Checked	Approved	Subsoil Conditions	CLIENT	Drawing No. 20049 Fig2
	21.11.2020	Test Location Plan	kb	fh	kb			Scale: NTS
						LOTS 50 AND M1456 GREAT NORTHERN HIGHWAY MUCHEA	Tallangatta Beef Pty Ltd	Sheet SIze: A4
								Job No. 20049
								FIGURE 2

APPENDIX A

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	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
	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 Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405491 6504955

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry	Fines=8% Sand=79% Gravel=13%	
			0.5					
	Not Encountered				GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0					
			1.5					
						REFUSAL Borehole TH01 terminated at 1.6m		
			2.0					
			2.5					

BOREHOLE NUMBER TH02

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405738 6505809

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5					
	Not Encountered				GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0					
			1.5					
						REFUSAL Borehole TH02 terminated at 1.8m		
			2.0					
			2.5					

BOREHOLE NUMBER TH03

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** --- **DATUM** ---

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405992 6505834

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES ---

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered		0.0			TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0			REFUSAL Borehole TH03 terminated at 1m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH04

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406198 6505805

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
	Not Encountered		0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0					
			1.5					
						REFUSAL Borehole TH04 terminated at 1.6m		
			2.0					
			2.5					

BOREHOLE NUMBER TH05

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** --- **DATUM** ---

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406306 6505635

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES ---

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
	Not Encountered		0.5		SP-SM	SAND: Medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			1.0					
			1.5					
			2.0					
						Borehole TH05 terminated at 2m		
			2.5					

BOREHOLE NUMBER TH06

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** --- **DATUM** ---

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406306 6505635

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES ---

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered		0.0			TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5					
			1.0					
			1.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry	LL=34 PL=13 Fines=27% LS=6%	
			2.0			Borehole TH06 terminated at 2m		
			2.5					

BOREHOLE NUMBER TH07

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405567 6505550

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			0.5			REFUSAL Borehole TH07 terminated at 0.5m		
			1.0					
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH08

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405251 6505641

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GM	GRAVELLY SAND:Medium dense, fine to medium grained, grey, with silt, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0			REFUSAL Borehole TH08 terminated at 1m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH09

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** --- **DATUM** ---

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 404995 6505634

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES ---

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5					
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
	Not Encountered		1.0					
			1.5					
			2.0					
						Borehole TH09 terminated at 2m		
			2.5					

BOREHOLE NUMBER TH10

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405083 6505388

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0			REFUSAL Borehole TH10 terminated at 0.9m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH11

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405447 6505378

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			0.5					
						REFUSAL Borehole TH11 terminated at 0.6m		
			1.0					
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH12

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405709 6505396

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			0.5			REFUSAL Borehole TH12 terminated at 0.5m		
			1.0					
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH13

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406306 6505635

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, yellowish brown & grey, with silt, trace gravel, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0			REFUSAL Borehole TH13 terminated at 1.1m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH14

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406082 6505424

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
	Not Encountered		0.5		SP-SM	SAND: Medium dense, fine to medium grained, yellowish brown & grey, with silt and gravel, dry		
			1.0				Fines=22% Sand= 71% Gravel=7%	
			1.5					
			2.0			Borehole TH14 terminated at 2m		
			2.5					

BOREHOLE NUMBER TH15

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406323 6505444

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered		0.5			TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	GRAVELLY SAND / LATERITE: Very dense (cemented), fine to coarse, brown, dry		
			1.0			REFUSAL Borehole TH15 terminated at 0.6m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH16

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406312 6505233

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
	Not Encountered		0.5		GPS	GRAVELLY SAND / LATERITE: Very dense (cemented), fine to coarse, brown, dry		
			1.0			REFUSAL Borehole TH16 terminated at 0.8m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH17

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406063 6505177

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to coarse grained, grey, with silt, trace gravel, dry		
			0.5					
			1.0					
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.5					
						REFUSAL Borehole TH17 terminated at 1.6m		
			2.0					
			2.5					

BOREHOLE NUMBER TH18

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405768 6505169

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to coarse grained, grey, with silt, trace gravel, dry		
	Not Encountered		0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0					
			1.5			REFUSAL Borehole TH18 terminated at 1.6m		
			2.0					
			2.5					

BOREHOLE NUMBER TH19

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405463 6505127

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense to dense, fine to coarse grained, grey, trace silt, dry		
			0.5				Fines=4% Sand=26% Gravel=70%	
	Not Encountered				GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0					
							LL=28 PL=14 Fines=19% LS=4%	
			1.5					
						REFUSAL Borehole TH19 terminated at 1.8m		
			2.0					
			2.5					

BOREHOLE NUMBER TH20

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405178 6505190

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense to dense, fine to coarse grained, grey, trace silt, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0					
			1.5					
						REFUSAL Borehole TH20 terminated at 1.6m		
			2.0					
			2.5					

BOREHOLE NUMBER TH21

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405246 6504978

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered		0.0			TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Medium dense, fine to coarse grained, yellowish brown & grey, with silt, trace gravel, dry		
			0.5					
			1.0					
			1.5			with some clay below 1.5m	LL=35 PL=16 Fines=24% LS=6%	
			2.0			Borehole TH21 terminated at 2m		
			2.5					

BOREHOLE NUMBER TH22

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405246 6504978

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
			0.5		SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
	Not Encountered		1.0		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.5					
			2.0			REFUSAL Borehole TH22 terminated at 1.9m		
			2.5					

BOREHOLE NUMBER TH23

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405762 405762

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH23 terminated at 0.8m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH24

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** --- **DATUM** ---

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406273 6504973

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES ---

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5					
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
						REFUSAL Borehole TH24 terminated at 0.7m		
			1.0					
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH25

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406284 6504795

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH25 terminated at 0.7m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH26

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405946 6504827

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH26 terminated at 1m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH27

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405784 6504955

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
						REFUSAL Borehole TH27 terminated at 0.7m		
			1.0					
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH28

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405541 6504777

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt and gravel, dry		
			0.5					
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0					
						REFUSAL Borehole TH28 terminated at 1m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH29

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405342 6504804

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry	Fines=5% Sand=27% Gravel=68%	
	Not Encountered		0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry	LL=23 PL=17 LS=2%	
			1.0					
						REFUSAL Borehole TH29 terminated at 1.3m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH30

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405416 6504605

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
	Not Encountered		0.5					
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0					
						REFUSAL Borehole TH30 terminated at 1.3m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH31

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405570 6504604

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
						REFUSAL Borehole TH31 terminated at 0.7m		
			1.0					
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH32

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405859 6504616

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH32 terminated at 0.8m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH33

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405984 6504614

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH33 terminated at 0.7m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH34

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406020 6504417

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH34 terminated at 1m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH35

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405736 6504450

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH35 terminated at 0.9m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH36

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405519 6504466

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH36 terminated at 0.7m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH37

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405588 6504333

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
	Not Encountered		0.5					
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0				LL=31 PL=14 Fines=21% LS=6%	
			1.5					
						REFUSAL Borehole TH37 terminated at 1.6m		
			2.0					
			2.5					

BOREHOLE NUMBER TH38

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405777 6504329

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH38 terminated at 0.7m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH39

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406096 6504327

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Dense, fine to medium grained, grey, with silt, dry		
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			0.5			REFUSAL Borehole TH39 terminated at 0.5m		
			1.0					
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH40

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406357 6504220

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Dense, fine to medium grained, grey, with silt, dry		
			0.5					
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0					
						REFUSAL Borehole TH40 terminated at 1m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH41

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406108 6504220

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Dense, fine to medium grained, grey, with silt, dry		
	Not Encountered		0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0					
			1.5			REFUSAL Borehole TH41 terminated at 1.6m		
			2.0					
			2.5					

BOREHOLE NUMBER TH42

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405842 6504214

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Dense, fine to medium grained, grey, with silt, dry		
	Not Encountered		0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0					
						REFUSAL Borehole TH42 terminated at 1.3m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH43

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** --- **DATUM** ---

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405652 6504213

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

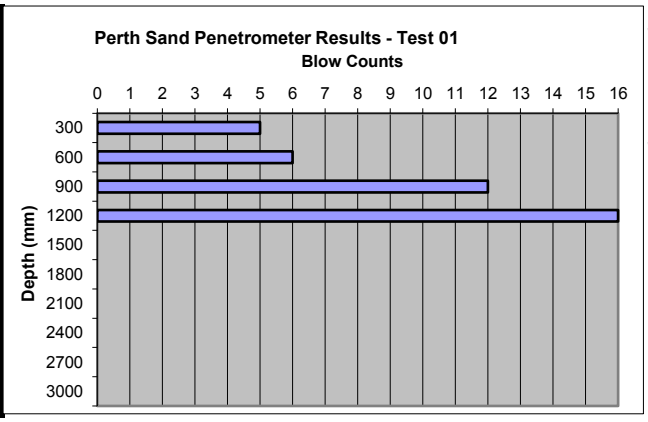
NOTES ---

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
	Not Encountered		0.5		GPS	SANDY GRAVEL: Dense, fine to medium grained, grey, with silt, dry		
			1.0					
			1.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			2.0			REFUSAL Borehole TH43 terminated at 1.8m		
			2.5					

APPENDIX B

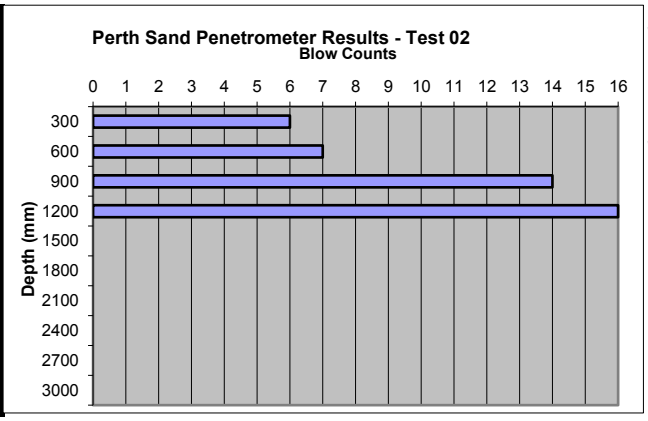
Perth Sand Penetrometer Test Plots

Depth (mm)	Blow Counts
300	5
600	6
900	12
1200	16
1500	
1800	
2100	
2400	
2700	
3000	



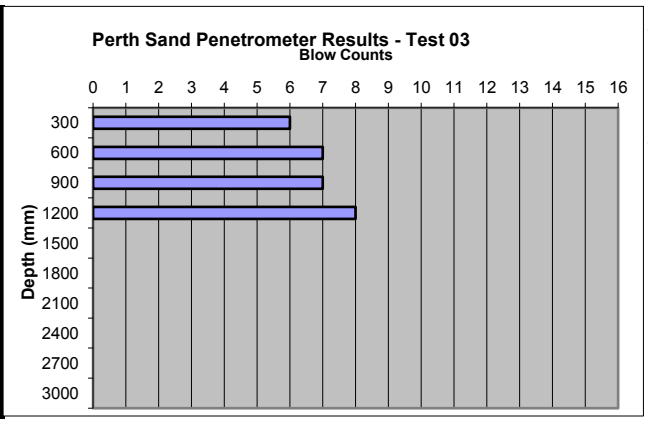
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH01

Depth (mm)	Blow Counts
300	6
600	7
900	14
1200	16
1500	
1800	
2100	
2400	
2700	
3000	



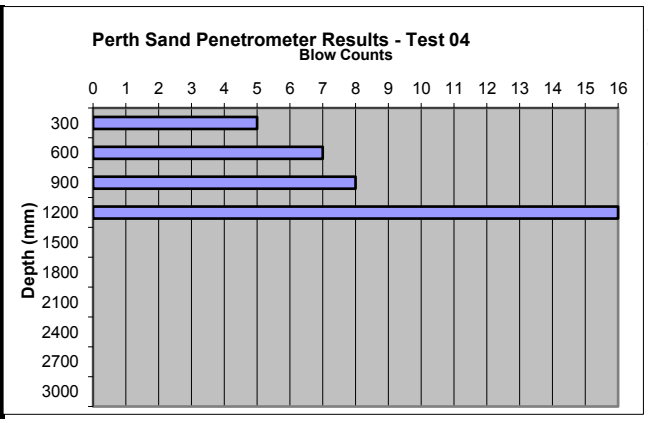
Job Name: Lot 50 & M1456
Job No: 20049
Date: 20/11/2020
Location: TH03

Depth (mm)	Blow Counts
300	6
600	7
900	7
1200	8
1500	
1800	
2100	
2400	
2700	
3000	



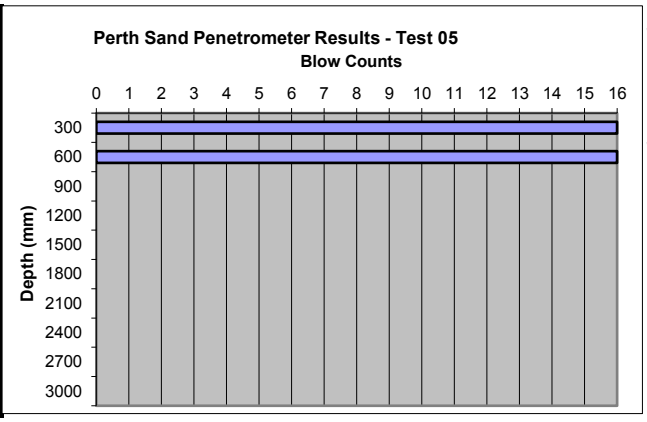
Job Name: Lot 50 & M1456
Job No: 20049
Date: 20/11/2020
Location: TH05

Depth (mm)	Blow Counts
300	5
600	7
900	8
1200	16
1500	
1800	
2100	
2400	
2700	
3000	



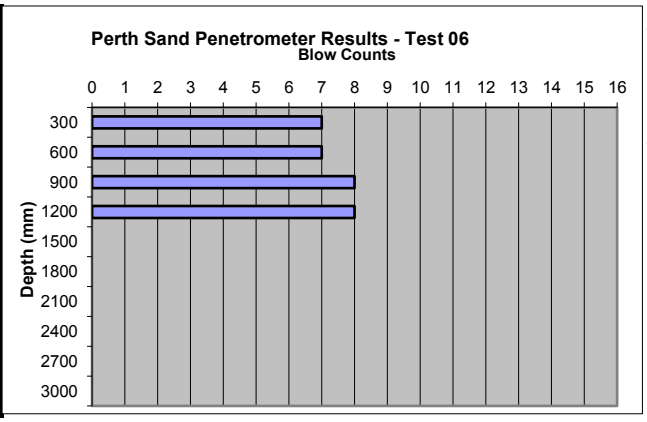
Job Name: Lot 50 & M1456
Job No: 20049
Date: 20/11/2020
Location: TH09

Depth (mm)	Blow Counts
300	16
600	16
900	
1200	
1500	
1800	
2100	
2400	
2700	
3000	



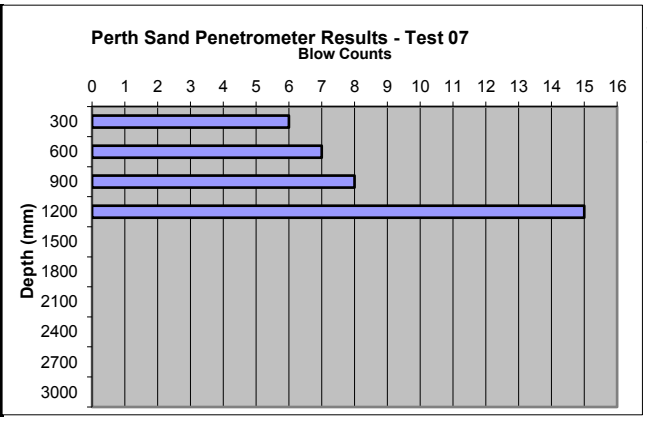
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH11

Depth (mm)	Blow Counts
300	7
600	7
900	8
1200	8
1500	
1800	
2100	
2400	
2700	
3000	



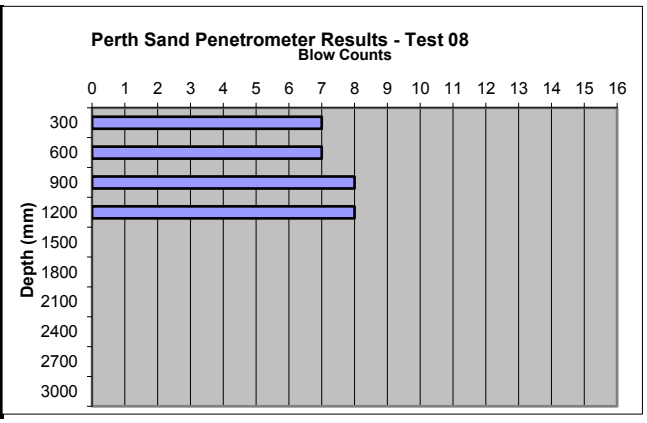
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH14

Depth (mm)	Blow Counts
300	6
600	7
900	8
1200	15
1500	
1800	
2100	
2400	
2700	
3000	



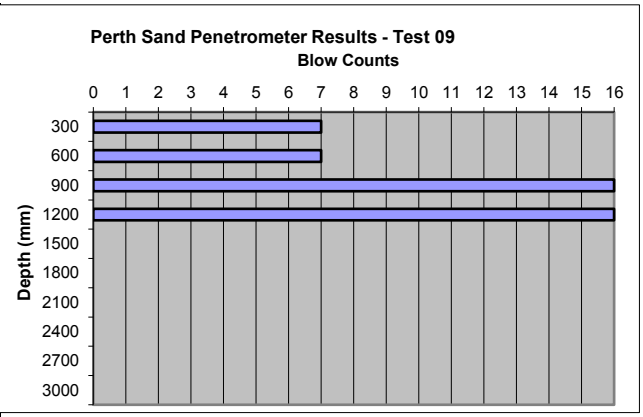
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH17

Depth (mm)	Blow Counts
300	7
600	7
900	8
1200	8
1500	
1800	
2100	
2400	
2700	
3000	



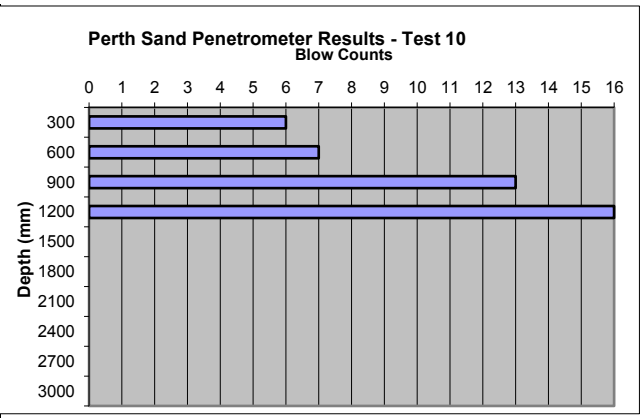
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH21

Depth (mm)	Blow Counts
300	7
600	7
900	16
1200	16
1500	
1800	
2100	
2400	
2700	
3000	



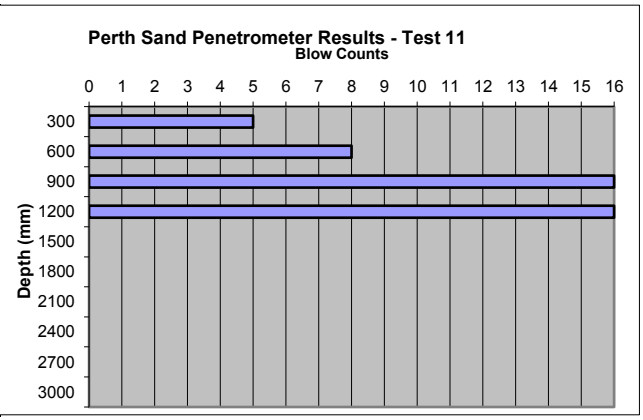
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH26

Depth (mm)	Blow Counts
300	6
600	7
900	13
1200	16
1500	
1800	
2100	
2400	
2700	
3000	



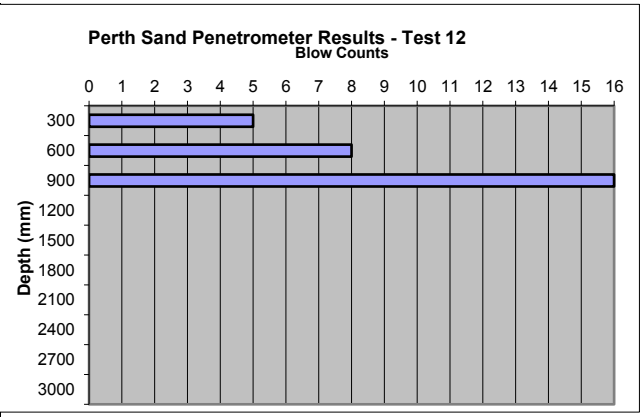
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH28

Depth (mm)	Blow Counts
300	5
600	8
900	16
1200	16
1500	
1800	
2100	
2400	
2700	
3000	



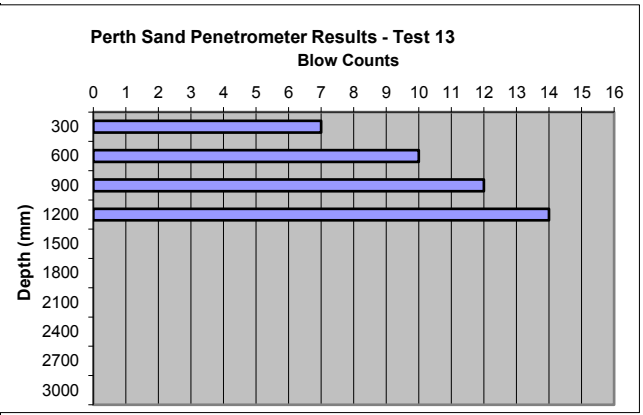
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH32

Depth (mm)	Blow Counts
300	5
600	8
900	16
1200	
1500	
1800	
2100	
2400	
2700	
3000	



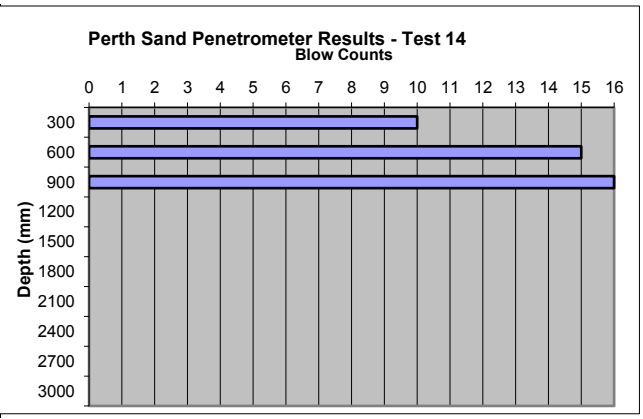
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH38

Depth (mm)	Blow Counts
300	7
600	10
900	12
1200	14
1500	
1800	
2100	
2400	
2700	
3000	



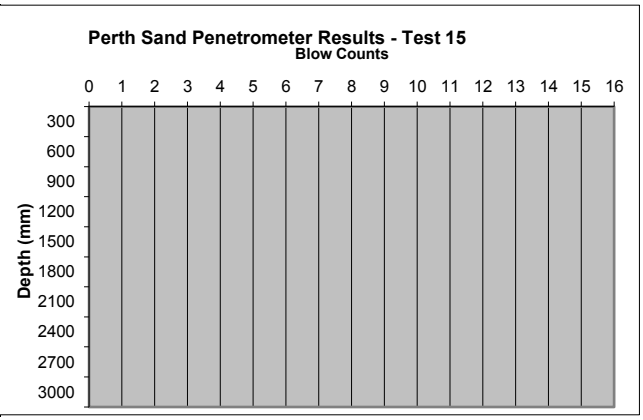
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH40

Depth (mm)	Blow Counts
300	10
600	15
900	16
1200	
1500	
1800	
2100	
2400	
2700	
3000	



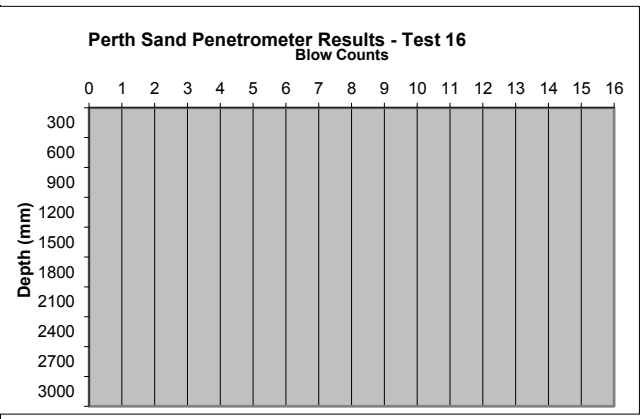
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH43

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



Job Name:
Job No:
Date:
Location:

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



Job Name:
Job No:
Date:
Location:

APPENDIX C

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

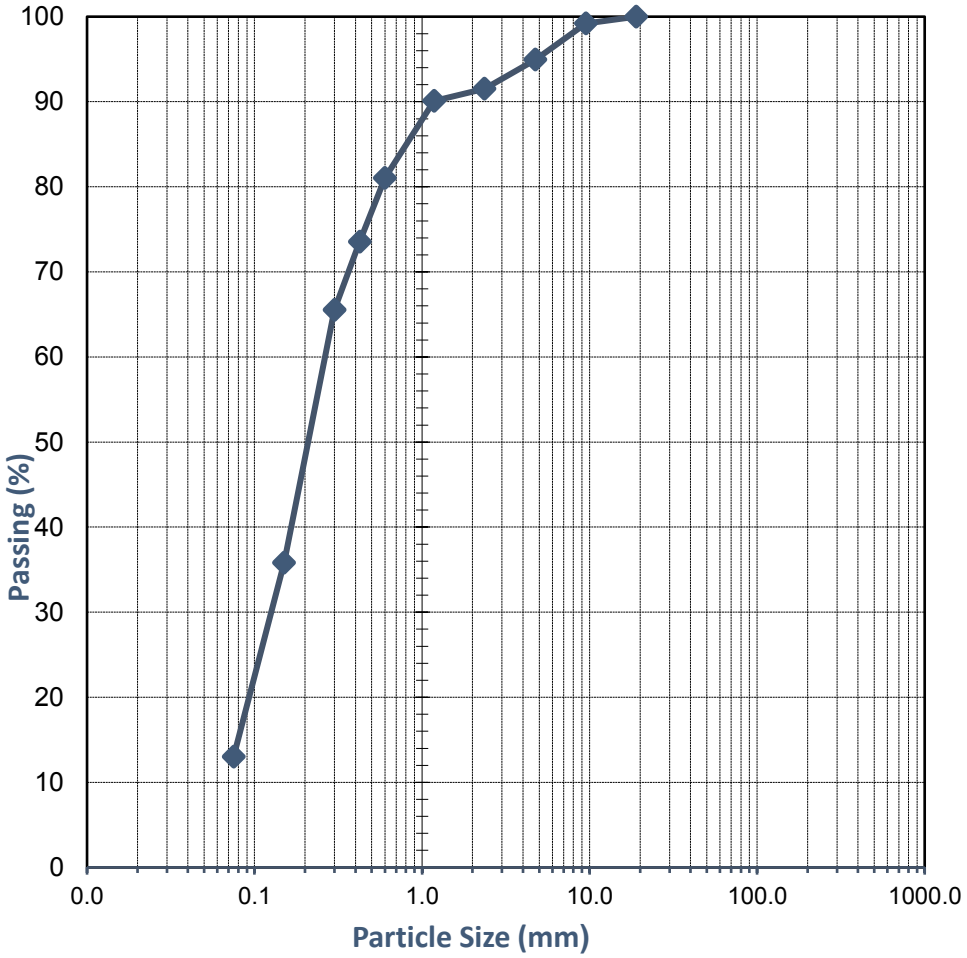
TEST REPORT - AS 1289.3.6.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9800_1_PSD
Project:	Tallangatta	*Sample No.*	WG20/9800
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH1 0.2-0.5m	*Date Tested:*	28-29/10/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
150.0	
100.0	
75.0	
37.5	
19.0	100
9.5	99
4.75	95
2.36	92
1.18	90
0.600	81
0.425	74
0.300	66
0.150	36
0.075	13



Comments:

Approved Signatory:

Name: Brooke Elliott

Date: 30-October-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

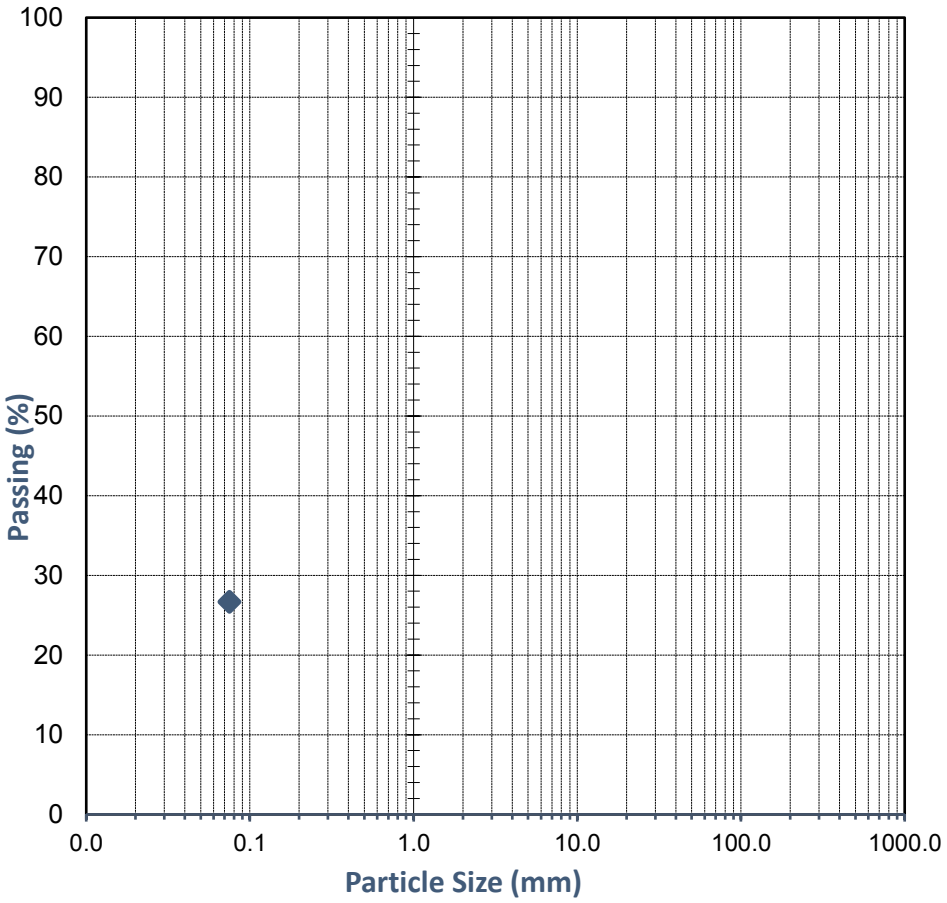
TEST REPORT - AS 1289.3.6.1 (% Fines)

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9801_1_%FINES
Project:	Tallangatta	*Sample No.*	WG20/9801
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH6 1.5-2.0m	*Date Tested:*	28-29/10/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	
1.18	
0.600	
0.425	
0.300	
0.150	
0.075	27



Comments: Clients request for the % Fines of Material passing 0.075mm only.

Approved Signatory:

Name: Brooke Elliott

Date: 30-October-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9801_1_PI
Project:	Tallangatta	*Sample No.*	WG20/9801
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH6 1.5-2.0m	*Date Tested:*	29-10-2020

TEST RESULTS - Consistency Limits (Casagrande)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°C**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.1	**Liquid Limit (%)**	**34**
AS 1289.3.2.1	**Plastic Limit (%)**	**13**
AS 1289.3.3.1	**Plasticity Index (%)**	**21**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**6.5**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**Cracked, Curled**

Comments:

Approved Signatory:

Name: Brooke Elliott

Date: 02-November-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - ASTM D2974-14 (Test Method C)

Client:	Brown Geotechnical	*Ticket No.*	S1ϕнy
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/фулл_1_ORG
Project:	Tallangatta	*Sample No.*	WG20/9802-1
Location:	Muchae	*Date Sampled:*	2л-мл-2020
Sample Identification:	TH14 0.1m	*Date Tested:*	нy-мл-2020

TEST RESULTS - Organic Content

Sampling Method: Sampled by Client, Tested as Received

Testing Completed By: KT

Furnace Temperature (°C): 440

Sample Number	Sample Identification	Ash Content (%)	Organic Content (%)
WG20/9802-1	S1	94.2	5.8
0	0	#DIV/0!	#DIV/0!
0	0	#DIV/0!	#DIV/0!
0	0	#DIV/0!	#DIV/0!
0	0	#DIV/0!	#DIV/0!
0	0	#DIV/0!	#DIV/0!
0	0	#DIV/0!	#DIV/0!
0	0	#DIV/0!	#DIV/0!
0	0	#DIV/0!	#DIV/0!

Comments:

Approved Signatory:

Name: Brooke Elliott

Date:30-October-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

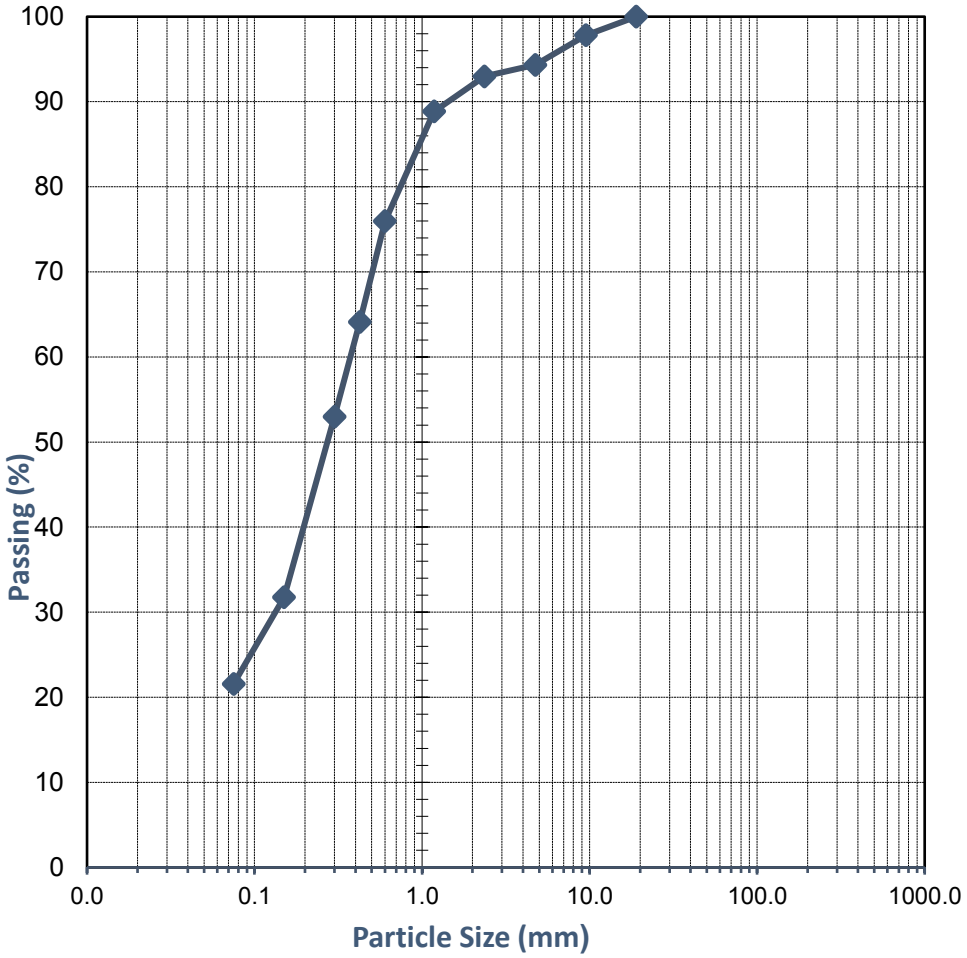
TEST REPORT - AS 1289.3.6.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9802_1_PSD
Project:	Tallangatta	*Sample No.*	WG20/9802
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH14 1.0-1.5m	*Date Tested:*	28-29/10/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
150.0	
100.0	
75.0	
37.5	
19.0	100
9.5	98
4.75	94
2.36	93
1.18	89
0.600	76
0.425	64
0.300	53
0.150	32
0.075	22



Comments:

Approved Signatory:

Name: Brooke Elliott

Date: 30-October-2020

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

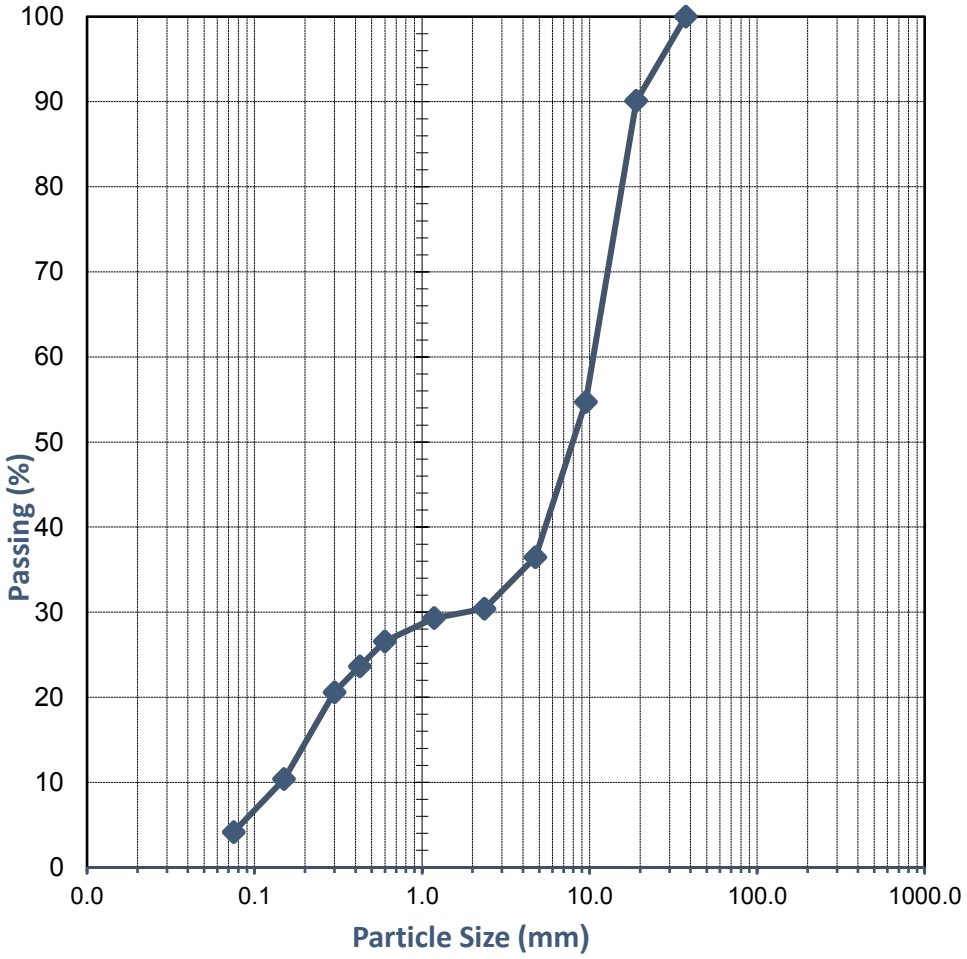
TEST REPORT - AS 1289.3.6.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9803_1_PSD
Project:	Tallangatta	*Sample No.*	WG20/9803
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	Th19 0.3-0.8m	*Date Tested:*	28-29/10/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
150.0	
100.0	
75.0	
37.5	100
19.0	90
9.5	55
4.75	36
2.36	30
1.18	29
0.600	27
0.425	24
0.300	21
0.150	10
0.075	4



Comments:

Approved Signatory:

Name: Brooke Elliott

Date: 30-October-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

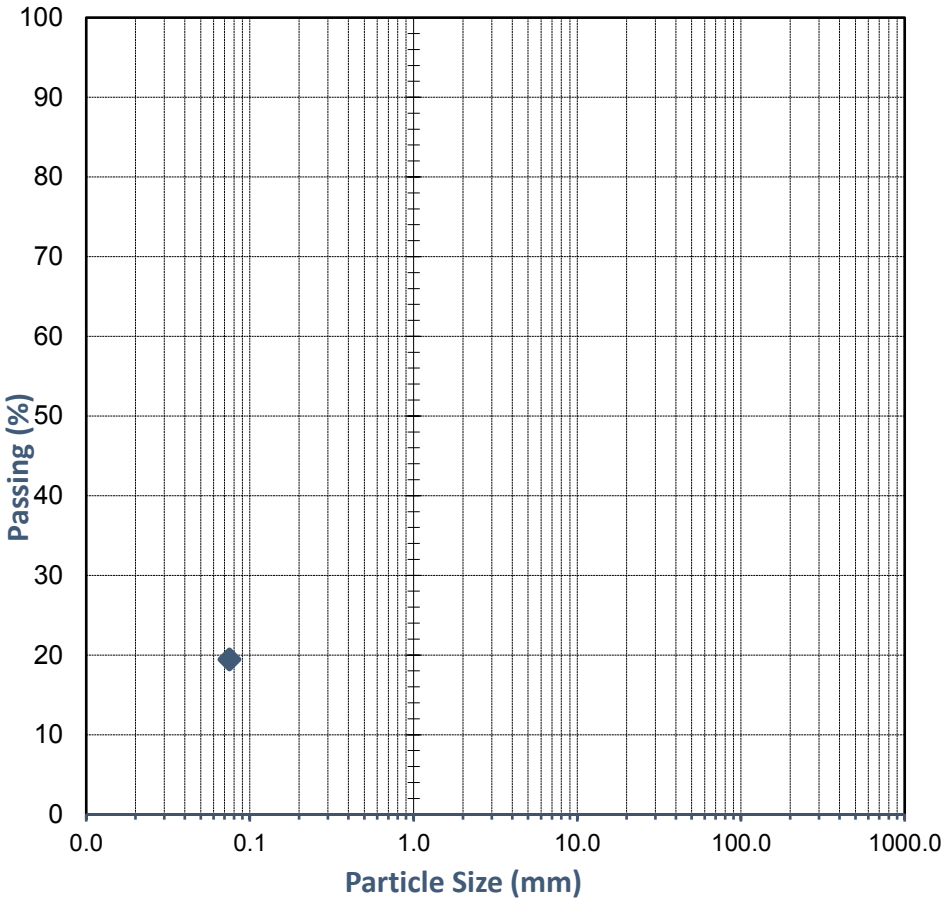
TEST REPORT - AS 1289.3.6.1 (% Fines)

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9804_1_%FINES
Project:	Tallangatta	*Sample No.*	WG20/9804
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH19 1.0-1.5m	*Date Tested:*	28-29/10/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	
1.18	
0.600	
0.425	
0.300	
0.150	
0.075	19



Comments: Clients request for the % Fines of Material passing 0.075mm only.

Approved Signatory:

Name: Brooke Elliott

Date: 02-November-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9804_1_PI
Project:	Tallangatta	*Sample No.*	WG20/9804
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH19 1.0-1.5m	*Date Tested:*	29-10-2020

TEST RESULTS - Consistency Limits (Casagrande)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°C**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.1	**Liquid Limit (%)**	**28**
AS 1289.3.2.1	**Plastic Limit (%)**	**14**
AS 1289.3.3.1	**Plasticity Index (%)**	**14**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**4.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**-**

Comments:

Approved Signatory:

Name: Brooke Elliott

Date: 02-November-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

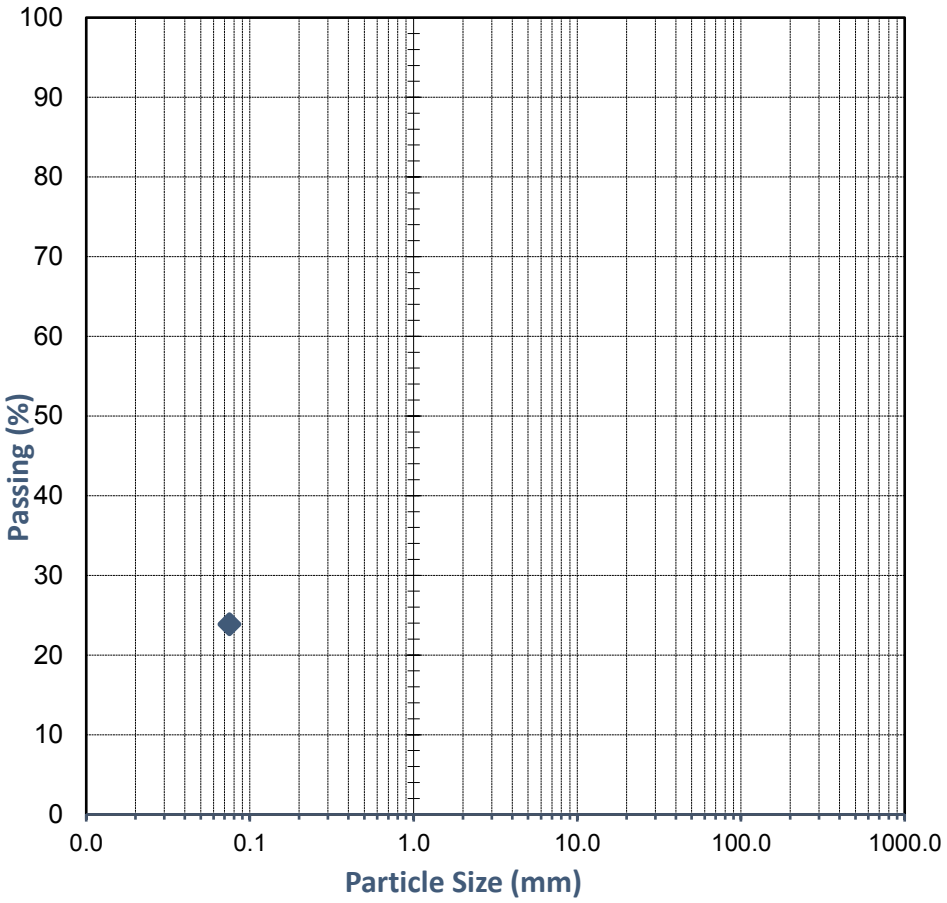
TEST REPORT - AS 1289.3.6.1 (% Fines)

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9805_1_%FINES
Project:	Tallangatta	*Sample No.*	WG20/9805
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH21 1.5-1.9m	*Date Tested:*	28-29/10/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	
1.18	
0.600	
0.425	
0.300	
0.150	
0.075	24



Comments: Clients request for the % Fines of Material passing 0.075mm only.

Approved Signatory:

Name: Brooke Elliott

Date: 30-October-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9805_1_PI
Project:	Tallangatta	*Sample No.*	WG20/9805
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH21 1.5-1.9m	*Date Tested:*	29-10-2020

TEST RESULTS - Consistency Limits (Casagrande)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°C**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.1	**Liquid Limit (%)**	**35**
AS 1289.3.2.1	**Plastic Limit (%)**	**16**
AS 1289.3.3.1	**Plasticity Index (%)**	**19**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**6.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**Cracked**

Comments:

Approved Signatory:

Name: Brooke Elliott

Date: 02-November-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

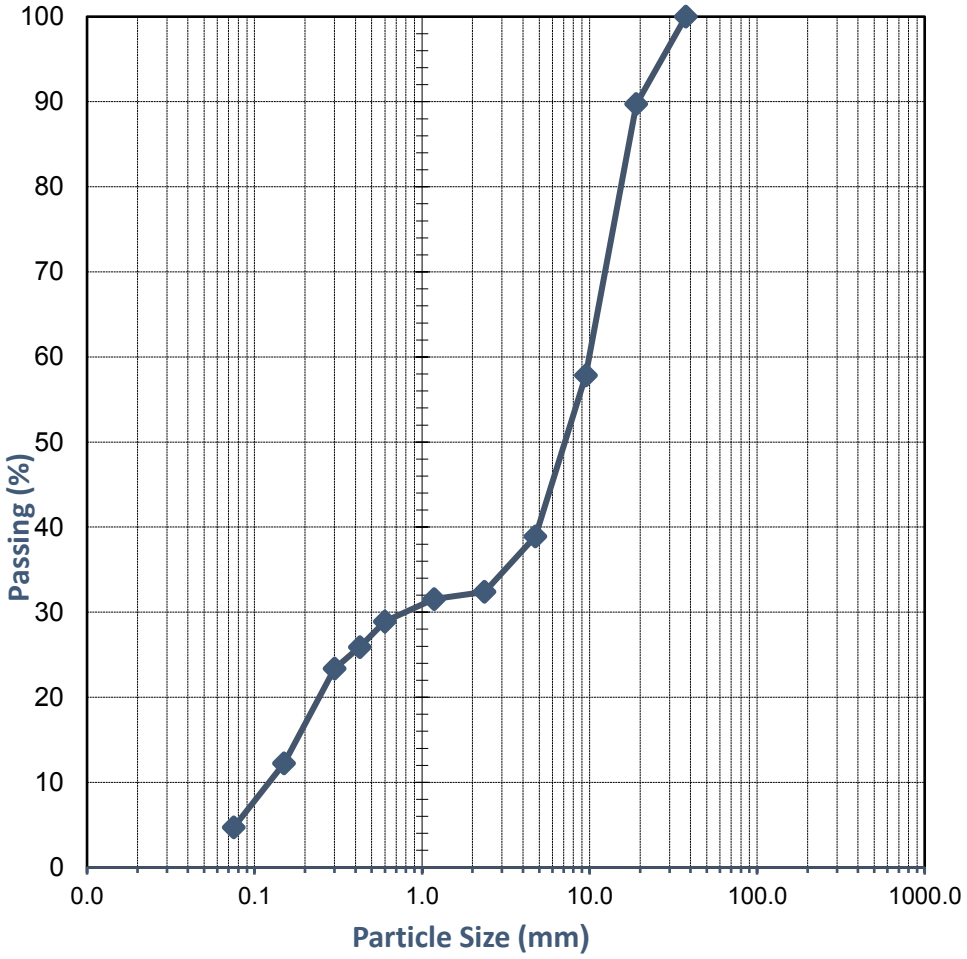
TEST REPORT - AS 1289.1.1*,3.6.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9806_1_PSD
Project:	Tallangatta	*Sample No.*	WG20/9806
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH29 0.1-0.5m	*Date Tested:*	28-10-2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
150.0	
100.0	
75.0	
37.5	100
19.0	90
9.5	58
4.75	39
2.36	32
1.18	32
0.600	29
0.425	26
0.300	23
0.150	12
0.075	5



*Comments: *AS 1289.1.1- Deviation from standard: Insufficient sample according to test method requirements. NATA accreditation does not cover the performance of this service.*

Approved Signatory:

Name: Brooke Elliott

Date: 30-October-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9807_1_PI
Project:	Tallangatta	*Sample No.*	WG20/9807
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH29 0.5-1.1m	*Date Tested:*	29-10-2020

TEST RESULTS - Consistency Limits (Casagrande)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°C**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.1	**Liquid Limit (%)**	**23**
AS 1289.3.2.1	**Plastic Limit (%)**	**17**
AS 1289.3.3.1	**Plasticity Index (%)**	**6**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**2.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**Cracked**

Comments:

Approved Signatory:

Name: Brooke Elliott

Date: 02-November-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

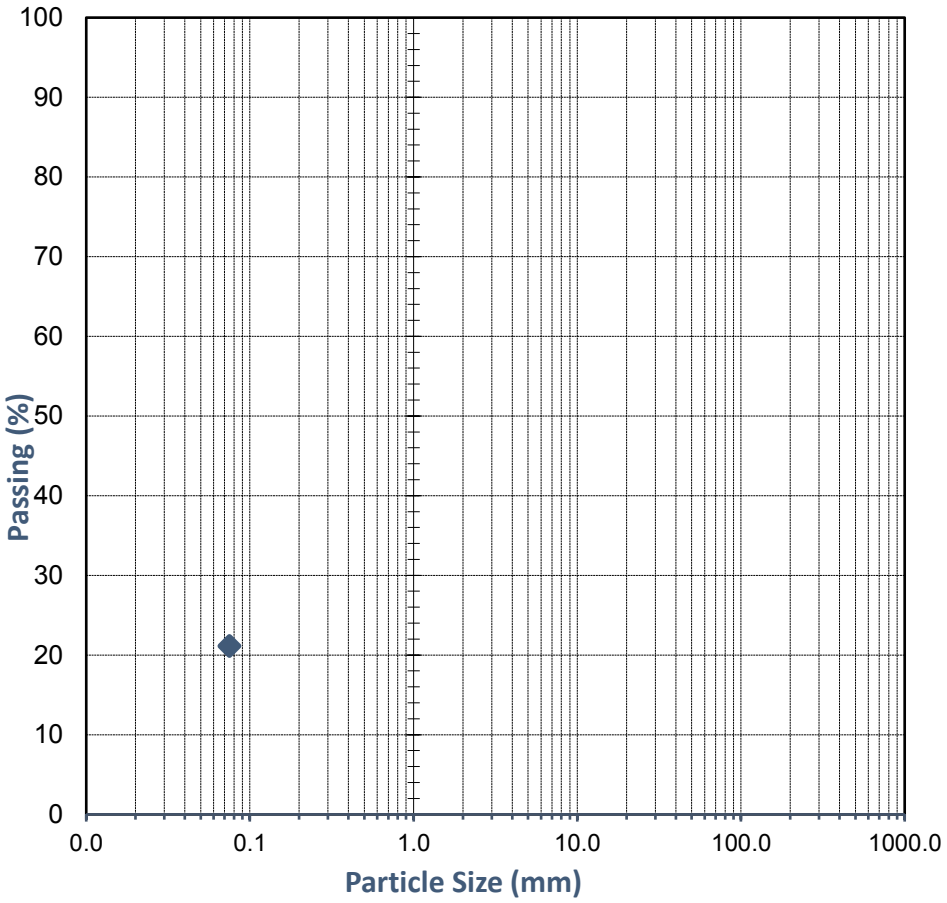
TEST REPORT - AS 1289.3.6.1 (% Fines)

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9808_1_%FINES
Project:	Tallangatta	*Sample No.*	WG20/9808
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH37 1.2-1.6m	*Date Tested:*	28-29/10/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	
1.18	
0.600	
0.425	
0.300	
0.150	
0.075	21



Comments: Clients request for the % Fines of Material passing 0.075mm only.

Approved Signatory:

Name: Brooke Elliott

Date: 30-October-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9808_1_PI
Project:	Tallangatta	*Sample No.*	WG20/9808
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH37 1.2-1.6m	*Date Tested:*	29-10-2020

TEST RESULTS - Consistency Limits (Casagrande)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°C**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.1	**Liquid Limit (%)**	**31**
AS 1289.3.2.1	**Plastic Limit (%)**	**14**
AS 1289.3.3.1	**Plasticity Index (%)**	**17**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**6.5**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**-**

Comments:

Approved Signatory:

Name: Brooke Elliott

Date: 02-November-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

Accredited for compliance with ISO/IEC 17025 - Testing

Appendix D

Groundwater Measurements

TALLANGATTA BORES
STATIC DATA

Bore	Easting	Northing	Install Date	RLT (mAHD)	RLG (mAHD)	Total Depth (mbtoc)	Stickup (magl)	Total Depth (mbgl)
TB1	405754	6505172	13/06/2017	65.91	65.25	5.9	0.66	5.24
TB2	406361	6505180	13/06/2017	85.62	85	6.03	0.62	5.41
TB3	406340	6505764	13/06/2017	81.08	80.55	2.2	0.53	1.67
TB4	404938	6505808	13/06/2017	55.5	54.8	4.32	0.7	6.91
TB5	405623	6505941	13/06/2017	67.69	67	4.16	0.69	3.47
TB6	405100	6505093	13/06/2017	54.61	54	4.63	0.61	4.02
TB7	405596	6504222	13/06/2017	59.09	58.4	5.24	0.69	4.55
TB8	405932	6504216	13/06/2017	65.84	65.25	4.76	0.59	4.17
TB9	406375	6504202	13/06/2017	75.48	74.8	3.61	0.68	2.93
GD20	405300	6506021	uk	62.09	61.48	19.51	0.61	18.9
2-98	406399	6502795	uk	58.893	58.29	18.603	0.603	18

TALLANGATTA BORES
DEPTHS TO WATER

	DEPTH TO WATER (mbgl)						
Bore	**17/08/2017**	**12/01/2018**	**18/10/2018**	**30/05/2019**	**21/08/2020**	**9/09/2020**	**2/10/2020**
TB1	2.4		0.6		4.64		>5.18
TB2	1.51		1.38		2.95		2.95
TB3	0.35		0.61		0.7		0.94
TB4	0.22		0.83		0.41		1.09
TB5	0.61		0.76		>3.45		>3.45
TB6	0.28		0.66		0.37	0.45	0.83
TB7	0.82		1.2		1.14		1.3
TB8	0.44		1.02		1.11		2.22
TB9	0.26		0.82		0.56		1.02
GD20	0.19				0.88		1.48
2-98	1.49				2.117		2.267

TALLANGATTA BORES
WATER LEVELS

	WATER LEVEL (m AHD)						
Bore	**17/08/2017**	**12/01/2018**	**18/10/2018**	**30/05/2019**	**21/08/2020**	**9/09/2020**	**2/10/2020**
TB1	62.85		64.67		60.61		<60.07
TB2	83.49		83.66		82.05		82.05
TB3	80.2		79.92		79.85		79.61
TB4	54.58		54		54.39		53.71
TB5	66.39		66.24		<63.55		<63.55
TB6	53.72		53.34		53.63	53.55	53.17
TB7	57.58		57.23		57.26		57.1
TB8	64.81		64.22		64.14		63.03
TB9	74.54		73.97		74.24		73.78
GD20	61.29		60.91		60.6		60
2-98	56.793		56.623		56.173		56.023

TALLANGATTA BORES
AAMGL and MGL
from 21/8/20 measurements

Bore	AAMGL (mAHD)	MGL (mAHD)	DTAAMGL (m)	DTMGL (m)
TB1	61.037	61.617	4.213	3.633
TB2	82.477	83.057	2.523	1.943
TB3	80.277	80.857	0.273	-0.307
TB4	54.817	55.397	-0.017	-0.597
TB5				
TB6	54.057	54.637	-0.057	-0.637
TB7	57.687	58.267	0.713	0.133
TB8	64.567	65.147	0.683	0.103
TB9	74.667	75.247	0.133	-0.447
GD20	59.85	61.35	1.63	0.13
2-98	56.6	57.18	1.69	1.11

Appendix E

Letter from Aqua Ferre Pty Ltd

AQUA FERRE PTY LTD
ACN 121 146 772
PO Box 1982 West Perth WA 6872
Level 1, 5 Ord Street West Perth WA 6005
Tel: 08 9282 5400
Fax: 08 9282 5484

29 January 2018

Tom Carmody
Director and Licensee
Tomahawk Property on behalf of the Muchea Employment Node Precinct 3 Landowner Group
8/355 Stirling Highway
Claremont WA 6010

Dear Mr Carmody

Muchea Employment Node Precinct 3 Landowner Group

I refer to your enquiries to Aqua Ferre Pty Ltd (Aqua Ferre) regarding the availability of water and the potential future supply of water, within the Muchea region.

You have advised that you represent a number of landowners with properties on Great Northern Highway and Brand Highway in Muchea (collectively described as the Muchea Employment Node Precinct 3 Landowner Group or more generally the landowner group).

On behalf of the landowner group you have requested information from Aqua Ferre in support of two planning documents:

- Shire of Chittering Town Planning Scheme No 6 Amendment No.67 - Rezoning Lots M1601, 800-804, 192, 194 and 35 Great Northern Highway, Muchea from 'Agricultural Resource' zone to 'Industrial Development' zone, and amending the Scheme Maps accordingly; and
- Precinct 3 Muchea Industrial Park Structure Plan.

In particular you have sought information regarding Aqua Ferre's water entitlements, the prospect that some of Aqua Ferre's water entitlement may be allocated to the landowner group properties, and whether the water can be practically supplied from Aqua Ferre's operations to the landowner group properties.

1 MEN & Precinct 3

The Muchea Employment Node Structure Plan (MENSP) was adopted by the WAPC in August 2011, and provides a 20-year planning framework for industrial development within the Shire of Chittering. We understand that the MENSP is currently under review and a revised document is expected to be released during 2019.

You have advised that the subject land is located within Precinct 3, which forms the eastern portion of the MENSP, to the west of Great Northern Highway (GNH).

Precinct 3 of the Muchea Employment Node (more recently referred to as the Muchea Industrial Park (MIP)) ('the Structure Plan area') is approximately 185ha in area and located to the south east of the

townsite of Muchea. Precinct 3 is triangular in shape and extends in a lineal pattern from Brand Highway in the north, along Great Northern Highway (GNH) in the east, to the southern boundary of the Shire of Chittering, and along the Perth-Darwin Highway (PDNH) to the west, which is currently under construction.

Figure 1 below shows the proposed Precinct 3 development boundaries (Urbis 2019, LPS Amendment, Muchea Employment Node, DWG-11).

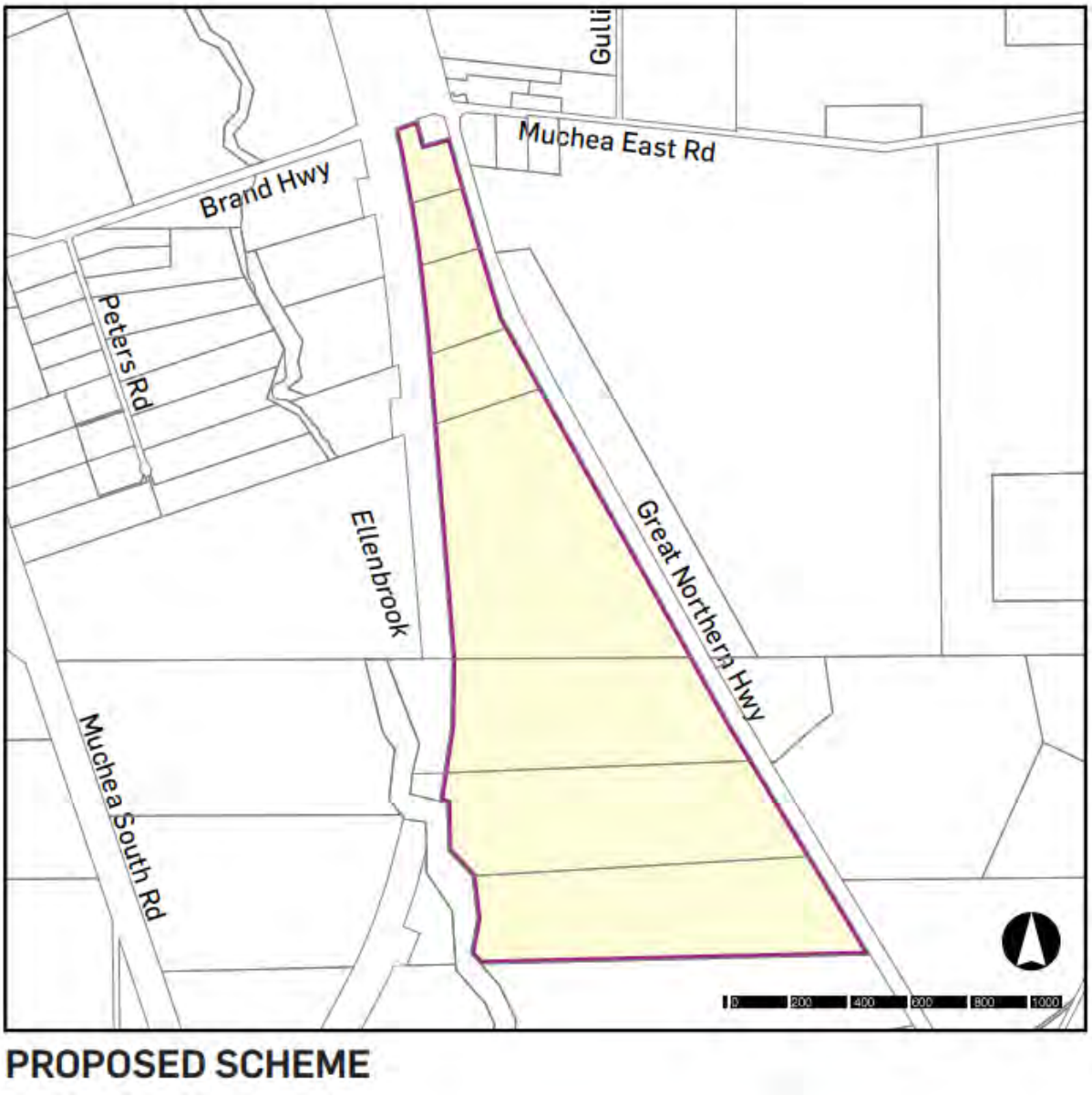


Figure 1 Proposed Precinct 3 development

Urbis[1] have indicated that the land has largely been historically cleared for agricultural purposes and contains stands of large, mature trees with degraded understorey, and a number of rural drainage lines.

[1] Urbis Pty Ltd 2019, Precinct 3, Muchea Industrial Park, Structure Plan, Draft January 2019

You have advised that the Structure Plan[2] will provide approximately 51 lots of approximately 1.3ha to 7.6ha providing flexibility for a range of industrial uses, expected to be primarily transport logistics related.

We understand that the Structure Plan is being progressed concurrently with Amendment No.67 to LPS6 which proposes to rezone the land from 'Agricultural Resource Zone' to the 'Industrial Development' zone, to introduce land use permissibility for Precinct 3; clarify requirements for the preparation of Management Plans, and introduce provisions relating to provision of reticulated water and construction of the loop road.

2 Aqua Ferre

Aqua Ferre was established to be an independent water service provider following approaches by property development groups seeking water services in the Chittering/Muchea region. Aqua Ferre is proposing to build and operate a potable water supply system at Reserve Road, Chittering (as shown in Figure 2).

The proposed water treatment plant (WTP) would be operated as a constant flow rate to promote a stable process with the intention of producing reliable potable water that meets the Australian Drinking Water Guidelines.

Figure 2 below broadly shows the Precinct 3 development (outlined in red) to the south of Harvis' proposed MEN (Phase 1) development (outlined in yellow) and Aqua Ferre's proposed water facility to the north.

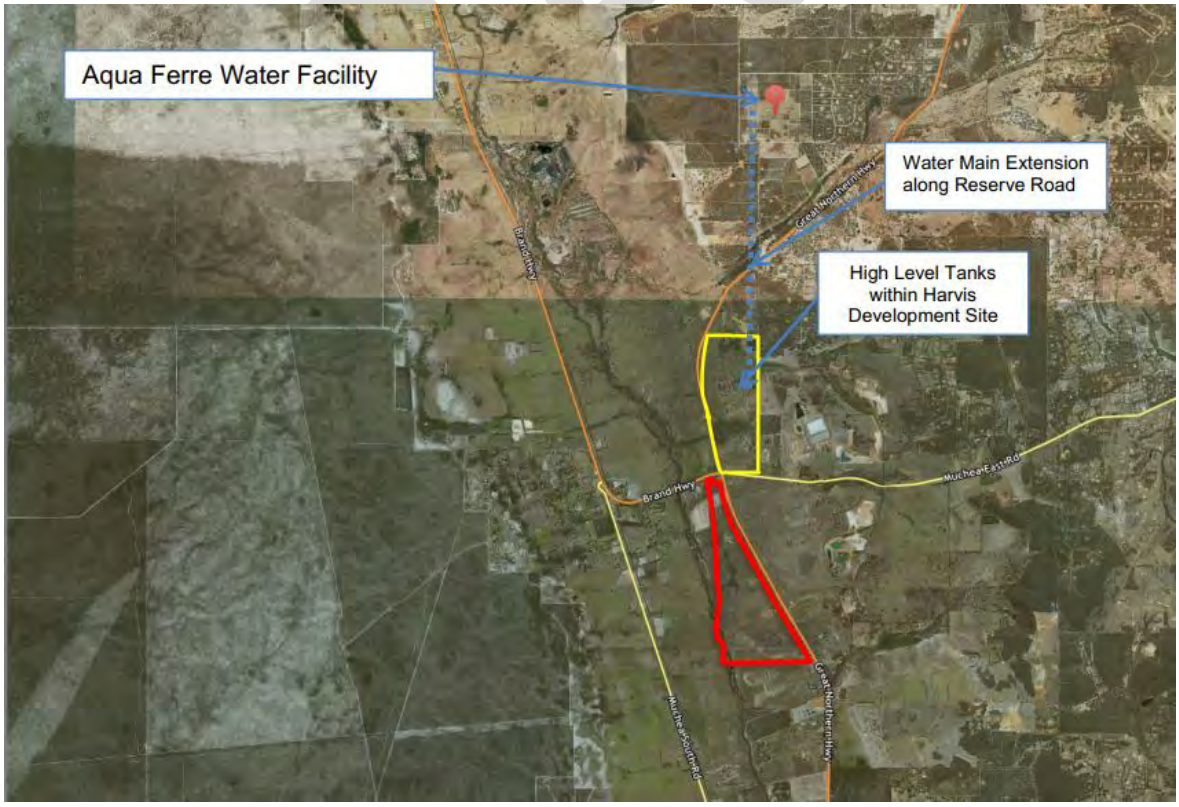


Figure 2 Development boundaries

[2] Urbis Pty Ltd 2019, Precinct 3, Muchea Industrial Park, Structure Plan, Draft January 2019

2.1 Water Entitlement

The Reserve Road (Chittering) property currently has a total water entitlement or allocation (licence to abstract water from an artesian aquifer) of 288,800 kL per annum. The developer of the Reserve Road residential development, Riverside, has transferred the Water Licence GWL 59907(3) to the Water Corporation to enable the licence to be changed from an agricultural extraction to public water supply. It is intended that this water entitlement will be transferred to Aqua Ferre when a water service licence has been granted.

Aqua Ferre has similar entitlement rights to a further 362,900 kL per annum licence, originally GWL 102502(4) which is now part of GWL 65011.

In total, it is intended that Aqua Ferre will have access to 651,700 kL of water per annum.

There is an existing production bore located within the proposed Reserve Road development that was previously used for wildflower irrigation, where the proposed potable WTP would be located.

2.2 Existing water supply commitments

Aqua Ferre intends supplying approximately 153 ML of treated potable water to the residential development at Reserve Road, Chittering, and to a commercial/industrial development at the adjacent MEN (northern Precinct 1 only). It is intended that a further 75 ML will be set aside for future demand across these two developments.

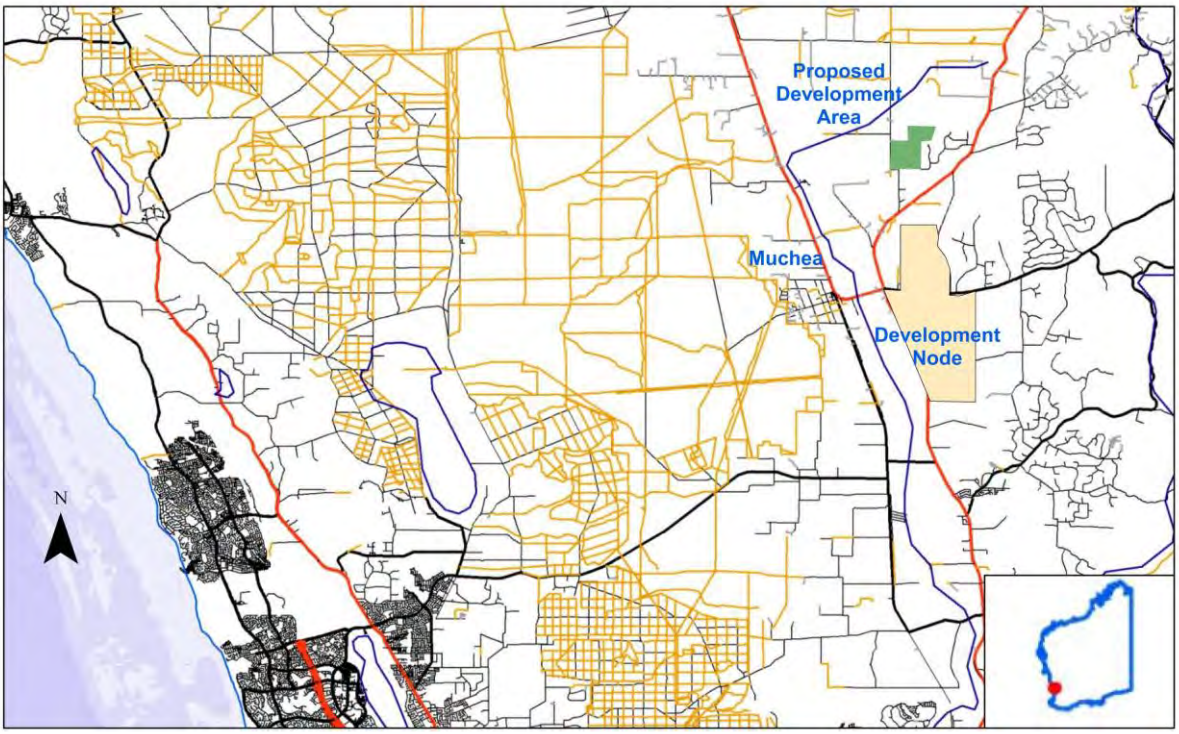


Figure 3 Location of Reserve Road residential development and MEN

The new Reserve Road rural living allotment development is located 8km north east of the Muchea town site and 80km north of the Perth central business district. It is also in close proximity (4km) to the

proposed MEN on the eastern side of Great Northern Highway. The development is in accordance with the Shire of Chittering's planning scheme (2004). The Reserve Road development covers an area of approximately 160 hectares and involves the creation of approximately 245 rural residential allotments in progressive stages. It is a requirement of the development approval that potable reticulated water is available.

Figure 4 Contour map (5m contour lines) of the Harvis MEN development showing ephemeral swale

Phase 1 of the MEN development is being undertaken by development group Harvis Capital Pty Ltd (Harvis). The Harvis development is located on the northern end of the proposed MEN. The site is slightly undulating with an ephemeral swale running through the development (Figure 4). The development is well placed and has been planned around the proposed Perth Darwin Highway.

It is the intention of the MEN development that these lots also have a reticulated water resource. Currently, the area does not have a public water supply scheme. Aqua Ferre is finalising documentation to allow the Economic Regulation Authority Western Australia to consider an application for a water services licence.

It is proposed that the water supply for the Harvis MEN development will have a standalone delivery and network system, to ensure that the demand of both systems can meet peak demand and firefighting requirements.

After treatment, it is intended that the water required for the Harvis MEN site will be delivered to a 500kL holding tank with aeration. Water would be reticulated to customers using a standard, continually pressurised water reticulation network. The piping would follow the general topography and alignment of the development streets and will have 600mm coverage.

3 Precinct 3 water requirement

You have advised that the intention is that the land the subject of the Structure Plan would be serviced with reticulated water provided by a licensed water provider.

The total area of supply is for an industrial development totalling approximately 185 hectares. No indication of staging of development has been provided at this point.

Estimated annual water usage has been provided (based on preliminary modelling by Cossill & Webley) as 203ML per annum on a net area of 139 hectares (after allowing for a 25% reduction in land area calculation to accommodate roads/drainage). The proposed system has been modelled at 4kL/day per hectare based on advice from Cossill & Webley of studies of similar industry types and uses. It is noted that this compares to the Water Corporation design standard for industrial land of approximately 17 kL/ha/day.

Based on your advice of estimated water usage, Aqua Ferre would have capacity under its entitlements to meet the demand of the subject land. This is not an undertaking to commit an allocation of water, or to supply water, to the Muchea Employment Node Precinct 3 Landowner Group. Any such arrangements would be the subject to future commercial negotiation, agreement on terms including pricing and remaining water availability under Aqua Ferre's entitlements.

4 Supply assessment

Aqua Ferre has conducted a preliminary desktop assessment of the potential supply route from its planned water treatment plant at Reserve Road to the proposed Precinct 3 development via Harvis' phase 1 MEN development. This represents a distance of approximately 3.5 kilometres.

The assessment did not highlight any major engineering impediments to the provision of water to the proposed development. (This is not to say, however, that any impediments would not become apparent on more detailed analysis.)

Any proposal for supply would be inclusive of the requirements of:

- Water Corporation Design Standard DS 63 – Water Reticulation Standard Design and Construction Requirements for Water Reticulation Systems or Water Reticulation Systems up to DN250
- DFES requirements for firefighting services
- Hydraulic modelling using EPANET 2 for system hydraulics.

Hydraulic modelling would require topographical mapping at 0.5m.

Additionally, there would be a requirement for a water reserve for tanks, pumps, sumps, generator and chlorination which would need to be met by the subject landowners' group.

5 Disclaimer

This report is dated 29 January 2019 and incorporates information available to Aqua Ferre up to that date only. It excludes consideration of any information arising, or event occurring, after that date which may impact opinions expressed or statements made by Aqua Ferre in this report.

Aqua Ferre has prepared this report on the instructions, and for the sole benefit, of Tomahawk Property (Instructing Party), for inclusion within a rezoning application and Structure Plan as described in paragraph 3 of this letter (Purpose) and not for any other purpose or use. To the extent permitted by applicable law, Aqua Ferre expressly disclaims all liability, whether direct or indirect:

- to the Instructing Party, which may arise in connection with any reliance or purported reliance on this report for any purpose other than the Purpose, and
- to any other person, which may arise in connection with any reliance or purported reliance on this report for any purpose whatsoever (including the Purpose).

All statements and opinions contained in or associated with this report are made on the basis of information supplied to Aqua Ferre as at the date of this report, and upon which Aqua Ferre has relied. To the extent permitted by applicable law, Aqua Ferre expressly disclaims any liability, whether direct or indirect, which may arise in connection with any errors or omissions in this report arising from information provided to Aqua Ferre by the Instructing Party or by any other person.

Achievement of any proposed or intended events or circumstances described in this report will depend, among other things, on the actions of others, over which Aqua Ferre has no control. To the extent permitted by applicable law, Aqua Ferre expressly disclaims any liability, whether direct or indirect, which may arise in connection with the delay in, or failure to occur of, any proposed or intended events or circumstances described in this report.

Yours sincerely

Peter Fogarty
Director

Appendix F

Flow Calculations

LOTS - 1 YEAR ARI 1 HOUR

Rainfall Intensity i (mm/h)	15.1	(1yr, 1hr Storm)
Runoff Coefficient Lots	0.8	
Permeability k (m/hr)	0.0417	

Segment	Lot(s)	Lot Area (m2)	Ai (m2)	Q (L/s)	Vinflow (m3)
A1					
	14	20000	16000	67	242
	15	20000	16000	67	242
	16	20000	16000	67	242
	42	22000	17600	74	266
	45	76000	60800	255	919
A2				0	0
	10	12000	9600	40	145
	11	13000	10400	44	157
	12	16000	12800	54	193
	13	17000	13600	57	206
A3				0	0
	43	15000	12000	50	181
	44	13000	10400	44	157
A4				0	0
	46	116000	92800	390	1402
A5				0	0
	47	91000	72800	306	1100
	48	66000	52800	222	798
	49N	33000	26400	111	399
B1				0	0
C1				0	0
	22	23000	18400	77	278
C2				0	0
	23	12000	9600	40	145
	24	13000	10400	44	157
C3				0	0
	20	15000	12000	50	181
	21	15000	12000	50	181
	32	15000	12000	50	181
C4				0	0
	33	51000	40800	171	617
	34	50000	40000	168	604
	35	50000	40000	168	604
	36	41000	32800	138	496
	37	60000	48000	201	725
	38	40000	32000	134	484
	39	40000	32000	134	484
	40	40000	32000	134	484
	41	40000	32000	134	484
D1				0	0
	25	16000	12800	54	193
	28	20000	16000	67	242
	29	20000	16000	67	242
	30	21000	16800	71	254
	31	14000	11200	47	169
D2				0	0
	26	13000	10400	44	157
	27	13000	10400	44	157
D3				0	0
	54	33000	26400	111	399
	55	21000	16800	71	254
D4					
D5					
	49S	33000	26400	111	399
	50	51000	40800	171	617
	51	61000	48800	205	737
Others					
	1	8512	6810	29	103
	2	10000	8000	34	121
	3	11000	8800	37	133
	4	16000	12800	54	193
	5	19000	15200	64	230
	6	25000	20000	84	302
	7	25000	20000	84	302
	8	18000	14400	60	218
	9	22000	17600	74	266
	17	40000	32000	134	484
	18	36000	28800	121	435
	19	34000	27200	114	411
	52	40000	32000	134	484
	53	40000	32000	134	484

Basin Sizing		Depth	Slope 1:x	Base Width	Base Length	Top Width (m)	Top Length (m)	Volume	Effective Volume	Surface Area (m2)	Volume check
A1											
	14	0.5	4	20	20	24	24	243	263	576	ok
	15	0.5	4	20	20	24	24	243	263	576	ok
	16	0.5	4	20	20	24	24	243	263	576	ok
	42	0.5	4	21	21	25	25	265	287	625	ok
	45	0.5	4	40	40	44	44	883	956	1936	ok
A2											
	10	0.5	4	15	15	19	19	145	157	361	ok
	11	0.5	4	15	15	19	19	145	157	361	ok
	12	0.5	4	17	17	21	21	181	196	441	ok
	13	0.5	4	18	18	22	22	201	217	484	ok
A3											
	43	0.5	4	17	17	21	21	181	196	441	ok
	44	0.5	4	15	15	19	19	145	157	361	ok
A4											
	46	0.5	4	49	49	53	53	1301	1410	2809	ok
A5											
	47	0.5	4	44	44	48	48	1059	1147	2304	ok
	48	0.5	4	37	37	41	41	761	825	1681	ok
	49N	0.5	4	29	29	33	33	481	521	1089	ok
A6											
B1											
C1											
	22	0.5	4	21	21	25	25	265	287	625	ok
C2											
	23	0.5	4	15	15	19	19	145	157	361	ok
	24	0.5	4	15	15	19	19	145	157	361	ok
C3											
	20	0.5	4	17	17	21	21	181	196	441	ok
	21	0.5	4	17	17	21	21	181	196	441	ok
	32	0.5	4	17	17	21	21	181	196	441	ok
C4											
	33	0.5	4	32	32	36	36	579	627	1296	ok
	34	0.5	4	32	32	36	36	579	627	1296	ok
	35	0.5	4	32	32	36	36	579	627	1296	ok
	36	0.5	4	29	29	33	33	481	521	1089	ok
	37	0.5	4	35	35	39	39	685	742	1521	ok
	38	0.5	4	28	28	32	32	451	488	1024	ok
	39	0.5	4	28	28	32	32	451	488	1024	ok
	40	0.5	4	28	28	32	32	451	488	1024	ok
	41	0.5	4	28	28	32	32	451	488	1024	ok
D1											
	25	0.5	4	17	17	21	21	181	196	441	ok
	28	0.5	4	20	20	24	24	243	263	576	ok
	29	0.5	4	20	20	24	24	243	263	576	ok
	30	0.5	4	20	20	24	24	243	263	576	ok
	31	0.5	4	16	16	20	20	163	176	400	ok
D2											
	26	0.5	4	15	15	19	19	145	157	361	ok
	27	0.5	4	15	15	19	19	145	157	361	ok
D3											
	54	0.5	4	26	26	30	30	393	425	900	ok
	55	0.5	4	20	20	24	24	243	263	576	ok
D4											
D5											
	49S	0.5	4	26	26	30	30	393	425	900	ok
	50	0.5	4	32	32	36	36	579	627	1296	ok
	51	0.5	4	35	35	39	39	685	742	1521	ok
Others											
	1	0.5	4	12	12	16	16	99	107	256	ok
	2	0.5	4	13	13	17	17	113	123	289	ok
	3	0.5	4	14	14	18	18	129	139	324	ok
	4	0.5	4	17	17	21	21	181	196	441	ok
	5	0.5	4	19	19	23	23	221	240	529	ok
	6	0.5	4	22	22	26	26	289	313	676	ok
	7	0.5	4	22	22	26	26	289	313	676	ok
	8	0.5	4	19	19	23	23	221	240	529	ok
	9	0.5	4	21	21	25	25	265	287	625	ok
	17	0.5	4	28	28	32	32	451	488	1024	ok
	18	0.5	4	27	27	31	31	421	456	961	ok
	19	0.5	4	26	26	30	30	393	425	900	ok
	52	0.5	4	28	28	32	32	451	488	1024	ok
	53	0.5	4	28	28	32	32	451	488	1024	ok

1 YEAR ARI 1 HOUR FLOWS - ROADS

Rainfall Intensity i (mm/h)	15.1	(1yr, 1hr Storm)
Runoff Coefficient Road Reserves	0.8	
Runoff Coefficient Swale	1	
Runoff Coefficient Lots	0	
Runoff Coefficient OS	0	
Permeability k (m/hr)	**0.0417**	
Driveway Width (m)	10.0	
Swale Side Slope (1/x)	3.00	

Segment	Road Reserve (m2)	Swale Length (m)	Swale Depth (m)	Weir Height (m)	Swale Base Width (m)	Swale Top Width (m)	Swale Area (m2)	Lots (m2)	POS (m2)	Ai	Segment Peak Flow (L/s)	Segment 1 hr Flow (m3)
A1	32745	870	0.6	0.3	5	8.60	7482	0	0	27692	116	418.5
A2	8531	256	0.5	0.3	4	7.00	1792	0	0	7183	30	108.6
A3	9956	295	0.5	0.3	3	6.00	1770	0	0	8319	35	125.7
A4	10792	229	0.6	0.3	2	5.60	1282	0	0	8890	37	134.3
A5	24409	583	0.6	0.3	3.5	7.10	4139	0	0	20355	85	307.6
A6	13299	420	0.5	0.3	4	7.00	2940	0	0	11227	47	169.7
B1	13269	296	0.5	0.3	2	5.00	1480	0	0	10911	46	164.9
C3	7868	249	0.6	0.3	3	6.60	1643	0	0	6623	28	100.1
C4	29301	885	0.8	0.3	4.5	9.30	8231	0	0	25087	105	379.1
D1	4310	141	0.6	0.3	3.5	7.10	1001	0	0	3648	15	55.1
D2	5856	189	0.6	0.3	3	6.60	1247	0	0	4934	21	74.6
D3	15265	326	0.6	0.3	3	6.60	2152	0	0	12642	53	191.1
D4	10526	335	0.5	0.3	4	7.00	2345	0	0	8890	37	134.3
D5	27241	623	0.6	0.3	3.5	7.10	4423	0	0	22677	95	342.7

Trapezoidal Swales

Swale Segment	No. Driveways	No. Weirs	Length	Weir Spacing (m)	Long Slope	Max U/S Reach (m)	Upstream Ht (m)	1 hr Inflow per Weir (m3)	Storage per Weir (m3)	Total Storage (m3)	Effective Storage per Weir (m3)	Effective Total Storage (m3)	Volume Check
A1	5	65	870	13	0.0179	12.6	0.1	6.44	12.55	816.05	15.66	1017.58	ok
A2	3	4	256	64	0.0066	45.5	0.0	27.14	22.27	89.09	29.42	117.70	ok
A3	2	5	295	59	0.0044	55.0	0.1	25.14	33.33	166.67	42.11	210.53	ok
A4	1	17	229	13	0.014	12.9	0.1	7.90	7.08	120.29	8.69	147.73	ok
A5	3	23	583	25	0.0086	24.0	0.1	13.37	18.87	433.99	23.32	536.39	ok
A6	0	19	420	22	0.019	15.8	0.0	8.93	7.74	147.00	10.22	194.20	ok
B1	1	26	296	11	0.0182	11.0	0.1	6.34	5.67	147.41	7.03	182.68	ok
C3	2	13	249	19	0.0185	16.2	0.0	7.70	6.32	82.22	8.34	108.36	ok
C4	7	5	885	177	0.0016	163.0	0.0	75.82	127.28	636.39	160.49	802.46	ok
D1	0	3	141	47	0.0071	42.3	0.0	18.38	18.59	55.77	24.54	73.61	ok
D2	0	5	189	38	0.0079	37.8	0.0	14.91	15.67	78.36	20.39	101.93	ok
D3	2	26	326	13	0.0172	11.8	0.1	7.35	8.26	214.64	10.19	265.06	ok
D4	2	19	335	18	0.0209	14.4	0.0	7.07	7.03	133.64	9.29	176.55	ok
D5	3	20	623	31	0.008	29.7	0.1	17.14	20.80	416.01	26.20	524.01	ok

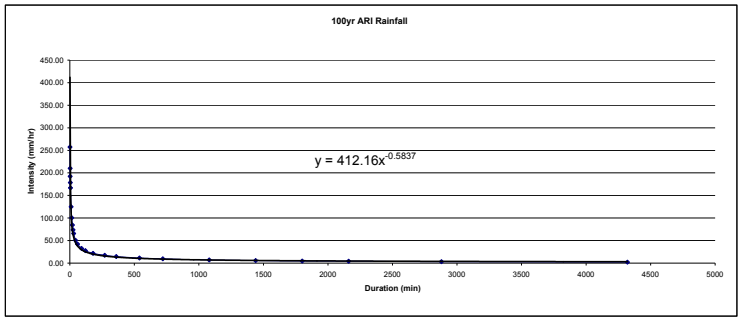
100 YEAR ARI DRAINAGE PROPERTIES - LOTS

Segment	Lot(s)	AREAS (m2)			TIME OF CONCENTRATION PRE-DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)	
		Area (m2)	Effective Area (m2)		Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (min)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (min)	Pre-Dev	Post-Dev
			Pre	Post												
A1																
	14	20000	7000	17000	200	65	60.6	22.00	10.3	200	65	60.6	22.00	9.4	105.8	111.5
	15	20000	7000	17000	200	62	59	15.00	11.1	200	62	59	15.00	10.1	101.2	106.6
	16	20000	7000	17000	193	59.8	57.4	12.44	11.1	193	59.8	57.4	12.44	10.2	101.1	106.5
	42	22000	7700	18700	204	67.5	64.5	14.71	11.2	204	67.5	64.5	14.71	10.3	100.4	105.7
	45	76000	26600	64600	410	72.6	67	13.66	20.3	410	72.6	67	13.66	18.5	71.2	75.0
A2																
	10	12000	4200	10200	162	60	58.2	11.11	10.0	162	60	58.2	11.11	9.2	107.3	113.0
	11	13000	4550	11050	177	62	59.4	14.69	10.3	177	62	59.4	14.69	9.4	105.7	111.4
	12	16000	5600	13600	198	64	61	15.15	11.2	198	64	61	15.15	10.2	100.6	106.0
	13	17000	5950	14450	189	65.5	63	13.23	10.9	189	65.5	63	13.23	10.0	102.1	107.5
A3																
	43	15000	5250	12750	179	68.1	65.4	15.08	10.2	179	68.1	65.4	15.08	9.3	106.3	111.9
	44	13000	4550	11050	175	68.6	66	14.86	10.1	175	68.6	66	14.86	9.3	106.6	112.3
A4																
	46	116000	40600	98600	466	82	71	23.61	19.8	466	82	71	23.61	18.1	72.2	76.0
A5																
	47	91000	31850	77350	430	89.7	70.9	43.72	16.5	430	89.7	70.9	43.72	15.1	80.1	84.4
	48	66000	23100	56100	366	84.5	72.2	33.61	15.3	366	84.5	72.2	33.61	14.0	83.8	88.3
	49N	33000	11550	28050	305	83.9	75.4	27.87	14.2	305	83.9	75.4	27.87	13.0	87.6	92.2
A6																
B1																
C1																
	22	23000	8050	19550	179	57.2	54	17.88	9.4	179	57.2	54	17.88	8.6	111.1	117.0
C2																
	23	12000	4200	10200	156	57.4	55.3	13.46	9.3	156	57.4	55.3	13.46	8.5	112.2	118.1
	24	13000	4550	11050	158	57.2	54.9	14.56	9.2	158	57.2	54.9	14.56	8.4	112.9	118.9
C3																
	20	15000	5250	12750	179	60	58.2	10.06	11.1	179	60	58.2	10.06	10.1	101.3	106.7
	21	15000	5250	12750	179	58.7	56.7	11.17	10.8	179	58.7	56.7	11.17	9.9	102.6	108.1
	32	15000	5250	12750	179	60.5	57.5	16.76	10.0	179	60.5	57.5	16.76	9.1	107.6	113.3
C4																
	33	51000	17850	43350	309	66	60.5	17.80	15.1	309	66	60.5	17.80	13.8	84.6	89.1
	34	50000	17500	42500	317	67.6	60.5	22.40	14.8	317	67.6	60.5	22.40	13.5	85.5	90.1
	35	50000	17500	42500	249	69	61.5	30.12	11.0	249	69	61.5	30.12	10.0	101.9	107.3
	36	41000	14350	34850	309	68	61.5	21.04	14.9	309	68	61.5	21.04	13.6	85.2	89.7
	37	60000	21000	51000	354	74	63.5	29.66	15.3	354	74	63.5	29.66	14.0	83.7	88.2
	38	40000	14000	34000	282	74.7	68.1	23.40	13.3	282	74.7	68.1	23.40	12.2	90.8	95.7
	39	40000	14000	34000	283	74.8	67.7	25.09	13.2	283	74.8	67.7	25.09	12.1	91.4	96.3
	40	40000	14000	34000	282	73	65.6	26.24	13.0	282	73	65.6	26.24	11.9	92.1	97.0
	41	40000	14000	34000	273	69.8	65.5	15.75	14.0	273	69.8	65.5	15.75	12.8	88.4	93.1
D1																
	25	16000	5600	13600	190	57	54.8	11.58	11.3	190	57	54.8	11.58	10.4	99.9	105.2
	28	20000	7000	17000	193	62	58.2	19.69	10.1	193	62	58.2	19.69	9.3	106.7	112.3
	29	20000	7000	17000	200	62.3	57	26.50	9.9	200	62.3	57	26.50	9.1	108.2	113.9
	30	21000	7350	17850	210	61	56.7	20.48	10.9	210	61	56.7	20.48	10.0	102.3	107.7
	31	14000	4900	11900	182	60.5	57.3	17.58	10.1	182	60.5	57.3	17.58	9.3	106.7	112.4
D2																
	26	13000	4550	11050	165	58	55.3	16.36	9.4	165	58	55.3	16.36	8.6	111.6	117.5
	27	13000	4550	11050	163	59.6	56.8	17.18	9.2	163	59.6	56.8	17.18	8.4	113.0	119.0
D3																
	54	33000	11550	28050	254	63.5	60	13.78	13.6	254	63.5	60	13.78	12.5	89.8	94.5
	55	21000	7350	17850	202	61.5	58.5	14.85	11.2	202	61.5	58.5	14.85	10.2	100.8	106.2
D4																
D5																
	49S	33000	11550	28050	301	83.8	75.5	27.57	14.0	301	83.8	75.5	27.57	12.9	88.1	92.8
	50	51000	17850	43350	333	82	72.5	28.53	14.8	333	82	72.5	28.53	13.5	85.6	90.1
	51	61000	21350	51850	268	78.4	70.3	30.22	11.5	268	78.4	70.3	30.22	10.6	98.8	104.1
Others																
	1	8512	2979	7235	152	69.5	67.4	13.82	9.3	152	69.5	67.4	13.82	8.5	111.9	117.9
	2	10000	3500	8500	144	67.3	65.7	11.11	9.1	144	67.3	65.7	11.11	8.3	113.7	119.7
	3	11000	3850	9350	157	65.5	63.8	10.83	9.9	157	65.5	63.8	10.83	9.0	108.4	114.1
	4	16000	5600	13600	200	64	61.5	12.50	11.8	200	64	61.5	12.50	10.8	97.8	103.0
	5	19000	6650	16150	231	61.6	59.5	9.09	14.2	231	61.6	59.5	9.09	13.0	87.5	92.2
	6	25000	8750	21250	257	60	57.8	8.56	15.6	257	60	57.8	8.56	14.3	83.0	87.4
	7	25000	8750	21250	267	58	54	14.98	14.5	267	58	54	14.98	13.2	86.6	91.2
	8	18000	6300	15300	253	57.5	54	13.83	14.4	253	57.5	54	13.83	13.2	86.9	91.5
	9	22000	7700	18700	207	57.4	54	16.43	11.2	207	57.4	54	16.43	10.2	100.8	106.2
	17	40000	14000	34000	291	57.2	54	11.00	16.0	291	57.2	54	11.00	14.7	81.7	86.0
	18	36000	12600	30600	285	58.3	55.5	9.82	16.2	285	58.3	55.5	9.82	14.8	81.1	85.4
	19	34000	11900	28900	267	61	58.2	10.49	15.1	267	61	58.2	10.49	13.8	84.6	89.1
	52	40000	14000	34000	276	70	66.5	12.68	14.8	276	70	66.5	12.68	13.5	85.6	90.2
	53	40000	14000	34000	296	67.5	63.5	13.51	15.6	296	67.5	63.5	13.51	14.3	82.8	87.2

Runoff Coefficients

Cleared Upland	0.35
Hardstand	0.85

Event	Duration (mins)	Intensity (mm/hr)
1 min	1	257.40
2 min	2	210.00
3 min	3	192.40
4 min	4	178.50
5 min	5	166.80
10 min	10	124.80
15 min	15	100.40
20 min	20	84.60
25 min	25	73.68
30 min	30	65.60
45 min	45	50.53
1 hr	60	42.10
1.5 hr	90	32.73
2 hr	120	27.55
3 hr	180	21.73
4.5 hr	270	17.24
6 hr	360	14.62
9 hr	540	11.44
12 hr	720	9.50
18 hr	1080	7.17
24 hr	1440	5.75
30 hr	1800	4.77
36 hr	2160	4.08
48 hr	2880	3.17
72 hr	4320	2.19



100 YEAR ARI FLOWS - LOTS

A1																				
Storm Duration (mins)	14				15				16				42				45			
	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)
1	205.81	1215.50	1009.69	-35.80	196.81	1215.50	1018.69	-39.27	196.60	1215.50	1018.90	-39.35	214.70	1337.05	1122.35	-43.92	525.97	4618.90	4092.93	-272.88
2	205.81	991.67	785.85	2.36	196.81	991.67	794.85	-0.63	196.60	991.67	795.07	-0.70	214.70	1090.83	876.13	-1.32	525.97	3768.33	3242.37	-114.33
3	205.81	908.56	702.74	36.75	196.81	908.56	711.74	34.28	196.60	908.56	711.96	34.21	214.70	999.41	784.71	37.18	525.97	3452.51	2926.55	30.83
4	205.81	842.92	637.10	65.21	196.81	842.92	646.10	63.25	196.60	842.92	646.32	63.20	214.70	927.21	712.51	69.15	525.97	3203.08	2677.12	153.50
5	205.81	787.67	581.85	88.85	196.81	787.67	590.85	87.40	196.60	787.67	591.07	87.36	214.70	866.43	651.73	95.82	525.97	2993.13	2467.17	257.88
10	205.81	589.33	383.52	154.61	196.81	589.33	392.52	155.73	196.60	589.33	392.74	155.75	214.70	648.27	433.56	171.49	525.97	2239.47	1713.50	580.43
15	205.81	474.11	268.30	175.81	196.81	474.11	277.30	179.51	196.60	474.11	277.51	179.59	214.70	521.52	306.82	198.16	525.97	1801.62	1275.66	733.82
20	205.81	399.50	193.69	176.17	196.81	399.50	202.69	182.45	196.60	399.50	202.90	182.60	214.70	439.45	224.75	201.91	525.97	1518.10	992.13	808.19
25	205.81	347.93	142.12	165.79	196.81	347.93	151.12	174.65	196.60	347.93	151.34	174.86	214.70	382.73	168.02	193.85	525.97	1322.15	796.18	841.94
30	205.81	309.78	103.97	148.20	196.81	309.78	112.97	159.66	196.60	309.78	113.18	159.93	214.70	340.76	126.05	177.86	525.97	1177.16	651.19	848.48
45	205.81	238.63	32.82	72.65	196.81	238.63	41.82	91.92	196.60	238.63	42.03	92.37	214.70	262.49	47.79	104.90	525.97	906.79	380.83	782.51
60	205.81	198.81	-7.01	-21.13	196.81	198.81	1.99	5.97	196.60	198.81	2.21	6.62	214.70	218.69	3.98	11.93	525.97	755.46	229.50	648.45
90	205.81	154.57	-51.24	-238.22	196.81	154.57	-42.24	-195.36	196.60	154.57	-42.02	-194.33	214.70	170.03	-44.67	-206.40	525.97	587.38	61.42	270.47
120	205.81	130.10	-75.71	-477.62	196.81	130.10	-66.72	-418.92	196.60	130.10	-66.50	-417.52	214.70	143.11	-71.60	-449.18	525.97	494.37	-31.60	-190.10
180	205.81	102.63	-103.18	-997.72	196.81	102.63	-94.18	-907.25	196.60	102.63	-93.97	-905.09	214.70	112.89	-101.81	-980.02	525.97	389.99	-135.97	-1264.52
270	205.81	81.43	-124.38	-1837.73	196.81	81.43	-115.38	-1699.44	196.60	81.43	-115.16	-1696.14	214.70	89.58	-125.13	-1841.91	525.97	309.44	-216.52	-3098.29
360	205.81	69.02	-136.79	-2724.70	196.81	69.02	-127.79	-2538.48	196.60	69.02	-127.57	-2534.03	214.70	75.93	-138.78	-2755.32	525.97	262.29	-263.68	-5107.26
540	205.81	54.04	-151.77	-4591.47	196.81	54.04	-142.77	-4309.28	196.60	54.04	-142.55	-4302.53	214.70	59.45	-155.26	-4684.11	525.97	205.36	-320.60	-9474.10
720	205.81	44.86	-160.95	-6536.80	196.81	44.86	-151.95	-6158.57	196.60	44.86	-151.74	-6149.52	214.70	49.35	-165.36	-6699.21	525.97	170.47	-355.49	-14137.23
1080	205.81	33.84	-171.97	-10554.03	196.81	33.84	-162.97	-9983.62	196.60	33.84	-162.75	-9969.98	214.70	37.23	-177.48	-10868.53	525.97	128.60	-397.36	-23941.36
1440	205.81	27.15	-178.66	-14672.72	196.81	27.15	-169.66	-13910.14	196.60	27.15	-169.44	-13891.90	214.70	29.87	-184.83	-15149.47	525.97	103.18	-422.79	-34131.26
1800	205.81	22.51	-183.30	-18851.83	196.81	22.51	-174.30	-17897.18	196.60	22.51	-174.09	-17874.34	214.70	24.76	-189.94	-19496.99	525.97	85.54	-440.43	-44553.86
2160	205.81	19.28	-186.53	-23051.83	196.81	19.28	-177.53	-21905.06	196.60	19.28	-177.31	-21877.62	214.70	21.21	-193.49	-23867.43	525.97	73.27	-452.69	-55054.25
2880	205.81	14.95	-190.86	-31499.41	196.81	14.95	-181.86	-29968.44	196.60	14.95	-181.64	-29931.81	214.70	16.45	-198.25	-32660.71	525.97	56.82	-469.14	-76237.24
4320	205.81	10.36	-195.45	-48472.06	196.81	10.36	-186.45	-46172.57	196.60	10.36	-186.23	-46117.55	214.70	11.40	-203.30	-50332.33	525.97	39.38	-486.59	-118893.80
Volume check				ok				ok				ok				ok				ok

A2																
Storm Duration (mins)	10				11				12				13			
	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)
1	125.16	729.30	604.14	-20.87	133.65	790.08	656.43	-23.32	156.51	972.40	815.89	-31.79	168.78	1033.18	864.40	-32.78
2	125.16	595.00	469.84	1.93	133.65	644.58	510.94	1.49	156.51	793.33	636.82	-0.83	168.78	842.92	674.14	-0.02
3	125.16	545.13	419.98	22.48	133.65	590.56	456.92	23.85	156.51	726.84	570.33	27.15	168.78	772.27	603.49	29.57
4	125.16	505.75	380.59	39.45	133.65	547.90	414.25	42.36	156.51	674.33	517.82	50.38	168.78	716.48	547.70	54.11
5	125.16	472.60	347.44	53.54	133.65	511.98	378.34	57.73	156.51	630.13	473.62	69.75	168.78	669.52	500.74	74.55
10	125.16	353.60	228.44	92.52	133.65	383.07	249.42	100.51	156.51	471.47	314.96	124.68	168.78	500.93	332.16	132.21
15	125.16	284.47	159.31	104.76	133.65	308.17	174.53	114.33	156.51	379.29	222.78	143.97	168.78	402.99	234.22	151.99
20	125.16	239.70	114.54	104.50	133.65	259.68	126.03	114.61	156.51	319.60	163.09	146.60	168.78	339.58	170.80	154.07
25	125.16	208.76	83.60	97.79	133.65	226.16	92.51	107.90	156.51	278.35	121.84	140.63	168.78	295.74	126.97	147.01
30	125.16	185.87	60.71	86.76	133.65	201.36	67.71	96.50	156.51	247.82	91.31	128.90	168.78	263.31	94.53	133.84
45	125.16	143.18	18.02	39.98	133.65	155.11	21.46	47.51	156.51	190.90	34.39	75.52	168.78	202.84	34.06	74.97
60	125.16	119.28	-5.87	-17.75	133.65	129.22	-4.42	-13.34	156.51	159.04	2.53	7.59	168.78	168.98	0.21	0.62
90	125.16	92.74	-32.41	-150.93	133.65	100.47	-33.17	-154.21	156.51	123.66	-32.85	-151.83	168.78	131.39	-37.39	-173.12
120	125.16	78.06	-47.10	-297.51	133.65	84.56	-49.08	-309.59	156.51	104.08	-52.43	-329.03	168.78	110.58	-58.20	-365.76
180	125.16	61.58	-63.58	-615.47	133.65	66.71	-66.94	-647.18	156.51	82.10	-74.41	-716.38	168.78	87.24	-81.54	-786.09
270	125.16	48.86	-76.30	-1128.36	133.65	52.93	-80.71	-1192.49	156.51	65.15	-91.36	-1345.14	168.78	69.22	-99.56	-1467.36
360	125.16	41.41	-83.74	-1669.43	133.65	44.87	-88.78	-1768.31	156.51	55.22	-101.29	-2011.37	168.78	58.67	-110.11	-2188.46
540	125.16	32.43	-92.73	-2807.32	133.65	35.13	-98.52	-2980.30	156.51	43.23	-113.28	-3417.99	168.78	45.94	-122.84	-3709.51
720	125.16	26.92	-98.24	-3992.34	133.65	29.16	-104.49	-4243.35	156.51	35.89	-120.62	-4887.40	168.78	38.13	-130.65	-5297.28
1080	125.16	20.31	-104.85	-6438.36	133.65	22.00	-111.65	-6851.72	156.51	27.07	-129.44	-7927.38	168.78	28.77	-140.01	-8580.34
1440	125.16	16.29	-108.87	-8945.25	133.65	17.65	-116.00	-9526.05	156.51	21.72	-134.79	-11048.54	168.78	23.08	-145.70	-11949.64
1800	125.16	13.51	-111.65	-11488.38	133.65	14.63	-119.01	-12239.64	156.51	18.01	-138.50	-14218.12	168.78	19.13	-149.65	-15370.37
2160	125.16	11.57	-113.59	-14044.05	133.65	12.53	-121.11	-14966.82	156.51	15.43	-141.08	-17404.37	168.78	16.39	-152.39	-18808.83
2880	125.16	8.97	-116.19	-19183.93	133.65	9.72	-123.93	-20452.09	156.51	11.96	-144.55	-23814.97	168.78	12.71	-156.07	-25726.20
4320	125.16	6.22	-118.94	-29510.20	133.65	6.74	-126.91	-31473.01	156.51	8.29	-148.22	-36698.05	168.78	8.81	-159.97	-39626.74
Volume check				ok				ok				ok				ok

A3									A4			
Storm Duration (mins)	43				44				46			
	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)
1	154.96	911.63	756.66	-26.63	134.71	790.08	655.36	-22.93	813.96	7049.90	6235.94	-408.01
2	154.96	743.75	588.79	1.96	134.71	644.58	509.87	1.83	813.96	5751.67	4937.70	-166.60
3	154.96	681.42	526.45	27.72	134.71	590.56	455.85	24.13	813.96	5269.62	4455.66	54.34
4	154.96	632.19	477.23	49.03	134.71	547.90	413.18	42.57	813.96	4888.92	4074.95	240.95
5	154.96	590.75	435.79	66.72	134.71	511.98	377.27	57.88	813.96	4568.47	3754.50	399.64
10	154.96	442.00	287.04	115.87	134.71	383.07	248.35	100.36	813.96	3418.13	2604.17	888.81
15	154.96	355.58	200.62	131.60	134.71	308.17	173.46	113.87	813.96	2749.84	1935.88	1119.78
20	154.96	299.63	144.66	131.70	134.71	259.68	124.96	113.84	813.96	2317.10	1503.14	1230.13
25	154.96	260.95	105.99	123.74	134.71	226.16	91.44	106.82	813.96	2018.01	1204.05	1278.48
30	154.96	232.33	77.37	110.37	134.71	201.36	66.64	95.12	813.96	1796.71	982.75	1285.28
45	154.96	178.97	24.01	53.19	134.71	155.11	20.40	45.20	813.96	1384.05	570.09	1175.02
60	154.96	149.10	-5.86	-17.68	134.71	129.22	-5.49	-16.57	813.96	1153.07	339.11	960.74
90	154.96	115.93	-39.03	-181.55	134.71	100.47	-34.24	-159.32	813.96	896.53	82.57	364.43
120	154.96	97.57	-57.39	-362.16	134.71	84.56	-50.15	-316.58	813.96	754.56	-59.40	-358.06
180	154.96	76.97	-77.99	-754.36	134.71	66.71	-68.00	-657.94	813.96	595.25	-218.71	-2037.17
270	154.96	61.07	-93.89	-1387.58	134.71	52.93	-81.78	-1208.93	813.96	472.31	-341.66	-4895.17
360	154.96	51.77	-103.19	-2056.02	134.71	44.87	-89.85	-1790.44	813.96	400.33	-413.63	-8020.73
540	154.96	40.53	-114.43	-3462.53	134.71	35.13	-99.59	-3013.82	813.96	313.45	-500.51	-14804.60
720	154.96	33.65	-121.32	-4927.96	134.71	29.16	-105.55	-4288.27	813.96	260.19	-553.77	-22040.80
1080	154.96	25.38	-129.58	-7953.76	134.71	22.00	-112.72	-6919.46	813.96	196.29	-617.67	-37242.74
1440	154.96	20.36	-134.60	-11055.65	134.71	17.65	-117.06	-9616.59	813.96	157.49	-656.48	-53033.50
1800	154.96	16.88	-138.08	-14202.86	134.71	14.63	-120.08	-12352.98	813.96	130.55	-683.41	-69179.25
2160	154.96	14.46	-140.50	-17365.73	134.71	12.53	-122.18	-15102.96	813.96	111.84	-702.12	-85443.83
2880	154.96	11.22	-143.75	-23727.17	134.71	9.72	-124.99	-20633.85	813.96	86.73	-727.23	-118251.02
4320	154.96	7.77	-147.19	-36508.16	134.71	6.74	-127.98	-31745.99	813.96	60.10	-753.86	-184309.11
Volume check				ok				ok				ok

Storm Duration (mins)	A5												C1			
	47				48				49N				22			
	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)
1	709.03	5530.53	4821.49	-271.94	537.70	4011.15	3473.45	-183.25	404.60	2888.03	2483.43	-122.35	248.49	1397.83	1149.33	-37.00
2	709.03	4512.08	3803.05	-86.24	537.70	3272.50	2734.80	-49.80	404.60	2356.20	1951.60	-27.18	248.49	1140.42	891.93	6.24
3	709.03	4133.93	3424.90	83.13	537.70	2998.23	2460.54	71.72	404.60	2158.73	1754.13	59.32	248.49	1044.84	796.35	45.12
4	709.03	3835.27	3126.24	225.54	537.70	2781.63	2243.93	173.68	404.60	2002.77	1598.17	131.75	248.49	969.35	720.86	77.17
5	709.03	3583.88	2874.85	346.05	537.70	2599.30	2061.60	259.75	404.60	1871.50	1466.90	192.73	248.49	905.82	657.33	103.68
10	709.03	2681.47	1972.44	709.92	537.70	1944.80	1407.10	517.02	404.60	1400.26	995.66	373.01	248.49	677.73	429.24	175.92
15	709.03	2157.21	1448.18	871.18	537.70	1564.57	1026.87	627.33	404.60	1126.49	721.89	447.48	248.49	545.23	296.74	196.92
20	709.03	1817.73	1108.69	937.78	537.70	1318.35	780.65	668.96	404.60	949.21	544.61	472.48	248.49	459.43	210.93	193.95
25	709.03	1583.10	874.07	955.66	537.70	1148.18	610.48	675.24	404.60	826.69	422.09	472.02	248.49	400.12	151.63	178.61
30	709.03	1409.49	700.46	940.90	537.70	1022.27	484.57	657.83	404.60	736.03	331.43	454.48	248.49	356.24	107.75	154.98
45	709.03	1085.76	376.73	793.81	537.70	787.48	249.78	530.95	404.60	566.98	162.38	348.06	248.49	274.42	25.93	57.84
60	709.03	904.57	195.53	564.77	537.70	656.06	118.36	344.50	404.60	472.36	67.76	198.68	248.49	228.63	-19.86	-60.31
90	709.03	703.31	-5.72	-25.65	537.70	510.09	-27.60	-124.58	404.60	367.27	-37.33	-169.51	248.49	177.76	-70.73	-330.67
120	709.03	591.94	-117.09	-715.70	537.70	429.32	-108.38	-666.13	404.60	309.11	-95.49	-590.03	248.49	149.61	-98.88	-626.76
180	709.03	466.96	-242.07	-2280.59	537.70	338.68	-199.02	-1883.62	404.60	243.85	-160.75	-1528.09	248.49	118.02	-130.47	-1266.58
270	709.03	370.52	-338.51	-4895.77	537.70	268.73	-268.97	-3904.62	404.60	193.48	-211.12	-3075.77	248.49	93.65	-154.84	-2295.38
360	709.03	314.06	-394.98	-7721.82	537.70	227.78	-309.92	-6078.88	404.60	164.00	-240.60	-4734.01	248.49	79.38	-169.11	-3378.30
540	709.03	245.90	-463.13	-13793.03	537.70	178.34	-359.35	-10731.72	404.60	128.41	-276.19	-8269.89	248.49	62.15	-186.34	-5651.05
720	709.03	204.12	-504.91	-20219.78	537.70	148.04	-389.65	-15642.64	404.60	106.59	-298.01	-11991.74	248.49	51.59	-196.90	-8014.24
1080	709.03	153.98	-555.05	-33646.52	537.70	111.68	-426.02	-25880.54	404.60	80.41	-324.19	-19735.21	248.49	38.92	-209.57	-12886.29
1440	709.03	123.55	-585.49	-47535.10	537.70	89.60	-448.09	-36453.37	404.60	64.52	-340.08	-27719.83	248.49	31.23	-217.27	-17875.01
1800	709.03	102.42	-606.61	-61701.23	537.70	74.28	-463.42	-47227.22	404.60	53.48	-351.12	-35848.95	248.49	25.89	-222.61	-22933.10
2160	709.03	87.73	-621.30	-75961.06	537.70	63.63	-474.06	-58069.17	404.60	45.82	-358.78	-44027.22	248.49	22.17	-226.32	-28015.27
2880	709.03	68.04	-640.99	-104698.41	537.70	49.35	-488.35	-79910.83	404.60	35.53	-369.07	-60497.25	248.49	17.20	-231.29	-38234.27
4320	709.03	47.15	-661.88	-162522.37	537.70	34.20	-503.50	-123847.82	404.60	24.62	-379.98	-93620.23	248.49	11.92	-236.57	-58761.55
Volume check				ok				ok				ok				ok

Storm Duration (mins)	C2								C3											
	23				24				20				21				32			
	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)
1	130.84	729.30	598.46	-18.91	142.65	790.08	647.42	-20.19	147.80	911.63	763.83	-29.37	149.63	911.63	762.00	-28.65	156.88	911.63	754.75	-25.93
2	130.84	595.00	464.16	3.59	142.65	644.58	501.93	4.14	147.80	743.75	595.95	-0.41	149.63	743.75	594.12	0.22	156.88	743.75	586.87	2.55
3	130.84	545.13	414.29	23.81	142.65	590.56	447.91	25.99	147.80	681.42	533.62	25.76	149.63	681.42	531.79	26.29	156.88	681.42	524.54	28.20
4	130.84	505.75	374.91	40.46	142.65	547.90	405.24	43.98	147.80	632.19	484.39	47.48	149.63	632.19	482.56	47.90	156.88	632.19	475.31	49.40
5	130.84	472.60	341.76	54.22	142.65	511.98	369.33	58.83	147.80	590.75	442.95	65.59	149.63	590.75	441.12	65.90	156.88	590.75	433.87	66.99
10	130.84	353.60	222.76	91.57	142.65	383.07	240.41	99.04	147.80	442.00	294.20	116.78	149.63	442.00	292.37	116.57	156.88	442.00	285.12	115.58
15	130.84	284.47	153.62	102.19	142.65	308.17	165.52	110.28	147.80	355.58	207.79	134.56	149.63	355.58	205.96	133.83	156.88	355.58	198.70	130.77
20	130.84	239.70	108.86	100.29	142.65	259.68	117.02	107.96	147.80	299.63	151.83	136.71	149.63	299.63	150.00	135.46	156.88	299.63	142.75	130.31
25	130.84	208.76	77.92	91.94	142.65	226.16	83.50	98.66	147.80	260.95	113.15	130.81	149.63	260.95	111.32	129.03	156.88	260.95	104.07	121.80
30	130.84	185.87	55.02	79.27	142.65	201.36	58.70	84.66	147.80	232.33	84.54	119.51	149.63	232.33	82.71	117.20	156.88	232.33	75.45	107.88
45	130.84	143.18	12.33	27.55	142.65	155.11	12.46	27.85	147.80	178.97	31.17	68.54	149.63	178.97	29.35	64.64	156.88	178.97	22.09	49.03
60	130.84	119.28	-11.56	-35.14	142.65	129.22	-13.43	-40.86	147.80	149.10	1.31	3.92	149.63	149.10	-0.52	-1.57	156.88	149.10	-7.78	-23.51
90	130.84	92.74	-38.10	-178.29	142.65	100.47	-42.18	-197.53	147.80	115.93	-31.87	-147.41	149.63	115.93	-33.70	-156.10	156.88	115.93	-40.95	-190.74
120	130.84	78.06	-52.79	-334.88	142.65	84.56	-58.09	-368.76	147.80	97.57	-50.22	-315.42	149.63	97.57	-52.05	-327.32	156.88	97.57	-59.31	-374.72
180	130.84	61.58	-69.27	-672.93	142.65	66.71	-75.94	-738.18	147.80	76.97	-70.83	-682.33	149.63	76.97	-72.65	-700.69	156.88	76.97	-79.91	-773.70
270	130.84	48.86	-81.98	-1216.06	142.65	52.93	-89.72	-1331.39	147.80	61.07	-86.72	-1277.47	149.63	61.07	-88.55	-1305.55	156.88	61.07	-95.81	-1417.11
360	130.84	41.41	-89.43	-1787.43	142.65	44.87	-97.79	-1955.20	147.80	51.77	-96.03	-1907.75	149.63	51.77	-97.86	-1945.57	156.88	51.77	-105.11	-2095.76
540	130.84	32.43	-98.42	-2985.98	142.65	35.13	-107.52	-3263.30	147.80	40.53	-107.27	-3237.86	149.63	40.53	-109.09	-3295.19	156.88	40.53	-116.35	-3522.73
720	130.84	26.92	-103.93	-4231.72	142.65	29.16	-113.49	-4622.52	147.80	33.65	-114.15	-4626.84	149.63	33.65	-115.98	-4703.68	156.88	33.65	-123.23	-5008.64
1080	130.84	20.31	-110.54	-6799.22	142.65	22.00	-120.66	-7423.33	147.80	25.38	-122.42	-7499.65	149.63	25.38	-124.24	-7615.54	156.88	25.38	-131.50	-8075.40
1440	130.84	16.29	-114.55	-9427.59	142.65	17.65	-125.00	-10290.09	147.80	20.36	-127.43	-10448.56	149.63	20.36	-129.26	-10603.51	156.88	20.36	-136.51	-11218.26
1800	130.84	13.51	-117.34	-12092.14	142.65	14.63	-128.02	-13196.02	147.80	16.88	-130.92	-13442.86	149.63	16.88	-132.74	-13636.84	156.88	16.88	-140.00	-14406.40
2160	130.84	11.57	-119.27	-14769.26	142.65	12.53	-130.12	-16115.59	147.80	14.46	-133.34	-16452.79	149.63	14.46	-135.16	-16685.81	156.88	14.46	-142.42	-17610.23
2880	130.84	8.97	-121.87	-20152.01	142.65	9.72	-132.93	-21985.60	147.80	11.22	-136.58	-22508.36	149.63	11.22	-138.41	-22819.47	156.88	11.22	-145.66	-24053.56
4320	130.84	6.22	-124.63	-30964.11	142.65	6.74	-135.92	-33776.10	147.80	7.77	-140.03	-34677.54	149.63	7.77	-141.85	-35144.83	156.88	7.77	-149.11	-36998.37
Volume check				ok				ok				ok				ok				ok

Storm Duration (mins)	C4																			
	33				34				35				36				37			
	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)
1	419.49	3099.53	2680.04	-139.34	415.71	3038.75	2623.04	-134.13	495.47	3038.75	2543.28	-96.79	339.52	2491.78	2152.25	-110.74	488.48	3646.50	3158.02	-166.78
2	419.49	2528.75	2109.26	-36.42	415.71	2479.17	2063.46	-33.47	495.47	2479.17	1983.70	-0.38	339.52	2032.92	1693.39	-28.12	488.48	2975.00	2486.52	-45.45
3	419.49	2316.82	1897.33	57.25	415.71	2271.39	1855.68	58.12	495.47	2271.39	1775.92	86.69	339.52	1862.54	1523.01	47.05	488.48	2725.67	2237.19	65.04
4	419.49	2149.44	1729.95	135.81	415.71	2107.29	1691.58	134.89	495.47	2107.29	1611.82	158.92	339.52	1727.98	1388.45	110.08	488.48	2528.75	2040.27	157.76
5	419.49	2008.55	1589.06	202.10	415.71	1969.17	1553.46	199.62	495.47	1969.17	1473.70	219.11	339.52	1614.72	1275.19	163.24	488.48	2363.00	1874.52	236.02
10	419.49	1502.80	1083.31	399.76	415.71	1473.33	1057.63	392.15	495.47	1473.33	977.87	388.95	339.52	1208.13	868.61	321.50	488.48	1768.00	1279.52	470.00
15	419.49	1208.98	789.49	483.87	415.71	1185.28	769.57	473.34	495.47	1185.28	689.81	447.41	339.52	971.93	632.40	388.46	488.48	1422.33	933.85	570.37
20	419.49	1018.73	599.24	514.90	415.71	998.75	583.04	502.50	495.47	998.75	503.28	453.78	339.52	818.98	479.45	412.76	488.48	1198.50	710.02	608.32
25	419.49	887.23	467.74	518.61	415.71	869.83	454.13	504.87	495.47	869.83	374.37	433.30	339.52	713.26	373.74	415.09	488.48	1043.80	555.32	614.12
30	419.49	789.93	370.44	504.02	415.71	774.44	358.74	489.29	495.47	774.44	278.98	394.82	339.52	635.04	295.52	402.70	488.48	929.33	440.85	598.39
45	419.49	608.51	189.02	402.52	415.71	596.57	180.87	385.95	495.47	596.57	101.11	222.49	339.52	489.19	149.67	319.13	488.48	715.89	227.41	483.33
60	419.49	506.95	87.47	254.99	415.71	497.01	81.31	237.45	495.47	497.01	1.55	4.64	339.52	407.55	68.03	198.54	488.48	596.42	107.94	314.12
90	419.49	394.16	-25.32	-114.45	415.71	386.44	-29.27	-132.49	495.47	386.44	-109.03	-504.70	339.52	316.88	-22.65	-102.45	488.48	463.72	-24.76	-111.73
120	419.49	331.75	-87.74	-539.93	415.71	325.24	-90.47	-557.42	495.47	325.24	-170.22	-1069.66	339.52	266.70	-72.82	-448.51	488.48	390.29	-98.19	-603.47
180	419.49	261.71	-157.78	-1494.78	415.71	256.57	-159.13	-1509.19	495.47	256.57	-238.89	-2302.61	339.52	210.39	-129.13	-1224.19	488.48	307.89	-180.59	-1709.10
270	419.49	207.65	-211.84	-3077.64	415.71	203.58	-212.13	-3084.58	495.47	203.58	-291.89	-4301.35	339.52	166.94	-172.59	-2508.81	488.48	244.30	-244.18	-3544.60
360	419.49	176.01	-243.48	-4778.98	415.71	172.56	-243.15	-4776.18	495.47	172.56	-322.91	-6417.24	339.52	141.50	-198.03	-3888.72	488.48	207.07	-281.41	-5519.42
540	419.49	137.81	-281.68	-8416.88	415.71	135.11	-280.60	-8390.06	495.47	135.11	-360.36	-10880.89	339.52	110.79	-228.74	-6837.66	488.48	162.13	-326.35	-9745.72
720	419.49	114.40	-305.09	-12254.25	415.71	112.15	-303.56	-12199.53	495.47	112.15	-383.31	-15540.78	339.52	91.97	-247.56	-9946.98	488.48	134.58	-353.90	-14206.63
1080	419.49	86.30	-333.19	-20250.52	415.71	84.61	-331.10	-20133.77	495.47	84.61	-410.86	-25176.79	339.52	69.38	-270.15	-16424.14	488.48	101.53	-386.95	-23506.69
1440	419.49	69.24	-350.25	-28505.61	415.71	67.88	-347.83	-28321.75	495.47	67.88	-427.59	-35066.47	339.52	55.66	-283.86	-23109.36	488.48	81.46	-407.02	-33111.23
1800	419.49	57.40	-362.09	-36915.98	415.71	56.27	-359.44	-36661.90	495.47	56.27	-439.19	-45107.40	339.52	46.14	-293.38	-29898.31	488.48	67.53	-420.95	-42898.51
2160	419.49	49.17	-370.32	-45379.00	415.71	48.21	-367.50	-45053.69	495.47	48.21	-447.26	-55200.45	339.52	39.53	-300.00	-36771.75	488.48	57.85	-430.63	-52747.71
2880	419.49	38.13	-381.36	-62426.91	415.71	37.38	-378.32	-61956.75	495.47	37.38	-458.08	-75505.60	339.52	30.66	-308.87	-50574.45	488.48	44.86	-443.62	-72589.51
4320	419.49	26.42	-393.06	-96718.82	415.71	25.91	-389.80	-95955.18	495.47	25.91	-469.56	-116309.37	339.52	21.24	-318.28	-78337.52	488.48	31.09	-457.39	-112503.74
Volume check				ok				ok				ok				ok				ok

C4

Storm Duration (mins)	38				39				40				41			
	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)
1	353.27	2431.00	2077.73	-96.51	355.41	2431.00	2075.59	-95.46	358.02	2431.00	2072.98	-94.20	343.76	2431.00	2087.24	-101.32
2	353.27	1983.33	1630.06	-17.08	355.41	1983.33	1627.92	-16.14	358.02	1983.33	1625.31	-15.02	343.76	1983.33	1639.57	-21.38
3	353.27	1817.11	1463.84	55.02	355.41	1817.11	1461.70	55.84	358.02	1817.11	1459.09	56.81	343.76	1817.11	1473.35	51.25
4	353.27	1685.83	1332.56	115.26	355.41	1685.83	1330.42	115.96	358.02	1685.83	1327.81	116.78	343.76	1685.83	1342.07	112.04
5	353.27	1575.33	1222.06	165.87	355.41	1575.33	1219.92	166.44	358.02	1575.33	1217.31	167.12	343.76	1575.33	1231.57	163.18
10	353.27	1178.67	825.39	314.02	355.41	1178.67	823.25	313.98	358.02	1178.67	820.64	313.92	343.76	1178.67	834.91	314.03
15	353.27	948.22	594.95	373.09	355.41	948.22	592.81	372.44	358.02	948.22	590.20	371.64	343.76	948.22	604.46	375.81
20	353.27	799.00	445.73	390.51	355.41	799.00	443.59	389.25	358.02	799.00	440.98	387.70	343.76	799.00	455.24	395.95
25	353.27	695.87	342.59	386.49	355.41	695.87	340.45	384.62	358.02	695.87	337.84	382.32	343.76	695.87	352.11	394.65
30	353.27	619.56	266.28	368.09	355.41	619.56	264.14	365.60	358.02	619.56	261.53	362.56	343.76	619.56	275.80	378.97
45	353.27	477.26	123.99	267.54	355.41	477.26	121.85	263.20	358.02	477.26	119.24	257.90	343.76	477.26	133.50	286.64
60	353.27	397.61	44.34	130.76	355.41	397.61	42.20	124.56	358.02	397.61	39.59	117.00	343.76	397.61	53.85	158.13
90	353.27	309.15	-44.12	-201.33	355.41	309.15	-46.27	-211.27	358.02	309.15	-48.87	-223.40	343.76	309.15	-34.61	-157.35
120	353.27	260.19	-93.08	-577.59	355.41	260.19	-95.22	-591.29	358.02	260.19	-97.83	-607.98	343.76	260.19	-83.56	-516.92
180	353.27	205.26	-148.01	-1411.93	355.41	205.26	-150.15	-1433.18	358.02	205.26	-152.76	-1459.07	343.76	205.26	-138.50	-1317.75
270	353.27	162.86	-190.41	-2782.06	355.41	162.86	-192.55	-2814.68	358.02	162.86	-195.16	-2854.40	343.76	162.86	-180.89	-2637.41
360	353.27	138.05	-215.23	-4245.41	355.41	138.05	-217.37	-4289.42	358.02	138.05	-219.98	-4343.02	343.76	138.05	-205.71	-4050.17
540	353.27	108.09	-245.19	-7356.99	355.41	108.09	-247.33	-7423.81	358.02	108.09	-249.94	-7505.19	343.76	108.09	-235.67	-7060.43
720	353.27	89.72	-263.55	-10625.20	355.41	89.72	-265.69	-10714.87	358.02	89.72	-268.30	-10824.04	343.76	89.72	-254.04	-10227.26
1080	353.27	67.69	-285.59	-17414.14	355.41	67.69	-287.73	-17549.49	358.02	67.69	-290.34	-17714.30	343.76	67.69	-276.07	-16813.28
1440	353.27	54.31	-298.97	-24406.04	355.41	54.31	-301.11	-24587.09	358.02	54.31	-303.72	-24807.53	343.76	54.31	-289.45	-23602.29
1800	353.27	45.02	-308.25	-31519.43	355.41	45.02	-310.40	-31746.15	358.02	45.02	-313.00	-32022.18	343.76	45.02	-298.74	-30512.90
2160	353.27	38.56	-314.71	-38674.27	355.41	38.56	-316.85	-38946.66	358.02	38.56	-319.46	-39278.32	343.76	38.56	-305.19	-37464.89
2880	353.27	29.91	-323.36	-53079.40	355.41	29.91	-325.51	-53443.15	358.02	29.91	-328.11	-53886.02	343.76	29.91	-313.85	-51464.40
4320	353.27	20.73	-332.55	-82043.83	355.41	20.73	-334.69	-82590.31	358.02	20.73	-337.30	-83255.66	343.76	20.73	-323.03	-79617.42
Volume check				ok				ok				ok				ok

D1

Storm Duration (mins)	25				28				29				30				31			
	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)
1	155.37	972.40	817.03	-81.28	207.43	1215.50	1008.07	-95.69	210.33	1215.50	1005.17	-94.47	208.88	1276.28	1067.40	-104.39	145.23	850.85	705.62	-24.63
2	155.37	793.33	637.96	-39.52	207.43	991.67	784.24	-44.19	210.33	991.67	781.33	-43.13	208.88	1041.25	832.37	-49.84	145.23	694.17	548.93	2.02
3	155.37	726.84	571.48	-7.48	207.43	908.56	701.12	-4.90	210.33	908.56	698.22	-4.01	208.88	953.98	745.11	-8.08	145.23	635.99	490.75	26.02
4	155.37	674.33	518.96	18.96	207.43	842.92	635.49	27.40	210.33	842.92	632.58	28.13	208.88	885.06	676.19	26.35	145.23	590.04	444.81	45.88
5	155.37	630.13	474.76	41.06	207.43	787.67	580.24	54.26	210.33	787.67	577.33	54.83	208.88	827.05	618.17	55.07	145.23	551.37	406.13	62.36
10	155.37	471.47	316.10	29.97	207.43	589.33	381.90	39.80	210.33	589.33	379.00	40.23	208.88	618.80	409.92	40.29	145.23	412.53	267.30	108.06
15	155.37	379.29	223.92	77.24	207.43	474.11	266.68	95.11	210.33	474.11	263.78	94.71	208.88	497.82	288.94	100.92	145.23	331.88	186.64	122.57
20	155.37	319.60	164.23	98.10	207.43	399.50	192.07	117.39	210.33	399.50	189.17	116.16	208.88	419.48	210.60	126.87	145.23	279.65	134.42	122.48
25	155.37	278.35	122.98	104.83	207.43	347.93	140.50	122.01	210.33	347.93	137.60	119.94	208.88	365.33	156.45	134.29	145.23	243.55	98.32	114.88
30	155.37	247.82	92.45	102.59	207.43	309.78	102.35	115.40	210.33	309.78	99.45	112.49	208.88	325.27	116.39	129.92	145.23	216.84	71.61	102.23
45	155.37	190.90	35.53	45.96	207.43	238.63	31.20	41.07	210.33	238.63	28.30	37.39	208.88	250.56	41.68	54.27	145.23	167.04	21.81	48.34
60	155.37	159.04	3.68	7.69	207.43	198.81	-8.63	-18.28	210.33	198.81	-11.53	-24.50	208.88	208.75	-0.13	-0.27	145.23	139.16	-6.07	-18.33
90	155.37	123.66	-31.71	-89.35	207.43	154.57	-52.86	-150.83	210.33	154.57	-55.76	-159.52	208.88	162.30	-46.57	-131.85	145.23	108.20	-37.03	-172.34
120	155.37	104.08	-51.29	-229.30	207.43	130.10	-77.33	-349.02	210.33	130.10	-80.23	-362.81	208.88	136.60	-72.27	-324.24	145.23	91.07	-54.17	-341.97
180	155.37	82.10	-73.27	-441.18	207.43	102.63	-104.80	-636.75	210.33	102.63	-107.70	-655.57	208.88	107.76	-101.12	-610.91	145.23	71.84	-73.39	-710.16
270	155.37	65.15	-90.22	-840.43	207.43	81.43	-126.00	-1182.27	210.33	81.43	-128.90	-1211.29	208.88	85.50	-123.37	-1152.32	145.23	57.00	-88.23	-1304.37
360	155.37	55.22	-100.15	-1446.98	207.43	69.02	-138.41	-2010.86	210.33	69.02	-141.31	-2055.32	208.88	72.47	-136.40	-1974.79	145.23	48.32	-96.92	-1931.46
540	155.37	43.23	-112.13	-2171.19	207.43	54.04	-153.39	-2985.72	210.33	54.04	-156.29	-3045.46	208.88	56.75	-152.13	-2951.40	145.23	37.83	-107.40	-3250.64
720	155.37	35.89	-119.48	-3549.09	207.43	44.86	-162.57	-4849.17	210.33	44.86	-165.47	-4939.88	208.88	47.10	-161.77	-4812.75	145.23	31.40	-113.83	-4624.82
1080	155.37	27.07	-128.29	-5083.92	207.43	33.84	-173.59	-6907.24	210.33	33.84	-176.49	-7028.58	208.88	35.53	-173.34	-6879.48	145.23	23.69	-121.54	-7461.79
1440	155.37	21.72	-133.65	-8065.11	207.43	27.15	-180.28	-10916.03	210.33	27.15	-183.18	-11099.32	208.88	28.51	-180.37	-10898.07	145.23	19.01	-126.23	-10369.79
1800	155.37	18.01	-137.36	-11130.10	207.43	22.51	-184.92	-15029.42	210.33	22.51	-187.82	-15274.63	208.88	23.63	-185.24	-15026.58	145.23	15.76	-129.48	-13320.06
2160	155.37	15.43	-139.94	-14236.23	207.43	19.28	-188.15	-19194.31	210.33	19.28	-191.05	-19501.46	208.88	20.25	-188.63	-19209.12	145.23	13.50	-131.74	-16284.97
2880	155.37	11.96	-143.41	-17425.74	207.43	14.95	-192.48	-23460.05	210.33	14.95	-195.38	-23828.41	208.88	15.70	-193.17	-23499.82	145.23	10.47	-134.77	-22248.09
4320	155.37	8.29	-147.08	-23698.91	207.43	10.36	-197.07	-31859.36	210.33	10.36	-199.97	-32350.19	208.88	10.88	-198.00	-31942.32	145.23	7.25	-137.98	-34228.57
Volume check				ok				ok				ok				ok				ok

D2

Storm Duration (mins)	26				27				54				55			
	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)
1	141.00	790.08	649.07	-20.73	142.82	790.08	647.26	-20.13	287.96	2005.58	1717.61	-81.36	205.80	1276.28	1070.47	-41.57
2	141.00	644.58	503.58	3.68	142.82	644.58	501.77	4.18	287.96	1636.25	1348.29	-15.64	205.80	1041.25	835.45	-0.96
3	141.00	590.56	449.56	25.62	142.82	590.56	447.75	26.02	287.96	1499.12	1211.15	44.04	205.80	953.98	748.18	35.74
4	141.00	547.90	406.89	43.71	142.82	547.90	405.08	44.00	287.96	1390.81	1102.85	93.93	205.80	885.06	679.26	66.21
5	141.00	511.98	370.98	58.66	142.82	511.98	369.17	58.85	287.96	1299.65	1011.69	135.88	205.80	827.05	621.25	91.62
10	141.00	383.07	242.07	99.34	142.82	383.07	240.25	99.01	287.96	972.40	684.44	259.10	205.80	618.80	413.00	163.61
15	141.00	308.17	167.17	111.05	142.82	308.17	165.36	110.20	287.96	782.28	494.32	308.82	205.80	497.82	292.01	188.82
20	141.00	259.68	118.67	109.21	142.82	259.68	116.86	107.84	287.96	659.18	371.21	324.19	205.80	419.48	213.67	192.15
25	141.00	226.16	85.16	100.38	142.82	226.16	83.34	98.49	287.96	574.09	286.13	321.87	205.80	365.33	159.53	184.21
30	141.00	201.36	60.35	86.86	142.82	201.36	58.54	84.44	287.96	511.13	223.17	307.69	205.80	325.27	119.46	168.70
45	141.00	155.11	14.11	31.48	142.82	155.11	12.29	27.49	287.96	393.74	105.77	227.74	205.80	250.56	44.76	98.31
60	141.00	129.22	-11.78	-35.78	142.82	129.22	-13.59	-41.36	287.96	328.03	40.07	117.93	205.80	208.75	2.94	8.82
90	141.00	100.47	-40.53	-189.55	142.82	100.47	-42.34	-198.32	287.96	255.05	-32.92	-149.96	205.80	162.30	-43.50	-201.09
120	141.00	84.56	-56.44	-357.87	142.82	84.56	-58.25	-369.83	287.96	214.66	-73.30	-454.25	205.80	136.60	-69.20	-434.34
180	141.00	66.71	-74.29	-721.46	142.82	66.71	-76.11	-739.83	287.96	169.34	-118.63	-1130.31	205.80	107.76	-98.04	-944.09
270	141.00	52.93	-88.07	-1305.88	142.82	52.93	-89.89	-1333.90	287.96	134.36	-153.60	-2242.17	205.80	85.50	-120.30	-1771.37
360	141.00	44.87	-96.14	-1920.89	142.82	44.87	-97.95	-1958.59	287.96	113.89	-174.08	-3430.90	205.80	72.47	-133.33	-2647.84
540	141.00	35.13	-105.87	-3211.36	142.82	35.13	-107.69	-3268.42	287.96	89.17	-198.79	-5960.83	205.80	56.75	-149.06	-4498.12
720	141.00	29.16	-111.84	-4552.95	142.82	29.16	-113.66	-4629.39	287.96	74.02	-213.94	-8619.96	205.80	47.10	-158.70	-6430.80
1080	141.00	22.00	-119.00	-7318.46	142.82	22.00	-120.82	-7433.68	287.96	55.84	-232.12	-14146.49	205.80	35.53	-170.27	-10428.96
1440	141.00	17.65	-123.35	-10149.92	142.82	17.65	-125.17	-10303.92	287.96	44.80	-243.16	-19840.47	205.80	28.51	-177.29	-14533.66
1800	141.00	14.63	-126.37	-13020.58	142.82	14.63	-128.18	-13213.33	287.96	37.14	-250.82	-25634.72	205.80	23.63	-182.17	-18701.91
2160	141.00	12.53	-128.47	-15904.86	142.82	12.53	-130.28	-16136.38	287.96	31.82	-256.15	-31463.14	205.80	20.25	-185.56	-22892.04
2880	141.00	9.72	-131.28	-21704.31	142.82	9.72	-133.10	-22013.35	287.96	24.67	-263.29	-43198.76	205.80	15.70	-190.10	-31322.31
4320	141.00	6.74	-134.27	-33353.67	142.82	6.74	-136.08	-33817.78	287.96	17.10	-270.87	-66797.13	205.80	10.88	-194.92	-48264.07
Volume check				ok				ok				ok				ok

	D5											
Storm Duration (mins)	**49S**				**50**				**51**			
	Pre-Dev Flow (l/s)	**Post-Dev Flow (l/s)**	**Excess Flow (l/s)**	**Storage (m3)**	**Pre-Dev Flow (l/s)**	**Post-Dev Flow (l/s)**	**Excess Flow (l/s)**	**Storage (m3)**	**Pre-Dev Flow (l/s)**	**Post-Dev Flow (l/s)**	**Excess Flow (l/s)**	**Storage (m3)**
1	282.79	2005.58	1722.78	-84.01	424.30	3099.53	2675.22	-136.66	586.07	3707.28	3121.21	-125.61
2	282.79	1636.25	1353.46	-18.02	424.30	2528.75	2104.45	-34.00	586.07	3024.58	2438.51	-7.00
3	282.79	1499.12	1216.32	41.95	424.30	2316.82	1892.51	59.40	586.07	2771.09	2185.03	100.27
4	282.79	1390.81	1108.02	92.14	424.30	2149.44	1725.14	137.69	586.07	2570.90	1984.83	189.44
5	282.79	1299.65	1016.86	134.39	424.30	2008.55	1584.25	203.70	586.07	2402.38	1816.31	263.92
10	282.79	972.40	689.61	259.07	424.30	1502.80	1078.50	400.00	586.07	1797.47	1211.40	476.38
15	282.79	782.28	499.49	310.26	424.30	1208.98	784.68	482.74	586.07	1446.04	859.97	552.96
20	282.79	659.18	376.38	327.11	424.30	1018.73	594.42	512.41	586.07	1218.48	632.41	566.00
25	282.79	574.09	291.30	326.26	424.30	887.23	462.93	514.74	586.07	1061.20	475.13	546.30
30	282.79	511.13	228.34	313.56	424.30	789.93	365.63	498.77	586.07	944.82	358.75	504.64
45	282.79	393.74	110.94	238.09	424.30	608.51	184.20	393.12	586.07	727.82	141.75	310.35
60	282.79	328.03	45.23	132.76	424.30	506.95	82.65	241.41	586.07	606.36	20.29	60.60
90	282.79	255.05	-27.75	-126.11	424.30	394.16	-30.14	-136.42	586.07	471.45	-114.62	-528.59
120	282.79	214.66	-68.13	-421.33	424.30	331.75	-92.55	-570.33	586.07	396.80	-189.27	-1185.49
180	282.79	169.34	-113.46	-1079.18	424.30	261.71	-162.60	-1542.13	586.07	313.02	-273.05	-2624.75
270	282.79	134.36	-148.43	-2163.62	424.30	207.65	-216.65	-3150.51	586.07	248.37	-337.70	-4965.46
360	282.79	113.89	-168.91	-3324.87	424.30	176.01	-248.29	-4877.43	586.07	210.52	-375.55	-7448.89
540	282.79	89.17	-193.62	-5799.75	424.30	137.81	-286.49	-8566.57	586.07	164.83	-421.24	-12698.36
720	282.79	74.02	-208.77	-8403.80	424.30	114.40	-309.91	-12455.21	586.07	136.83	-449.24	-18187.10
1080	282.79	55.84	-226.95	-13820.08	424.30	86.30	-338.00	-20554.11	586.07	103.22	-482.85	-29550.18
1440	282.79	44.80	-237.99	-19403.83	424.30	69.24	-355.06	-28911.81	586.07	82.82	-503.25	-41222.75
1800	282.79	37.14	-245.65	-25087.90	424.30	57.40	-366.90	-37424.73	586.07	68.65	-517.42	-53080.05
2160	282.79	31.82	-250.98	-30806.12	424.30	49.17	-375.13	-45990.33	586.07	58.81	-527.26	-65000.84
2880	282.79	24.67	-258.12	-42321.35	424.30	38.13	-386.17	-63243.38	586.07	45.61	-540.46	-88987.73
4320	282.79	17.10	-265.70	-65478.88	424.30	26.42	-397.88	-97945.65	586.07	31.61	-554.46	-137197.31
Volume check				ok				ok				ok

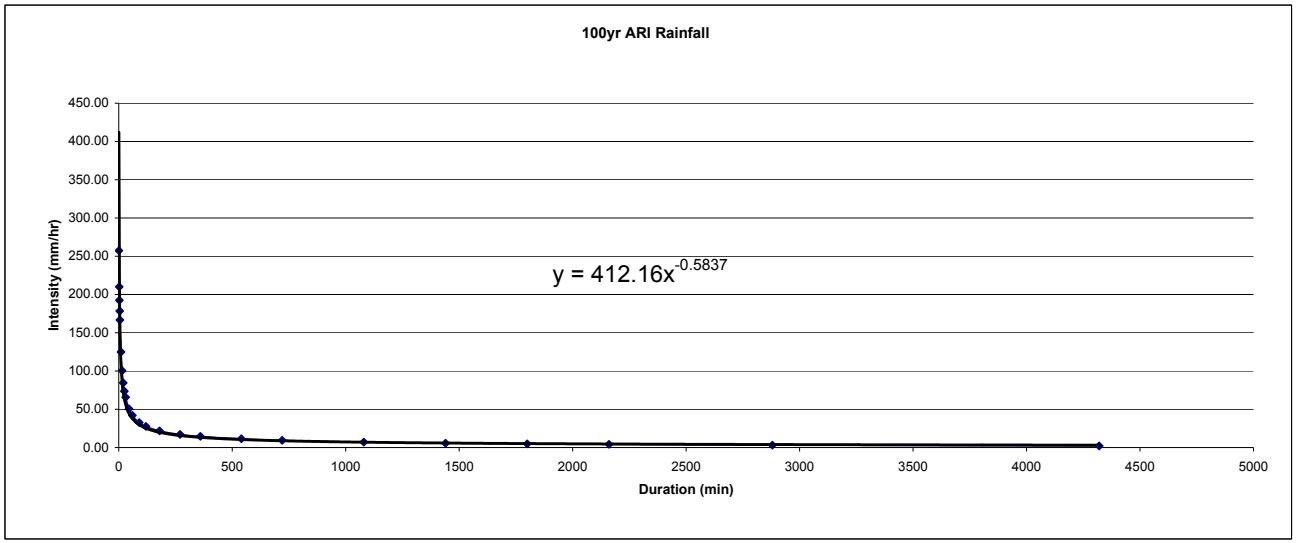
100 YEAR ARI DRAINAGE PROPERTIES - UPSTREAM CATCHMENTS

Catchment	AREAS (m2)			TIME OF CONCENTRATION PRE-DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)	
	Area (m2)	Effective Area (m2)		Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (min)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (min)	Pre-Dev	Post-Dev
		Pre	Post												
46U	85334	29867	29867	200	65	60.6	22.00	8.9	200	65	60.6	22.00	8.9	115.2	115.2
47U	25256	8840	8840	200	62	59	15.00	10.8	200	62	59	15.00	10.8	102.6	102.6
48U	63701	22295	22295	193	59.8	57.4	12.44	9.9	193	59.8	57.4	12.44	9.9	108.2	108.2
49NU	127362	44577	44577	204	67.5	64.5	14.71	9.4	204	67.5	64.5	14.71	9.4	111.2	111.2
49SU	4097	1434	1434	410	72.6	67	13.66	27.1	410	72.6	67	13.66	27.1	60.0	60.0
DRU	241611	84564	84564	162	60	58.2	11.11	7.4	162	60	58.2	11.11	7.4	127.8	127.8
50U	16395	5738	5738	177	62	59.4	14.69	10.0	177	62	59.4	14.69	10.0	107.2	107.2
51U	51525	18034	18034	198	64	61	15.15	10.0	198	64	61	15.15	10.0	107.7	107.7
SDU	1174437	411053	411053	2014	145	74.5	35.00	62.7	2014	145	74.5	35.00	62.7	36.8	36.8

Runoff Coefficients

Cleared Upland	0.35
Hardstand	0.85

Event	Duration (mins)	Intensity (mm/hr)
1 min	1	257.40
2 min	2	210.00
3 min	3	192.40
4 min	4	178.50
5 min	5	166.80
10 min	10	124.80
15 min	15	100.40
20 min	20	84.60
25 min	25	73.68
30 min	30	65.60
45 min	45	50.53
1 hr	60	42.10
1.5 hr	90	32.73
2 hr	120	27.55
3 hr	180	21.73
4.5 hr	270	17.24
6 hr	360	14.62
9 hr	540	11.44
12 hr	720	9.50
18 hr	1080	7.17
24 hr	1440	5.75
30 hr	1800	4.77
36 hr	2160	4.08
48 hr	2880	3.17
72 hr	4320	2.19



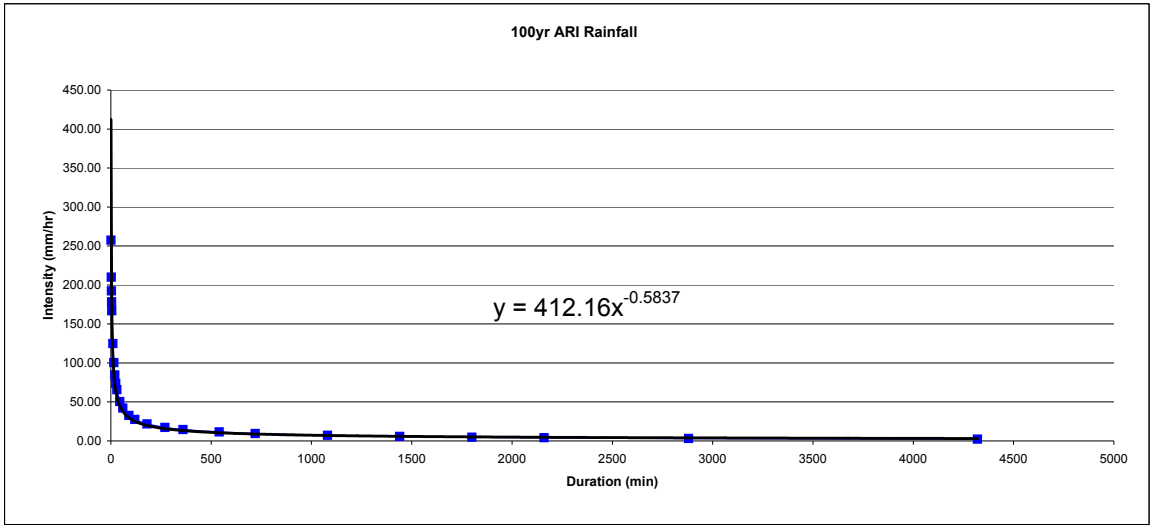
100 YEAR ARI DRAINAGE PROPERTIES - ROADS

CATCHMENT	AREAS (m2)					EFFECTIVE AREAS (m2)		TIME OF CONCENTRATION PRE DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)	
	Road Reserve (m2)	Swale	Lots (m2)	POS (m2)	Total	Pre	Post	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (mln)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (mln)	Pre-Dev	Post-Dev
A1	32745	870	0	0	33615	11765	27964	989	70	54	16.18	51.3	989	70	54	16.18	47.0	44.0	46.5
A2	8531	256	0	0	8787	3075	7290	290	58.5	56.8	5.86	21.1	290	58.5	56.8	5.86	19.3	77.0	81.3
A3	9956	295	0	0	10251	3588	8507	340	66	64	5.88	24.3	340	66	64	5.88	22.3	70.4	74.3
A4	10792	229	0	0	11021	3857	9208	231	73.7	70.4	14.29	13.7	231	73.7	70.4	14.29	12.6	100.7	106.4
A5	24409	583	0	0	24992	8747	20835	612	75	70	8.17	37.5	612	75	70	8.17	34.3	53.6	56.6
A6	13299	420	0	0	13719	4802	11367	500	66	58	16.00	28.4	500	66	58	16.00	26.1	63.8	67.3
B1	13269	296	0	0	13565	4748	11323	213	73	72	4.69	15.5	213	73	72	4.69	14.2	93.4	98.6
C1	4400	0	0	0	4400	1540	3740	183	55.7	54	9.29	13.0	183	55.7	54	9.29	11.9	104.3	110.3
C2	4813	0	0	0	4813	1685	4091	233	55.5	54.5	4.29	19.1	233	55.5	54.5	4.29	17.5	81.8	86.5
C3	7868	249	0	0	8117	2841	6725	258	60.4	55.7	18.22	15.1	258	60.4	55.7	18.22	13.8	95.1	100.3
C4	29301	885	0	0	30186	10565	25039	570	63	60.5	4.39	38.8	570	63	60.5	4.39	35.6	52.5	55.4
D1	4310	141	0	1	4452	1558	3685	145	55.5	54	10.34	10.1	145	55.5	54	10.34	9.2	122.4	129.2
D2	5856	189	0	2	6047	2116	5006	195	57	55.5	7.69	13.9	195	57	55.5	7.69	12.8	99.8	105.4
D3	15265	326	0	0	15591	5457	13024	402	63.2	56.8	15.92	22.6	402	63.2	56.8	15.92	20.7	73.7	77.8
D4	10526	335	0	0	10861	3801	8997	338	70.5	63.2	21.60	18.5	338	70.5	63.2	21.60	17.0	83.5	88.1
D5	27241	623	0	0	27864	9752	23248	407	75	70.5	11.06	23.2	407	75	70.5	11.06	21.3	72.5	76.5

Runoff Coefficients	Pre-Dev	Post-Dev
Roads	0.35	0.85
Swales/Basins	0.35	1
Lots	0.35	0
OS	0.35	0

Rainfall IFD

Event	Duration (mins)	Intensity (mm/hr)
1 min	1	257.40
2 min	2	210.00
3 min	3	192.40
4 min	4	178.50
5 min	5	166.80
10 min	10	124.80
15 min	15	100.40
20 min	20	84.60
25 min	25	73.68
30 min	30	65.60
45 min	45	50.53
1 hr	60	42.10
1.5 hr	90	32.73
2 hr	120	27.55
3 hr	180	21.73
4.5 hr	270	17.24
6 hr	360	14.62
9 hr	540	11.44
12 hr	720	9.50
18 hr	1080	7.17
24 hr	1440	5.75
30 hr	1800	4.77
36 hr	2160	4.08
48 hr	2880	3.17
72 hr	4320	2.19



100 YEAR ARI FLOWS - ROADS

Storm Duration (mins)	A1 Pre-Dev Flow (l/s)	A1 Post-Dev Flow (l/s)	A1 Excess Flow (l/s)	A1 Storage (m3)	A2 Pre-Dev Flow (l/s)	A2 Post-Dev Flow (l/s)	A2 Excess Flow (l/s)	A2 Storage (m3)
1	143.93	1999.41	1855.48	-265.41	65.77	521.22	455.44	-39.29
2	143.93	1631.22	1487.29	-191.67	65.77	425.24	359.46	-21.31
3	143.93	1494.51	1350.58	-123.76	65.77	389.60	323.82	-5.08
4	143.93	1386.54	1242.60	-65.60	65.77	361.45	295.68	8.60
5	143.93	1295.65	1151.72	-15.35	65.77	337.76	271.98	20.21
10	143.93	969.41	825.48	149.60	65.77	252.71	186.94	55.77
15	143.93	779.88	635.95	241.31	65.77	203.30	137.53	72.21
20	143.93	657.15	513.22	298.81	65.77	171.31	105.53	79.68
25	143.93	572.32	428.39	338.72	65.77	149.20	83.42	82.51
30	143.93	509.56	365.63	366.84	65.77	132.84	67.06	82.22
45	143.93	392.53	248.60	414.10	65.77	102.33	36.55	71.46
60	143.93	327.02	183.09	431.83	65.77	85.25	19.48	52.69
90	143.93	254.26	110.33	419.63	65.77	66.28	0.51	2.16
120	143.93	214.00	70.07	371.57	65.77	55.79	-9.99	-58.26
180	143.93	168.82	24.89	208.93	65.77	44.01	-21.77	-197.37
270	143.93	133.95	-9.98	-131.46	65.77	34.92	-30.86	-432.50
360	143.93	113.54	-30.39	-547.83	65.77	29.60	-36.18	-688.24
540	143.93	88.90	-55.03	-1531.80	65.77	23.17	-42.60	-1240.11
720	143.93	73.79	-70.14	-2644.13	65.77	19.24	-46.54	-1826.00
1080	143.93	55.67	-88.26	-5075.80	65.77	14.51	-51.26	-3052.51
1440	143.93	44.66	-99.27	-7674.46	65.77	11.64	-54.13	-4322.50
1800	143.93	37.03	-106.91	-10373.69	65.77	9.65	-56.12	-5617.94
2160	143.93	31.72	-112.21	-13106.67	65.77	8.27	-57.51	-6922.57
2880	143.93	24.60	-119.33	-18651.45	65.77	6.41	-59.36	-9552.02
4320	143.93	17.05	-126.89	-29866.96	65.77	4.44	-61.33	-14844.75
Volume check				ok				ok

Storm Duration (mins)	A3 Pre-Dev Flow (l/s)	A3 Post-Dev Flow (l/s)	A3 Excess Flow (l/s)	A3 Storage (m3)	A4 Pre-Dev Flow (l/s)	A4 Post-Dev Flow (l/s)	A4 Excess Flow (l/s)	A4 Storage (m3)
1	70.15	608.24	538.09	-50.69	107.95	658.34	550.39	-35.09
2	70.15	496.23	426.09	-29.40	107.95	537.11	429.16	-13.60
3	70.15	454.64	384.50	-10.11	107.95	492.09	384.14	5.54
4	70.15	421.80	351.65	6.20	107.95	456.54	348.59	21.45
5	70.15	394.15	324.01	20.10	107.95	426.62	318.67	34.74
10	70.15	294.90	224.76	63.37	107.95	319.20	211.24	72.83
15	70.15	237.25	167.10	84.33	107.95	256.79	148.84	86.73
20	70.15	199.91	129.77	94.84	107.95	216.38	108.43	89.29
25	70.15	174.11	103.96	99.94	107.95	188.45	80.50	85.94
30	70.15	155.01	84.87	101.41	107.95	167.78	59.83	78.64
45	70.15	119.41	49.27	94.32	107.95	129.25	21.30	44.08
60	70.15	99.48	29.34	77.96	107.95	107.68	-0.27	-0.78
90	70.15	77.35	7.20	30.17	107.95	83.72	-24.23	-107.26
120	70.15	65.10	-5.04	-29.05	107.95	70.46	-37.49	-226.56
180	70.15	51.36	-18.79	-168.61	107.95	55.59	-52.36	-488.78
270	70.15	40.75	-29.40	-408.56	107.95	44.11	-63.84	-916.35
360	70.15	34.54	-35.61	-672.39	107.95	37.38	-70.57	-1370.43
540	70.15	27.04	-43.10	-1247.01	107.95	29.27	-78.68	-2330.21
720	70.15	22.45	-47.70	-1861.21	107.95	24.30	-83.65	-3333.28
1080	70.15	16.93	-53.21	-3153.32	107.95	18.33	-89.62	-5409.04
1440	70.15	13.59	-56.56	-4496.17	107.95	14.71	-93.24	-7539.68
1800	70.15	11.26	-58.88	-5868.88	107.95	12.19	-95.76	-9701.99
2160	70.15	9.65	-60.50	-7252.24	107.95	10.44	-97.51	-11876.15
2880	70.15	7.48	-62.66	-10042.60	107.95	8.10	-99.85	-16249.78
4320	70.15	5.19	-64.96	-15662.57	107.95	5.61	-102.34	-25040.32
Volume check				ok				ok

Storm Duration (mins)	A5 Pre-Dev Flow (l/s)	A5 Post-Dev Flow (l/s)	A5 Excess Flow (l/s)	A5 Storage (m3)	A6 Pre-Dev Flow (l/s)	A6 Post-Dev Flow (l/s)	A6 Excess Flow (l/s)	A6 Storage (m3)
1	130.31	1489.71	1359.40	-163.47	85.10	812.75	727.66	-75.47
2	130.31	1215.38	1085.07	-109.52	85.10	663.08	577.99	-46.63
3	130.31	1113.52	983.21	-60.12	85.10	607.51	522.42	-20.39
4	130.31	1033.07	902.77	-17.98	85.10	563.62	478.53	1.87
5	130.31	965.36	835.05	18.24	85.10	526.68	441.58	20.91
10	130.31	722.28	591.98	135.11	85.10	394.06	308.97	81.05
15	130.31	581.07	450.76	197.38	85.10	317.02	231.92	111.38
20	130.31	489.62	359.32	234.13	85.10	267.13	182.03	127.76
25	130.31	426.43	296.12	257.71	85.10	232.65	147.55	136.93
30	130.31	379.66	249.36	272.48	85.10	207.13	122.04	141.27
45	130.31	292.46	162.16	288.94	85.10	159.56	74.47	138.96
60	130.31	243.65	113.35	283.14	85.10	132.93	47.84	124.33
90	130.31	189.45	59.14	235.53	85.10	103.36	18.26	75.10
120	130.31	159.45	29.14	160.74	85.10	86.99	1.90	10.75
180	130.31	125.78	-4.52	-39.20	85.10	68.62	-16.47	-145.95
270	130.31	99.80	-30.50	-412.09	85.10	54.45	-30.65	-421.56
360	130.31	84.59	-45.71	-842.27	85.10	46.15	-38.94	-728.88
540	130.31	66.24	-64.07	-1816.16	85.10	36.14	-48.96	-1405.99
720	130.31	54.98	-75.32	-2886.15	85.10	30.00	-55.10	-2135.84
1080	130.31	41.48	-88.83	-5181.04	85.10	22.63	-62.47	-3680.49
1440	130.31	33.28	-97.03	-7600.29	85.10	18.16	-66.94	-5292.96
1800	130.31	27.59	-102.72	-10093.83	85.10	15.05	-70.04	-6945.52
2160	130.31	23.63	-106.67	-12612.85	85.10	12.89	-72.20	-8612.21
2880	130.31	18.33	-111.98	-17709.31	85.10	10.00	-75.10	-11977.27
4320	130.31	12.70	-117.61	-27996.91	85.10	6.93	-78.17	-18759.58
Volume check				ok				ok

Storm Duration (mins)	B1 Pre-Dev Flow (l/s)	B1 Post-Dev Flow (l/s)	B1 Excess Flow (l/s)	B1 Storage (m3)	C1 Pre-Dev Flow (l/s)	C1 Post-Dev Flow (l/s)	C1 Excess Flow (l/s)	C1 Storage (m3)
1	123.17	809.60	686.42	-47.75	44.61	267.41	222.80	-13.14
2	123.17	660.51	537.34	-20.85	44.61	218.17	173.55	-4.48
3	123.17	605.15	481.98	3.21	44.61	199.88	155.27	3.24
4	123.17	561.43	438.26	23.30	44.61	185.44	140.83	9.64
5	123.17	524.63	401.46	40.17	44.61	173.29	128.67	14.98
10	123.17	392.53	269.36	89.64	44.61	129.65	85.04	30.16
15	123.17	315.79	192.61	109.37	44.61	104.30	59.69	35.52
20	123.17	266.09	142.92	115.16	44.61	87.89	43.28	36.27
25	123.17	231.75	108.57	113.71	44.61	76.55	31.93	34.63
30	123.17	206.33	83.16	107.41	44.61	68.15	23.54	31.38
45	123.17	158.94	35.77	72.97	44.61	52.50	7.89	16.51
60	123.17	132.42	9.24	25.95	44.61	43.74	-0.88	-2.52
90	123.17	102.96	-20.22	-88.58	44.61	34.01	-10.61	-47.35
120	123.17	86.65	-36.52	-218.74	44.61	28.62	-15.99	-97.37
180	123.17	68.36	-54.82	-507.90	44.61	22.58	-22.03	-206.93
270	123.17	54.24	-68.93	-983.43	44.61	17.92	-26.70	-385.10
360	123.17	45.97	-77.20	-1491.37	44.61	15.19	-29.43	-573.99
540	123.17	36.00	-87.18	-2570.51	44.61	11.89	-32.72	-972.69
720	123.17	29.88	-93.29	-3702.76	44.61	9.87	-34.74	-1388.94
1080	123.17	22.54	-100.63	-6052.68	44.61	7.45	-37.17	-2249.66
1440	123.17	18.09	-105.09	-8470.10	44.61	5.97	-38.64	-3132.68
1800	123.17	14.99	-108.18	-10926.66	44.61	4.95	-39.66	-4028.61
2160	123.17	12.84	-110.33	-13397.69	44.61	4.24	-40.37	-4929.34
2880	123.17	9.96	-113.21	-18370.96	44.61	3.29	-41.32	-6741.08
4320	123.17	6.90	-116.27	-28370.50	44.61	2.28	-42.33	-10382.08
Volume check				ok				

Storm Duration (mins)	C2 Pre-Dev Flow (l/s)	C2 Post-Dev Flow (l/s)	C2 Excess Flow (l/s)	C2 Storage (m3)	C3 Pre-Dev Flow (l/s)	C3 Post-Dev Flow (l/s)	C3 Excess Flow (l/s)	C3 Storage (m3)	C4 Pre-Dev Flow (l/s)	C4 Post-Dev Flow (l/s)	C4 Excess Flow (l/s)	C4 Storage (m3)
1	38.27	292.51	254.24	-19.68	75.02	480.85	405.83	-28.11	154.02	1790.26	1636.24	-202.22
2	38.27	238.64	200.37	-9.70	75.02	392.30	317.28	-12.20	154.02	1460.59	1306.56	-137.22
3	38.27	218.64	180.37	-0.69	75.02	359.42	284.40	2.01	154.02	1338.17	1184.15	-77.69
4	38.27	202.85	164.58	6.89	75.02	333.46	258.44	13.85	154.02	1241.50	1087.48	-26.90
5	38.27	189.55	151.28	13.31	75.02	311.60	236.58	23.78	154.02	1160.12	1006.10	16.80
10	38.27	141.82	103.55	32.79	75.02	233.14	158.12	52.71	154.02	868.00	713.98	158.04
15	38.27	114.09	75.82	41.53	75.02	187.56	112.54	63.99	154.02	698.30	544.28	233.67
20	38.27	96.14	57.87	45.25	75.02	158.04	83.02	66.97	154.02	588.41	434.39	278.63
25	38.27	83.73	45.46	46.37	75.02	137.64	62.62	65.65	154.02	512.46	358.44	307.77
30	38.27	74.55	36.28	45.74	75.02	122.55	47.53	61.44	154.02	456.26	302.24	326.31
45	38.27	57.43	19.15	38.31	75.02	94.40	19.38	39.57	154.02	351.47	197.45	348.47
60	38.27	47.84	9.57	26.41	75.02	78.65	3.63	10.19	154.02	292.81	138.79	343.86
90	38.27	37.20	-1.07	-4.64	75.02	61.15	-13.87	-60.80	154.02	227.67	73.64	291.37
120	38.27	31.31	-6.96	-41.21	75.02	51.47	-23.55	-141.13	154.02	191.61	37.59	206.19
180	38.27	24.70	-13.57	-124.52	75.02	40.60	-34.42	-319.03	154.02	151.16	-2.86	-24.69
270	38.27	19.60	-18.68	-264.25	75.02	32.21	-42.80	-610.84	154.02	119.94	-34.08	-458.74
360	38.27	16.61	-21.66	-415.49	75.02	27.31	-47.71	-922.00	154.02	101.66	-52.36	-961.69
540	38.27	13.01	-25.27	-740.58	75.02	21.38	-53.64	-1581.97	154.02	79.60	-74.42	-2104.00
720	38.27	10.80	-27.48	-1084.72	75.02	17.75	-57.27	-2273.56	154.02	66.07	-87.95	-3361.83
1080	38.27	8.14	-30.13	-1803.65	75.02	13.39	-61.63	-3707.54	154.02	49.85	-104.18	-6063.66
1440	38.27	6.53	-31.74	-2546.99	75.02	10.74	-64.28	-5181.62	154.02	39.99	-114.03	-8914.95
1800	38.27	5.42	-32.86	-3304.67	75.02	8.90	-66.11	-6678.85	154.02	33.15	-120.87	-11855.48
2160	38.27	4.64	-33.63	-4067.48	75.02	7.63	-67.39	-8184.72	154.02	28.40	-125.62	-14826.65
2880	38.27	3.60	-34.67	-5604.45	75.02	5.92	-69.10	-11214.96	154.02	22.02	-132.00	-20839.19
4320	38.27	2.49	-35.78	-8697.30	75.02	4.10	-70.92	-17307.02	154.02	15.26	-138.76	-32978.07
Volume check								ok				ok

Storm Duration (mins)	D1				D2				D3				D4				D5			
	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)	Pre-Dev Flow (l/s)	Post-Dev Flow (l/s)	Excess Flow (l/s)	Storage (m3)
1	52.99	263.45	210.46	-10.82	58.70	357.93	299.23	-19.65	111.73	931.23	819.50	-72.90	88.15	643.31	555.16	-44.21	196.30	1662.25	1465.96	-132.92
2	52.99	214.94	161.94	-2.68	58.70	292.01	233.32	-7.94	111.73	759.74	648.01	-40.55	88.15	524.85	436.70	-22.34	196.30	1356.15	1159.85	-75.02
3	52.99	196.92	143.93	4.46	58.70	267.54	208.84	2.48	111.73	696.07	584.34	-11.26	88.15	480.86	392.71	-2.68	196.30	1242.49	1046.20	-22.57
4	52.99	182.70	129.70	10.29	58.70	248.21	189.52	11.14	111.73	645.78	534.05	13.46	88.15	446.12	357.97	13.83	196.30	1152.73	956.43	21.74
5	52.99	170.72	117.73	15.08	58.70	231.94	173.25	18.37	111.73	603.45	491.72	34.49	88.15	416.88	328.73	27.78	196.30	1077.17	880.88	59.45
10	52.99	127.73	74.74	27.67	58.70	173.54	114.84	39.14	111.73	451.50	339.78	99.48	88.15	311.91	223.76	69.81	196.30	805.94	609.65	176.34
15	52.99	102.76	49.77	30.58	58.70	139.61	80.91	46.75	111.73	363.23	251.50	130.31	88.15	250.93	162.78	88.23	196.30	648.37	452.07	232.24
20	52.99	86.59	33.60	28.93	58.70	117.64	58.94	48.19	111.73	306.07	194.34	145.13	88.15	211.44	123.29	95.57	196.30	546.34	350.04	259.58
25	52.99	75.41	22.42	24.90	58.70	102.46	43.76	46.43	111.73	266.56	154.83	151.68	88.15	184.15	96.00	97.17	196.30	475.82	279.52	272.15
30	52.99	67.14	14.15	19.28	58.70	91.22	32.52	42.50	111.73	237.33	125.60	152.67	88.15	163.95	75.80	94.91	196.30	423.64	227.34	274.81
45	52.99	51.72	-1.27	-2.71	58.70	70.27	11.57	23.84	111.73	182.82	71.09	138.01	88.15	126.30	38.15	75.86	196.30	326.34	130.04	251.31
60	52.99	43.09	-9.90	-28.91	58.70	58.54	-0.15	-0.44	111.73	152.31	40.58	109.14	88.15	105.22	17.07	46.88	196.30	271.88	75.58	202.46
90	52.99	33.50	-19.49	-88.18	58.70	45.52	-13.18	-58.14	111.73	118.42	6.70	28.31	88.15	81.81	-6.34	-27.28	196.30	211.39	15.09	63.61
120	52.99	28.20	-24.80	-152.72	58.70	38.31	-20.39	-122.85	111.73	99.67	-12.06	-70.03	88.15	68.85	-19.29	-113.75	196.30	177.91	-18.38	-106.47
180	52.99	22.24	-30.75	-291.52	58.70	30.22	-28.48	-265.15	111.73	78.63	-33.10	-299.10	88.15	54.32	-33.83	-309.44	196.30	140.35	-55.95	-504.37
270	52.99	17.65	-35.34	-513.80	58.70	23.98	-34.72	-497.29	111.73	62.39	-49.34	-689.62	88.15	43.10	-45.05	-635.93	196.30	111.36	-84.93	-1184.91
360	52.99	14.96	-38.03	-746.91	58.70	20.33	-38.37	-743.89	111.73	52.88	-58.85	-1116.75	88.15	36.53	-51.62	-988.03	196.30	94.39	-101.90	-1930.74
540	52.99	11.71	-41.28	-1234.05	58.70	15.91	-42.78	-1265.22	111.73	41.40	-70.32	-2042.91	88.15	28.60	-59.55	-1742.30	196.30	73.91	-122.39	-3550.67
720	52.99	9.72	-43.27	-1738.67	58.70	13.21	-45.49	-1810.11	111.73	34.37	-77.36	-3029.70	88.15	23.74	-64.41	-2538.69	196.30	61.35	-134.95	-5278.78
1080	52.99	7.34	-45.66	-2775.99	58.70	9.97	-48.73	-2937.79	111.73	25.93	-85.80	-5100.85	88.15	17.91	-70.24	-4199.17	196.30	46.28	-150.01	-8909.14
1440	52.99	5.89	-47.11	-3835.25	58.70	8.00	-50.70	-4095.30	111.73	20.80	-90.93	-7249.70	88.15	14.37	-73.78	-5913.31	196.30	37.13	-159.16	-12678.19
1800	52.99	4.88	-48.11	-4906.97	58.70	6.63	-52.07	-5269.98	111.73	17.24	-94.48	-9444.22	88.15	11.91	-76.24	-7658.68	196.30	30.78	-165.51	-16528.81
2160	52.99	4.18	-48.81	-5983.55	58.70	5.68	-53.02	-6451.14	111.73	14.77	-96.96	-11655.06	88.15	10.21	-77.94	-9415.49	196.30	26.37	-169.93	-20408.54
2880	52.99	3.24	-49.75	-8146.73	58.70	4.40	-54.29	-8827.18	111.73	11.46	-100.27	-16112.92	88.15	7.91	-80.24	-12953.95	196.30	20.45	-175.85	-28232.60
4320	52.99	2.25	-50.75	-12490.68	58.70	3.05	-55.64	-13602.85	111.73	7.94	-103.79	-25088.77	88.15	5.48	-82.67	-20072.82	196.30	14.17	-182.12	-43987.99
Volume check				ok				ok				ok				ok				ok

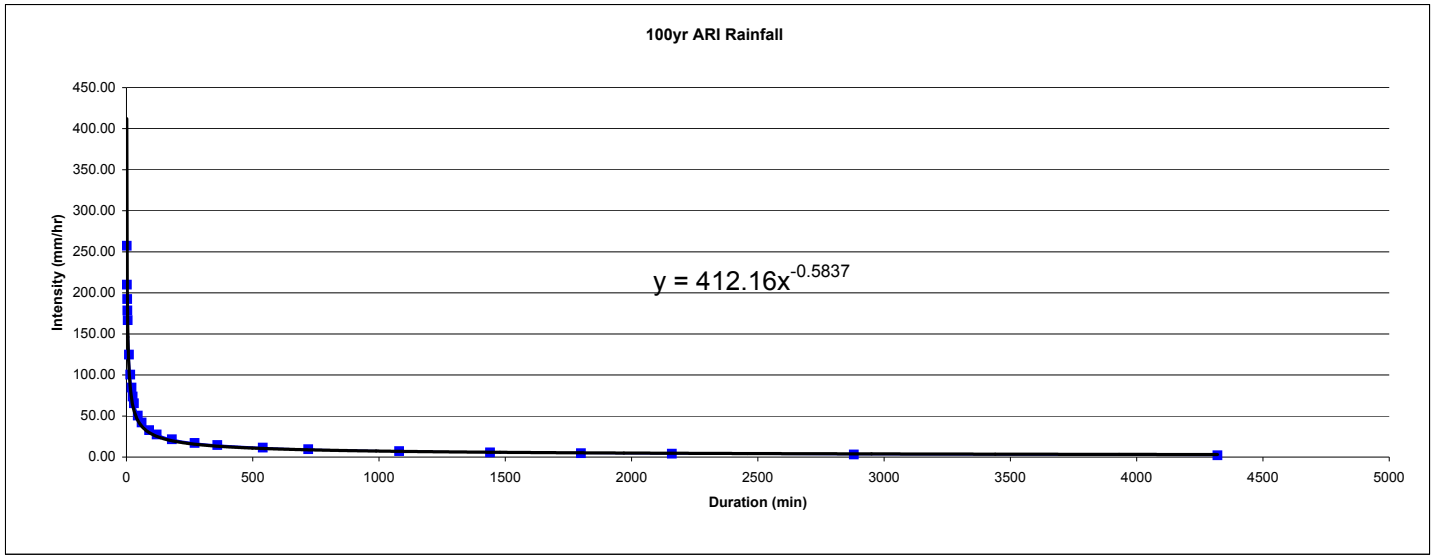
COMBINED 100 YEAR ARI DRAINAGE PROPERTIES

	CATCHMENT			CUMULATIVE EFFECTIVE AREAS (m2)			TIME OF CONCENTRATION					CRITICAL STORM INTENSITY (mm/h)
	Contibuting Segments	Contributing Lots	Contributing Upstream Catchments	Road	Lots	Upstream	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (mIn)	Pre-Dev
A1	A1-A5	10-16, 42-49n	46U,47U,49U,49NU	31033	192500	105579	2463	126	54	29.23	81.3	31.6
A2	A2	10-13		3075	20300	0	290	58.5	57	5.17	17.6	77.2
A3	A3	43		3588	9800	0	350	68	64	11.43	19.2	73.5
A4	A4	46	46U	3857	40600	29867	836	123	70.5	62.80	27.5	59.6
A5	A5	47-49N	46U,47U,48U,49NU	8747	66500	75712	1493	126	70	37.51	50.7	41.7
A6	A6			13299	0	0	453	66	58	17.66	22.8	66.5
B1	B1			4748	0	0	149	73.5	70	23.49	7.8	123.8
C1	C1	22		14946	0	0	1387	75	54	15.14	71.1	34.2
C2	C2	23,24		1685	8750	0	304	57	55	6.58	19.1	73.7
C3	C3,C4	20,21,32-41		2841	159950	0	1204	75	55.5	16.20	48.0	43.0
C4	C4	33-41		10565	144200	0	939	75	60.5	15.44	38.0	49.3
D1	D1-D5	25-30,49S-51,54,55	49SU,50U,51U,DRU	1558	110600	109770	3125	125	54	22.72	112.8	26.1
D2	D2-D5	26,27,49S-51,54,55	49SU,50U,51U,DRU	2116	78750	109770	2980	125	55	23.49	108.5	26.7
D3	D3-D5	49S-51,54,55	49SU,50U,51U,DRU	5457	69650	109770	2789	125	57	24.38	101.1	27.9
D4	D4,D5	49S-51	49SU,50U,51U,DRU	3801	50750	109770	2394	125	63	25.90	86.8	30.5
D5	D5	49S-51	49SU,50U,51U,DRU	9752	50750	109770	2022	125	70.5	26.95	72.4	33.8

Runoff Coefficients	Pre-Dev	Post-Dev
Roads	0.35	0.85
Swales/Basins	0.35	0
Lots	0.35	0
OS	0.35	0
Cleared Upland	0.35	0.35

Rainfall IFD

Event	Duration (mins)	Intensity (mm/hr)
1 min	1	257.40
2 min	2	210.00
3 min	3	192.40
4 min	4	178.50
5 min	5	166.80
10 min	10	124.80
15 min	15	100.40
20 min	20	84.60
25 min	25	73.68
30 min	30	65.60
45 min	45	50.53
1 hr	60	42.10
1.5 hr	90	32.73
2 hr	120	27.55
3 hr	180	21.73
4.5 hr	270	17.24
6 hr	360	14.62
9 hr	540	11.44
12 hr	720	9.50
18 hr	1080	7.17
24 hr	1440	5.75
30 hr	1800	4.77
36 hr	2160	4.08
48 hr	2880	3.17
72 hr	4320	2.19



COMBINED 100 YEAR ARI FLOWS

Segment	Contributing Segments	Contributing Lots	Contributing Upstream Catchments	Total Cum Peak Flow (L/s)	Long Slope	Swale Base Width (m)	Swale Depth (m)	Height Over Weir (m)
A1	A1-A5	10-16, 42-49n	46U,47U,49U,49NU	2892.34	0.0179	5	0.6	0.28
A2	A2	10-13		501.31	0.0066	4	0.5	0.15
A3	A3	43		273.18	0.0044	3	0.5	0.13
A4	A4	46	46U	1230.24	0.0140	2	0.6	0.25
A5	A5	47-49N	47U,48U,49NU	1748.01	0.0086	3.5	0.6	0.30
A6	A6			245.51	0.0190	4	0.5	0.07
B1	B1			163.29	0.0182	2	0.5	0.07
C3	C3,C4	20,21,32-41		1946.20	0.0185	3	0.6	0.27
C4	C4	33-41		2121.04	0.0016	4.5	0.8	0.48
D1	D1-D5	25-30,49S-51,54,55	49SU,50U,51U,DRU	1610.66	0.0071	3.5	0.6	0.30
D2	D2-D5	26,27,49S-51,54,55	49SU,50U,51U,DRU	1415.40	0.0079	3	0.6	0.29
D3	D3-D5	49S-51,54,55	49SU,50U,51U,DRU	1430.40	0.0172	3	0.6	0.26
D4	D4,D5	49S-51	49SU,50U,51U,DRU	1390.13	0.0209	4	0.5	0.20
D5	D5	49S-51	49SU,50U,51U,DRU	1600.45	0.0080	3.5	0.6	0.29

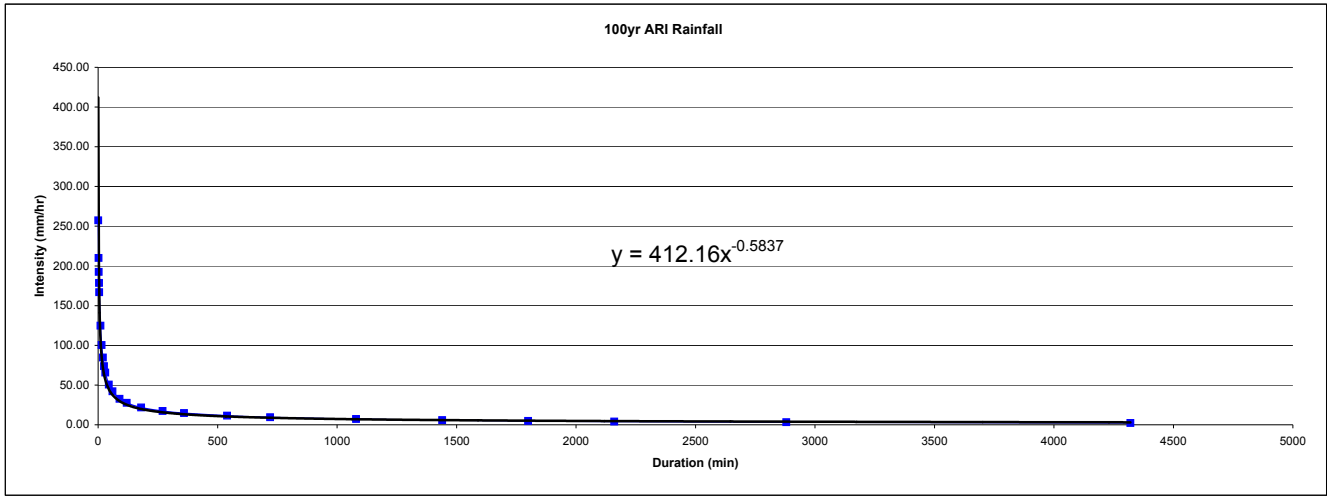
GNH CULVERT 100 YEAR ARI DRAINAGE PROPERTIES

CATCHMENT					EFFECTIVE AREAS (m2)							TIME OF CONCENTRATION					CRITICAL STORM INTENSITY (mm/h)
Group	Culverts	Contibuting Segments	Contributing Lots	Contributing Upstream Catchments	Lots	Road Reserve	Swales/ Drainage	POS	Upstream Forested	Upstream Cleared	Total	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (mln)	Pre-Dev
A	CH36.64 CH36.43	A6, B1	1-8,44	POS, NDU	50929	9299	251	58193	147021	1012858	1278551	6514	235	53	27.94	192.7	19.1
B	CH36.12 CH35.98 CH35.92 CH35.73 CH35.58 CH35.41	A1-A5,C1-C4,D1	9-25, 28-43,45-49N	POS, 46U-49NU	404269	47994	1228	3074		105579	562143	2540	126	54	28.35	80.0	31.9
C	CH35.23 CH35.02	D2-D5	26,27,49S-51,54,55, DR	49SU-51U, DRU	78750	20611	516			109770	209646	2800	125	56.7	24.39	100.3	28.0
D	CH34.79		52,53	DR, SDU	28000		1318			411053	440371	2850	145	58.5	30.35	90.7	29.7

Runoff Coefficients	Pre-Dev	Post-Dev
Roads	0.35	0.85
Swales/Basins	0.35	0
Lots	0.35	0.85
POS	0.35	0.35
Cleared Upstram	0.35	0.35
Forested Upstream	0.2	0.2

Rainfall IFD

Event	Duration (mins)	Intensity (mm/hr)
1 min	1	257.40
2 min	2	210.00
3 min	3	192.40
4 min	4	178.50
5 min	5	166.80
10 min	10	124.80
15 min	15	100.40
20 min	20	84.60
25 min	25	73.68
30 min	30	65.60
45 min	45	50.53
1 hr	60	42.10
1.5 hr	90	32.73
2 hr	120	27.55
3 hr	180	21.73
4.5 hr	270	17.24
6 hr	360	14.62
9 hr	540	11.44
12 hr	720	9.50
18 hr	1080	7.17
24 hr	1440	5.75
30 hr	1800	4.77
36 hr	2160	4.08
48 hr	2880	3.17
72 hr	4320	2.19



100 yr CULVERT FLOWS

Culvert Properties							Catchment Properties			Post Development (=Pre Development) Flows			Storage	
Group	**Culverts**	**No. & Size**	**Length**	**Slope**	**Max Flow (m3/s)**	**Total Capacity (L/s)**	**100 yr Total Effective Area (m2)**	**100 yr Critical Storm Intensity (mm/hr)**	**100 yr TC (min)**	**100yr Flow (L/s)**	**GNH Swale Length (m)**	**GNH Swale Volume (m3)**	**Storage Required (m3)**	**Volume Check**
A	CH36.64	5 x 1.2 x 0.5	17.3	0.0068	6.5025	7618.3	1278551	19	193	6788.06	396.00	1089.00	0.00	ok
	CH36.43	1 x 0.9 x 0.45	14.8	0.0142	1.1158									
B	CH36.12	1 x 0.6	17.2	0.0152	0.6258	3583.9	562143	32	80	4986.14	1000.00	2750.00	1892.96	ok
	CH35.98	2 x 0.5	14.8	0.0172	0.8202									
	CH35.92	1 x 0.6	14.8	0.0110	0.5324									
	CH35.73	1 x 0.9 x 0.6	16	0.0086	1.2656									
	CH35.58	1 x 0.45	16	0.0088	0.2217									
	CH35.41	1 x 0.45	16	0.0025	0.1182									
C	CH35.23	5 x 1.2 x 0.75	20.8	0.0057	10.28	12898	209646	28	100	1630.10	433.00	1190.75	0.00	ok
	CH35.02	2 x 1.2 x 0.45	25.6	0.0092	2.618									
D	CH34.79	4 x 1.2 x 0.75	25.6	0.0094	10.4872	10487.2	440371	30	91	3630.26	11.00	30.25	0.00	ok

GNH Swale Dimensions

Base width (m)	4
Depth (m)	0.5
Side slope	3

APPENDIX E

Bushfire Management Plan

Bushfire Management Plan Coversheet

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

Bushfire Management Plan and Site Details

Site Address / Plan Reference: Lot 1456 (3488) Great Northern Highway

Suburb: Muchea **State**: WA **P/code**: 6051

Local government area: Shire of Chittering

Description of the planning proposal: Rezoning application for industrial development

BMP Plan / Reference Number: 20PER-15939 **Version**: v1 **Date of Issue**: 17/02/21

Client / Business Name: Bayley Environmental Services

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

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

High level strategic rezoning application from agricultural to industrial land uses

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

BPAD Accredited Practitioner Details and Declaration

Name	Accreditation Level	Accreditation No.	Accreditation Expiry
Alex Aitken	Level 2	37739	November 2021

Company	Contact No.
Eco Logical Australia	08 6218 2200

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

Signature of Practitioner		Date	17-Feb-21

Bushfire Management Plan:
Rezoning Application: Lots 1456 (3488) Great Northern Highway, Muchea

Bayley Environmental Services

ecological AUSTRALIA
A TETRA TECH COMPANY

BPAD Bushfire Planning & Design Accredited Practitioner Level 3

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DOCUMENT TRACKING

Project Name	Bushfire Management Plan: Rezoning Application: Lots 1456 (3488) Great Northern Highway, Muchea
Project Number	20PER-15939
Project Manager	James Leonard
Prepared by	Alex Aitken (BPAD Level 2 – 37739)
Reviewed by	James Leonard**;** Daniel Panickar (BPAD Level 3 – 37802)
Approved by	Daniel Panickar (BPAD Level 3 – 37802)
Status	Draft
Version Number	v1
Last saved on	17 February 2021

This report should be cited as 'Eco Logical Australia 2021. *Bushfire Management Plan: Rezoning Application: Lots 1456 (3488) Great Northern Highway, Muchea* . Prepared for Bayley Environmental Services.

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from Bayley Environmental Services (the client).

Template 2.8.1

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List of Tables

1. Introduction

1.1 Proposal details

Eco Logical Australia (ELA) was commissioned by Bayley Environmental Services to prepare a Bushfire Management Plan (BMP) to support a rezoning application for Lots 1456 (3488) Great Northern Highway, Muchea (hereafter referred to as the subject site, Figure 1). The subject site is currently zoned as 'Agricultural Resource' under the local planning scheme and is proposed to be zoned as 'Industrial Development'.

The subject site is within a designated bushfire prone area as per the *Western Australia State Map of Bush Fire Prone Areas* (DFES 2019; Figure 3), which triggers bushfire planning requirements *under State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7; Western Australian Planning Commission (WAPC) 2015) and reporting to accompany submission of the development application in accordance with the associated *Guidelines for Planning in Bushfire Prone Areas v 1.3* (the Guidelines; WAPC 2017).

The subject site is part of Precinct 2 within the Muchea Industrial Park being developed by the Shire of Chittering, with assistance from State and Federal Governments.

This assessment has been prepared by ELA Senior Bushfire Consultants Alex Aitken (FPAA BPAD Level 2 Certified Practitioner No. BPAD37739) and James Leonard with quality assurance undertaken by Principal Bushfire Consultant Daniel Panickar (FPAA BPAD Level 3 Certified Practitioner No. BPAD37802).

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

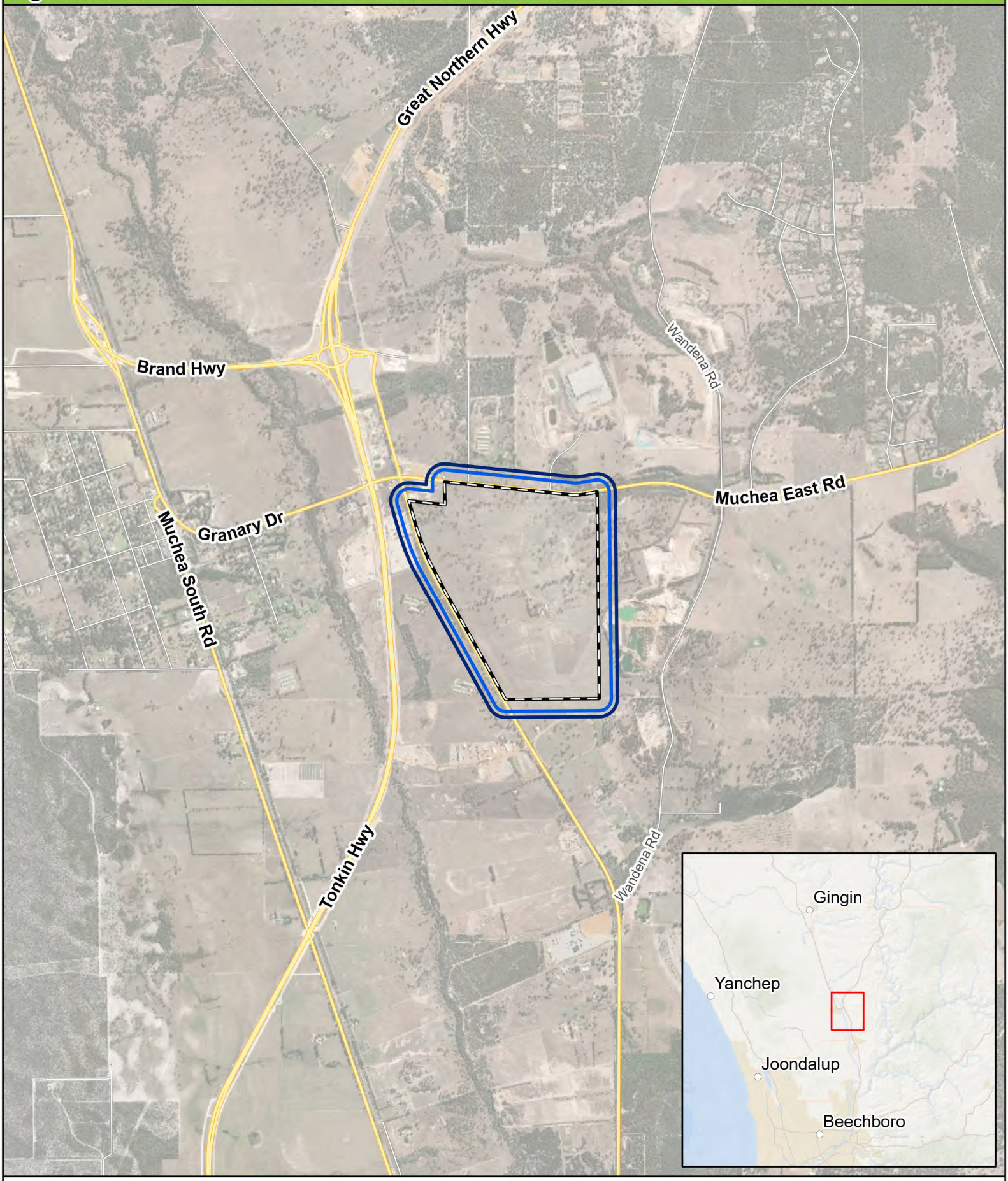
SPP 3.7 policy objective 5.4 recognises the need to consider bushfire risk management measures alongside environmental, biodiversity and conservation values.

The subject site has been historically cleared for agricultural operations with the majority of the subject site currently being utilised as a cattle farm.

Any clearing (including re-clearing) of native vegetation and/or non-native vegetation providing habitat for Matters of National Environmental Significance onsite may require consultation with State and Commonwealth Government environmental agencies and subsequent approvals prior to development commencing.

The areas of Public Open Space (POS), foreshore reserve and drainage swales are proposed to be revegetated with shrubs up to 2 m in height as part of the future development. The landscaping plans for the revegetated areas will be further defined at future planning stages.

Figure 1: Site Overview



Legend

- Subject site
- 100m site assessment
- 150m site assessment

0 0.5 1
Kilometers
Datum/Projection:
GDA 1994 MGA Zone 50

N

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Figure 2: Site Plan

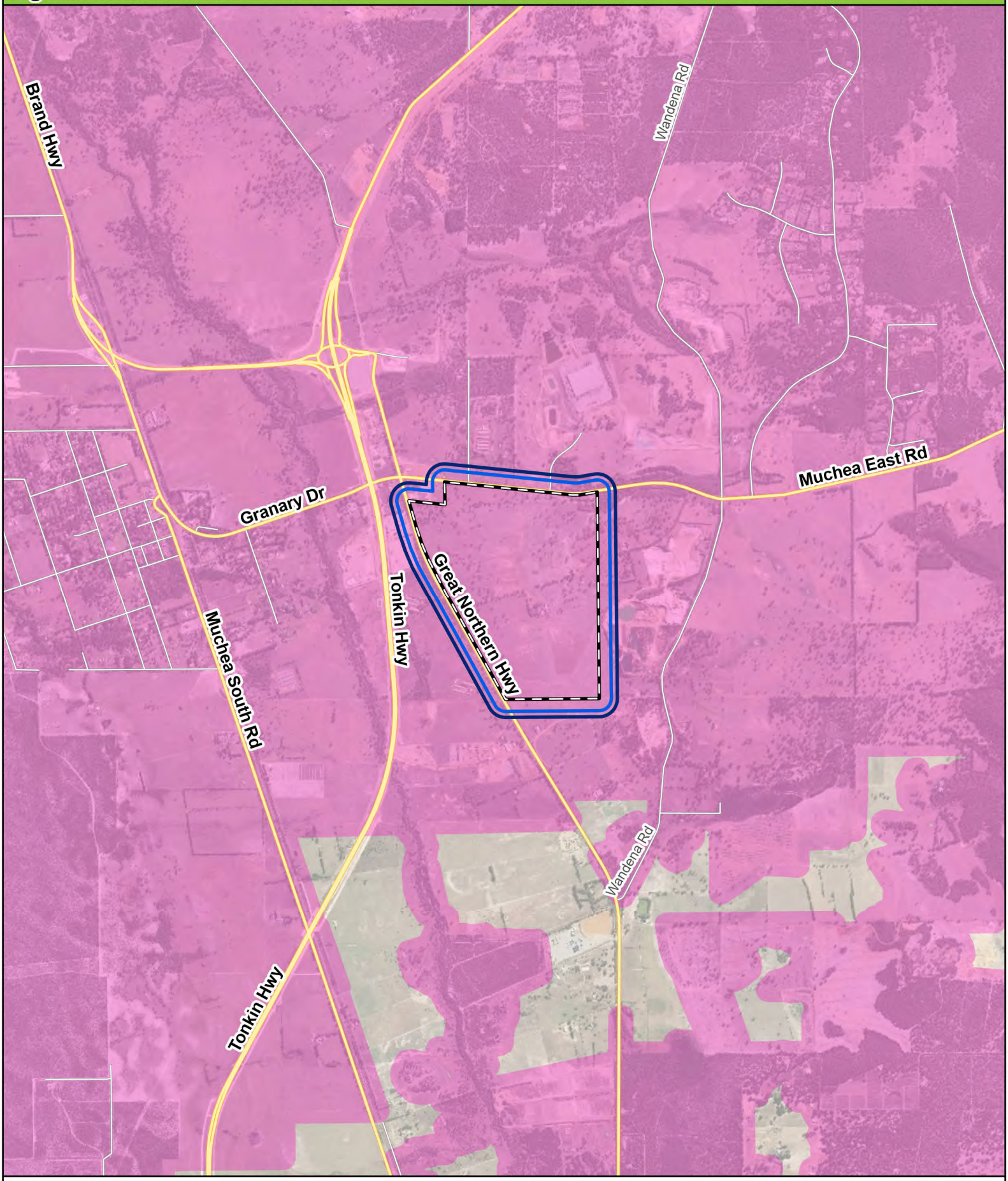
Site boundary
Proposed lot boundary
Creekline
Foreshore reserve
Bioretention swale
POS
Drainage reserve
Tree retention

Tallangatta

Structure Plan

bayley environmental services

Figure 3: Bushfire Prone Areas



Legend

- Subject site
- 100m site assessment
- 150m site assessment
- Bushfire Prone Mapping (DFES 2019)

0 0.5 1
Kilometers
Datum/Projection:
GDA 1994 MGA Zone 50

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2. Bushfire assessment results

2.1 Bushfire 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 Fire Danger Index

A blanket rating of FDI 80 is adopted for Western Australia, as outlined in Australian Standard (AS) 3959–2018 and endorsed by Australasian Fire and Emergency Service Authorities Council (AFAC).

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 3959-2018 Construction of Buildings in Bushfire Prone Areas* (SA 2018) with regard given to the *Visual guide for bushfire risk assessment in Western Australia* (DoP 2016). Site assessment was undertaken on 29 October 2019.

The classified vegetation for the site from each of the identified vegetation plots are identified below, Table 1 and Figure 4.

Table 1: Classified vegetation as per AS 3959-2018

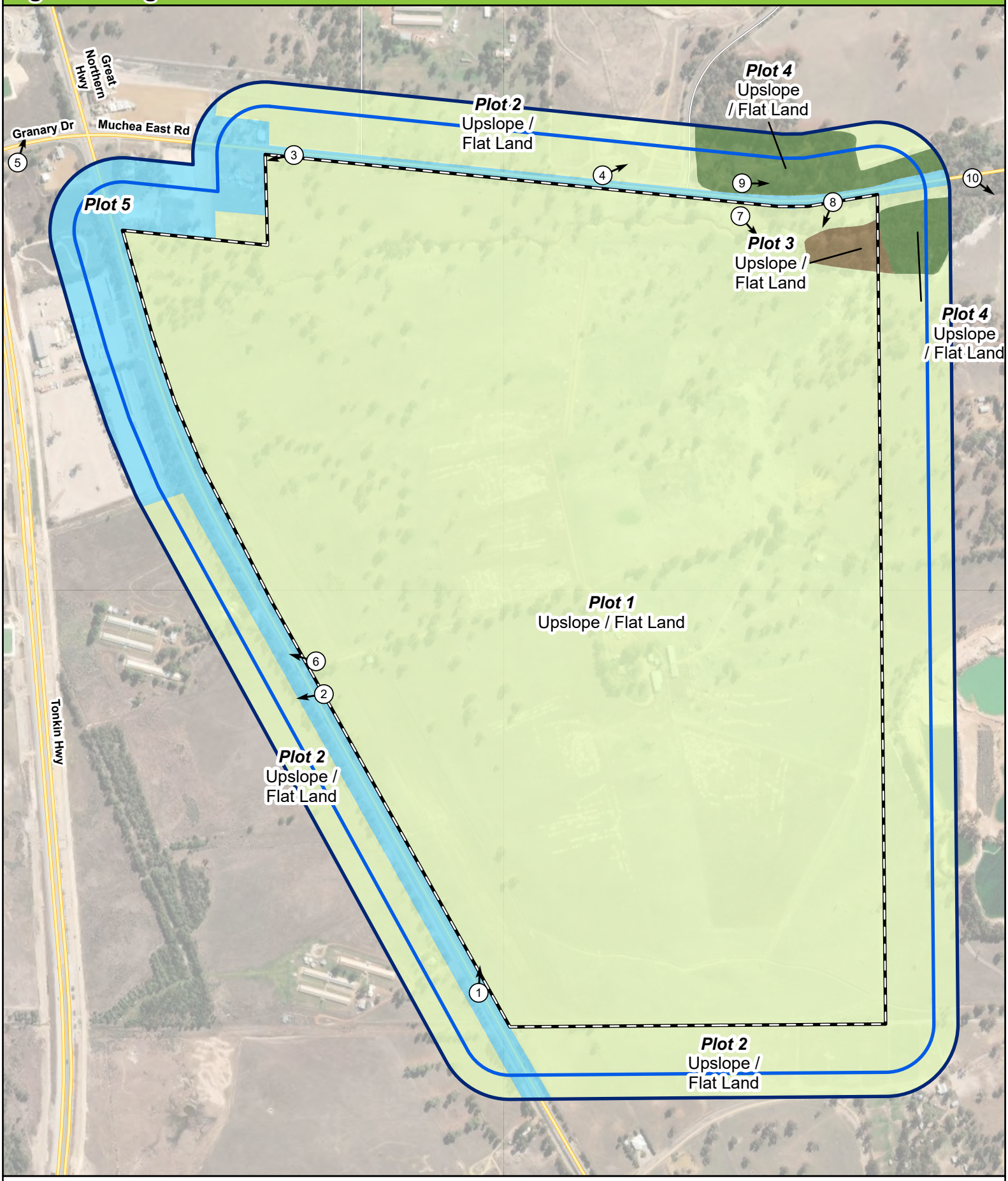
Plot	Vegetation Classification	Effective Slope
1	Class G Grassland	All upslopes and flat land (0 degrees)
2	Class G Grassland	All upslopes and flat land (0 degrees)
3	Class B Woodland	All upslopes and flat land (0 degrees)
4	Class A Forest	All upslopes and flat land (0 degrees)
5	Excluded AS 3959-2018 2.2.3.2 (e)	-

Photographs relating to each area and 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 3959-2018 and is depicted in Figure 4. Slope under classified vegetation was assessed and is shown in Table 1.

Figure 4: Vegetation Classification



Legend

- Subject site
- 100m site assessment
- 150m site assessment

Vegetation classification

- Class A forest
- Class B woodland
- Class G grassland
- Excluded as per clause 2.2.3.2 (e) and (f)

0 75 150 300
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

N

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2.2 Bushfire assessment outputs

A bushfire hazard level (BHL) assessment has been undertake in accordance with SPP 3.7, the guidelines, AS 3959-2018 and the bushfire assessment inputs in Section 2.1.

2.2.1 Bushfire hazard level (BHL) assessment

All land located within 150 m of the site has been classified as per AS3959-2018 as shown in Figure 4. These vegetation classifications have been combined with slope under the classified vegetation to define the BHL as per the methodology indicated within the Guidelines. In addition, all land within 100 m of Extreme and Moderate BHLs has also been mapped as a Moderate hazard as per the Guidelines.

The BHL provides an indication of potential bushfire impact on the subject site by providing a likely intensity based on the classified vegetation.

Table 2 and Figure 5 display the BHL assessment that has been completed for the proposed rezoning in accordance with the Guidelines and AS 3959-2018 methodology.

Clearing will be undertaken within the subject site for development purposes, and consequently the pre-development BHLs are subject to change. A post-development BHL assessment is provided in Table 2 and Figure 6 which takes into account the assumption that the entire subject site will be managed in a low threat state as per the Guidelines and AS3959-2018. Within the current concept plans provided to ELA (Figure 2) there are areas of revegetation along the creekline in the north of the subject site and minor drainage swales within several road reserves. These areas are proposed to be revegetated with shrubs and have been considered in the post-development BHL assessment.

Table 2: BHL assessment

Plot and vegetation classification	Effective slope	BHL rating Pre-Development	BHL rating Post-Development
Plot 1- Class G Grassland	All upslopes and flat land (0 degrees)	Moderate	Low
Plot 2- Class G Grassland	All upslopes and flat land (0 degrees)	Moderate	Low
Plot 3 - Class B Woodland	All upslopes and flat land (0 degrees)	Extreme	Low
Plot 4- Class A Forest	All upslopes and flat land (0 degrees)	Extreme	Extreme
Plot 5- Excluded AS 3959-2018 2.2.3.2 (e)	-	Low	Low

2.3 Identification of issues arising from the BHL assessment

The on-site vegetation extent is proposed to be cleared to enable development of an industrial zone amongst areas of landscaped/managed Public Open Space (POS) 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 (both external and internal [e.g. retained vegetation] to the subject site), and ongoing fuel management that can be undertaken in and around individual development stages.

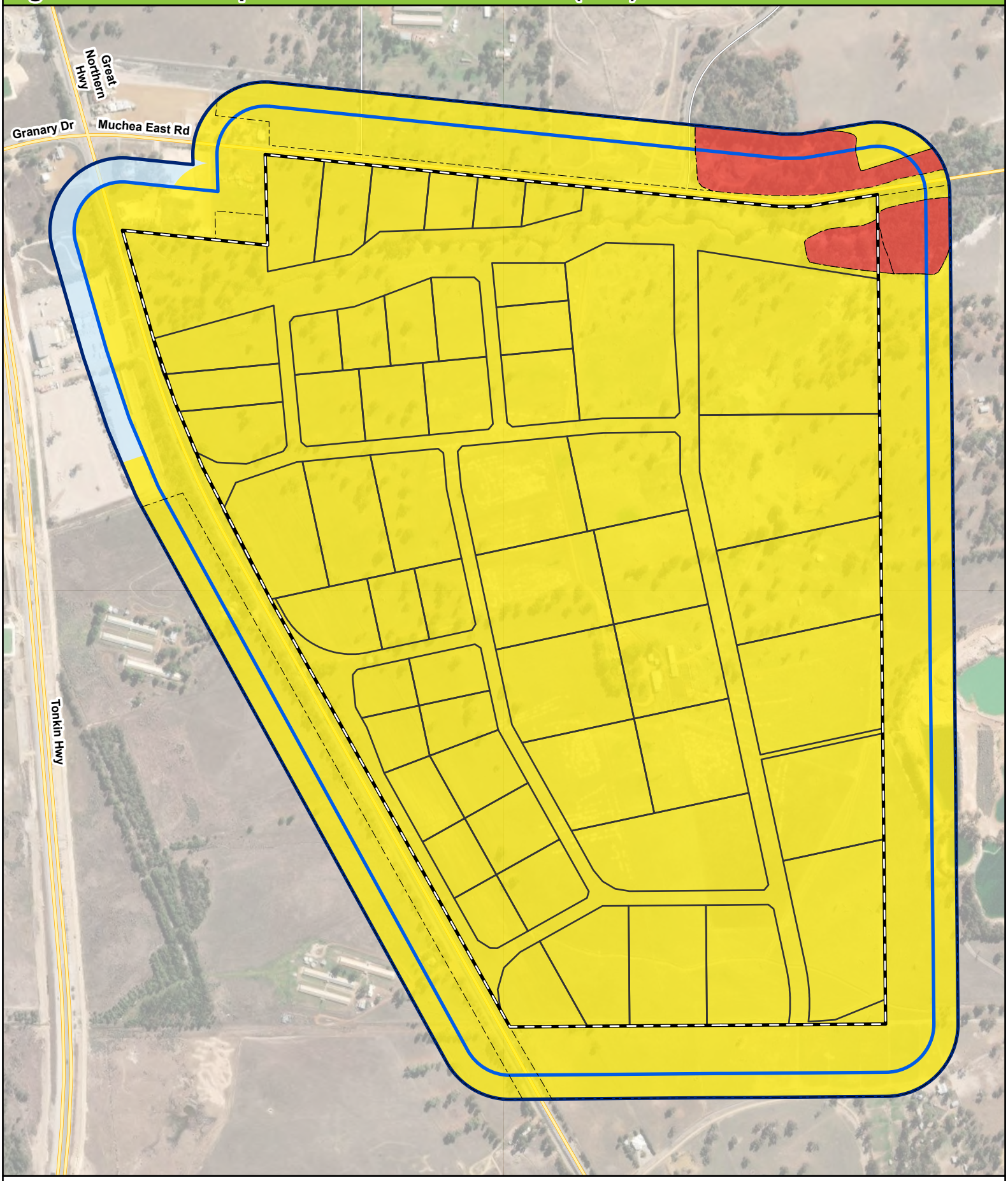
On the basis of the above information, ELA considers that the bushfire hazards within and adjacent to the subject site and the associated bushfire risk is readily manageable through standard management

responses and compliance with acceptable solutions outlined in the Guidelines. 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 AS3959-2018 at future planning stages will also depend on the developer'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.

Should there be any changes in development design or vegetation/hazard extent that requires a modified bushfire management response, then the above BHL ratings will need to be reassessed for the affected areas and documented in a brief addendum to this BMP.

Figure 5: Pre-Development Bushfire Hazard Level (BHL) Assessment



Legend

- Subject site
- 100m site assessment
- 150m site assessment
- Conceptual lot boundary
- Bushfire Hazard Interface

Bushfire Hazard Level (BHL)

- Extreme
- Moderate
- Low

0 75 150 300
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

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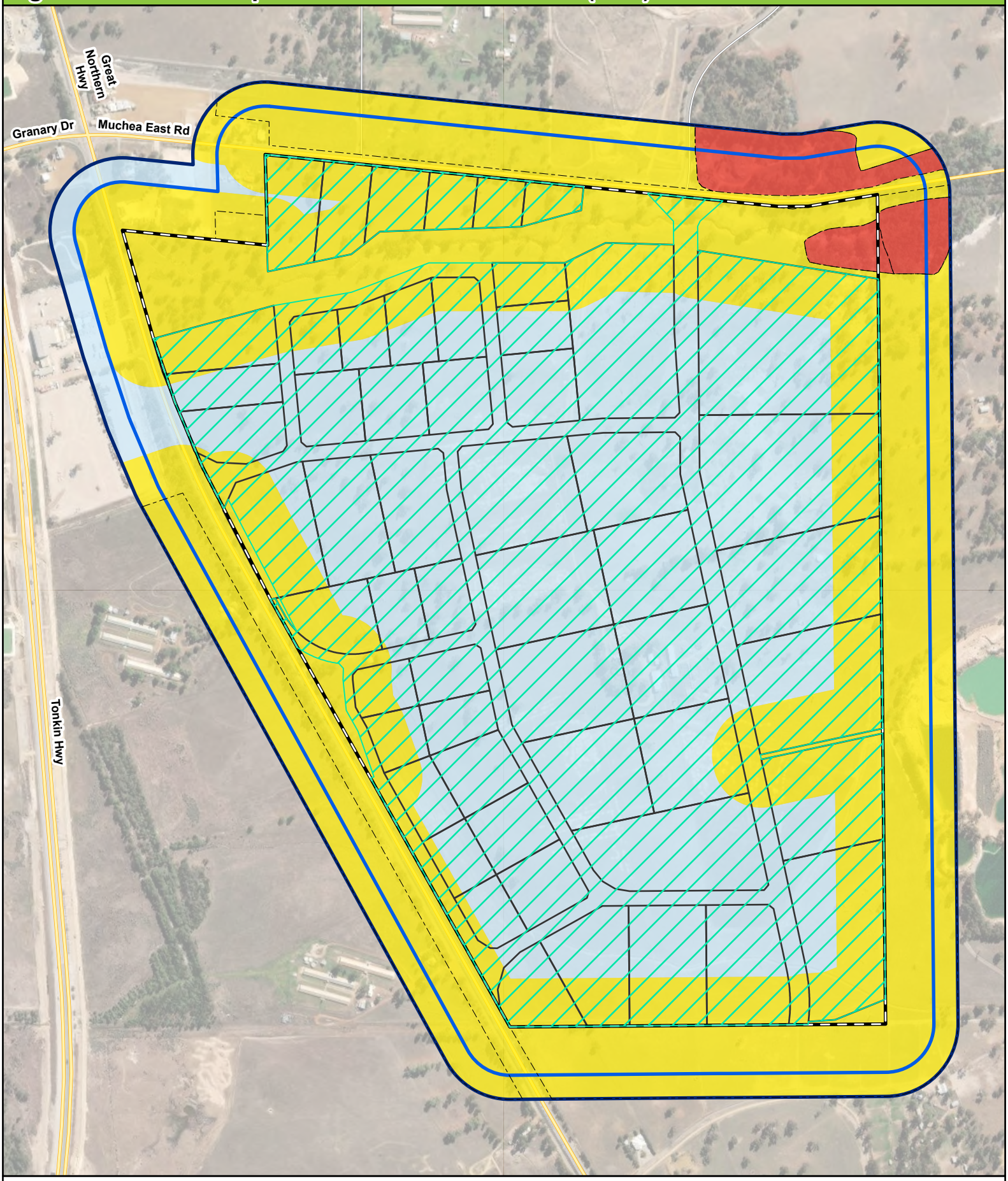
Figure 6: Post-Development Bushfire Hazard Level (BHL) Assessment



Legend

- Subject site
- 100m site assessment
- 150m site assessment
- Conceptual lot boundary
- Bushfire Hazard Interface
- Indicative Asset Protection Zone (APZ)

Bushfire hazard level (BHL)

- Extreme
- Moderate
- Low

0 75 150 300
Metres
Datum/Projection:
GDA 1994 MGA Zone 50

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3. Assessment against the Bushfire Protection Criteria

3.1 Compliance

The proposed rezoning 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.

In response to the above requirements of SPP 3.7 and the Guidelines, bushfire risk management measures, as outlined, have been devised for the proposed rezoning in accordance with the Guideline acceptable solutions to meet compliance with bushfire protection criteria.

Table 3 outlines the Acceptable Solutions (AS) that are relevant to the proposal and summaries how the intent of each Bushfire Protection Criteria has been achieved. No Performance Solutions (PS) have been proposed for this proposal. These management measures are depicted in Figure 7 where relevant.

Table 3: Summary of solutions used to achieve bushfire protection criteria

Bushfire Protection Criteria	AS	PS	N/A	Comment
Element 1: Location A1.1 Development location	☒	☐	☐	Post-development, the subject site will be predominantly located in an area subject to BHLs of Low and Moderate. A minor portion of Extreme hazard associated with the POS areas in the north east will remain, however will be separated from future built assets by Asset Protection Zones (APZs) (Figure 6; Figure 7). These APZs will ensure that future assets will be subject to BAL ratings of BAL-29 or lower. The proposed rezoning is considered to be compliant with A1.1.
Element 2: Siting and design of development A2.1 Asset Protection Zone (APZ)	☒	☐	☐	As the lot layout is currently unconfirmed, APZs are unable to be prescribed at this level of planning. APZs will be defined in BMPs supporting future planning applications (subdivision) to ensure that all future lots will be subject to a BAL rating of BAL-29 or lower. Figure 6 and Figure 7 depict indicative APZs which will be refined at future stages of planning. These indicative APZs however, demonstrate that the majority of the subject site will be subject to BHLs of Moderate or Low and ELA expects that APZs will be able to be accommodated within road reserves, maintained Public Open Space areas and within individual lots etc. The proposed rezoning is considered to be compliant with A2.1.
Element 3: Vehicular access A3.1 Two access routes	☒	☐	☐	There are currently two access routes from the subject site being north/south on Great Northern Highway and east/west on Muchea Road East (Figure 7).

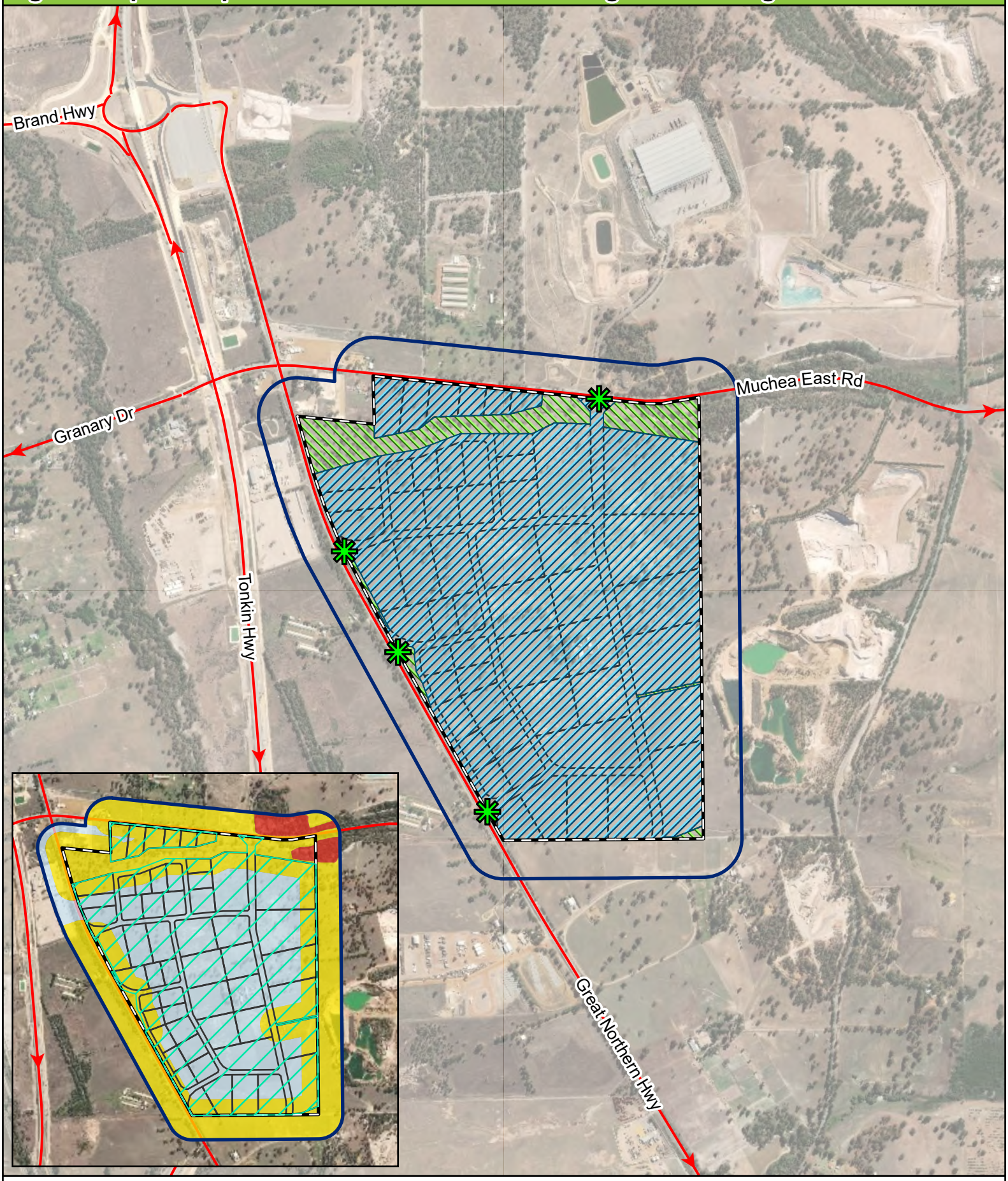
Bushfire Protection Criteria	AS	PS	N/A	Comment
				BMPs supporting future planning applications (subdivision) will provide greater detail on road networks and ensure that all stages of development are provide with two forms of access at all times where relevant and possible. The proposed development is considered to be compliant with A3.1.
A3.2 Public road	☒	☐	☐	All future public roads will be designed and constructed to comply with the Guidelines (Appendix C). BMPs supporting future planning applications (subdivisions) will address this element in greater detail. The proposed development is considered to be compliant with A3.2.
A3.3 Cul-de-sac	☐	☐	☒	At this stage, no cul-de-sacs are proposed to be constructed within the subject site.
A3.4 Battle-axe	☐	☐	☒	At this stage, no battle-axe lots are proposed within the subject site.
A3.5 Private Driveway longer than 50 m	☐	☐	☒	At this stage, no private driveways longer than 50 m are proposed to be constructed within the subject site.
A3.6 Emergency Access way	☐	☐	☒	At this stage, no emergency access ways are proposed to be constructed.
A3.7 Fire-service access routes	☐	☐	☒	At this stage, no fire service access routes are proposed to be constructed.
A3.8 Firebreak width	☒	☐	☐	The subject site will be managed in accordance with the Shire of Chittering Firebreak & Bushfire Hazard Reduction Notice. BMPs supporting future planning applications (subdivisions) will address this element in greater detail. The proposed development is considered to be compliant with A3.8.
Element 4: Water A4.1 Reticulated areas	☐	☐	☒	The subject site is not connected to a reticulated water supply. Reticulated water is not present within the area.
A4.2 Non-Reticulated areas	☒	☐	☐	No reticulated water is currently available to the subject site. Future planning stages will ensure that a firefighting water supply will be provided in accordance with the Guidelines. The proposed development is considered to be compliant with A4.2.
A4.3 Individual Lots within non-reticulated areas	☐	☐	☒	It is unlikely that a development proposal for the subject site will result in the construction of one additional lot.

NOTE – AS- ACCEPTABLE SOLUTION, PS- PERFORMANCE SOLUTION, N/A- NOT APPLICABLE

3.2 Additional Bushfire Requirements

Future demonstration of compliance with the relevant requirements of SPP 3.7, the Guidelines and AS3959-2018 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.

Figure 7: Spatial representation of the bushfire management strategies



Legend

- Subject site
- Conceptual lot boundary
- Indicative Asset Protection Zone (APZ)
- Public Open Space (POS)
- Access / egress route
- Access point

Bushfire hazard level (BHL)

- Extreme
- Moderate
- Low

0 150 300 600
Meters

Datum/Projection:
GDA 1994 MGA Zone 50

N

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4. Implementation and enforcement

Implementation of the BMP applies to the developer, the Shire of Chittering, 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 3, where applicable, will be incorporated into development design as early as possible and confirmed through Structure Plan and 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 BMPs or addendums to this BMP are 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.

5. 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 rezoning. As such, the proposed rezoning is consistent with the aim and objectives of SPP 3.7 and associated guidelines and is recommended for approval.

6. References

Department of Fire and Emergency Services, 2019, *Map of Bush Fire Prone Areas, [Online]*, Government of Western Australia, available from: http://www.dfes.wa.gov.au/regulationandcompliance/bushfireproneareas/Pages/default.aspx

Department of Planning (DoP), 2016, *Visual guide for bushfire risk assessment in Western Australia*. DoP, Perth.

Shire of Chittering. 2020. *Shire of Chittering Firebreak & Bushfire Hazard Reduction Notice*.

Standards Australia, 2018, *Construction of buildings in bushfire-prone areas, AS 3959-2018*. SAI Global, Sydney.

Western Australian Planning Commission, 2015, *State Planning Policy 3.7 Planning in Bushfire Prone Areas*. WAPC, Perth.

Western Australian Planning Commission,2017, *Guidelines for Planning in Bushfire Prone Areas Version 1.3 (including appendices),* WAPC, Perth.

Western Australian Planning Commission, 2019, *A guide to developing a Bushfire Emergency Evacuation Plan, October 2019*.

Appendix A – Classified Vegetation Photos

Plot	1	Classification or Exclusion Clause	Class G Grassland

Photo Point 1

Classified vegetation is onsite unmanaged grassland, grazing paddocks.

Slope under the vegetation has been assessed as flat land.

Plot	1	Classification or Exclusion Clause	Class G Grassland

Photo Point 2

Classified vegetation is onsite unmanaged grassland, Onsite paddocks with scattered trees up to 10m.

Slope under the vegetation has been assessed as flat land.

Plot	1	Classification or Exclusion Clause	Class G Grassland

Photo Point 3

Classified vegetation is onsite unmanaged grassland, Onsite paddocks with scattered trees up to 10m.

Slope under the vegetation has been assessed as flat land.

Plot 2	Classification or Exclusion Clause	Class G Grassland

Photo Point 4

Classified vegetation is offsite unmanaged grassland.

Slope under the vegetation has been assessed as flat land.

Plot 2	Classification or Exclusion Clause	Class G Grassland

Photo Point 5

Classified vegetation is onsite unmanaged grassland, Offsite paddocks with scattered trees up to 8m.

Slope under the vegetation has been assessed as flat land.

Plot 2	Classification or Exclusion Clause	Class G Grassland

Photo Point 6

Classified vegetation is offsite unmanaged grassland.

Grass paddocks with minor tree line along road verge.

Slope under the vegetation has been assessed as flat land.

Plot 3	Classification or Exclusion Clause	Class B Woodland

Photo Point 7

Classified vegetation is onsite open woodland, remanent native trees over grass. 10-20% canopy cover.

Note: onsite grassland to the right hand side, woodland in background of left hand side

Slope under the vegetation has been assessed as flat land.

Plot 3	Classification or Exclusion Clause	Class B Woodland

Photo Point 8

Classified vegetation is onsite open woodland, remanent native trees over grass. 10-20% canopy cover. Trees up to 8m

Note woodland with no understorey under trees.

Slope under the vegetation has been assessed as flat land.

Plot 4	Classification or Exclusion Clause	Class A Forest

Photo Point 9

Classified vegetation is low open forest with canopy cover and shrub understorey, trees up to 10m.

Slope under the vegetation has been assessed as flat land.

Plot 4	Classification or Exclusion Clause	Class A Forest

Photo Point 10

Classified vegetation is low open forest with canopy cover and shrub understorey, trees up to 10m.

Low open forest vegetation along watercourse

Slope under the vegetation has been assessed as flat land.

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 8**).

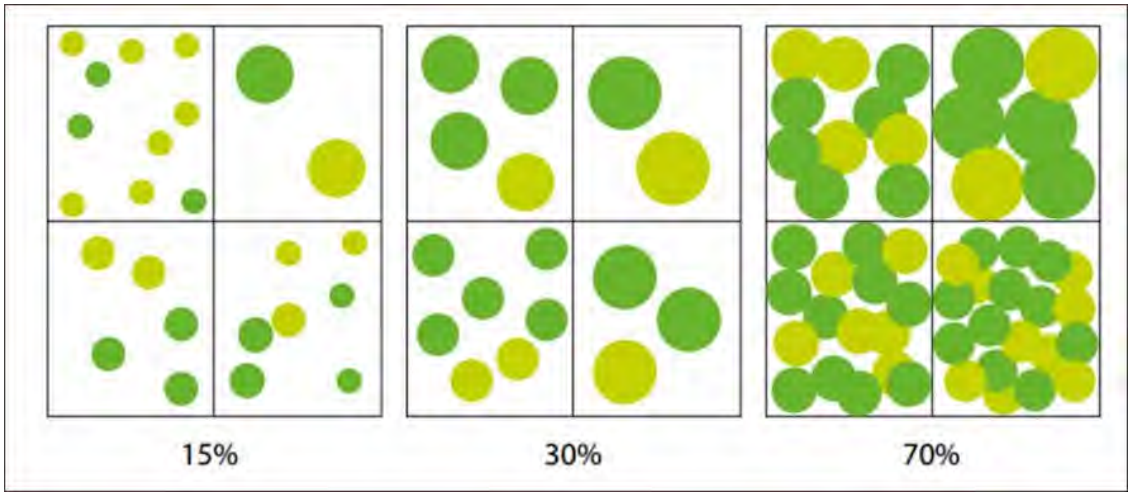

Figure 8: Illustrated tree canopy cover projection (WAPC 2017)

- **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 5m^2 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

The Asset Protection Zone (APZ) is an area surrounding a building that is managed to reduce the bushfire hazard to an acceptable level. Hazard separation in the form of using subdivision design elements or excluded and low threat vegetation adjacent to the lot may be used to reduce the dimensions of the APZ within the lot.

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.

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 F

Transport Impact Assessment

Lots 50 and M1456 Great Northern Hwy, Muchea

Proposed Amendments to the Town Planning Scheme No. 6

Transport Impact Assessment

PREPARED FOR:
Tallangatta Beef Pty Ltd

July 2021

Document history and status

Author	Revision	Approved by	Date approved	Revision type
M Rasouli	r01	B Bordbar	07/12/2020	Draft
M Rasouli	r01a	B Bordbar	27/07/2021	Final

File name: t20.116.mr.r01a

Author: Mohammad Rasouli

Project manager: Mohammad Rasouli

Client: Tallangatta Beef Pty Ltd

Project: Lots 50 and M1456 Great Northern Hwy, Muchea

Document revision: r01a

Project number: t20.116

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REPORT FIGURES

REPORT TABLES

1.0 Introduction and Background

This Transport Impact Assessment (TIA) has been prepared by Transcore for the proposed Amendment to the Shire of Chittering's Town Planning Scheme No. 6 for Lots 50 & M1456 Great Northern Highway, Muchea (subject site). The proposed amendment includes rezoning of the subject site from "Agricultural Resource" to 'Industrial'. As part of the proposed rezoning a Preliminary Structure Plan Development Concept (SPDC) was also prepared by Taylor Burrel Barnett for the site consistent with Draft Muchea Industrial Park Structure Plan (DMIPSP). Copies of the proposed SPDC and DMIPSP are provided in **Appendix A**.

As shown in **Figure 1** the subject site is located within "Precinct 2 – South" under Muchea Employment Node Structure Plan (MENSP) and is identified as "Proposed Industrial Development". The Western Australian Planning Commission (WAPC) have recently prepared the DMIPSP. When finalised, DMIPSP will replace MENSP.

The DMIPSP has been prepared to coordinate the development of the Muchea Industrial Park to provide industrial land and employment opportunities in the Shire of Chittering. The DMIPSP reviews and updates the WAPC's 2011 MENSP.

Figure 2 shows the location of the subject site. The subject site is located at the south-east corner of the intersection of Great Northern Highway and Muchea Road. Muchea Road traverses under the recently constructed North Link and forms a four-way signalised intersection with Great Northern Highway.

This TIA will review the traffic generation and distribution resulting from the proposed SPDC and will assess the traffic operations of the SPDC area and its impact on the signalised intersection of Great Northern Highway and Muchea Road.

During the course of preparation of this TIA, amongst other relevant publications, the following documents have been reviewed:

- Muchea Employment Node Structure Plan by Department of Planning (August 2011); and,
- Draft Muchea Industrial Park Structure Plan by WAPC (October 2020).

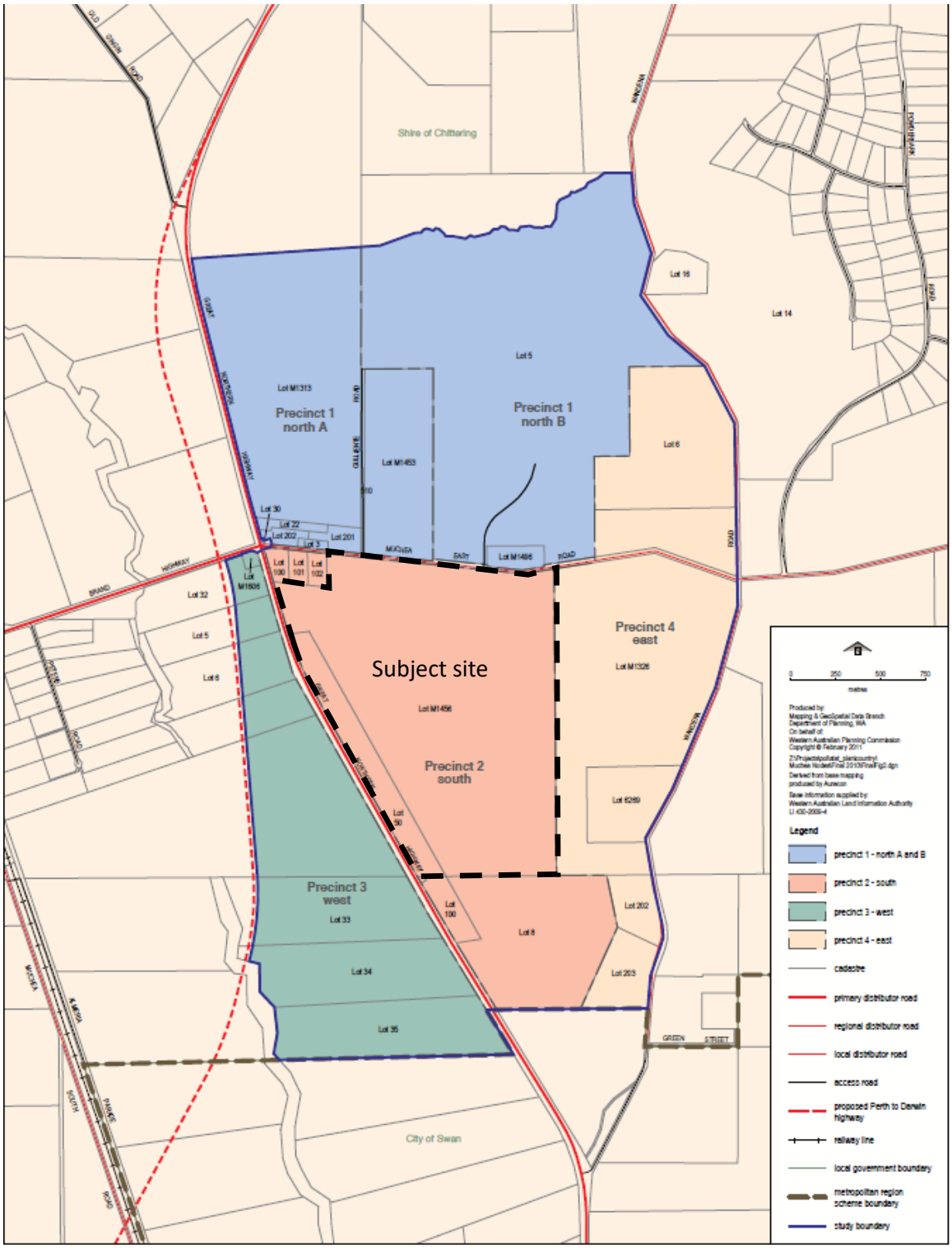


Figure 1: Location of subject site within the proposed Precinct Plan of Muchea Employment Node

Figure 2: Location of the subject site

2.0 Proposed Structure Plan Development Concept

Figure 3 illustrates the Preliminary Structure Plan Development Concept for the site.

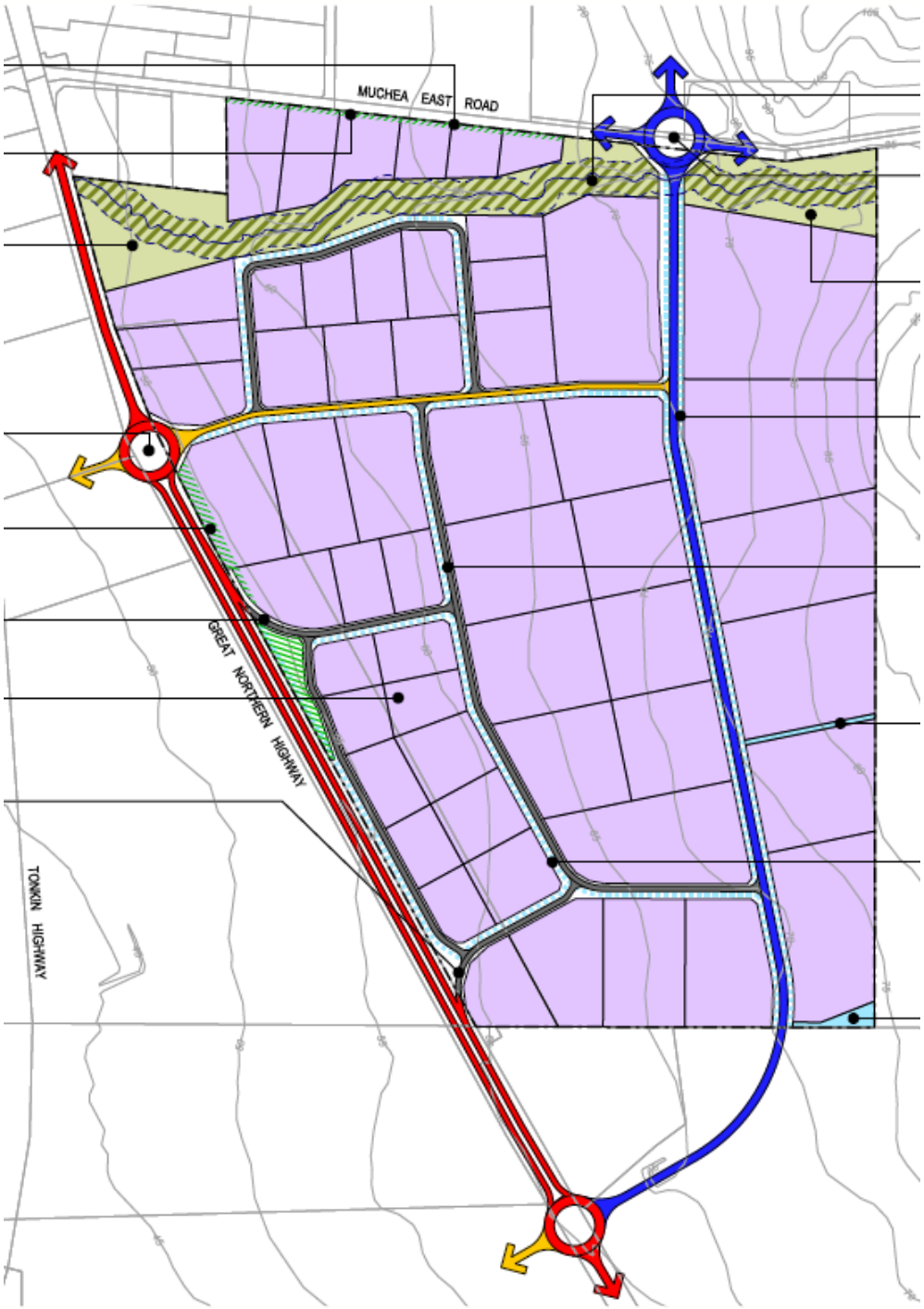


Figure 3: Preliminary Structure Plan Development Concept

The proposed SPDC is located within Precinct 2. According to DMIPSP "*this precinct forms the central-most area of the industrial park with the least fragmented land ownership, and is the most suited area within the industrial park for general industry"*.

The proposed SPDC will provide about 171 ha of developable Lot area for general industry land uses.

The key part of the future DMIPSP road network proposed to serve the North and South Precincts, including the subject site, is the Loop Road which connects to Great Northern Highway north and south of Muchea East Road intersection and loops through the North and South Precincts intersecting with Muchea East Road.

The road network of the proposed SPDC area has been established in line with the proposed road network for the DMIPSP. The road network proposes a distributor road network designed to accommodate RAV10 vehicles which integrates with the DMIPSP RAV 10 road network.

The proposed SPDC includes an internal road parallel to GNH which connects to GNH at two locations with provision of separate left in and left out intersections on GNH at both ends. This internal road (or service road) will improve the accessibility of the proposed smaller Lots along GNH without disrupting the GNH traffic. The proposed left in intersection will be used by all vehicles including RAV 10 vehicles. Appropriate left turn lane on GNH will be provided to improve traffic operations and safety and satisfy Austroads requirements. The left-out intersection on GNH will be used by light vehicles only.

3.0 Existing Situation

3.1 Existing Land Use

The subject site is currently vacant land. The surrounding lands to the south and east are also mainly vacant rural lands. Great Northern Highway is forming the western boundary of the subject site.

3.2 Existing Road Network

The Muchea industrial park including the subject site is located at the junction of three primary distributor roads being GNH, Brand Highway and Tonkin Highway (NorthLink). Muchea East Road is a regional distributor road and Wandena Road, to the east of the park, is a local distributor.

Great Northern Highway runs north-south connecting Perth's suburb of Midland with the far north regions of WA passing through a number of major agriculture and resource industry nodes. It carries a significant portion of heavy vehicles in the traffic mix. Great Northern Highway is a Primary Distributor Road under care and control of Main Roads WA. It is generally constructed as a two-lane, single carriageway road with posted speed limit of 110kmh in the vicinity of the subject site. The recently constructed North Link is expected to take significant volume of regional traffic, particularly heavy vehicles away from Great Northern Highway.

According to Main Roads WA Restricted Access Vehicle (RAV) mapping Great Northern Highway at this location is classified as RAV 7(refer **Figure 4**) but it is planned to be upgraded to RAV 10.

Muchea East Road extends eastwards of Brand Highway providing an important east-west link to Chittering Road to the east. It is classified as a Regional Distributor road under control of Local Government. Muchea East Road is currently constructed as a single carriageway two-lane road.

According to Main Roads WA Restricted Access Vehicle (RAV) mapping Muchea East Road is classified as RAV 7 in the vicinity of the subject site (refer **Figure 4**).

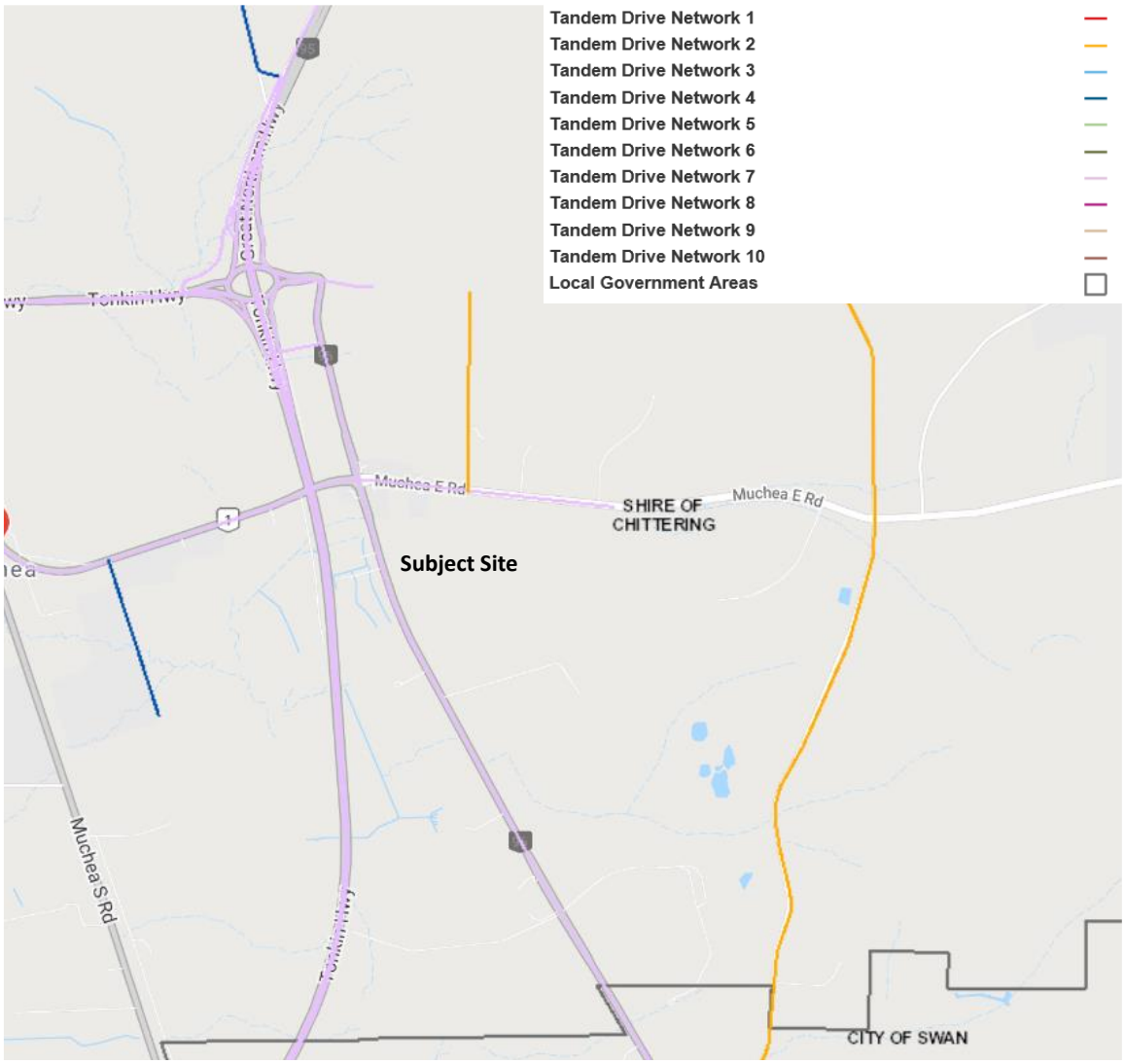


Figure 4: Existing RAV network

3.3 Existing Traffic Counts

Existing average weekday traffic (AWT) volumes on surrounding roads have been obtained from Main Roads WA and are illustrated in **Figure 5**. The latest SCATS data for the signalised intersection of GNH/ Muchea East Road was also obtained and is reported in this figure. The turn movements which were not captured by SCATS were surveyed by Transcore in early December 2020. The PM peak hour tuning volumes are shown in blue in this figure.

As outlined before it is expected that the current traffic volumes on Great Northern Highway are less than that reported in Figure 5.

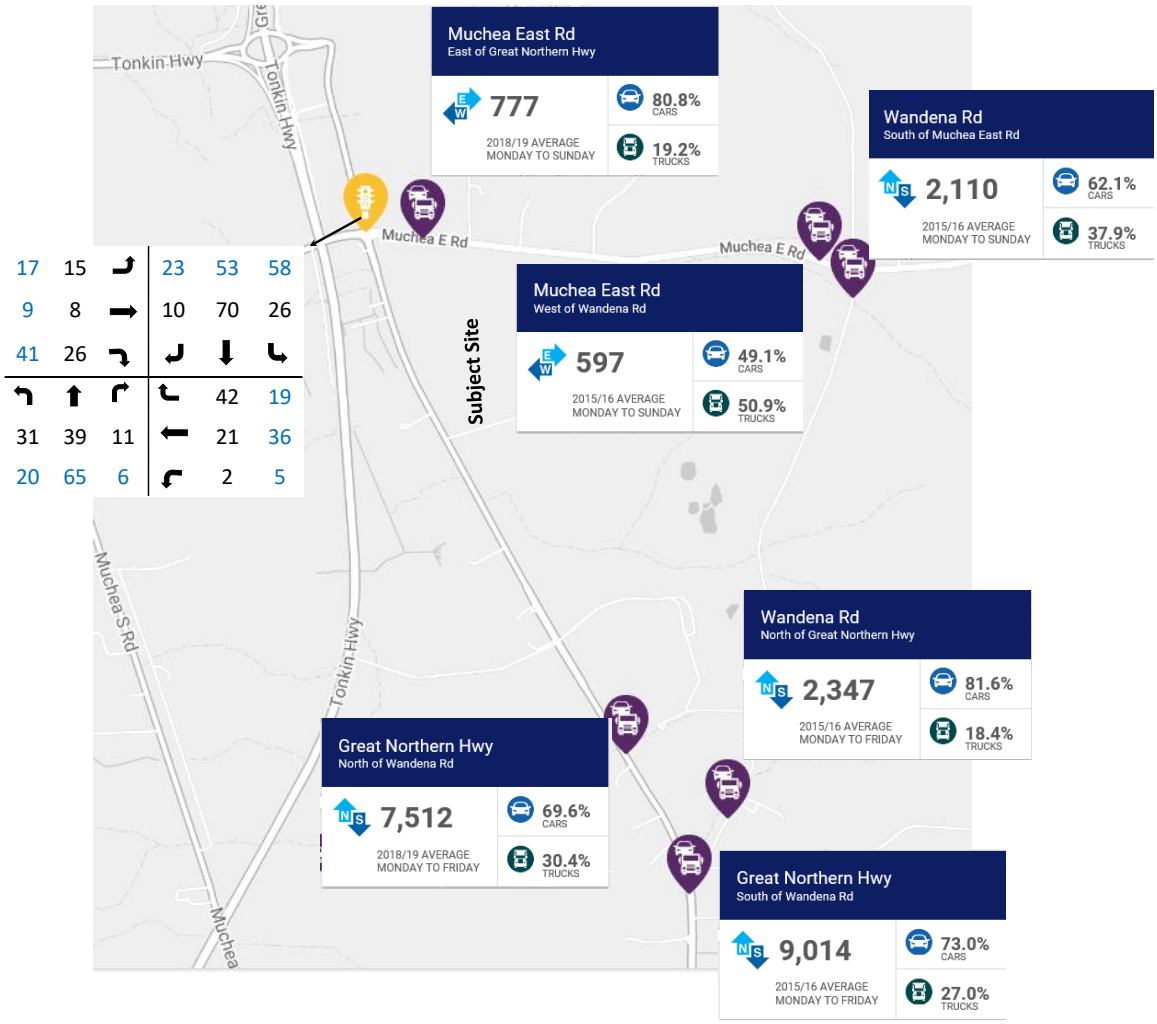


Figure 5: Existing traffic counts

3.4 Public Transport

Currently, there are no bus services to the subject site. The Midland to Geraldton railway line is located to the west of the subject site.

The line is strategically important as a freight route between Perth (Midland) and the northern Wheatbelt and Mid-West regions. The freight rail network provides connections to and between the ports of Esperance, Albany, Bunbury, Fremantle (Perth) and Geraldton.

3.5 Pedestrian and Cyclist Facilities

Currently, there are no pedestrian and cyclist facilities on the surrounding road network around the subject site. According to the Muchea Employment Node Structure Plan *"No formal cycle or pedestrian facilities are provided in the structure plan. A sealed shoulder is recommended in the road cross-sections which could be used by cyclists. The*

large-scale industrial land use would largely make provision of a pedestrian network difficult. Pedestrian links could be developed in subdivision guide plans if desire lines are identified".

3.6 Changes to the Surrounding Road Network

The major changes to the surrounding road network in this locality in accordance with DMIPSP are the completion of NorthLink project, which includes an interchange directly adjoining the industrial park and planned RAV10 upgrades to 220km of GNH north of Muchea to Wubin, including the Bindoon Bypass resulting in triple road trains up to 53.5m long (RAV10 vehicles) being able to travel on these roads.

The proposed road network of the DMIPSP (refer **Figure 6**) shows the alignment and connectivity of the surrounding road network including Great Northern Highway, Brand Highway and North Link. This figure also shows the proposed loop road which will run through the proposed SPDC area and would have two intersections on Great Northern Highway:

- Northern Loop Road/Great Northern Highway intersection: Loop Road connects at its northern end to Northlink/Great Northern Highway/Brand Highway (realigned) interchange at the western side of MIPSP; and,
- Southern Loop Road/Great Northern Highway intersection north of existing Wandena Road intersection with Loop Road terminating on approach to Great Northern Highway in the form of a roundabout intersection.

With the implementation of the Loop Road through the rezoning area and other Precincts of MENSP, the access to the rezoning area would be shifted from Muchea East Road to the new Loop Road. This road's primary objective is to take over the current function of Muchea East Road and provide high capacity freight route with access opportunities for future developments within the structure plan area. Loop Road would be designed to accommodate vehicles exceeding current 36.5m limit (up to 53.5m road trains) in anticipation of re-classification of Great Northern Highway from RAV 7 to RAV 10 network.

The SPDC area shows a central connection to GNH in the form of a roundabout intersection in line with the DMIPSP road network as shown in **Figure 6**. Separate left in and left out intersections are also planned on GNH between the central and southern roundabout intersections to improve accessibility of the smaller lots along GNH.

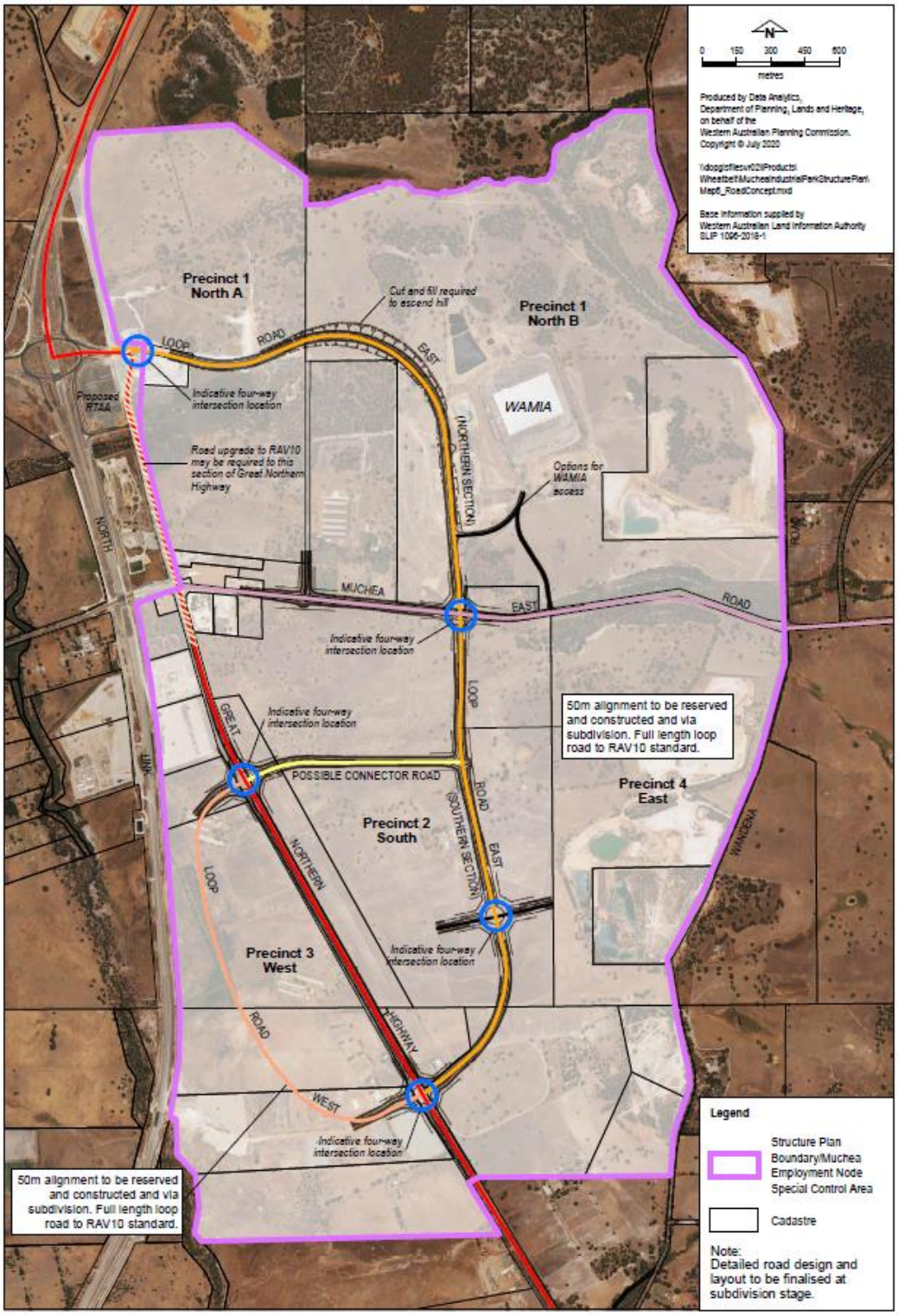


Figure 6: Proposed rezoning area road network concept

(Source: Draft Muchea industrial park structure plan)

3.7 Public Transport Network Planning

According to the Muchea Employment Node Structure Plan "*The provision of public transport facilities has not been included in the structure plan. The large-scale industrial land uses proposed for the site would make feasible provision of public transport difficult to achieve. The proposed road network is designed to provide access for trucks, and would enable bus routes to be introduced if desired in the future*".

4.0 Proposed Movement Network

4.1 Road reservations

The design of the internal road network of the SPDC area will be in line with WAPC's D.C. 4.1 Policy for industrial estates, Muchea Employment Node Structure Plan and Draft Muchea Industrial Park Structure Plan. The internal road network of the SPDC area would exclude cul-de-sac or battle-axe lot access configurations.

According to WAPC's D.C. 4.1 Policy, "*In industrial areas, a minimum road reserve width of 20 metres is required to provide for safe and efficient traffic movement. For heavily trafficked/major through routes, a minimum road reserve width of 25 metres is required. Carriageway widths of 10 metres are favoure*d".

All roads and intersections accommodating RAV10 vehicles, will need to be designed to safely accommodate RAV10 vehicles and other road users in accordance with Main Roads WA specifications.

The DMIPSP Road design indicates that "*Based on the trips generated and the distribution of trips outlined above there is no demand for two lanes on the loop road even with the fully realised ultimate development as less than 10,000vpd would be on the loop road*". Therefore, Loop Road would be designed as single carriageway standard road within a 40m road reserve as shown in the SPDC. The roundabout intersection of Loop Road/Muchae East Road would also be designed as single lane roundabout intersection.

The projected traffic volumes on GNH are expected to be less than 10,000vpd and GNH is expected to remain as single carriageway standard road. The proposed roundabout intersections on GNH would also be designed as single lane roundabout intersections.

The internal roads are not expected to carry more than 5,000vpd and therefore the 20m road reserve with 10m traffic lanes should be sufficient for all internal roads.

Table 1 summarises the proposed road reserve widths and classifications for the key internal and external roads. However, more detailed traffic modelling and analysis would be required during the local structure planning and subdivision stage of the project to inform the accurate design and cross sections of the key roads within and surrounding the proposed SPDC area.

Table 1: Proposed road reservations for major internal and external roads

Key Roads	Proposed Road Category	Proposed number of traffic lanes	Recommended road reserve width (ultimate)
GNH (fronting the site)	Primary Distributor	2 lanes	40m
Loop Road (Within the site)	Integrator A	2 lanes	40m
Muchea E Road	Integrator A	2 lanes	40m

The level of upgrades on GNH will depend on the staging and timing of construction for the full loop road which is dependent on individual developer intentions. However, it is expected that any upgrades on GNH (including RAV 10 classification) would be managed within the current 40-50 road reserve of the GNH.

4.2 Integration with Surrounding Area

The proposed rezoning area is located within precinct 2. According to DMIPSP "*this precinct forms the central-most area of the industrial park with the least fragmented land ownership, and is the most suited area within the industrial park for general industry"*.

Accordingly, the proposed SPDC area will provide about 171 ha of developable Lot area for general industry land uses.

The road network of the SPDC will connect to the surrounding road network including GNH and Muchea East Road via a number of proposed intersections.

5.0 Analysis of the Movement Network

5.1 Assessment Period

The assessment year that has been adopted for this analysis is 2031, with the assumption of full development of the proposed SPDC area by this time.

5.2 Traffic generation and distribution

The Road and Traffic Authority of NSW document "*Guide to Traffic Generating Developments (October 2002)*" and the information available to Transcore for industrial projects have been sourced to estimate the trip generation for anticipated land uses for the SPDC area.

The proposed land uses for the SPDC area are predominantly general industry uses. Accordingly, a trip rate of 5 vehicles per day (VPD) per 100m^2 Gross Floor Area (GFA) was adopted and it was assumed that the GFA would be about 20% of the total efficient land area (total land minus public open space and roads).

Table 1 summarises the assumptions, trip rates and trip generation for the proposed SPDC area. Accordingly, the total trip generation of the anticipated land uses for the subject site is estimated to be about 16,840vpd.

Table 1: Daily Trip Generation Calculation

Efficient Land Area (ha)	Build Up Area Factor	Daily Trip Rate per 100m2 GFA	Daily Trip Generation
171	0.20	5	**17,100**

The estimated trip generation of the proposed SPDC area was distributed on the surrounding areas based on the following assumptions:

- 30% of trips travelling east;
- 19% of trips travelling west;
- 30% of trips travelling north; and,
- 21% of trips travelling south.

5.3 Traffic Flow Forecasts

Figure 7 illustrates the SPDC area traffic flows on internal and external roads. it should be noted that the reported figures do not include the background traffic on the external roads.

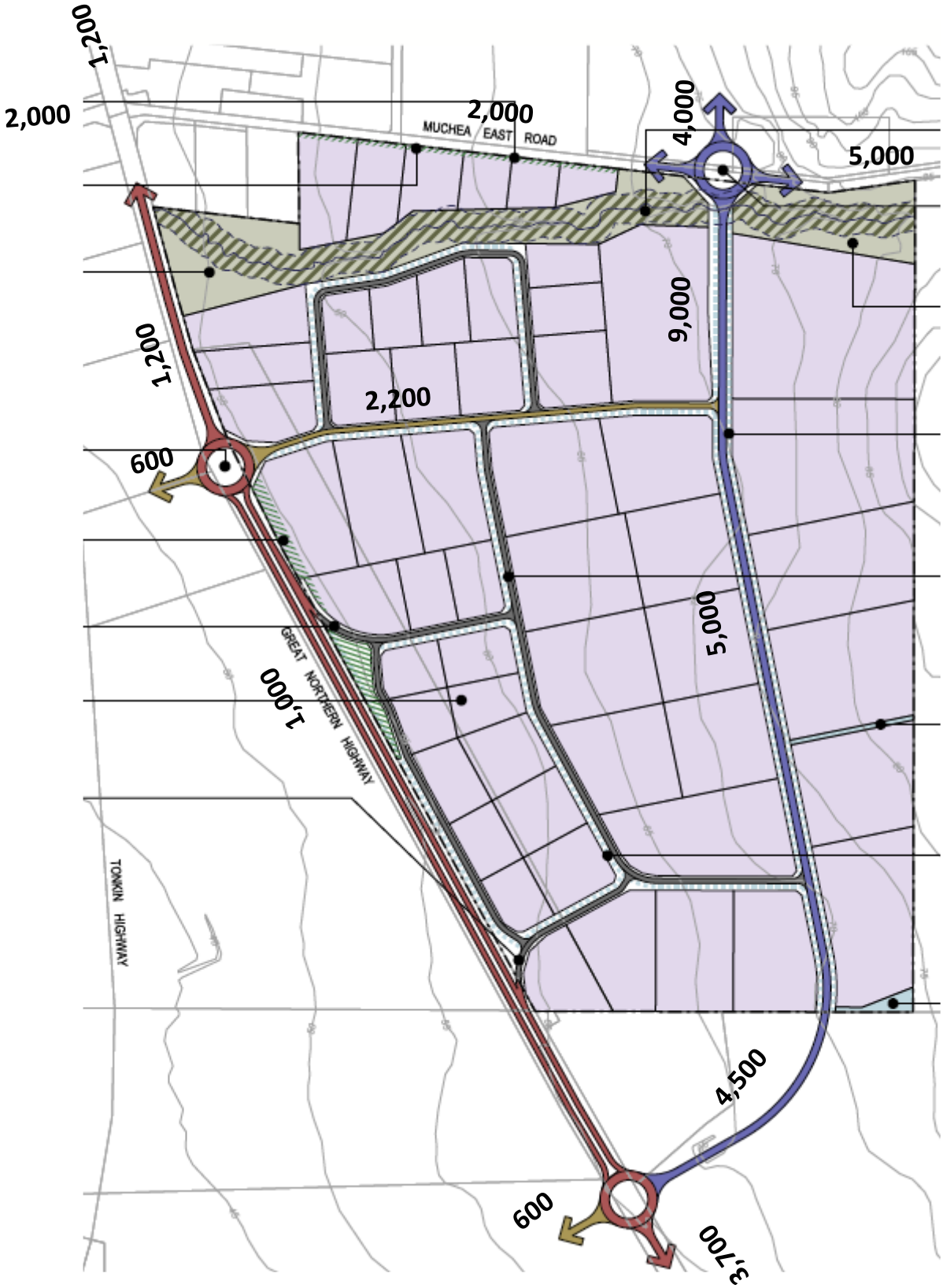


Figure 7: SPDC projected traffic volumes (vpd)

5.4 Roads and Intersections

Figure 8 details the proposed intersection controls for key intersections of the SPDC area.

According to DMIPSP for loop roads and GNH, a typical priority-controlled T-intersection shall feature auxiliary turn lanes and typical four leg intersection shall be a roundabout with an indicative 40m radius.

Appropriate left turn lane is also proposed to be provided for the proposed left in intersection on GNH to improve traffic operations and safety and to satisfy Austroad requirements. The details of the layout of the SPDC area internal and external intersections will be confirmed through further detailed traffic modelling and analysis during subsequent stages of the project.

The intersection of GNH/ Muchea East Road is currently operating as traffic signals.

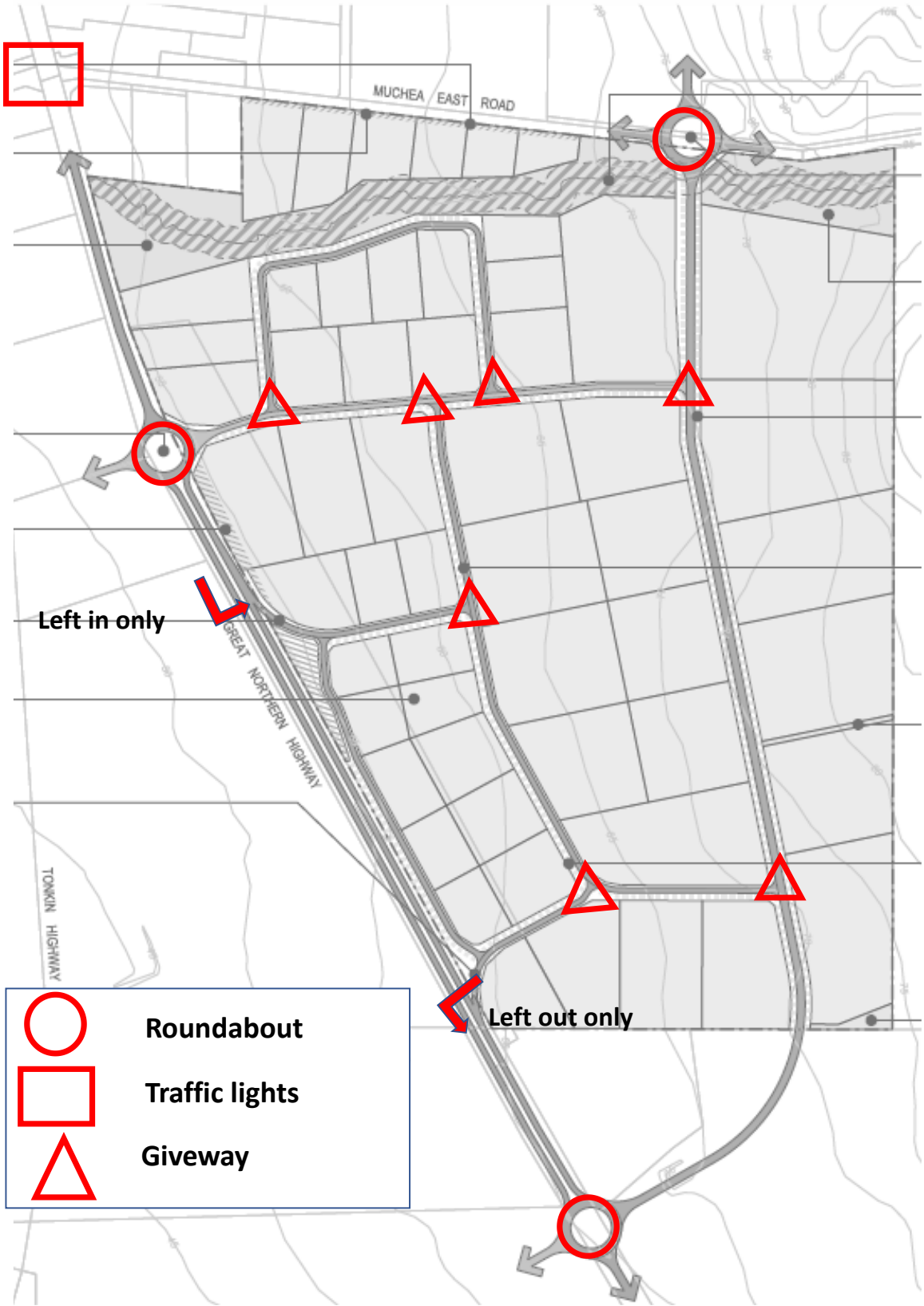


Figure 8: Intersection Control & Treatments

5.5 Intersection Analysis

The operation of the existing signalised intersection GNH/ Muchea East Road has been assessed in SIDRA for the weekday AM and PM peak hours for existing and 2031 scenarios.

SIDRA is an intersection modelling tool commonly used by traffic engineers for all types of intersections. SIDRA outputs are presented in the form of Degree of Saturation, Level of Service, Average Delay and 95% Queue. These characteristics are defined as follows:

- **Degree of Saturation (DoS)**: is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The Degree of Saturation ranges from close to zero for varied traffic flow up to one for saturated flow or capacity.
- **Level of Service (LoS)**: is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. In general, there are 6 levels of service, designated from A to F, with Level of Service A representing the best operating condition (i.e. free flow) and Level of Service F the worst (i.e. forced or breakdown flow).
- **Average Delay**: is the average of all travel time delays for vehicles through the intersection.
- **95% Queue**: is the queue length below which 95% of all observed queue lengths fall.

The results of the SIDRA analysis are attached in **Appendix B**. The estimated 2031 AM and PM peak hour volumes at the signalised intersection are shown in **Figure 9**. The peak hour traffic projections were established using the daily traffic projections in **Figure 7** and assuming the in/ out traffic split of about 80% / 20% for the AM and reverse for the PM peak hour. A conservative 2% annual traffic growth was also applied to all the turning movements of the intersection for year 2031.

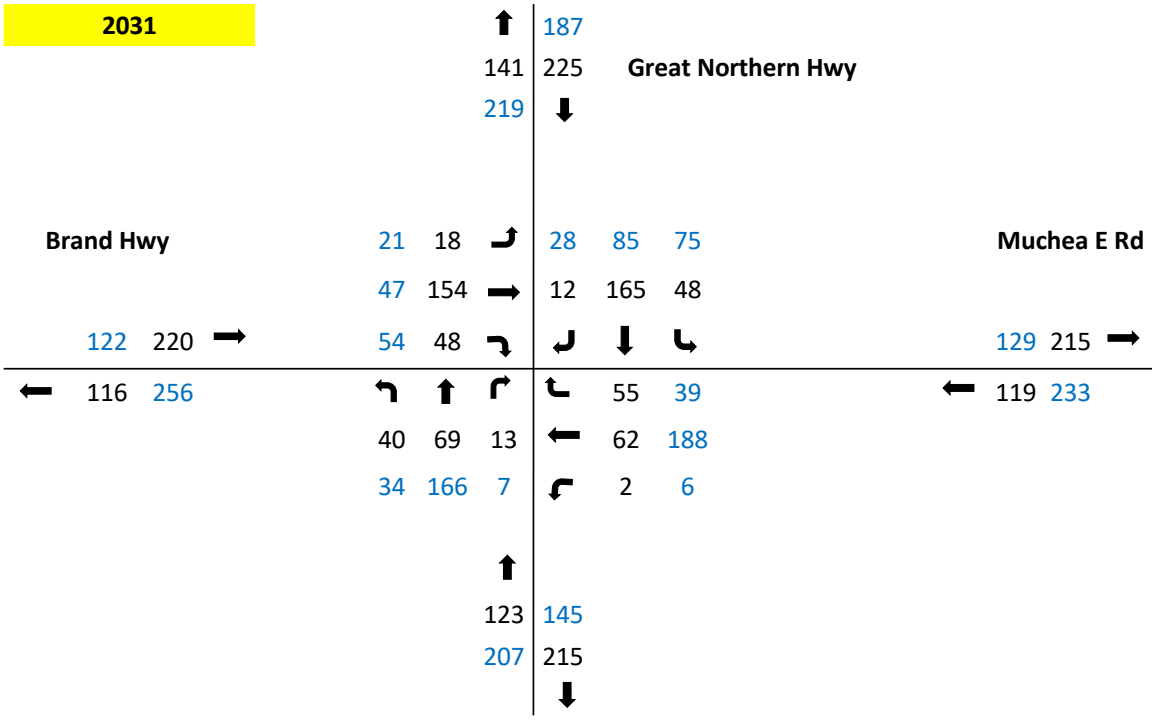


Figure 9: 2031 AM and PM peak hour traffic projections

The SIDRA analysis results indicate that the signalised intersection of GNH/ Muchea East Road presently operates satisfactorily and with an overall LoS B with minimum queues and delays during both weekday peak hours.

The addition of the SPDC area traffic to the intersection resulted in negligible increases in overall queues and delays. No significant change in overall LoS for the intersection is reported and ample spare capacity remains available after full development of the SPDC area.

6.0 Conclusions

The subject of this TIA is the proposed Amendment to the Shire of Chittering's Town Planning Scheme No. 6 for Lots 50 & M1456 Great Northern Highway, Muchea. The proposed amendment includes rezoning of the subject site from "Agricultural Resource" to 'Industrial'.

As part of the proposed rezoning a Preliminary Structure Plan Development Concept (SPDC) has also been prepared by Taylor Burrel Barnett for the site consistent with Draft Muchea Industrial Park Structure Plan (DMIPSP).

The proposed SPDC is located within Precinct 2 of the DMIPSP. According to DMIPSP "*this is the most suited area within the industrial park for general industry"*. Accordingly, the proposed SPDC area will provide about 171 ha of developable Lot area for general industry land uses which would generate about 17,100vpd.

The road network of the proposed SPDC area has been established in line with the proposed road network for the DMIPSP. The SPDC area distributor road network will be designed to accommodate RAV10 vehicles which integrates with the DMIPSP RAV 10 road network.

Separate left only in and left out only intersections are also proposed on GNH to improve accessibility of the proposed smaller Lots along GNH. The proposed left in intersection will be used by all vehicles including RAV 10 vehicles. Appropriate left turn lane on GNH will be provided at this intersection to improve traffic operations and safety and satisfy Austroads requirements. The left-out intersection on GNH will be used by light vehicles only.

The design of the internal road network of the SPDC area will be in line with WAPC's D.C. 4.1 Policy for industrial estates and Draft Muchea Industrial Park Structure Plan. All roads and intersections accommodating RAV10 vehicles, will need to be designed to safely accommodate RAV10 vehicles and other road users in accordance with Main Roads WA specifications.

Therefore, Loop Road would be designed as single carriageway (two lane two way) standard road within a 40m road reserve as shown in the SPDC. The roundabout intersection of Loop Road/Muchae East Road would also be designed as single lane roundabout intersection.

The projected traffic volumes on GNH are expected to be less than 10,000vpd and therefore GNH is expected to remain as single carriageway standard road. The proposed roundabout intersections on Loop Road and GNH would also be designed as single lane roundabout intersections.

The internal roads are not expected to carry more than 5,000vpd and therefore the 20m road reserve with 10m traffic lanes should be sufficient for all internal roads.

Further detailed traffic modelling and analysis would be required during the local structure planning and subdivision stage of the project to inform the accurate design and cross sections of the key roads within and surrounding the SPDC area.

Intersection analysis undertaken indicates satisfactory traffic operation of the existing signalised intersection of GNH/ Muchea East Road during the AM/ PM peak hours in 2031 and assuming full developemnt of the rezoning area.

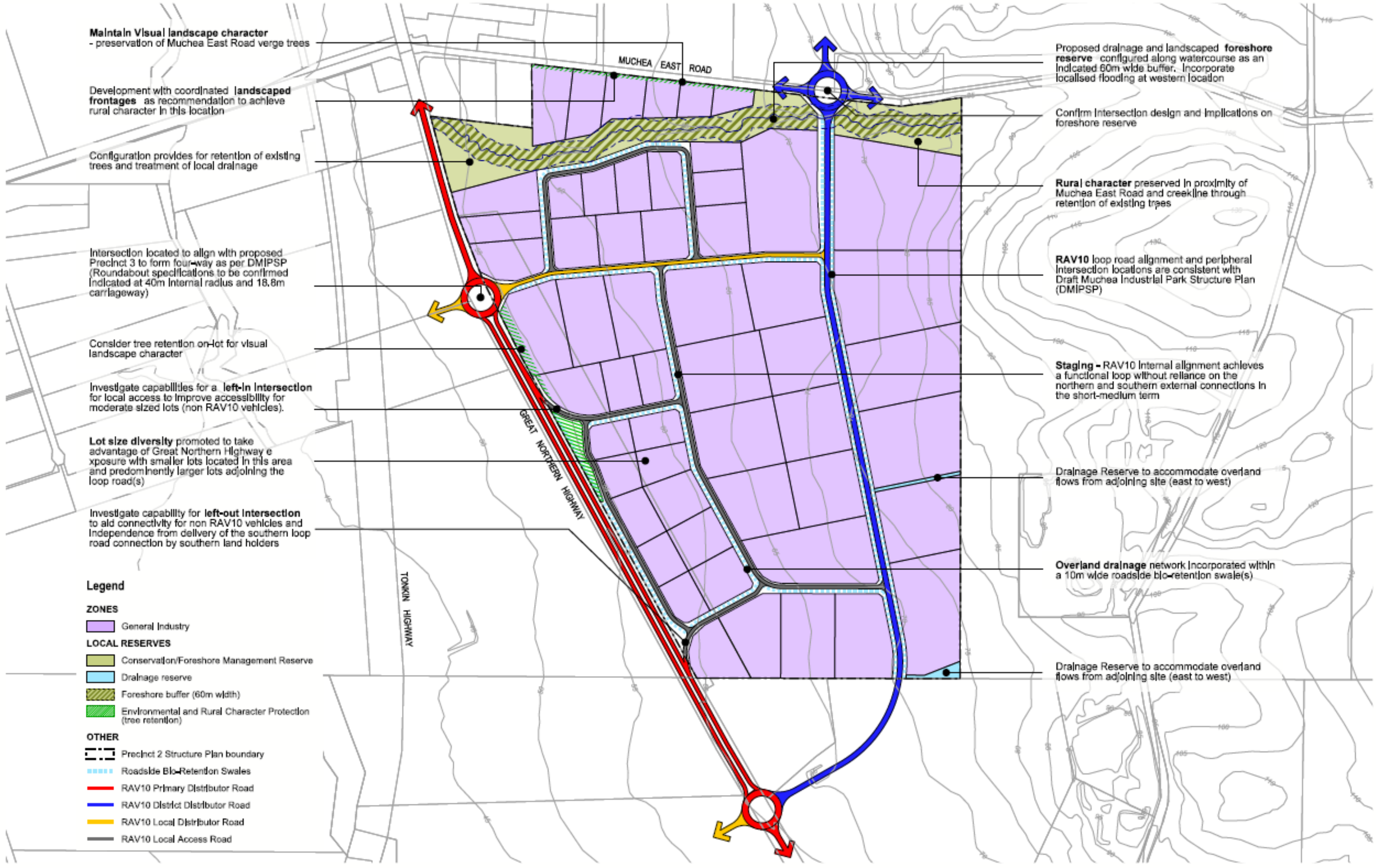
According to DMIPSP for loop road and GNH, a typical priority-controlled T-intersection shall feature auxiliary turn lanes and typical four leg intersection shall be a roundabout with an indicative 40m radius.

Appendix A

PRELIMINARY STRUCTURE PLAN DEVELOPMENT CONCEPT

&

DRAFT MUCHEA INDUSTRIAL PARK STRUCTURE PLAN



Preliminary Structure Plan Development Concept

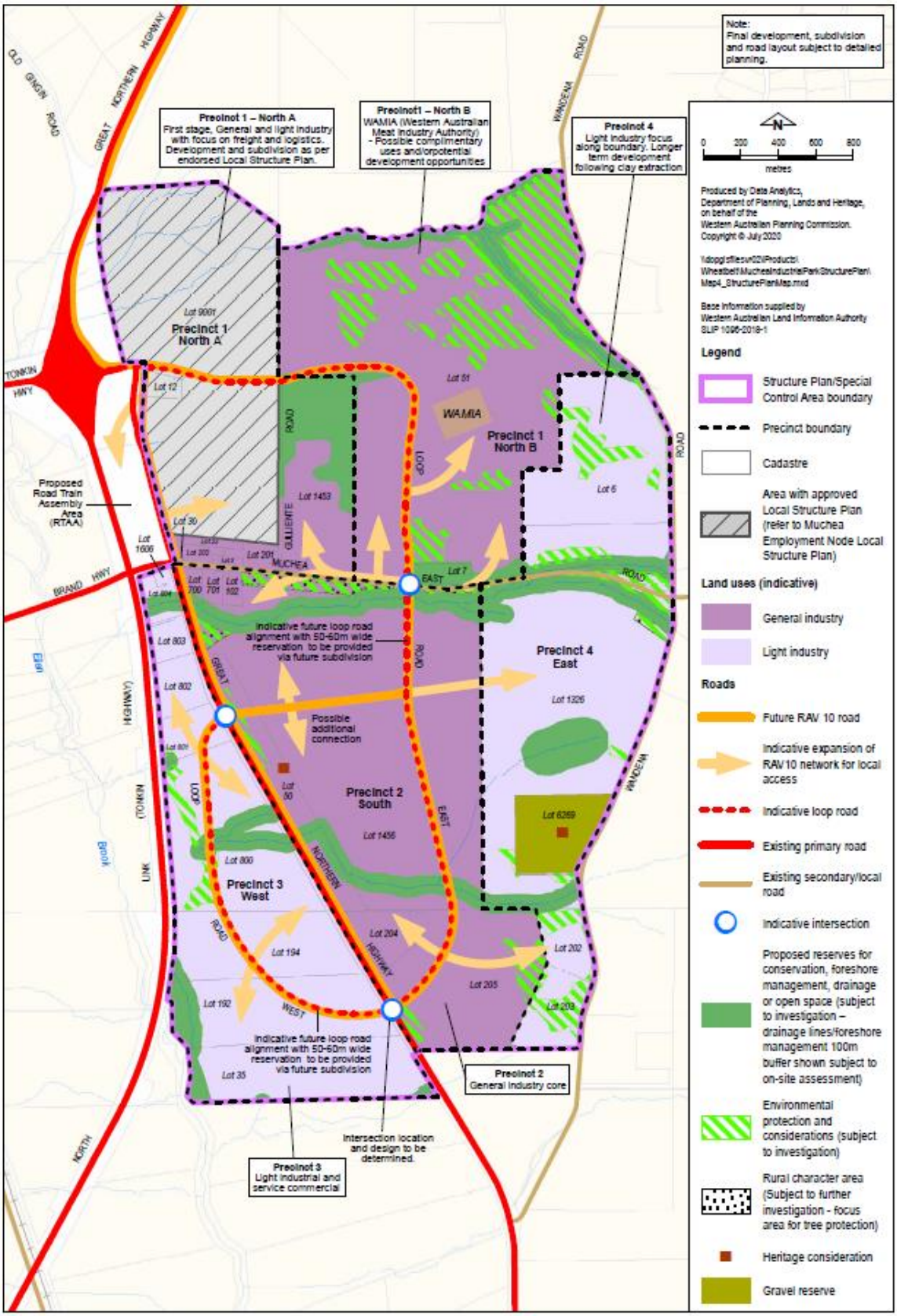
LOT 50 & M1456
GREAT NORTHERN HIGHWAY, MUCHEA

An iParks Property Group Project

scale 1:10,000@A3 | 15,000@A1
0 100 200m
plan 20/094/011A
date 31/03/2021

Taylor Burrell Barnett Town Planning & Design
Level 7, 160 St Georges Terrace, Perth WA 6000

Taylor Burrell Barnett


Note:
Final development, subdivision and road layout subject to detailed planning.
Precinct 1 – North A
First stage, General and light industry with focus on freight and logistics. Development and subdivision as per endorsed Local Structure Plan.
Precinct1 – North B
WAMIA (Western Australian Meat Industry Authority) - Possible complimentary uses and/orpotential development opportunities
Precinct 4
Light industry focus along boundary. Longer term development following clay extraction
Precinct 1 North A
Precinct 1 North B
WAMIA
Precinct 2 South
Precinct 3 West
Precinct 4 East
Proposed Road Train Assembly Area (RTAA)
Indicative future loop road alignment with 50-60m wide reservation to be provided via future subdivision
Possible additional connection
Indicative future loop road alignment with 50-60m wide reservation to be provided via future subdivision
Intersection location and design to be determined.
Precinct 2
General industry core
Precinct 3
Light industrial and service commercial
Produced by Data Analytics, Department of Planning, Lands and Heritage, on behalf of the Western Australian Planning Commission.
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Base information supplied by Western Australian Land Information Authority
SLIP 1096-2018-1
Legend
Structure Plan/Special Control Area boundary
Precinct boundary
Cadastre
Area with approved Local Structure Plan (refer to Muchea Employment Node Local Structure Plan)
Land uses (indicative)
General industry
Light industry
Roads
Future RAV 10 road
Indicative expansion of RAV10 network for local access
Indicative loop road
Existing primary road
Existing secondary/local road
Indicative intersection
Proposed reserves for conservation, foreshore management, drainage or open space (subject to investigation – drainage lines/foreshore management 100m buffer shown subject to on-site assessment)
Environmental protection and considerations (subject to investigation)
Rural character area (Subject to further investigation - focus area for tree protection)
Heritage consideration
Gravel reserve

Appendix B

SIDRA RESULTS

MOVEMENT SUMMARY

Site: [Great Northern Hwy - Muchea E Rd - Brand Hwy - Existing- AM]

Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 57 seconds (Site User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Great Northern Hwy (S)												
30	L2	33	38.0	0.034	10.9	LOS B	0.1	1.6	0.24	0.68	0.24	56.2
31	T1	41	38.0	0.074	9.0	LOS A	0.6	8.4	0.57	0.44	0.57	86.6
32	R2	12	38.0	0.026	19.6	LOS B	0.2	2.5	0.59	0.70	0.59	48.8
Approach		85	38.0	0.074	11.2	LOS B	0.6	8.4	0.45	0.56	0.45	66.0
East: Muchea E Rd (E)												
21	L2	2	23.1	0.002	8.7	LOS A	0.0	0.1	0.25	0.61	0.25	58.8
22	T1	22	23.1	0.173	16.6	LOS B	1.4	14.4	0.77	0.70	0.77	54.6
6	R2	44	23.1	0.173	24.1	LOS C	1.4	14.4	0.77	0.70	0.77	48.2
Approach		68	23.1	0.173	21.2	LOS C	1.4	14.4	0.76	0.70	0.76	50.4
North: Great Northern Hwy (N)												
7	L2	27	29.6	0.176	18.9	LOS B	1.7	20.9	0.60	0.56	0.60	55.7
25	T1	74	29.6	0.176	9.5	LOS A	1.7	20.9	0.60	0.56	0.60	81.3
26	R2	11	29.6	0.020	18.6	LOS B	0.2	2.1	0.57	0.69	0.57	51.3
Approach		112	29.6	0.176	12.7	LOS B	1.7	20.9	0.60	0.58	0.60	69.6
West: Brand Hwy (W)												
27	L2	16	33.9	0.071	23.8	LOS C	0.5	6.4	0.74	0.66	0.74	36.4
28	T1	8	33.9	0.071	16.0	LOS B	0.5	6.4	0.74	0.66	0.74	55.2
29	R2	27	33.9	0.078	23.9	LOS C	0.6	7.2	0.75	0.71	0.75	45.7
Approach		52	33.9	0.078	22.6	LOS C	0.6	7.2	0.75	0.69	0.75	43.5
All Vehicles		317	31.2	0.176	15.7	LOS B	1.7	20.9	0.62	0.62	0.62	58.3

MOVEMENT SUMMARY

Site: [Great Northern Hwy - Muchea E Rd - Brand Hwy - Existing- PM]

Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 56 seconds (Site User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Great Northern Hwy (S)												
30	L2	21	38.0	0.023	11.1	LOS B	0.1	1.1	0.26	0.67	0.26	56.2
31	T1	68	38.0	0.121	8.8	LOS A	1.1	13.9	0.58	0.46	0.58	87.0
32	R2	6	38.0	0.015	19.7	LOS B	0.1	1.3	0.59	0.68	0.59	48.8
Approach		96	38.0	0.121	10.0	LOS B	1.1	13.9	0.51	0.52	0.51	74.2
East: Muchea E Rd (E)												
21	L2	5	23.1	0.005	8.9	LOS A	0.0	0.2	0.28	0.62	0.28	58.7
22	T1	38	23.1	0.153	16.7	LOS B	1.2	12.5	0.78	0.65	0.78	56.4
6	R2	20	23.1	0.153	24.3	LOS C	1.2	12.5	0.78	0.65	0.78	49.6
Approach		63	23.1	0.153	18.5	LOS B	1.2	12.5	0.74	0.65	0.74	54.2
North: Great Northern Hwy (N)												
7	L2	61	29.6	0.204	18.6	LOS B	1.9	23.8	0.61	0.64	0.61	54.3
25	T1	56	29.6	0.204	9.2	LOS A	1.9	23.8	0.61	0.64	0.61	78.3
26	R2	24	29.6	0.049	18.4	LOS B	0.4	4.7	0.57	0.72	0.57	51.5
Approach		141	29.6	0.204	14.8	LOS B	1.9	23.8	0.60	0.65	0.60	61.1
West: Brand Hwy (W)												
27	L2	18	33.9	0.084	24.2	LOS C	0.6	7.2	0.76	0.67	0.76	36.3
28	T1	9	33.9	0.084	16.4	LOS B	0.6	7.2	0.76	0.67	0.76	54.9
29	R2	43	33.9	0.133	25.4	LOS C	0.9	11.9	0.79	0.73	0.79	44.8
Approach		71	33.9	0.133	23.9	LOS C	0.9	11.9	0.78	0.71	0.78	43.3
All Vehicles		371	31.5	0.204	15.9	LOS B	1.9	23.8	0.63	0.63	0.63	58.0

MOVEMENT SUMMARY

Site: [Great Northern Hwy - Muchea E Rd - Brand Hwy - 2031 - AM]

Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 57 seconds (Site User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Great Northern Hwy (S)												
30	L2	42	47.2	0.052	11.9	LOS B	0.2	3.2	0.30	0.69	0.30	53.0
31	T1	73	47.2	0.153	9.5	LOS A	1.2	19.1	0.60	0.48	0.60	85.6
32	R2	14	47.2	0.046	23.1	LOS C	0.3	4.1	0.67	0.71	0.67	44.6
Approach		128	47.2	0.153	11.7	LOS B	1.2	19.1	0.51	0.57	0.51	65.8
East: Muchea E Rd (E)												
21	L2	2	23.1	0.002	9.8	LOS A	0.0	0.1	0.36	0.62	0.36	58.0
22	T1	65	23.1	0.437	21.7	LOS C	3.1	31.8	0.90	0.76	0.90	51.7
6	R2	58	23.1	0.437	29.2	LOS C	3.1	31.8	0.90	0.76	0.90	46.0
Approach		125	23.1	0.437	25.0	LOS C	3.1	31.8	0.89	0.76	0.89	49.0
North: Great Northern Hwy (N)												
7	L2	13	39.4	0.380	20.6	LOS C	3.5	54.5	0.68	0.59	0.68	52.7
25	T1	174	39.4	0.380	10.8	LOS B	3.5	54.5	0.68	0.59	0.68	82.0
26	R2	51	39.4	0.120	20.4	LOS C	0.9	13.6	0.62	0.74	0.62	47.6
Approach		237	39.4	0.380	13.4	LOS B	3.5	54.5	0.67	0.62	0.67	69.3
West: Brand Hwy (W)												
27	L2	19	33.9	0.511	26.7	LOS C	4.4	56.1	0.88	0.74	0.88	36.8
28	T1	162	33.9	0.511	18.9	LOS B	4.4	56.1	0.88	0.74	0.88	56.0
29	R2	51	33.9	0.151	26.0	LOS C	1.1	14.3	0.80	0.74	0.80	44.5
Approach		232	33.9	0.511	21.1	LOS C	4.4	56.1	0.86	0.74	0.86	51.0
All Vehicles		722	36.2	0.511	17.6	LOS B	4.4	56.1	0.74	0.67	0.74	57.9

MOVEMENT SUMMARY

Site: [Great Northern Hwy - Muchea E Rd - Brand Hwy - 2031 - PM]

Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 57 seconds (Site User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Great Northern Hwy (S)												
30	L2	36	47.2	0.049	12.8	LOS B	0.3	4.1	0.38	0.69	0.38	52.3
31	T1	175	47.2	0.367	10.7	LOS B	3.2	52.1	0.68	0.57	0.68	83.2
32	R2	7	47.2	0.024	22.9	LOS C	0.1	2.2	0.66	0.69	0.66	44.8
Approach		218	47.2	0.367	11.5	LOS B	3.2	52.1	0.63	0.59	0.63	73.8
East: Muchea E Rd (E)												
21	L2	6	23.1	0.007	9.3	LOS A	0.0	0.3	0.33	0.63	0.33	58.4
22	T1	198	23.1	0.594	19.5	LOS B	6.0	60.8	0.90	0.78	0.92	55.1
6	R2	41	23.1	0.594	27.0	LOS C	6.0	60.8	0.90	0.78	0.92	48.6
Approach		245	23.1	0.594	20.5	LOS C	6.0	60.8	0.89	0.77	0.90	54.0
North: Great Northern Hwy (N)												
7	L2	79	39.4	0.354	20.5	LOS C	3.1	48.6	0.67	0.67	0.67	50.4
25	T1	89	39.4	0.354	10.6	LOS B	3.1	48.6	0.67	0.67	0.67	76.6
26	R2	29	39.4	0.095	23.2	LOS C	0.6	8.9	0.68	0.73	0.68	46.0
Approach		198	39.4	0.354	16.4	LOS B	3.1	48.6	0.67	0.68	0.67	58.6
West: Brand Hwy (W)												
27	L2	22	33.9	0.205	24.7	LOS C	1.6	19.8	0.78	0.66	0.78	37.0
28	T1	49	33.9	0.205	16.9	LOS B	1.6	19.8	0.78	0.66	0.78	56.5
29	R2	57	33.9	0.269	30.7	LOS C	1.5	18.5	0.89	0.76	0.89	42.2
Approach		128	33.9	0.269	24.3	LOS C	1.6	19.8	0.83	0.70	0.83	45.5
All Vehicles		789	35.6	0.594	17.6	LOS B	6.0	60.8	0.75	0.69	0.76	57.7

APPENDIX G

Servicing Strategy

Report Name: Servicing Report

Project Title: Lot M1456 (No. 3488) & Lot 50 Great Northern Highway, Muchea

Reference No: PC20171.REP.001

Revision	Description	Author	Checked	Approved	Date
A	DRAFT	HW	OO	OO	15/11/2020
B	Interim Issue	HW	OO	OO	02/03/2021
C	Final Issue	HW	OO	OO	12/04/2021
D	Geotech, AAMGL & Earthworks	HW	OO	OO	17/05/2021

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Date	17/05/2021

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1. EXECUTIVE SUMMARY

Peritas undertook servicing due diligence for Lot 50 & Lot M1456 (No. 3488) Great Northern Highway, Muchea (Development Sites), which is located within Precinct 2 of the Muchea Industrial Precinct (MIP). The subject land can sustain the increased density of Industrial Lots. The following are the summary of the due diligence study.

- Site Characteristics
    - Topography – Elevations from Landgate noted that Development Sites has minimal grade north to south. The land primarily grade east (high) to west (low) from approximately 60m Australian Height Datum (AHD) to 55m AHD at a grade of approximately 3%.
    - Geotechnical – Brown Geotechnics undertook site investigation works in November 2020 indicating the site to be mainly non-cohesive ground underlain with clayey soils. The site classification in accordance with AS2870 to range from Class S to Class A sites.
    - Groundwater – Various data sources area available for groundwater level. Bayley Environmental Services completed an analysis of the Annual Average Maximum Groundwater Level (AAMGL) and noted this to range from 0m to 6m depth below the surface.
    - Water Resources – Groundwater allocation are still available (can be licensed) from the Superficial Swan Aquifer and Yarragadee North Aquifer.
    - Environmental – there appear to be constraints associated with significant flora and fauna to be considered (the same conclusion was noted on Precinct 3).
        - Black Cockatoo Roosting and Breeding Site — No
        - Carnabys Cockatoo Confirmed Breeding Areas — Yes
        - Carnabys Cockatoo Feeding Habitat — Small area to north-east
        - Geomorphic Wetland — Multiple Use
        - Bush Forever — No
        - Acid Sulfate Soils — No Data
        - Clearing Regulations — Small are
        - Public Drinking Water Source Areas — No
        - Surface Water Management Areas — Yes

      Bayley Environmental Services completed a site surveys. Refer to “Tallangatta Farm, Lots 50 and 1456 Great Northern Highway, Muchea, Environmental Assessment and Strategy.
    - Existing Services – Power and communication only.
    - Other notable constraints –
        - Power and communication services appear to encroach into the property.
        - Non-perennial waterway needed to be restored to conservation level unless they are proven to have no environmental or ecological function.
- Serviceability
    - Road Network
        - Based on traffic count information, approximately 7,500-7,700 vehicles travel to the site (from north and south), comprising of 28-30% trucks.

- Access to site is greatly improved with the completion of the Main Roads Northlink Project.
- RAV 10 network is currently proposed to circulate internally within the precinct (as part of Shire of Chittering Local Planning Policy No33).
- However, the RAV 10 network loop outside of land holdings owned by Tallangatta Beef and therefore temporary circulation arrangement are considered in the Local Structure Plan proposed within Tallangatta Beef land holding.

- Earthworks
  - The Developer will be required to undertake earthworks for road Construction.
  - Future lot owners may choose to fill the site to suit their own development.
- Surface Water Management
  - Small Rainfall Event– bio-retention recommended for impervious area created (excluding roof). Bio-retention to manage 15mm of rainfall.
  - Minor Rainfall Event – Institute of Public Works Engineering Australasia recommended industrial sites to be designed with pit and pipe infrastructures to manage up to 10% AEP. However, Muchea Precinct 3 manage only up to 20% AEP and the therefore the same philosophy is recommended for Precinct 2. Minor rainfall to be managed by overland flow and detention basin with minor infiltration (where possible) and outlet.
  - Major Rainfall Event – 1% AEP event to be managed via overland flow and detention basin. A 0.3m freeboard from building to flood water level is recommended for asset protection.
- Groundwater
  - Stormwater infiltration systems with groundwater separation less than 3m-5m shall be appropriately modelled to consider reduced permeability.
  - Subsoil pipes, if proposed, shall be positioned above the AAMGL.
- Water
  - Fit for purpose water usage is critical as there are limited potable water sources.
  - Non-potable – supply can be sourced either via rainwater tank or bores.
  - Potable – The Development Sites are outside of Water Corporation's catchment. Limited supply should be available from Muchea Water (Aqua Ferra), the balance water supply requires individual tenancy to manage.

    This can by means of treating water using Reverse Osmosis, ultraviolet disinfection, or chlorine treatment.
- Wastewater
  - The Development Sites are outside of Water Corporation's catchment. Recommended approach is by means of an Aerobic Treatment Unit.
  - A centralised wastewater management approach is not recommended.
- Power
  - Western Power forecast shows adequate capacity.

- Communication
    - Telstra service is available and NBN service is due to be available July – September2021.
- Gas
    - No service available.

The following additional studies are recommended (related to Civil):

- Feature Survey
- Environmental study for waterways to determine if they can be removed. Not required if drain is retained and rehabilitated.

2. BACKGROUND

Peritas Consulting Pty. Ltd. (Peritas) was engaged by Tallangatta Beef Pty. Ltd. (Developer) to review the Engineering constraints and servicing requirements associated with the development of Lot 50 & Lot M1456 (No. 3488) Great Northern Highway, Muchea (Development Sites).

The Development Sites are in Muchea, approximately 45km north-east of Perth, within the Shire of Chittering (SoC). Refer to Annexure A sketch PC20171.SKT.001 for site locality plan.

Lot 50 Great Northern Highway occupy a land area of 21.588ha while the larger Lot M1456 (No. 3488) occupy a 190.5646ha. The Developer proposes for the site to be subdivided into 55 industrial properties, ranging in size from 0.9-12ha. Refer to Annexure B for proposed development layout.

2.1 Planning Context

The Development Sites are zoned as “Agricultural Resources” under the SoC Local Planning Scheme No.6 (LPS 6).

In June 2016, the SoC endorsed a “Muchea Employment Node Special Control Area”. The special control area is also known as the Muchea Industrial Precinct (MIP), comprising of approximately 1,150ha of land area, divided into 4 precincts (Refer to Annexure A sketch PC20171.SKT.003 for planning context plans). The Development Site represents approximately 75% of Precinct 2 of the MIP. Refer to Annexure A sketch PC20171.SKT.003 for planning context diagrams.

The creation of the MIP complements the Main Roads Western Australia (MRWA) Northlink project, linking Morley to Muchea. The Northlink project commenced mid-2016 completed April 2020 with the intent to shift 80% of traffic from Great Northern Highway to the newly constructed road, which is noted to be the safer road.

2.2 Relevant Documents & Previous Studies

Further to the formalisation of the MIP, as part of LPS6, the Shire of Chittering also adopted the “Shire of Chittering Local Planning Policy No.33” (LPP 33). The LPP33 was developed and adopted in Aug 2019 to provide design guidelines for the MIP area.

A scheme amendment was prepared by Urbis in Oct 2019. The “Muchea Industrial Park Scheme Amendment Precinct 3” (Precinct 3 Report) was prepared for Tomahawk Property for Precinct 3 of the MIP. Within the documentation are studies in support of the scheme amendment which is also relevant to Precinct 2. Refer to Annexure A sketch PC20171.SKT.003 showing location of Precinct 3 relative to Precinct 2 (Development Sites).

3. PRE-DEVELOPMENT ENVIRONMENT

This section outlined the pre-development condition of Lot 50 & Lot M1456 (No. 3488) Great Northern Highway, Muchea (Development Sites). The information is compiled in consideration of the studies requirements noted in Local Planning Scheme No.6 (LPS 6) and Shire of Chittering Local Planning Policy No.33 (LPP33).

It should be noted that the information presented in this section is intended for a high-level overview of the site. The findings also briefly mentioned data relating to disciplines such as environmental, hydrology, geotechnical, etc. The developer has commissioned other studies concurrent with this servicing report. When completed, these reports sha take precedence over the findings noted in this document.

3.1 Topography

Annexure A sketch PC20171.SKT.004 shows an overlay of contour and aerial imagery for the Development Site. The contours are sourced from Landgate with 1m interval. Geoscience Australia National Elevation Data Audit 2011 noted elevation in this region to have an accuracy level ranging from 0.1m to 0.15m

The Development Site falls from 90m Australian Height Datum (m AHD) to the east to approximately 55m AHD to the west, over approximately 1.3km distance. There is a consistent grade from east to west of approximately 3% (1:33), elevation increasing to the east, parallel with the Great Norther Highway (GNH).

A 3% grade is within the ideal range for road and gravity services design, assuming the infrastructure is perpendicular to the fall. However, roadways or services running parallel with the GNH will have difficulties in obtaining fall (same level north-south direction).

Feature survey of the site are recommended to confirm site topography.

3.2 Geology & Geotechnical

Annexure A sketch PC20171.SKT.005 shows Geoscience Australia 1:50,000 geology map. The Development Site consisted of 4 types of geology as follow:

- Mgs1 Pebbly Silt
- ST1 Siltstone
- S5 Sand
- Msg Sandy Silt

Most of the site appear to comprise of gravelly silty geology. This indicates potentially plastic material with low to medium permeability.

3.2.1 Precinct 3 Geotechnical Summary

Structerre Consulting undertook geotechnical investigation in 2018 for Precinct 3 of the Muchea Industrial Precinct (MIP). The investigation was carried out between the 26th and 27th of November 2018, comprising of 37 boreholes, 7 permeability tests and 37 Dynamic Cone Penetrometer.

The Structerre geotechnical report noted Precinct 3 geology consisting of pebbly silt (Mgs1). This is the same geology to 50% of Precinct 2 Development Site (west side). The bore logs by Structterre (upon site investigation), identified typical Guildford formation - sand cover overt plastic clay & silt. The sand cover is typically shallow but does extend to 1.0m in some bore logs. Plasticity index tested from 0.1-1.3m depth is in the range of 19% to 32% and permeability rates ranging from 0.3m/day to 1.2m/day.

3.2.2 Precinct 2 Geotechnical Summary

Brown Geotechnical undertake site investigation in November 2020 for Precinct 2 of the MIP. The report "Preliminary Geotechnical Investigation for Local Structure Plan – Lots 50 and M1456 Great Northern Highway Muchea, Western Australia" noted 40 boreholes, 3 permeability tests and 14 Perth Sand Penetrometer.

The Brown Geotechnical report noted Precinct 2 consisted mainly of sand and gravel underlain with clayey subgrade to majority of site except for the north west where sand pockets appear to exceed 2m depth. Site classification, in accordance with AS2870 mainly divided into Class A and Class S.

Plasticity index tested from 0.5m-2.0m depth range from 6% to 21% and permeability rates range from negligible to 43m/day.

The findings within the geotechnical report differ from the geology map.

3.3 Groundwater

There are several data sources available to estimate the groundwater level across the sites. All data indicated shallow groundwater table (close to surface) west of the Development Sites.

The data sources noted high variance in groundwater level as tabulated on Table 3-1. Typically the adopted groundwater level is dictated within a Local Water Management Strategy (LWMS).

Table 3-1 Groundwater Summary

Source	Precinct 2 west	Precinct 2 east
Groundwater Atlas	Surface[A]	25m bgl
Long Term Bores	1.3m bgl[B]	-18.9m bgl[C]
Precinct 3 report	0.6m bgl	1.8m bgl
Precinct 2 AAMGL	0.0m bgl	6.0m bgl

A Inferred information (refer to Section 3.3.1)
B bgl below ground level
C -ve Data indicated artesian bore.

Refer to Annexure A sketch PC20171.SKT.006 for groundwater level information.

3.3.1 Department of Water and Environmental Regulation – Groundwater Atlas

There is no maximum historical Groundwater Level (GWL) data recorded on Department of Water and Environmental Regulations (DWER) groundwater atlas. However, minimum groundwater level of 50m AHD (west) to 55m AHD (east) was recorded.

The closest maximum historical groundwater information is approximately 5km to the west, noting minimum and maximum groundwater variation of approximately 10m. It can be inferred that the maximum groundwater level over the Development Site is approximately 60m ADH (west) – 65m AHD (east).

Landgate contours suggest that elevations west of the Development Site is approximately 55m Australian Height Datum (AHD) and 90m AHD to the east (Annexure A sketch PC20171.SKT.004). Therefore, indicating that groundwater is at surface level to the west, dropping to around 25m depth to the east of Precinct 2.

3.3.2 Department of Water and Environmental Regulation – Long Term Monitoring Bores

There are several DWER long term monitoring bores around the site with recorded data ranging from 8years to 43 years, data from 1978 to 2020.

Bore 61611180 indicated that the groundwater level near the intersection of GNH and Muchea East Road to be approximately 53.7m AHD. Bore 61611188 indicated artesian system to the east of the site.

The long-term monitoring bores and Landgate contours (Annexure A sketch PC20171.SKT.004) suggest groundwater levels ranging from 1.3m below ground to the west and going up to 18.9m above the ground (artesian bore).

3.3.3 Bayley Environmental Services – Precinct 3

Bayley Environmental Services measured groundwater levels across 9 monitoring bores as part of Precinct 3 Local Water Management Strategy (LWMS). The calculated Average Annual Maximum Groundwater (AAMGL) data are shown below on Figure 3-1, which extend into Precinct 2.

It should be noted that the Precinct 3 LWMS indicated perched groundwater systems. The AAMGL would refer to the actual groundwater level. Perched groundwater would still be an issue during wetter winter periods.

The AAMGL calculated by Bayley Environmental Services noted groundwater levels to range from 0.6m(west) to 1.8m (east) below ground.

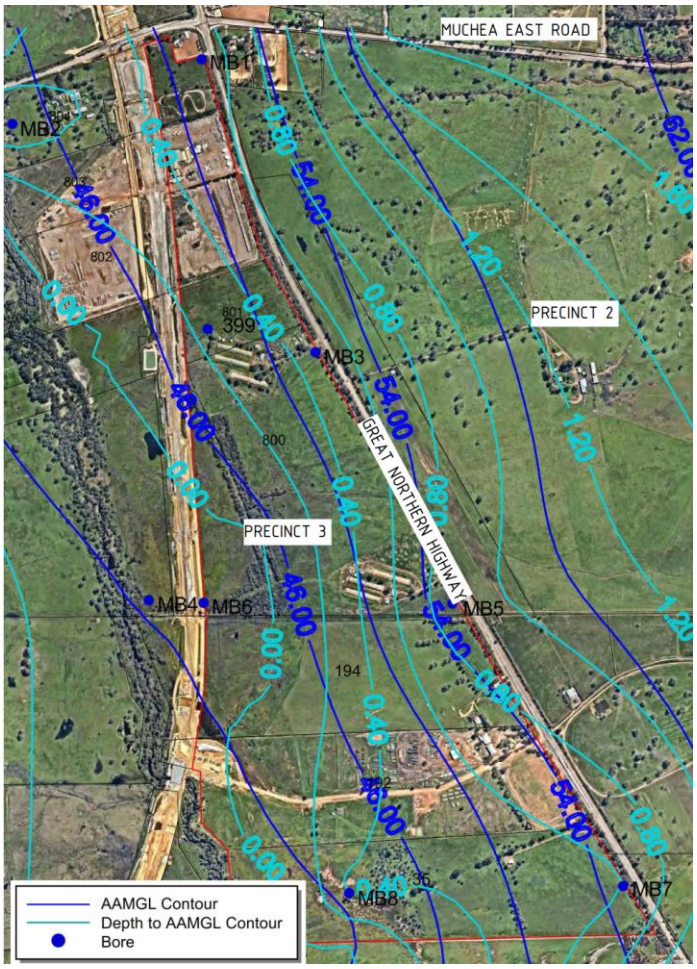

Figure 3-1 Extract from Bayley Environmental Services Muchea Employment Node Precinct 3 Local Water Management Strategy.

3.3.4 Bayley Environmental Services – Precinct 2

As noted in Section 3, this servicing report was undertaken concurrent with other studies. At the time of initial reporting, the AAMGL specific to Precinct 2 was not available.

Bayley Environmental Services has since installed 9 groundwater monitoring bores within Precinct 2 sites and re-calibrated the AAMGL noted in Section 3.3.3. The revised AAMGL is included in Annexure C.

The AAMGL is noted to be 0m below the surface, west of GNH and up to 6m deep to the east of the site.

3.4 Water Resources

Annexure A sketch PC20171.SKT.007 shows information from DWER database, showing availability of two groundwater resources for extraction as follow:

- Gingin, Eclipse Hill, Perth - Superficial Swan Aquifer and
- Gingin, Chandala Confined, Perth - Yarragadee North.

A third, Cowalla confined, Perth – Leederville – Parmelia aquifer was noted to be fully allocated.

Currently, 13 licenses are issued for the Perth-Superficial Swan aquifer as summarised on Table 3-2.

Table 3-2 Current Perth - Superficial Swan aquifer allocation

WRI No.	Issue Date	Expiry Date	License Allocation	License Holder
63704	20/02/2015	19/02/2025	113265 KL	Larussa Assets Pty. Limited
110168	09/07/2015	08/07/2025	20950 KL	Mackey, Craig Vincent, Mackey, Collette
110833	28/01/2014	27/01/2024	64025 KL	Harley, Gary Thomas
153393	16/05/2014	15/05/2024	84800 KL	Grant, Karen, Grant, Paul
158431	21/04/2020	20/04/2025	54000 KL	Curran, John Lawrence
164435	11/09/2014	11/09/2024	15000 KL	Wright, Wayne Colin
167085	03/03/2015	15/08/2021	245940 KL	Gratte, Bethwyn Irene Brooke
167566	11/08/2017	10/08/2027	90450 KL	Cocking, Brian James
168103	04/12/2019	03/12/2029	82200 KL	Ross Maitland Love
180394	03/03/2015	02/03/2025	50000 KL	Hall, Tricia Verdell, Peter John Hall
181940	02/02/2016	01/02/2026	24280 KL	Temma Nominees Pty Ltd
202022	12/10/2018	11/10/2020	52000 KL	Sirona Capital Management Pty Ltd
203543	01/11/2019	31/10/2020	20000 KL	Perkins (WA) Pty Ltd
Total			**916,910 KL**	

The Gingin, Chandala Confined, Perth - Yarragadee North aquifer has 2 groundwater extraction licenses issued, as summarised on Table 3-3.

Table 3-3 Current Perth - Yarragadee North aquifer allocation

WRI No.	Issue Date	Expiry Date	License Allocation	License Holder
104858	21/12/2015	20/12/2025	6,000 KL	Iluka Resources Limited
200411	08/06/2020	23/10/2027	850,000 KL	Stavros Trandos, Arthur Trandos; Dimitrios Trandos
Total			**856,000 KL**	

According to Department of Water's Gingin groundwater allocation plan, the following licensable allocation limit applies:

- Gingin, Eclipse Hill, Perth - Superficial Swan aquifer 980,000 KL/yr
- Gingin, Chandala Confined, Perth - Yarragadee North 1,050,000 KL/yr

The Department of Water noted salinity levels in the vicinity of 250-500mg/l. Salinity levels less than 500mg/l are considered fresh, suitable for drinking and all irrigation.

Availability of groundwater for water resource will be critical for this development, refer to Section 4.3.2. Further studies on water balance will be necessary.

3.5 Environmental Consideration

With reference to Annexure D, Table 3-4 summarised environmental constraints.

Table 3-4 Current Perth - Yarragadee North aquifer allocation

Sketch No.	Environmental Constraint	Applicable to Site
PC20171.SKT.008	Black Cockatoo Roosting and Breeding Site	No
PC20171.SKT.009	Carnabys Cockatoo Confirmed Breeding Areas	Yes
PC20171.SKT.010	Carnabys Cockatoo Feeding Habitat	Small area to north-east
PC20171.SKT.011	Geomorphic Wetland	Multiple Use
PC20171.SKT.012	Bush Forever	No
PC20171.SKT.013	Acid Sulfate Soils	No Data
PC20171.SKT.014	Clearing Regulations	Small area
PC20171.SKT.015	Public Drinking Water Source Areas	No
PC20171.SKT.016	Surface Water Management Areas	Yes

The Carnabys Cockatoo breeding area is perhaps the most significant environmental element to be considered. It should be noted that the Urbis "Muchea Industrial Park Scheme Amendment" also highlighted 3 threatened Fauna and one Priority Fauna species, which included the Carnaby'sc Cockatoo and the Red-tailed Black Cockatoo.

Bayley Environmental Services completed a site surveys. Refer to "Tallangatta Farm, Lots 50 and 1456 Great Northern Highway, Muchea, Environmental Assessment and Strategy.

3.6 Existing Services

Peritas undertook Dial Before You Dig (DBYD) investigation for the site. The following services are available within close vicinity to the Precinct.

- Power
- Communication

No other services are available. Refer to Annexure E for DBYD summary.

It should be noted that the DBYD indicated Telstra and Power services encroaching within the site boundary. It is recommended for underground service locating to be undertaken to confirm services position.

3.7 Other Notable Features

Figure 3-2 shows power infrastructure located south of Lot 50. There is a land parcel set aside specifically for this infrastructure and according to DBYD, there appear to be below High Voltage (HV) ground cable linking the infrastructure to Western Power overhead transmission line. This is outside of the Development Site however cables leading and out of the infrastructure should be located.

Figure 3-3 shows a compound that is located immediately opposite of Gulliente Road and Muchea East Road intersection. Warning signs are noted on the fences, its function cannot be determined based on desktop assessment.

Figure 3-4 shows non-perennial waterways flowing from east to west of the site and eventually under the GNH. Preliminary consultation with the DWER (Refer to Annexure F) indicated that the drain will need to be retained and rehabilitated. The DWER also require for a reserve to be created over the drain for conservation purposes.

Hydrological study is recommended to determine the environmental value of the drainage network and determine if retention and rehabilitation is necessary.

Figure 3-2 Existing power infrastructure.

Figure 3-3 Unknown Compound

Figure 3-4 Non-perennial waterway

4. INFRASTRUCTURE AND SERVICING

The following sections outlined recommended servicing approach for Lot 50 & Lot M1456 (No. 3488) Great Northern Highway, Muchea (Development Sites), which forms part of Muchea Industrial Precinct (MIP) Precinct 2.

4.1 Road Network

Precinct 2 can be reached either via the Great Northern Highway (GNH) or the New Northlink (Tonkin Highway) extension.

It is envisaged that the new Northlink will divert 80% of traffic volume from the Great Northern Highway. Traffic count data are included in Annexure G sketch PC20171.SKT.017, showing mostly data from 2015-2016. New data from 2020-2021 are available only for the Tonkin Highway extension.

In general, approximately 7,500-7,700 vehicles per day would be heading in the direction of Precinct 2 from either Tonkin Highway or Great Northern highway, comprising of 28-30% trucks.

Porter Consulting Engineers prepared a "Road and Drainage Guidance Note Muchea Industrial Park", which is incorporated as part of the Shire of Chittering Local Planning Policy No. 33. Figure 4-1 shows an extract from the Porter Consulting report, noting the below proposed circulating road within Precinct 2.

The Eastern Loop Road (solid red line) is a proposed Register of Approved Vehicles (RAV) 10 road, which is designed for vehicles up to 53.5m long with a total mass of 147.5kg. A secondary RAV 10 road may be requested for Precinct 2, this is shown as the Precinct 2 Access Road (dashed red).

However, it should be noted that the RAV 10 road network loops from the southern extent of Precinct 2 to Precinct 1, outside of Tallangatta Beef Pty Ltd (Developer) land holding. Therefore, temporary roadway may need to be considered within Precinct 2.

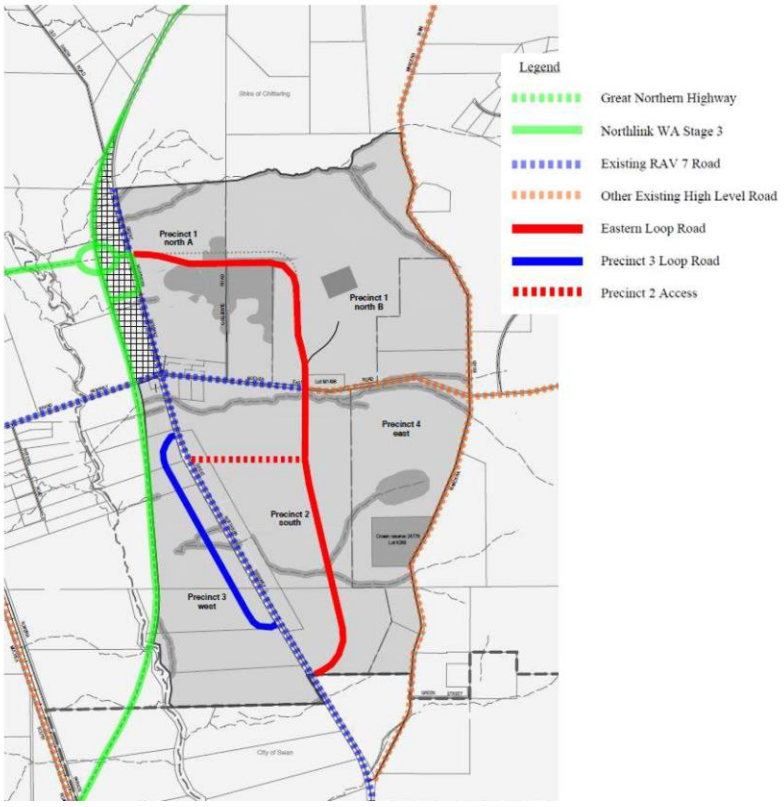

Figure 4-1 Extract from Road and Drainage Guidance Note Muchea Industrial Park.

4.2 Earthworks

Based on the information on "Preliminary Geotechnical Investigation for Local Structure Plan – Lots 50 and M1456 Great Northern Highway Muchea, Western Australia" (Precinct 2 Geotechnical Report), the site is suitable to be subdivided with no further earthworks required by the developer (except for road construction and associated drainage). The Developer may choose to clear the land and undertake earthworks (level site) for the purpose of marketing and sales.

The future lot owners may choose to fill the lots to meet their own development requirements. Various factors influence earthworks required for the site. On larger lots, it is likely that only select areas within the development footprint will be filled as the lot footprint is relatively large. Considerations for fill requirements included:

4.2.1 Road network

The Developer will need to undertake earthworks on road reserve to ensure that roadways are adequately drained.

As discussed in Section 3.1, the site has good grade from east to west. However, the site is relatively flat in the north-south direction. Fill will be required to create falls to drain water within roadways.

Austroads publication "Rural Road Design A guide to the Geometric Design or Rural Roads" noted minimum desirable longitudinal grade of 1.0% and an absolute minimum of 0.3% to drain water. However, the Austroads does allow 0% longitudinal grade if water can drain away from the road (the road must have a crossfall). Maximum longitudinal grades are dictated by vehicle performance and design speed. As an example, a 6-8% grade area considered "mountainous" for a design speed of 100km/hr but considered "flat" for a design speed of 60km/hr.

Austroads range from crossfall on straight road is limited to 2.5-3%.

As noted above, given the 3% fall from east to west, more than likely road network will match this grade. However, in the north-south direction, more than likely the road will utilise minimum grades to minimise fill required.

Fill within roadway will also be linked with the drainage network, ensuring adequate pipe cover at the upstream most extent of the network while allowing the pipe to discharge above the groundwater level at the downstream end.

4.2.2 Lot Site Classification

AS 2870 provided guidance for site classification. Site prone to shrinkage and swelling has high surface movement and therefore require sturdier building foundation.

Precinct 2 Geotechnical Report noted site classification to range from Class A to Class S. Class A being a site with little or no surface movement while Class S site has approximately 20mm of surface movement. The geotechnical report provided advise to fill the site from 0.7m up to 1.8m to convert a Class S site to a Class A.

The site is developable as a Class S. The future lot owners may choose to fill the site to Class A to reduce building slab thickness and reinforcement requirements.

The above is associated with a cost assessment between importing sand material to site relative to the expense incurred in a sturdier footing.

4.2.3 Lot Separation to Groundwater

There is no known guidelines advising the minimum separation required to groundwater in an industrial development.

The document "Specification for Separation Distances for Groundwater-Controlled Urban Development" by the Institute of Public Works Engineering Australasia (IPWEA), recommended 0.15m-0.65m separation to the 20% AEP (5YR ARI) and 50% (1.5YR ARI), depending on the functionality of the site. However, the above are not associated with engineering requirements, they are for amenity reasons.

Separation to groundwater ranging from 1.2m to 1.5m is typically proposed for the purpose of infiltration. The above would allow either 0.9m or 1.2m soakwells to be installed.

However, if the stormwater management adopted is a detention system, no infiltration consideration is necessary.

4.2.4 Lot Wastewater Serviceability

Wastewater management recommendation is discussed in Section 4.2.4. Each lot will more than likely adopt an Aerobic Treatment Unit (ATU).

Fill may be required to provide minimum separation to groundwater. This is only in limited areas as most locations as reasonable separation.

Further to the above sewer internal plumbing are dictated by AS3500.2 for "Plumbing and drainage part 2: Sanitary plumbing and drainage". Plumbers are required to adhere to specific falls depending on the unit fixture loading.

The fixture unit loading are different for each development and therefore it is up to the future lot owners to determine if fill is required (and how much) to ensure sewer serviceability. They may also choose to use other systems such as vacuum sewer or pump system to avoid fill.

4.2.5 Lot Drainage

Drainage management for the development is discussed in Section 4.3.1 The site is not known to be at risk of flooding and therefore no requirement to fill the site for it to be developable.

However, future lot owners will be required to grade their site to drain water away from critical infrastructures.

The grading of the site depends on site layout and functionality. As an example, an unsealed hardstand is recommended to be grade at 4% minimum while a concrete hardstand can be graded as low as 1%. Some facilities designed specifically for washdown may require steeper grades to mobilise washed material, etc.

4.3 Water Management Framework

With reference to the Western Australian Planning Commission (WAPC) "Better Urban Water Management" publication, Figure 4-2 shows planning framework and relevant water management strategies. Like the planning framework, water strategies are tiered from state level down to development scale.

In context of the Development Site, at Local Structure Plan (LSP) Level, a Local Water Management Strategy (LWMS) will be required. This is followed by Urban Water Management Plan (UWMP) at subdivision level, typically to be completed post WAPC conditional approval.

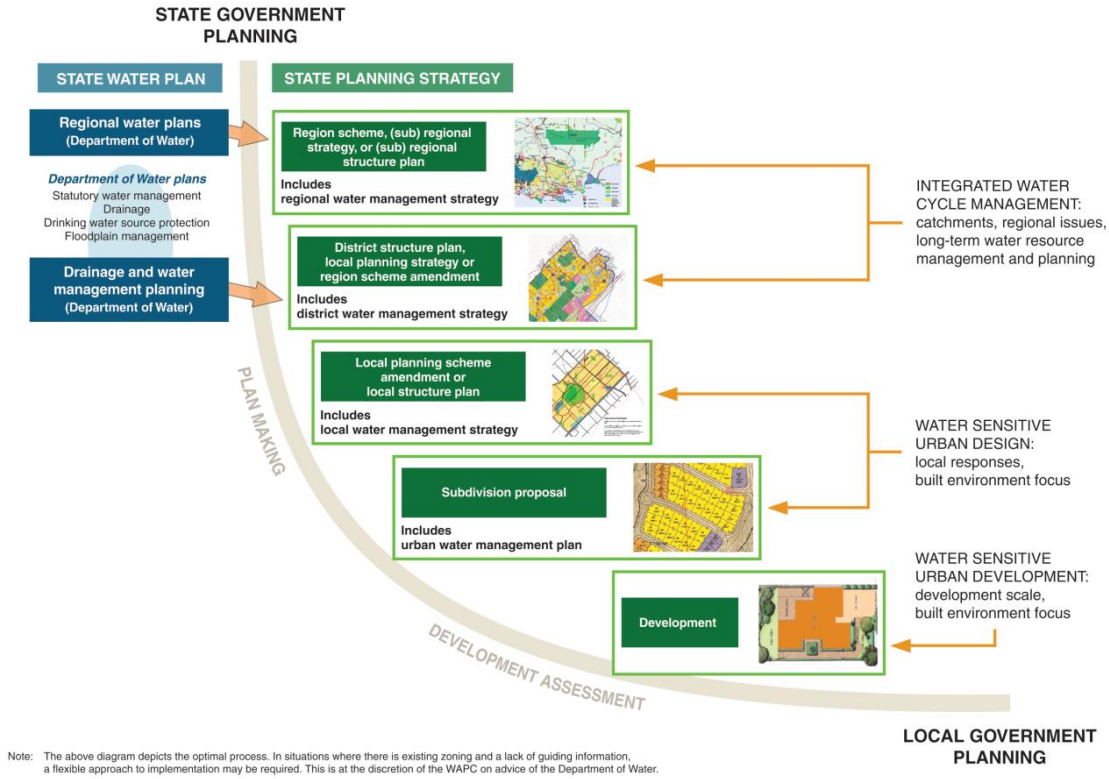

Figure 4-2 Extract from Western Australian Planning Commission Better Urban Water Management.

4.3.1 Surface Water Management

The proposed concept surface water management noted in Sections 4.3.1.1 to 4.3.1.4 is in accordance with Department of Water and Environmental Regulation (DWER) "Decision Process for Stormwater Management in Western Australia".

Simplifying the intent of the Better Urban Water Management, it highlighted two different water management study scales:

- Regional water management, which included surrounding areas outside of the Development Sites.
- Local water management, which is the management of water within the Development Sites.

4.3.1.1 Regional Stormwater Management

Peritas liaised with the DWER (Annexure F) who noted that there is no known flood information in the site vicinity. Therefore, flood management are predominantly local to the site (further discussed in Section 4.3.1.4).

As noted on Section 3.7 and Annexure F, the DWER has also noted a Perennial drain requiring to be retained and rehabilitated. The DWER initially requested to retain only the northern drain. However, the DWER later confirmed that the southern drain will also require retention and rehabilitation unless it can be shown that this drain does not perform any environmental and hydrological functions.

The Precinct 2 site grades from east to west, the topography continue to grade down to the west (Refer to Section 3.1). The "Muchea Industrial Park Scheme Amendment Precinct 3" (Precinct 3 Report) by Urbis noted a series of culvers across Great Northern Highway (GNH), refer to Annexure H. These culverts will need to remain operational to convey water from Precinct 2 to Precinct 3, maintaining pre-

development flow regime. The flow rates limitation will need to be assessed on a LWMS and further refined in a UWMP.

4.3.1.2 Local Stormwater Management – Small Rainfall Events for Ecological Protection (15mm Management)

Runoff generated from the first 15mm of rainfall (over constructed impervious surfaces) shall be retained at source for treatment. The above is in consideration that the 15mm first flush can mobilise soluble substances such as silts, dust, oils, organics, hydrocarbons, nutrients, etc. This excluded runoff from roof as they can be considered as "clean, not requiring further treatment.

The most economical approach of stormwater treatment is by means of bio-retention/biofiltration infrastructures. Bio-retention infrastructures shall be constructed in accordance with Facility for Advancing Biofiltration (FAWB) "Stormwater Biofiltration Systems Adoption Guidelines" and planted in accordance with Monash University "Vegetation guidelines for stormwater biofilters in the south-west of Western Australia. Refer to Figure 4-3 for a typical bio-retention infrastructure profile.

It is noted that the plant species guidelines is perhaps not suitable for the site. However, there has been no known studies for plant species recommended in the wheatbelt region. Therefore, more than likely irrigation infrastructures will need to be installed to maintain the vegetation. The criteria for bio-retention are typically specified in the LWMS and refined in the UWMP.

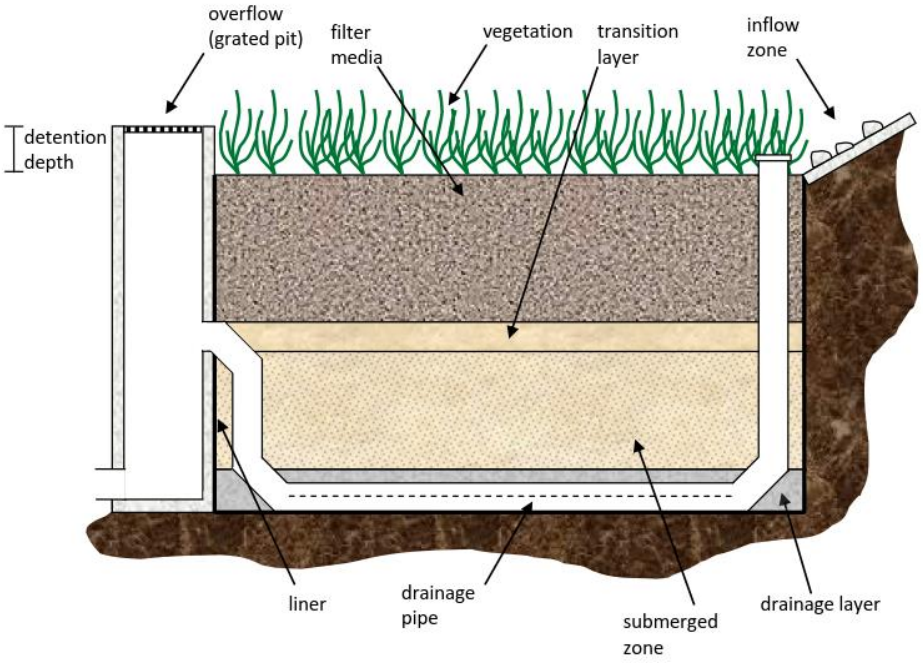

Figure 4-3 Extract from FAWB "Stormwater Biofiltration Systems Adoption Guidelines" – Main Components of biofiltration systems that have to be specified.

4.3.1.3 Local Stormwater Management – Minor Rainfall Events for Serviceability, Amenity and Road Safety (20% Annual Exceedance Probability Event)

The Institute of Public Works Engineering Australasia (IPWEA) "Local Government Guidelines for Subdivisional development" recommended the management of 10% Annual Exceedance Probability Event (AEP) for commercial and industrial areas.

However, the "Muchea Employment Node Precinct 3 Local Water management Strategy" by Bayley Environmental services (precinct 3 LWMS), mentioned 20% AEP (5YR ARI) serviceability design and therefore Pertias recommend adopting the same philosophy as Precinct 3 for consistency purposes.

Existing site conditions pertaining to drainage management were discussed in Sections 3.2 and Section 3.3, noting low permeability site with seasonal high groundwater. Therefore, it is recognised that the site has restricted potential for infiltration at source.

The recommended approach for the serviceability management is a combination of swale network and a detention system. Stormwater exceeding the first 15mm first flush shall be conveyed via drainage swales into a detention infrastructure. The conveyance swale can also be integrated with the bio-retention system discussed in Section 4.3.1.2 as a living stream. Detention infrastructure can range from an open basin (integrated as part of soft landscaped areas), rainwater tank, underground storage modules, etc. Open basin is recommended, in consideration of construction cost and ease of maintenance.

It is recommended for piped stormwater conveyance and culverts to be minimised due to high silt content in the ground. Silts are easily mobilised by surface runoff, causing clogging issues.

The detention basin shall be designed in accordance with the principles noted in Department of Water "Stormwater Management Manual for Western Australia, Structure Controls". Given low infiltration potential of the pre-developed site, high surface runoff is expected and therefore the detention system will more than likely be relatively modest in size.

Note that it is also possible for the detention structure to allow infiltration to assist in the stormwater disposal process. However, the predominant mode of stormwater management is by allowing off-site discharge at pre-development flow rates. The detention system sizing, flow rates and infiltration parameters will need to be assessed on a LWMS and further refined in a UWMP with the assistance of geotechnical site investigation.

4.3.1.4 Local Stormwater Management – Major Rainfall Events for Flood Protection (1% Annual Exceedance Probability Event)

Storm event exceeding 10% AEP up to 1% AEP are considered as major flood events. As noted on Section 4.3.1, storm events can typically be classed as regional and local. Regional refers to flood from the greater catchment and cannot be controlled by local stormwater management. Local flood management refer to runoff generated within the site and this can be managed by structural Best Management Practices (BMP).

It is not practical to size stormwater conveyance infrastructures for these events, as these would result in excessively large infrastructures. It is a common practice to allow conveyance of major rainfall event to be my means of surface runoff.

Typical major rainfall event management approach in areas non-conductive to infiltration, included the provision of a detention BMP (allowing pre-development discharge) and the provision of 0.3m of freeboard to habitable spaces for asset protection reasons.

Flood levels, flood protection, flow rates and conveyance mechanism will need to be assessed on a LWMS and further refined in a UWMP.

4.3.2 Groundwater Management

Groundwater separation less than 3m-5m from infiltration infrastructures are considered shallow. The 15mm retention proposed in Section 4.3.1.2 shall be appropriately modelled to consider the effects of shallow groundwater to infiltration systems.

Subsoil pipes, if proposed shall be positioned above the AAMGL.

4.3.3 Water

Peritas liaised with the Water Corporation (Annexure I) who advised that Precinct 2 is well beyond the Water Corporation reticulation area. The nearest Water Corporation asset is located approximately 11km south east of Muchea, in Bullsbrook. Due to restricted potable water supply, fit for purpose water supply will be critical.

4.3.3.1 Non-Potable Water

Non-potable water supply can be sourced either via groundwater bores or by means of rainwater tanks. Non-potable water usage included, toilets, irrigation, vehicle washing, process water, etc.

Peritas preliminary due diligence noted that there are groundwater resources available for Precinct 2 (refer to Section 3.4). However, water quality and sustainable yield will need to be assessed. This assessment is recommended to be undertaken at LWMS level, alongside with the groundwater level monitoring recommended in Section 3.3.4. It is generally not recommended to undertake these studies at UWMP stage as inadequate water resource will impact on the feasibility of the subdivision.

Rainwater tanks may be installed on site to capture water during rainy season. The Bureau of Meteorology recorded an annual mean rainfall of 652mm at Pierce airbase (in Bullsbrook).

To assist in placing the rainwater tank requirement in context, as a rule, irrigation of turf area will consume approximately 7,500 kL/ha/a. Therefore, a lawn area of 500m² require 375m³ (375 kL) of water, which in turn will require 580m² of roof area to collect (excluding losses). A 375 kL tank is approximately 8m in diameter and 8m high. From the above scenario, it can be demonstrated that rainwater tank is best used as a supplement to the groundwater bore, as opposed to being the primary mode of non-potable water source.

The water requirements shall be assessed by individual future tenancies as this depends on the type of activities conducted on site.

4.3.3.2 Potable Water

Muchea Water (Aqua Ferre) is an independent water service provider in Muchea, located approximately 7km north or Precinct 2 (refer to Figure 4-4). Muchea Water currently has a groundwater license allocation of 651ML/a (sourced from DWER).

Peritas have liaised with Muchea Waters to confirm potable water availability. The correspondence records are attached in Annexure J.

Muchea water have advised that 142ML/a is currently allocated to a residential development at Reserve Road and a further 50ML/Pa with additional 50ML/a option is committed to Harvis Capital. Correspondence records in “Muchea Industrial Park Scheme Amendment Precinct 3” (Precinct 3 Report) indicated that Harvis Capital have sought the allocation for Precinct 1 North A of the MIP.

Precinct 3 also have had similar discussions with Muchea Water, requesting for 203mL/a to be allocated for their 139ha site (net site area).

Without hydraulics consultant’s input, Peritas have estimated Precinct 2 potable water consumption based on Precinct 3 assumptions. Precinct 3 assumed potable water consumption of 4kL/ha/day (in contrast to Water Corporation estimate of 17kL/ha/day).

Assuming 30% of Precinct 2 is dedicate to drainage and road reserves, the net industrial land use is 212ha, requiring an estimate potable water allocation of 309ML/a.

Based on the allocated water, Muchea Water currently have 409ML/a available. However, this allocation is not adequate to service both Precinct 2 and 3 (Total requirement of 512ML/a). There will

be a shortfall of approximately 100ML/a.

As a contingency measure, should Precinct 3 formalise an agreement with Muchea Water earlier than Precinct 2, potable water can either be sourced by treating bore water using technologies such as Reverse Osmosis (RO), ultraviolet disinfection or by means of chlorine treatment. Water servicing license is generally not required if treatment is for the purpose of self-supply.

It should also be noted that water supply via Muchea Water may not have adequate flow rate or pressure for industrial application or firefighting purposes. Muchea Water have chosen not to disclose their current level of supply, indicating that this cannot be provided until an agreement is in place with Precinct 2.

Therefore, it will not be unusual for each property to require infrastructures such as booster pumps and storage tanks, especially for fire water purposes.

Further to the above, there are also capital works and cost required to extend distribution and reticulation pipework into and within Precinct 2. Muchea Water have estimated distribution water main extension to cost approximately $150,000/km. The current extent of Muchea Water distribution water main is to the new BP station at Precinct 1, approximately 1000m from Muchea East road.

The internal reticulation system within Precinct 2 will have to be funded fully by the Developer and handed over at no cost to Muchea Water. All works to comply with Muchea Water specification.

Figure 4-4 Aqua Ferre Reserve St Facility Relative to Precinct 2.

4.3.4 Wastewater

Peritas liaised with the Water Corporation (Annexure H) who advised that Precinct 2 is well beyond the Water Corporation reticulation area. The nearest Water Corporation asset is located approximately 11km south east of Muchea, in Bullsbrook.

The recommended wastewater management approach is by on-site treatment using an Aerobic

Treatment Unit (ATU). The ATU shall be in compliance with Department of Health's "Code of Practice for the Design Manufacture, Installation and Operation of Aerobic Treatment Units".

Hydraulic loading rates are provided by the Department of Health as a guide. However, these loading rates are associated with residential and commercial application. Loading rates are as shown on Table 4-1.

Industrial loading rates may vary substantially, depending on the Industry and therefore needed to be assessed separately. A hydraulics consultant will need to be involved at detail design stage.

Table 4-1 Extract from Department of Health Hydraulic Loading

Type of residential premises	Number of bedrooms	Volume of wastewater (L/day)
Standard residential dwelling	2 or less	564
	3	761
	4-5	829
	6 or more	150L/day
Ancillary accommodation sharing a common system with the main residential dwelling	The combined hydraulic loading is based on the total combined number of bedrooms (ancillary dwelling PLUS main residential dwelling) and sized as a "Standard residential dwelling" (as above). Example: 3 bedroom main dwelling PLUS 2 bedroom ancillary accommodation = 5 bedroom system (829L/day) 4 bedroom main dwelling PLUS 2 bedroom ancillary accommodation = 6 bedroom system (150L/person/day)	
Aged home accommodation	2 or less	564
	3	761
	4-5	829
	Developments with communal system	Hydraulic calculation basing on actual occupancies can be permitted if local government planning approval sets occupancy limits for the entire development.

Type of premises (Regulation 29)	Equivalent Use	Combined Flow (L/person/day)
Hotel	Minesite accomodation camp units	180
Motel		140
School (boarding)		140
Public Building (Frequent use)	Bakery sit in customers (per sitting) Café sit in customers (per sitting)	30

Type of premises (Regulation 29)	Equivalent Use	Combined Flow (L/person/day)
	Place of worship (with cooking and catering facilities) Health centre staff (non-showering) Minesite office facilities Offices (non-showering staff) Restaurants sit in customers (per sitting) Winery sit in customers – Café and food catering facilities (per sitting)	
Public Building (Infrequent use)	Airport (Non-staff) Place of worship (with no cooking facilities) Community hall Hardware stores Health centre patients (non-showering) Library Petrol station customers	10
Caravan Parks	3 persons / caravan park bay	140
	2 persons / tent site	140
	Park homes / chalets / Standard short-stay holiday houses 2 or less bedrooms/dwelling 3 bedrooms/dwelling 4 or more bedrooms/dwelling	 564/dwelling 761/dwelling 829/dwelling
	Large short-stay holiday houses (>6 persons) / Eco-tourism accommodation facilities	140
Swimming Pool		15
Drive-in theatres	2 persons per car	10
Factories & shops (an 8 hour day)	Bakery Staff Café staff Caravan park staff member (not living onsite Gym (with showers) Health centre patients (using shower facilities) Office staff (using shower facilities) Restaurant staff Warehouse staff Workshop staff	70
Construction camps (temporary)		45
Clubs	Men's shed	15
Clubs (licensed)		35

The ATU effluent (post ATU treatment) can be managed by either below ground dripper system or above ground irrigation. Either option require 0.5m minimum separation to groundwater. The dripper system imply separation from the invert of the discharge pipe while the above ground spray system require separation from finished level.

Peritas does not recommend the use of a centralised treatment system as this will complicate the

structure of the development. The following issues will need to be addressed:

- Land must be dedicated for central sewer management system, reducing developable lot yield.
- Water Service licence needed to be obtained, via the DWER, in order to provide sewerage collection service.
- An organisation will need to be formalised to manage the sewer collection, including collection of tariffs, maintenance of constructed asset, ensuring constant compliance with updated health standards, upgrading of old systems, etc.

4.4 Power

Dial Before You Dig (DBYD) data (Annexure E) indicated a 3 phase 1kV-33kV overhead High Voltage (HV) distribution line along Great Northern highway. It would appear that the overhead cables are located within the property boundary of Precinct 2.

Extract from Western Power Network Capacity Forecast 2026 in included in Annexure K. The forecast indicate up to 30MVA remaining capacity in 2026, more than adequate to service the entire Precinct 2.

Each industrial property will have different power requirements. Therefore, it is difficult to forecast the power draw required for the entire Precinct. At the time of detail design for each lot, an application will have to be made to Western Power to confirm connection location and capacity.

The overhead power line is a High Voltage distribution main, therefore switch gears and step-down transformers are to be expected to be required.

4.5 Communication

Dial Before You Dig (DBYD) data (Annexure E) indicated Telstra fibre optics along the western verge of Great Northern Highway. The data is schematic but also appear to indicate that some cables are within the Precinct 2 lot boundary.

NBN network is scheduled for the area, when the report was originally drafted, NBN noted availability of service by December 2020. Currently the latest forecast is for NBN to be available from July – September 2021.

4.6 Gas

Dial Before You Dig (Annexure E) did not identify gas services within the vicinity. Precinct 2 tenancies will be required to install their own gas storage tank if gas supply is required.

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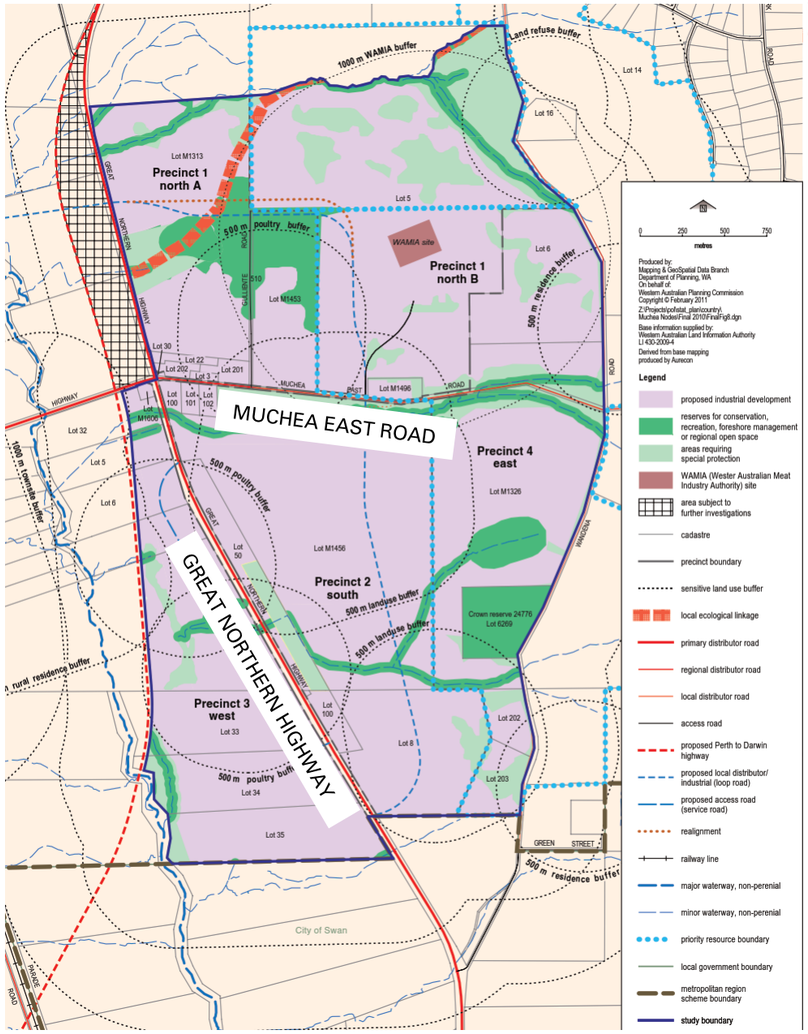
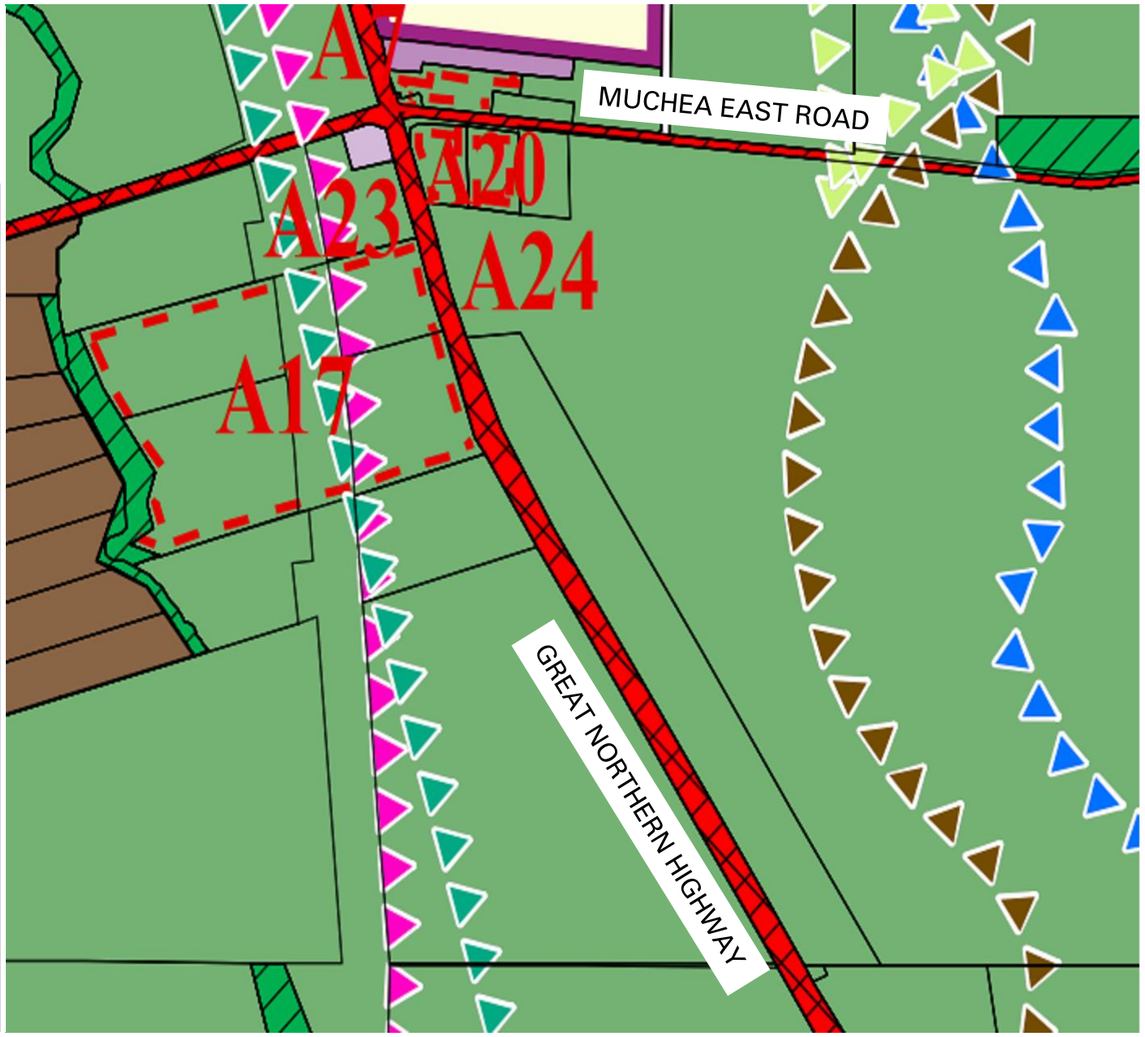
Annexure A – Sketches

Sketch No.	Title
PC20171.SKT.001	Locality Plan
PC20171.SKT.003	Planning Context
PC20171.SKT.004	Topography
PC20171.SKT.005	Geology
PC20171.SKT.006	Groundwater Level
PC20171.SKT.007	Water Resources

	PROJECT	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Scale:**	N.T.S	
	CLIENT	IPARKS	**Drawn:**	HW	
	LOCATION	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Date:**	20.10.20	
	TITLE	LOCATILY PLAN	**Reference:**	PC20171.SKT.001	Rev. **A**



EXTRACT FROM SHIRE OF CHITTERING
LOCAL PLANNING POLICY NO.33



EXTRACT FROM SHIRE OF CHITTERING
TOWN PLANNING SCHEME NO.6

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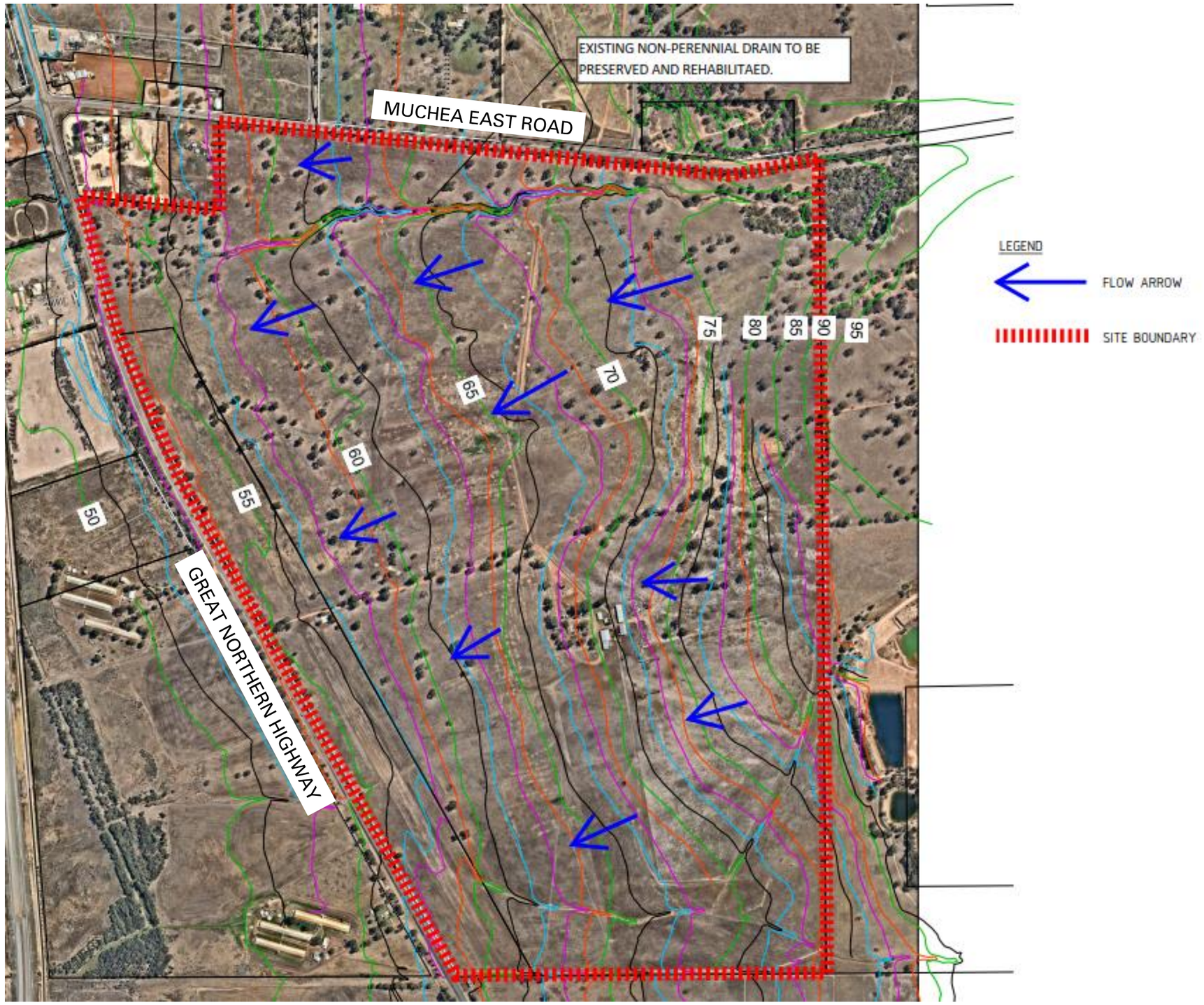
TITLE	PLANNING CONTEXT	**Reference:**	PC20171.SKT.003	Rev. **A**



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TITLE	TOPOGRAPHY	**Reference:**	PC20171.SKT.004 Rev. **A**

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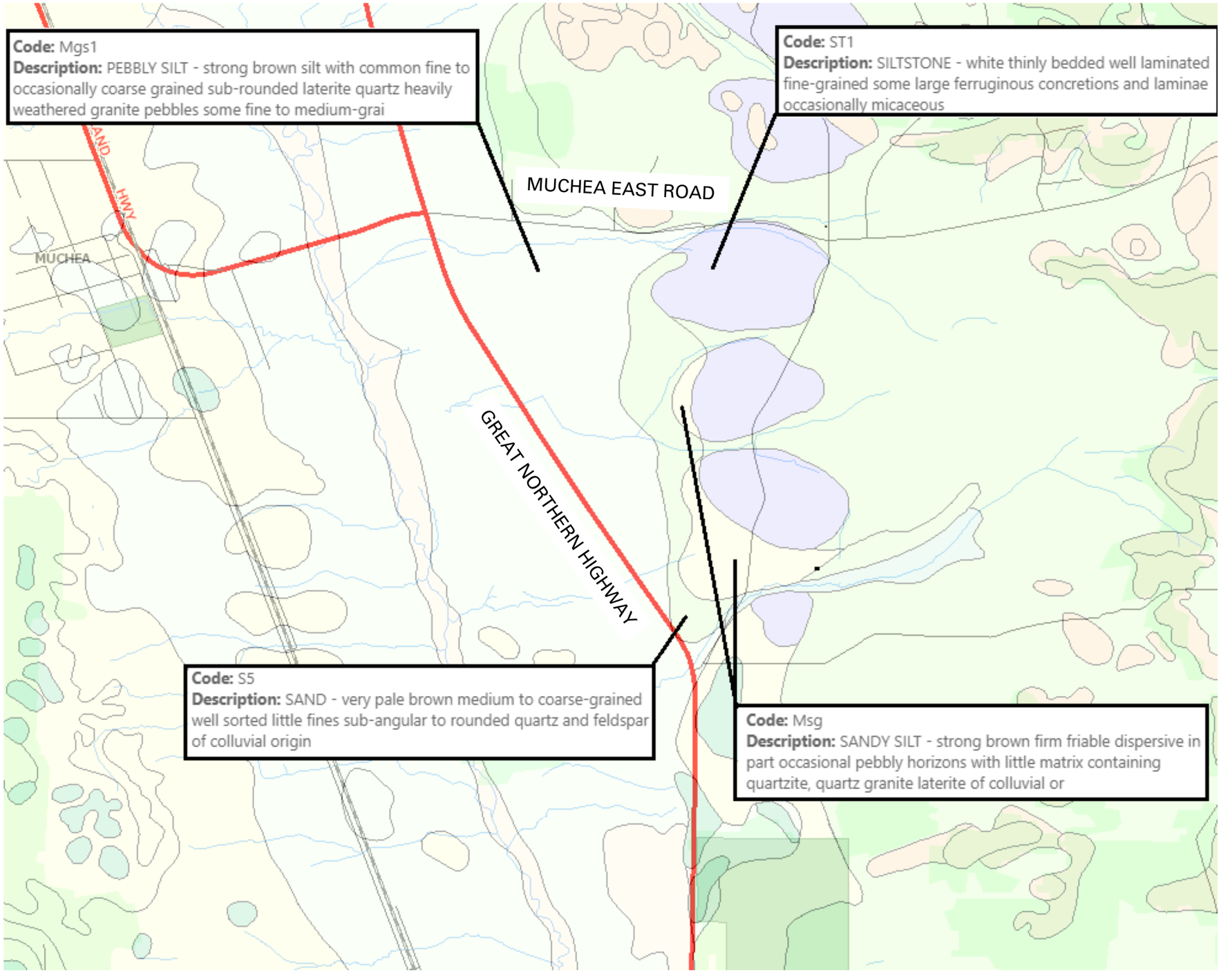

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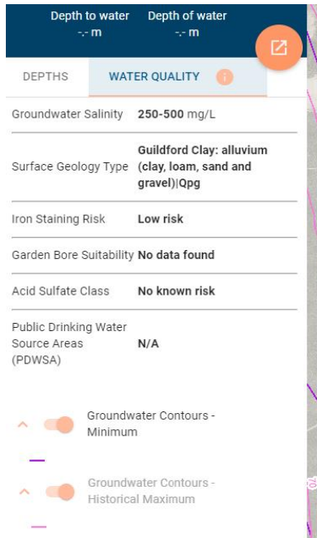
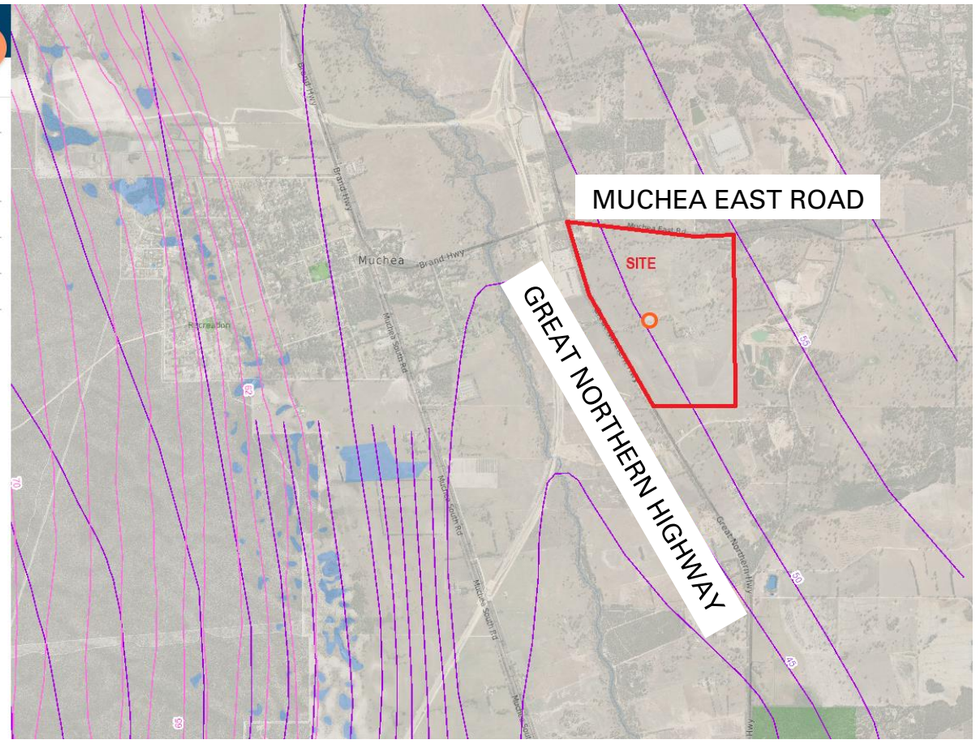
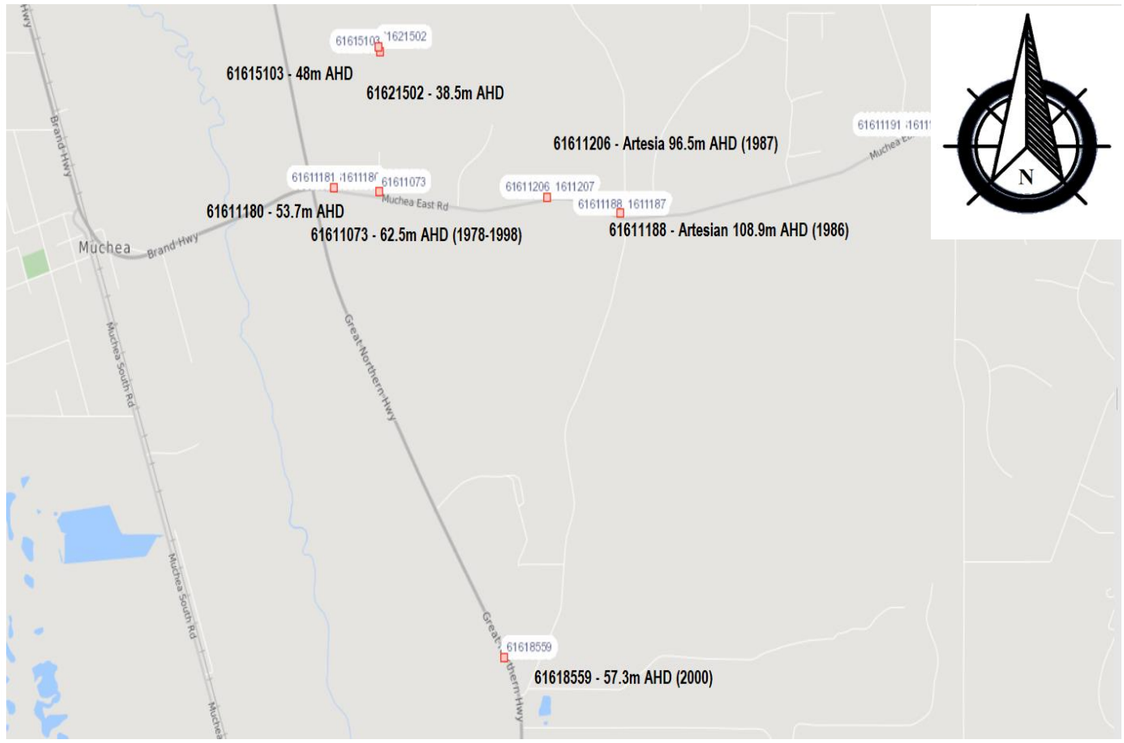
TITLE	GEOLOGY	**Reference:**	PC20171.SKT.005 Rev. **A**

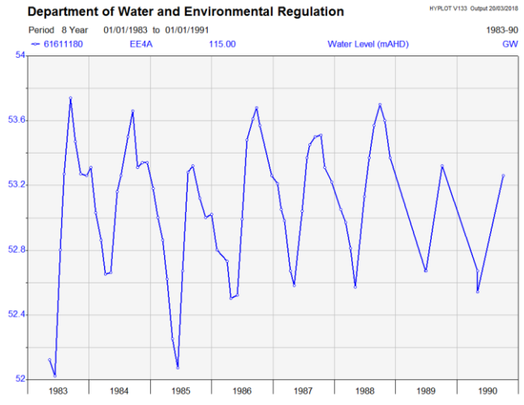


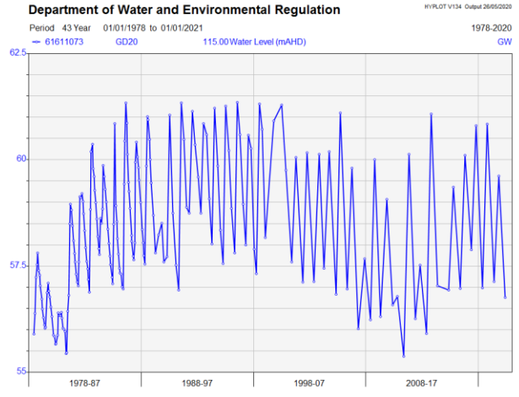


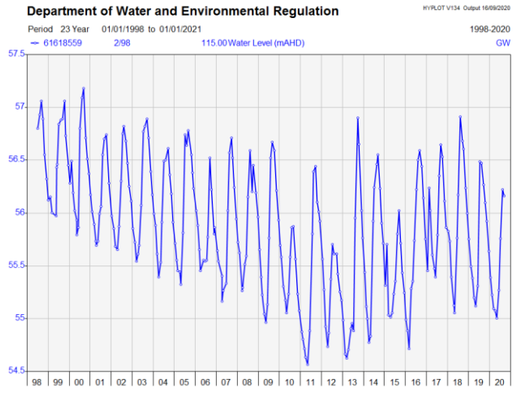


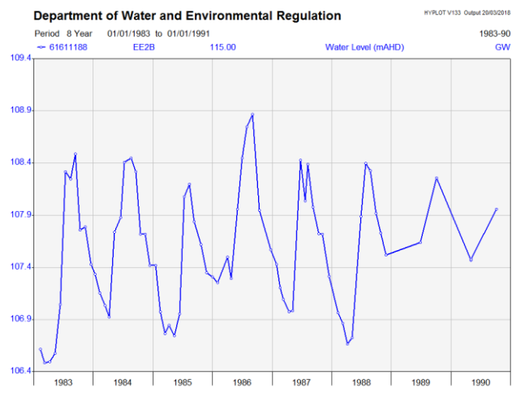
DEPARTMENT OF WATER AND ENVIRONMENTAL REGULATION GROUNDWATER ATLAS

DEPARTMENT OF WATER AND ENVIRONMENTAL REGULATION LONG TERM MONITORING BORES









PROJECT	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Scale:**	N.T.S	
CLIENT	IPARKS	**Drawn:**	HW	
LOCATION	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Date:**	20.10.20	
TITLE	GROUNDWATER LEVEL	**Reference:**	PC20171.SKT.006	Rev. **A**

Resources 4 | Licences 0

RESOURCES | LICENCES

Surface Water Area: **Swan River and Tributaries**
Subarea: **Ellen Brook**
Resource: **Ellen Brook**

Area: **Gingin**
Subarea: **Eclipse Hill**
Aquifer: **Perth - Superficial Swan**
Level: **1**

Area: **Gingin**
Subarea: **Cowalla Confined**
Aquifer: **Perth - Leederville - Parmelia**
Level: **2**

Area: **Gingin**
Subarea: **Chandala Confined**
Aquifer: **Perth - Yarragadee North**
Level: **3**

Resource Legend

Water availability is shown as a combination of resource type and colour:

Surface water | Groundwater

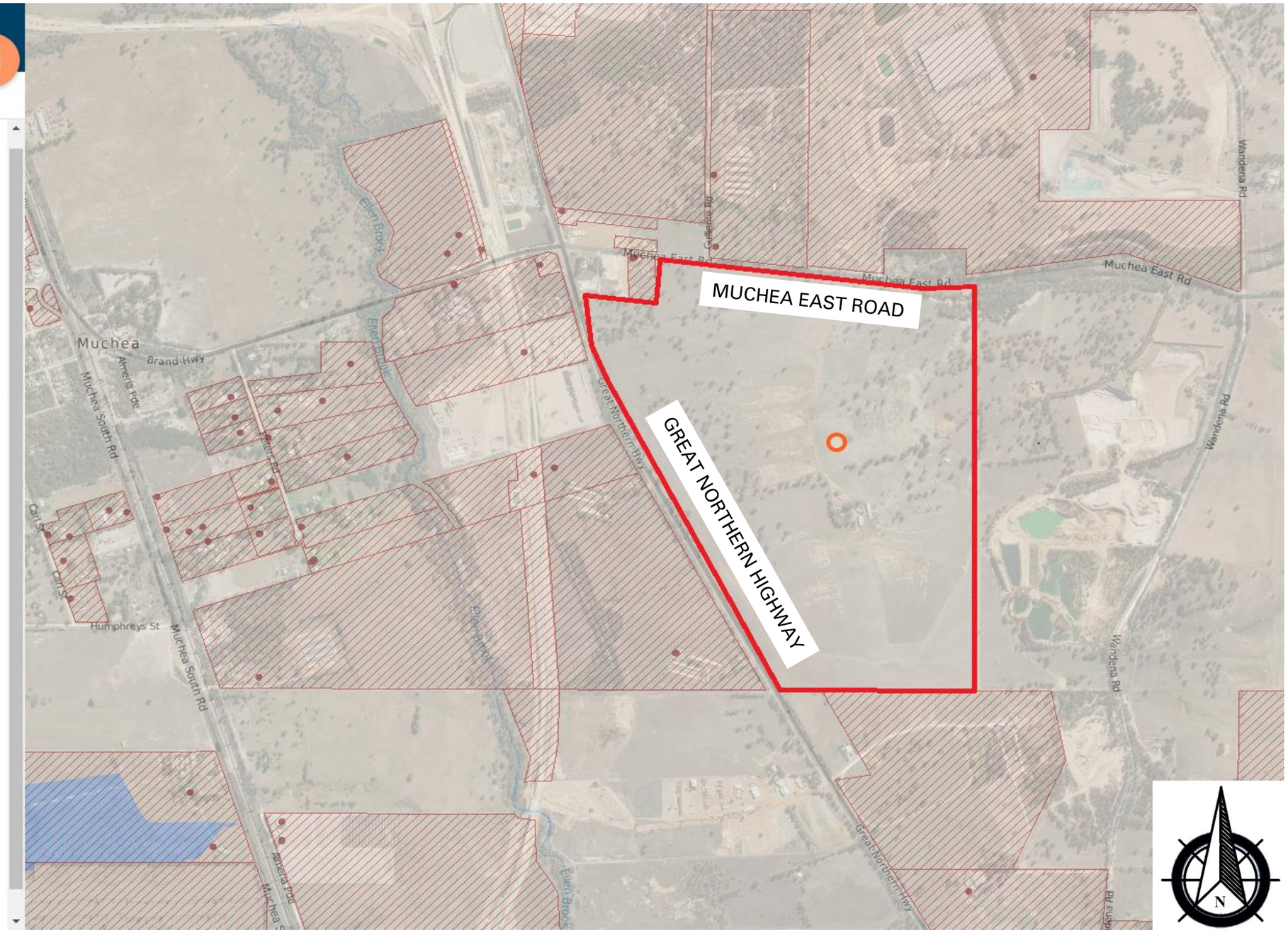
- Allocation Available
- Fully Allocated
- Limited Information

Water Availability Disclaimer

Water availability gives a general indication as to whether water is still available in a resource for licensing. It is determined from the amount of water that may be available to take sustainably from a resource, minus water that has already been allocated or committed to licensed users.

However, additional applications may already be under assessment to access the remaining water, and water availability ***does not*** reflect the water that may be assigned to these applications until they are finalised.

This information changes on a daily basis. To discuss water availability for your resource, please contact your regional licensing office.



PROJECT	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Scale:**	N.T.S	
CLIENT	IPARKS	**Drawn:**	HW	
LOCATION	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Date:**	20.10.20	
TITLE	WATER RESOURCES	**Reference:**	PC20171.SKT.007	Rev. **A**

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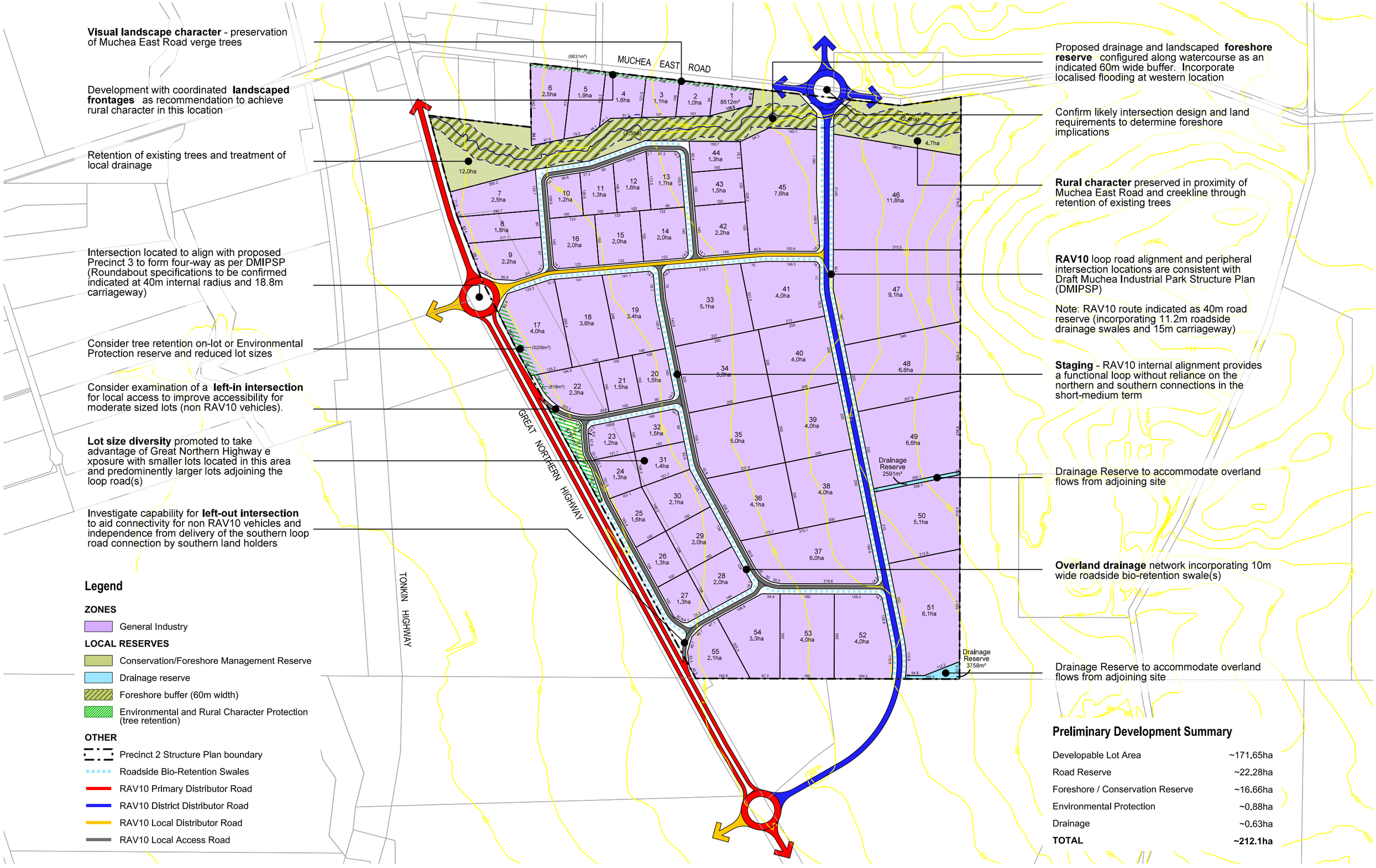
Annexure B – Concept Structure Plan



Visual landscape character - preservation of Muchea East Road verge trees

Development with coordinated **landscaped frontages** as recommendation to achieve rural character in this location

Retention of existing trees and treatment of local drainage

Intersection located to align with proposed Precinct 3 to form four-way as per DMIPSP (Roundabout specifications to be confirmed indicated at 40m internal radius and 18.8m carriageway)

Consider tree retention on-lot or Environmental Protection reserve and reduced lot sizes

Consider examination of a **left-in intersection** for local access to improve accessibility for moderate sized lots (non RAV10 vehicles).

Lot size diversity promoted to take advantage of Great Northern Highway e xposure with smaller lots located in this area and predominently larger lots adjoining the loop road(s)

Investigate capability for **left-out intersection** to aid connectivity for non RAV10 vehicles and independence from delivery of the southern loop road connection by southern land holders

Proposed drainage and landscaped **foreshore reserve** configured along watercourse as an indicated 60m wide buffer. Incorporate localised flooding at western location

Confirm likely intersection design and land requirements to determine foreshore implications

Rural character preserved in proximity of Muchea East Road and creekline through retention of existing trees

RAV10 loop road alignment and peripheral intersection locations are consistent with Draft Muchea Industrial Park Structure Plan (DMIPSP)

Note: RAV10 route indicated as 40m road reserve (incorporating 11.2m roadside drainage swales and 15m carriageway)

Staging - RAV10 internal alignment provides a functional loop without reliance on the northern and southern connections in the short-medium term

Drainage Reserve to accommodate overland flows from adjoining site

Overland drainage network incorporating 10m wide roadside bio-retention swale(s)

Drainage Reserve to accommodate overland flows from adjoining site

Legend

ZONES
- General Industry

LOCAL RESERVES
- Conservation/Foreshore Management Reserve
- Drainage reserve
- Foreshore buffer (60m width)
- Environmental and Rural Character Protection (tree retention)

OTHER
- Precinct 2 Structure Plan boundary
- Roadside Bio-Retention Swales
- RAV10 Primary Distributor Road
- RAV10 District Distributor Road
- RAV10 Local Distributor Road
- RAV10 Local Access Road

Preliminary Development Summary

Developable Lot Area	~171.65ha
Road Reserve	~22.28ha
Foreshore / Conservation Reserve	~16.66ha
Environmental Protection	~0.88ha
Drainage	~0.63ha
TOTAL	**~212.1ha**

Preliminary Structure Plan Development Concept

LOT 50 & M1456
GREAT NORTHERN HIGHWAY, MUCHEA
An IParks Property Group Project

DRAFT

scale 1:10,000@A3 | 1:5,000@A1
0 100 200m
plan 20/034/011
date 21 Dec 2020

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

Taylor Burrell Barnett

Annexure C –Average Annual Maximum Groundwater Level

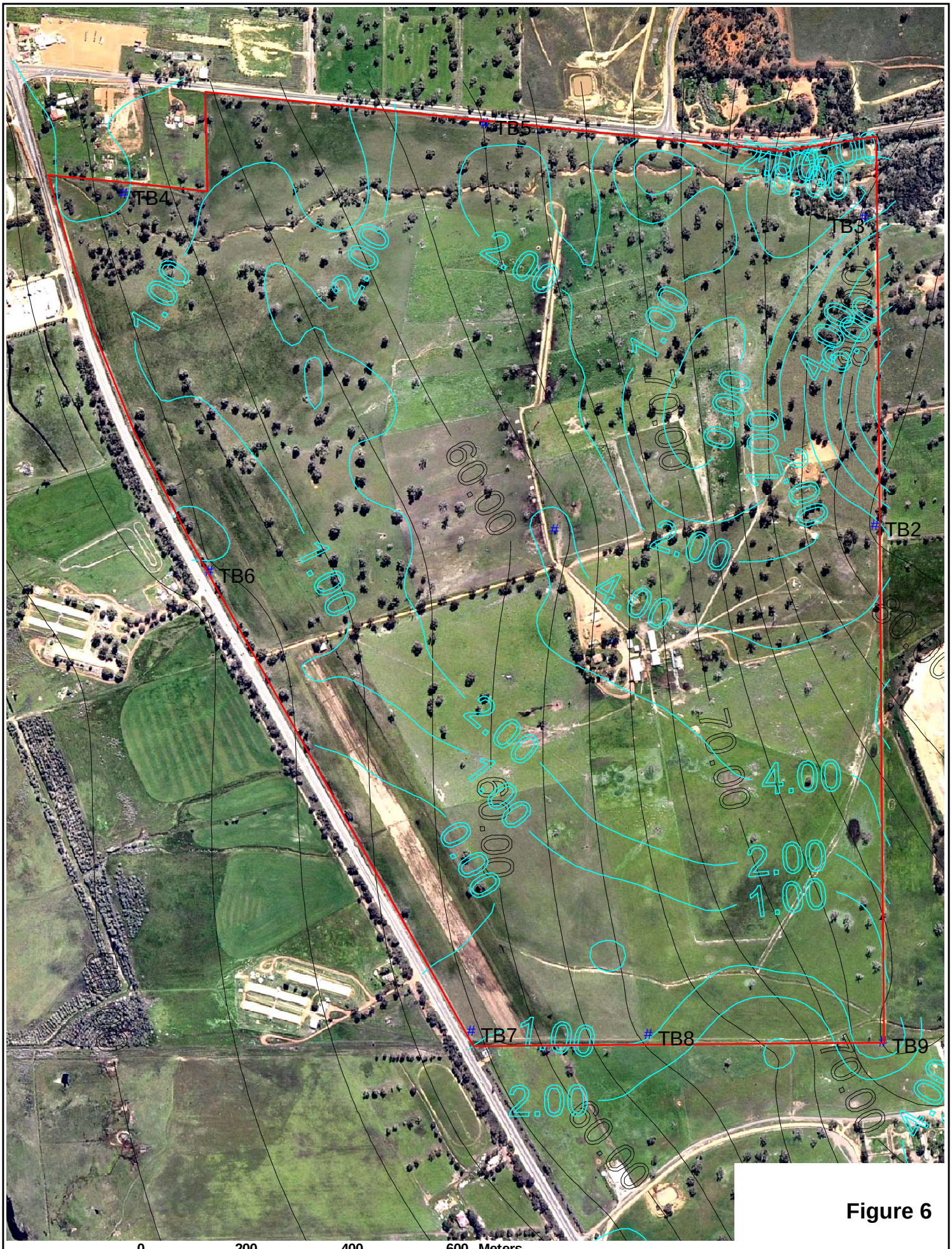


Figure 6

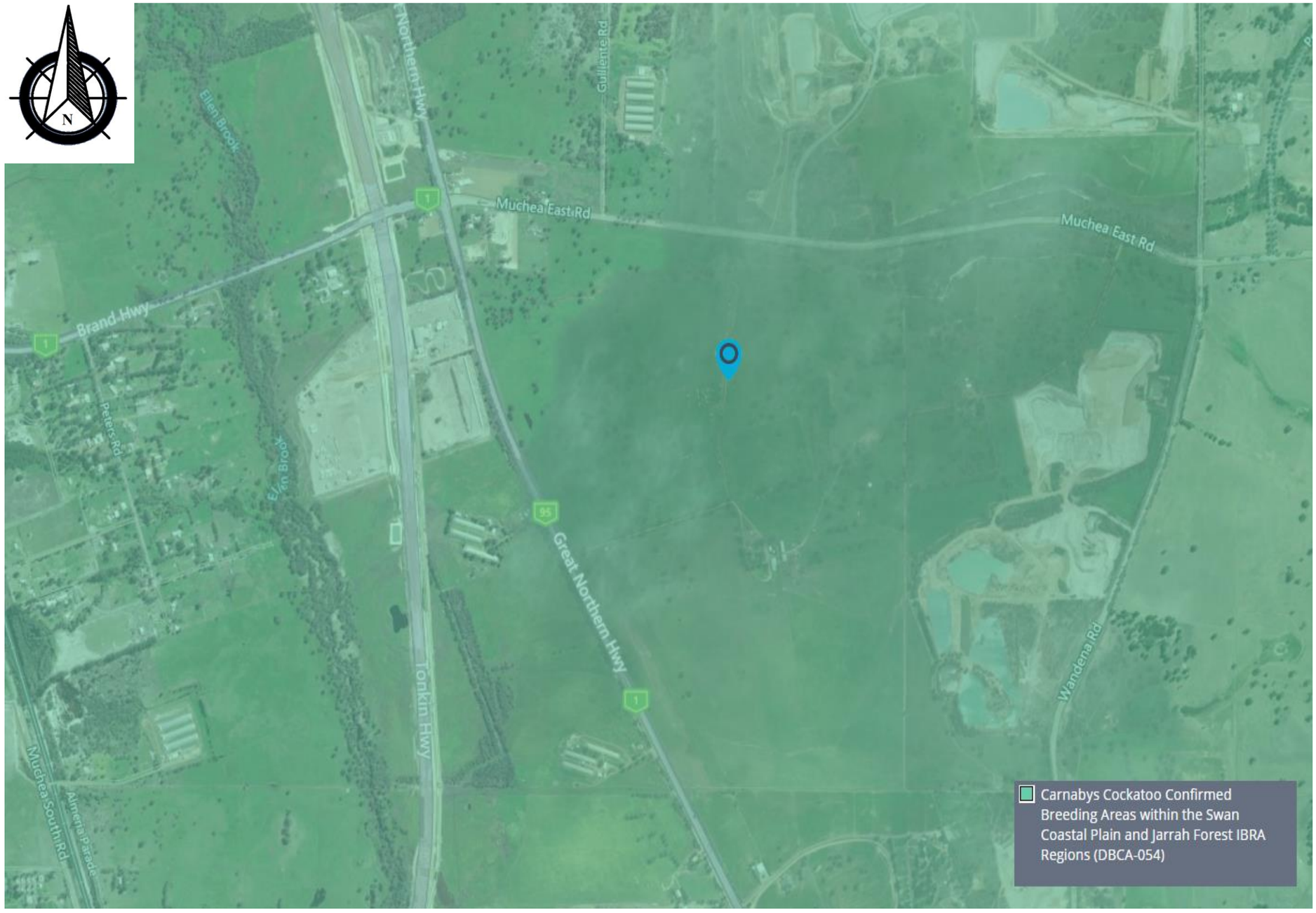
GROUNDWATER HYDROLOGY

bayley environmental services

Annexure D – Environmental

Sketch No.	Title
PC20171.SKT.008	Black Cockatoo Roosting and Breeding Sites
PC20171.SKT.009	Carnabys Cockatoo Confirmed Breeding Areas
PC20171.SKT.010	Carnabys Cockatoo Feeding Habitat
PC20171.SKT.011	Geomorphic Wetland
PC20171.SKT.012	Bush Forever
PC20171.SKT.013	Acid Sulfate Soils
PC20171.SKT.014	Clearing Regulations
PC20171.SKT.015	Public Drinking Water Source Areas
PC20171.SKT.016	Surface Water Management Areas

peritas group / iPARKS Design • Develop • Deliver • Maintain	**PROJECT**	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Scale:**	N.T.S	
	CLIENT	IPARKS	**Drawn:**	HW	
	LOCATION	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Date:**	20.10.20	
	TITLE	BLACK COCKATOO ROSSTING AND BREEDING SITES	**Reference:**	PC20171.SKT.008	Rev. **A**



	PROJECT	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Scale:**	N.T.S	
	CLIENT	IPARKS	**Drawn:**	HW	
	LOCATION	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Date:**	20.10.20	
	TITLE	CARNABYS COCKATOO CONFIRMED BREEDING AREAS	**Reference:**	PC20171.SKT.009	Rev. **A**

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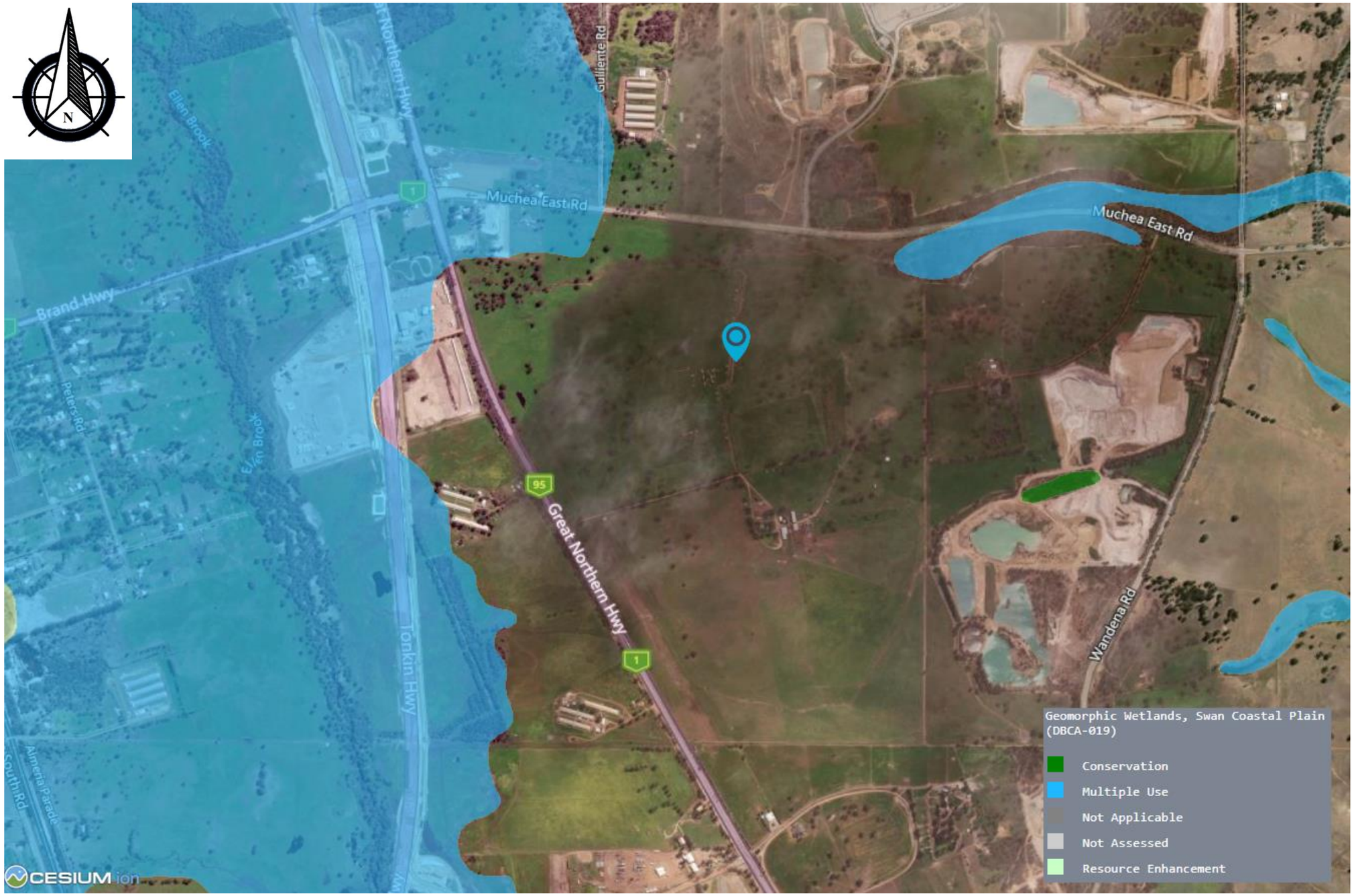
PROJECT	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Scale:**	N.T.S	
CLIENT	IPARKS	**Drawn:**	HW	
LOCATION	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Date:**	20.10.20	
TITLE	CARNABYS COCKATOO FEEDING HABITAT	**Reference:**	PC20171.SKT.010	Rev. **A**



PROJECT	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Scale:**	N.T.S	
CLIENT	IPARKS	**Drawn:**	HW	
LOCATION	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Date:**	20.10.20	
TITLE	GEOMORPHIC WETLAND	**Reference:**	PC20171.SKT.011	Rev. **A**

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PROJECT	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY		**Scale:**	N.T.S	
CLIENT	IPARKS		**Drawn:**	HW	
LOCATION	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY		**Date:**	20.10.20	
TITLE	BUSH FOREVER		**Reference:**	PC20171.SKT.012	Rev. **A**

PROJECT	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Scale:**	N.T.S
CLIENT	IPARKS	**Drawn:**	HW
LOCATION	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Date:**	20.10.20
TITLE	ACID SULFATE SOILS	**Reference:**	PC20171.SKT.013 Rev. **A**

PROJECT	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Scale:**	N.T.S	
CLIENT	IPARKS	**Drawn:**	HW	
LOCATION	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Date:**	20.10.20	
TITLE	CLEARING REGULATIONS	**Reference:**	PC20171.SKT.014	Rev. **A**

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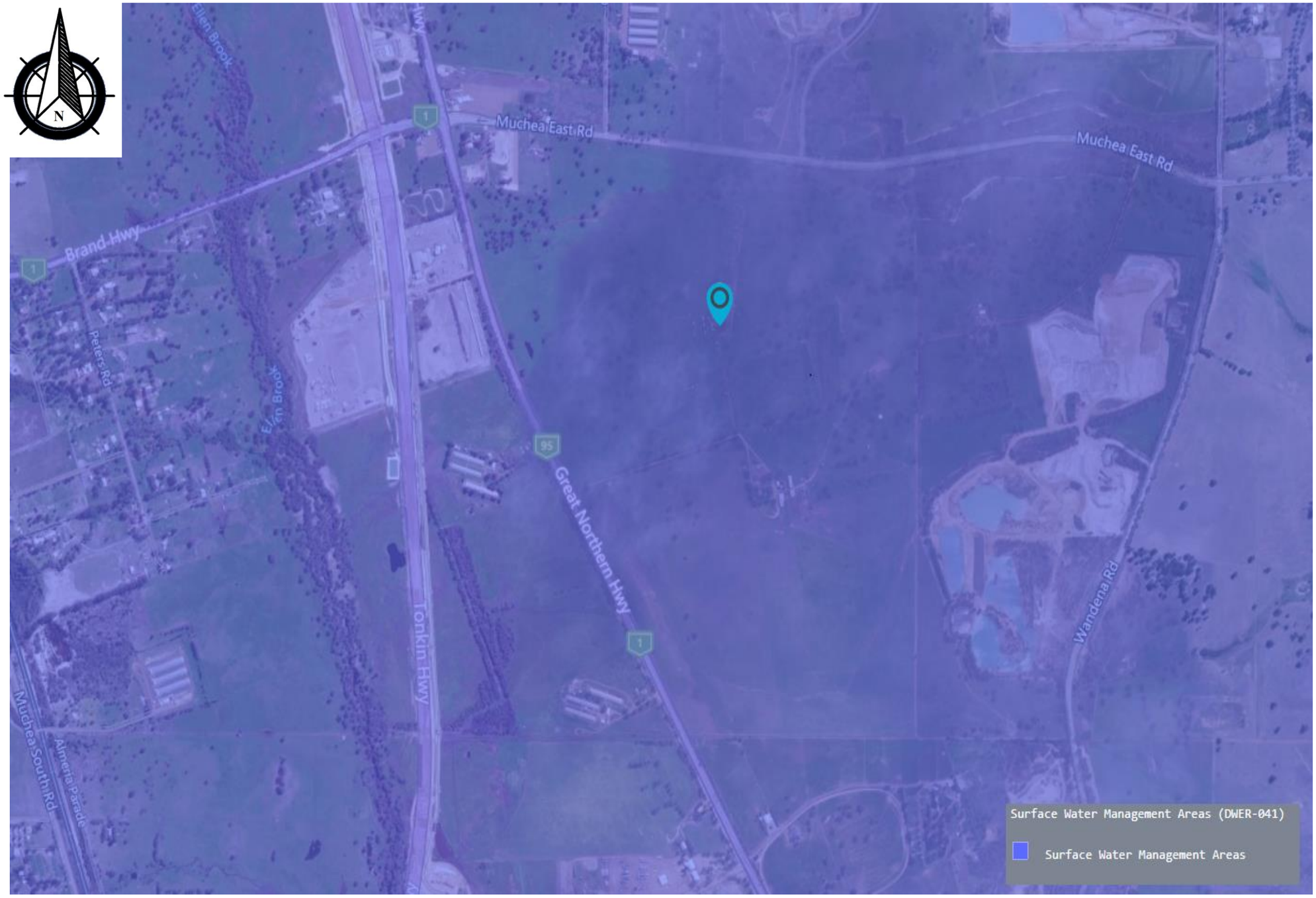
	CLIENT	IPARKS	**Drawn:**	HW	
	LOCATION	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Date:**	20.10.20	
	TITLE	PUBLIC DRINKING WATER SOURCE AREAS	**Reference:**	PC20171.SKT.015	Rev. **A**



	PROJECT	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Scale:**	N.T.S	
	CLIENT	IPARKS	**Drawn:**	HW	
	LOCATION	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Date:**	20.10.20	
	TITLE	SURFACE WATER MANAGEMENT AREAS	**Reference:**	PC20171.SKT.016	Rev. **A**

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Annexure E – Dial Before You Dig Summary

ATCO GAS AUSTRALIA UNDERGROUND ASSET DETAILS
NO GAS ASSETS RECORDED

GAS DIVISION

NO ATCO GAS AUSTRALIA ASSETS RECORDED

Mr Hendrik Wijaya
Peritas Group
74 Goodwood Parade
Burswood
WA, 6100

Job No: **20304128**
Sequence No: **102126190**
Date of Issue: 23/09/2020
Phone: 0863369262
Mobile: 0403886278
Fax: Not Supplied

DBYD Utility Registration Name: **70852 - ATCO Gas Australia**
DBYD Location: **Great Northern Highway, Muchea, WA, 6501**

Our records indicate that there are NO ATCO Gas Australia underground Assets / Pipes present in the vicinity of the above enquiry, however please read all the information and conditions below.

ATTENTION: This response to your inquiry has been interpreted from details in your requested DBYD picture location request only (not any street address you gave). It is your duty to ensure the accompanying plan/s match your geographical area of works.

IF YOU SEE, HEAR, SMELL OR OTHERWISE DETECT GAS,
LEAVE THE IMMEDIATE AREA AND THEN CALL 13 13 52

Our records indicate that ATCO Gas Australia Pty Ltd gas infrastructure ***IS NOT PRESENT*** in the vicinity of and/or surrounding area of the above enquiry. This response relates only to ATCO GAS AUSTRALIA assets. Your Duty of Care requires that personnel must at all times comply with, and have on site, this information sheet and the accompanying plan(s). All plans are subject to this information sheet. You should also refer to the "Questionnaire for works near ATCO Gas Australia gas infrastructure" on page [5] of this document, which must be read and all questions answered. If you answer "**yes**" to any of the questions you must contact ATCO Gas Australia during business hours on 1300 926 755.

All information provided is to be used as a guide only (see Disclaimer item 5). It does not absolve you or third parties from your Duty of Care obligations, including to take additional precautions where work has the potential to impact on gas assets, public safety or the environment, or from your duties at law (including Reg 3.21 of the Occupational Safety and Health Regulations 1996).

WARNINGS

- No works of any type within 15 metres of any **HIGH PRESSURE** gas infrastructure without prior approval from ATCO Gas Australia.
- **NO HOT WORK** within 15 metres of any gas infrastructure except in compliance with applicable laws & *Australian Standard 1674.* **DO NOT** let heat sources or hot works impact on gas infrastructure and take into consideration that the ground or adjacent structures may also be capable of transmitting heat so as to circumvent protection afforded by a heat shield or barrier.
- **DANGER** Gas can cause asphyxiation and is flammable. Keep all ignition sources well away (e.g., flames, matches/lighters, sparks, electrical devices, vehicles or engines, mobile phones, cameras).
- Gas pipes must not be unsupported or left without adequate cover or protection without prior approval from ATCO Gas Australia.
- Damage to the pipe coating or pipe itself can be very dangerous if not given immediate attention. Report any damage to ATCO Gas Australia immediately on 13 13 52. Do not attempt to repair any damaged gas infrastructure.
- No alteration or removal of live or abandoned gas infrastructure without prior written approval from ATCO Gas Australia.
- Any abandoned or proposed gas infrastructure indicated on the gas plans must be treated as live.
- Never assume the location or depth of any gas infrastructure. Pipes may not follow straight lines or maintain a constant depth. Always check carefully (e.g., by careful hand digging of potholes).
- Unauthorised repairs or tampering with gas infrastructure may result in prosecution under the *Energy Operators (Powers) Act 1979*. ATCO Gas Australia reserves all rights to recover compensation for loss or damage to its gas infrastructure or other property including for indirect or consequential losses.

PLANS:

Plans provided are current for **30 days only** from date of request. You must use current plans at all times.

Plans do not show all gas service lines (which connect gas mains to individual meter positions). See condition 3(c) below.

Plans (including the location of pipes, services, infrastructure and boundaries) are **approximate only**. You must use safe and proper procedures – including **potholing** (see condition 4 below).

Plans are not a guide as to gas availability for connection purposes.

To call ATCO Gas Australia: **Weekdays from 8am to 4pm, call – 1300 926 755**
After hours, weekends and emergencies, call – 13 13 52

CONDITIONS FOR WORKS IN THE VICINITY OF ATCO GAS AUSTRALIA ASSETS

1. Compliance with Warnings

You must comply with the Warnings contained in this information sheet and the accompanying plan(s).

2. Compliance with 'Additional Information for Working around Gas Pipelines' (AGA-O&M-PR24), applicable laws and duty of care

All work (including but not limited to using Excavator's Augers, Directional, drilling machines, 'Ditch Witch' type trenching machine, Loader, Dozer, Skid Steer (Bob Cat)) must comply with all applicable requirements in the 'Additional Information for Working around Gas Pipelines' (AGA-O&M-PR24) and with all applicable laws and Australian Standards. All due care must be exercised to locate any gas infrastructure in the vicinity and when conducting any works near them.

3. All Gas Infrastructure

All work that may have any impact upon any gas infrastructure (see 3(a), (b) and (c) below for examples) should be carefully planned with notification to ATCO Gas Australia well in advance of commencement. Contact ATCO Gas Australia Engineering Services on (08) 1300 926 755 or email engineering.services@atcogas.com.au. Amongst other things, this includes excavation of or near gas pipelines, boring/drilling, crossings of pipelines (including by other underground infrastructure e.g. drains, power cables, etc.), road works and structural installations. In addition:

a) High Pressure Pipelines (HP, PEHP > 110, CHP)

No works of any type are permitted within 15 metres of these pipelines without prior approval from ATCO Gas Australia. For approvals contact ATCO Gas Australia on 1300 926 755.

You must ascertain the location of any high pressure pipeline, in relation to your proposed work by:

- Locating a straight line between two high pressure warning signs, and
- Assessing the distance from this line to your proposed work area.

ATCO Gas Australia may require stand-by supervision during your works and will advise of attendance requirements.

b) Medium (MP), Medium-Low (MLP), Low (LP) and other Pipeline Pressures

These pipelines are installed in most streets throughout the Perth metro area and several country centres. Main valves, regulator sets and test points also exist at intervals along these pipelines. Where work may impact upon these pipelines or assets then ATCO Gas Australia must be contacted as per item 3 above.

c) Gas Services and Meters

If a gas meter is installed on a property, an underground gas service pipe will run from the meter position to the gas main in the street. Plans do not show all gas service lines, but their presence must be anticipated. Most gas meter boxes installed since 1996, most gas meter boxes will include a sticker giving approximate guidelines for the gas service line location. All due care must be exercised to locate any gas services in the vicinity and when conducting any works near them.

4. Compliance with Safe Work Practices

It is your responsibility to have and comply with adequate safe work practices and procedures.

Without limiting your obligations:

PLAN The complete Dial Before You Dig documentation and plans must always be on site and referred to for the duration of work. Refer to regulation 3.21 of the *Occupational Safety and Health Regulations 1996* and the Utility Providers "Code of Practice" for further useful information.

POTHOLE Using current Dial Before You Dig plans, all gas pipes should be located (including any deviation in the direction of a gas pipe) by exposing them by careful digging using a HAND SHOVEL. Where the proposed work is parallel to a gas pipeline, pothole every 5 metres along the entire route. Damage to the pipe coating or to the pipe itself can create a very dangerous situation if not given immediate attention. If damage does occur, it must be reported to ATCO Gas Australia immediately on Ph. 13 13 52.

PROTECT Supervise and monitor all excavations near gas infrastructure using a dedicated spotter. Where any gas infrastructure is required to be exposed, adequate protection of the gas infrastructure is required to prevent potential damage. Also implement appropriate controls when conducting 'hot work' (in accordance with AS 1674) in the vicinity of the ATCO GAS AUSTRALIA GDS such as; isolation; separation distance; the placement of an effective non-combustible barrier of sufficient size and thermal resistance for the intensity, type and duration of heat exposure; gas monitoring; monitoring the environment surrounding the ATCO GAS AUSTRALIA GDS to ensure it is not being impacted by the work, and other controls as necessary.

5. Disclaimer and Further Terms

a) Nothing in this document, any accompanying plan or the 'Additional Information for Working around Gas Pipelines' (AGA-O&M-PR24) (together called "**Documents**") purports to exclude or modify any term, condition or warranty to the extent that by law it cannot lawfully be excluded or modified by agreement or notice, including but not limited to those contained in Schedule 2 of the *Competition and Consumer Act* 2010 (Cth) and corresponding provisions of state legislation.

b) If any of ATCO Gas Australia Pty Ltd, or their respective related entities, officers, employees, agents, contractors or advisers (together called "**Associates**") is liable for a breach of a term, condition or warranty described in paragraph 5(a) above, its liability is, to the fullest extent permitted by law, limited to any one or more of the following as it determines in its absolute discretion:

i) in relation to goods supplied by them, replacing or repairing the goods, supplying an equivalent item, paying the cost of replacing or repairing the goods or paying the cost of acquiring or hiring an equivalent item; and

ii) in relation to services supplied by them, the re-supply of the services or the payment of the cost of having the services re-supplied.

c) Subject to paragraphs 5(a) and (b), but otherwise despite any other provision in the Documents, no representation or warranty is made or given (whether expressly or by implication) by any of ATCO Gas Australia or their respective Associates in respect of any information contained or referred to in any of the Documents or in any other communication from ATCO Gas Australia concerning any of the Documents or the subject matter of any of the Documents ("Information"). In particular, but without limiting the generality of the foregoing limitation, none of ATCO Gas Australia or their respective Associates makes any warranty or representation as to the truth, accuracy, completeness, reliability, currency, timeliness, quality or fitness for any purpose of or the standard of care taken in the preparation of any Document or Information (including, but not limited to, the accuracy of the scale of, or the location of anything or symbol shown on, any plan or diagram).

d) Subject to paragraphs 5(a) and (b), to the maximum extent permitted by law, none of ATCO Gas Australia or their respective Associates is liable to any person or other body ("**Recipient**") who receives or otherwise obtains access to all or any part or parts of the Documents or Information, in any way (including, but not limited to, liability for negligence, breach of statutory duty or lack of care) in respect of any cost, expense, damages, loss or liability, including, but not limited to:

i) any financial or economic loss, cost, expense or damage, including but not limited to loss of production, loss of profit, loss of revenue, loss of use, loss of contract, loss of goodwill or loss of business opportunity;

ii) any new or increased costs or expenses, including but not limited to financing or operating costs;

iii) any failure to achieve any actual or anticipated saving in respect of any cost or expense;

iv) any cost, expense, damage or loss resulting from any liability of the Recipient to any other person or body howsoever and whensoever arising, suffered or incurred by the Recipient in relation to, or in connection with, the disclosure to them of, or use of, or reliance on, all or any part or parts of the Documents or Information.

e) By using any Document or Information, each Recipient is taken to represent and warrant to ATCO Gas Australia that the Recipient will comply with the conditions and other terms referred to in the Documents or Information, including but not limited to conditions that:

i) the Recipient must comply with the conditions in numbered paragraphs 1 to 4 above and this paragraph 5;

ii) as between ATCO Gas Australia and each Recipient, ATCO Gas Australia owns the Information and all rights and title in and to the Information are to remain vested in ATCO Gas Australia;

iii) no Recipient has any right, title or interest in the Information or, except as expressly provided for in the Documents, any licence or right to copy, alter, modify, publish or otherwise use or deal with the Information without prior written approval from ATCO Gas Australia;

iv) ATCO Gas Australia makes no representation and gives no warranty as to its right to disclose any Information;

v) the Recipient relies on any Information entirely at its own risk and expense;

vi) the Recipient must undertake its own independent due diligence and investigations in relation to the Information;

vii) none of ATCO Gas Australia or their respective Associates owes the Recipient any duty of care in respect of the Information; and

viii) none of ATCO Gas Australia or their respective Associates is under any obligation to correct, update or revise any Documents or Information.

GAS MAIN AND SERVICE IDENTIFICATION

LEGEND

1. Pipe Diameter (Millimetre's)
2. Pipe Material
   CI = Cast Iron PE = Polyethylene
   GI = Galvanised Iron PVC = PVC
   ST = Steel
3. Alignment (in metres from property line)
4. Pressure in main (MP 70Kpa = Medium Pressure and MAOP(Maximum Allowable Operating Pressure).
5. Off Line Service – service may not be straight line to meter. (**<u>WARNING</u> – OLS may not always be shown on plan**. See item 3c above).
6. Service Valve in the vicinity.

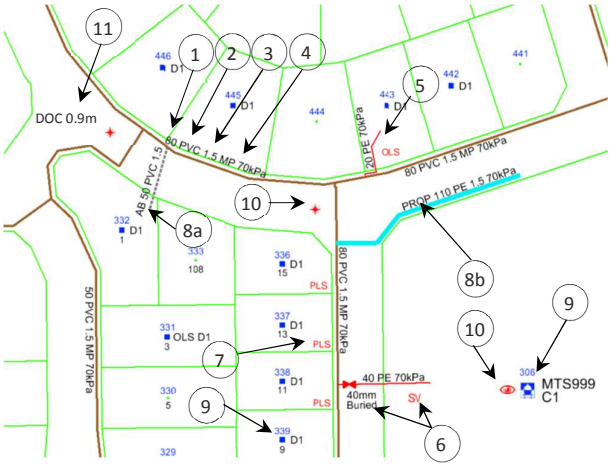
(Note: Service Valve may be **"BURIED"**).

7. Pre-Laid Service laid in Common Trench.
8. Main Status: (See WARNINGS page 1).

8a. AB = Abandoned Mains

8b. PROP = Proposed Mains

9. Customer Connection: Does not indicate actual location of Meter Position.
   D1 = Domestic
   C1 = Commercial
10. **Additional detail available and must be obtained if within area of proposed works – see page 2 above.**
11. Depth of Cover (DOC) in metres.



QUESTIONNAIRE FOR WORKS NEAR ATCO GAS AUSTRALIA GAS INFRASTRUCTURE

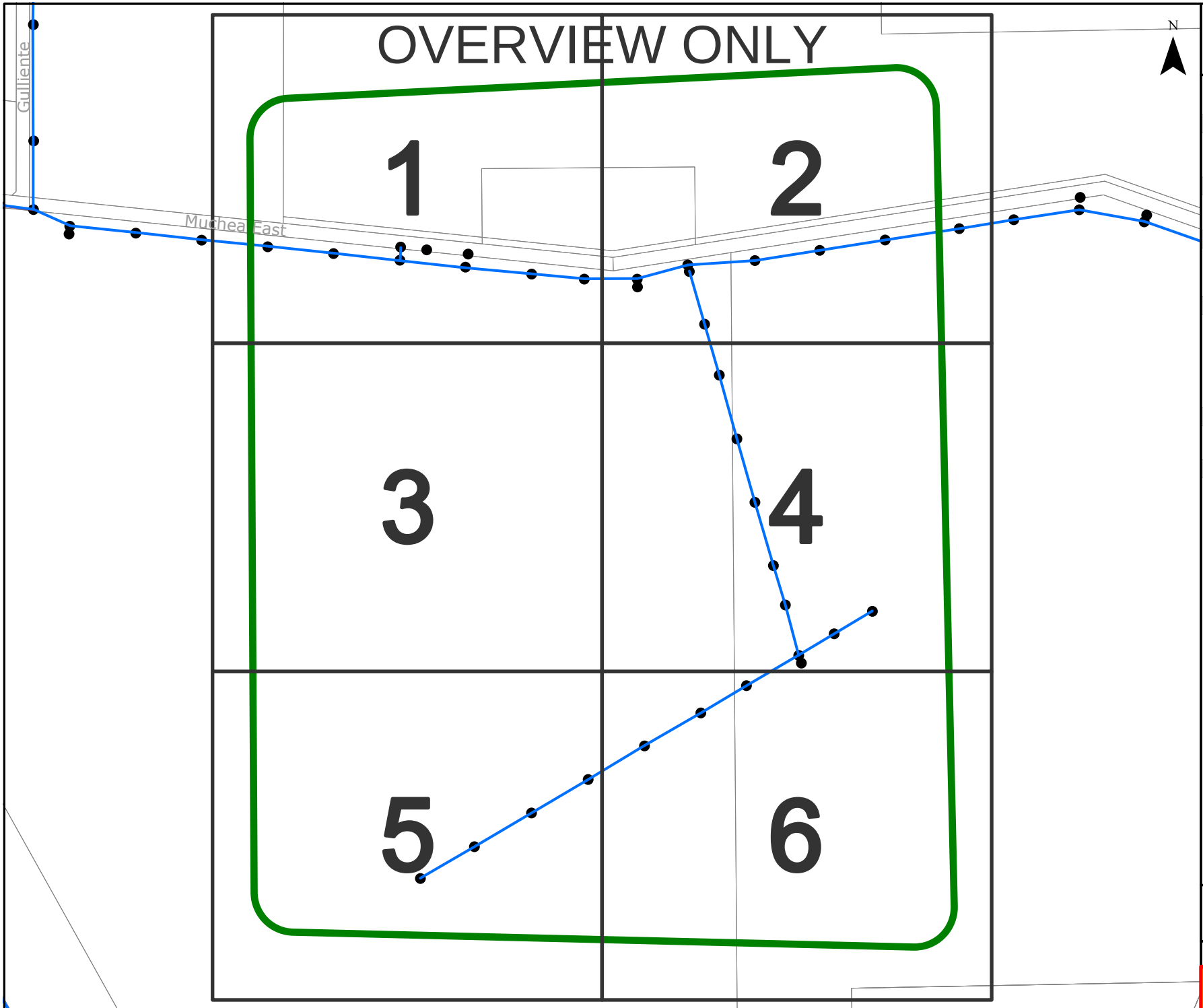
The accompanying documentation must be read and the following questions answered and instructions followed when planning and **before commencing any work**.

Questions		Yes	No
1	Will any works be within 15 metres of any High Pressure gas infrastructure?	☐	☐
If answered ***Yes*** you must contact the ATCO Gas Australia **High Pressure Coordinator** to seek prior approval on ***1300 926 755*** between 08:00 hours – 16:00 hours (Monday – Friday***,*** except public holidays).			
If you answer ***Yes*** to any of the following questions you must contact ATCO Gas Australia **Engineering Services** to seek prior approval on ***1300 926 755*** between the above hours. Plan ahead and allow sufficient time for ATCO Gas Australia Engineering Services to consider your request.			
Question		**Yes**	**No**
2	Will any works require the use of a vibrating roller within 15 metres of any gas mains?	☐	☐
3	Will any works involve boxing the ground out to a depth of 300mm or more for the construction of a road/car park or crossover/driveway over a gas main?	☐	☐
4	Will any works affect water flows or drainage, e.g., surface drainage, within 15 metres of any gas mains?	☐	☐
5	Will any works involve traversing any gas infrastructure with any heavy vehicle or plant (e.g., cranes, agitators or trucks)?	☐	☐
6	Will any works involve stockpiling of spoil, dangerous goods or any other materials over any gas infrastructure?	☐	☐
7	Will any works or structure (e.g., fencing) obstruct access to gas infrastructure?	☐	☐
8	Will any works involve placing infrastructure e.g., cable, pipes etc. that will not comply with the minimum separation distances to the gas infrastructure: 300mm crossing, 500mm parallel?	☐	☐
9	Will any works involve blasting that could affect any gas infrastructure?	☐	☐
10	Will any works involve the installation of electrical infrastructure to operate above 22kV in the vicinity of any steel gas infrastructure?	☐	☐

If unsure, please contact ATCO Gas Australia Engineering Services on ***1300 926 755***.

IMPORTANT*:** It is your responsibility to ***TAKE CARE to comply with all requirements of ATCO Gas Australia Engineering Services (including their 'Additional Information for Working around Gas Pipelines' (AGA-O&M-PR24)), the ATCO Gas Australia Dial Before You Dig cover sheets and maps and all applicable laws and standards.

IF YOU SEE, HEAR, SMELL OR OTHERWISE DETECT GAS, LEAVE THE IMMEDIATE AREA AND THEN CALL 13 13 52



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

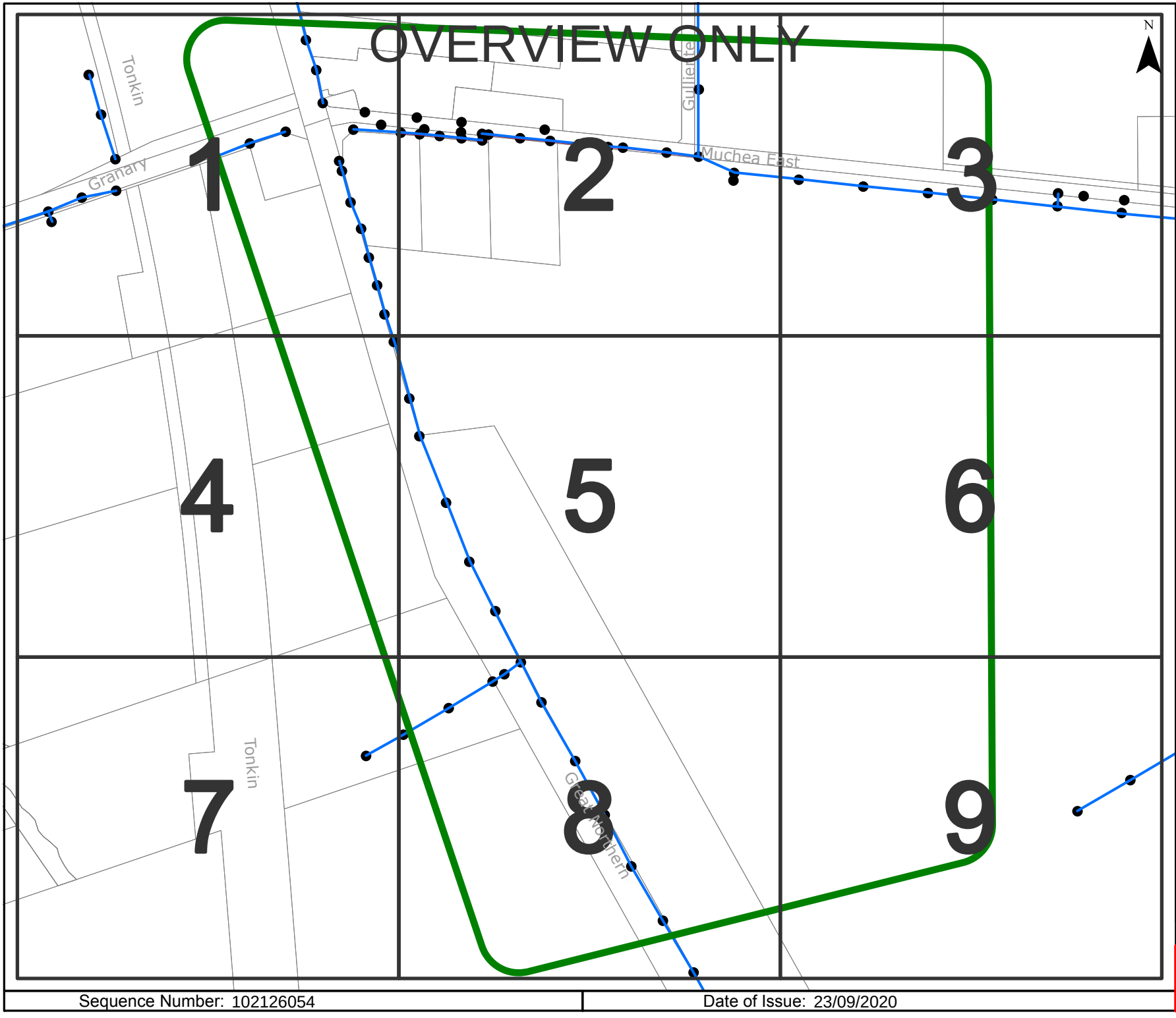
Information valid for 30 days from date of issue

A4	Scale : 1:7687

WARNING! Look out for overhead power lines

Sequence Number: 102126188

Date of Issue: 23/09/2020



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

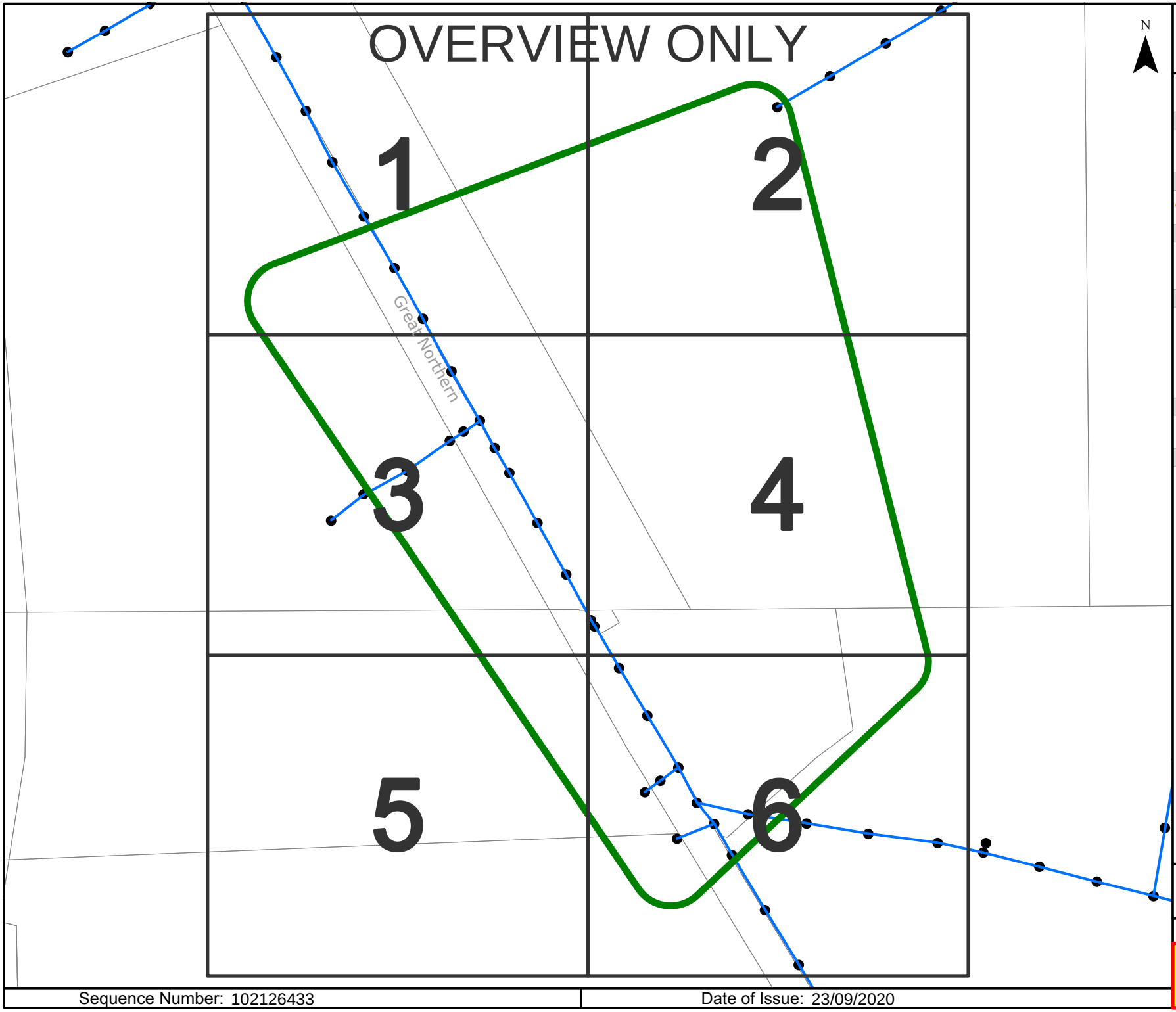
Information valid for 30 days from date of issue

A4	Scale : 1:7687

WARNING! Look out for overhead power lines

Sequence Number: 102126054

Date of Issue: 23/09/2020



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

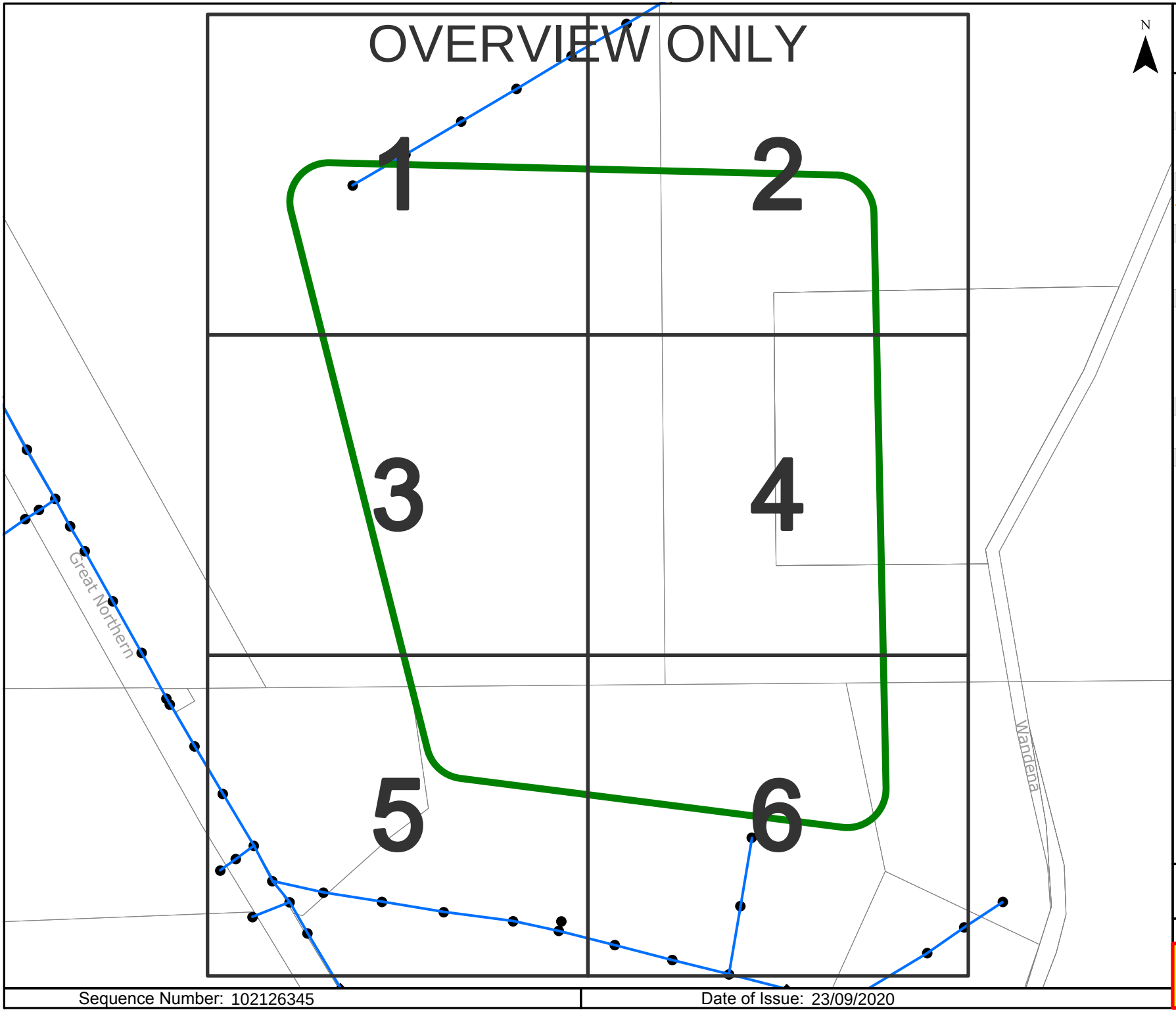
Information valid for 30 days from date of issue

A4	Scale : 1:7687

WARNING! Look out for overhead power lines

Sequence Number: 102126433

Date of Issue: 23/09/2020



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

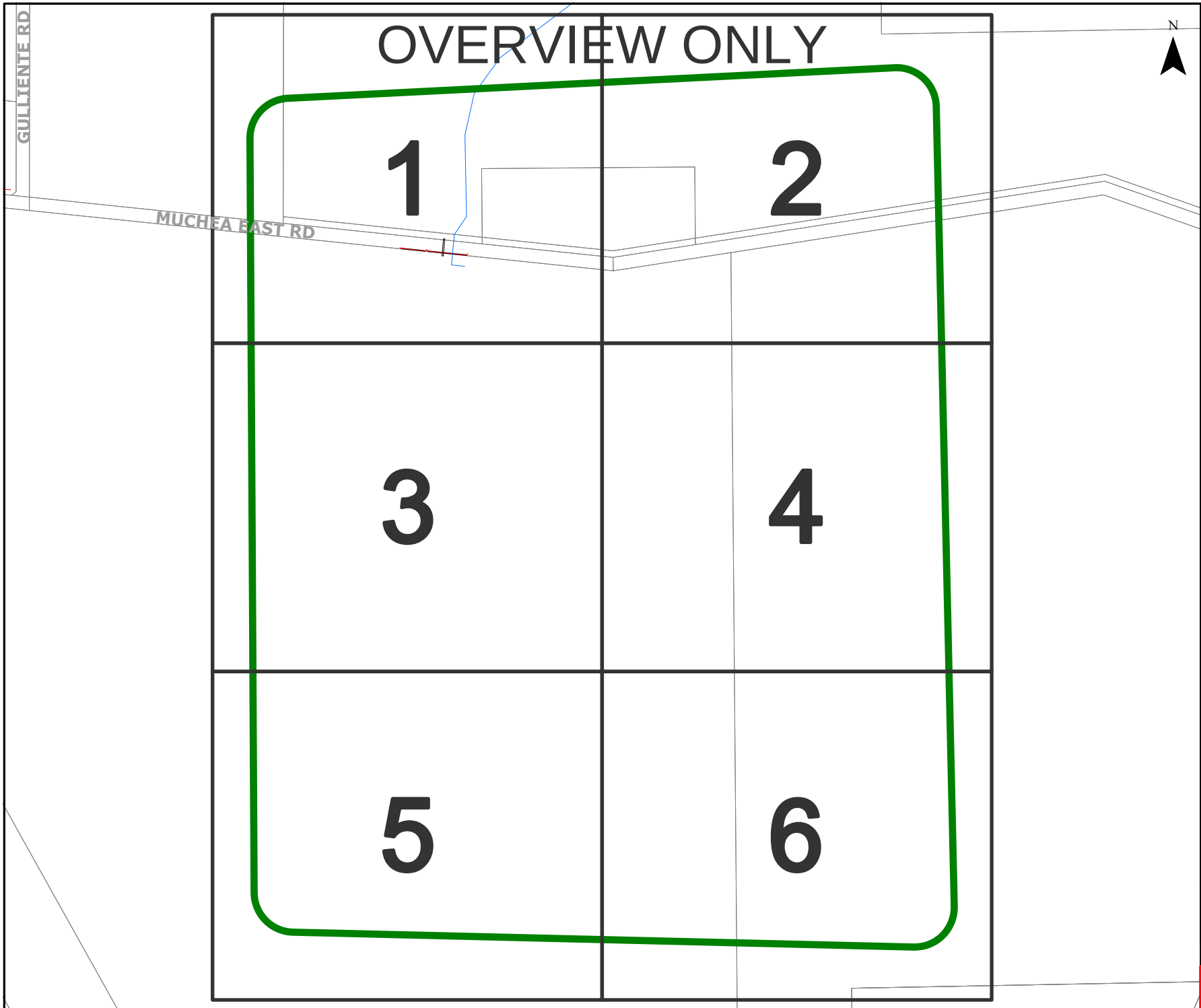
Information valid for 30 days from date of issue

A4	Scale : 1:7687

WARNING! Look out for overhead power lines

Sequence Number: 102126345

Date of Issue: 23/09/2020



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

*** 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

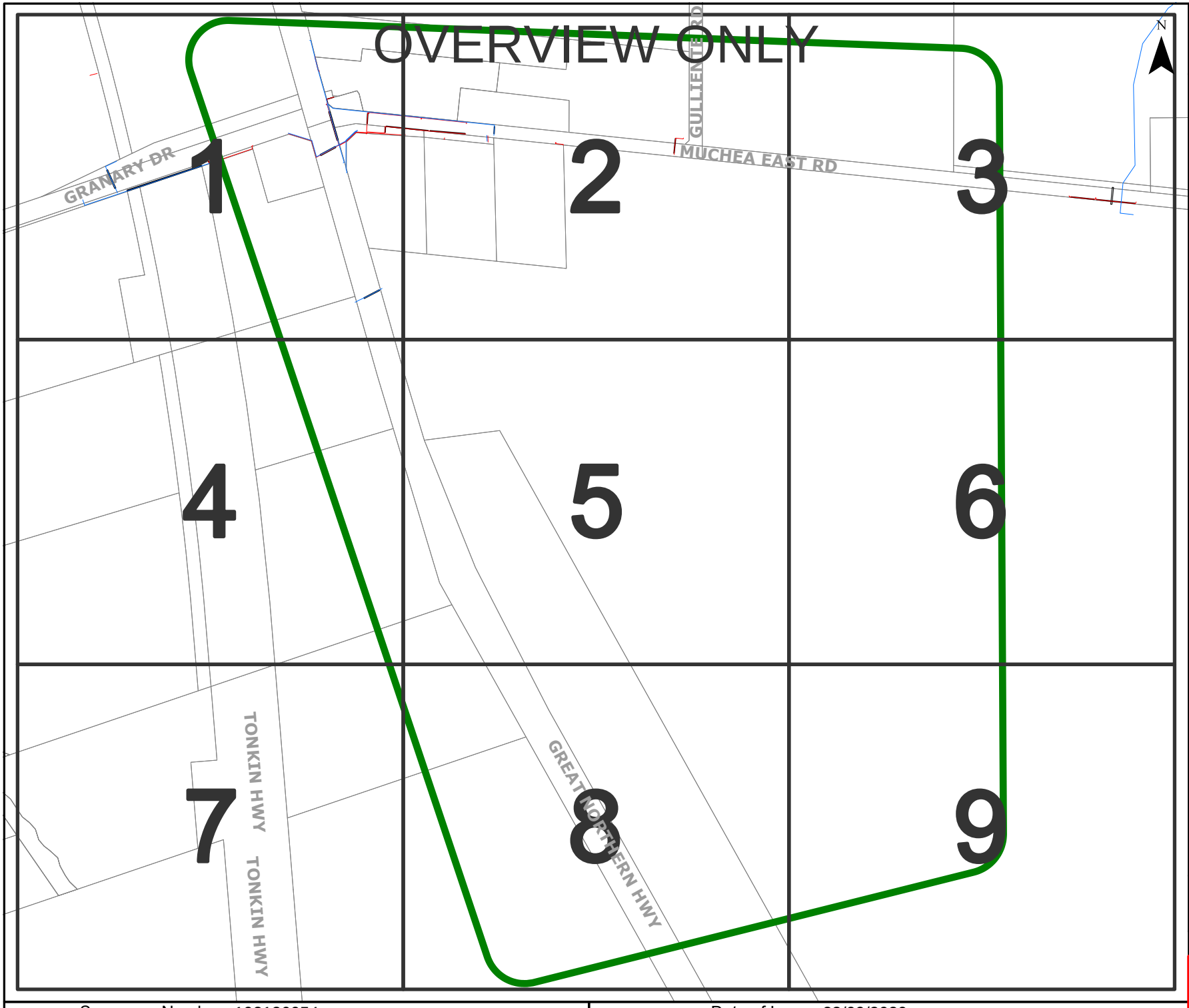
Information valid for 30 days from date of issue

A4	Scale : 1:7687

WARNING! Look out for overhead power lines

Sequence Number: 102126188

Date of Issue: 23/09/2020



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

*** 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

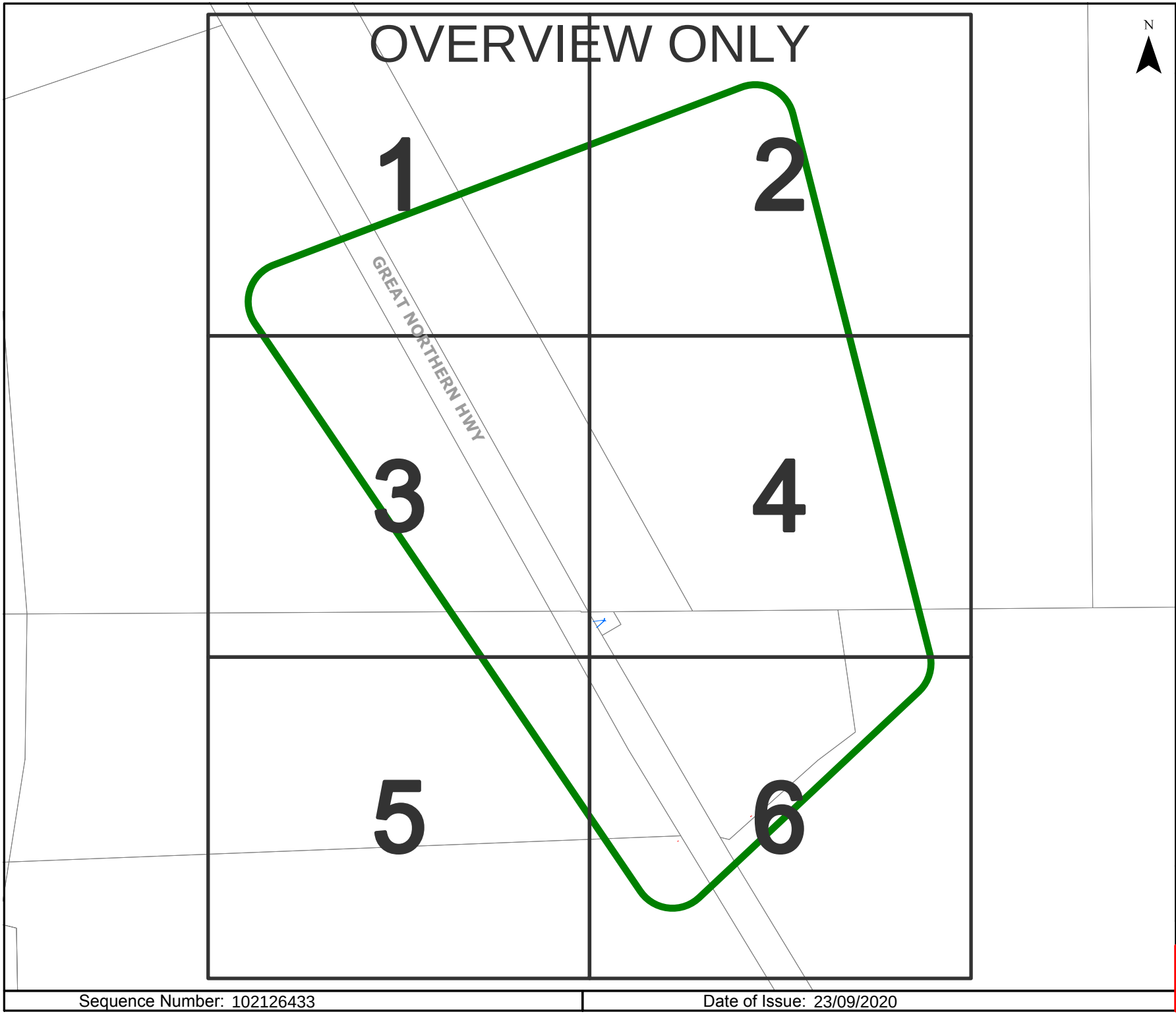
Information valid for 30 days from date of issue

A4	Scale : 1:7687

WARNING! Look out for overhead power lines

Sequence Number: 102126054

Date of Issue: 23/09/2020



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

*** 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 : 1:7687

WARNING! Look out for overhead power lines

Sequence Number: 102126433

Date of Issue: 23/09/2020

Annexure F – Department of Water Correspondence

Hendrik Wijaya

From: Flood <flood@dwer.wa.gov.au>
Sent: 30 September 2020 13:26
To: Hendrik Wijaya
Cc: Oleg Omelchuk
Subject: Floodplain management advice - 3488 (Lot M1456) & Lot 50 Great Northern Highway, Muchea - Hendrik Wijaya - 30092020
Attachments: 50gnh.pdf

Hendrik

We have no information on flooding or flood levels at this location. The available contour information indicate the presence of a waterway feature in the north of the Lot and the entire Lot may be subject to shallow overland flow from the east towards Great Northern Highway during major rainfall events.

Regards

Simon Rodgers
Supervising Engineer
Surface Water Assessment and Flood Risk Science

Department of Water and Environmental Regulation
Prime House, 8 Davidson Terrace, JOONDALUP WA 6027
Locked Bag 10, Joondalup DC, WA 6919
T: (08) 6364 6923 M: 0429 080 517
E: simon.rodgers@dwer.wa.gov.au | www.dwer.wa.gov.au

From: Hendrik Wijaya <hwijaya@peritasgroup.com.au>
Sent: Thursday, 24 September 2020 12:13 PM
To: Flood <flood@dwer.wa.gov.au>
Cc: Oleg Omelchuk <oleg@peritasgroup.com.au>
Subject: 3488 (Lot M1456) & Lot 50 Great Northern Highway, Muchea - Flood data request

Hi Simon,
Can I please have a quick check if this site is influenced by flood.

Government of Western Australia
Department of Water and Environmental Regulation

Lot 30 Great Northern Highway, Muchea

Legend

- FPM Flood Level Points (m AHD)
- FPM Historical Flood Levels (m AHD)
- Cadastre

Notes

0.5 0 0.23 0.5 Kilometers

WGS_1984_Web_Mercator_Auxiliary_Sphere

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Author: SR

Recipient:

Hendrik Wijaya

From: Jim MacKintosh <jim.mackintosh@dwer.wa.gov.au>
Sent: 02 February 2021 13:21
To: Hendrik Wijaya
Cc: Bree Lyons; Oleg Omelchuk
Subject: RE: Floodplain management advice - 3488 (Lot M1456) & Lot 50 Great Northern Highway, Muchea - Hendrik Wijaya - 30092020

Dear Hendrik,

I have review the site on our GIS and within the Draft Regional Water Management Strategy (RWMS) produced by DPLH – Did you get a copy of this RWMS like I suggested?

The waterway is mapped as a waterway and tributary of the Ellenbrook River. Therefore the DWER would expect that it would be retained and rehabilitated to a more natural waterway. This is consistent with the information in the RWMS which also requires its retention and it performs an important hydrological, environmental and flood control function.

This position may be negotiated if it can be demonstrated that the waterway was a former drain and does not perform any environmental or hydrological function.

I hope this answers your query. I strongly recommend obtaining a copy of the Draft RWMS from DPLH as this document has a lot of information on both waterways at that site.

Regards

Jim Mackintosh

Department of Water and Environmental Regulation

Program Manager

Swan Avon Region

Planning Advice Section

T 08 6250 8043 |
E jim.mackintosh@dwer.wa.gov.au
Visit our website www.dwer.wa.gov.au

From: Hendrik Wijaya <hwijaya@peritasgroup.com.au>
Sent: Tuesday, 2 February 2021 12:20 PM
To: Jim MacKintosh <jim.mackintosh@dwer.wa.gov.au>
Cc: Bree Lyons <bree.lyons@dwer.wa.gov.au>; Oleg Omelchuk <oleg@peritasgroup.com.au>
Subject: RE: Floodplain management advice - 3488 (Lot M1456) & Lot 50 Great Northern Highway, Muchea - Hendrik Wijaya - 30092020

Hi Jim,
Hope you are keeping well. Time flies and the break is over and we are into another crisis!

Have you had a chance to look at the below?

Thank you

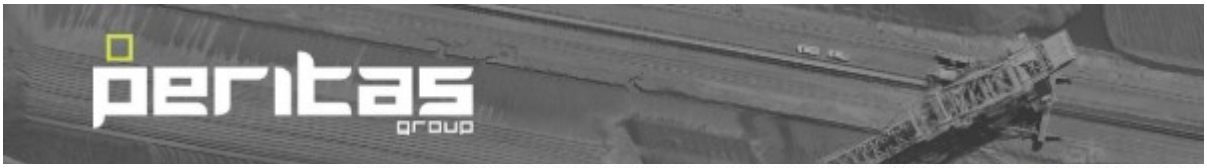
Kind Regards,

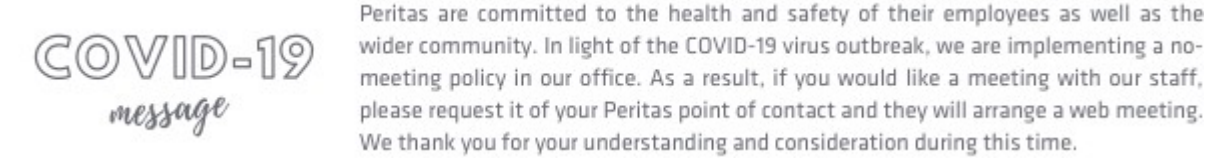
Hendrik Wijaya

SENIOR CIVIL ENGINEER

Peritas Consulting Pty Ltd

Perth | Melbourne
E: hwijaya@peritasgroup.com.au
M: 0403 886 278
P: + 61 8 6109 6514





From: Hendrik Wijaya
Sent: Wednesday, 16 December 2020 1:43 PM
To: Jim MacKintosh <jim.mackintosh@dwer.wa.gov.au>
Cc: Bree Lyons <bree.lyons@dwer.wa.gov.au>; Oleg Omelchuk <oleg@peritasgroup.com.au>
Subject: RE: Floodplain management advice - 3488 (Lot M1456) & Lot 50 Great Northern Highway, Muchea - Hendrik Wijaya - 30092020

Hi Jim,
Thank you for getting back to me with the timeframes, look forward to hearing back from you mid next year.

have a Merry Christmas and Happy New Year.

thank you

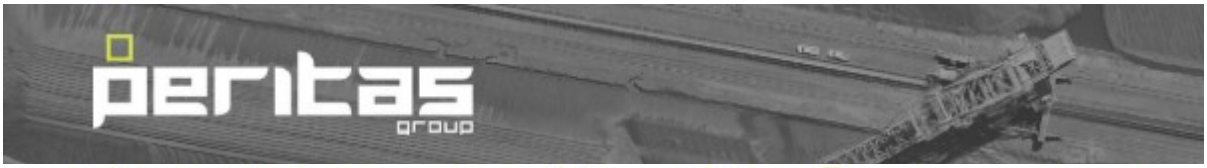
Regards,

Hendrik Wijaya

SENIOR CIVIL ENGINEER

Peritas Consulting Pty Ltd

Perth | Melbourne
E: hwijaya@peritasgroup.com.au
M: 0403 886 278
P: + 61 8 6109 6514



Merry Christmas & Happy New Year

Please be advised that the Peritas office will be closed during the festive season.
The closure will commence Thursday 24th December 2020, returning to the office Monday 4th January 2021.

From: Jim MacKintosh <jim.mackintosh@dwer.wa.gov.au>
Sent: 16 December 2020 13:41
To: Hendrik Wijaya <hwijaya@peritasgroup.com.au>
Cc: Bree Lyons <bree.lyons@dwer.wa.gov.au>; Oleg Omelchuk <oleg@peritasgroup.com.au>
Subject: RE: Floodplain management advice - 3488 (Lot M1456) & Lot 50 Great Northern Highway, Muchea - Hendrik Wijaya - 30092020

Dear Hendrik,

The Department's position/advice is related to the northern waterway as that was the question you had previously asked. I would need to check the District Water Management Strategy (DWMS) and our GIS mapping to determine if this requirement applies to the southern waterway (even if it is a drain as it is performing a hydrological function and potentially an environmental function). The DWMS should have some information and direction on this waterway so I hope you have obtained a copy from DPLH.

I cannot attend to this query at this time due to our substantial queue of other referrals and queries. A response would likely be provided by mid to late January 2021.

Regards

Jim Mackintosh

Department of Water and Environmental Regulation

Program Manager

Swan Avon Region

Planning Advice Section

T 08 6250 8043 |
E jim.mackintosh@dwer.wa.gov.au
Visit our website www.dwer.wa.gov.au

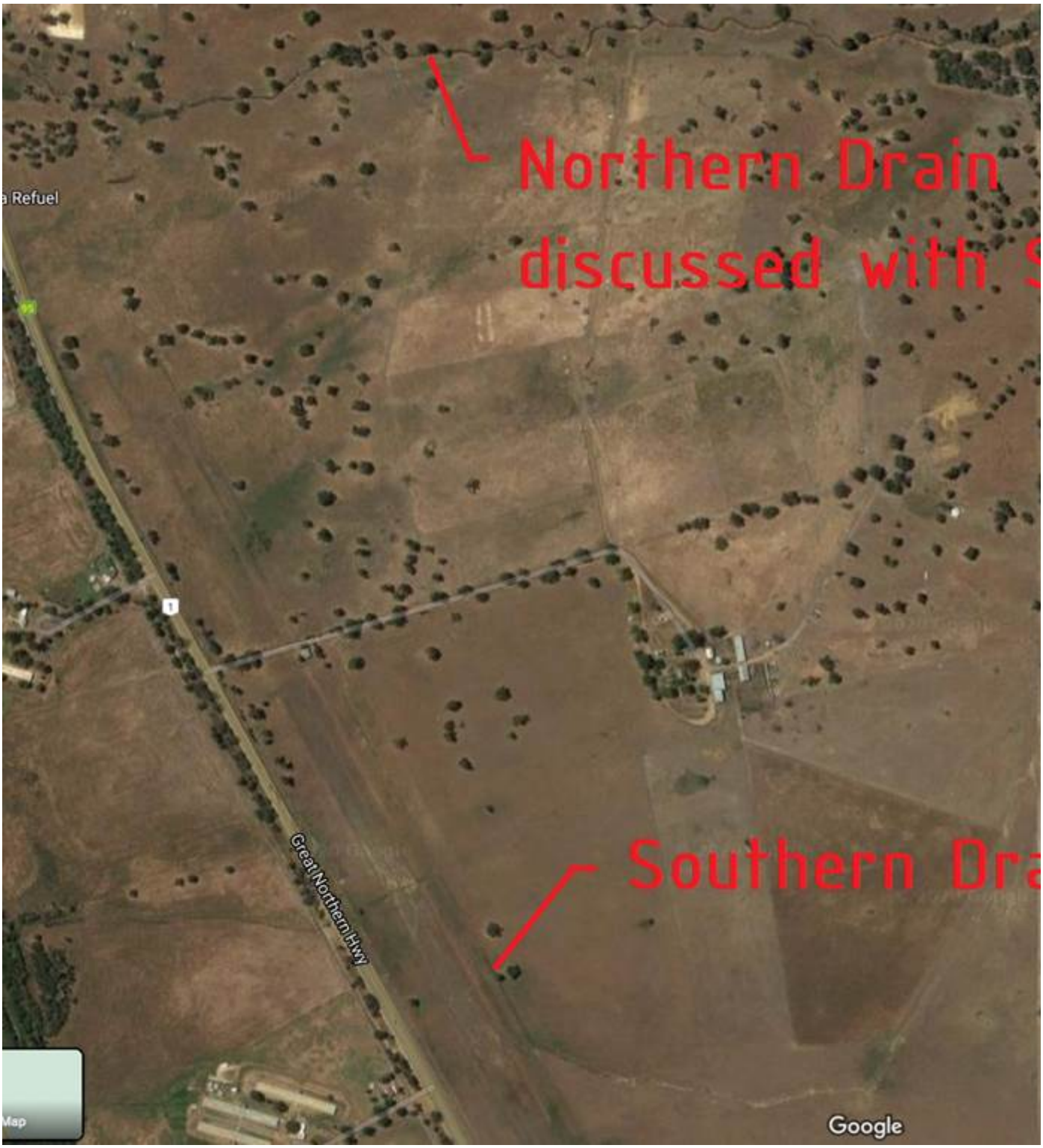
From: Hendrik Wijaya <hwijaya@peritasgroup.com.au>
Sent: Wednesday, 16 December 2020 12:22 PM
To: Jim MacKintosh <jim.mackintosh@dwer.wa.gov.au>
Cc: Bree Lyons <bree.lyons@dwer.wa.gov.au>; Simon Rodgers <simon.rodgers@dwer.wa.gov.au>; Oleg Omelchuk <oleg@peritasgroup.com.au>
Subject: RE: Floodplain management advice - 3488 (Lot M1456) & Lot 50 Great Northern Highway, Muchea - Hendrik Wijaya - 30092020

Hi Jim,
We just had a team discussion on site constraints and the client wanted confirmation if your comments below (preserving and rehabilitating drain from east to west) is associated with all of the drains traversing the site or is it just for the northern drain?

The initial discussion with Simon Rodgers was to do with the norther drain, which led to referral to yourself. I didn't specifically consider the southern drain until it was raised at the meeting yesterday.

The northern drain looks natural and I can appreciate the need to preserve it. The southern drain on the other hand looks man made (not meandering, straight with distinct angles). This looked to me more like a farmers drain.

can you please get back to us. Thank you



Regards,

Hendrik Wijaya

SENIOR CIVIL ENGINEER

Peritas Consulting Pty Ltd

Perth | Melbourne
E: hwijaya@peritasgroup.com.au
M: 0403 886 278
P: + 61 8 6109 6514

From: Jim MacKintosh <jim.mackintosh@dwer.wa.gov.au>
Sent: 13 October 2020 15:09
To: Hendrik Wijaya <hwijaya@peritasgroup.com.au>
Cc: Bree Lyons <bree.lyons@dwer.wa.gov.au>
Subject: RE: Floodplain management advice - 3488 (Lot M1456) & Lot 50 Great Northern Highway, Muchea - Hendrik Wijaya - 30092020

Dear Hendrik,

The subject site contains a mapped non-perennial waterway (see below) that flows east to west across the site (from the property to the east, under Great Northern Hwy and Tonkin Hwy to the Ellen Brook). The Department of Water and Environmental Regulation (DWER) require that the waterway is retained, rehabilitated and reserved in a foreshore reserve (or similar) for conservation purposes. The foreshore reserve should be determined based on the DWER's *Operational P:olicy 4.3 – Identifying and establishing waterways foreshore areas* (DWER, Sept 2012).

The Department of Planning, Lands and Heritage (DPLH) has prepared a District Water Management Strategy (DWMS) to guide future development. It is recommended that you contact DPLH (Matthew.Burnett@dplh.wa.gov.au or Cath.Meaghan@dplh.wa.gov.auor) or the Shire of Chittering to obtain a copy of this DWMS.

Regards

Jim Mackintosh

Department of Water and Environmental Regulation

Program Manager

Swan Avon Region

Planning Advice Section

T 08 6250 8043 |
E jim.mackintosh@dwer.wa.gov.au
Visit our website www.dwer.wa.gov.au

From: Flood <flood@dwer.wa.gov.au>
Sent: Thursday, 1 October 2020 11:32 AM
To: Hendrik Wijaya <hwijaya@peritasgroup.com.au>
Cc: Swan Avon Land Use Planning <swanavon.landuse@dwer.wa.gov.au>
Subject: RE: Floodplain management advice - 3488 (Lot M1456) & Lot 50 Great Northern Highway, Muchea - Hendrik Wijaya - 30092020

Hi Hendrik

I have forwarded your query to our land use planning group at the Vic park office who should be able to provide some comment on this matter.

Regards

Simon Rodgers
Supervising Engineer
Surface Water Assessment and Flood Risk Science

Department of Water and Environmental Regulation
Prime House, 8 Davidson Terrace, JOONDALUP WA 6027
Locked Bag 10, Joondalup DC, WA 6919
T: (08) 6364 6923 M: 0429 080 517
E: simon.rodgers@dwer.wa.gov.au | www.dwer.wa.gov.au

From: Hendrik Wijaya <hwijaya@peritasgroup.com.au>
Sent: Thursday, 1 October 2020 11:18 AM
To: Flood <flood@dwer.wa.gov.au>
Cc: Oleg Omelchuk <oleg@peritasgroup.com.au>
Subject: RE: Floodplain management advice - 3488 (Lot M1456) & Lot 50 Great Northern Highway, Muchea - Hendrik Wijaya - 30092020

Hi Simon,
Thank you for getting back to me promptly.

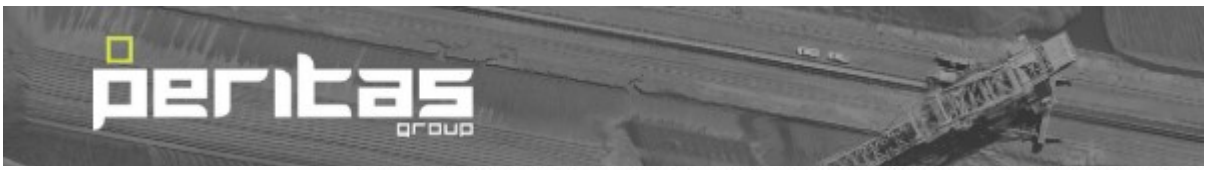
Looking at google, it does not look like the stream goes anywhere once it gets to GNH. If the site were to be developed as an industrial area, will there be a requirement to retain a drainage path?

Thank you

Regards,

Hendrik Wijaya
SENIOR CIVIL ENGINEER

Peritas Consulting Pty Ltd
Perth | Melbourne
E: hwijaya@peritasgroup.com.au
M: 0403 886 278
P: + 61 8 6109 6514



Peritas are committed to the health and safety of their employees as well as the wider community. In light of the COVID-19 virus outbreak, we are implementing a no-meeting policy in our office. As a result, if you would like a meeting with our staff, please request it of your Peritas point of contact and they will arrange a web meeting. We thank you for your understanding and consideration during this time.

From: Flood <flood@dwer.wa.gov.au>
Sent: 30 September 2020 13:26
To: Hendrik Wijaya <hwijaya@peritasgroup.com.au>
Cc: Oleg Omelchuk <oleg@peritasgroup.com.au>
Subject: Floodplain management advice - 3488 (Lot M1456) & Lot 50 Great Northern Highway, Muchea - Hendrik Wijaya - 30092020

Hendrik

We have no information on flooding or flood levels at this location. The available contour information indicate the presence of a waterway feature in the north of the Lot and the entire Lot may be subject to shallow overland flow from the east towards Great Northern Highway during major rainfall events.

Regards

Simon Rodgers
Supervising Engineer
Surface Water Assessment and Flood Risk Science

Department of Water and Environmental Regulation
Prime House, 8 Davidson Terrace, JOONDALUP WA 6027
Locked Bag 10, Joondalup DC, WA 6919
T: (08) 6364 6923 M: 0429 080 517
E: simon.rodgers@dwer.wa.gov.au | www.dwer.wa.gov.au

From: Hendrik Wijaya <hwijaya@peritasgroup.com.au>
Sent: Thursday, 24 September 2020 12:13 PM
To: Flood <flood@dwer.wa.gov.au>
Cc: Oleg Omelchuk <oleg@peritasgroup.com.au>
Subject: 3488 (Lot M1456) & Lot 50 Great Northern Highway, Muchea - Flood data request

Hi Simon,
Can I please have a quick check if this site is influenced by flood.

Thank you

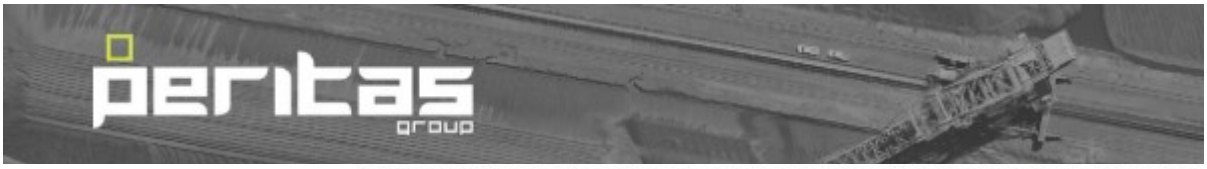
Regards,

Hendrik Wijaya

SENIOR CIVIL ENGINEER

Peritas Consulting Pty Ltd

Perth | Melbourne
E: hwijaya@peritasgroup.com.au
M: 0403 886 278
P: + 61 8 6109 6514



COVID-19 *message*

Peritas are committed to the health and safety of their employees as well as the wider community. In light of the COVID-19 virus outbreak, we are implementing a no-meeting policy in our office. As a result, if you would like a meeting with our staff, please request it of your Peritas point of contact and they will arrange a web meeting. We thank you for your understanding and consideration during this time.

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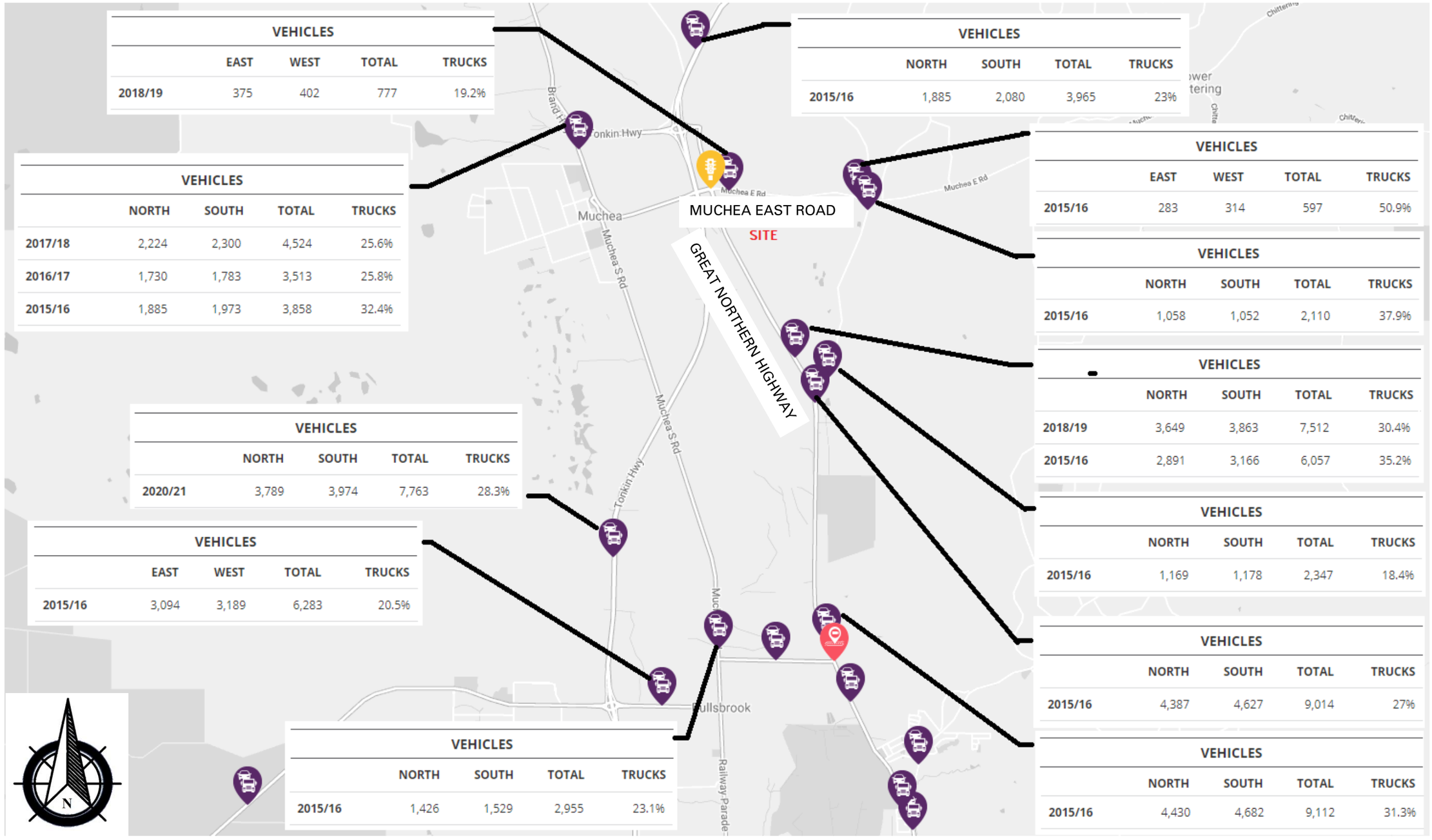
Annexure G – Traffic Count



VEHICLES

	EAST	WEST	TOTAL	TRUCKS
2018/19	375	402	777	19.2%

VEHICLES

	NORTH	SOUTH	TOTAL	TRUCKS
2015/16	1,885	2,080	3,965	23%

VEHICLES

	NORTH	SOUTH	TOTAL	TRUCKS
2017/18	2,224	2,300	4,524	25.6%
2016/17	1,730	1,783	3,513	25.8%
2015/16	1,885	1,973	3,858	32.4%

VEHICLES

	EAST	WEST	TOTAL	TRUCKS
2015/16	283	314	597	50.9%

VEHICLES

	NORTH	SOUTH	TOTAL	TRUCKS
2015/16	1,058	1,052	2,110	37.9%

VEHICLES

	NORTH	SOUTH	TOTAL	TRUCKS
2020/21	3,789	3,974	7,763	28.3%

VEHICLES

	NORTH	SOUTH	TOTAL	TRUCKS
2018/19	3,649	3,863	7,512	30.4%
2015/16	2,891	3,166	6,057	35.2%

VEHICLES

	EAST	WEST	TOTAL	TRUCKS
2015/16	3,094	3,189	6,283	20.5%

VEHICLES

	NORTH	SOUTH	TOTAL	TRUCKS
2015/16	1,169	1,178	2,347	18.4%

VEHICLES

	NORTH	SOUTH	TOTAL	TRUCKS
2015/16	4,387	4,627	9,014	27%

VEHICLES

	NORTH	SOUTH	TOTAL	TRUCKS
2015/16	1,426	1,529	2,955	23.1%

VEHICLES

	NORTH	SOUTH	TOTAL	TRUCKS
2015/16	4,430	4,682	9,112	31.3%

peritas group

iPARKS Design • Develop • Deliver • Maintain

PROJECT	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Scale:**	N.T.S
CLIENT	IPARKS	**Drawn:**	HW
LOCATION	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Date:**	20.10.20
TITLE	TRAFFIC COUNT	**Reference:**	PC20171.SKT.017 Rev. **A**

Annexure H – Main Roads Western Australia Drainage Culverts

CH	Chainage (MRWA)
1.2x0.45 x 2 (eg)	Rectangular culvert (width x height x no. barrels)
0.5 o x 2 (eg)	Round culvert (diameter x no. barrels)

GN Hwy Culverts

bayley environmental services

Annexure I – Water Corporation Correspondence

Hendrik Wijaya

From: Brett Coombes <Brett.Coombes@watercorporation.com.au>
Sent: 01 October 2020 10:37
To: Hendrik Wijaya
Subject: M1456 Great Northern Highway Muchea

Good morning Hendrik,

Lot M1456 is located well north of the Water Corporation's planning areas for water and wastewater. The Water Corporation does not have any infrastructure in the area.

Regards

Brett Coombes
Senior Planner
Development Services
Tel. 9420-3165

Annexure J – Muchea Water Correspondence

Hendrik Wijaya

From: Peter Fogarty <pf@pendulumgroup.com.au>
Sent: 17 February 2021 09:36
To: Hendrik Wijaya
Subject: RE: Tallanga Beef Pty Ltd - Lot 50 & Lot M1456 (No. 3488) Great Northern Highway - Muchea Industrial Precinct (Precinct 2) Potable water

Hendrik,
In answer to your email we advise as follows:

1. The current connection to Muchea Industrial Precinct extends to where the new BP service station is located.
   Our mains pipe joins the Harvis Stage 1 reticulation behind and slightly North of the BP site.
2. The internal reticulation is designed constructed and paid for by the Developer and legal ownership is transferred to Muchea Water on connection and as part of Development and water supply agreement.
   Harvis worked with our engineers to conform with specification.

Regards
Peter

Peter Fogarty
Chairman
Muchea water
PO Box 1982 West Perth WA 6872 Australia
Level 1, 5 Ord Street West Perth WA 6005
Tel: +61 8 9282 5401 Fax: +61 8 9282 5444 Mob +61 41 112 0519
Email: pf@pendulumgroup.com.au

From: Hendrik Wijaya <hwijaya@peritasgroup.com.au>
Sent: Friday, 12 February 2021 11:28 AM
To: Peter Fogarty <pf@pendulumgroup.com.au>
Subject: RE: Tallanga Beef Pty Ltd - Lot 50 & Lot M1456 (No. 3488) Great Northern Highway - Muchea Industrial Precinct (Precinct 2) Potable water

Hi Peter,
Thank you for the information below and my apologies for not getting back to you sooner. There are transport network and planning items that needed to be resolved and hence the rest of the discipline are just waiting.

Can you please advise extent of Muchea Water current asset – this will give us an indication on how far we need to extend the asset to Precinct 2 and the contribution amount.

Are the internal reticulation within the precinct to be constructed by the developer or will Muchea Water have the same arrangement as per the trunk service – i.e constructed by Muchea Water with Developer contribution?

Thank you

Regards,

Hendrik Wijaya
SENIOR CIVIL ENGINEER

Peritas Consulting Pty Ltd

Perth | Melbourne
E: hwijaya@peritasgroup.com.au
M: 0403 886 278
P: + 61 8 6109 6514

From: Peter Fogarty <pf@pendulumgroup.com.au>
Sent: 15 January 2021 14:43
To: Hendrik Wijaya <hwijaya@peritasgroup.com.au>
Subject: FW: Tallanga Beef Pty Ltd - Lot 50 & Lot M1456 (No. 3488) Great Northern Highway - Muchea Industrial Precinct (Precinct 2) Potable water

Dear Hendrik

It is just come to my attention that this email was sent to the cc address from your email and not directly to you – my apologies.

Please see the email below from Peter in response to your email.

Regards

Sue

Sue Hancock

Pendulum Capital Pty Limited
PO Box 1982 West Perth WA 6872 Australia
Level 1, 5 Ord Street West Perth WA 6005
Tel: +61 8 9282 5400 Fax: +61 8 9282 5484
Email: sueh@pendulumgroup.com.au

AFSL No 280970

From: Peter Fogarty
Sent: Monday, 21 December 2020 12:13 PM

To: oleg@peritasgroup.com.au
Subject: FW: Tallanga Beef Pty Ltd - Lot 50 & Lot M1456 (No. 3488) Great Northern Highway - Muchea Industrial Precinct (Precinct 2) Potable water

Dear Hendrik

We refer to your email of 13 November 2020 and apologise for not responding sooner but your email was delayed in re-direction from our Muchea Water address.

Your information on the water available and allocations is incorrect. We do have 651ML pa of water licence and hold an ERA Service Provider Licence WL51. The water allocations to date are to Riverside Investments (WA) No 2 Pty Ltd for its Reserve Road residential area (142ML pa) and 50ML and 50ML option to Harvis.

We do not have any arrangement with Precinct 3 for 203ML pa. Several developers have requested water supply but no firm agreements have been entered into.

Accordingly, we have 409ML pa available, subject to final agreement and payment for the allocation agreed. There is no future demand of 75ML pa currently committed. Some parties have expressed interest but no binding agreements are in place. We do not allocate water unless a binding supply agreement is entered into. Precinct 3 has not done this.

Accordingly, in answer to your questions we respond as follows:

- Muchea Water is willing to negotiate for the supply of potable water to your client.
- The main pipe to Muchea is already installed and operational. Extending the network to Stage 2 is relatively straight-forward. We can't give timeframes until we have clear specifications and a contribution to our costs of investigating your requirements.
- Any developer will be required to meet the cost of constructing the infrastructure to deliver the water from the existing mains and make a "mains pipe" network contribution. We expect this will be approximately $150,000 per kilometre depending on the pipe size and pressure requirements. In addition, an extension to the network will require a developer contribution to the existing pipeline that delivers to any connecting network.
- Information on the flow rate and level of supply will only be provided once heads of agreement are in place and we have more information on usage rates.

Regards

Peter Fogarty
Chairman

Muchea Water

Aqua Ferre (Muchea) Pty Ltd t/as Muchea Water (WL51)
PO Box 1982 West Perth WA 6872
Level 1, 5 Ord Street West Perth WA 6005
T 08 9282 5401 **F** 08 9282 5484
E pf@pendulumgroup.com.au

From: Hendrik Wijaya
Sent: 13 November 2020 14:06
To: accounts@mucheawater.com.au
Cc: Oleg Omelchuk <oleg@peritasgroup.com.au>
Subject: Tallanga Beef Pty Ltd - Lot 50 & Lot M1456 (No. 3488) Great Northern Highway - Muchea Industrial Precinct (Precinct 2) Potable water

Hi,
I am currently undertaking a servicing report on Precinct 2 of the Muchea Industrial Precinct. It is my understanding that you have considered supplying water to Precinct 3.

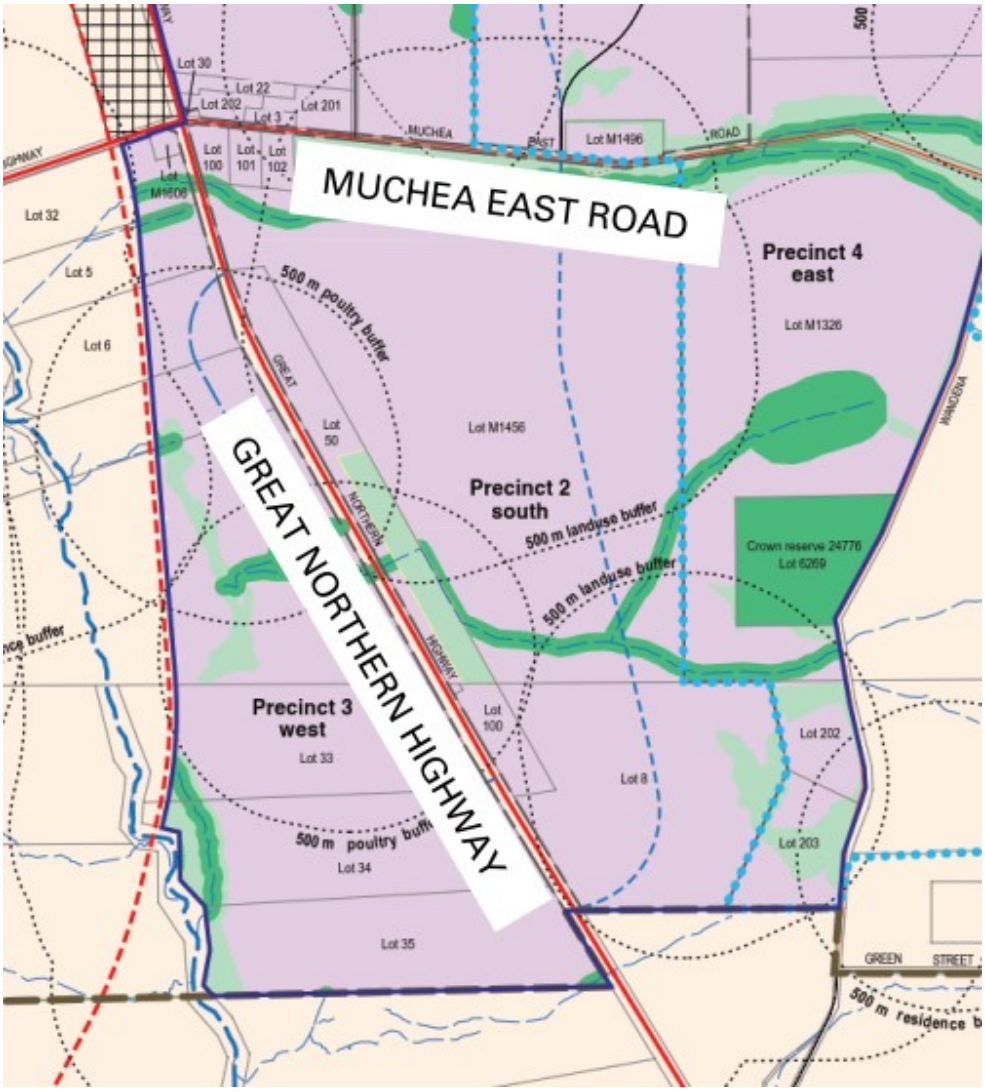
Our client represents approximately 75% of Precinct 2, their sites are Lot 50 & Lot M1456 (No. 3488) Great Northern Highway. The total industrial land area is approximately 210ha. We have not been supplied with water demand by hydraulics consultants. However, Precinct 3 estimated their potable demand to be approximately 203ML/a over a land area of 139ha. Accordingly, we should expect our potable demand to be in the vicinity of 306ML.

It is our understanding that Aqua Ferre will have access to 651MLpa and out of these the following are "allocated"

- Reserve road residential & MEN Industrial 153MLpa
- Future Demand 75MLpa
- Precinct 3 Water demand 203MLpa

Based on these figures, Aqua Ferre does not have adequate allocation to fully supply Precinct 2 development. Can you please advise:

- If Aqua Ferre is interested or will be able to source additional water allocation to meet Precinct 2 requirements.
- Forecasted timeframes of when the infrastructures will be completed.
- It would appear that over 3.5km of pipeline will be required to bring water supply to Precinct 2 and 3. Is the intent for Aqua Ferre to construct the infrastructure at their own cost or a cost share or cost contribution is required by Precinct 2?
- Please also advise the level of supply – flow rate and pressure (mainly to gauge the infrastructure required by the commercial tenancy – if they are required to provide fire water tanks and booster pump assembly, etc)



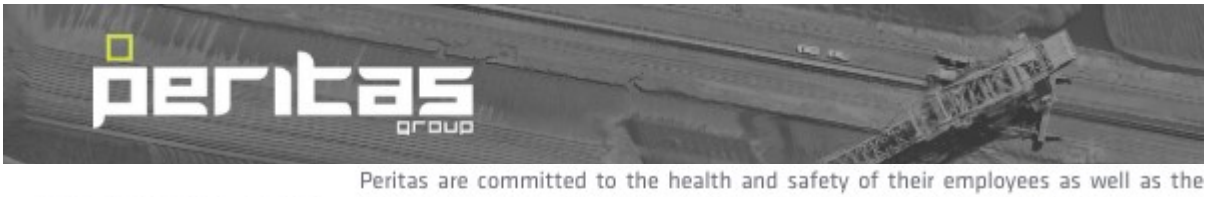
Regards,

Hendrik Wijaya

SENIOR CIVIL ENGINEER

Peritas Consulting Pty Ltd

Perth | Melbourne
E: hwijaya@peritasgroup.com.au
M: 0403 886 278
P: + 61 8 6109 6514



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Annexure K – Western Power Network Capacity Forecast 2026

PROJECT	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Scale:**	N.T.S	
CLIENT	IPARKS	**Drawn:**	HW	
LOCATION	3488 (LOT M1456) & LOT 50 GREAT NORTHERN HIGHWAY	**Date:**	20.10.20	
TITLE	WESTERN POWER NETWORK CAPACITY FORECAST 2026	**Reference:**	PC20171.SKT.018	Rev. **A**

APPENDIX H

Landscape Masterplan

TALLANGATTA FARM
LOTS 50 AND 1456 GREAT NORTHERN HIGHWAY, MUCHEA

LANDSCAPE MASTER PLAN

Prepared for

Tallangatta Beef Pty Ltd
c/- iParks Property Group Pty Ltd
38 Mandurah Rd
KWINANA BEACH WA 6167

Draft Report No. J19018c
11 March 2021

BAYLEY ENVIRONMENTAL SERVICES
30 Thomas Street
SOUTH FREMANTLE WA 6162

Sundowner Nominees Pty Ltd as trustee for the Bayley Cook Family Trust ABN 20 822 598 897
trading as Bayley Environmental Services

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1.0 INTRODUCTION

Tallangatta Farm (Lots 50 and 1456 Great Northern Highway, Muchea) is located on the corner of Muchea East Road and Great Northern Highway, Muchea. Tallangatta Beef Pty Ltd, the owner of Tallangatta Farm, has applied to the Shire of Chittering for the property to be rezoned from Agricultural Resource to General Industry. The *Muchea Industrial Park Structure Plan* (MIPSP) shows Tallangatta as part of Precinct 2 (General Industry Core) of the Muchea Industrial Park. Figure 1 shows the location of the site within the draft Muchea Industrial Park Structure Plan area.

The total area of Tallangatta is 213 hectares. Figure 2 shows the boundaries of the site. Figure 3 shows a preliminary conceptual plan of subdivision.

The Local Structure Plan for Tallangatta has been submitted to the Department of Planning, Lands & Heritage and the Shire of Chittering, and is currently being considered by these agencies.

The Muchea Industrial Park will form the southern gateway to the Shire of Chittering. A priority of the Shire Council is that the MIP should present an attractive visual landscape for observers travelling on the main approaches into Chittering. This includes preserving native vegetation (mostly roadside trees and some paddock trees) where possible, landscape plantings, building design and layout of development within lots.

The Shire of Chittering has set out its priorities in its *Muchea Industrial Park Design Guidelines* (2018). The Guidelines deal with development layout within lots, streetscaping, landscaping, bushfire management, fencing, signage and building design. The Shire of Chittering Town Planning Scheme No. 6 also contains provisions relating to landscape within industrial zones. This Landscape Master Plan recognises and reflects the recommendations of the Design Guidelines and the Scheme provisions.

2.0 EXISTING LANDSCAPE

Tallangatta is visible from Great Northern Highway and Muchea East Road, from where it presents a view of open grazing paddocks with scattered trees. The view is mostly unobstructed by the few trees and shrubs present in the road verge. Figure 4 shows views of the site from the adjoining roads.

3.0 LANDSCAPING STRATEGY

Landscaping of the project area will focus on the use of species with low water demand. Plantings will include bioretention swales and basins, landscape buffers (to a minimum of 10% of the area of each lot) and street trees. The plantings will not be irrigated after the establishment phase. No turf grass will be planted in public areas, although individual lot owners may choose to plant grass. Lawn areas will not count towards the landscaping requirement on each lot.

Fertiliser use will be minimal. New tube stock plantings will be fertilised with slow-release nitrogen and phosphorus tablets on establishment and thereafter will be unfertilised.

The bioretention basins and swales will be densely planted with inundation and drought tolerant native species including sedges and low shrubs in order to stabilise the swales and maximise their ability to immobilise nutrients and sediments from the water.

The total area to be planted is approximately 40 hectares. If all of this area were planted simultaneously during the establishment phase at the DWER's default rate of 4,500 KL/ha/yr, approximately 180 ML of water would be required to irrigate the new plantings in the first year. As the project area is likely to be developed in a number of stages, the requirement for irrigation water is likely to be spread out over a number of years, with only a small part of the total demand being required in any one year.

The density of planting will be controlled to keep flammable ground fuel loads below 8 tonnes/ha, in accordance with the Bushfire Management Plan (Eco Logical Australia, 2021).

Figure 5 shows an overview of the Landscape Master Plan.

4.0 LANDSCAPING ZONES

4.1 Great Northern Highway

The Great Northern Highway road reserve includes a cleared verge 10m wide adjacent to the subject land. The road reserve is classed as "Excluded" under the Bushfire Management Plan, with a low fire hazard rating.

No landscape planting is proposed in the Great Northern Highway road reserve, in line with Main Roads WA advice (A. Rao, MRWA 2021 pers. comm.).

4.2 Muchea East Road

The Muchea East Road reserve includes a 3m to 7m wide, mostly cleared verge adjacent to the project area. Near the north-eastern corner the verge includes a few Wandoo and Marri trees with little understorey.

The Muchea East Road reserve is currently classed as "Excluded" under the Bushfire Management Plan, with a low fire hazard rating. The fire hazard could be increased by any substantial increase in the overstorey canopy density or by an increased understorey.

Landscaping in the Muchea East Road reserve will be limited to retention of existing trees and weed control.

4.3 Northern Creekline and POS

The existing creekline entering at the north-east of the property will be retained in its current alignment and protected within a vegetated foreshore and POS reserve that extends at least 30m and up to 150m from the creekline, measuring about 16.66ha in area. Appendix A presents a Foreshore Reserve Definition Study carried out in accordance with DWER Operational Policy River Restoration Series RR16 – *Determining Foreshore Reserves* (WRC, 2001) and Foreshore Policy 1 – *Identifying the Foreshore Area* (WRC, 2002a).

A smaller area of POS, measuring 0.88ha in area, will be located on the western boundary of the project area.

The POS areas will be planted with native sedges, shrubs and trees. In parts of the northern POS within 100m of lots, shrub plantings will be kept below 2m in height and trees will be spaced 15m apart in order to achieve a "Shrubland" bushfire hazard rating. In the north-west and north-east of the POS, more than 100m from lots, plantings of larger shrubs and denser trees may occur.

Existing native trees within the POS areas will be retained.

4.4 Bioretention Swales, Drainage Easements and Reserves

Bioretention swales 5m to 9m wide will be located on one or both sides of all roads within the project area, as well as several dedicated 10m wide drainage easements and drainage reserves. The swales, easements and reserves will carry road runoff, excess lot runoff and throughflow from catchments upstream of the project area.

The swales, easements and reserves will be densely planted with native sedges, small (<2m) shrubs and widely-spaced small trees to stabilise the swales, slow the water flows and maximise the uptake of sediments and nutrients from the water. Figure 6 shows conceptual profiles of the roadside swales.

4.5 Lots

The Shire of Chittering's Design Guidelines set out the Shire's requirements and recommendations for landscaping within lots. Other requirements arise from provisions for drainage and effluent disposal within the lots.

The general landscaping within lots will include:

- a minimum 2m wide landscape buffer on the primary road frontage;
- a minimum 1m wide landscape buffer on secondary road interface and side boundaries extending to the building setback line;
- one shade tree per four car parking bays;
- one tree per 10m of road frontage;
- a bioretention basin to hold the 1-year ARI 1-year storm, typically measuring about 2.7% of the total area of the lot;
- an effluent disposal area (probably ATU irrigation area) planted with low shrubs, with size depending on the lot workforce (about 23m^2 per full-time employee); and
- other landscape plantings to a total of 10% of the area of the lot.

Plantings within lots will generally feature sedges and other ground covers, low shrubs (<2m) and widely-spaced trees in order to comply with the requirements of the Bushfire Management Plan. It is noted that the Design Guidelines' requirement for one tree every 10m of road frontage may, depending on the size of the trees, exceed the permissible canopy density for "Shrubland" under the Bushfire Management Plan. It is proposed instead to space trees 15m apart in all areas within 100m of lots.

Figure 7 shows an indicative layout of landscape plantings for a typical lot.

5.0 SPECIES SELECTION AND PLANTING DENSITY

Species to be planted in the project area will be local native species, with species for specific areas selected for their height and inundation and/or drought tolerance. Recommended species for each situation are listed below:

5.1 Public Open Space

- Two areas around northern creekline and on mid-western boundary.
- Total planting area approx. 17.5ha.
- Areas within 100m of lots planted with sedges (in creekline), low shrubs (<2m) and trees (15m spacing) – "Shrubland" classification.
- Areas more than 100m from lots may be planted with larger shrubs and closer spaced trees – "Woodland" classification.
- Retain existing native trees.

Sedges & Herbs

- Planting density - In creekline: 10,000/ha (1m spacing)
  - Elsewhere: Scattered clumps of 10,000/ha; overall 2,000/ha.
- Recommended species:

Baumea articulata	*Juncus kraussii*
Baumea juncea	*Juncus pallidus*
Conostylis aculeata	*Lepidosperma longitudinale*
Dasypogon bromeliifolius	*Lyginia imberbis*
Gahnia trifida	*Patersonia occidentalis*
Hypolaena exsulca	*Phlebocarya ciliata*

Shrubs (<2m)

- Planting density 2,500/ha (2m spacing)
- Recommended species:

Acacia lasiocarpa	*Phyllanthus calycinus*
Hibbertia hypericoides	*Regelia ciliata*
Hypocalymma angustifolium	*Xanthorrhoea preissii*

Tall Shrubs (>2m) and Trees

- Planting density <50/ha (15m spacing).
- Recommended species:

Acacia saligna	*Corymbia calophylla*
Casuarina obesa	*Eucalyptus wandoo*
Viminaria juncea	*E. rudis*

5.2 Drainage Structures

- Includes in-lot bioretention basins, roadside swales, drainage easements and reserves.
- Planting area approx. 11.9ha.
- Densely planted with sedges, herbs, low shrubs and scattered small trees.
- "Shrubland" classification.

Sedges & Herbs

- Planting density 10,000/ha (1m spacing)
- Recommended species:

Baumea articulata	*Juncus kraussii*
Baumea juncea	*Juncus pallidus*
Conostylis aculeata	*Lepidosperma longitudinale*
Dasypogon bromeliifolius	*Lyginia imberbis*
Gahnia trifida	*Patersonia occidentalis*
Hypolaena exsulca	*Phlebocarya ciliata*

Shrubs (<2m)

- Planting density 2,500/ha (2m spacing)
- Recommended species:

Acacia lasiocarpa	*Phyllanthus calycinus*
Hibbertia hypericoides	*Regelia ciliata*
Hypocalymma angustifolium	*Xanthorrhoea preissii*

Tall Shrubs (>2m) and Trees

- Planting density <50/ha (15m spacing).
- Recommended species:

Acacia saligna	*Melaleuca rhaphiophylla*
Casuarina obesa	*Viminaria juncea*
Melaleuca preissiana	

5.3 Effluent Irrigation Areas

- Planting area approx. 1ha (depending on workforce on individual lots).
- Planted with dense low shrubs, sedges &herbs.
- "Shrubland" classification.

Sedges & Herbs

- Planting density 10,000/ha (1m spacing).
- Recommended species:

Hypolaena exsulca	*Lyginia imberbis*
Juncus kraussii	*Patersonia occidentalis*
Lepidosperma longitudinale	*Phlebocarya ciliata*

Low Shrubs (<2m)

- Planting density 2,500/ha (2m spacing).
- Recommended species:

Acacia lasiocarpa	*Phyllanthus calycinus*
Hibbertia hypericoides	*Regelia ciliata*
Hypocalymma angustifolium	*Xanthorrhoea preissii*

5.4 Lot Landscaping

- Planting area approx. 9.5ha.
- Includes front & side boundary landscape buffers and other plantings to total 10% of lot area.
- Planted with sedges & herbs, low shrubs and scattered trees.
- "Shrubland" classification.

Sedges & Herbs

- Planting density 2,500/ha (2m spacing).
- Recommended species:

Hypolaena exsulca	*Lyginia imberbis*
Juncus kraussii	*Patersonia occidentalis*
Lepidosperma longitudinale	*Phlebocarya ciliata*

Low Shrubs (<2m)

- Planting density 2,500/ha (2m spacing).
- Recommended species:

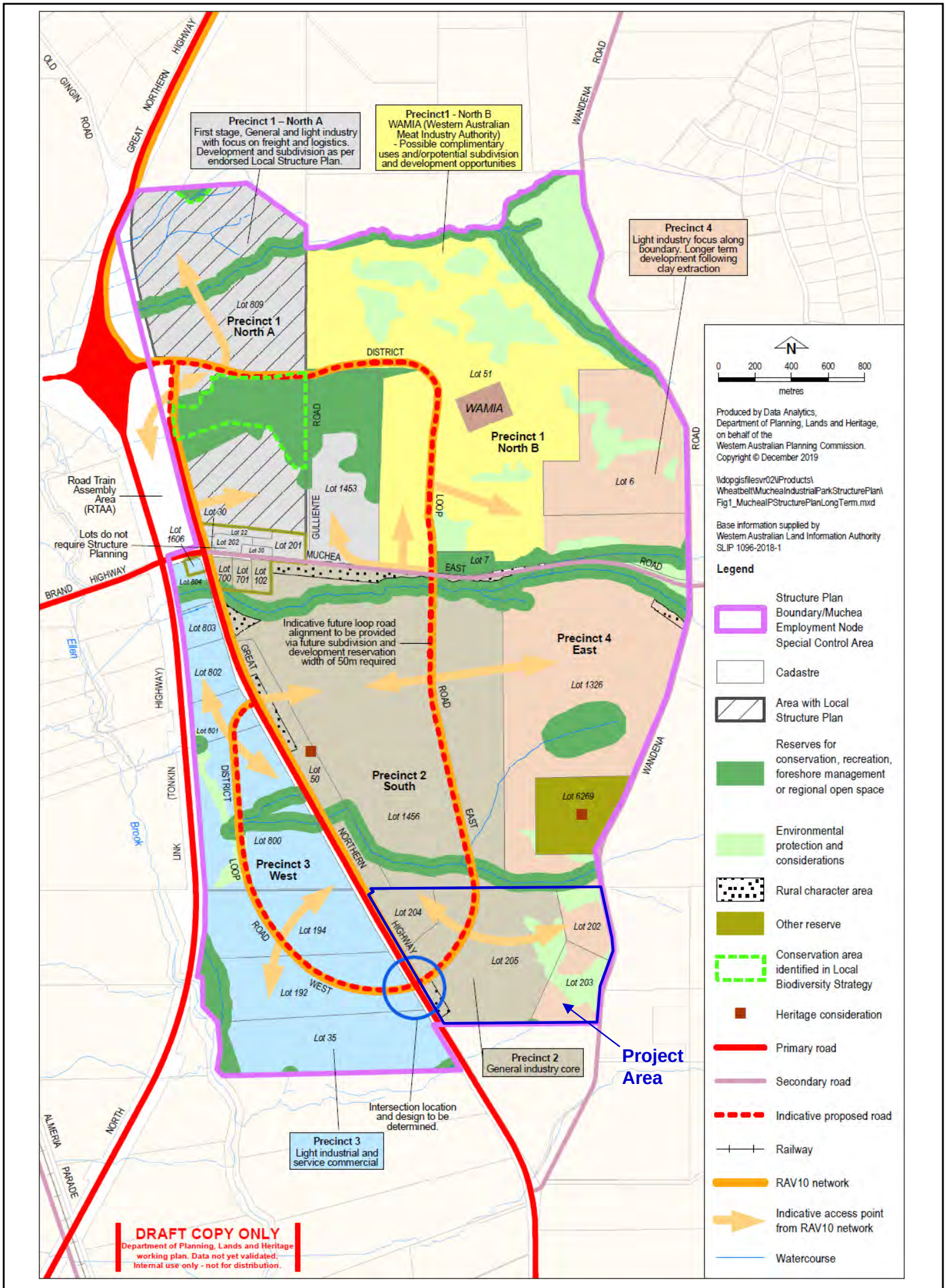
Acacia lasiocarpa	*Phyllanthus calycinus*
Hibbertia hypericoides	*Xanthorrhoea preissii*
Hypocalymma angustifolium	

Tall Shrubs (>2m) and Trees

- Planting density <50/ha (15m spacing).
- Recommended species:

Allocasuarina fraseriana	*M. teretifolia*
Casuarina obesa	*M. preissiana*
Corymbia calophylla	*M. rhaphiophylla*
Eucalyptus rudis	*Gastrolobium ebracteolatum*
E. wandoo	*Viminaria juncea*
Melaleuca incana	

Figures



Source: WAPC, 2019

Figure 1

DRAFT MUCHEA INDUSTRIAL PARK STRUCTURE PLAN

bayley environmental services

Figure 2

THE SITE AND SURROUNDINGS

Image source: Google

bayley environmental services

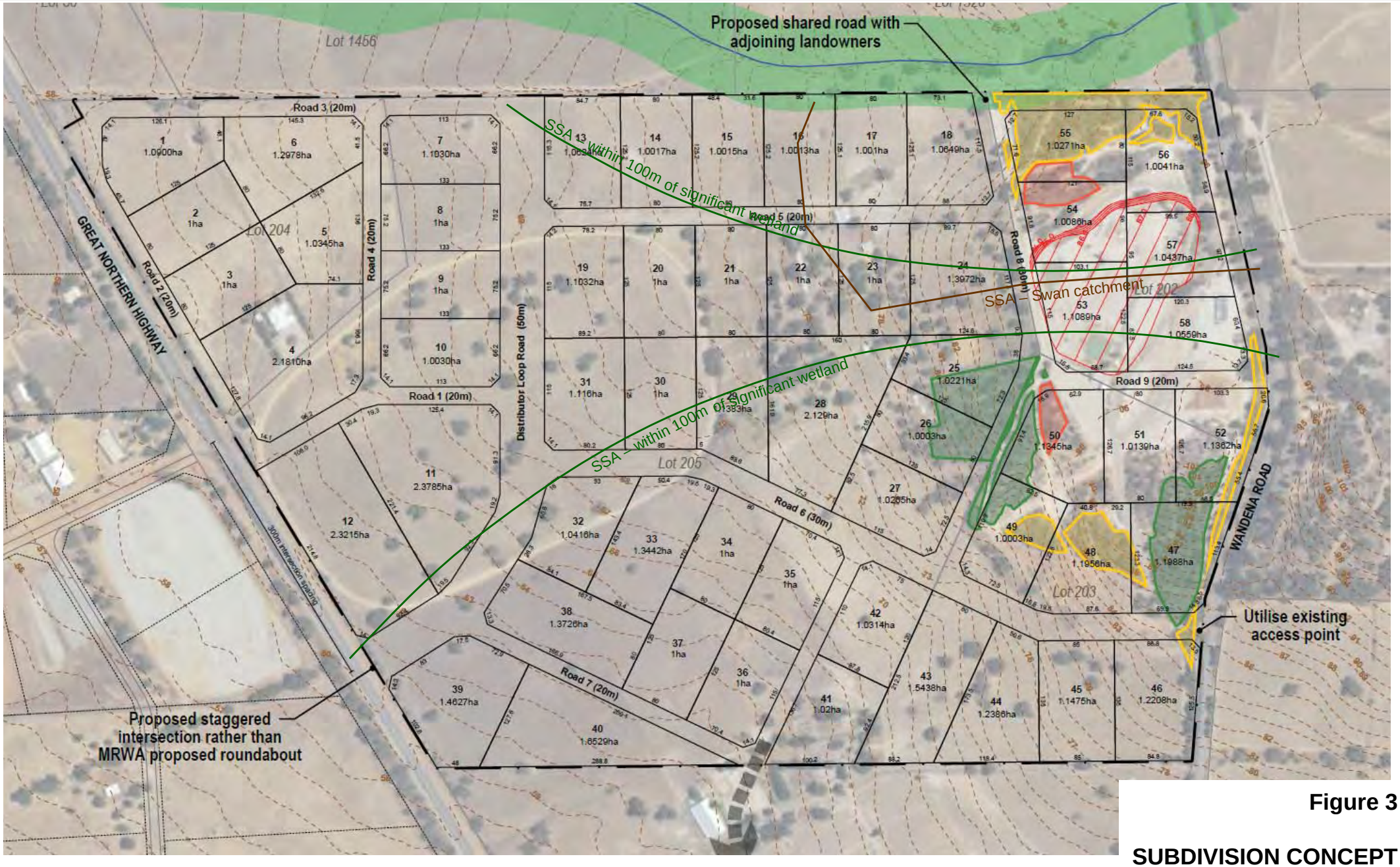


Figure 3

SUBDIVISION CONCEPT

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1 Great Northern Highway looking north-east

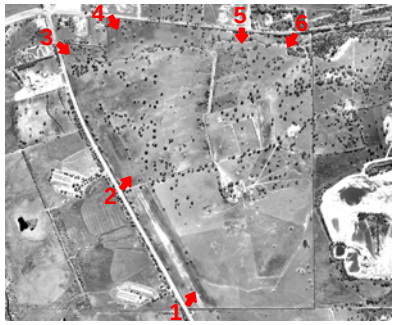
2 Great Northern Highway looking north-east

3 Great Northern Highway looking south-east

4 Muchea East Road looking south-east

5 Muchea East Road looking south

6 Muchea East Road looking south-west



Images: Google (2018)

Figure 4

VIEWS FROM GREAT NORTHERN HIGHWAY AND MUCHEA EAST ROAD

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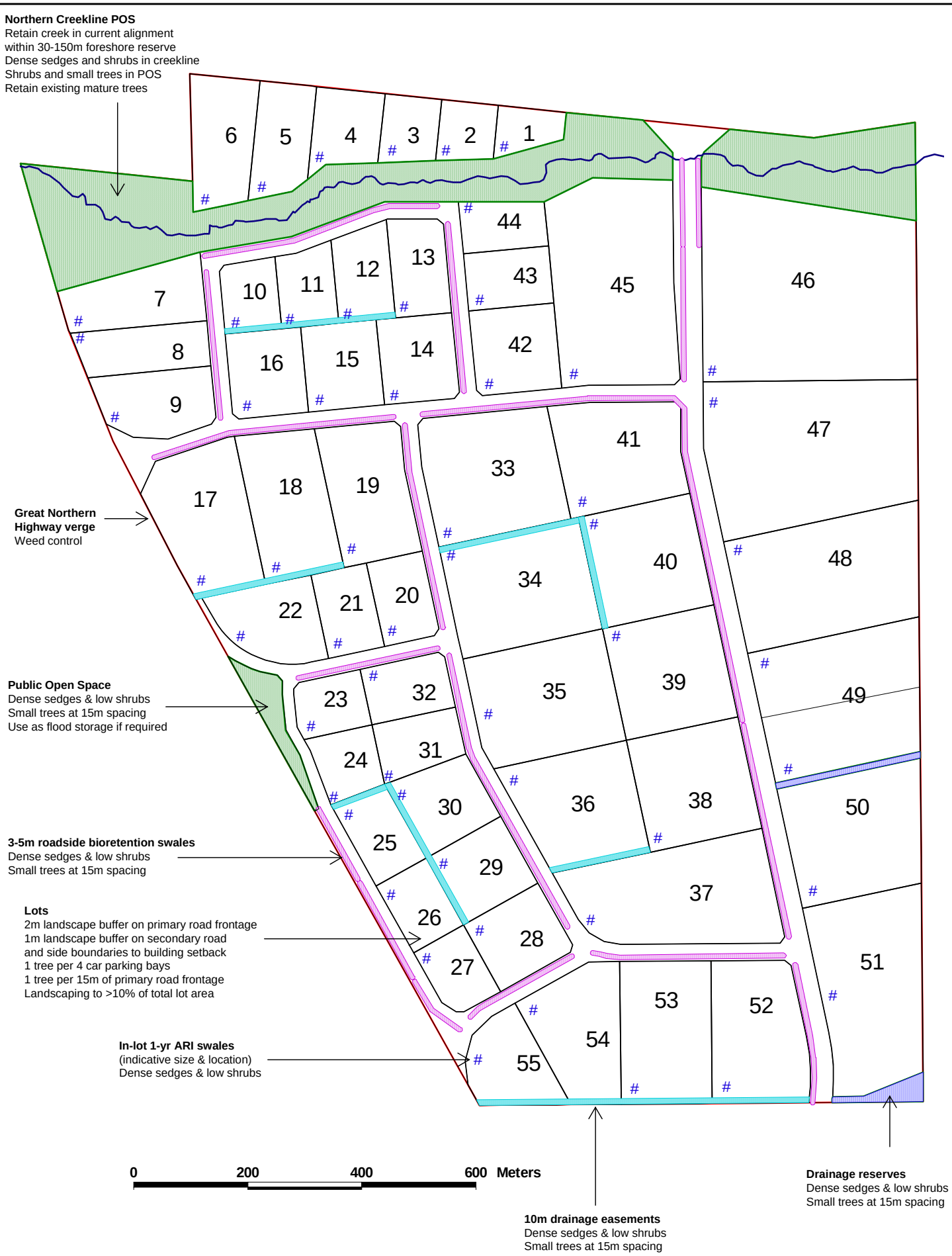

Figure 5

LANDSCAPE MASTER PLAN

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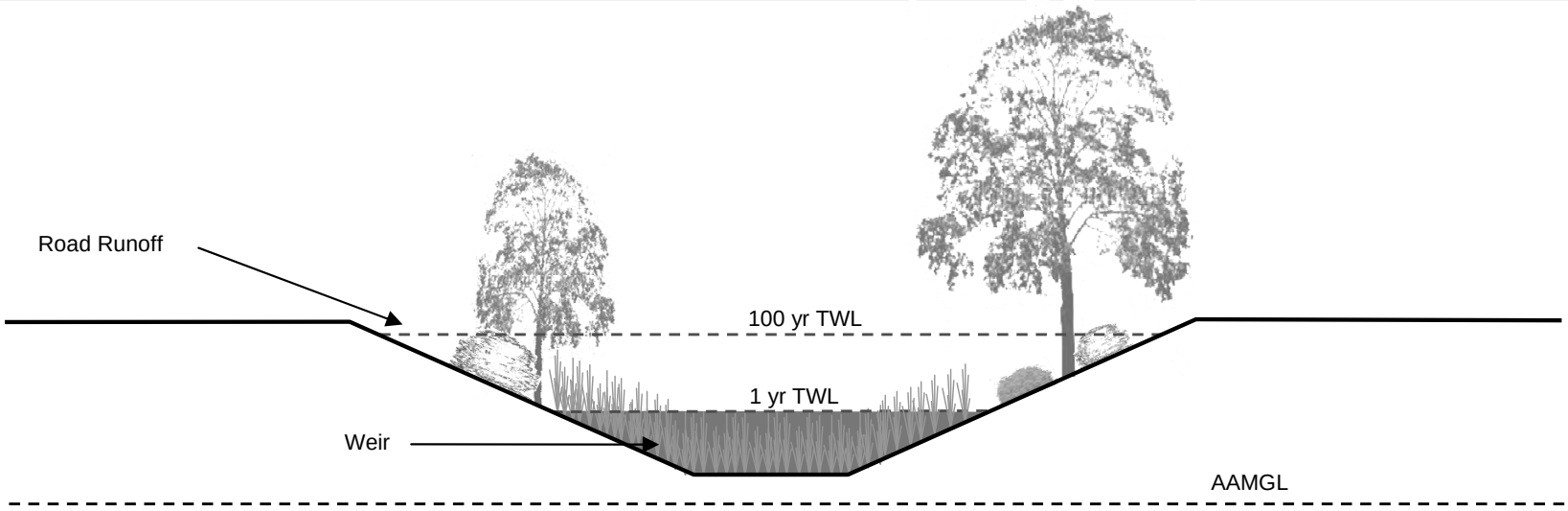

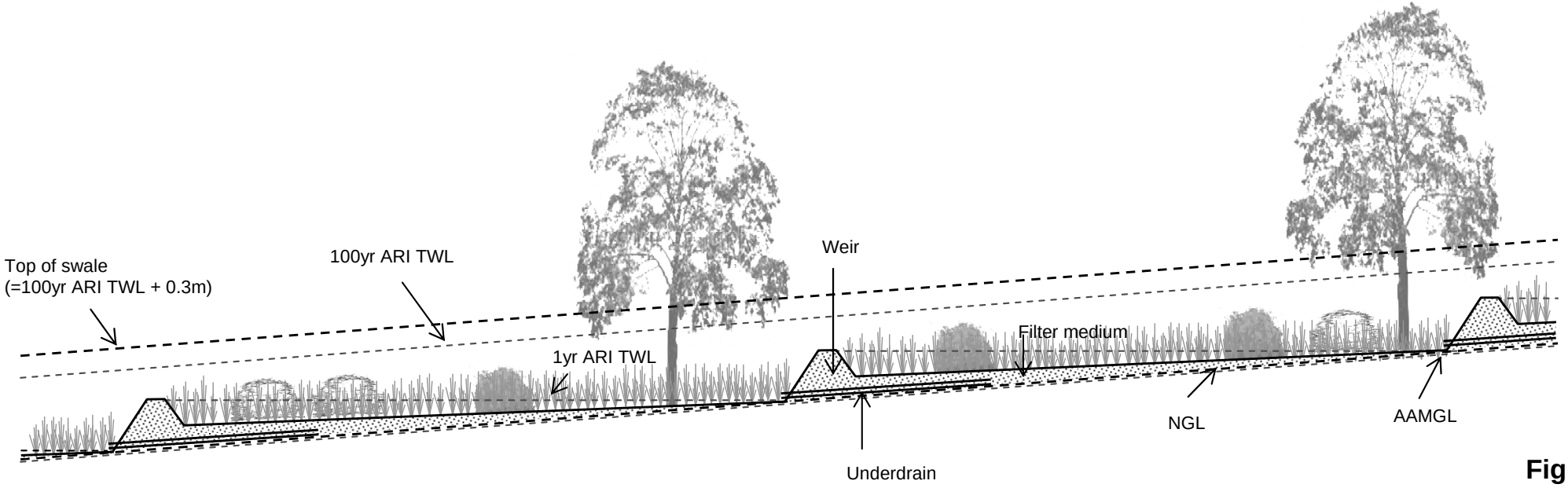

Figure 6

BIORETENTION SWALES

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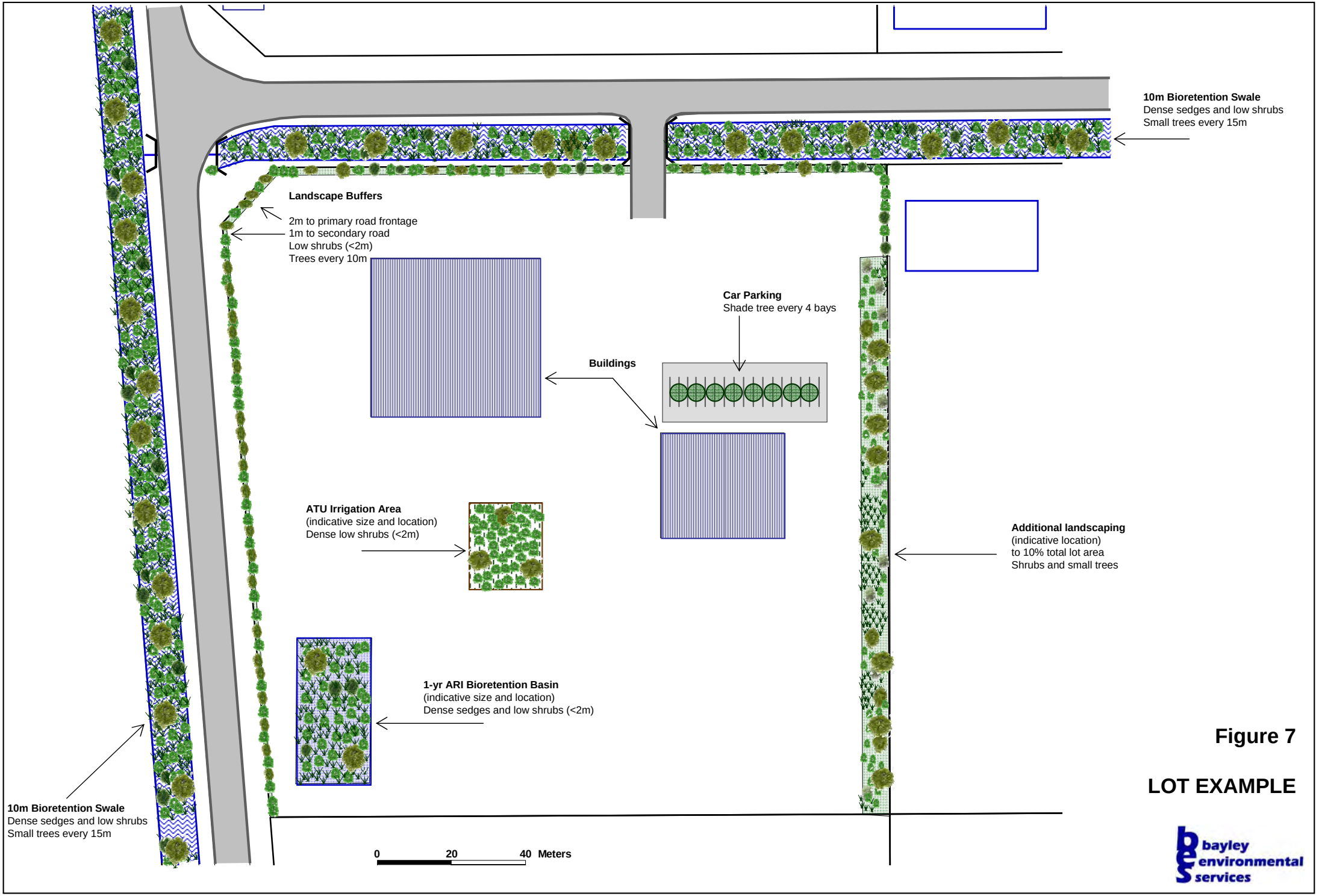

Figure 7

LOT EXAMPLE

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Appendix A

Northern Creekline Foreshore Definition

DETERMINATION OF FORESHORE SETBACK
USING THE METHODOLOGY SET OUT IN RIVER RESTORATION SERIES 16

Introduction

Foreshore reserve requirements for waterways are governed by WAPC Development Control Policy No. DC2.3: *Public Open Space in Residential Areas.* DC2.3 specifies a default foreshore reserve width of 30 metres for waterways but includes provision to vary the default setback for reasons of topography, condition of banks or floodway protection. DWER policy on foreshore setbacks is set out in Operational Policy River Restoration Series No. RR16 – *Determining Foreshore Reserves* (WRC, 2001) and Foreshore Policy 1 - *Identifying the Foreshore Area* (WRC, 2002a). These documents also set out a methodology for determining the foreshore setback in each case.

The Muchea Industrial Park Structure Plan (WA Govt, 2020) designated nominal 50m foreshore reserves on each side of the northern creekline and the middle drainage line in the south of the site. Historical Landgate aerial photography shows that the two drainage lines in the south of the site are artificial drains constructed between 1965 and 1979, as described in the EAMS (BES, 2021), and therefore do not require foreshore reserves.

The Structure Plan noted that the reserve could be modified at the Urban Water Management Plan stage in accordance with DWER *Operational Policy 4.3: Determining foreshore reserves* (DoW, 2012), *Water Note 23 – Determining Foreshore Reserves* (DoW, 2001) and *River Restoration Manual Chapter 16 – Determining foreshore reserves* (DoW, 2001).

This Foreshore Definition Study was undertaken in accordance with the above DoW policies to define the required foreshore reserve of the northern creekline.

Step 1: Background information and preliminary investigations

Waterway significance and management issues
The northern creekline is a minor tributary of Ellen Brook. The Ellen Brook catchment is the largest sub-catchment of the Swan-Canning River system, contributing 6% of the total annual flow in the system, and is the largest single contributor of nutrients to the system (WA Govt, 2011).

The creekline is a natural waterway, incised at the eastern side of the property but flatter and shallower at the western side. The creek drains an upstream surface catchment of about 360ha and an additional catchment of 250ha within the property. The depth of the creek channel is estimated at 1m in the east and 0.5m at the west, with a width of 5-10m.

The creekline within the property is set within cleared farm paddocks with scattered mature trees, mostly Marri and Wandoo. It has low habitat value in its present state.

Aerial photography
Figure 1 shows an aerial photograph of the northern creekline and its setting within the subject land.

Maps of extent of floodway and floodplains, topographical features, cadastral boundaries, soils, underlying geology and vegetation complexes.
These features are shown on Figure 2.

Relevant reports on the river and region
No previous reports have been published on the northern creekline. A number of reports have been published on Ellen Brook and its catchment, including:

- Water & Rivers Commission (1999). *Foreshore Assessment in the Ellen Brook Catchment.* Water Resource Management Series No. 16.

- WRC (2002b). *Hydrogeological Information for Management Planning in the Ellen Brook Catchment*. Salinity and Land Use Impacts Series No. SLUI 11.

- Swan River Trust (2009). *Swan Canning Water Quality Improvement Plan.*

Site Visit
Inspections of the northern creekline within the project area were carried out on several occasions between June 2017 and October 2020. The inspections included creek morphology, water sampling, surrounding vegetation and fauna habitats. Figure 3 shows photographs of the creek and its fringing vegetation.

Relevant stakeholders
The owner of the lot surrounding the creekline, Tallangatta Beef Pty Ltd, is the proponent of the structure plan and is involved in the planning of the site.

Step 2: Biophysical criteria of the waterway

Riparian vegetation
The riparian vegetation of the creekline within the property has been almost entirely removed by past clearing and grazing. What remains is mostly scattered mature Wandoo and Marri trees on the higher banks. At the eastern end a small copse of young Flooded Gum is present in a seepage zone to the south of the creekline. Apart from this there are a few scattered sedges in the lower part of the watercourse.

The condition of the fringing vegetation is Completely Degraded.

The riparian vegetation of the subject land, is mapped by Heddle *et al.* (1980) mostly as "Coonambidgee Complex: Low open-forest and low woodland of pricklybark-banksia … to open woodland of marri-banksia". The western end of the creekline is mapped as "Yanga Complex: Low open-forest of *Casuarina obesa*, *Actinostrobus* (now *Callitris*) *pyramidalis, Melaleuca* spp. (including *M. lateritia, M. hamulosa*, *M. preissiana and M. rhaphiophylla*) and *Eucalyptus rudis* in the lower-lying areas." The eastern end of the creekline is mapped as "Reagan Complex: Low open-woodland of banksia-pricklybark to closed-heath, depending on the depth of soil."

The Yanga Complex has been moderately heavily cleared since European settlement, with 17.75% of its original extent remaining and less than 2% formally protected. The Reagan and Coonambidgee Complexes are well represented, with 34% and 46% respectively of their pre-European extent remaining. The proportion held in reserves is 10.3% for the Coonambidgee Complex but only 3.8% for the Reagan Complex.

Soils that support riparian vegetation

The Geological Survey of Western Australia (GSWA, 1978) maps the creekline and its and surrounds within the property as Qpa: Guildford Formation, with soils of pebbly silt (Mgs_1). Upstream of the property the soils are mapped as Leederville Formation siltstone (ST_1) and colluvial sand (S_6). This soil mapping is supported by visual evidence in the eroded creek bed.

Floodway and floodplain – 1 in 100 yr flood levels, peak flow and river hydrology

Flows in the creekline are normally confined to the incised channel of the creek, although high flows may cause inundation of adjacent towards the western end.

Table 1 summarises estimated 100-year ARI (average recurrence interval) flows under current conditions in the northern creekline, calculated using the Rational Method (Institute of Engineers Australia, 1987) assuming a runoff coefficient of 0.3. The table also shows estimated water depths, widths and flow velocities in the creekline at the upstream, mid-point and downstream ends of the site, calculated with Manning's open channel flow formula (Fang, 2002), using a roughness coefficient (Manning's *n*) of 0.03.

Table 1 100-year ARI Flows in Northern Creekline

Upstream Catchment (ha)		360
100-yr ARI Flow (m^3/sec)		7.04
Water Depth (m)	*Upstream*	0.7
	Mid-point	0.8
	Downstream	0.4
Top Water Width (m)	*Upstream*	4.6
	Mid-point	6.9
	Downstream	28
Flow Velocity (m/sec)	*Upstream*	3.5
	Mid-point	2.0
	Downstream	1.1

The flow calculations in Table 1 suggest that the northern creek is likely to overtop its banks at its western end during a 100-year storm, creating flooding to about 15m each side of the creek. The eastern part of the creek appears unlikely to overtop in a 100-year storm.

The calculations shown in Table 1 are preliminary and based on desktop estimates of channel morphology and catchment characteristics. They should not be used for design purposes.

Soil types prone to erosion

The creek channel appears stable to date, with little evidence of undercutting or erosion on bends. The base of the channel consists largely of rock (laterite or hardpan) and gravel, suggesting that further incision or erosion of the channel would be slow under normal conditions. The soils surrounding the creek channel are similar to those forming the channel, and would be similarly slow to erode.

Landgate aerial photography since 1965 shows no discernible change in the alignment of the watercourse. Table 1 above predicts that the flow velocity in the eastern part of the creek is relatively high and may cause scouring of the creek bed in a 100-year storm. Given that a storm of this size may not have occurred since the creekline and its catchment were cleared for farming, such an event may alter the shape of the watercourse. Some protection works such as revegetation, riffling and barriers may be necessary to reduce the risk of this occurring. However, given the relatively steep topography in the vicinity of the creekline, any scouring is likely to result in minor straightening of the watercourse rather than any major change in its alignment.

Landforms and drainage lines important to watercourse function

The bed of the creekline falls from an elevation of about 80m AHD at the eastern property boundary crossing to 53m AHD at the western boundary, at a gradient of about 1 in 60 (1.6%). For most of its length within the site the brook is contained within moderately steep (approx. 40% slope) banks about 3m high. At the western end the banks are much shallower, with the bed only about 0.5m deep within flat paddocks.

Habitat areas

The vegetation in and around the creekline within the property has been cleared apart from scattered mature trees. As a result the creek offers little useful fauna habitat apart from a seasonal water source. Some of the remaining mature trees in the paddocks near the creek contain hollows Brook are a few isolated large flooded gums containing small hollows that might provide nesting sites for birds. A detailed hollow survey in October 2020 found five confirmed hollows, two of which were occupied by nesting corellas and Australian kestrels.

Kangaroos were observed in the paddocks near the creek. There is no cover within the property, so these were probably moving into the site to feed from vegetated areas to the east. There is no dense ground cover to provide habitat for quenda, and no evidence of quenda was observed.

Adjacent land use with potential to affect the foreshore
The current grazing land use on the subject land has had significant impacts on the creekline, including clearing of fringing vegetation, trampling and bank erosion. Cattle have historically had access to the creek, which has resulted in bank erosion, grazing of native vegetation, trampling and spread of weeds.

Development of the subject land as planned will benefit the creekline by removing the impact of cattle and enabling the re-establishment of native vegetation.

Aboriginal Heritage Sites
The DPLH has advised that the gazetted boundary of one Aboriginal heritage site, DAA 3525: Ellenbrook-Upper Swan, intersects the northern end of the Tallangatta property. Another registered site, DAA 20008: Gingin Brook Waugal Site, is mapped over part of Tallangatta but the gazetted boundary does not impinge on the project area. The results of the database search and the DPLH advice are attached in Appendix A1.

Under Section 18 of the *Aboriginal Heritage Act 1972*, permission from the Minister for Aboriginal Affairs is required for any disturbance of a registered Aboriginal site. An application under Section 18 will be required before any ground-disturbing development work is undertaken in the gazetted area. Planting and revegetation work within the creekline POS is not expected to require any approval under the Act.

Step 3: Other factors

Fire Management
The vegetation in the foreshore zone presents a low to moderate fire hazard due to the absence of understorey and middle storey vegetation. With the removal of cattle grazing there could be heavy growth of grasses and weeds, which could pose a high fire risk unless it were managed. Therefore, weed control, mowing of grasses and/or replacement with native low understorey species will be required to manage the fire hazard.

Risks and consequences resulting from the proposed foreshore alignment
The principal consequence of establishing a foreshore setback in this location will be the opportunity to undertake rehabilitation of the foreshore. This will improve the ecological value of the foreshore as well as providing increased social amenity.

The main risk in the proposed alignment is the possibility of flooding above the modelled 100 year flood level. However, the POS reserve at the western end, where overtopping is most likely to occur, extends, almost three times further from the creek than the predicted extent of flooding. Additionally, the affected area is also subject to shallow groundwater, which will necessitate filling of lots to provide clearance for buildings and effluent disposal. This will raise buildings and other structures out of reach of any floodwaters.

Step 4: Finalisation of the alignment

Rationale for the alignment
The key factors in the delineation of the foreshore setback are:

- Compliance with policy - The WAPC's Development Control Policy 2.3 specifies a default minimum setback of 30m from waterways. The proposed foreshore reserve extends between 30m and 150m from the creek.

- 100 year extent - The proposed foreshore reserve extends nearly three times the width of predicted inundation in a 100-year ARI storm.

- Vegetation - The creek surrounds support only scattered remnant trees. The densest concentrations of these are included within the foreshore reserve.

- Shoreline processes - The proposed foreshore reserve is more than sufficiently wide to accommodate any foreseeable variations in the alignment of the watercourse.

- Fire protection - Fire protection will be achieved by a combination of separation from the edge the foreshore reserve and control of revegetation height and density in the part of the foreshore reserve closest to development areas. The zoning of vegetation plantings within the foreshore reserve is shown on Figure 4. A detailed treatment of fire hazard and fire protection measures is presented in the Bushfire Management Plan (Appendix _ to the Structure Plan report).

- Aboriginal heritage - The registered Aboriginal mythological site no. 3525 impinges on the north-western corner of the project area, including the western part of the creekline and POS reserve. Establishment of the POS reserve will protect the part of the heritage site within its boundaries. Any earthworks outside of the POS area and within the registered site will require approval under Section 18 of the *Aboriginal Heritage Act 1945.*

Map of Foreshore Setback
Figure 4 shows the proposed boundary of the foreshore reserve.

FORESHORE TENURE AND MANAGEMENT

The creekline and foreshore within the subject land are currently privately owned and zoned Agricultural Resource under the Shire of Chittering Town Planning Scheme (TPS). With the subdivision of the subject land, the river and foreshore reserve are expected to be ceded as Public Open Space to the Shire and rezoned accordingly.

The owners of the foreshore at the time of subdivision will manage the foreshore reserve for at least two years after the completion of subdivision adjacent to the reserve and revegetation works in the reserve. After two years the foreshore reserve will be handed over to the Shire of Chittering to be managed primarily for conservation.

REFERENCES

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Gozzard J.R. (1982). *Muchea Sheet 2034 I and part 2134 IV, Perth Metropolitan Region.* Environmental Geology Series. Geological Survey of Western Australia, Perth.

Heddle E.M., Loneragan O.W. & Havel J.J. (1980). Vegetation Complexes of the Darling System, Western Australia. In: *Atlas of Natural Resources Darling System, Western Australia*. Department of Conservation and Environment, Perth.

Institute of Engineers, Australia (1987). *Australian Rainfall and Runoff: A Guide to Flood Estimation.* Institute of Engineers, Australia, Barton, ACT.

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WRC (2002b). *Hydrogeological Information for Management Planning in the Ellen Brook Catchment*. Salinity and Land Use Impacts Series No. SLUI 11. Water & Rivers Commission, Perth.

Figures

Figure 1

AERIAL VIEW

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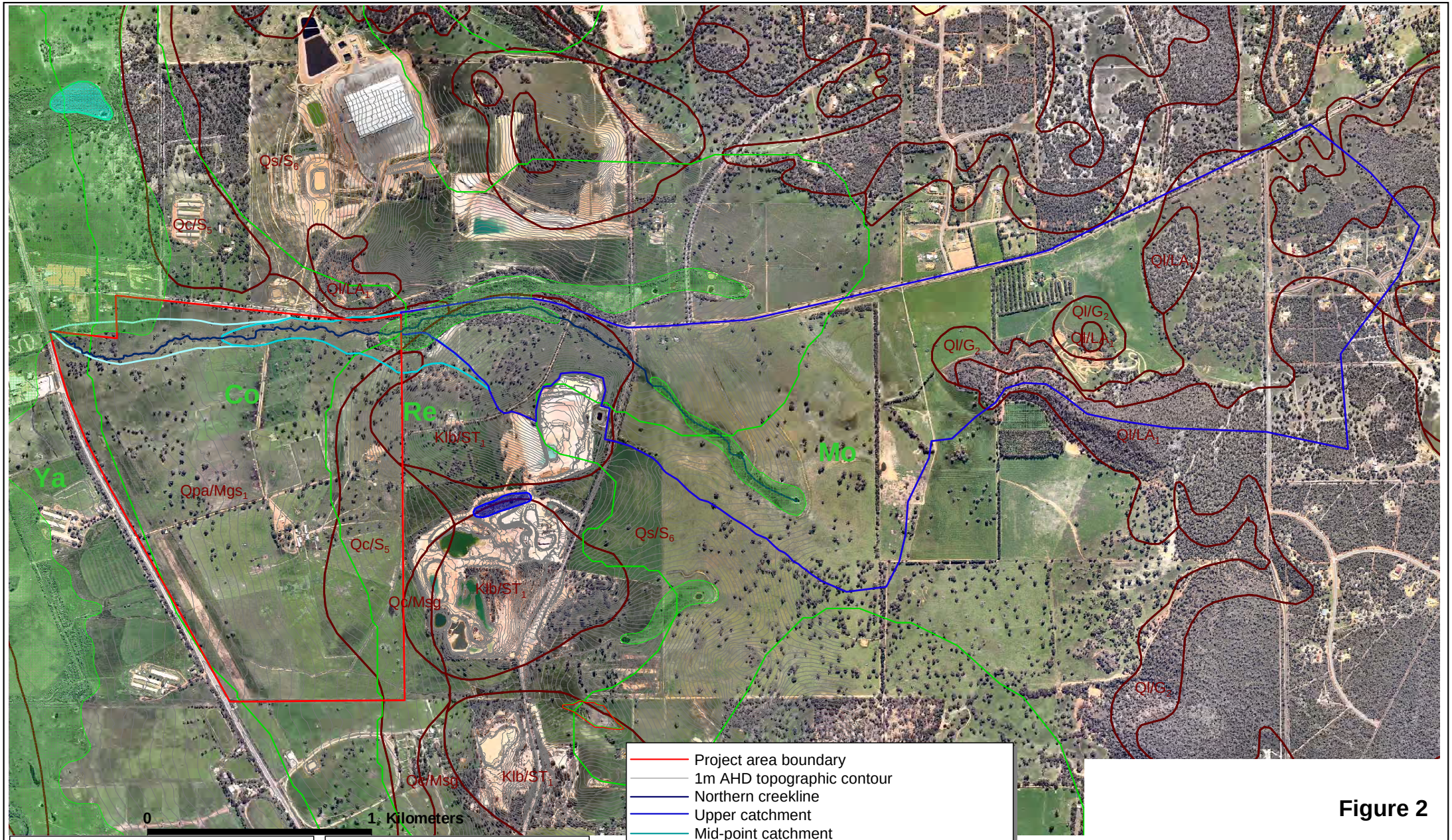

Geological Units (GSWA)

Qpa/Mgs_1	Guildford Formation pebbly silt
Klb/ST_1	Leederville Formation siltstone
Qc/S_5	Colluvial sand
Qs/S_6	Colluvial sand
Qc/Msg	Colluvial sandy silt
Ql/G_2	Lateritic gravel
Ql/LA_1	Laterite

Vegetation Complexes (Heddle *et al.*)

Ya	Yanga
Co	Coonambidgee
Re	Reagan
Mo	Mogumber

- Project area boundary
- 1m AHD topographic contour
- Northern creekline
- Upper catchment
- Mid-point catchment
- Lower catchment
- Wetlands (DBCA)
  - Conservation
  - Resource Enhancement
  - Multiple Use
- Geological unit boundary (GSWA)
- Vegetation complex boundary (Heddle *et al.*)

Figure 2

ENVIRONMENTAL FEATURES

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1 Western end of creek at exit from site

2 Lower middle creekline

3 Upper middle creekline

4 Eastern end of creek near entrance to site

Figure 3

VIEWS FROM GREAT NORTHERN HIGHWAY AND MUCHEA EAST ROAD

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Property boundary
Lot boundaries
Foreshore Reserve/POS boundary
Planting Zones (see Landscape Master Plan)
<100 from lots: “Shrubland” planting
>100 from lots: Unrestricted planting

Figure 4

FORESHORE RESERVE

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Appendix A1

Aboriginal Heritage Sites Report and DPLH Advice

Search Criteria

2 Registered Aboriginal Sites in Coordinates search area; 404797.00mE, 6505844.00mN z50 (MGA94) : 405094.00mE, 6505817.00mN z50 (MGA94) : 405094.00mE, 6506005.00mN z50 (MGA94) : 406180.00mE, 6505893.00mN z50 (MGA94) : 406368.00mE, 6505923.00mN z50 (MGA94) : 406376.00mE, 6504206.00mN z50 (MGA94) : 405598.00mE, 6504197.00mN z50 (MGA94) : 404958.00mE, 6505368.00mN z50 (MGA94)

Disclaimer

The *Aboriginal Heritage Act 1972* preserves all Aboriginal sites in Western Australia whether or not they are registered. Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist.

The information provided is made available in good faith and is predominately based on the information provided to the Department of Aboriginal Affairs by third parties. The information is provided solely on the basis that readers will be responsible for making their own assessment as to the accuracy of the information. If you find any errors or omissions in our records, including our maps, it would be appreciated if you email the details to the Department at heritageenquiries@daa.wa.gov.au and we will make every effort to rectify it as soon as possible.

South West Settlement ILUA Disclaimer

Your heritage enquiry is on land **within or adjacent to** the following Indigenous Land Use Agreement(s): Whadjuk People ILUA

On 8 June 2015, six identical Indigenous Land Use Agreements (ILUAs) were executed across the South West by the Western Australian Government and, respectively, the Yued, Whadjuk People, Gnaala Karla Booja, Ballardong People, South West Boojarah #2 and Wagyl Kaip & Southern Noongar groups, and the South West Aboriginal Land and Sea Council (SWALSC).

The ILUAs bind the parties (including 'the State', which encompasses all State Government Departments and certain State Government agencies) to enter into a Noongar Standard Heritage Agreement (NSHA) when conducting Aboriginal Heritage Surveys in the ILUA areas, unless they have an existing heritage agreement. It is also intended that other State agencies and instrumentalities enter into the NSHA when conducting Aboriginal Heritage Surveys in the ILUA areas. It is recommended a NSHA is entered into, and an 'Activity Notice' issued under the NSHA, if there is a risk that an activity will 'impact' (i.e. by excavating, damaging, destroying or altering in any way) an Aboriginal heritage site. The Aboriginal Heritage Due Diligence Guidelines, which are referenced by the NSHA, provide guidance on how to assess the potential risk to Aboriginal heritage.

Likewise, from 8 June 2015 the Department of Mines and Petroleum (DMP) in granting Mineral, Petroleum and related Access Authority tenures within the South West Settlement ILUA areas, will place a condition on these tenures requiring a heritage agreement or a NSHA before any rights can be exercised.

If you are a State Government Department, Agency or Instrumentality, or have a heritage condition placed on your mineral or petroleum title by DMP, you should seek advice as to the requirement to use the NSHA for your proposed activity. The full ILUA documents, maps of the ILUA areas and the NSHA template can be found at https://www.dpc.wa.gov.au/lantu/Claims/Pages/SouthWestSettlement.aspx.

Further advice can also be sought from the Department of Aboriginal Affairs (DAA) at heritageenquiries@daa.wa.gov.au.

Coordinate Accuracy
Accuracy is shown as a code in brackets following the coordinates. Map coordinates (Latitude/Longitude and Easting/Northing) are based on the GDA 94 Datum. The Easting/Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '500000mE:Z50' means Easting=500000, Zone=50.

Terminology (NB that some terminology has varied over the life of the legislation)
Place ID/Site ID: This a unique ID assigned by the Department of Aboriginal Affairs to the place
Status:
- **Registered Site**: The place has been assessed as meeting Section 5 of the *Aboriginal Heritage Act 1972*
- **Other Heritage Place which includes:**
  - **Stored Data / Not a Site:** The place has been assessed as not meeting Section 5 of the *Aboriginal Heritage Act 1972*
  - **Lodged:** Information has been received in relation to the place, but an assessment has not been completed at this stage to determine if it meets Section 5 of the *Aboriginal Heritage Act 1972*

Status Reason: e.g. Exclusion - Relates to a portion of an Aboriginal site or heritage place as assessed by the Aboriginal Cultural Material Committee (ACMC). e.g. such as the land subject to a section 18 notice.
Origin Place ID: Used in conjuction with Status Reason to indicate which Registered Site this Place originates from.
Access and Restrictions:
- **File Restricted = No:** Availability of information (other than boundary) that the Department of Aboriginal Affairs holds in relation to the place is not restricted in any way.
- **File Restricted = Yes:** Some of the information that the Department of Aboriginal Affairs holds in relation to the place is restricted if it is considered culturally sensitive. This information will only be made available if the Department of Aboriginal Affairs receives written approval from the informants who provided the information. Download the Request to Access Restricted Information letter and form.
- **Boundary Restricted = No:** place location is shown as accurately as the information lodged with the Registrar allows.
- **Boundary Restricted = Yes:** To preserve confidentiality the exact location and extent of the place is not displayed on the map. However, the shaded region (generally with an area of at least 4km²) provides a general indication of where the place is located. If you are a landowner and wish to find out more about the exact location of the place, please contact DAA.
- **Restrictions:**
  - **No Restrictions:** Anyone can view the information.
  - **Male Access Only:** Only males can view restricted information.
  - **Female Access Only:** Only females can view restricted information

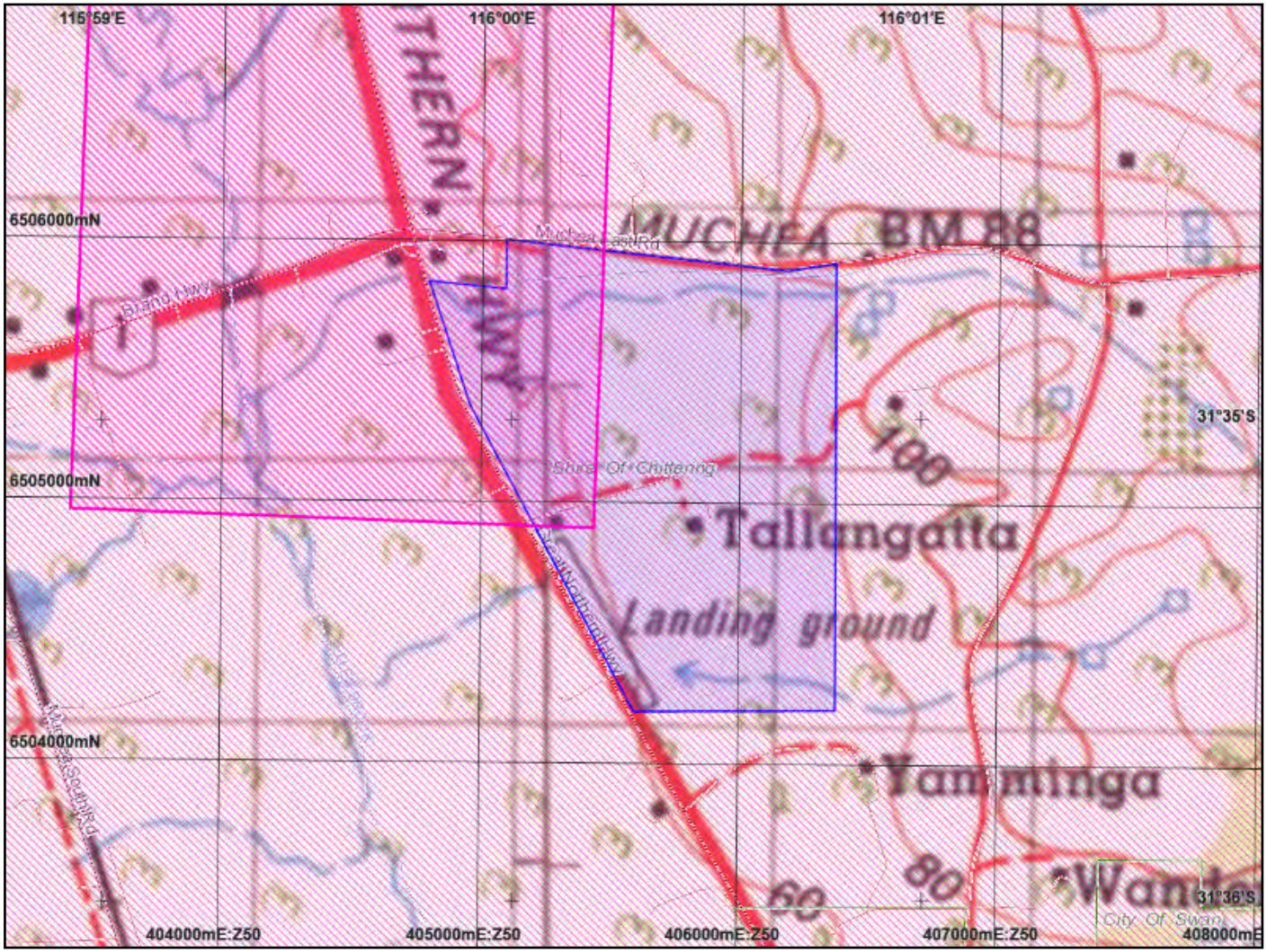
Legacy ID: This is the former unique number that the former Department of Aboriginal Sites assigned to the place. This has been replaced by the Place ID / Site ID.

List of Registered Aboriginal Sites with Map

Site ID	Site Name	File Restricted	Boundary Restricted	Restrictions	Status	Status Reason	Origin Place ID	Site Type	Knowledge Holders	Coordinates	Legacy ID
3525	ELLEN BROOK: UPPER SWAN	Yes	Yes	No Gender Restrictions	Registered Site			Mythological	*Registered Knowledge Holder names available from DAA	Not available when location is restricted	S02516
20008	Gingin Brook Waggyl Site	Yes	Yes	No Gender Restrictions	Registered Site			Historical, Mythological, Camp, Hunting Place, Plant Resource, Water Source	*Registered Knowledge Holder names available from DAA	Not available when location is restricted	

Aboriginal Heritage Inquiry System

Aboriginal Sites Database



Legend

Selected Heritage Sites

- Registered Sites
- Aboriginal Community Occupied
- Aboriginal Community Unoccupied
- Town
- Search Area

Government of **Western Australia**
Department of **Aboriginal Affairs**

ENQUIRIES: Heritage Enquiries- Ph 6551 8000

OUR REF: 2017/0048-01

Mr Phil Bayley
Bayley Environmental Services

via Email: bayley@iinet.net.au

Dear Mr Bayley

ABORIGINAL HERITAGE INQUIRY MUCHEA

Thank you for your email dated 7 April 2017 regarding Muchea East Road and Great Northern Highway, Muchea.

A review of the Register of Places and Objects as well as the Department of Aboriginal Affairs (DAA) Aboriginal Heritage Database concludes that DAA 3525 (Ellen Brook: Upper Swan) intersects within the northern portion of the study area.

Please note that while DAA 4299 (Upper Swan Bridge) and DAA 27868 (Upper Swan Lot 39 Artefact Scatter) intersects within the study area the actual boundary as administered by DAA is not within the study area and no approvals under the *Aboriginal Heritage Act 1972 (*AHA) are required.

DAA suggests that as there is a registered Aboriginal site within the study area that before any development is undertaken that contact be made to DAA with regards to whether any application under the AHA will be necessary.

If you have any questions regarding the above, please contact Heritage Enquiries on 6551 or email heritageenquiries@daa.wa.gov.au.

Yours sincerely

Tanya Butler
DIRECTOR HERITAGE OPERATIONS

12 April 2017

Ground Floor, 151 Royal Street, EAST PERTH, Western Australia, 6004
PO Box 3153, EAST PERTH, Western Australia, 6892
Telephone 1300 651 077 Facsimile (08) 6551 8088
www.daa.wa.gov.au

APPENDIX I

Geotechnical Investigation

PRELIMINARY GEOTECHNICAL INVESTIGATION

For Local Structure Plan

LOTS 50 and M1456
GREAT NORTHERN HIGHWAY
MUCHEA
WESTERN AUSTRALIA

DECEMBER 2020
Ref: 20049

FOR
Tallangatta Beef Pty Ltd
c/- iParks Property Group Pty

Brown Geotechnical

CONDITIONS RELATING TO THIS REPORT

1. This report has been prepared for the sole use of Tallangatta Beef Pty Ltd. 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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1 Introduction

In November 2020 Brown Geotechnical was commissioned by iParks Property Group on behalf of the client – Tallangatta Beef Pty Ltd to undertake a preliminary geotechnical investigation for the development of a Local Structure Plan at Lots 50 and M1456 Great Northern Highway, Muchea (the site), refer Figure 1. This report presents the results of the investigation conducted at the site. The fieldwork was carried out over the 19th and 20th November 2020. Details of the site were supplied by planners iParks Property Group Pty.

Note: It should be noted that this is a preliminary geotechnical investigation for the development of a Local Structure Plan. In portions of the site where soils are non-homogenous, or where boundaries lines are drawn on Figures, for example between zones of different soil types or site classification, additional investigation should be undertaken. The conclusions in this report are based on limited sampling and testing, and should be used as starting point for further detailed investigations as the project proceeds.

2 Brief

The brief discussed with the planners required the report to address:

- Subsurface conditions.
- An estimate of existing soil classification in accordance with AS2870 (2011).
- Any earthworks required to obtain a classification suitable for development including estimated additional fill thickness requirements.
- The presents of uncontrolled fill.
- Estimated CBR for road pavement design.
- Suitability of existing soils for use in the development.
- An assessment of acid sulphate soil issues
- Estimated site permeability and likely drainage issues.

3 Desk Studies

The site covers approximately 213ha and consists of large fenced paddocks. The paddocks are mostly grass covered with some areas of trees. A small creek runs east west across the north of the site. The depth varies from 0.5m to 1m.

The geological map for the area indicates the majority of the site to be underlain by the Guildford Formation consisting of clay, sand, silt and gravels. Quartz sand is noted in the centre and along the eastern boundary, with lateritic gravels towards the north eastern corner.

The Perth Groundwater Map indicates the historical maximum groundwater level to be about 50m AHD, approximately 8m below ground level. It is understood that pre-development groundwater monitoring is to be carried out on the site by others.

The acid sulphate soil risk map for the area, indicates soils to be in the No Known Risk category.

The site rises eastwards from approx. 50m along the Great Northern Highway to 93m AHD in the north east. Some steeper slopes rise in the north east, likely associated with the outcropping laterite deposits noted on the geological map.

4 Fieldwork and Laboratory Testing

4.1 Scope of Work

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

- A desk study to determine likely soil types below the site.
- Follow-up fieldwork including a walk-over survey to determine any obvious geological features, hazards and ASS indicators.
- Test holes excavated at approximate 200m centres to confirm soil type identified in the desk study. Some areas allowed limited access, however enough information was collected for the preliminary report.
- Limited soil sampling was carried out for laboratory analysis to determine soil classification and geotechnical properties.
- Laboratory testing included: particle size distribution, Atterberg Limits, percent fines content and organic content.
- In the absence of any high-risk ASS indicators, no preliminary acid sulphate soil testing was required as initially indicated in the proposal.
- Organic content determination was carried out for potential blending ratios of topsoil with clean sand fill for use in the future development.
- Permeability testing was carried out typical soil types encountered for site drainage information.

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

4.2 Laboratory Testing

Soil samples were delivered to the NATA accredited Western Geotechnical Laboratory Services 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 and inferred from laboratory test results and PSP plots are described as follows:

5.1.1 Topsoil and Fill

Test holes encountered topsoil consisting of grey silty sand with organics, locally with rootlets. The topsoil varied in thickness from 0.1m to 0.15m, the average across the site being 0.1m.

No uncontrolled fill was encountered in test holes and there were no obvious signs of old structures, foundations or infill areas within the paddocks.

5.1.2 Sand with Silt

Fine to medium grained, sand with low to moderate silt content was encountered in all test holes below the topsoil in the central and north western portion of the site (refer Figure 2). Penetrometer tests show the material to be medium dense. The thickness varied from approximately 0.3m to 0.5m.

The sand extends to greater depths in the north eastern portion of the site, locally >2m and at one locality on the western boundary (refer Figure 2).

5.1.3 Sandy Gravel

Fine to medium grained, gravel with sand was encountered in all test holes below the topsoil in the southern portion of the site (refer Figure 2). Penetrometer tests show the material to be medium dense to dense. The thickness varied from approximately 0.1m to 0.55m.

5.1.4 Laterite (Cemented Sandy Gravel)

A very dense, often cemented, sandy gravel or Laterite was encountered at the surface in TH15 and TH16 on the eastern boundary. The excavator refused in the material at about 0.6m.

5.1.5 Gravelly Sand with Clay

Very dense, fine to medium grained sandy gravel with clay was encountered below the silty sand and sandy gravel areas of the site. The material was occasionally present at the surface in the center of the site in the vicinity of TH7, 11 and 12. Test results show the material to have a moderate fines content, intermediate to low plasticity with a low expansive nature. The material often became hard after about 1m due to pockets of iron rich cementation resulting in slow excavation and often caused refusal of the 5 tonne excavator.

5.1.6 Groundwater

No groundwater was not encountered in test holes. The Perth Groundwater Map indicates the historical maximum groundwater levels to be about 50m AHD, approximately 8m below ground level.

5.2 Laboratory Test Results

Laboratory test results are summarized in Table 1

Table 1 – Classification Test Results

Test Hole No.	Depth (m)	LL (%)	PL (%)	PI (%)	Particle Size Distribution			Organic (%)
					Fines (%)	Sand (%)	Gravel(%)	
TH01	0.2-0.5	NP	NP	NP	13	79	8	
TH06	1.5-2.0	31	13	21	27			
TH14	0.1							5.8
TH14	1.0-1.5	NP	NP	NP	22	71	7	
TH19	0.3-0.8				4	26	70	
TH19	1.0-1.5	28	14	14	19			
TH21	1.5-1.9	35	16	19	24			
TH29	0.1-0.5	NP	NP	NP	5	27	68	
TH29	0.5-1.1	23	17	6				
TH37	1.2-1.6	31	14	17	21			

*Non-plastic

5.3 Soil Permeability

Permeability test results are summarized in Table 2.

Table 2 – Permeability Test Results

Test Location	Testing Material	In-situ Permeability Test Result (m/s)	Drainage Characteristics
P1 (TH12)	Very dense gravelly sand with clay	*$1x10^{-9}$m/s	Poor
P2 (TH01)	Medium dense sand with silt	$5x10^{-4}$m/s	Moderate to Good
P3 (TH19)	Medium dense sandy gravel with silt	$6x10^{-4}$m/s	Moderate to Good

*Estimated: Minimal Soakage

6 Analysis and Conclusions

6.1 Subsurface Conditions (refer Figure 2)

The topsoil has an average thickness of 0.1m. Once the grass and roots are removed the topsoil will be relatively low in organic content. Testing a typical sample gave an organic content of 5.8%. It should be suitable for use as engineering fill when screened and blended with clean sand fill at a ratio of approximately 1:3 (screened topsoil : clean sand). Further testing following screening could bring the ratio down to 1:2 or 1:1 for some portions of the site.

Below the topsoil, much of the site is covered by 0.3-0.5m of granular soils with a moderate silt content (sand and gravels). These soils are non-cohesive, relatively free draining with moderate to good drainage characteristics.

These sand and gravels are underlain by a clayey subgrade across the majority of the site, except for the north east area. The soil is a very dense gravel with clay. The clayey subgrade extends to at least 2.0m. The soils have a moderate to low plastic fines content, an intermediate to low plasticity and a low expansive nature. The drainage in the clayey soil is poor. The material often becomes hard with iron cementation below about 1m which caused refusal of the 5 tonne excavator in most holes.

The north eastern area consists of deeper sands, with hard lateritic soils on the eastern boundary which caused refusal of the 5 tonne excavator close to the surface.

No uncontrolled fill was encountered in test holes.

With respect to the desk study and geological information obtained prior to the fieldwork, it appears that the sands discussed are not as extensive as anticipated, confined only to the north east area. The remainder of the site is underlain by the Guildford Formation as suggested, with the laterite deposits to the east.

6.2 Groundwater

No groundwater was not encountered in test holes. The Perth Groundwater Map indicates the historical maximum groundwater levels to be about 50m AHD, approximately 8m below ground level. It is likely that in times of heavy rainfall, the granular soils above of the clayey subgrade will saturate resulting in a perched water table. The soils would then likely drain towards the creek; or the deeper sand deposits from the raised lateritic area.

6.3 Site Classification and Fill Requirements

Based on this preliminary geotechnical investigation, test hole spacing and limited testing, the classification for the site in accordance with AS 2870 – 2011 can be divided in to two classes. The portion underlain by a clayey subgrade with moderate to low plastic fines content, low plasticity and low expansive nature has an existing classification of Class ‘S’. The portion underlain by deeper sand and laterite has an existing classification of Class ‘A’ (refer Figure 2 and Table 3).

To obtain a site classification of Class 'A' in all areas, additional sand fill will be required. A total of 1.8m of granular material will be required above the clayey subgrade. The approximate thickness of additional fill varies from 0.2m to 1.8m and is shown on Figure 2.

Further investigation will be required to determine the exact boundaries between the site classification zones for specific Lots, and the amount of sand fill required could vary.

Table 3 – 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”. This section should act as a guide to likely earthwork requirements for the site, pending a detailed investigation.

6.4.2 Topsoil and Fill Management

A thin layer of topsoil is present across the site. It is not suitable for foundation support and should be removed along with trees and roots then replaced with clean sand fill. The topsoil may be used in landscaping following the removal of any tree roots, unless screened and blended as described below. A geotechnical inspection will be required to confirm topsoil stripping.

6.4.1 Blending of Topsoil for use as Engineering Fill

Topsoil in most areas of the site appears to be of lower quality i.e. lower in organic and fines content. An option would be to blend the screened topsoil with clean sand fill to reduce the organic and fines content to acceptable levels for use in residential or commercial development. Limited testing on non-screened topsoil, but with grass and roots removed, suggest a ratio of approximately 1:3 (screened topsoil : clean sand) to be appropriate. Further testing following screening could bring the ration down to 1:2 or 1:1 for portions of the site.

Ongoing tests for organic and fines content would be required post screening and on the blended soil to confirm suitability for use in the development.

6.4.2 Proof Rolling

Following the removal of topsoil, prior to footing placement or placing any additional fill on site, the surface should be proof rolled to achieve at least 95% SMDD for residential and 98% SMDD for commercial developments.

6.4.3 Imported Fill Material

Any sand fill imported to obtain site formation levels should be compacted in layers not more than 300mm thick to at least 95% SMDD for residential and 98% SMDD for commercial developments. In-situ density tests should be carried out to calibrate a PSP to specific densities of the compacted material to check fill compaction. 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 maintain good drainage conditions.

Following excavation for foundations, the bases of pad and strip footings should also be compacted to achieve at least 95% SMDD for residential and 98% SMDD for commercial developments.

6.4.4 Earthwork Inspections

A geotechnical engineer should inspect the site following the removal of vegetation, trees, roots and unsuitable materials, and to confirm the compaction of the subsurface following proof rolling. Inspections and auditing of the earthworks should be carried out by the geotechnical engineer to enable confirmation of the final site classification.

6.5 Suitability of In-situ Soils as Engineering Fill

The majority of the in-situ sands, particularly in the central and north area, contain a moderate fines content but zero plasticity. The soils will be suitable for use as engineering fill in the future development but have a reduced permeability due to the raised silt content. Blending with clean sand fill would reduce the fines content and increase drainage potential.

The sandy gravel with clay could also be blended with clean sand to reduce the fines. The material may be appropriate as a base layer above the existing clayey subgrade if major earthworks are required and removal of the existing granular soils is necessary.

6.6 Design CBR

Assuming the subgrade material below the road pavement or car park areas will be the natural in-situ near surface sand, a design CBR of 20 is suitable pavement design. Pavements founded on the sandy gravels could have a higher CBR of at least 30. Pavements founded within imported sand fill will require CBR testing during earthworks.

6.7 Retaining Wall Parameters

The site is gently sloping to the west and some retaining maybe required in the development. The following retaining wall parameters have been based on a compacted dense sand soil with ϕ=40^o.

γ=19 kN/m^3
Ko=0.36
Ka=0.22
Kp=4.6

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

6.8 Acid Sulphate Soils

The acid sulphate soil risk map for the area indicate soils below the site to be in the No Known Risk category. The walkover survey and descriptions from test holes indicated no soils associated with high-risk ASS.

6.9 Site Permeability and Drainage Recommendations

The near surface sand and gravels contain moderate fines, zero plasticity and are free draining. The drainage condition within the sands prior to proof rolling is moderate to good. Permeability of approx. 5x10^{-4}m/s was recorded. Permeability of the underlying clayey subgrade was poor.

For soakwell installation, additional sand fill may be required in some areas, especially where the clayey subgrade approaches the existing surface. A suitably designed drainage system would allow for the use of soakwells if sufficient height, say at least 1.2m, is obtained above the clayey subgrade and the groundwater. Further permeability testing and groundwater monitoring is recommended as part of the detailed geotechnical investigation to refine these observations.

If clean fill sand is to be imported on to the site to raise site formation levels, permeability can vary depending on the source, and could vary between 1x10^{-3} and a 1x10^{-5} m/s based on observed results on typical Perth fill sands.

Permeability and drainage conditions may be reduced during earthworks due to compaction of in-situ and imported sands. Over compaction during earthworks can seriously reduce soil permeability. It is recommended that further permeability testing be carried out following earthworks to confirm parameters used during drainage design.

BROWN GEOTECHNICAL

Ferry Haryono
Senior Geotechnical Engineer

Reviewed by
Ken Brown
Senior Geotechnical Engineer

REFERENCES

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

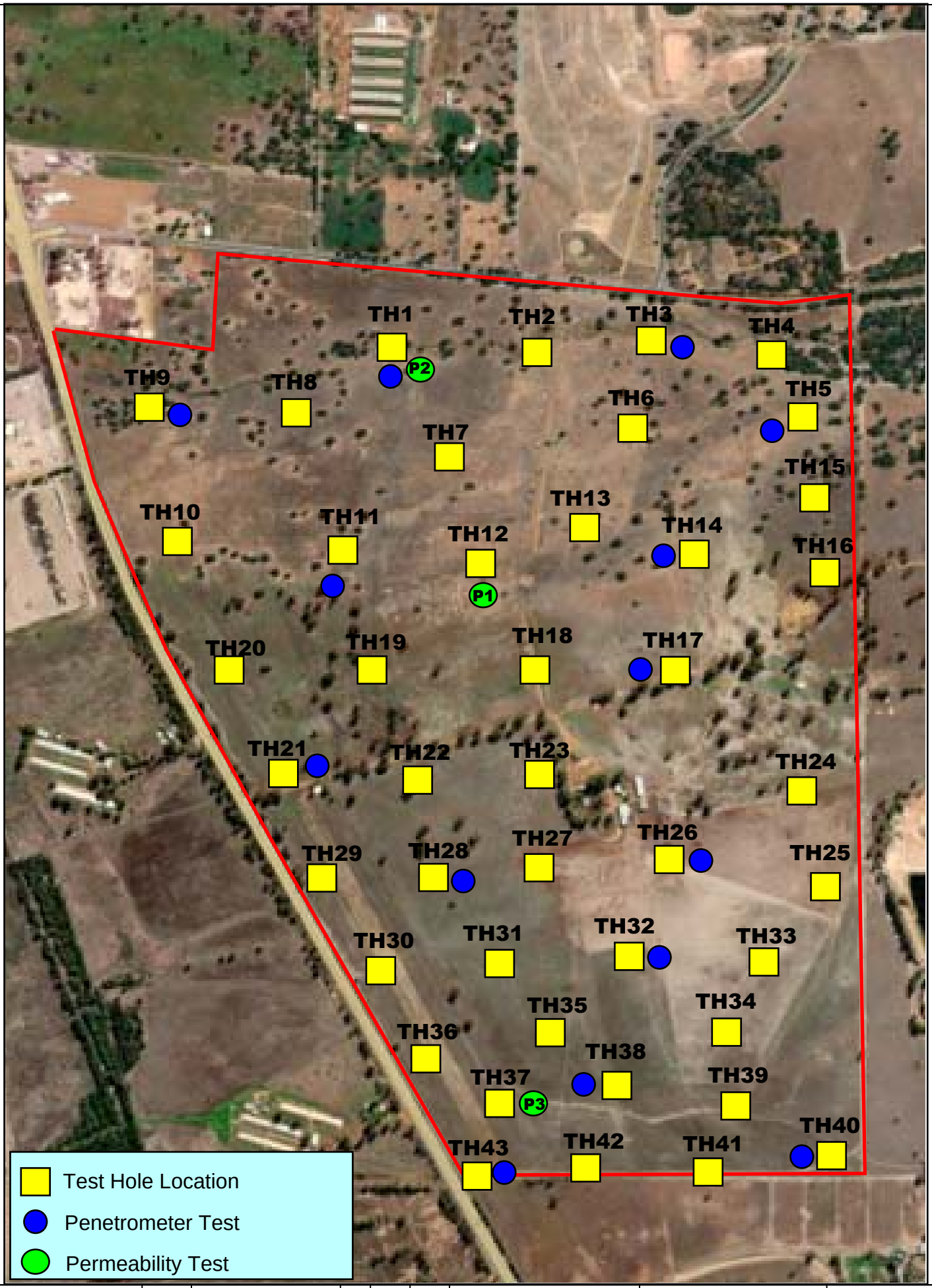
2. Geological Survey of Western Australia. 1:50,000 Environmental Geology Series, Perth.

3. Department of Water. *Perth Groundwater Map*

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
21.11.2020	Test Location Plan	kb	fh	kb

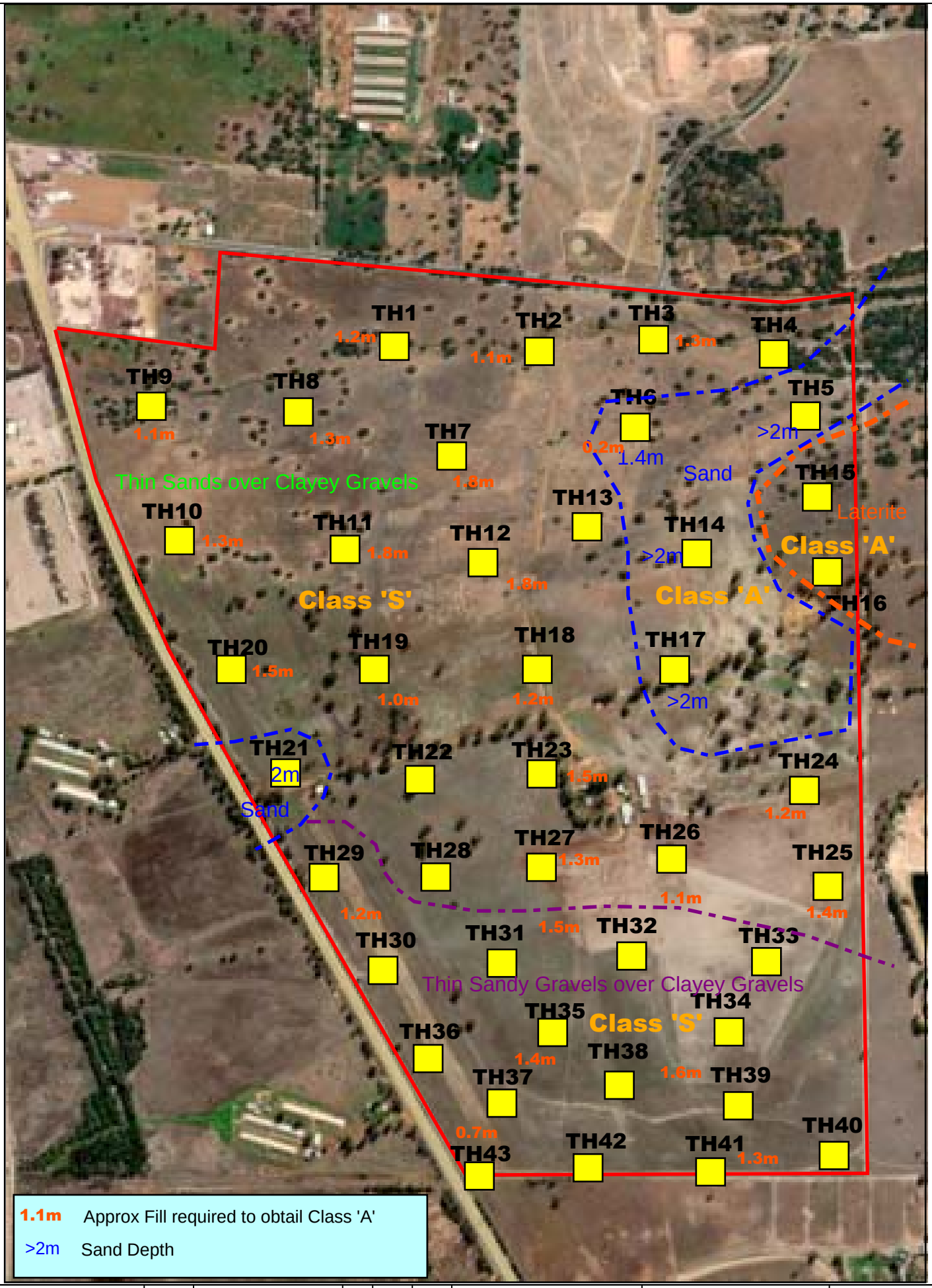
TEST LOCATION PLAN

LOTS 50 AND M1456
GREAT NORTHERN HIGHWAY
MUCHEA

CLIENT

Tallangatta Beef Pty Ltd

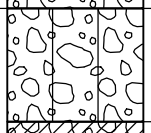
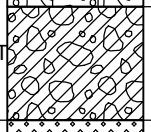
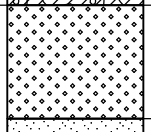
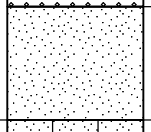
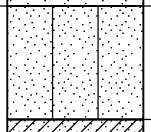
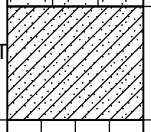
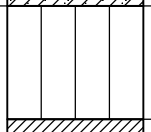
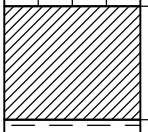
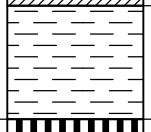
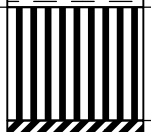
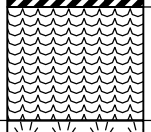
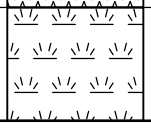
Drawing No. 20049 Fig1
Scale: NTS
Sheet Size: A4
Job No. 20049
FIGURE 1



BG Brown Geotechnical	Date	Description	Drawn	Checked	Approved	Subsoil Conditions	CLIENT	Drawing No. 20049 Fig2
	21.11.2020	Test Location Plan	kb	fh	kb			Scale: NTS
						LOTS 50 AND M1456 GREAT NORTHERN HIGHWAY MUCHEA	Tallangatta Beef Pty Ltd	Sheet SIze: A4
								Job No. 20049
								FIGURE 2

APPENDIX A

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	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
	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 Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405491 6504955

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry	Fines=8% Sand=79% Gravel=13%	
			0.5					
	Not Encountered				GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0					
			1.5					
						REFUSAL Borehole TH01 terminated at 1.6m		
			2.0					
			2.5					

BOREHOLE NUMBER TH02

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405738 6505809

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5					
	Not Encountered				GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0					
			1.5					
						REFUSAL Borehole TH02 terminated at 1.8m		
			2.0					
			2.5					

BOREHOLE NUMBER TH03

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** --- **DATUM** ---

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405992 6505834

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES ---

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered		0.0			TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0			REFUSAL Borehole TH03 terminated at 1m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH04

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** --- **DATUM** ---

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406198 6505805

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES ---

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
	Not Encountered		0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0					
			1.5					
						REFUSAL Borehole TH04 terminated at 1.6m		
			2.0					
			2.5					

BOREHOLE NUMBER TH05

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** --- **DATUM** ---

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406306 6505635

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES ---

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
	Not Encountered		0.5		SP-SM	SAND: Medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			1.0					
			1.5					
			2.0					
						Borehole TH05 terminated at 2m		
			2.5					

BOREHOLE NUMBER TH06

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** --- **DATUM** ---

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406306 6505635

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES ---

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered		0.0			TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5					
			1.0					
			1.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry	LL=34 PL=13 Fines=27% LS=6%	
			2.0			Borehole TH06 terminated at 2m		
			2.5					

BOREHOLE NUMBER TH07

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405567 6505550

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			0.5			REFUSAL Borehole TH07 terminated at 0.5m		
			1.0					
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH08

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405251 6505641

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GM	GRAVELLY SAND:Medium dense, fine to medium grained, grey, with silt, dry		
			0.5					
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0					
						REFUSAL Borehole TH08 terminated at 1m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH09

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** --- **DATUM** ---

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 404995 6505634

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES ---

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5					
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
	Not Encountered		1.0					
			1.5					
			2.0					
						Borehole TH09 terminated at 2m		
			2.5					

BOREHOLE NUMBER TH10

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405083 6505388

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0			REFUSAL Borehole TH10 terminated at 0.9m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH11

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405447 6505378

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			0.5					
						REFUSAL Borehole TH11 terminated at 0.6m		
			1.0					
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH12

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405709 6505396

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			0.5			REFUSAL Borehole TH12 terminated at 0.5m		
			1.0					
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH13

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406306 6505635

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, yellowish brown & grey, with silt, trace gravel, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0			REFUSAL Borehole TH13 terminated at 1.1m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH14

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406082 6505424

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
	Not Encountered		0.5		SP-SM	SAND: Medium dense, fine to medium grained, yellowish brown & grey, with silt and gravel, dry	Fines=22% Sand= 71% Gravel=7%	
			1.0					
			1.5					
			2.0			Borehole TH14 terminated at 2m		
			2.5					

BOREHOLE NUMBER TH15

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406323 6505444

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	GRAVELLY SAND / LATERITE: Very dense (cemented), fine to coarse, brown, dry		
			0.5					
						REFUSAL Borehole TH15 terminated at 0.6m		
			1.0					
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH16

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406312 6505233

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
	Not Encountered		0.5		GPS	GRAVELLY SAND / LATERITE: Very dense (cemented), fine to coarse, brown, dry		
			1.0			REFUSAL Borehole TH16 terminated at 0.8m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH17

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** --- **DATUM** ---

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406063 6505177

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES ---

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered		0.0			TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to coarse grained, grey, with silt, trace gravel, dry		
			0.5					
			1.0					
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.5					
						REFUSAL Borehole TH17 terminated at 1.6m		
			2.0					
			2.5					

BOREHOLE NUMBER TH18

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405768 6505169

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to coarse grained, grey, with silt, trace gravel, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0					
			1.5					
						REFUSAL Borehole TH18 terminated at 1.6m		
			2.0					
			2.5					

BOREHOLE NUMBER TH19

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405463 6505127

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense to dense, fine to coarse grained, grey, trace silt, dry		
	Not Encountered		0.5				Fines=4% Sand=26% Gravel=70%	
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0					
							LL=28 PL=14 Fines=19% LS=4%	
			1.5					
						REFUSAL Borehole TH19 terminated at 1.8m		
			2.0					
			2.5					

BOREHOLE NUMBER TH20

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 20/10/20 **COMPLETED** 20/10/20 **R.L. SURFACE** --- **DATUM** ---

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405178 6505190

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES ---

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense to dense, fine to coarse grained, grey, trace silt, dry		
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			0.5					
			1.0					
			1.5					
						REFUSAL Borehole TH20 terminated at 1.6m		
			2.0					
			2.5					

BOREHOLE NUMBER TH21

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** --- **DATUM** ---

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405246 6504978

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES ---

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
	Not Encountered		0.5		SP-SM	SAND: Medium dense, fine to coarse grained, yellowish brown & grey, with silt, trace gravel, dry		
			1.0					
			1.5			with some clay below 1.5m	LL=35 PL=16 Fines=24% LS=6%	
			2.0					
						Borehole TH21 terminated at 2m		
			2.5					

BOREHOLE NUMBER TH22

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405246 6504978

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5					
	Not Encountered				GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0					
			1.5					
						REFUSAL Borehole TH22 terminated at 1.9m		
			2.0					
			2.5					

BOREHOLE NUMBER TH23

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** --- **DATUM** ---

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405762 405762

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES ---

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH23 terminated at 0.8m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH24

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** --- **DATUM** ---

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406273 6504973

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES ---

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered		0.0			TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
						REFUSAL Borehole TH24 terminated at 0.7m		
			1.0					
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH25

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406284 6504795

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH25 terminated at 0.7m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH26

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405946 6504827

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH26 terminated at 1m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH27

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405784 6504955

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt, trace gravel, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
						REFUSAL Borehole TH27 terminated at 0.7m		
			1.0					
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH28

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405541 6504777

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					SP-SM	SAND: Loose to medium dense, fine to medium grained, grey, with silt and gravel, dry		
			0.5					
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0					
						REFUSAL Borehole TH28 terminated at 1m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH29

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405342 6504804

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry	Fines=5% Sand=27% Gravel=68%	
	Not Encountered		0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry	LL=23 PL=17 LS=2%	
			1.0					
						REFUSAL Borehole TH29 terminated at 1.3m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH30

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405416 6504605

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
	Not Encountered		0.5					
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown, dry		
			1.0					
						REFUSAL Borehole TH30 terminated at 1.3m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH31

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405570 6504604

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
						REFUSAL Borehole TH31 terminated at 0.7m		
			1.0					
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH32

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405859 6504616

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH32 terminated at 0.8m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH33

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405984 6504614

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH33 terminated at 0.7m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH34

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406020 6504417

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH34 terminated at 1m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH35

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405736 6504450

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH35 terminated at 0.9m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH36

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405519 6504466

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH36 terminated at 0.7m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH37

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405588 6504333

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
	Not Encountered		0.5					
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0				LL=31 PL=14 Fines=21% LS=6%	
			1.5					
						REFUSAL Borehole TH37 terminated at 1.6m		
			2.0					
			2.5					

BOREHOLE / TEST PIT MUCHAE.GPJ GINT STD AUSTRALIA.GDT 15/12/20

BOREHOLE NUMBER TH38

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405777 6504329

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Medium dense, fine to medium grained, grey, with silt, dry		
			0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0			REFUSAL Borehole TH38 terminated at 0.7m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH39

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406096 6504327

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Dense, fine to medium grained, grey, with silt, dry		
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			0.5			REFUSAL Borehole TH39 terminated at 0.5m		
			1.0					
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH40

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406357 6504220

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
	Not Encountered					TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Dense, fine to medium grained, grey, with silt, dry		
			0.5					
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0					
						REFUSAL Borehole TH40 terminated at 1m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH41

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 406108 6504220

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Dense, fine to medium grained, grey, with silt, dry		
	Not Encountered		0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0					
			1.5			REFUSAL Borehole TH41 terminated at 1.6m		
			2.0					
			2.5					

BOREHOLE NUMBER TH42

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405842 6504214

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
					GPS	SANDY GRAVEL: Dense, fine to medium grained, grey, with silt, dry		
	Not Encountered		0.5		GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.0					
						REFUSAL Borehole TH42 terminated at 1.3m		
			1.5					
			2.0					
			2.5					

BOREHOLE NUMBER TH43

BG Brown Geotechnical

CLIENT Tallangatta Beef Pty Ltd **PROJECT NAME** LOTS 50 and M1456

PROJECT NUMBER 20049 **PROJECT LOCATION** MUCHEA

DATE STARTED 21/10/20 **COMPLETED** 21/10/20 **R.L. SURFACE** **DATUM**

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

EQUIPMENT 5 tonne excavator **HOLE LOCATION** 405652 6504213

HOLE SIZE 0.5mx1.5m **LOGGED BY** FH **CHECKED BY** KB

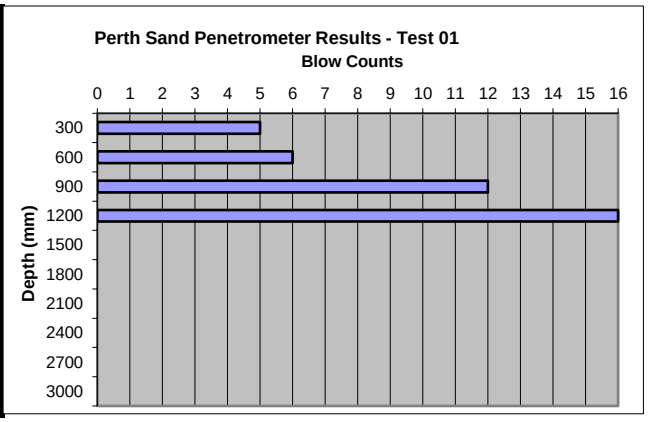
NOTES

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Additional Observations
						TOPSOIL: Loose, dark grey, silty sand with rootlets		
	Not Encountered		0.5		GPS	SANDY GRAVEL: Dense, fine to medium grained, grey, with silt, dry		
			1.0					
					GP-GC	GRAVELLY SAND with CLAY: Very dense, fine to coarse, yellowish brown & grey, dry		
			1.5					
						REFUSAL Borehole TH43 terminated at 1.8m		
			2.0					
			2.5					

APPENDIX B

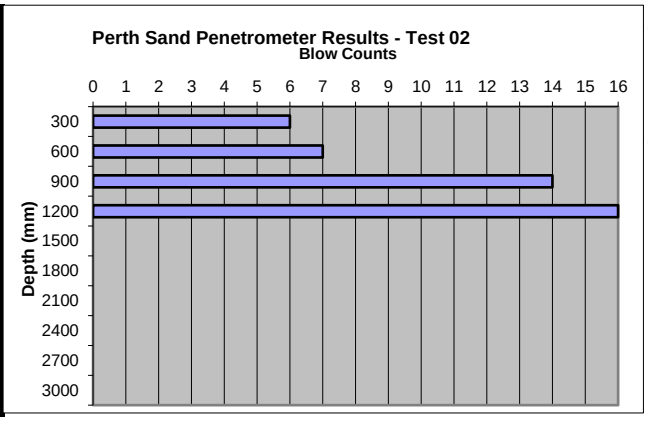
Perth Sand Penetrometer Test Plots

Depth (mm)	Blow Counts
300	5
600	6
900	12
1200	16
1500	
1800	
2100	
2400	
2700	
3000	



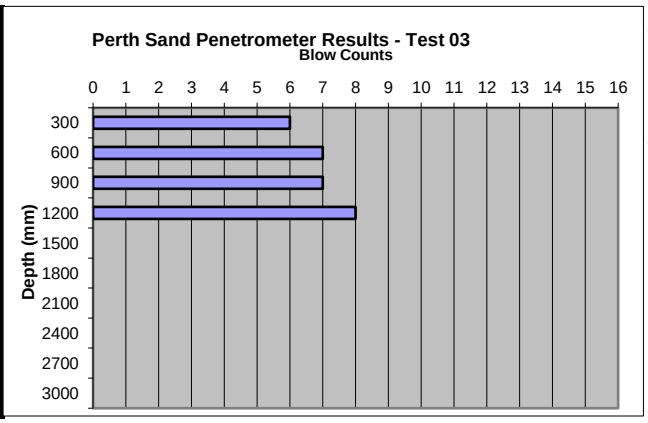
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH01

Depth (mm)	Blow Counts
300	6
600	7
900	14
1200	16
1500	
1800	
2100	
2400	
2700	
3000	



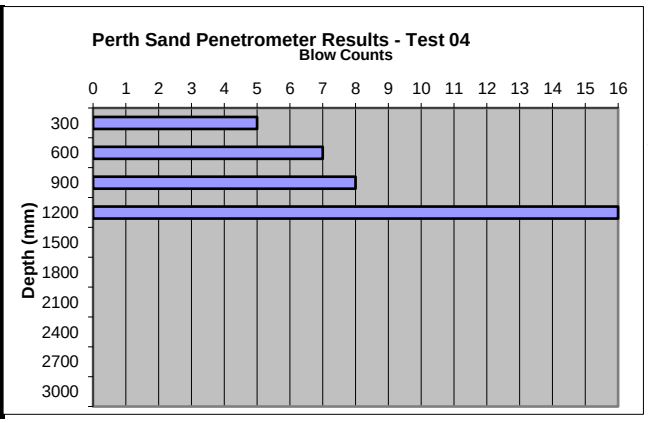
Job Name: Lot 50 & M1456
Job No: 20049
Date: 20/11/2020
Location: TH03

Depth (mm)	Blow Counts
300	6
600	7
900	7
1200	8
1500	
1800	
2100	
2400	
2700	
3000	



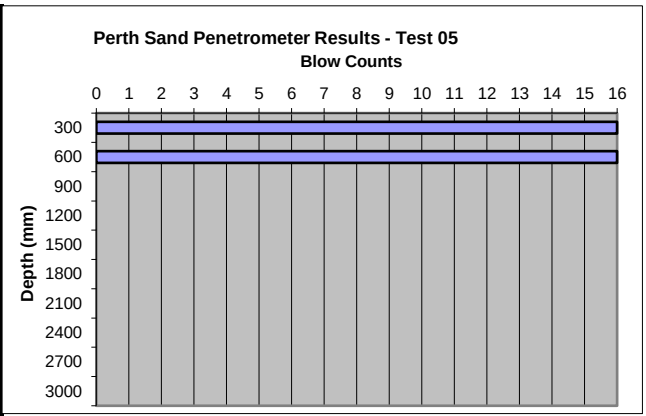
Job Name: Lot 50 & M1456
Job No: 20049
Date: 20/11/2020
Location: TH05

Depth (mm)	Blow Counts
300	5
600	7
900	8
1200	16
1500	
1800	
2100	
2400	
2700	
3000	



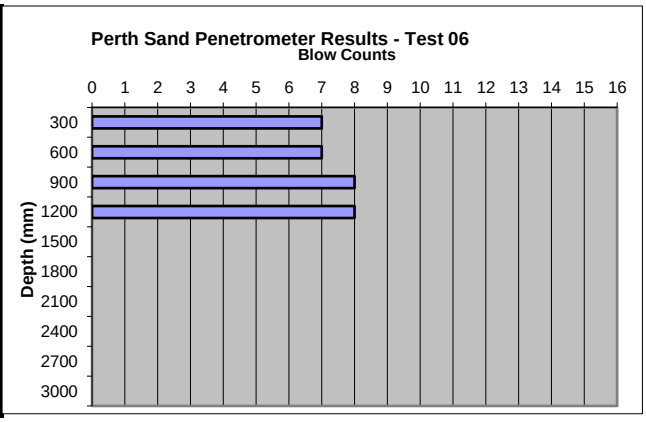
Job Name: Lot 50 & M1456
Job No: 20049
Date: 20/11/2020
Location: TH09

Depth (mm)	Blow Counts
300	16
600	16
900	
1200	
1500	
1800	
2100	
2400	
2700	
3000	



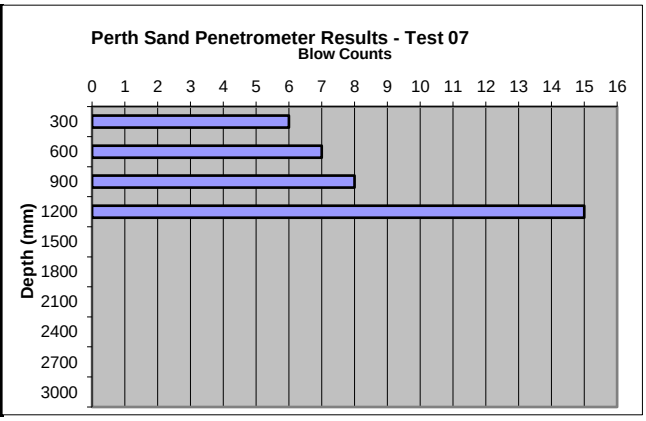
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH11

Depth (mm)	Blow Counts
300	7
600	7
900	8
1200	8
1500	
1800	
2100	
2400	
2700	
3000	



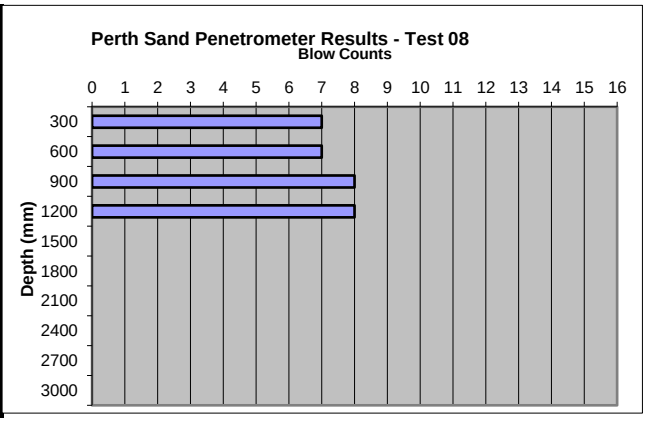
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH14

Depth (mm)	Blow Counts
300	6
600	7
900	8
1200	15
1500	
1800	
2100	
2400	
2700	
3000	



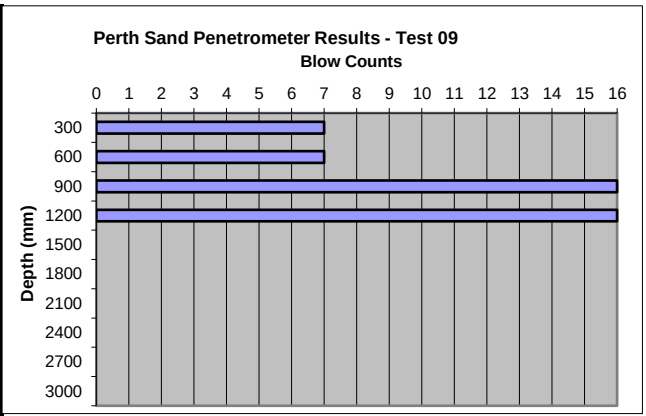
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH17

Depth (mm)	Blow Counts
300	7
600	7
900	8
1200	8
1500	
1800	
2100	
2400	
2700	
3000	



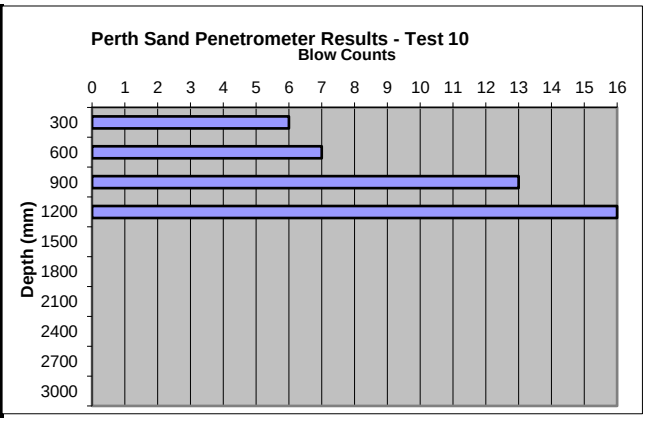
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH21

Depth (mm)	Blow Counts
300	7
600	7
900	16
1200	16
1500	
1800	
2100	
2400	
2700	
3000	



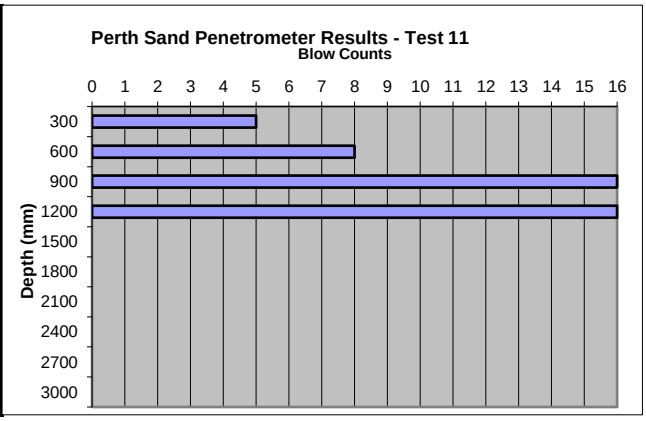
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH26

Depth (mm)	Blow Counts
300	6
600	7
900	13
1200	16
1500	
1800	
2100	
2400	
2700	
3000	



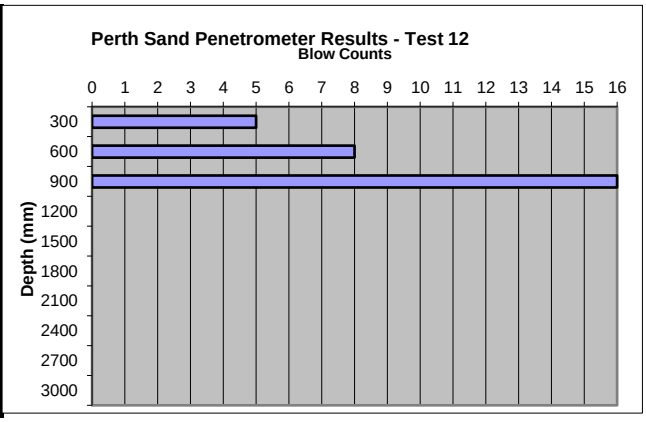
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH28

Depth (mm)	Blow Counts
300	5
600	8
900	16
1200	16
1500	
1800	
2100	
2400	
2700	
3000	



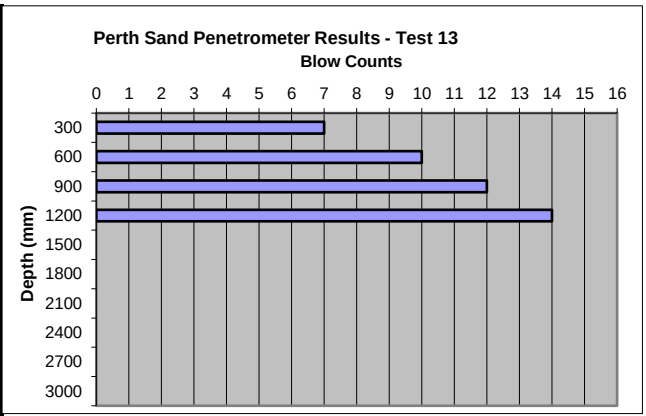
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH32

Depth (mm)	Blow Counts
300	5
600	8
900	16
1200	
1500	
1800	
2100	
2400	
2700	
3000	



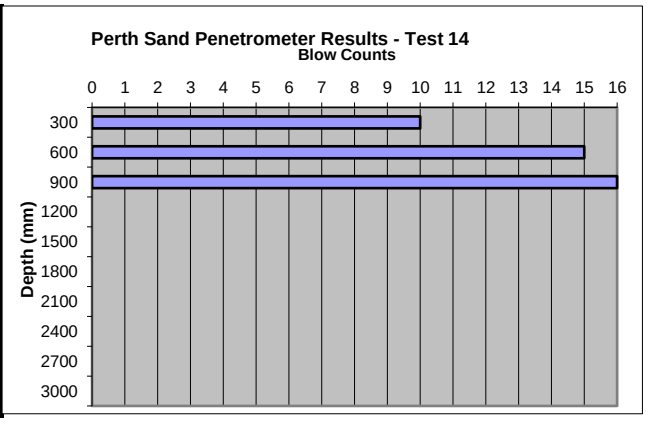
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH38

Depth (mm)	Blow Counts
300	7
600	10
900	12
1200	14
1500	
1800	
2100	
2400	
2700	
3000	



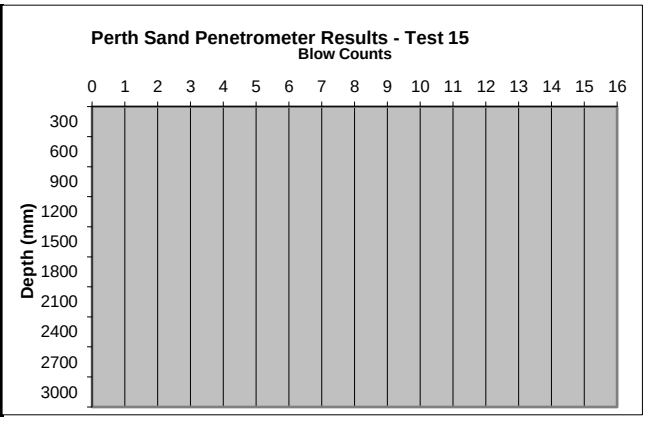
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH40

Depth (mm)	Blow Counts
300	10
600	15
900	16
1200	
1500	
1800	
2100	
2400	
2700	
3000	



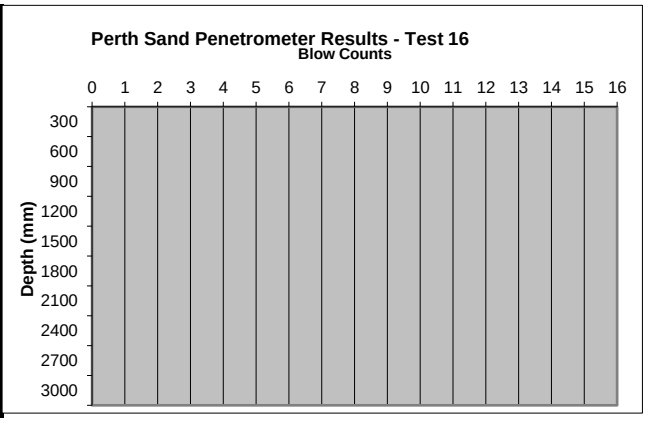
Job Name: Lot 50 & M1456 Muchae
Job No: 20049
Date: 20/11/2020
Location: TH43

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



Job Name:
Job No:
Date:
Location:

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



Job Name:
Job No:
Date:
Location:

APPENDIX C

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

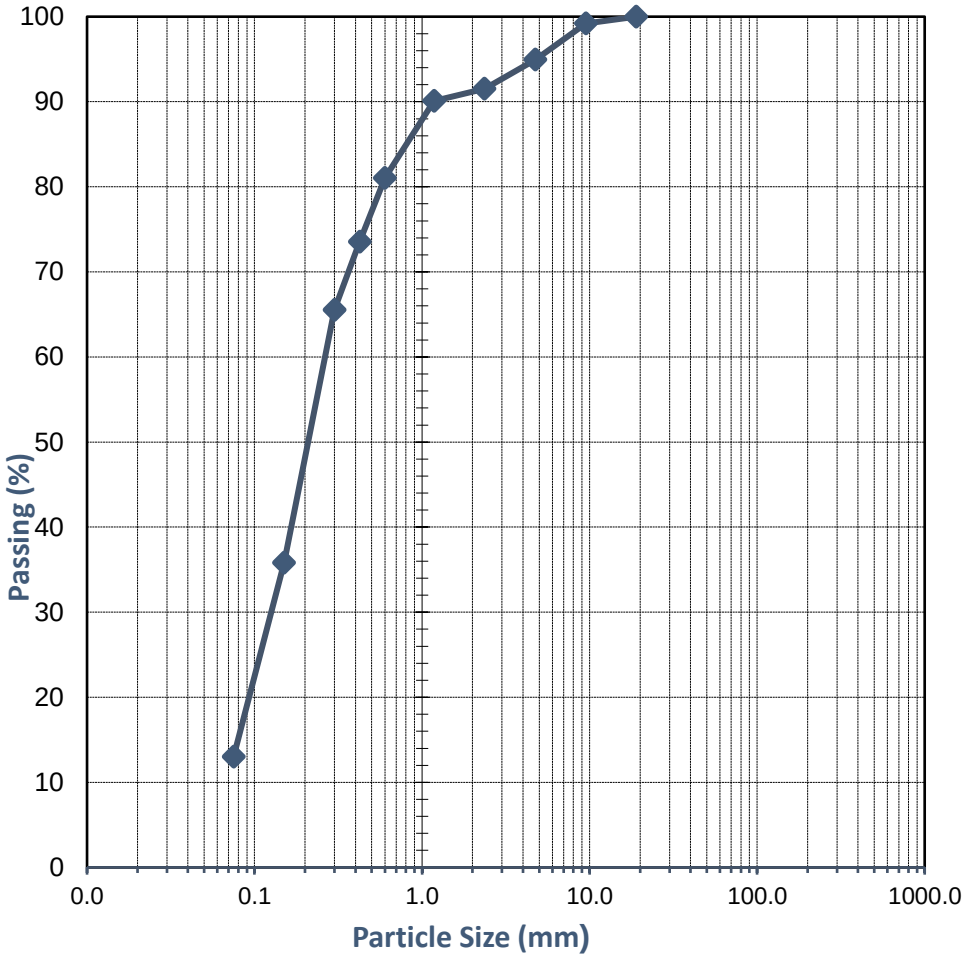
TEST REPORT - AS 1289.3.6.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9800_1_PSD
Project:	Tallangatta	*Sample No.*	WG20/9800
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH1 0.2-0.5m	*Date Tested:*	28-29/10/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
150.0	
100.0	
75.0	
37.5	
19.0	100
9.5	99
4.75	95
2.36	92
1.18	90
0.600	81
0.425	74
0.300	66
0.150	36
0.075	13



Comments:

Approved Signatory:

Name: Brooke Elliott

Date: 30-October-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

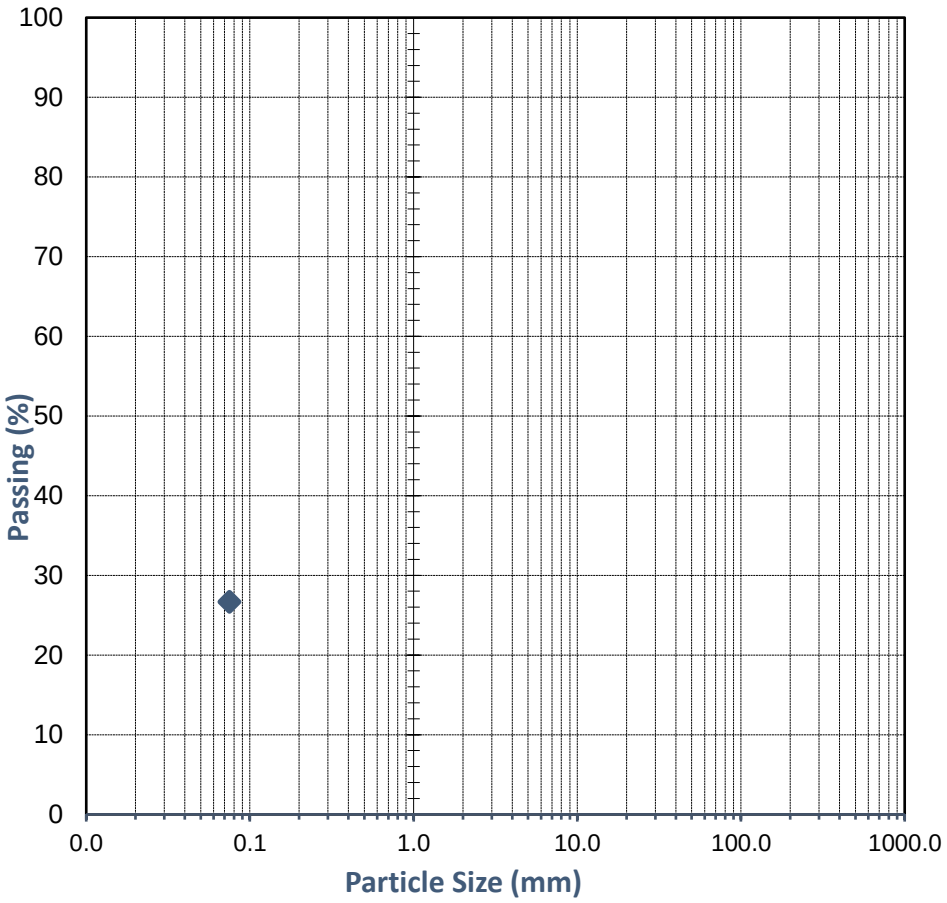
TEST REPORT - AS 1289.3.6.1 (% Fines)

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9801_1_%FINES
Project:	Tallangatta	*Sample No.*	WG20/9801
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH6 1.5-2.0m	*Date Tested:*	28-29/10/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	
1.18	
0.600	
0.425	
0.300	
0.150	
0.075	27



Comments: Clients request for the % Fines of Material passing 0.075mm only.

Approved Signatory:

Name: Brooke Elliott

Date: 30-October-2020

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9801_1_PI
Project:	Tallangatta	*Sample No.*	WG20/9801
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH6 1.5-2.0m	*Date Tested:*	29-10-2020

TEST RESULTS - Consistency Limits (Casagrande)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°C**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.1	**Liquid Limit (%)**	**34**
AS 1289.3.2.1	**Plastic Limit (%)**	**13**
AS 1289.3.3.1	**Plasticity Index (%)**	**21**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**6.5**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**Cracked, Curled**

Comments:

Approved Signatory:

Name: Brooke Elliott

Date: 02-November-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - ASTM D2974-14 (Test Method C)

Client:	Brown Geotechnical	*Ticket No.*	S1ϕнy
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/фулл_1_ORG
Project:	Tallangatta	*Sample No.*	WG20/9802-1
Location:	Muchae	*Date Sampled:*	2л-мл-2020
Sample Identification:	TH14 0.1m	*Date Tested:*	нy-мл-2020

TEST RESULTS - Organic Content

Sampling Method: Sampled by Client, Tested as Received

Testing Completed By: KT

Furnace Temperature (°C): 440

Sample Number	Sample Identification	Ash Content (%)	Organic Content (%)
WG20/9802-1	S1	94.2	5.8
0	0	#DIV/0!	#DIV/0!
0	0	#DIV/0!	#DIV/0!
0	0	#DIV/0!	#DIV/0!
0	0	#DIV/0!	#DIV/0!
0	0	#DIV/0!	#DIV/0!
0	0	#DIV/0!	#DIV/0!
0	0	#DIV/0!	#DIV/0!
0	0	#DIV/0!	#DIV/0!

Comments:

Approved Signatory:

Name: Brooke Elliott

Date:30-October-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

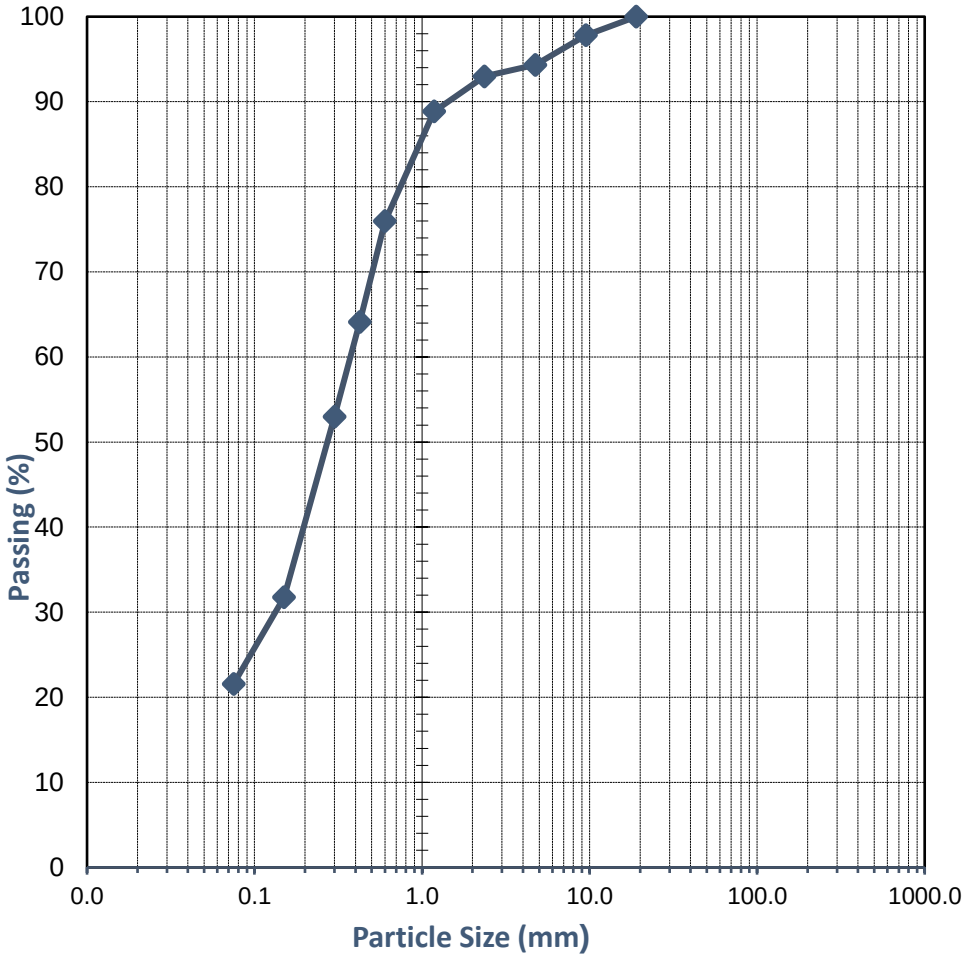
TEST REPORT - AS 1289.3.6.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9802_1_PSD
Project:	Tallangatta	*Sample No.*	WG20/9802
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH14 1.0-1.5m	*Date Tested:*	28-29/10/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
150.0	
100.0	
75.0	
37.5	
19.0	100
9.5	98
4.75	94
2.36	93
1.18	89
0.600	76
0.425	64
0.300	53
0.150	32
0.075	22



Comments:

Approved Signatory:

Name: Brooke Elliott

Date: 30-October-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

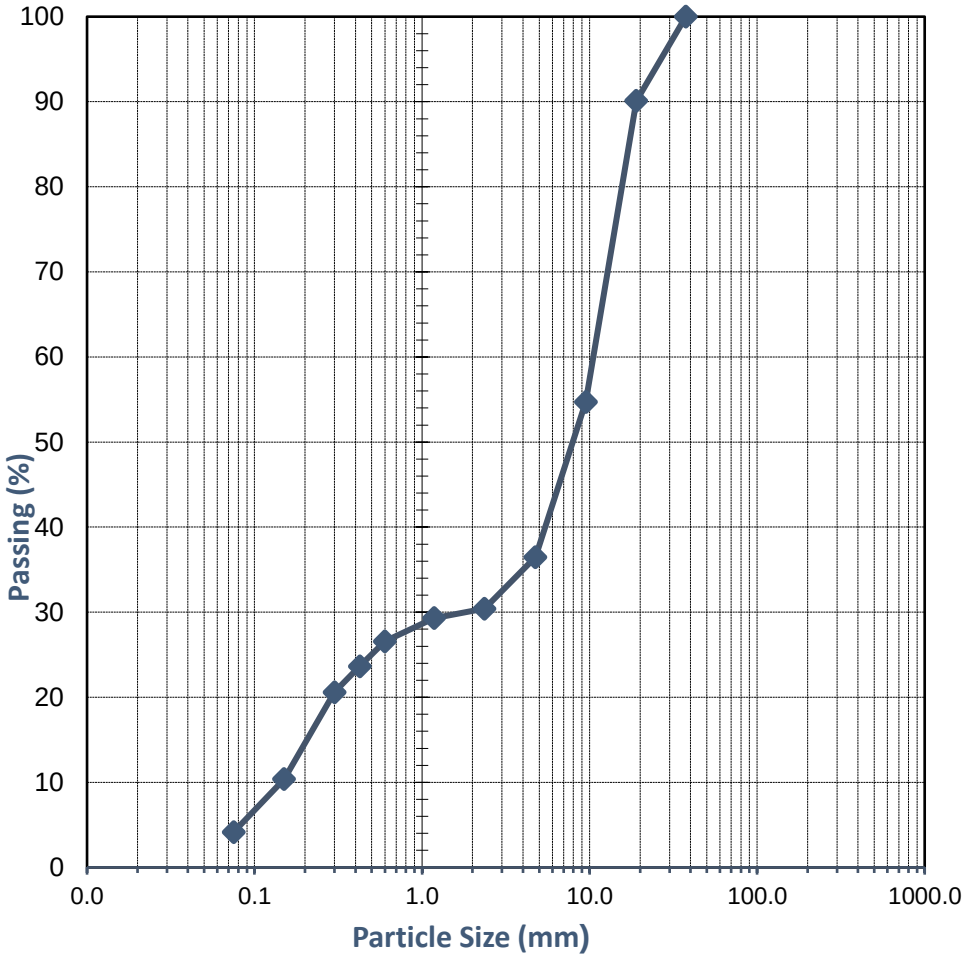
TEST REPORT - AS 1289.3.6.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9803_1_PSD
Project:	Tallangatta	*Sample No.*	WG20/9803
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	Th19 0.3-0.8m	*Date Tested:*	28-29/10/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
150.0	
100.0	
75.0	
37.5	100
19.0	90
9.5	55
4.75	36
2.36	30
1.18	29
0.600	27
0.425	24
0.300	21
0.150	10
0.075	4



Comments:

Approved Signatory:

Name: Brooke Elliott

Date: 30-October-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

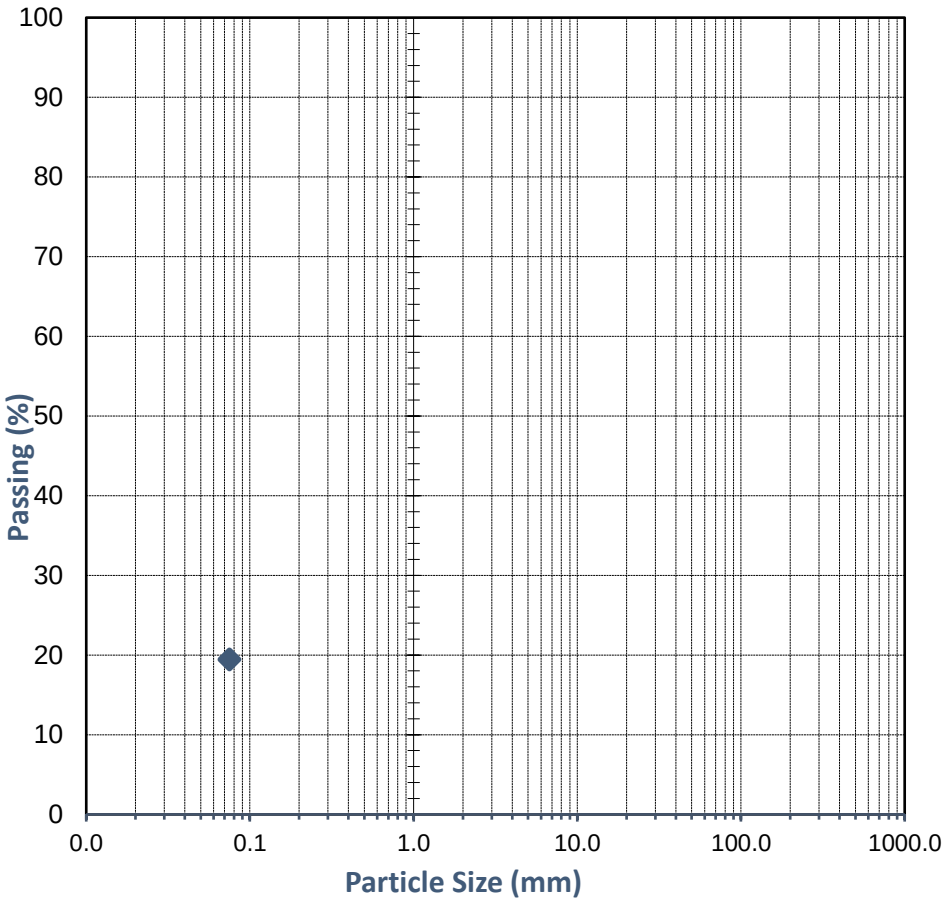
TEST REPORT - AS 1289.3.6.1 (% Fines)

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9804_1_%FINES
Project:	Tallangatta	*Sample No.*	WG20/9804
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH19 1.0-1.5m	*Date Tested:*	28-29/10/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	
1.18	
0.600	
0.425	
0.300	
0.150	
0.075	19



Comments: Clients request for the % Fines of Material passing 0.075mm only.

Approved Signatory:

Name: Brooke Elliott

Date: 02-November-2020

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9804_1_PI
Project:	Tallangatta	*Sample No.*	WG20/9804
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH19 1.0-1.5m	*Date Tested:*	29-10-2020

TEST RESULTS - Consistency Limits (Casagrande)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°C**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.1	**Liquid Limit (%)**	**28**
AS 1289.3.2.1	**Plastic Limit (%)**	**14**
AS 1289.3.3.1	**Plasticity Index (%)**	**14**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**4.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**-**

Comments:

Approved Signatory:

Name: Brooke Elliott

Date: 02-November-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

Accredited for compliance with ISO/IEC 17025 - Testing

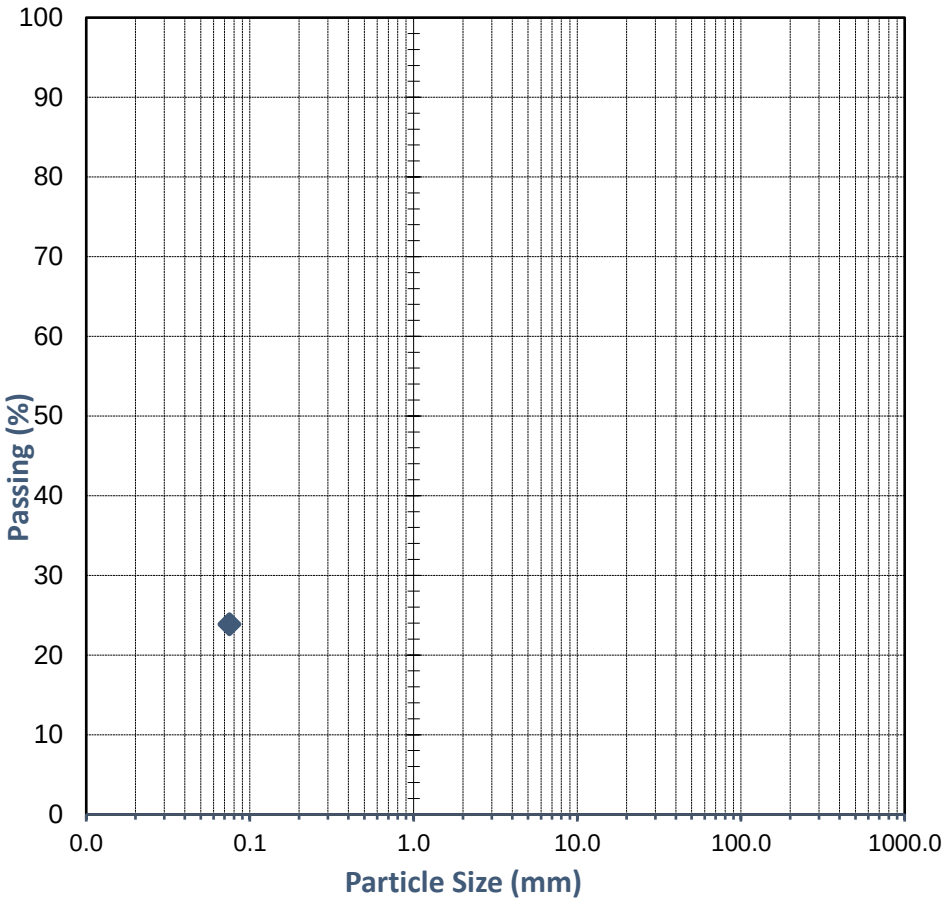
TEST REPORT - AS 1289.3.6.1 (% Fines)

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9805_1_%FINES
Project:	Tallangatta	*Sample No.*	WG20/9805
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH21 1.5-1.9m	*Date Tested:*	28-29/10/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	
1.18	
0.600	
0.425	
0.300	
0.150	
0.075	24



Comments: Clients request for the % Fines of Material passing 0.075mm only.

Approved Signatory:

Name: Brooke Elliott

Date: 30-October-2020

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9805_1_PI
Project:	Tallangatta	*Sample No.*	WG20/9805
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH21 1.5-1.9m	*Date Tested:*	29-10-2020

TEST RESULTS - Consistency Limits (Casagrande)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°C**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.1	**Liquid Limit (%)**	**35**
AS 1289.3.2.1	**Plastic Limit (%)**	**16**
AS 1289.3.3.1	**Plasticity Index (%)**	**19**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**6.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**Cracked**

Comments:

Approved Signatory:

Name: Brooke Elliott

Date: 02-November-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

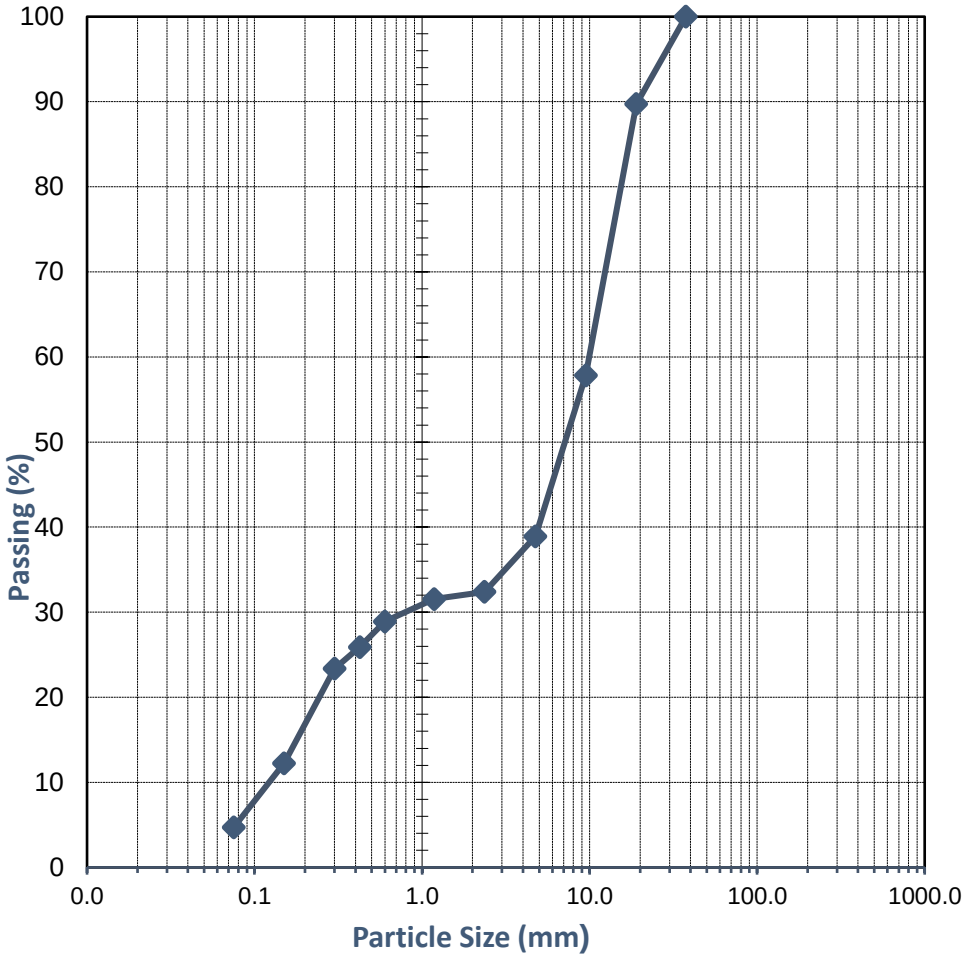
TEST REPORT - AS 1289.1.1*,3.6.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9806_1_PSD
Project:	Tallangatta	*Sample No.*	WG20/9806
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH29 0.1-0.5m	*Date Tested:*	28-10-2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
150.0	
100.0	
75.0	
37.5	100
19.0	90
9.5	58
4.75	39
2.36	32
1.18	32
0.600	29
0.425	26
0.300	23
0.150	12
0.075	5



*Comments: *AS 1289.1.1- Deviation from standard: Insufficient sample according to test method requirements. NATA accreditation does not cover the performance of this service.*

Approved Signatory:

Name: Brooke Elliott

Date: 30-October-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9807_1_PI
Project:	Tallangatta	*Sample No.*	WG20/9807
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH29 0.5-1.1m	*Date Tested:*	29-10-2020

TEST RESULTS - Consistency Limits (Casagrande)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°C**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.1	**Liquid Limit (%)**	**23**
AS 1289.3.2.1	**Plastic Limit (%)**	**17**
AS 1289.3.3.1	**Plasticity Index (%)**	**6**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**2.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**Cracked**

Comments:

Approved Signatory:

Name: Brooke Elliott

Date: 02-November-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

Accredited for compliance with ISO/IEC 17025 - Testing

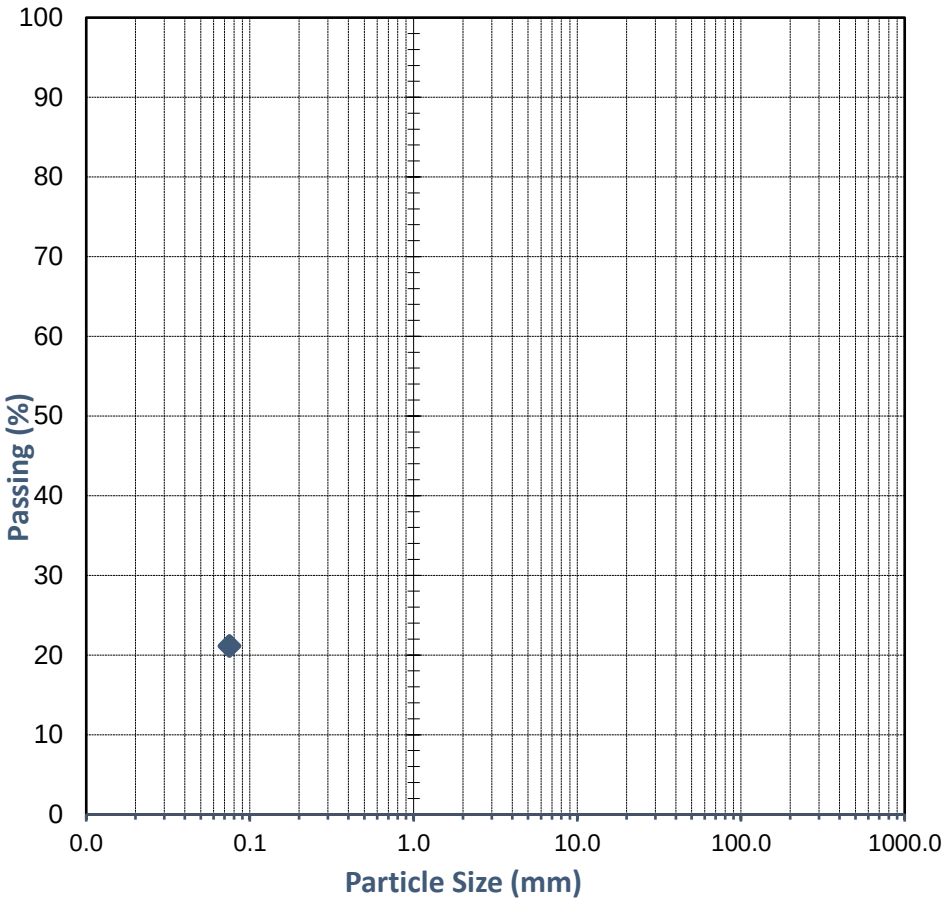
TEST REPORT - AS 1289.3.6.1 (% Fines)

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9808_1_%FINES
Project:	Tallangatta	*Sample No.*	WG20/9808
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH37 1.2-1.6m	*Date Tested:*	28-29/10/2020

TEST RESULTS - Particle Size Distribution of Soil

Sampling Method: Sampled by Client, Tested as Received

Sieve Size (mm)	Percent Passing Sieve (%)
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	
1.18	
0.600	
0.425	
0.300	
0.150	
0.075	21



Comments: Clients request for the % Fines of Material passing 0.075mm only.

Approved Signatory:

Name: Brooke Elliott

Date: 30-October-2020

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	Brown Geotechnical	*Ticket No.*	S1928
Client Address:	PO Box 278 Como, WA, 6952	*Report No.*	WG20/9808_1_PI
Project:	Tallangatta	*Sample No.*	WG20/9808
Location:	Muchae	*Date Sampled:*	20-10-2020
Sample Identification:	TH37 1.2-1.6m	*Date Tested:*	29-10-2020

TEST RESULTS - Consistency Limits (Casagrande)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50°C**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.1	**Liquid Limit (%)**	**31**
AS 1289.3.2.1	**Plastic Limit (%)**	**14**
AS 1289.3.3.1	**Plasticity Index (%)**	**17**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**6.5**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**-**

Comments:

Approved Signatory:

Name: Brooke Elliott

Date: 02-November-2020

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

Accredited for compliance with ISO/IEC 17025 - Testing