Shire of Chittering

Local Planning Scheme No. 6 Amendment No.

December 2021

HATCH | RobertsDay

PLANNING AND DEVELOPMENT ACT 2005
RESOLUTION DECIDING TO AMEND A TOWN PLANNING SCHEME
SHIRE OF CHITTERING DISTRICT ZONING SCHEME
LOCAL PLANNING SCHEME No. 6 - AMENDMENT No.

RESOLVED that the Council, pursuant to Section 75 of the Planning and Development Act 2005, initiate an Amendment to the Shire of Chittering Local Planning Scheme No. 6 to:

1. Modifying the Scheme Maps by introducing the Rural Residential zone over Lot M1942 Morley Road, Lower Chittering.
2. Insert the definition for building exclusion area under the General Definitions of Schedule 1 – Dictionary of Defined Words and Expressions in alphabetic order as follows:

building exclusion area	means the area of land within which buildings, effluent disposal facilities (excluding waste water disposal areas) and any other works on a lot must not be located or carried out.

3. Insert the following into Schedule 12 - Rural Residential:

No.	Description of Land	Conditions
2	Lot M1942 Morley Road, Lower Chittering	**General** 1. These conditions shall apply in conjunction with the Scheme requirements for the Rural Residential zone, and/or as otherwise approved by the local government. Where conflicts exist, these conditions prevail. 2. The minimum lot size shall be two (2) hectares. **Structure Planning** 3. A structure plan is not required to facilitate subdivision and development. **Subdivision** 4. The plan of subdivision and application must: a. identify building envelopes/exclusion areas which respond to the significant environmental features of the site, including: i. achieving suitable separation from water resources; and ii. minimising the clearing of vegetation including for asset protection zones, access, firebreaks, fencing and on-site effluent disposal systems; b. provide a logical road network designed to: i. link the subdivision area from its western boundary to Morley Road; ii. connect to Thornbill Place and Bronzewing Court; and iii. provide direct access to Lot 5 Morley Road. c. be supported by: i. an approved Local Water Management Strategy; ii. a site and soil evaluation conducted in accordance with AS/NZS 1547 On-site domestic wastewater management; and iii. a bushfire management plan.

No.	Description of Land	Conditions
		Local development plan 5. A local development plan is to be prepared and approved identifying building envelopes/exclusion areas consistent with Conditions 1 to 4 above. **Development and clearing of land** 6. Development shall be in accordance with the approved local development plan. 7. Other than to provide for subdivision in accordance with the conditions above, no further areas of vegetation shall be cleared felled or removed unless: a. the vegetation is dead, diseased or poses a danger to humans or stock; or b. the clearing is necessary for any firebreak required by law; or c. the clearing is required to provide for access to approved development; or d. the clearing is consistent with the parameters of an established building envelope/exclusion area; or e. the clearing is necessary to comply with the required bushfire management plan.

Dated this ..... day of ..... 20.....

.....
MATTHEW GILFELLON,
CHIEF EXECUTIVE OFFICER

1.0 Executive Summary

The purpose of this Shire of Chittering Local Planning Scheme No. 6 (LPS) amendment is to rezone Lot M1942 (No. 293) Morley Road, Lower Chittering (subject site) from 'Agricultural Resource' to 'Rural Residential' and include the subject site and associated conditions within Schedule 12 – Rural Residential.

The subject site was identified in the WAPC endorsed Shire of Chittering Local Planning Strategy (October 2019) as suitable for 'rounding off' of the existing rural residential areas. The subject site adjoins existing 'Rural Residential' zoned land to the south and land identified as 'Future Rural Living Area' in Shire's Local Planning Strategy.

2.0 Background and Context

2.1 Purpose and Scope of Amendment

Hatch RobertsDay acts on behalf of Sicicalab Pty Ltd in requesting an amendment to Lot M1942 (No. 293) Morley Road, Lower Chittering (subject site) from 'Agricultural Resource' to 'Rural Residential'.

A Subdivision Concept Plan (SCP) has also been prepared for the site. The SCP provides additional detail about the future development of the site, demonstrating its suitability and capacity for rural residential development proposed in this amendment request. The SCP is provided for information as Appendix B to this report.

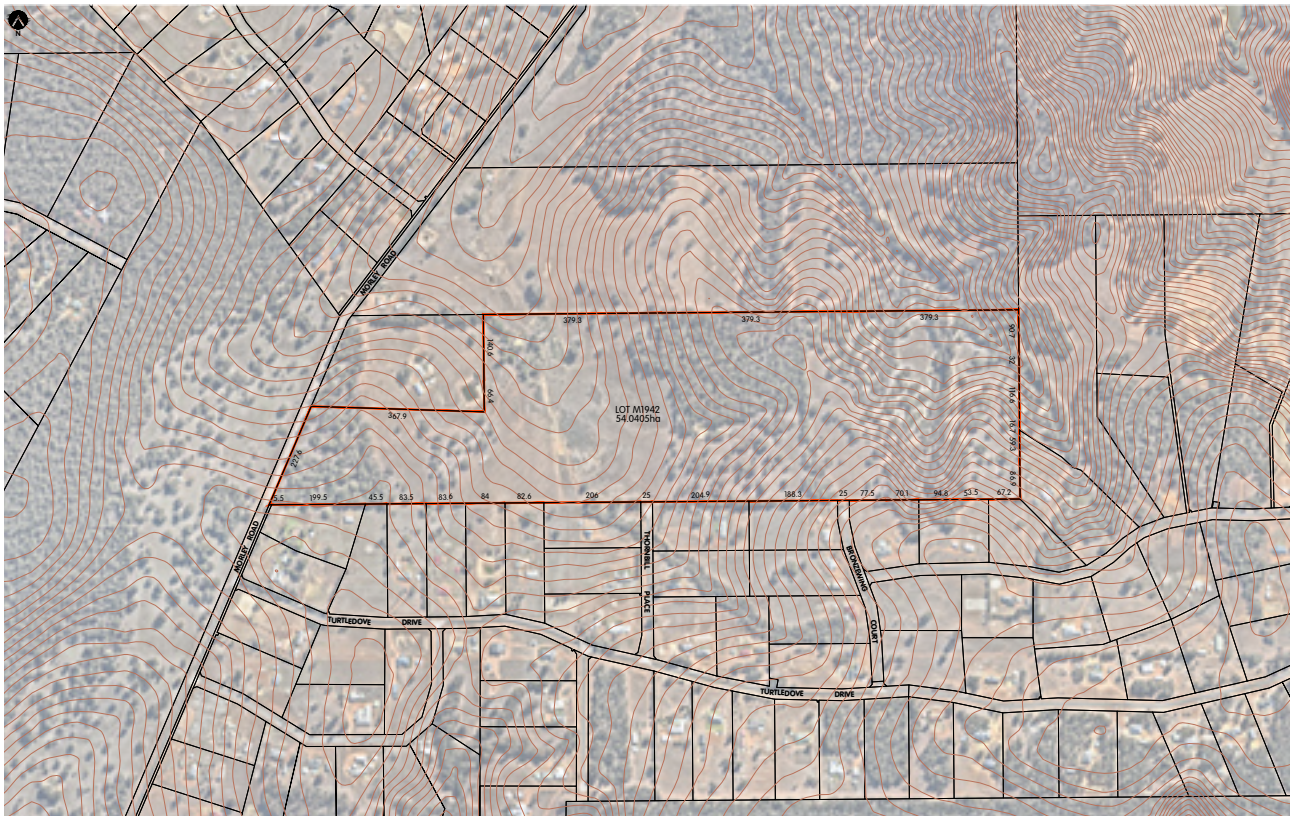
2.2 Site Details

2.2.1 Land particulars

The legal description of the subject site is:

LOT	CERTIFICATE OF TITLE	DIAGRAM	AREA
M1942 Morley Road, Lower Chittering	Volume 1970 Folio 88	013068	54.0339ha

Figure 1: Site Plan



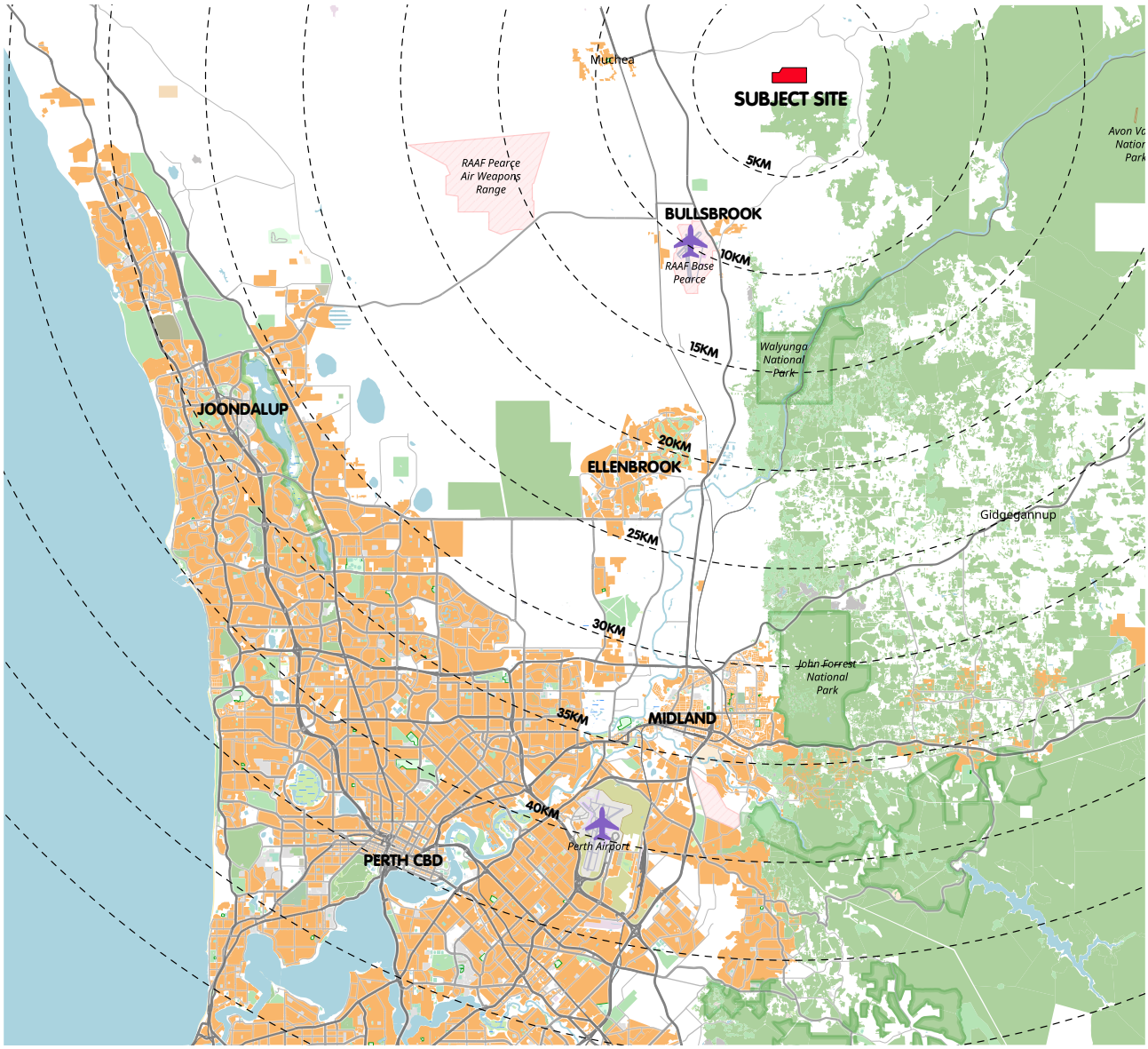
2.2.2 Location

The site is located in Lower Chittering, approximately 45 kilometres north-east of the Perth Central Business District and approximately 9 kilometres north-east of Bullsbrook. The site is bound by Morley Road to the west, semi-cleared farmland to the north and rural residential land to the east and south.

2.2.3 Land use

The site is predominately cleared and was previously used for horticulture (grapes and citrus). One dwelling and ancillary sheds are located on the north-western portion of the site.

Figure 2: Location Plan



2.3 Planning Context

2.3.1 State Planning Considerations

2.3.1.1 State Sustainability Strategy (State of Western Australia, 2003)

The State Sustainability Strategy provides an overarching framework for the State Government to respond to the sustainability agenda. The Strategy identifies the following six broad goals, to be achieved by 42 complementary strategy areas, to guide Government action towards achieving its vision for a sustainable Western Australia:

1. Sustainability and governance;
2. Contributing to global sustainability;
3. Sustainable natural resource management;
4. Sustainability and settlements;
5. Sustainability and community; and
6. Sustainability and business.

The policy objectives of the State Sustainability Strategy are incorporated into the planning system through the State and Local Government policy framework.

2.3.1.2 State Planning Strategy (WAPC, 2014)

Reflecting this changing and increasingly complex environment, the State Planning Strategy 2050 offers an integrated whole-of-Government view of the strategic planning needed to respond to the challenges and opportunities these factors present for the land use planning and development of Western Australia. The Strategy outlines the Government's intention to undertake a collaborative approach in planning for the State's land availability, physical and social infrastructure, environment, economic development and security. It offers a strategic context and guide for future strategies, plans, policies and decisions by public and local authorities with specific responsibilities or influence in the sustainable use and development of land throughout the State.

2.3.1.3 Statement of Planning Policy No.1 – State Planning Framework Policy (WAPC, 2017)

Statement of Planning Policy No.1 – State Planning Framework Policy (SPP1) integrates existing State and regional policies, strategies and statements within a central framework to provide a context for decision making on land use planning and development matters in Western Australia. The WAPC and local governments are required to consider the relevant planning instruments referred to under SPP1 for all planning decisions, including those concerning amendments to the MRS and Local Planning Schemes and subsequent planning proposals presented for individual sites.

2.3.1.4 *Statement of Planning Policy No.2 – Environmental and Natural Resources Policy (WAPC, 2003)*

Statement of Planning Policy No.2 – Environmental and Natural Resources Policy (SPP2) aims to integrate environmental and natural resource management within the planning framework, in order to protect and conserve the natural environment and to assist with the sustainable use of natural resources.

Amongst the general measures promoted by SPP2 and relevant to the subject site are requirements to:

- "Avoid development that may result in unacceptable environmental damage.
- Actively seek opportunities for improved environmental outcomes including support for development which provides for environmental restoration or enhancement.
- Protect significant natural, indigenous and cultural features, including sites and features significant as habitats and for their flora, cultural, built, archaeological, ethnographic, geological, geomorphological, visual or wilderness values.
- Support conservation, protection and management of native remnant vegetation where possible to enhance soil and land quality, water quality, biodiversity, fauna habitat, landscape, amenity values and ecosystem function."

These general measures are further augmented by a series of more specific measures relating to individual areas of interest such as water resources, biodiversity and landscape. The amendment addresses the various requirements of these measures detailed in SPP2 through following the design and environmental responses via proposed conditions within Schedule 12, including:

4. *The plan of subdivision and application must:*
   - *(b) identify building envelopes/exclusion areas which respond to the significant environmental features of the site, including:*
     - *iii. achieving suitable separation from water resources; and*
     - *iv. minimising the clearing of vegetation including for asset protection zones, access, firebreaks, fencing and on-site effluent disposal systems;*

7. *Other than to provide for subdivision in accordance with the conditions above, no further areas of vegetation shall be cleared felled or removed unless:*
   - *(f) the vegetation is dead, diseased or poses a danger to humans or stock; or*
   - *(g) the clearing is necessary for any firebreak required by law; or*
   - *(h) the clearing is required to provide for access to an approved dwelling or outbuildings; or*
   - *(i) the clearing is consistent with the parameters of an established building envelope/exclusion area; or the clearing is necessary to comply with the required bushfire management plan.*

2.3.1.4.1 State Planning Policy 2.5 Rural Planning (WAPC, 2016)

This policy provides guidance to minimise land use conflicts and promote sustainable rural settlement adjacent to existing urban areas. The policy also outlines the need to manage environmental, landscape and water resource assets in rural areas.

The policy defines Rural Living as lots with land area between 1 hectare to 40 hectares, which provide for a range of housing and lifestyle opportunities.

This amendment is consistent with the policy being land that is identified as 'Future rural living area' in the Shire's Local Planning Strategy.

The following is an extract of clause 5.3(c)(vi) of SPP2.5 regarding water supply:

(vi) water supply shall be as follows –

- *where lots with an individual area of four hectares or less are proposed and a reticulated water supply of sufficient capacity is available in the locality, the precinct will be required to be serviced with reticulated potable water by a licensed service provider. Should an alternative to a licensed supply be proposed it must be demonstrated that a licensed supply is not available; or*
- *where a reticulated supply is demonstrated to not be available, or the individual lots are greater than four hectares, the WAPC may consider a fit-for-purpose domestic potable water supply, which includes water for fire fighting. The supply must be demonstrated, sustainable and consistent with the standards for water and health; or*
- *the development cannot proceed if an acceptable supply of potable water cannot be demonstrated*

As demonstrated in the Servicing Report (Appendix C) there isn't a reticulated water supply of sufficient capacity is available in the locality. Therefore, the proposed lots will be serviced by on-site water tanks.

2.3.1.4.2 Statement of Planning Policy No.2.9 – Water Resources (WAPC, 2006)

Statement of Planning Policy 2.9 – Water Resources (SPP2.9) aims to protect, conserve and enhance water resources, to ensure availability and to promote and assist in the management and sustainable use of water resources.

The implementation of SPP2.9 is expected to occur through local planning strategies, structure plans and town planning schemes. The release of the WAPC's Better Urban Water Management (BUWM) Framework in October 2008, established the requirement for a LWMS to be prepared to support a town planning scheme amendment. BUWM aims to facilitate better management of urban water resources by ensuring an appropriate level of consideration is given to the total water cycle at each stage of the planning system.

A LWMS has been prepared for the site to demonstrate that the land is capable of supporting the proposed urban development with regard to water management (refer Appendix D). The LWMS complies with the provisions outlined in BUWM which is informed by the objectives of SPP2.9. The LWMS has been lodged with the Shire and DWER for review and approval.

2.3.1.4.3 Government Sewerage Policy (WAPC, 2019)

The Government Sewerage Policy requires all subdivision and development to be connected to reticulated sewerage, unless it is exempted from this requirement under the Policy. In sewerage sensitive areas, the Policy only exempts residential subdivision proposals from requiring connection to reticulated sewerage where lots are greater than 1 hectare.

The SCP proposes lots with a minimum area of 2 hectares to be serviced by non-reticulated private effluent treatment systems. Further details are included in the LWMS (refer Appendix D).

2.3.2 Local Planning Considerations

2.3.2.1 Shire of Chittering Local Planning Scheme No.6 (2004)

The subject site is reserved as 'Agricultural Resource' under the provisions of LPS6. This amendment requests the subject site be rezoned to 'Rural Residential'.

Figure 4: Current Local Planning Schme No. 6 Zoning Map

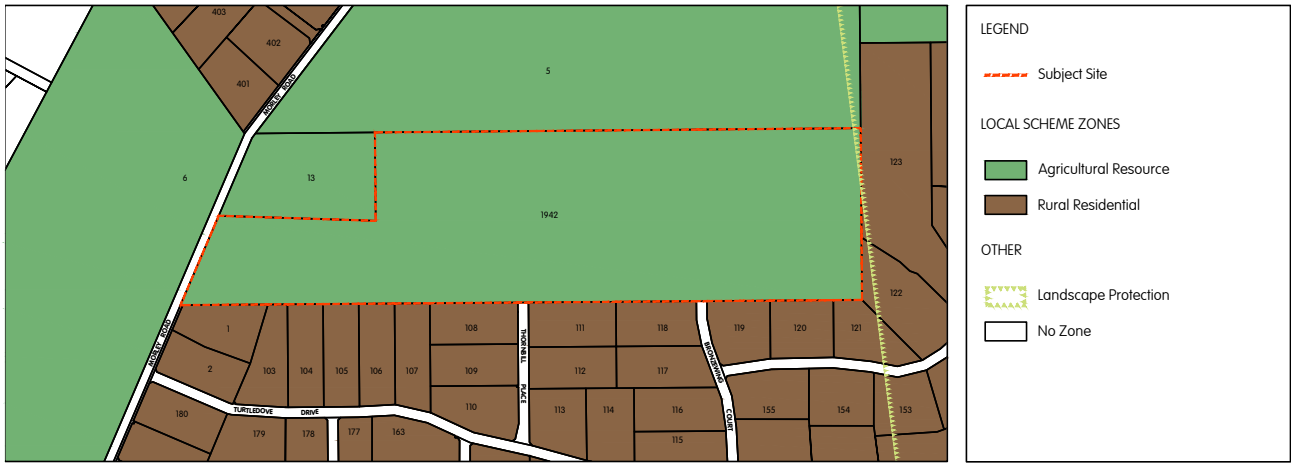
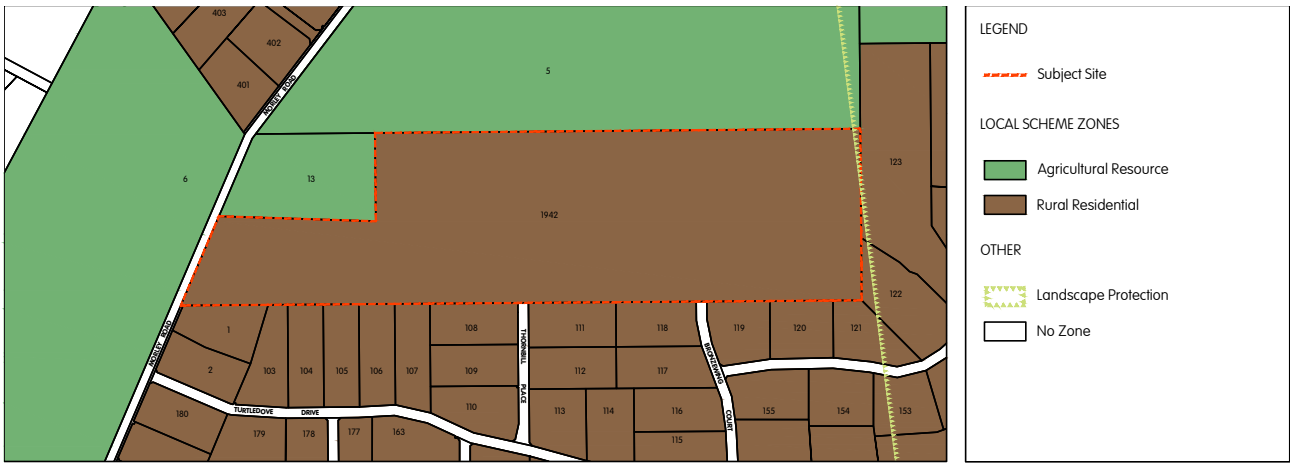


Figure 5: Proposed Local Planning Schme No. 6 Zoning Map



2.3.2.2 *Shire of Chittering Local Planning Strategy (2019)*

The Shire of Chittering Local Planning Strategy (LPS) provides the long-term planning vision for the Shire jurisdiction to guide land use planning over the next ten to fifteen years. The LPS was endorsed by the WAPC in October 2019.

The Local Planning Strategy Map (Figure 1) identifies the subject site 'Future rural living areas' and Figure 3 Settlement identifies the land as 'Rural residential'. The following is an extract from the LPS in respect to the subject site:

3.1.3 Rural living

Objective

1. *Consolidate rural living development within the Bindoon, Lower Chittering, and Reserve Road precincts through 'rounding off' consistent with the Local Planning Strategy Map (Figure 1).*

Strategy

a. *Consolidate existing rural living estates and provide for limited additional development, where proposals demonstrate and achieve improved environmental, bushfire and landscape outcomes.*

b. *Provide for district level community facilities.*

The proposed zoning is in accordance with the LPS.

2.3.2.3 *Shire of Chittering Local Biodiversity Strategy*

The Shire of Chittering Local Biodiversity Strategy provides ecological criteria for prioritising local

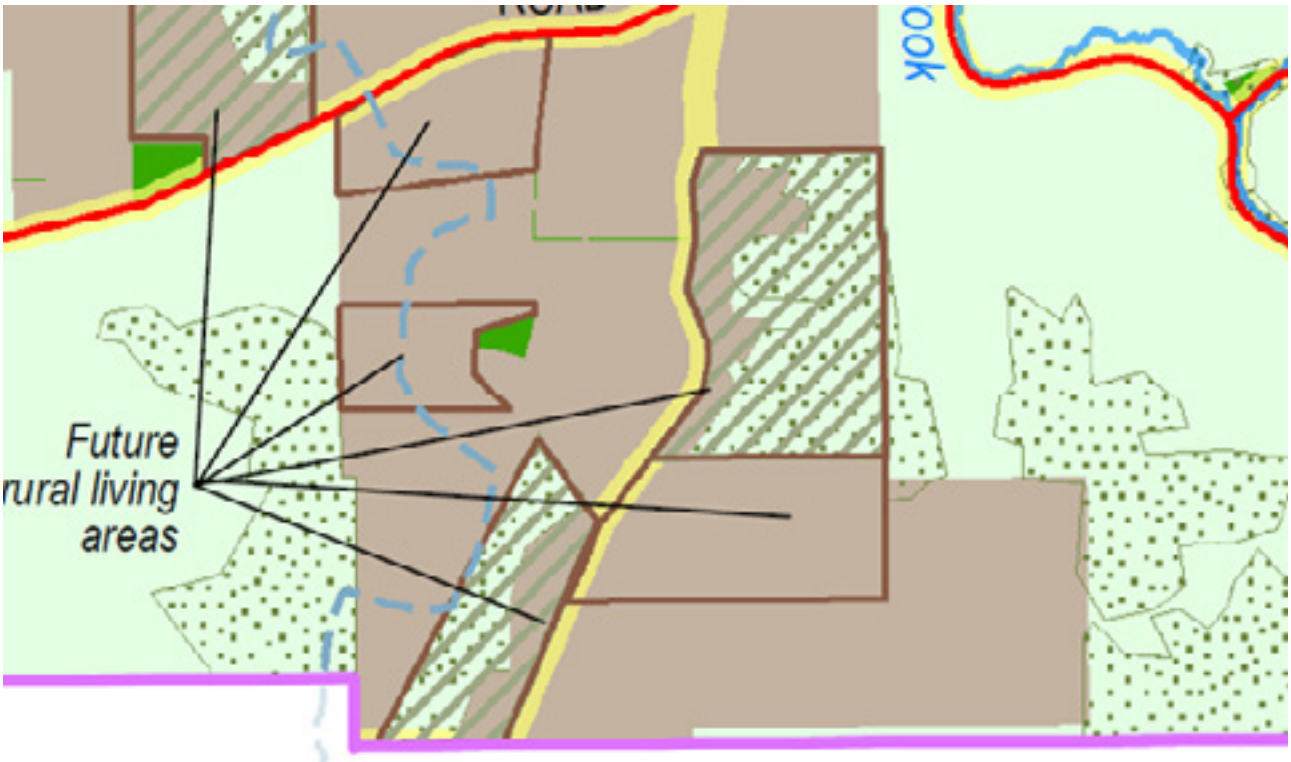
biodiversity assets, with results being available to inform land use planning decisions. The strategy

identifies Indicative High Conservation Value Areas (IHVCA) as well as Regional Ecological Linkages

and Local Ecological Linkages within the shire.

Refer to the Environmental Assessment Report (Appendix E) for further information.

Figure 6: Shire of Chittering Local Planning Strategy Map



2.4 Pre-lodgement consultation

DATE	ATTENDANCE	POINTS OF DISCUSSION
02.12.2020	Shire of Chittering – Executive Manager Development Services, Executive Manager Technical Services and Bushfire Risk Officer	Site visit with landowner and project team The following was discussed: • Review of concept design; • Vegetation retention; • Drainage and water management; • Access • Bushfire management; and • Statutory planning process.
16.07.21	Shire of Chittering Principal Planning Officer DPLH Senior Planning Officers x 2	Presentation of subdivision concept plan and summary of matters relating to bushfire, hydrology and environmental. Suggested by DPLH officers that a structure plan is not required as it is an unnecessary process. The conditions in Schedule 12 and the subdivision application should be adequate to control development.

2.5 Environment

An Environmental Assessment Report (EAR) has been prepared (Appendix E) to support the rezoning of the site by demonstrating that it is capable of supporting sympathetically located rural residential development without adversely impacting on the environment.

Key environmental features of the site include:

- The site is typically undulating, with topography ranging from approximately 200 m Australian Height Datum (mAHD) in the northwest portion of the site, to approximately 258 mAHD in the southeast of the site. Land generally slopes towards existing drainage lines that run south to north through the site.
- Geological maps for the site indicate that underlying geology comprises laterite overlying quartz mica-schist (weathered to silty clay), with areas of sandy silt along drainage channels.
- The site is mapped as having an 'Extremely Low Probability/Very Low Confidence' of containing Acid Sulfate Soils.
- Based on the site geology there is potential for perched groundwater or interflow (lateral flow of water across an impermeable layer) to be present in we period after rains.
- Several mapped watercourses are located throughout the site, flowing in a northerly direction towards Marbling Brook.
- No mapped geomorphic wetlands are located within or in proximity to the site.

2.5.1 Vegetation

Key vegetation and flora values are summarised as follows:

- Vegetation onsite comprised woodland, dampland, drainage line, parkland cleared and planted vegetation types.
- The majority of the site (85.82%) was found to be in 'Degraded' or poorer condition, on the basis of the highly modified and cleared nature of the site.
- No species of Threatened or Priority Flora were found onsite during the vegetation survey. An assessment of the 'Good' condition vegetation areas will be undertaken in Spring 2021 to assess the potential presence of conservation significant species which could occur in this location.
- No Threatened or Priority Ecological Communities were found to be present within the site.
- No Regional Ecological Linkages traverse the site. A local ecological linkage is indicatively located in a north-south alignment throughout the site.

2.5.2 Fauna

Key fauna and habitat values are summarised as follows:

- The fauna assemblage is likely to be depauperate with respect to ground-dwelling species based on the degraded nature of fauna habitat (i.e. lack of understorey).
- The Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso) was the only conservation-significant fauna species that was observed on site.
- 860 trees onsite were identified as potential black cockatoo habitat trees, within 28 of these containing hollows considered potentially suitable for black cockatoos.
- One possible Forest Red-tailed Black Cockatoo roosting location was observed in the western portion of the site, however no actual evidence was observed.
- Quality foraging habitat within the site can be defined as the areas containing marri. This vegetation unit has a total extent of approximately 0.9ha. More expansive foraging areas are likely to occur off site, given there is approximately 22,000 ha of remnant native vegetation within 12 km of the survey area.

2.5.3 Design and Management Actions

Design and management actions proposed for the site include the following:

- Limiting potential vegetation impacts to building envelopes, road reserve and asset protection zones areas which results in:
    - Potential impacts to 2.24ha (9%) of vegetation within building envelopes and road reserves
    - Potential impact to 4.65ha (19%) of vegetation within asset protection zones
    - Retention of a minimum of 18.03ha (72%) of vegetation located outside of building envelopes, road reserves and asset protection zones.
- Buffer to creek lines to be provided as follows:
    - Minimum 30m buffer to be provided between building envelopes and creek lines
    - 100m buffer to be provided between onsite wastewater disposal areas and creek lines
- Building envelopes have been sighted to minimise impacts to vegetation and habitat trees. Only 3 of the 28 habitat trees with hollows potentially suitable for black cockatoos intersect building envelopes.
- The design provides for habitat trees to be located as follows:
    - 98 (11%) habitat trees within building envelopes and road reserves, which may be impacted by development of the site
    - 182 (21%) habitat trees within asset protection zones which will be maximised for retention where possible
    - 580 (67%) habitat trees in other portions of the site which will not be impacted by the development
- Bushfire management actions proposed for the site minimise environmental impacts through:
    - Removal of habitat trees with hollow potentially suitable for black cockatoos located within asset protection zones will be avoided.
    - Strategic firebreaks will be utilised to minimise vegetation clearing requirements
- Construction and development protocols to minimise environmental impacts will include:
    - Prior to the commencement of clearing the clearing and construction boundary will be surveyed to ensure it is accurately located and demarcated.
    - Clearing will be undertaken in the direction of retained vegetation in order to encourage any remaining fauna to move in this direction.
    - Any vehicles on site will be restricted to the clearing and construction area footprint to minimise impact to vegetation beyond this boundary. Vehicle movements will be restricted to speeds of 30 km/hour.

Based on the above it is concluded that development of the site as proposed will not result in unacceptable environmental impacts. Refer to Appendix E for further information.

2.6 Heritage

2.6.1 European Heritage

The subject site is not listed on either the State Heritage Register or the Shire of Chittering Municipal Inventory.

2.7 Aboriginal Heritage Assessment

The Department of Aboriginal Affairs Aboriginal Heritage Inquiry System advises that there are no Registered Sites within the subject lots.

2.8 Bushfire Management

The subject site is designated as bushfire prone on the WA Map of Bush Fire Prone Areas (DFES 2021) due to the extent of on-site and adjacent vegetation. As a result, Strategen has prepared this Bushfire Management Plan (BMP) (refer to Appendix F) to inform strategic planning and fulfil the following key objective:

1. Accompany the rezoning application to the WAPC in order to meet planning requirements triggered under State Planning Policy 3.7 Planning in Bushfire-Prone Areas (SPP 3.7; WAPC 2015).

The following information is required to accompany the rezoning application and Structure Plan submission under SPP 3.7 Policy Measure 6.3:

- where the lot layout of the proposal is known, a Bushfire Attack Level (BAL) contour map to determine the indicative acceptable BAL ratings across the subject site, in accordance with Guidelines for Planning in Bushfire-Prone Areas (the Guidelines; WAPC 2017);
- identification of any bushfire hazard issues arising from the BAL contour map; and
- clear demonstration that compliance with the bushfire protection criteria in the Guidelines can be achieved in subsequent planning stages

The BMP has been prepared in accordance with the Guidelines and addresses all of the above information requirements to satisfy SPP 3.7.

The purpose of this BMP is to provide guidance on how to plan for and manage the bushfire risk to future life and property assets of the project area through integration of a range of bushfire management measures into development design and construction. The BMP outlines how future on-site assets can be protected during the summer months when the threat from bushfire is at its peak.

This is particularly relevant when existing fire appliances in the area may be unable to offer an immediate emergency suppression response; therefore, development planning and design should aim to provide mitigation strategies that protect future life and property from bushfire as a priority.

Strategen has identified a range of bushfire management measures that on implementation will enable all lots within the project area to be developed with a manageable level of bushfire risk and full compliance with the Guidelines and AS 3959. The bushfire management measures are discussed in the appended Bushfire Management Plan (Strategen, 2021).

Future BMPs prepared for subsequent subdivision and development applications are to meet the relevant commitments outlined in this strategic level BMP, address the relevant requirements of SPP 3.7 (i.e. Policy Measures 6.4 and 6.5 respectively) and demonstrate in detail how the proposed development will incorporate the relevant acceptable solutions or meet the performance requirements of the Guidelines.

2.9 Engineering and servicing consideration

A Preliminary Servicing Report has been prepared for the site which demonstrates that relevant services and infrastructure can be provided to facilitate development. This is provided as Appendix C.

2.9.1 Water Supply

Water supply to service dwelling will be by way of tanks installed on site and maintained by lot owners. A sufficient number of tanks will be installed by landowner, purchaser of lot, that will be filled via roof and other runoff. It is not proposed that the land developer will provide any water supply systems or tanks for individual lots. Refer to Condition 7 in Schedule 12 of LPS3 which states: All lots are to be provided with a demonstrated sustainable fit-for-purpose water supply in accordance with Scheme requirements, including the provision of a 120,000L tank.

2.9.2 Wastewater

The site will not be provided with a reticulated sewer system and is located within a sewerage

sensitive area. As such, lots will be required to treat and dispose of wastewater within lot boundaries and meet requirements of the Government Sewerage Policy (GSP) (State Government of Western Australia, 2019).

It is proposed to utilize secondary treatment systems to treat wastewater, with on-site irrigation areas being located 100m away from watercourses and at least 1.5m clearance between groundwater (perched) and the irrigation areas. Refer to the LWMS (Appendix D) for further information.

2.9.3 Power

There is existing Western Power infrastructure in the vicinity of the site. Western Power services consist of a 33kV high voltage aerial power line on the western side of Morley Road and underground high voltage power lines at the northern ends of the existing constructed Thornbill and Bronzewing roads. Low voltage power cables also exist on the eastern side of Morley Road that runs from the south western corner of the development lot to a power transformer in Turtledove Drive and at the northern end of Thornbill and Bronzewing.

2.9.4 Communications

Telstra infrastructure is available in the area. It is expected that there are too few lots to require an NBN development.

2.9.5 Drainage

Roads will be constructed with one-way crossfall towards the high side of the road. Water runoff will be directed to a table drains that will run parallel to the road and cater for stormwater runoff that will ultimately flow to the existing creek. Water flow will be controlled by the construction of vee drain weirs and possible detention basins depending on water runoff and velocity.

Where lot access crossings are constructed, and traverse table drains 375mm diameter pipe with headworks will be installed to ensure free flow of water runoff. Refer to the LWMS (Appendix D) for further information.

2.9.6 Gas

A reticulated gas supply is not available to the site.

2.10 Hydrology

A Local Water Management Strategy (LWMS) has been prepared for the site to demonstrate that the land is capable of supporting the proposed urban development with regard to water management (refer Appendix D).

The following table summarises the key elements of the site and the proposed hydrological management:

Key Elements	Description
Site Characteristics	• The site has an undulating topography, incised by drainage lines and dams. • Underlying soils are predominantly low permeability clays, cemented material, rock and silt, with a small area of sandy gravels to the mid- west. • Site soils are likely to be moderately to very strongly adsorbing of phosphorus. • The site is mapped within a sewerage sensitive area – the Brockman River catchment. • Drainage lines flow into the Marbling Brook from south to north, which ultimately flows into the Brockman River. • An on-site ground truthing drainage assessment determined the nature and extend of existing watercourses. This indicated the site is no longer hydrologically connected to the neighbouring site to the south, and minor changes to drainage lines in the centre and east of the site. • Groundwater was encountered at one location during geotechnical investigations. The site is likely to encounter perched groundwater in wet months.
Water Use Strategy	• Rainwater tanks will provide residential water supply. • Onsite wastewater treatment is required as no connection to the reticulated network is possible. • GSP requirements for onsite sewerage disposal will be met, with 100m buffer zones to watercourses and at least 1.5m clearance between groundwater (perched) and secondary treatment systems.
Stormwater Management	• Roof runoff will be collected for residential water use, disconnecting the lot impervious areas from the stormwater system. • Predevelopment catchments will be maintained post development and mimic the predevelopment hydrological processes. • A series of table drains, and weir systems will slow down peak flows and the velocity of stormwater from roads and convey stormwater runoff to existing watercourses. • The weir system will manage the first 15mm of rainfall and prevent scour and erosion in larger storm events. • The weir system will treat water quality parameters of concern such as sediments. • Overland flow paths will be managed in the table drains, road reserve and one drainage easement.
Groundwater Management	• The site is underlain by low permeability material at or just below the surface in most areas. Perched groundwater is therefore likely to occur. • No subsoil drainage is proposed. • Fill will be used to manage required building pad clearances and wastewater disposal area clearances.

Key Elements	Description
Flood management	• No regional flood mapping is available for the watercourses due to their minor ephemeral nature. • In accordance with Schedule 2 of the State Planning Policy 2.9 Water Resources (WAPC, 2006) and WAPC Development Control Policy 2.3 a setback of 30 m from ephemeral watercourses to the building pad envelopes has been provided to mitigate flood risk.
Monitoring and Reporting	• Post-development surface water monitoring in WC1 is proposed for two years post-development. • A final monitoring report will be provided prior to handover to council.

3.0 Schedule 12 – Rural Residential

In order to guide the subdivision and development on the subject site, it is proposed to insert the following table into Schedule 12 of LPS6:

No.	Description of Land	Conditions
2	Lot M1942 Morley Road, Lower Chittering	**General** 8. These conditions shall apply in conjunction with the Scheme requirements for the Rural Residential zone, and/or as otherwise approved by the local government. Where conflicts exist, these conditions prevail. 9. The minimum lot size shall be two (2) hectares. **Structure Planning** 10. A structure plan is not required to facilitate subdivision and development subject to the plan of subdivision and application meeting Conditions 4 to 5 below. **Subdivision** 11. The plan of subdivision and application must: c. identify building envelopes/exclusion areas which respond to the significant environmental features of the site, including: v. achieving suitable separation from water resources; and vi. minimising the clearing of vegetation including for asset protection zones, access, firebreaks, fencing and on-site effluent disposal systems; d. provide a logical road network designed to: iv. link the subdivision area from its eastern boundary to Morley Road; v. connect to Thornbill Place and Bronzewing Court; and vi. provide direct access to Lot 5 Morley Road. e. be supported by: iv. an approved Local Water Management Strategy; v. a site and soil evaluation conducted in accordance with AS/NZS 1547 On-site domestic wastewater management; and vi. a bushfire management plan. **Local development plan** 12. A local development plan is to be prepared and approved identifying building envelopes/exclusion areas consistent with Conditions 1 to 4 above.

No.	Description of Land	Conditions
		Development and clearing of land 13. Development shall be in accordance with the approved local development plan. 14. Other than to provide for subdivision in accordance with the conditions above, no further areas of vegetation shall be cleared felled or removed unless: j. the vegetation is dead, diseased or poses a danger to humans or stock; or k. the clearing is necessary for any firebreak required by law; or l. the clearing is required to provide for access to an approved dwelling or outbuildings; or m. the clearing is consistent with the parameters of an established building envelope/exclusion area; or n. the clearing is necessary to comply with the required bushfire management plan.

The conditions stated in this table address the matters raised in the Shire's Local Planning Strategy and relevant State Planning Policies.

4.0 Subdivision Concept Plan (SCP)

To ensure the design of future development responds to the varied constraints and planning instruments which relate to the subject site, the landowners engaged the expertise of specialist planning, environmental, bushfire, hydrological and engineering consultants to assist with the preparation of design concept for the subject site. The design concept and environmental management strategy detailed above demonstrate that the site is capable of sustaining rural residential development as envisaged by the strategic planning framework, whilst ensuring an improved and long-term solution for the preservation and enhancement of the sites ecological values.

In preparing the SCP (Appendix B), the project team has liaised with the Shire of Chittering, the Department of Planning and Department of Water and Environmental Regulation, to ensure the design responds to the various constraints and characteristics of the site and the broader regional context.

Under section 4.2.8 – 'Rural Residential Zone' of TPS6, the following objectives are outlined for the Rural Residential zone:

- To designate areas where rural residential developments can be accommodated without detriment to the environment or the rural character of the area.
- To meet the demand for a rural lifestyle on small lots, generally in excess of 1 hectare.
- To maintain and enhance the rural character and amenity of the locality.

As indicated within the SCP, the proposed lots will be subdivided into lots not less than 2 hectares each, therefore fulfilling the land size objectives of the Rural Residential zone.

It is anticipated that the SCP may be amended to reflect advice from various consultants during the preparation of the detailed subdivision design and Local Development Plan and it is therefore noted that the attached SCP is only an indicative plan at this stage.

4.1 Design Response

At the centre of the design response for the subject site is the aspiration to integrate human activity and habitation with the natural environment in a respectful and responsive way.

The concept planning for the site begins with an understanding of the site's topography, vegetation and the water courses, drainage lines and bush fire constraints. The design concept responds to the topographic opportunities, and capitalises upon the amenity offered by the site attributes and surrounding land.

4.1.1 Design Objectives

In accordance with State and Local planning requirements and the characteristics of the site the following design objectives have informed the design of the ISCP:

- Retain key natural landforms and vegetation to protect the sense of place distinctive to the Lower Chittering hills;
- Protection of watercourses;
- Mitigate bushfire risk; and
- Integrate with existing and future rural residential development.

4.1.2 Movement

The proposed lots will gain access from Morley Road in addition to integrating with Thornbill Place and Bronzewing Court on the subject site's southern boundary. A subdivision road will also connect to the north to Lot 5 Morley Road. This integration will assist with permeability to address bushfire access and facilitate future subdivision and development on Lot 5.

4.1.3 Environmental

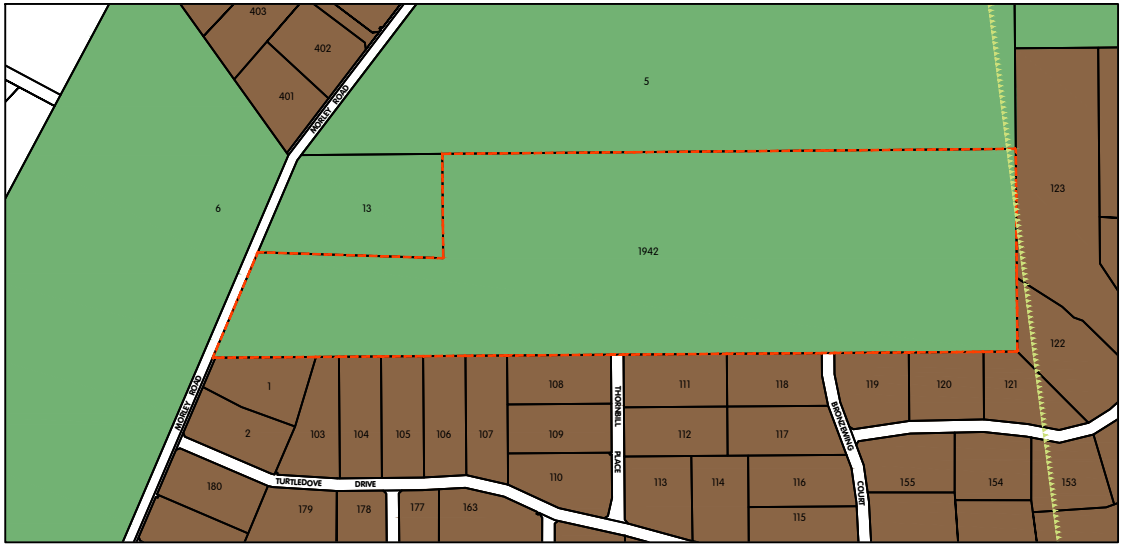
The proposed roads and building envelopes have been designed to avoid impacting on environmentally sensitive areas or attributes, where possible. No vegetation rated 'Good' higher is to be impacted by subdivision works or development. The proposed secondary treatment system irrigation areas are appropriately setback from watercourses and drainage lines.

5.0 Conclusion

The proposed design concept and associated environmental management strategy, Local Water Management Strategy, engineering report and bushfire management plan for the subject site demonstrates that the proposed for 'Rural Residential' zoning on Lot M1942 Morley Road, Lower Chittering is suitable.

Appendix A

Scheme Amendment Map



EXISTING ZONING

LEGEND

Subject Site

LOCAL SCHEME ZONES

Agricultural Resource

Rural Residential

OTHER

Landscape Protection

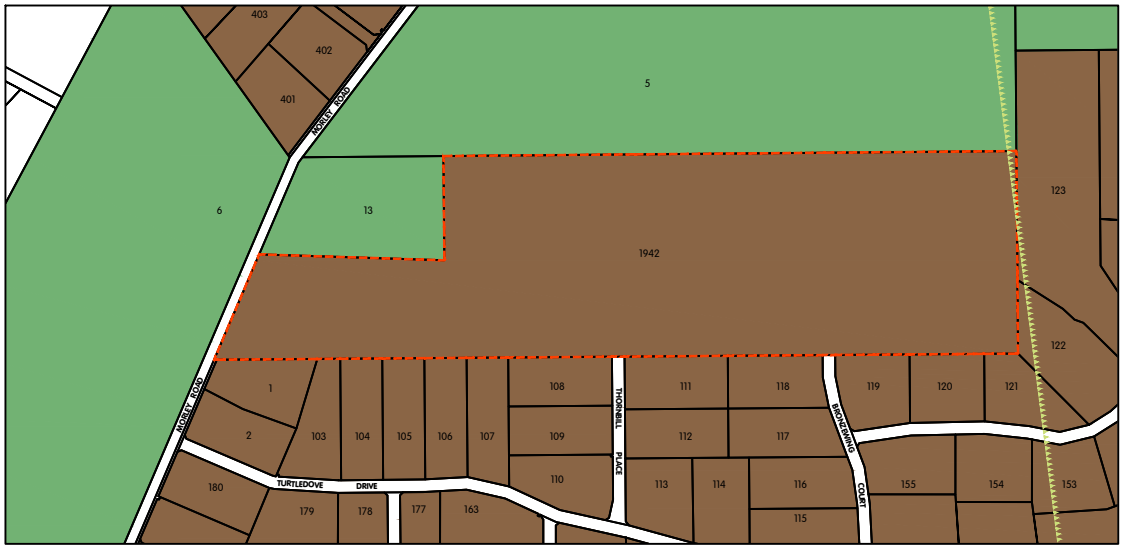
No Zone

ADOPTION/REFUSAL

ADOPTION [Regulation 12(1)]
ADOPTED by resolution of the Council of the Shire of Chittering at the Ordinary Meeting of the Council held on the _____ day of _____, 202__.

_____
PRESIDENT

_____
CHIEF EXECUTIVE OFFICER



PROPOSED ZONING

LEGEND

Subject Site

LOCAL SCHEME ZONES

Agricultural Resource

Rural Residential

OTHER

Landscape Protection

No Zone

FINAL APPROVAL

1. FINAL ADOPTION BY COUNCIL

   Adopted for Final Approval by Resolution of the Shire of Chittering at the _____Meeting of Council held on the day of _____ _____. _____ The Common Seal of the Shire of Chittering was hereunto affixed by authority of a resolution of the Council in the presence of:

   _____
   PRESIDENT

   _____
   CHIEF EXECUTIVE OFFICER

2. RECOMMENDED / SUBMITTED FOR FINAL APPROVAL:

   _____
   DELEGATED UNDER S.16 OF PD ACT 2005

   Date:_____

3. FINAL APPROVAL GRANTED

   _____
   MINISTER FOR PLANNING

   Date:_____

Shire of Chittering

TOWN PLANNING SCHEME No.6 AMENDMENT

(District Scheme)

N

0 metres 150 300 450 600 750

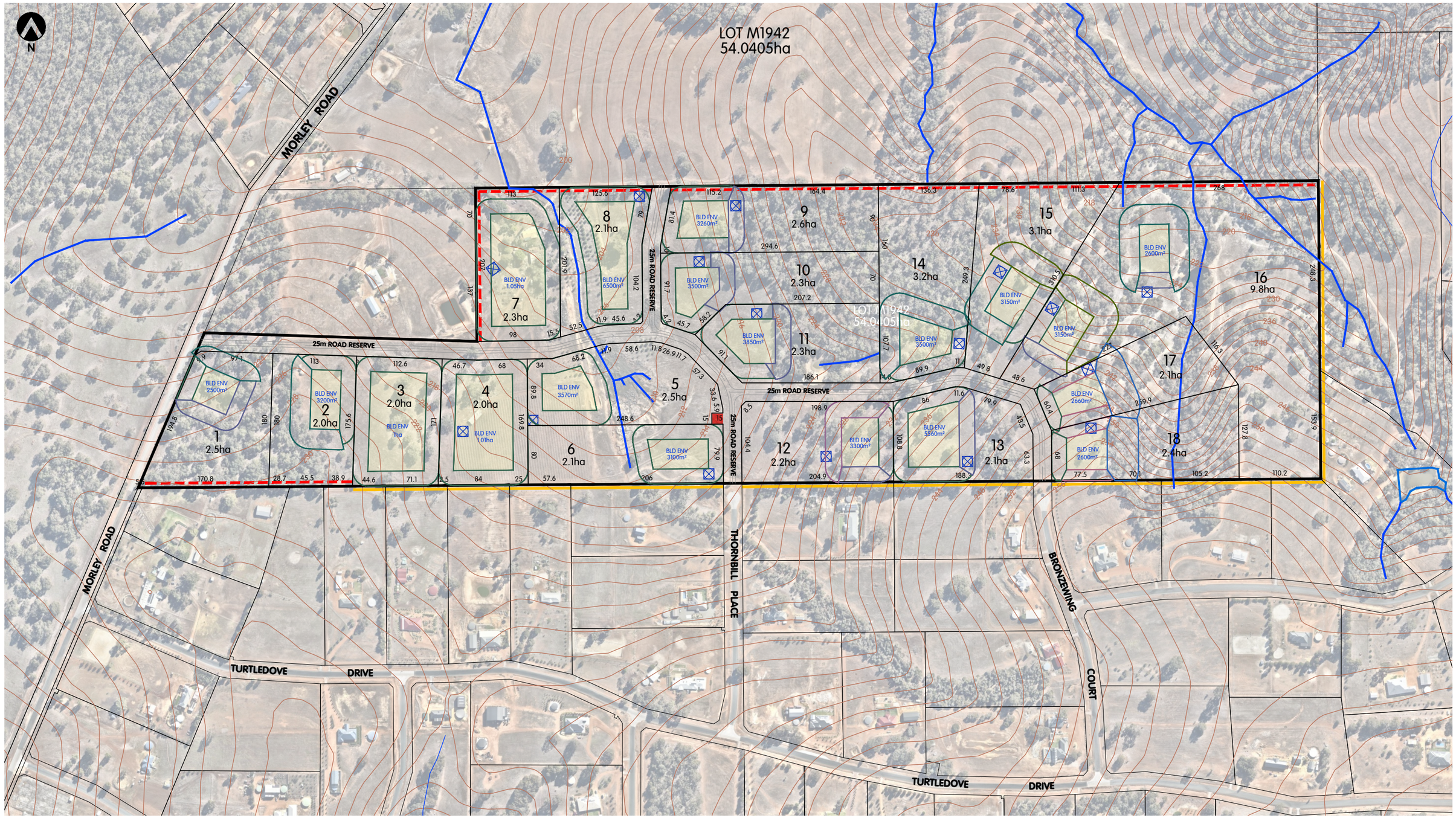
SIZE A4

DISCLAIMER: ISSUED FOR DESIGN INTENT ONLY. ALL AREAS AND DIMENSIONS ARE SUBJECT TO DETAIL DESIGN AND SURVEY - JOB CODE_CPGCHI DES DWG 003A

Appendix B

Subdivision Concept Plan

(HATCH ROBERTSDAY)



LEGEND

- 196m² WASTE WATER DISPOSAL AREA
- WATER COURSE
- BLD ENV — BUILDING ENVELOPE
- 6.0m FIRE SERVICE ACCESS ROUTE (ALIGNMENT TBC)
- EXISTING FIRE SERVICE ACCESS ROUTE
- WATER TANK SITE

APZs

- 15m
- 20m
- 21m
- 22m
- 27m
- 33m
- 42m

CADASTRAL INFORMATION
SOURCE: LANDGATE
YYMMDD: 201023
DWG REF: CHITTERING_CAD_201023
PROJECTION: GDA94
AERIAL PHOTOGRAPHY
SOURCE: NEARMAP
YYMMDD: 200509

HATCH | RobertsDay

SIZE A3_1:5000

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REV	DESCRIPTION	YYMMDD	DRAWN	APPR'D
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JOB CODE	SERVICE	DOC.TYPE	DRAW NO.	REV.
CPGCHI	DES	DWG	004	A

SUBDIVISION CONCEPT PLAN
M1942 Morley Road, Lower Chittering
Shire of Chittering

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Appendix C

Engineering Servicing Report

(PRITCHARD FRANCIS)

293 (M1942) Morley Road, Lower Chittering

Desktop Engineering Servicing Assessment

Project No: 20-030



pritchard francis lite
civil engineering consultants

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1 Introduction 4
2 Site Description 4
3 Local Authority 4
4 Geotechnical and Environmental 4
4.1 Ground Conditions 4
4.2 Acid Sulphate Soils 4
4.3 Aboriginal Heritage 4
5 Ground Water 4
6 Earthworks and Clearing 5
7 Roadworks and Lot Access 5
8 Stormwater Drainage 5
9 Water Supply 5
10 Wastewater Disposal 5
11 Electricity Services 6
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12 Communication 6
12.1 Developer Responsibility 6
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13 Conclusion 7

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Appendix Two: Layout and Topography Plan

Appendix Three: Geotechnical Site Plan

Appendix Four: Acid Sulphate Plan

Appendix Five: Aboriginal Heritage Plan

Appendix Six A: Typical Road and Drainage Plan

Appendix Six B: Crossover Detail Plan

Appendix Six C: Typical Drainage Control Systems Plan

Appendix Seven A: Underground Power Plan – Morley Road

Appendix Seven B: Underground Power Plan – Thornbill Place

Appendix Seven C: Underground Power Plan – Bronzewing Court

Appendix Seven D: Overhead Power Plan – Morley Road

Appendix Eight A: Telstra Plan – Morley Road

Appendix Eight B: Telstra Plan – Bronzewing Court

Revision	Description	Author	Date
0	Issued for Report	Philip Patterson	9 July 2021

1 Introduction

This report has been prepared by Pritchard Francis Lite for Sicicalab Pty and Cuttone Property Group and investigates and summarises services associated with servicing the proposed development off Morley Road, Lower Chittering (293 Morley Road, Lower Chittering).

The proposed development covers 54.03ha and will consist of 18 special rural lots when development is completed.

This report covers engineering infrastructure requirements including, roads, power and communication.

The information provided is based on information available as at June 2021.

2 Site Description

293 Morley Road is located about 63km north east of Perth CBD in the Shire of Chittering. See Appendix 1 for site location.

The site is located on the eastern side of Morley Road, about 3km south of East Muchea Road and Morley Road intersection. South of the development is an existing special rural development that this development will abut.

The site is undulating with the highest level of about 258m occurring in the south eastern part of the site. Where the development land ties in with Morley Road levels range from 220m to 230m AHD. The site grades down to 2 distinct valley/creek lines, which run through the centre of the property. These can be seen in Appendix 2 – Layout and Contour Plan.

The site is sparsely vegetated with more dense vegetation present along Morley Road and in the eastern portion of the development land. Lots have been configured to ensure suitable building areas are available on each lot with minimal clearing required.

3 Local Authority

As mentioned previously, the development site is located in the Shire of Chittering. The Shire is aware of the development and have been on site.

4 Geotechnical and Environmental

4.1 Ground Conditions

Geotechnical mapping indicates the site is generally made up of clayey material with sandy silt along the main drainage route which runs through the centre of the development (See Appendix 3 – Geotechnical Conditions).

4.2 Acid Sulphate Soils

The State Government produces a map which identifies possibility of acid sulphate soils. This plan identifies areas of low and high risk Acid Sulphate conditions. Information obtained for this development site indicates that there is no known risk of acid sulphate material on this site. See Appendix 4

4.3 Aboriginal Heritage

A search of Native Title/Heritage Registry has been undertaken and there is no Aboriginal Heritage places of interest noted on the land being developed. See Appendix 5

5 Ground Water

There are no published groundwater contours for this site available.

Given the presence of clay, it is possible that perched ground water will be evident during and following rainfall events. These events will mainly produce water runoff that will flow to the lower lying land (creeks) where water will flow and be discharged off the site.

6 Earthworks and Clearing

It is envisaged clearing of the land will be minimal and will mainly occur in road reserves where there are minimal trees.

Earthworks will be required for construction of roads and installation of services. This work will mainly be confined to proposed road reserves and not within the main proportion on the lots. Roads will be designed to match existing topography, where possible thus minimising earthworks. This will also avoid excessive earthworking of the remaining land thus avoiding disturbance of natural vegetation and land.

7 Roadworks and Lot Access

From previous experience and discussions with the local authority, Shire of Chittering, road construction will consist of one way crossfall pavements that will grade towards the high side of the road. This will reduce scouring of the lower batter and control stormwater runoff. See Appendix 6A.

The development will be serviced by unkerbed roads made up of a 7.0m wide asphalt running surface with 1.2m wide shoulders on either side of the asphalt, producing a 9.4m wide pavement formation. See Appendix 6A.

Intersection will be kerbed. Kerbing of steep grades will also be carried out to avoid water scouring and extensive lengths of rock pitching. Kerbing will be introduced to control water flows where required.

Extension of existing constructed roads will be accommodated for as part of the design phase to ensure a smooth tie-in with the existing Morley Road, Bronzewing Circuit and Thornbill Place.

Intersection will have lighting installed to luminate intersection.

In order to control lot access points, it is proposed to construct lot cross overs which will not only control location of crossings but also minimise disturbance to vegetation. These cross overs will be made up of a 4.0m wide sealed asphalt pavement with 0.3m wide unsealed shoulders producing a 4.6m wide formation. See Appendix 6B.

8 Stormwater Drainage

As mentioned in the previous road works section, roads will be constructed with one-way crossfall towards the high side of the road. Water runoff will be directed to a table drains that will run parallel to the road and cater for stormwater runoff that will ultimately flow to the existing creek.

Water flow will be controlled by the construction of vee drain weirs and possible detention basins depending on water runoff and velocity. (See Appendix 6A and 6C for typical drainage control methods.

Where lot access crossing are constructed and traverse table drains dia 375mm pipe with headworks will be installed to ensure free flow of water runoff.

9 Water Supply

Water supply to service dwelling will be by way of tanks installed on site and maintained by lot owners. A sufficient number of tanks will be installed by landowner, purchaser of lot, that will be filled via roof and other runoff. It is not proposed that the land developer will provide any water supply systems or tanks for individual lots.

10 Wastewater Disposal

Lots in the development will require private effluent treatment systems that will be installed by individual lot owners at time of dwelling construction.

Due to water courses and sensitivity of the area, Urbaqua have undertaken a separate study which confirms all lots can be serviced by a suitable wastewater disposal system that will not affect the environment or water courses. A separate plan has been prepared and is shown in Urbaqua's report. This report shows the location of the wastewater disposal system for individual lots. These systems are to be installed by individual lot owners.

11 Electricity Services

11.1 Existing Power Network

There is existing Western Power infrastructure in the vicinity of the site. Western Power services consist of a 33kV high voltage aerial power line on the western side of Morley Road (See Appendix7D) and underground high voltage power lines at the northern ends of the existing constructed Thornbill and Bronzewing roads. (See Appendix 7B and 7C). Low voltage power cables also exist on the eastern side of Morley Road that runs from the south western corner of the development lot to a power transformer in Turtledove Drive and at the northern end of Thornbill and Bronzewing. (See Appendix 7A, 7B and 7C).

There do not appear to be any Western Power assets within the development site.

11.2 Relocation of Existing Assets

From Dial Before You Dig information and an on-site inspection of Western Power assets confirmed overhead power lines do not run along the eastern side of Morley Drive in front of the lot and therefore we would expect no undergrounding or relocation of Western Power equipment be required.

11.3 Servicing of Lots

To service the 18 lots an underground 3 phase power supply will need to be installed. Western Power will own and maintain the direct and buried cables including transformers. New transformers will be installed with power supply being provided to individual lots.

The existing Western Power network has been set up to service this development and by way of extending the existing underground HV power cable in Thornbill and Bronzewing and connecting to the overhead HV power line in Morley Road, a suitable underground power system can be installed to service the development.

As mentioned previously, all newly created roads will require lighting of intersections to comply with Shire of Chittering requirements. Being a special rural development lighting of roads is not required.

12 Communication

12.1 Developer Responsibility

Developers have 2 obligations in relation to the provision of telecommunications infrastructure. Under the ACT, developers are obliged to provide a fibre ready pit and pipe to all new developments and under Federal Governments Telecommunications policy developers are required to provide telecommunications infrastructure as they do other utilities.

12.2 Proposed Communication Network

Given the size of the development and that Telstra have a significant network of infrastructure surround the development (see Appendix 8A & 8B) NBN may decline servicing this development but the developer will still have to install pits and pipe in readiness for cables to be installed.

If the development is outside NBN Co's footprint and expansive back haul changes are imposed, other suppliers such as Telstra or Opticomm can provide a communication system to service the development, For this development as Telstra already have a substantial network in the area, it is likely Telstra or Opticomm may install and maintain a communication system for the development.

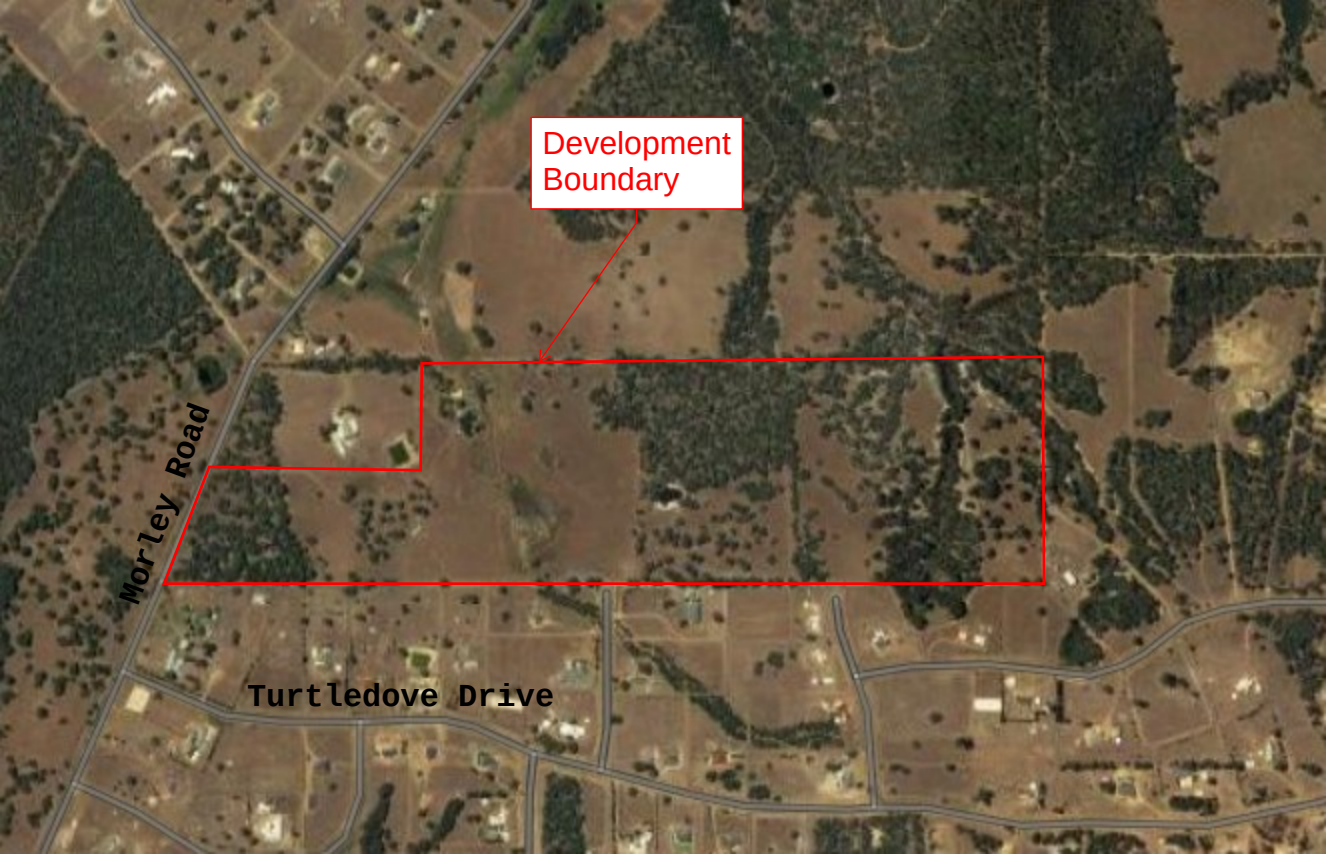
13 Conclusion

Indication from service and other authorities confirm that development of 293 Morley Road, Lower Chittering can be fully serviced and there are no issues getting the required services to site and complying with authorities legislation and requirements.

Appendices

Appendix One:	Site Plan
Appendix Two:	Layout and Topography Plan
Appendix Three:	Geotechnical Site Plan
Appendix Four:	Acid Sulphate Plan
Appendix Five:	Aboriginal Heritage Plan
Appendix Six A:	Typical Road and Drainage Plan
Appendix Six B:	Crossover Detail Plan
Appendix Six C:	Typical Drainage Control Systems Plan
Appendix Seven A:	Underground Power Plan – Morley Road
Appendix Seven B:	Underground Power Plan – Thornbill Place
Appendix Seven C:	Underground Power Plan – Bronzewing Court
Appendix Seven D:	Overhead Power Plan – Morley Road
Appendix Eight A:	Telstra Plan – Morley Road
Appendix Eight B:	Telstra Plan – Bronzewing Court

Appendix One: Site Plan



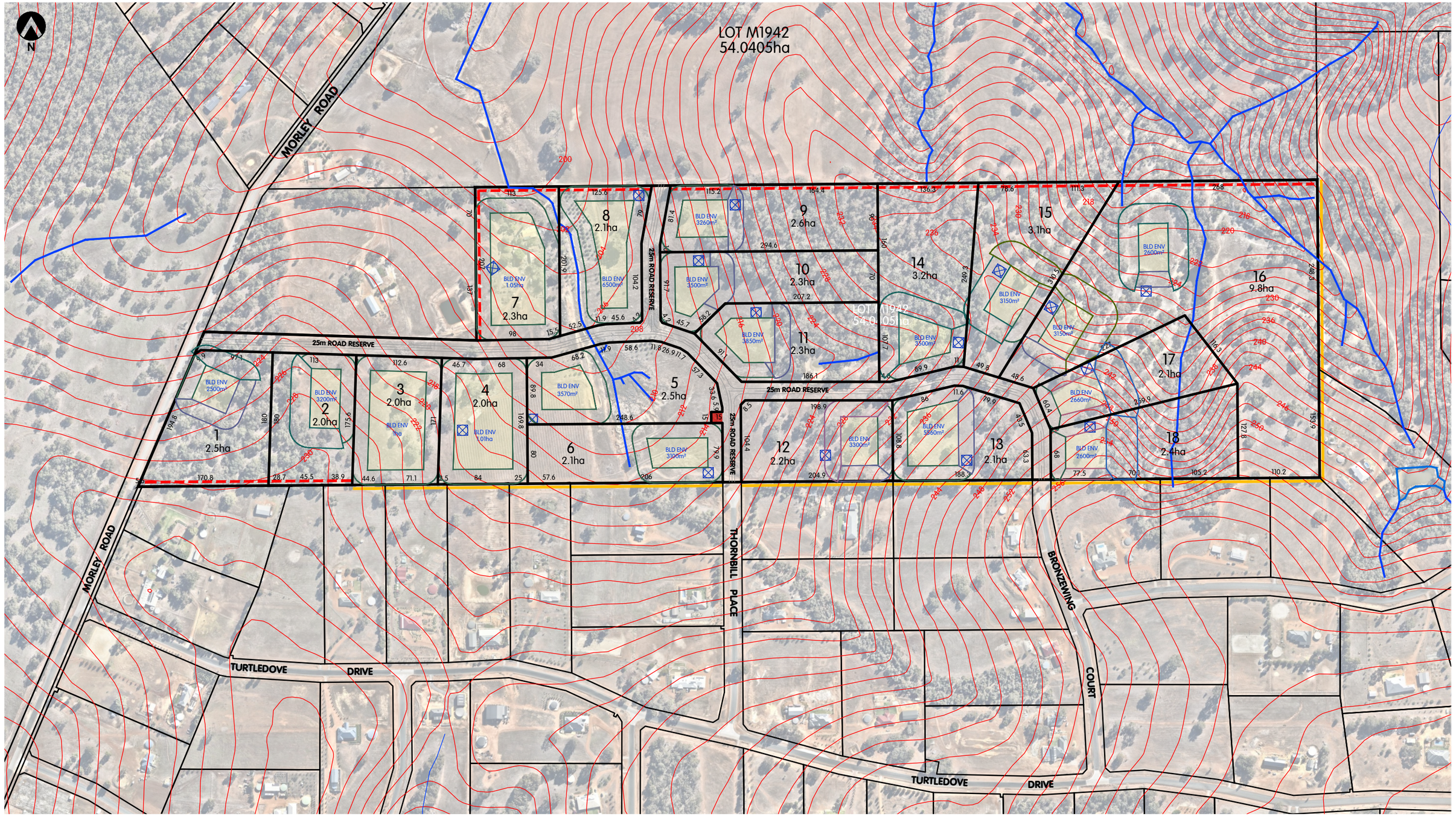
Appendix 1

M1942 Morley Road, Lower Chittering - Site Plan

7th July 2021

File No 20-030

Appendix Two: Layout and Topography Plan



LEGEND

- 196m² WASTE WATER DISPOSAL AREA
- WATER COURSE
- BLD ENV — BUILDING ENVELOPE
- 230 — Existing Ground Levels
- 6.0m FIRE SERVICE ACCESS ROUTE (ALIGNMENT TBC)
- EXISTING FIRE SERVICE ACCESS ROUTE
- WATER TANK SITE

APZs

- 15m
- 20m
- 21m
- 22m
- 27m
- 33m
- 42m

Appendix 2

M1942 Morley Road, Lower Chittering
- Layout and Topography Plan

7th July 2021
File No 20-030

CADASTRAL INFORMATION
SOURCE: LANDGATE
YYMMDD: 201023
DWG REF: CHITTERING_CAD_201023
PROJECTION: GDA94
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SOURCE: NEARMAP
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HATCH | RobertsDay

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DRAFT

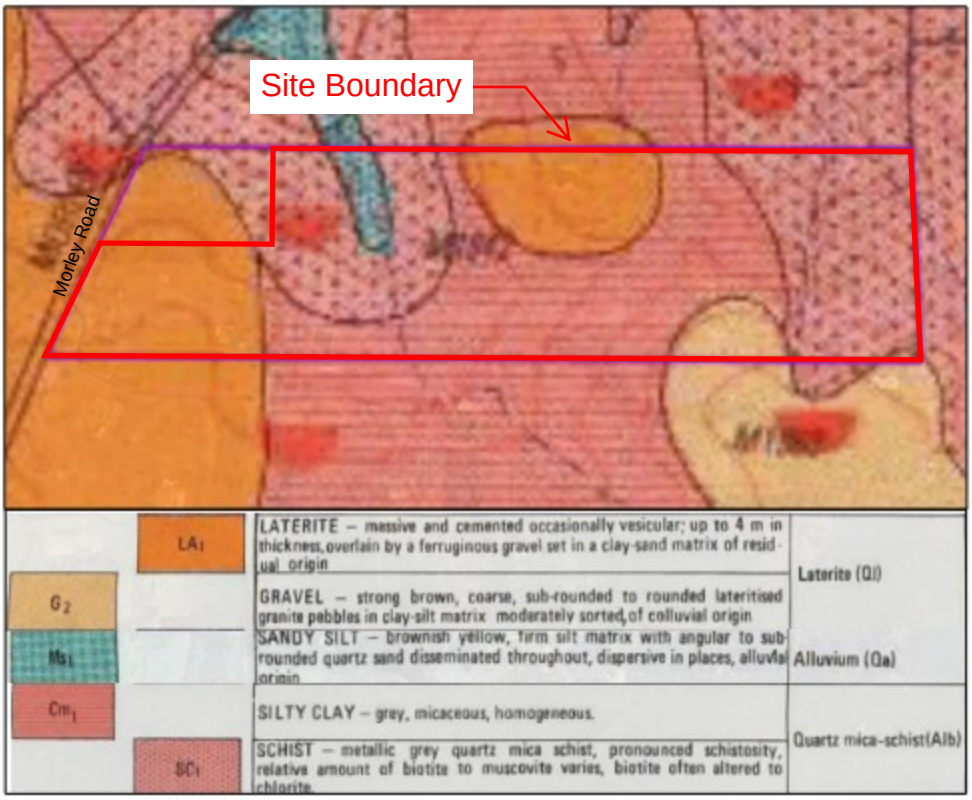
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JOB CODE	SERVICE	DOC.TYPE	DRAW NO.	REV.
CPGCHI	DES	DWG	004	A

SUBDIVISION CONCEPT PLAN
M1942 Morley Road, Lower Chittering
Shire of Chittering

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Appendix Three: Geotechnical Site Plan



	LA_1	LATERITE – massive and cemented occasionally vesicular; up to 4 m in thickness, overlain by a ferruginous gravel set in a clay-sand matrix of residual origin	Laterite (Ql)
G_2		GRAVEL – strong brown, coarse, sub-rounded to rounded lateritised granite pebbles in clay-silt matrix moderately sorted, of colluvial origin	
Ms_1		SANDY SILT – brownish yellow, firm silt matrix with angular to sub-rounded quartz sand disseminated throughout, dispersive in places, alluvial origin	Alluvium (Qa)
Cm_1		SILTY CLAY – grey, micaceous, homogeneous.	
	SC_1	SCHIST – metallic grey quartz mica schist, pronounced schistosity, relative amount of biotite to muscovite varies, biotite often altered to chlorite	Quartz mica-schist(Alb)

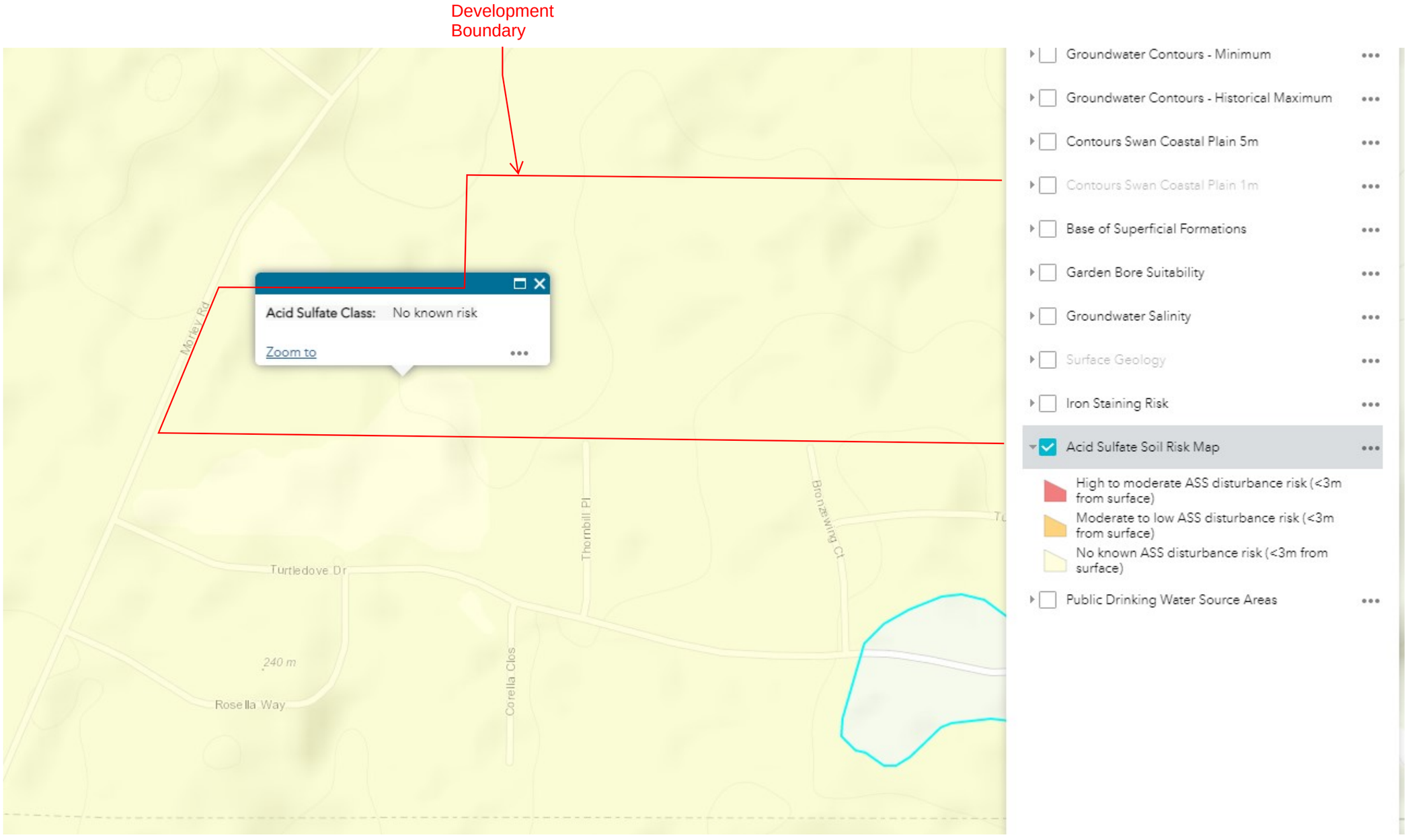
Appendix 3

M1942 Morley Road, Lower Chittering - Geotechnical Site Plan

7th July 2021

File No 20-030

Appendix Four: Acid Sulphate Plan



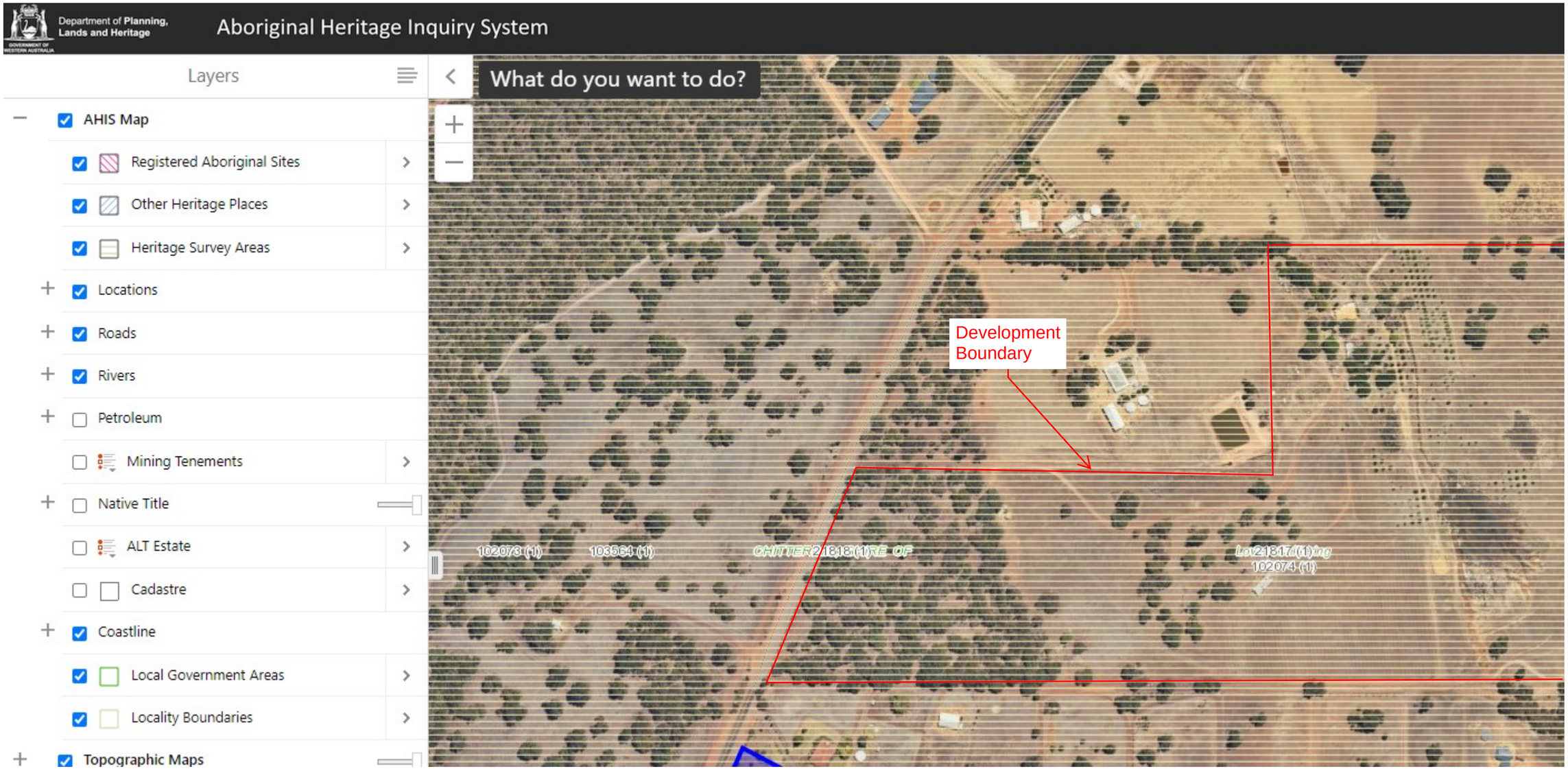
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M1942 Morley Road, Lower Chittering - Acid Sulphate Plan

7th July 2021

File No 20-030

Appendix Five: Aboriginal Heritage Plan



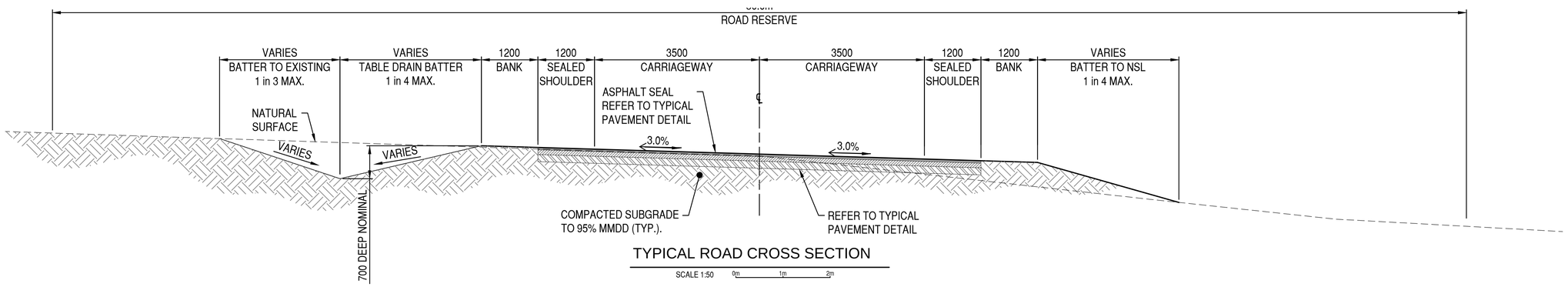
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M1942 Morley Road, Lower Chittering - Aboriginal Heritage Plan

7th July 2021

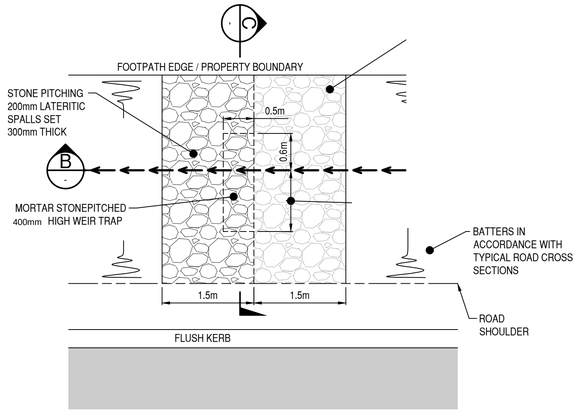
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Appendix Six A: Typical Road and Drainage Plan



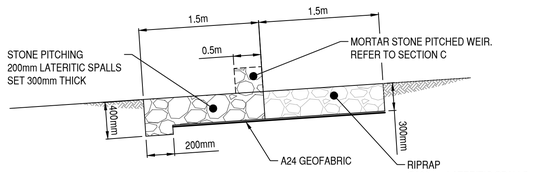
TYPICAL ROAD CROSS SECTION

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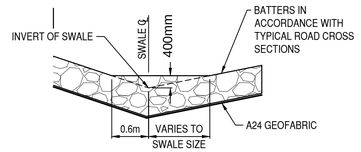


TYPICAL TRAPPED WEIR DETAIL

N.T.S.



SECTION B - N.T.S.



SECTION C - N.T.S.

Appendix 6A

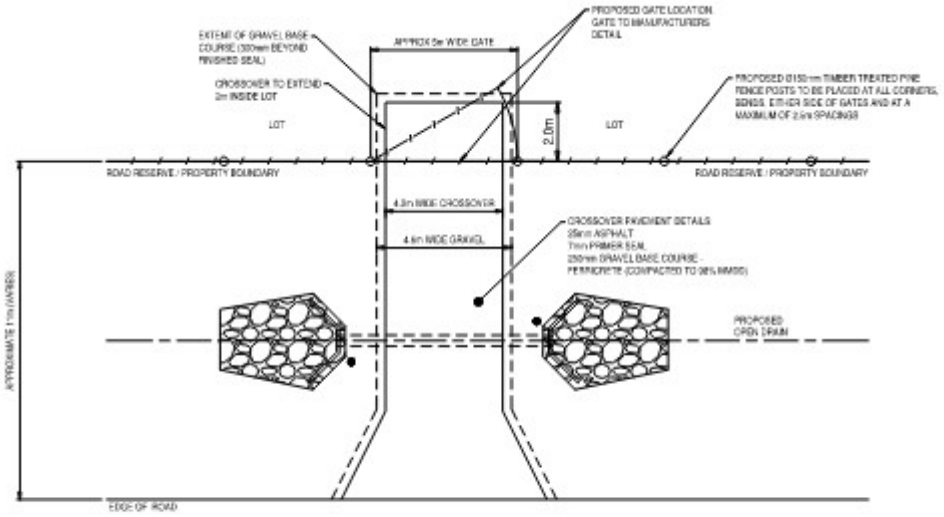
M1942 Morley Road, Lower Chittering - Typical Road and Drainage Plan
7th July 2021
File No 20-030

REV	DATE	DESCRIPTION	BY	CHKR
	15/06/21	INITIAL ISSUE		

pritchard francis lite
civil engineering consultants

DRAWING STATUS: Preliminary Detail Plan
DATE: June 2021 | GRID: LOCAL | DATUM: AHD
DESIGNED | DRAWN | CHECKED | APPROVED ...../ ....
W.A.P.C. | SCALE U.N.O. AS SHOWN @ A1
CLIENT & JOB: Cuttone Property Group
TITLE: Morley Road, Chittering - Development
SHEET SIZE: A1 | DRG No.: 20-030 - PFLT - SK -01 | REVISION: -

Appendix Six B: Crossover Detail Plan



FENCE / GATE SETOUT DETAILS
1:10

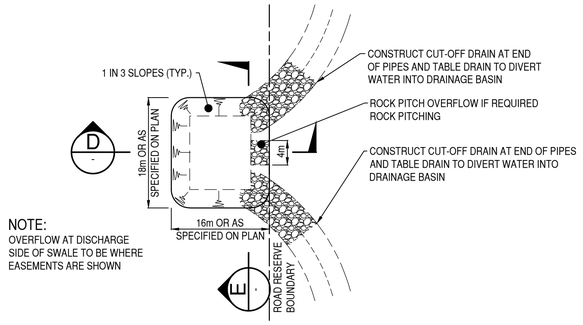
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M1942 Morley Road, Lower Chittering - Crossover Detail Plan

7th July 2021

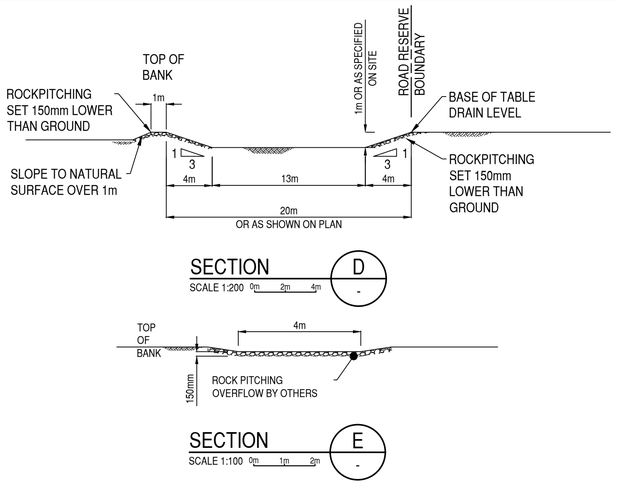
File No 20-030

Appendix Six C: Typical Drainage Control Systems Plan



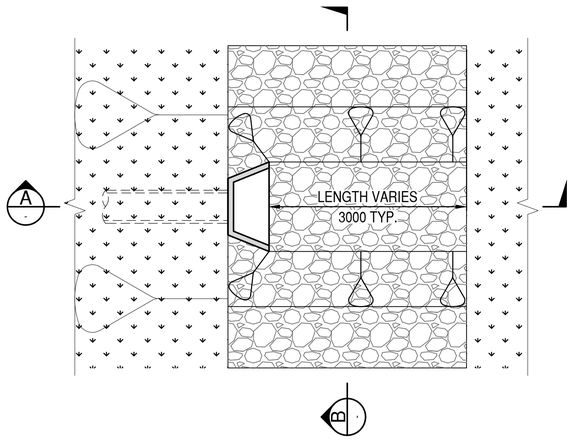
TYPICAL DETAIL DRAINAGE BASIN PLAN

SCALE 1:500

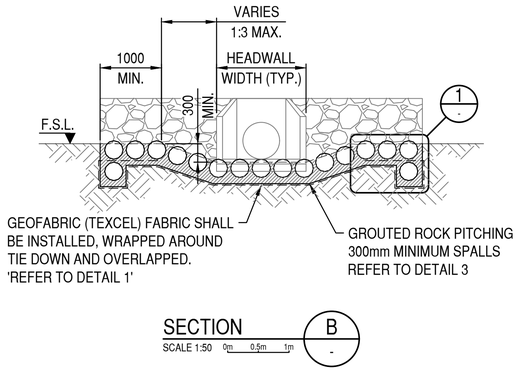


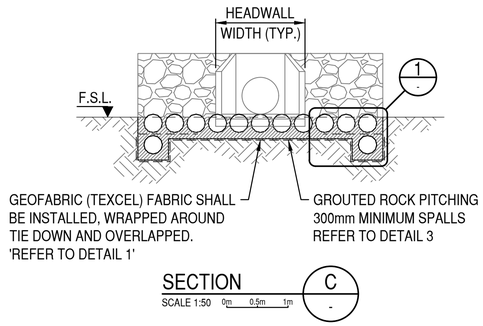
Appendix 6C

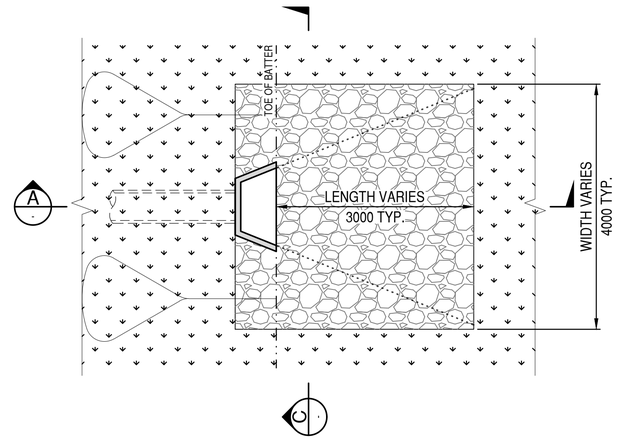
M1942 Morley Road, Lower Chittering - Typical Drainage Control Systems Plan
7th July 2021
File No 20-030



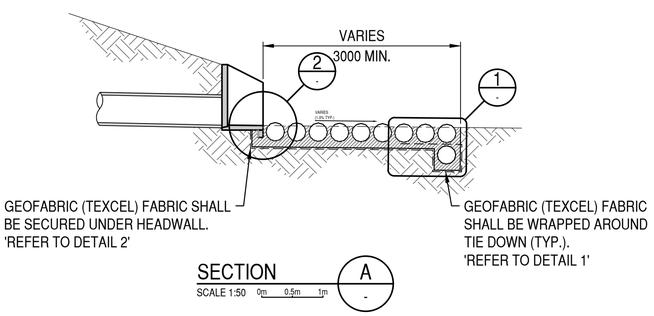
HEADWALL DISCHARGING TO SWALE DRAIN

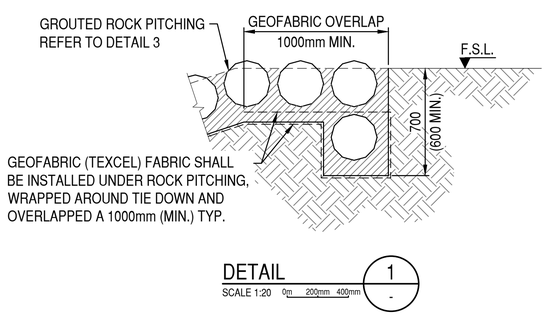


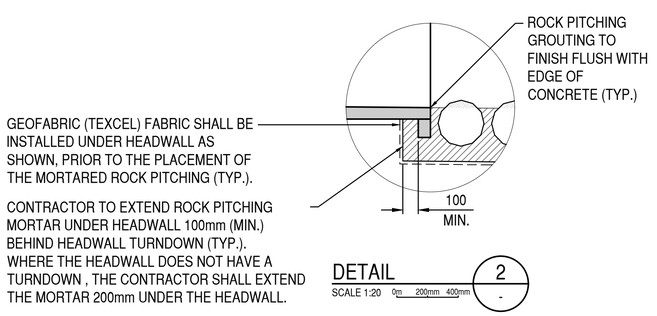


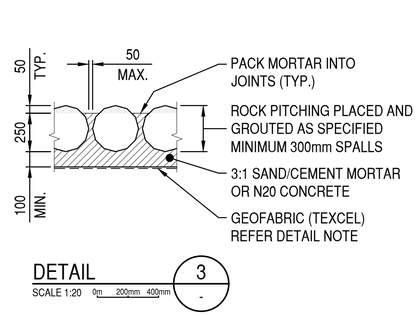


HEADWALL DISCHARGING BASE OF EMBANKMENT









TYPICAL HEADWALL ROCK PITCHING DETAILS

REV	DATE	DESCRIPTION	BY	CHKR
1	23/4/2021	ISSUED FOR CONSTRUCTION	RMH	PJP
A	31/01/2021	INITIAL ISSUE	RMH	PJP

pritchard francis lite
civil engineering consultants

DRAWING STATUS: FOR CONSTRUCTION

DATE: JANUARY 2021 | GRID: LOCAL | DATUM: AHD

DESIGNED: RMH | DRAWN: RMH | CHECKED: PJP | APPROVED: .... / ...

SCALE U.N.O.: AS SHOWN @ A1

TITLE: TYPICAL DETAILS - SHEET 3 OF 5

ORG No.: 21001-PFLT-C7-TD-04

REVISION: 1

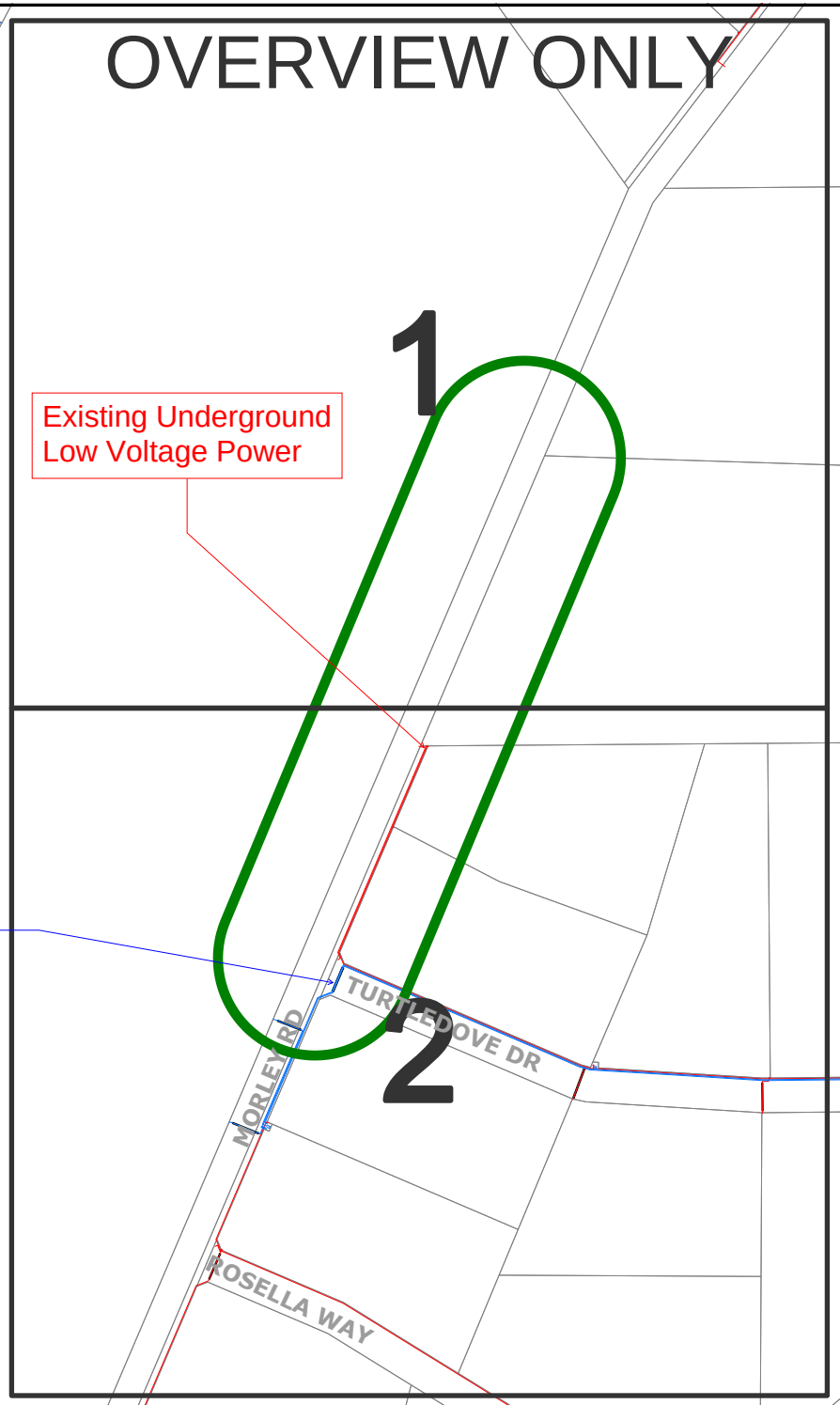
Appendix Seven A: Underground Power Plan – Morley Road

Appendix 7A

M1942 Morley Road, Lower Chittering - Underground Power Plan - Morley Rd

7th July 2021
File No 20-030

OVERVIEW ONLY



N

westernpower

UNDERGROUND LEGEND

Structures

- Pillar
- Metal Pole
- Transformer Site
- UG Crossing *
- Ring Main Unit
- LV Distribution Frame

Distribution Cables

- High Voltage Cable (1kV - 33kV)
- Low Voltage Cable (< 1kV)
- Street Light Circuit (< 1kV)
- 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.

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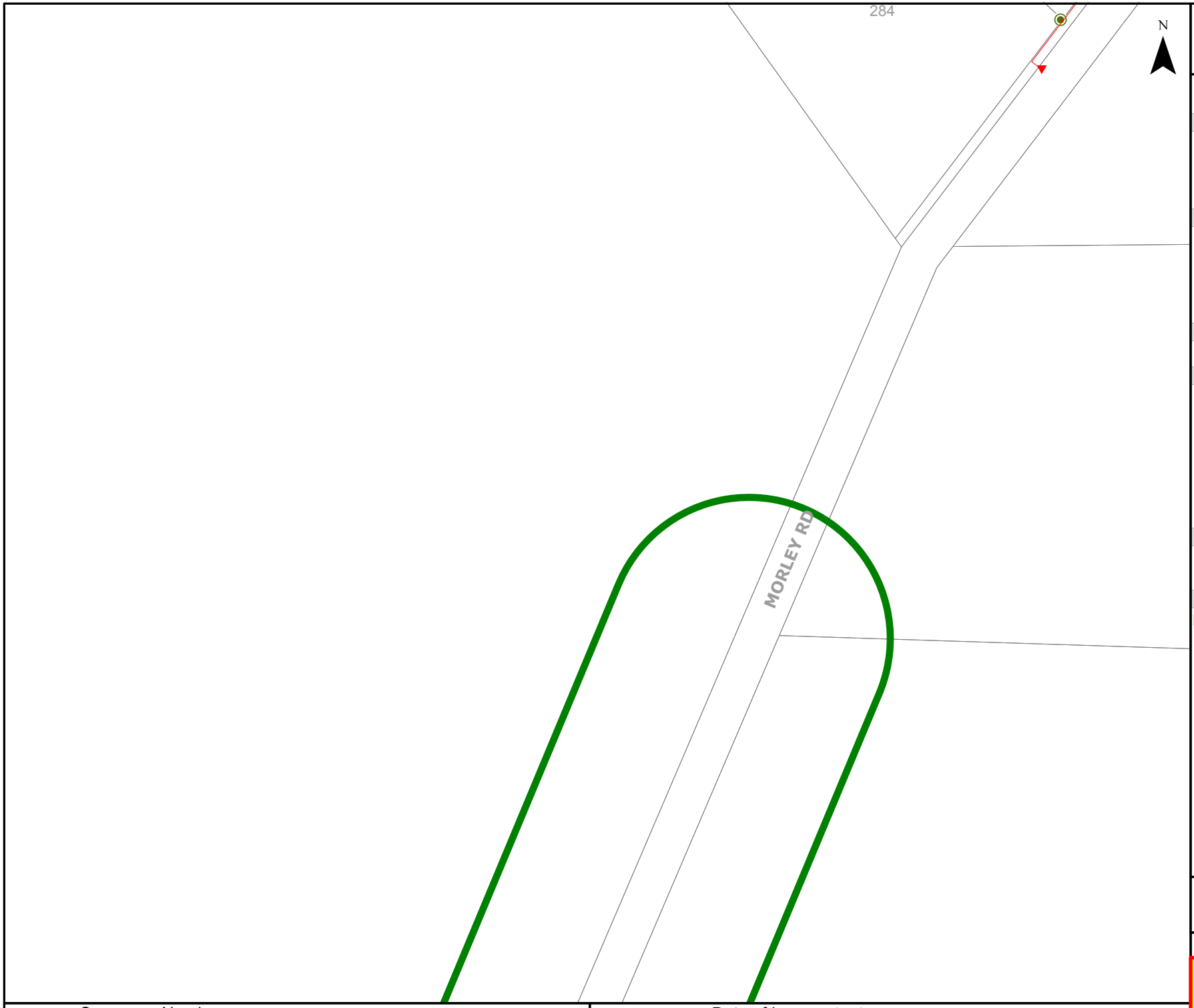
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A4	Scale : 1:5125

WARNING! Look out for overhead power lines

Sequence Number: 200326014

Date of Issue: 6/07/2021



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UNDERGROUND LEGEND

Structures

- Pillar
- Metal Pole
- Transformer Site
- UG Crossing *
- Ring Main Unit
- LV Distribution Frame

Distribution Cables

- High Voltage Cable (1kV - 33kV)
- Low Voltage Cable (< 1kV)
- Street Light Circuit (< 1kV)
- Street Light Pilot (< 1kV)
- Earth Wire

Cable Pole Terminations

- HV Termination
- LV Termination

Proposed Construction Assets

- Design Area *
- High Voltage Underground Cable
- Low Voltage Underground Cable
- Metal Pole
- Pillar
- Transformer site
- HV Termination
- LV Termination

State Underground Power Project

- CURRENT Work Area *
- COMPLETED Area *

Feature

- Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

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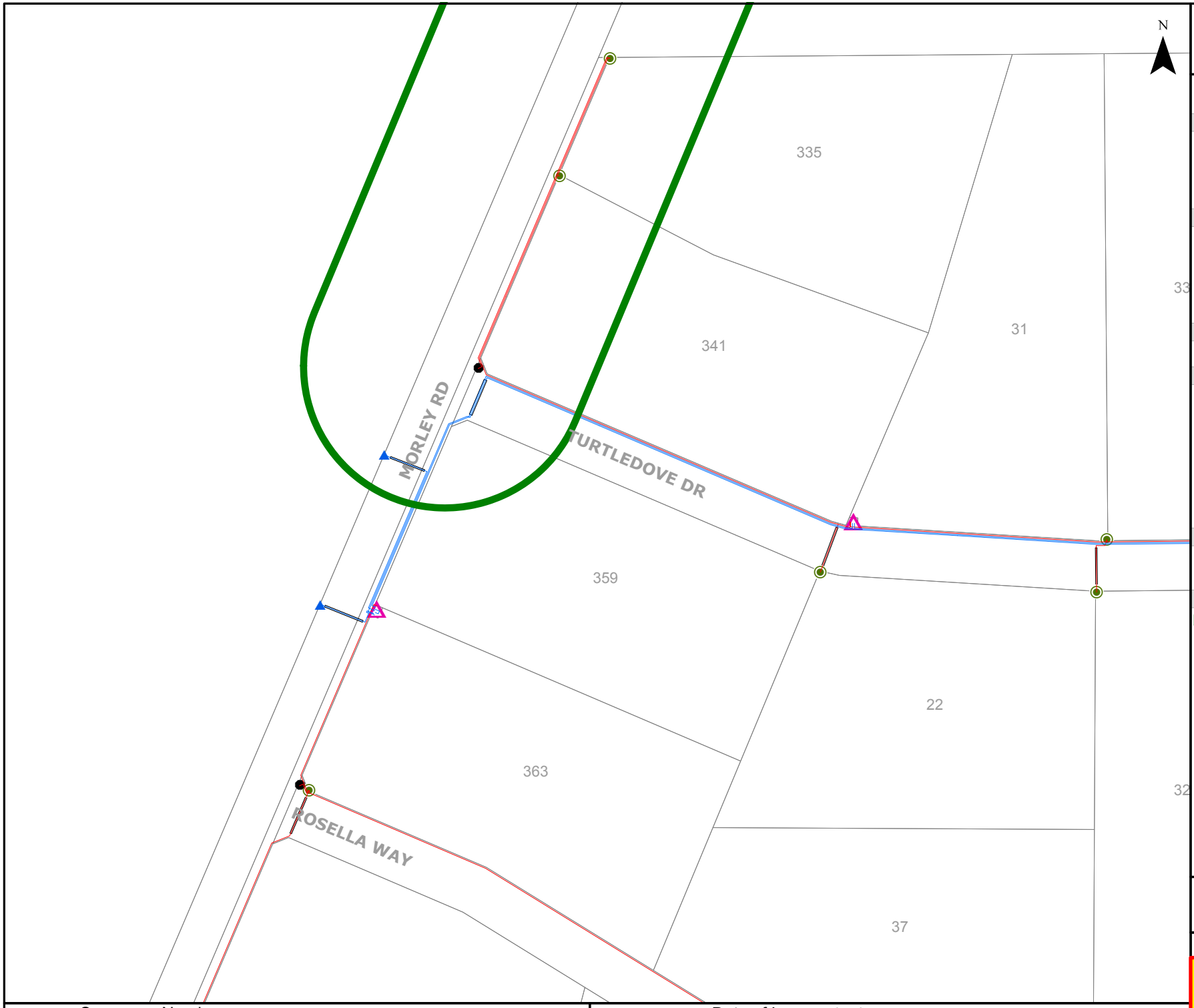
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A4	Scale : 1:2500

WARNING! Look out for overhead power lines

Sequence Number: 200326014

Date of Issue: 6/07/2021



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UNDERGROUND LEGEND

Structures

- Pillar
- Metal Pole
- Transformer Site
- UG Crossing *
- Ring Main Unit
- LV Distribution Frame

Distribution Cables

- High Voltage Cable (1kV - 33kV)
- Low Voltage Cable (< 1kV)
- Street Light Circuit (< 1kV)
- Street Light Pilot (< 1kV)
- Earth Wire

Cable Pole Terminations

- HV Termination
- LV Termination

Proposed Construction Assets

- Design Area *
- High Voltage Underground Cable
- Low Voltage Underground Cable
- Metal Pole
- Pillar
- Transformer site
- HV Termination
- LV Termination

State Underground Power Project

- CURRENT Work Area *
- COMPLETED Area *

Feature

- Area of Interest

*** 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
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Information valid for 30 days from date of issue

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WARNING! Look out for overhead power lines

Sequence Number: 200326014

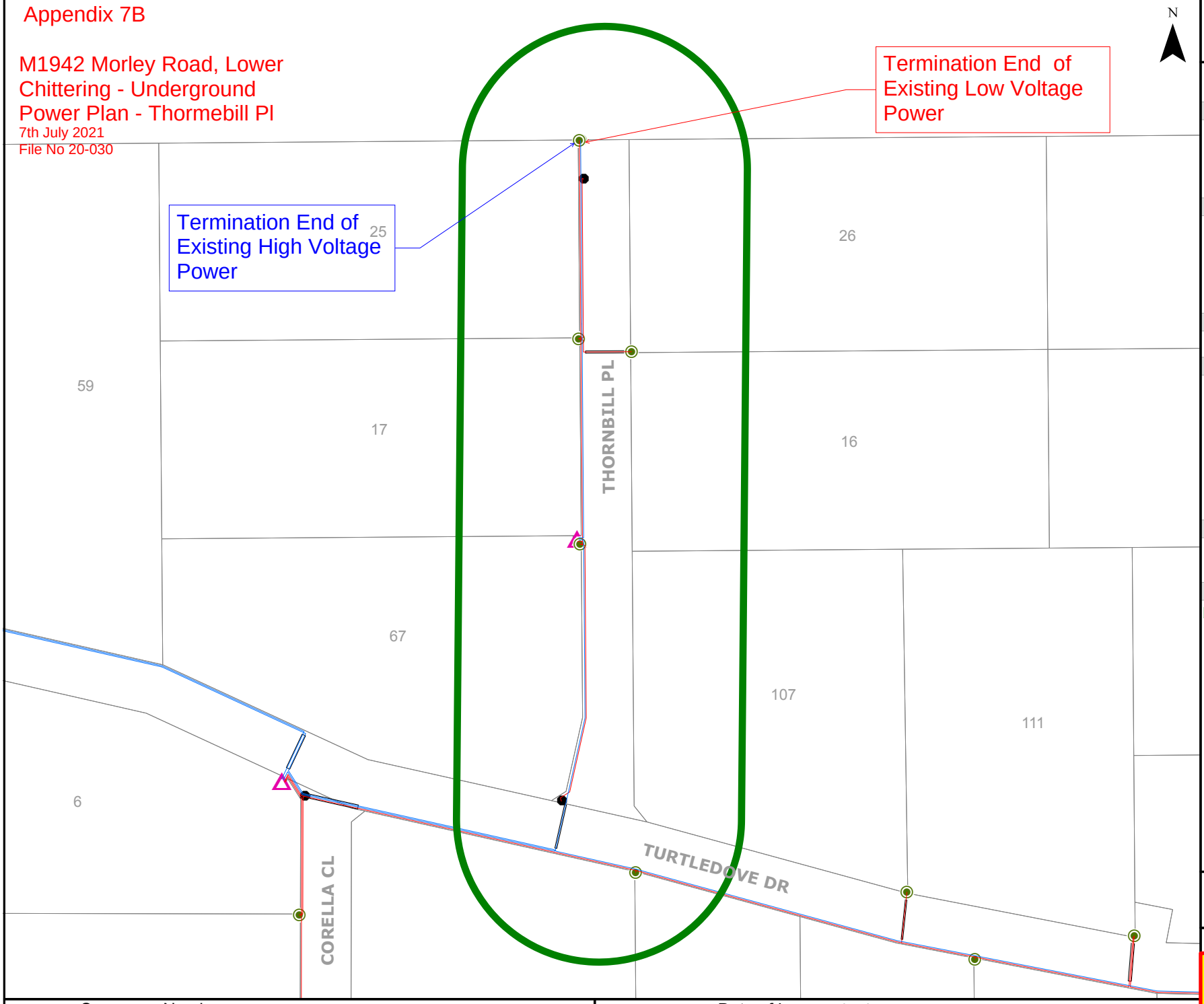
Date of Issue: 6/07/2021

Appendix Seven B: Underground Power Plan – Thornbill Place

Appendix 7B

M1942 Morley Road, Lower Chittering - Underground Power Plan - Thormebill Pl

7th July 2021
File No 20-030



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UNDERGROUND LEGEND

Structures

- Pillar
- Metal Pole
- Transformer Site
- UG Crossing *
- Ring Main Unit
- LV Distribution Frame

Distribution Cables

- High Voltage Cable (1kV - 33kV)
- Low Voltage Cable (< 1kV)
- Street Light Circuit (< 1kV)
- Street Light Pilot (< 1kV)
- Earth Wire

Cable Pole Terminations

- HV Termination
- LV Termination

Proposed Construction Assets

- Design Area *
- High Voltage Underground Cable
- Low Voltage Underground Cable
- Metal Pole
- Pillar
- Transformer site
- HV Termination
- LV Termination

State Underground Power Project

- CURRENT Work Area *
- COMPLETED Area *

Feature

- Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

This map is INDICATIVE ONLY. Hand exposure via pothole method is MANDATORY.

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Information valid for 30 days from date of issue

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WARNING! Look out for overhead power lines

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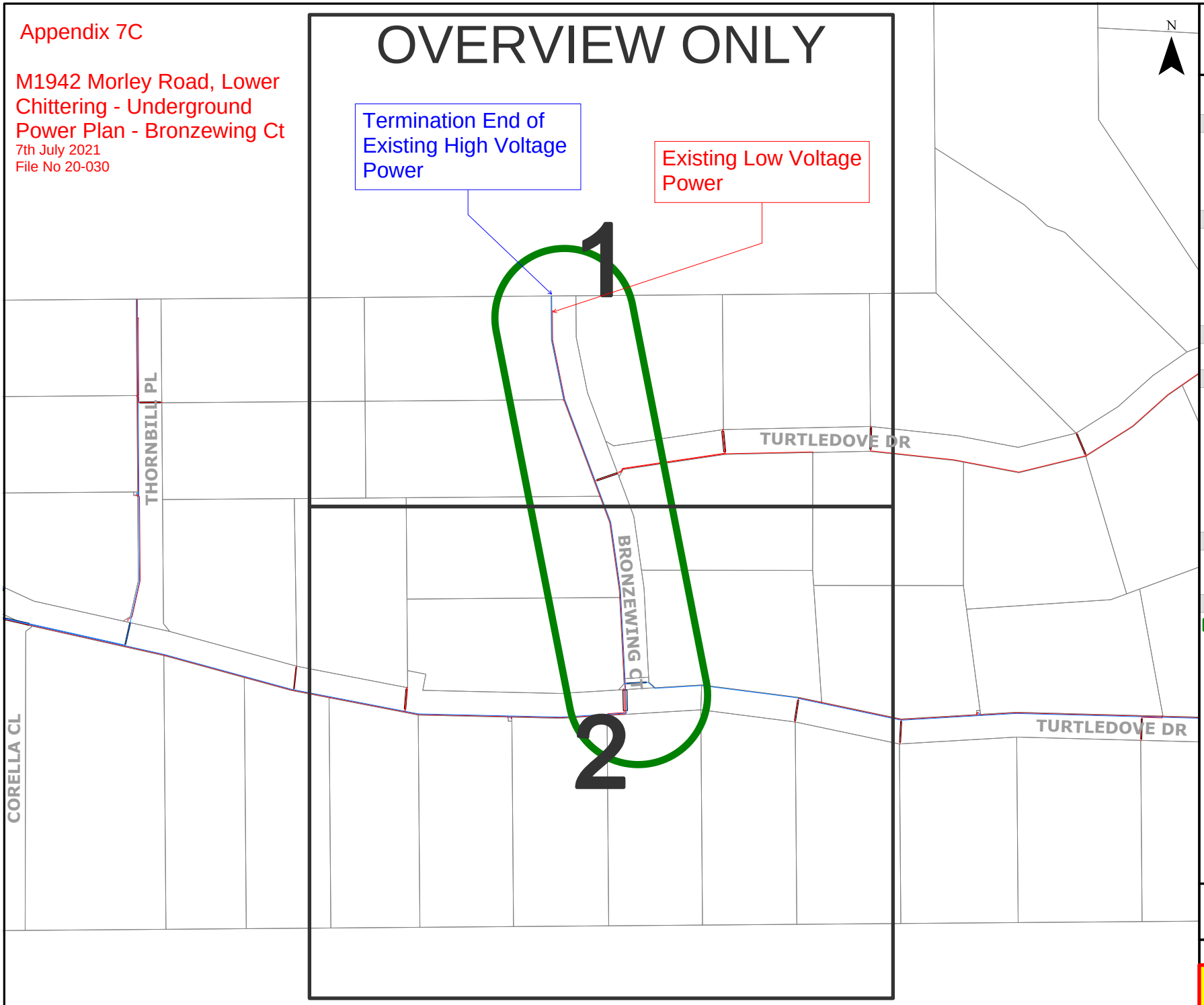
Appendix Seven C: Underground Power Plan – Bronzewing Court

Appendix 7C

M1942 Morley Road, Lower Chittering - Underground Power Plan - Bronzewing Ct

7th July 2021
File No 20-030

OVERVIEW ONLY



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)

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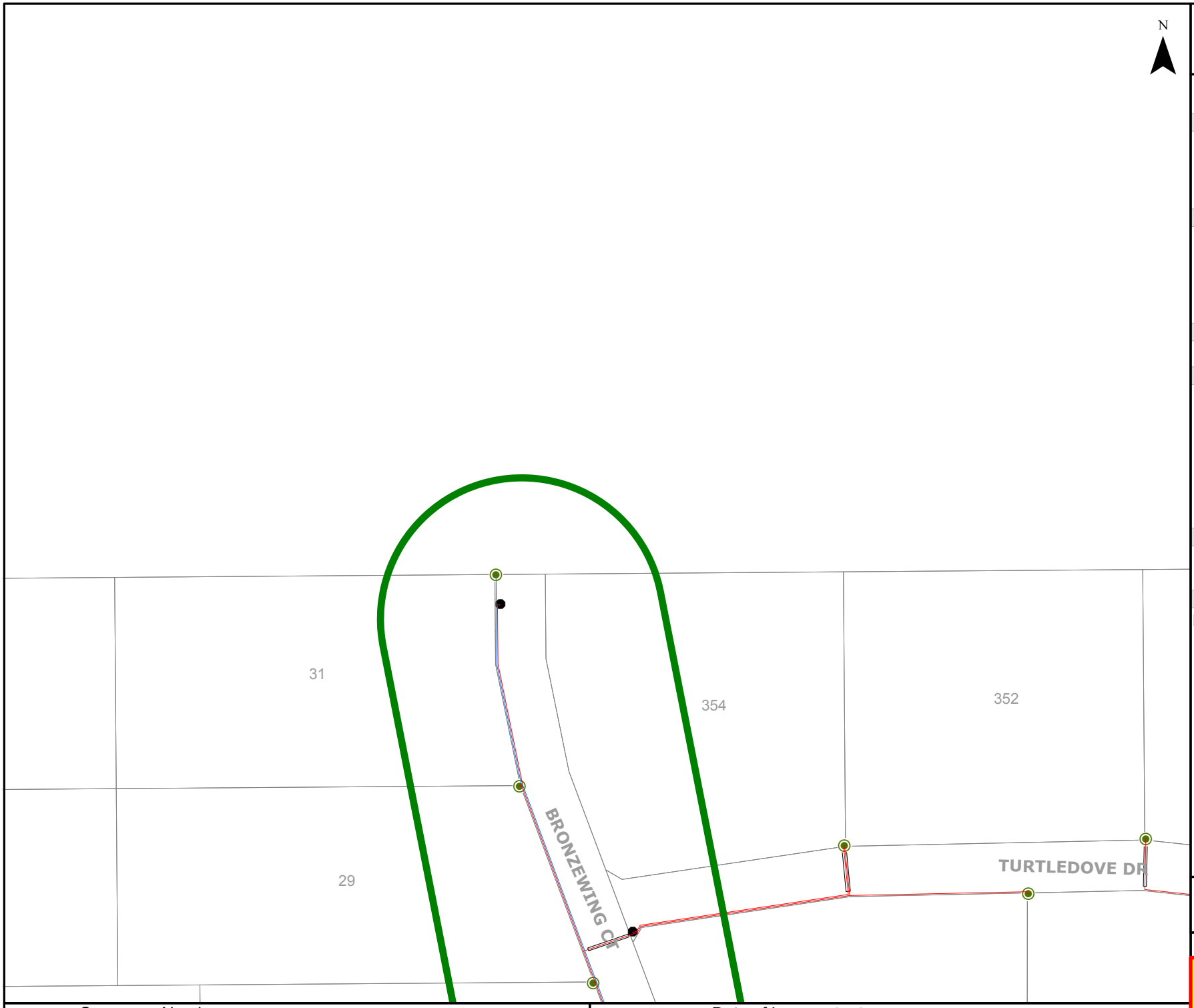
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Mon to Fri - 08:00 to 16:30

Information valid for 30 days from date of issue

A4 | Scale : 1:5125

WARNING! Look out for overhead power lines

Sequence Number: 200399866 | Date of Issue: 7/07/2021



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UNDERGROUND LEGEND

Structures

- Pillar
- Metal Pole
- Transformer Site
- UG Crossing *
- Ring Main Unit
- LV Distribution Frame

Distribution Cables

- High Voltage Cable (1kV - 33kV)
- Low Voltage Cable (< 1kV)
- Street Light Circuit (< 1kV)
- Street Light Pilot (< 1kV)
- Earth Wire

Cable Pole Terminations

- HV Termination
- LV Termination

Proposed Construction Assets

- Design Area *
- High Voltage Underground Cable
- Low Voltage Underground Cable
- Metal Pole
- Pillar
- Transformer site
- HV Termination
- LV Termination

State Underground Power Project

- CURRENT Work Area *
- COMPLETED Area *

Feature

- Area of Interest

*** 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

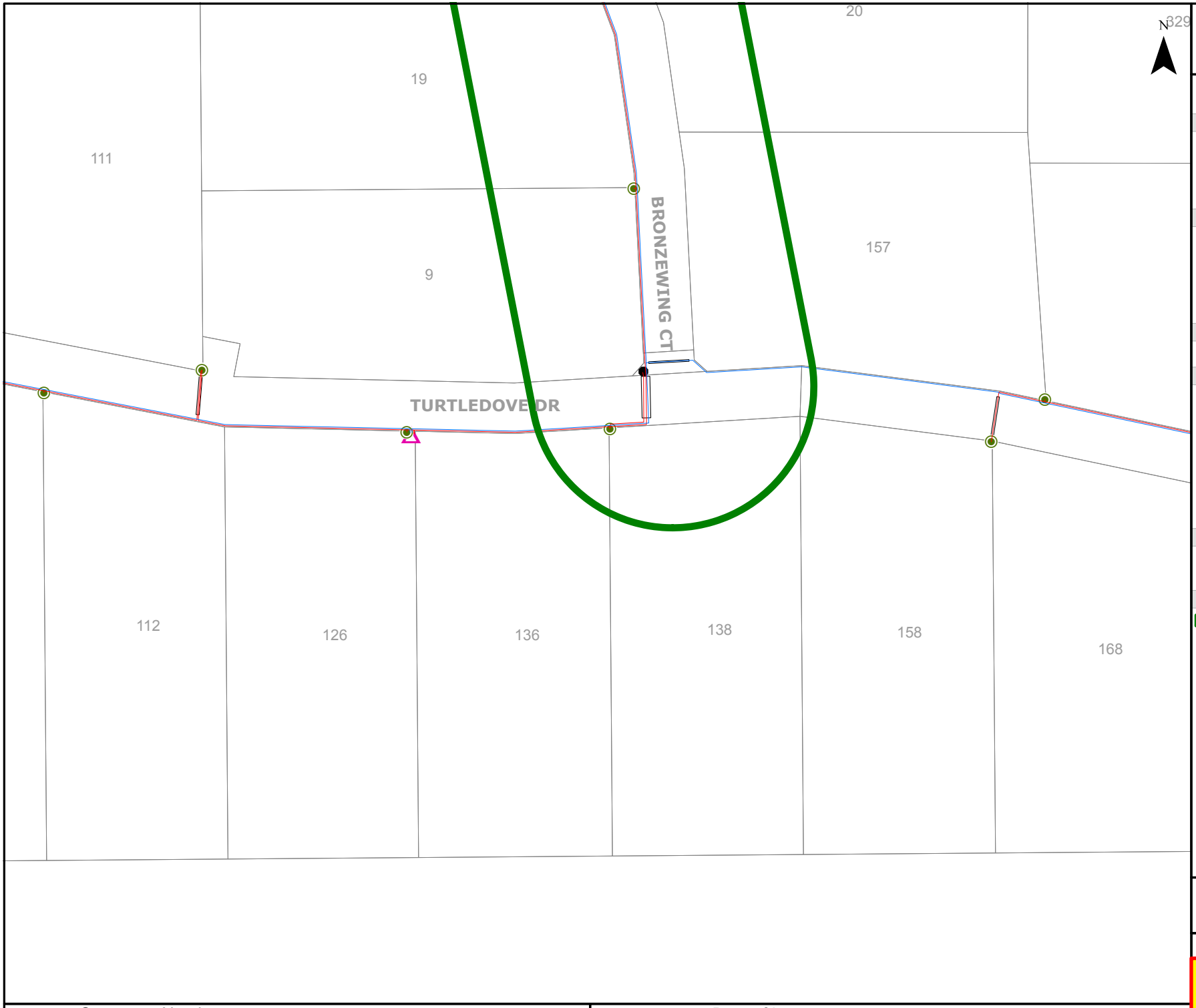
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A4	Scale : 1:2500

WARNING! Look out for overhead power lines

Sequence Number: 200399866

Date of Issue: 7/07/2021



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
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Information valid for 30 days from date of issue

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WARNING! Look out for overhead power lines

Sequence Number: 200399866

Date of Issue: 7/07/2021

Appendix Seven D: Overhead Power Plan – Morley Road

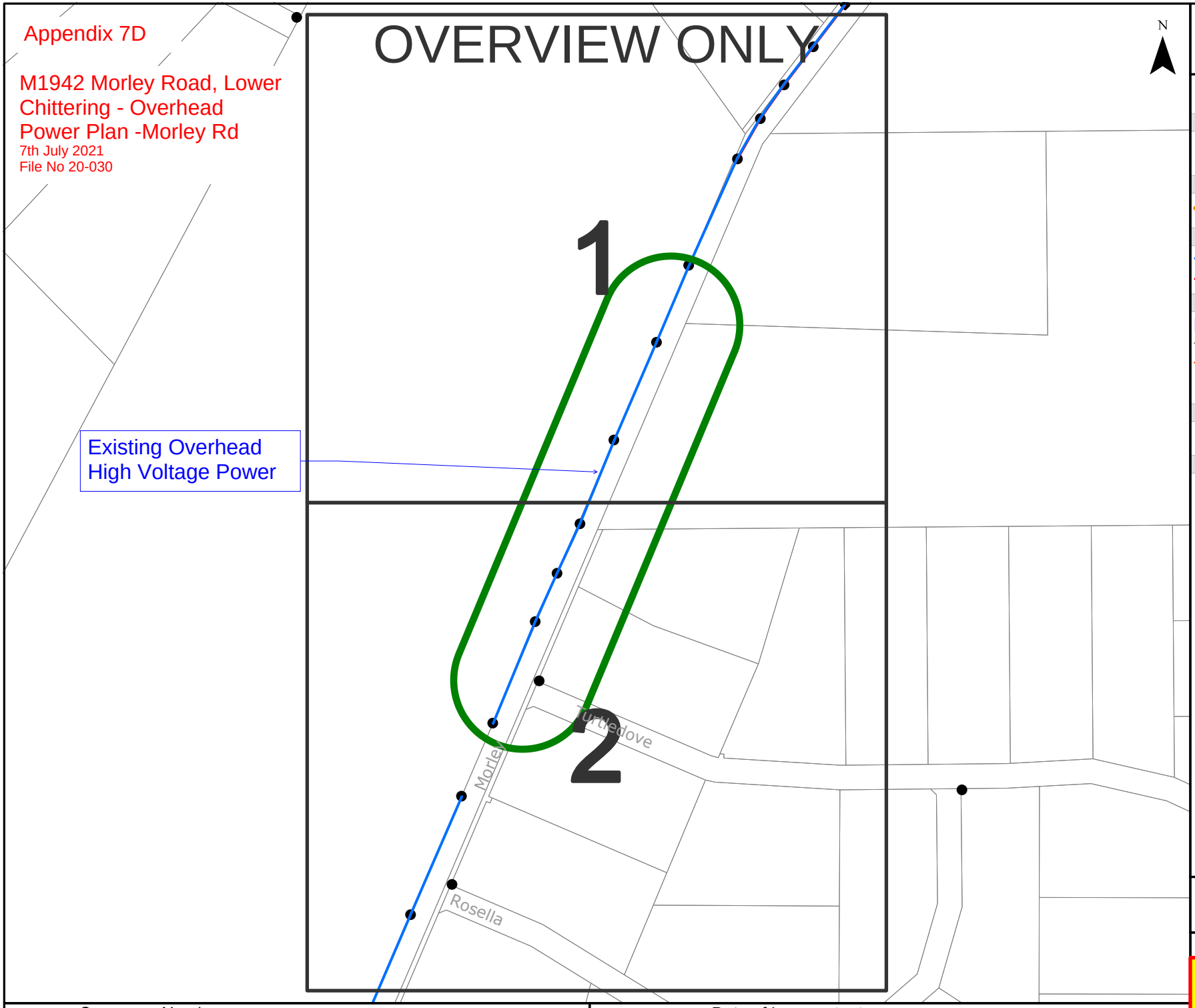
Appendix 7D

M1942 Morley Road, Lower Chittering - Overhead Power Plan -Morley Rd

7th July 2021

File No 20-030

OVERVIEW ONLY



N

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

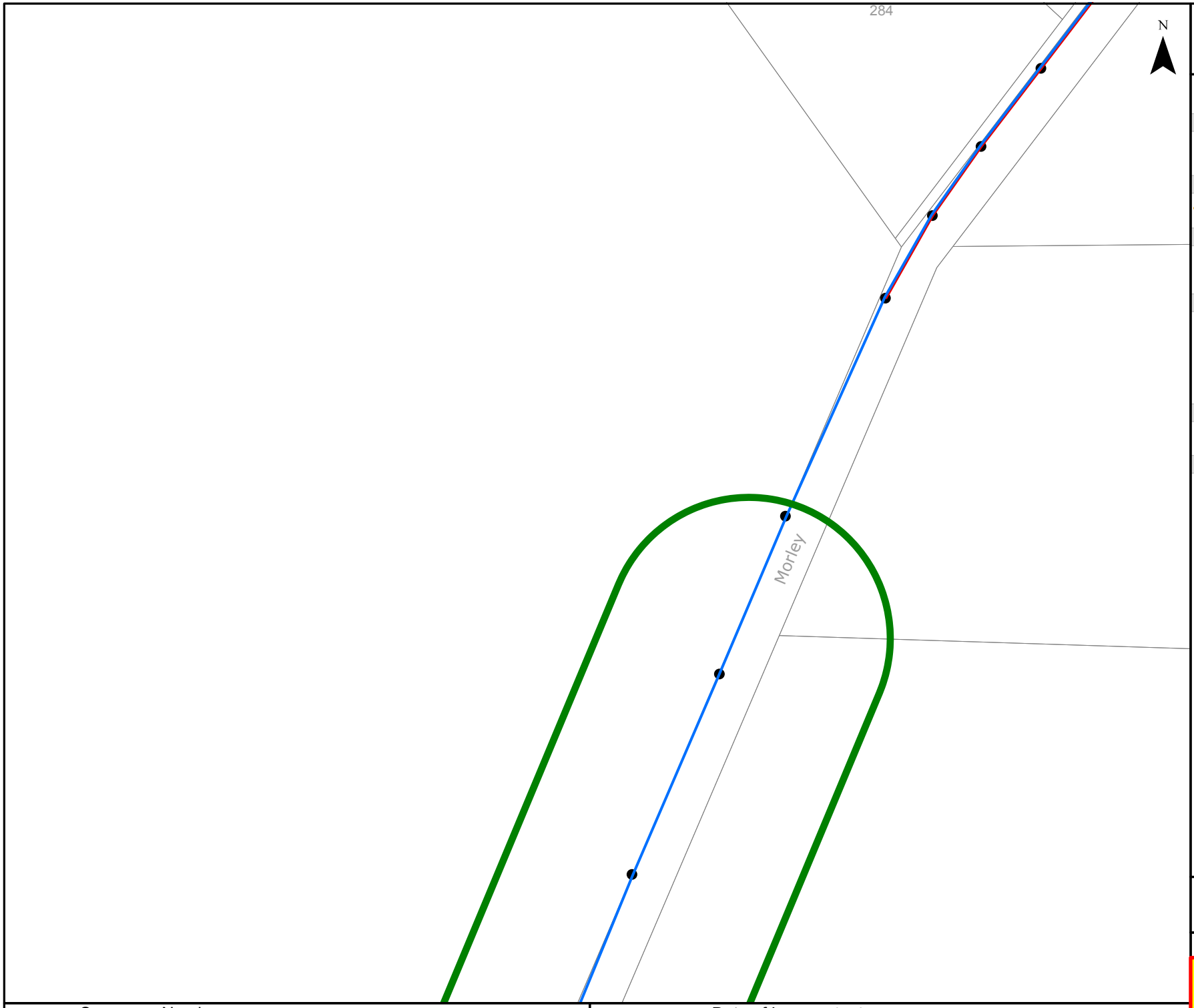
Information valid for 30 days from date of issue

A4 | Scale : 1:5125

WARNING! Look out for overhead power lines

Sequence Number: 200326014

Date of Issue: 6/07/2021



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OVERHEAD LEGEND

Structures

- Power Pole
- Transmission Poles

Transmission Overhead Powerline

- Transmission (33kV - 330kV)

Distribution Overhead Powerline

- High Voltage (1kV - 33kV)
- Low Voltage (< 1kV)

Proposed Construction Assets

- Design Area *
- High Voltage Overhead Powerline
- Low Voltage Overhead Powerline
- Power Pole

Communications Assets

- Overhead Pilot Cable

Feature

- Area of Interest

*** Please refer to coversheet**

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
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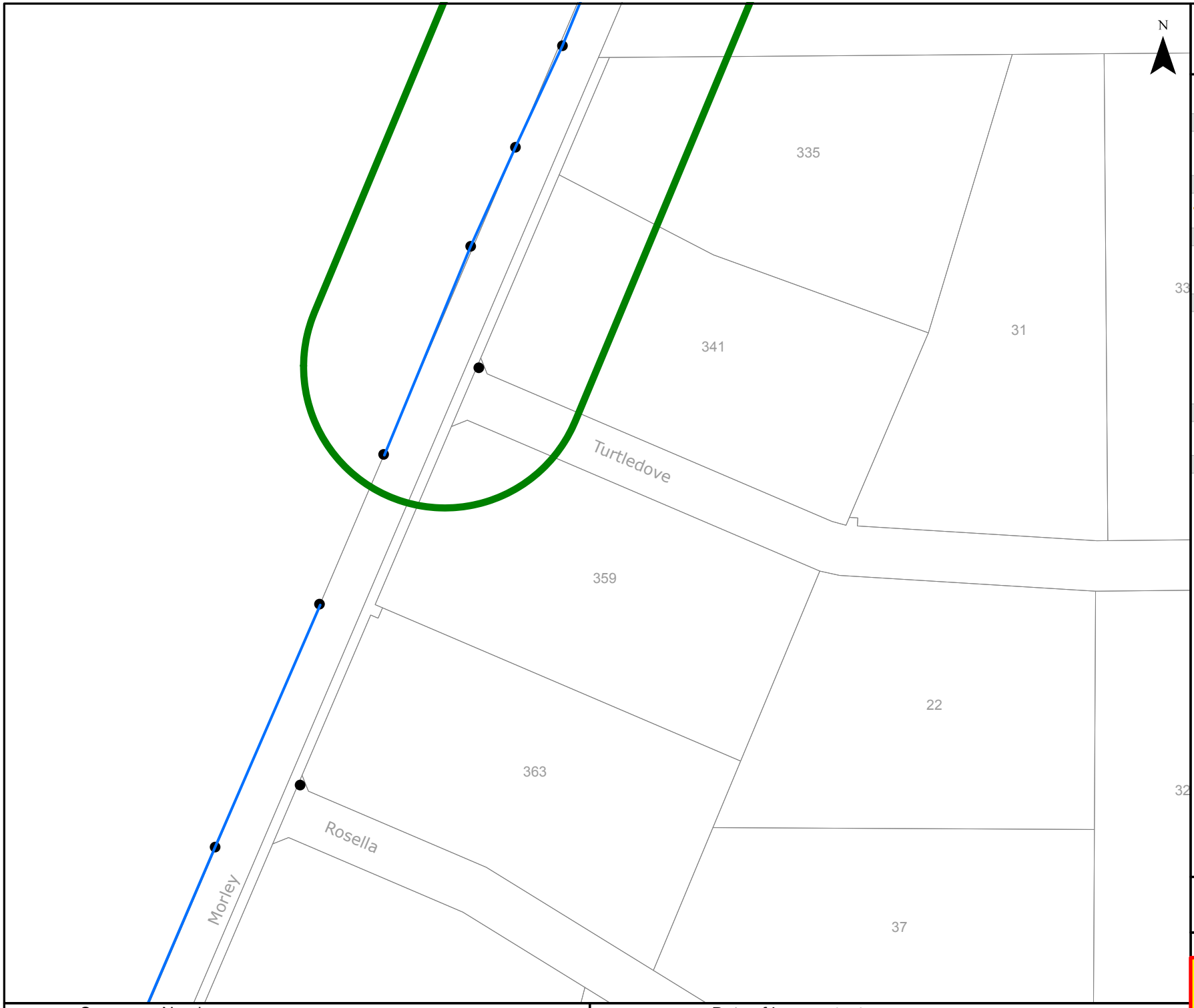
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WARNING! Look out for overhead power lines

Sequence Number: 200326014

Date of Issue: 6/07/2021



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

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WARNING! Look out for overhead power lines

Sequence Number: 200326014

Date of Issue: 6/07/2021

Appendix Eight A: Telstra Plan – Morley Road

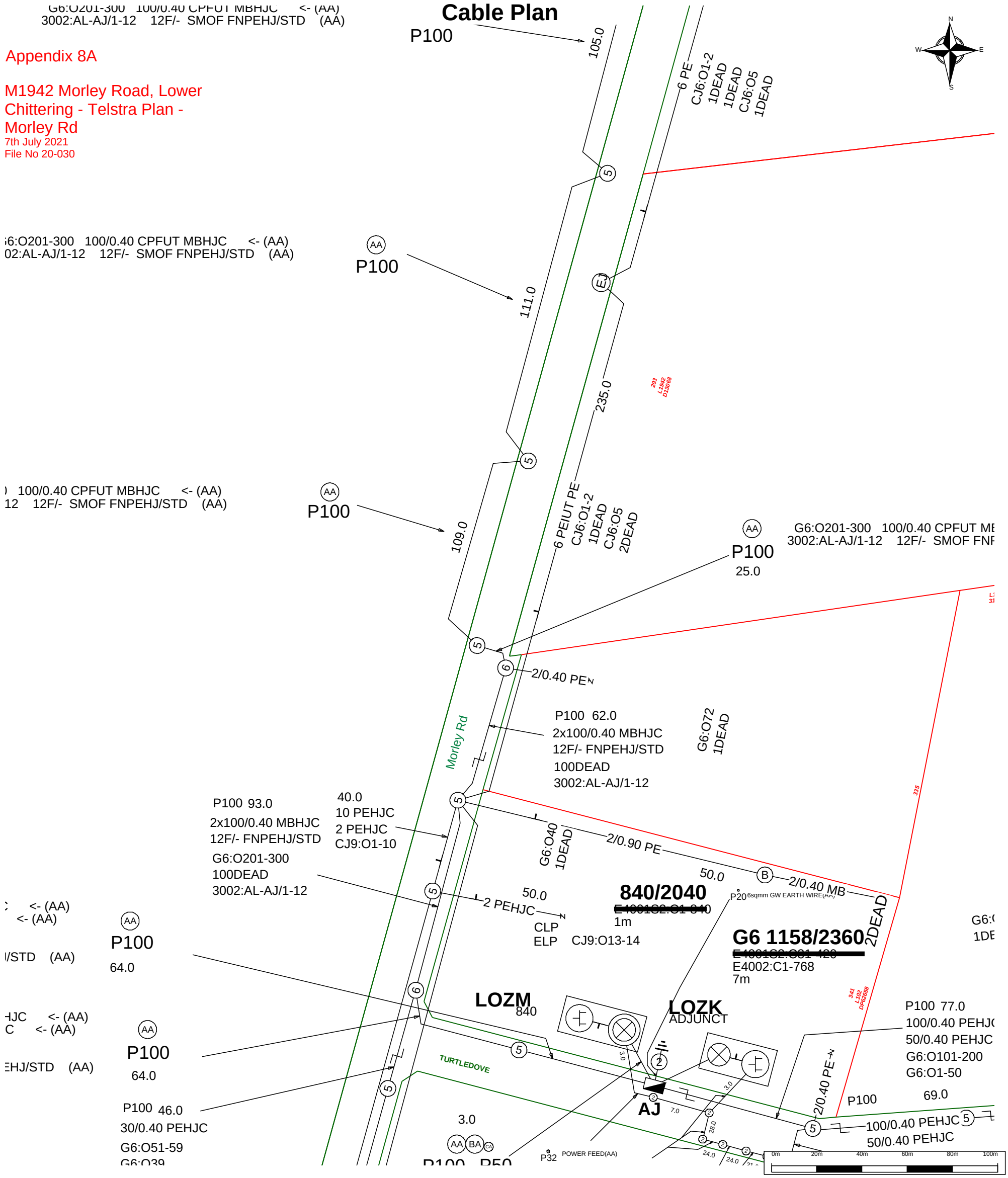
Cable Plan

Appendix 8A

M1942 Morley Road, Lower Chittering - Telstra Plan - Morley Rd

7th July 2021

File No 20-030



Telstra	For all Telstra DBYD plan enquiries - email - Telstra.Plans@team.telstra.com For urgent onsite contact only - ph 1800 653 935 (bus hrs)
TELSTRA CORPORATION LIMITED A.C.N. 051 775 556	
Generated On 06/07/2021 23:08:35	Sequence Number: 200326012
	CAUTION: Fibre optic and/ or major network present in plot area. Please read the Duty of Care and contact Telstra Plan Services should you require any assistance.

WARNING - Due to the nature of Telstra underground plant and the age of some cables and records, it is impossible to ascertain the precise location of all Telstra plant from Telstra's plans. The accuracy and/or completeness of the information supplied can not be guaranteed as property boundaries, depths and other natural landscape features may change over time, and accordingly the plans are indicative only. Telstra does not warrant or hold out that its plans are accurate and accepts no responsibility for any inaccuracy shown on the plans.

It is your responsibility to locate Telstra's underground plant by careful hand pot-holing prior to any excavation in the vicinity and to exercise due care during that excavation.

Please read and understand the information supplied in the duty of care statement attached with the Telstra plans. TELSTRA WILL SEEK COMPENSATION FOR LOSS CAUSED BY DAMAGE TO ITS PLANT.

Telstra plans and information supplied are valid for 60 days from the date of issue. If this timeframe has elapsed, please reapply for plans.

Appendix Eight B: Telstra Plan – Bronzewing Court

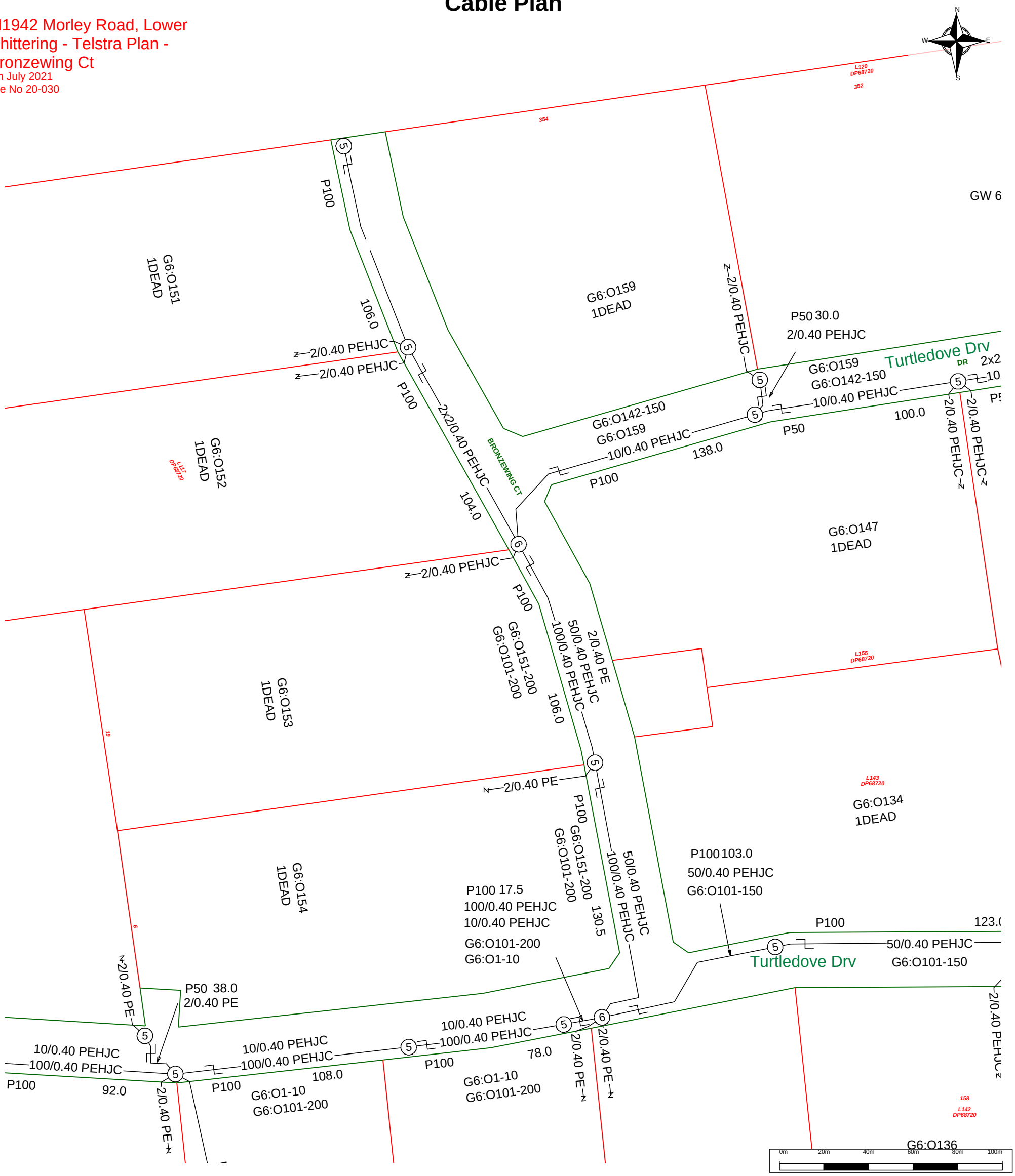
Appendix 8B

M1942 Morley Road, Lower Chittering - Telstra Plan - Bronzewing Ct

7th July 2021

File No 20-030

Cable Plan



For all Telstra DBYD plan enquiries -
email - Telstra.Plans@team.telstra.com
For urgent onsite contact only - ph 1800 653 935 (bus hrs)

TELSTRA CORPORATION LIMITED A.C.N. 051 775 556

Generated On 07/07/2021 17:44:51

Sequence Number: 200399864

Please read Duty of Care prior to any excavating

WARNING - Due to the nature of Telstra underground plant and the age of some cables and records, it is impossible to ascertain the precise location of all Telstra plant from Telstra's plans. The accuracy and/or completeness of the information supplied can not be guaranteed as property boundaries, depths and other natural landscape features may change over time, and accordingly the plans are indicative only. Telstra does not warrant or hold out that its plans are accurate and accepts no responsibility for any inaccuracy shown on the plans.

It is your responsibility to locate Telstra's underground plant by careful hand pot-holing prior to any excavation in the vicinity and to exercise due care during that excavation.

Please read and understand the information supplied in the duty of care statement attached with the Telstra plans. TELSTRA WILL SEEK COMPENSATION FOR LOSS CAUSED BY DAMAGE TO ITS PLANT.

Telstra plans and information supplied are valid for 60 days from the date of issue. If this timeframe has elapsed, please reapply for plans.

pritchard francis

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broome@pfeng.com.au

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DARWIN NT 0800
PO Box 104
PARAP NT 0804

Tel: (08) 7922 4100
nt@pfeng.com.au



Appendix D

Local Water Management Strategy

(URBAQUA)

293 Morley Road, Lower Chittering

Local Water Management Strategy

Prepared for Sicicalab Pty Ltd

By Urbaqua

July 2021

urbaqua
land and water solutions

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EXECUTIVE SUMMARY

Site Overview	Description
Site Location	293 Morley Road, Lower Chittering located within the Shire of Chittering. The site is intersected by existing drainage lines and associated dams.
Size	54.03 ha total area.
Proposed Change in Land Use	The new development will include 18 low-density residential blocks and associated access roads and drainage infrastructure.
Planning Context	Currently zoned rural residential under the Shire of Chittering LPS, and to be rezoned for development.
Hydrological Constraints	• Existing watercourses and drainage lines intersect the site, which flow to the Marbling Brook and ultimately the Brockman River. • The site has low permeability underlying soils which are at or close to surface in most areas.
Hydrological Opportunities	• Use the existing topography to convey stormwater runoff. • Maintain predevelopment flows to existing drainage lines. • Provide stormwater treatment in detention areas to maintain or improve stormwater runoff quality.

Key Elements	Description
Site Characteristics	• The site has an undulating topography, incised by drainage lines and dams. • Underlying soils are predominantly low permeability clays, cemented material, rock and silt, with a small area of sandy gravels to the mid-west. • Site soils are likely to be moderately to very strongly adsorbing of phosphorus. • The site is mapped within a sewerage sensitive area – the Brockman River catchment. • Drainage lines flow into the Marbling Brook from south to north, which ultimately flows into the Brockman River. • An on-site ground truthing drainage assessment determined the nature and extend of existing watercourses. This indicated the site is no longer hydrologically connected to the neighbouring site to the south, and minor changes to drainage lines in the centre and east of the site. • Groundwater was encountered at one location during geotechnical investigations. The site is likely to encounter perched groundwater in wet months.
Water Use Strategy	• Rainwater tanks will provide residential water supply. • Onsite wastewater treatment is required as no connection to the reticulated network is possible. • GSP requirements for onsite sewerage disposal will be met, with 100m buffer zones to watercourses and at least 1.5m clearance between groundwater (perched) and ATUs.

Key Elements	Description
Stormwater Management	• Roof runoff will be collected for residential water use, disconnecting the lot impervious areas from the stormwater system. • Predevelopment catchments will be maintained post development and mimic the predevelopment hydrological processes. • A series of table drains, and weir systems will slow down peak flows and the velocity of stormwater from roads and convey stormwater runoff to existing watercourses. • The weir system will manage the first 15mm of rainfall and prevent scour and erosion in larger storm events. • The weir system will treat water quality parameters of concern such as sediments. • Overland flow paths will be managed in the table drains, road reserve and one drainage easement.
Groundwater Management	• The site is underlain by low permeability material at or just below the surface in most areas. Perched groundwater is therefore likely to occur. • No subsoil drainage is proposed. • Fill will be used to manage required building pad clearances and wastewater disposal area clearances.
Flood management	• No regional flood mapping is available for the watercourses due to their minor ephemeral nature. • In accordance with Schedule 2 of the *State Planning Policy 2.9 Water Resources* (WAPC, 2006) and *WAPC Development Control Policy 2.3* a setback of 30 m from ephemeral watercourses to the building pad envelopes has been provided to mitigate flood risk.
Monitoring and Reporting	• Post-development surface water monitoring in WC1 is proposed for two years post-development. • A final monitoring report will be provided prior to handover to council.

1 INTRODUCTION

Sicicalab Pty Ltd and Cuttone Property Group propose to construct a subdivision within the Shire of Chittering, located at 293 Morley Road. The site is a 54.03 ha land area approximately 44km to the northeast of the Perth CBD, bound by Morley Road on the western border, the Rosa Park development to the south and rural development surrounding the North and east (Figure 1).

1.1 Proposed Development

The proposed development will be an 18-lot rural residential subdivision integrated within the natural landscape. The proposed lots range in size from 2.003 ha to 9.847 ha and will feature access roads and building envelope areas to minimise vegetation clearing as shown in Figure 2.

1.2 Planning Background

The site is currently zoned as rural residential and "For future rural living areas" in the Shire of Chittering Local Planning Strategy. To progress a rural residential development onsite the project will require an amendment to the Shire of Chittering Local Planning Scheme, Local Structure Plan preparation and ultimately subdivision approval. The rezoning and Local Structure Plan are proposed to be prepared concurrently.

1.3 LWMS Policy and Guidelines

This LWMS has been prepared in accordance with State Planning Policy 2.9 Water Resources (WAPC, 2006), *Better Urban Water Management* (WAPC, 2008), and *Interim: Local Water Management Strategies* (DoW, 2013). The LWMS checklist is provided in Appendix 1.

Additional guidance for the preparation of this LWMS is provided in:

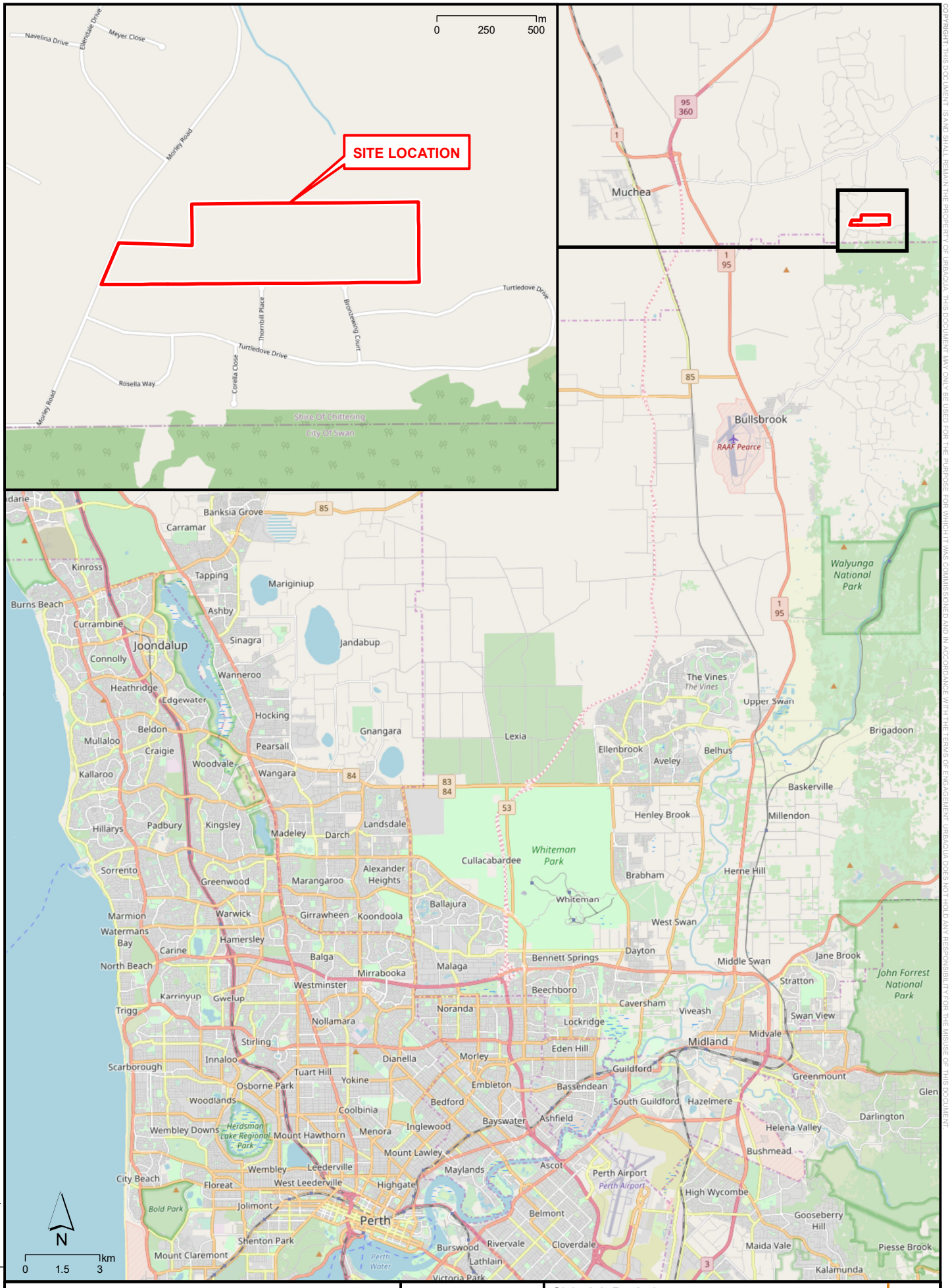
- Liveable Neighbourhoods (WAPC, 2009).
- Local Government Guidelines for Subdivisional Development (IPWEA, 2012).
- WA State Water Strategy (Department of the Premier and Cabinet, 2004).
- WA State Water Plan (Department of the Premier and Cabinet, 2007).
- Water Sensitive Design Policy (EMRC, 2008).
- Operation Policy 4.3: Identifying and establishing waterways foreshore areas (Department of Water, 2012).
- Government Sewerage Policy (Government of Western Australia, 2019).
- Perth and Peel @ 3.5 Million North-East Sub-Regional Planning Frameworks (Department of Planning, Lands and Heritage, 2018).

1.4 LWMS Design Objectives

The design objectives for the site are presented in Table 1 and have been derived from the policy and guidance listed in Section 1.3.

Table 1: Design Objectives

Element	Principle	Objective
Surface Water Management	Manage catchments to maintain or improve water resources.	Manage and treat stormwater as close to source as possible.
		Maintain pre-development surface water discharges from the site, and mimic pre-development flow paths.
		Maintain or where possible improve the water quality in the watercourses.
		Maintain surface water quality at pre-development levels.
	Maintain foreshore of watercourses	Exclude development from the foreshore of the watercourses where possible
Groundwater Management	Manage catchments to maintain or improve water resources.	Maintain or improve groundwater quality.
	Manage risks to human life and property.	Provide adequate management of perched groundwater (if present).
Flood Risk Management	Manage risks to human life and property.	Protect people and the built environment from flooding and inundation on site.
		No adverse impact in terms of flood risk to communities upstream and downstream of the development.
Nutrient Management	Manage catchments to maintain or improve water resources.	Reduce nitrogen load generated on the site.
		Reduce phosphorus load generated on the site.
Water conservation strategy (potable and wastewater)	Manage catchments to maintain or improve water resources.	Maintain or reduce water usage.
	Ensure the efficient use of water resources	Achieve WA State Water Plan targets of household potable water consumption
		Minimise the external use of potable water.



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LOWER CHITTERING LWMS
293 MORLEY ROAD, LOWER CHITTERING

SITE LOCATION

Figure 1

C:\GIS\Jobs\Urbaqua\J000753 - 293 Morley Rd, Lower Chittering, LWMS\Figures\J000753_F01 Site Location_210521.mxd

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LEGEND

- Site Boundary
- Cadastre
- Building Envelope
- Proposed Lot
- Existing Fire Service Access Route
- 6.0m Fire Service Access Route (Alignment TBC)

N

0 20 40 80 120 160 m

Scale: 1:4,399 @ A3

GDA 1994 MGA Zone 50

Ellendale Dr

Morley Rd

Turtledove Dr

Rosella Wy

Corella Cl

Thornbill Pl

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Source: Cadastre - Landgate, 2015
Orthophoto - NearMaps, 25.04.21
Concept Plan - HATCH | RobertsDay, 04.06.21

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293 MORLEY ROAD, LOWER CHITTERING

CONCEPT PLAN

Figure 2

2 PRE-DEVELOPMENT ENVIRONMENT

2.1 Location and Land Use

The site is located at 293 Morley Road within the Shire of Chittering and is surrounded by predominantly rural development and bushland in the north and east, with Morley Road running along the western edge and the Rosa Park development to the south.

There are three areas of dense forest vegetation located along the western boundary, at the top of the central hill and surrounding the deep drainage line on the eastern boundary. The remainder of the site is generally grassed paddocks. The land to the south of the existing homestead appears to have been used for growing vines.

2.2 Climate

Lower Chittering experiences a Mediterranean climate, which typically has warm to hot, dry summers and mild to cool, wet winters. The average monthly rainfall and at BoM Marbling (station number 9024), and evaporation at the Upper Swan Research Station (station number 9067) is provided in Table 2. The average annual rainfall at this weather station is 755.1 mm.

Table 2: Monthly Rainfall Averages at The Site

Month	Average Monthly Rainfall (mm)	Average Monthly Evaporation (mm) (1965-1991)
Jan	13.3	316.2
Feb	16.1	261.0
Mar	17.6	223.2
Apr	38.4	147.0
May	92.6	93.0
Jun	144.3	72.0
Jul	149.5	68.2
Aug	119.9	77.5
Sep	75.0	93.0
Oct	45.1	145.7
Nov	25.6	195.0
Dec	12.5	272.8

Sources: BoM 2021a, BoM 2021b

2.3 Topography

Regional topographic contours indicate a high point exists in the south-east corner of the site at 258 mAHD, with land generally sloping down to the north across the site, and towards existing drainage lines (see Section 2.6 for further information on drainage lines). Low points exist within the drainage lines causing undulation across the landscape, with the lowest elevation located along the northern boundary in the western-most drainage line at 200

mAHD. The drainage lines run south to north and cut through the rolling hills, with a delta formed in the lower-lying western paddock.

2.4 Geology and Soils

2.4.1 Regional Soils

The site is located within the Western Darling Scarp soil landscape zone, which is characterised by archaean, granitic, gneissic and migmatific rocks. Regional geology mapping indicates the site is underlain by:

- LATERITE – LA1 LATERITE - massive and vuggy to cemented pisolites up to 4m thick associated loose sandy pisolite gravel (G2) of residual origin. This is located across approximately 20% of the site in the western portion, and a small are along the northern boundary.
- SILTY CLAY – Cm1: grey micaceous homogenous. This is located across the largest portion of the site, generally in areas towards the middle and northeast.
- SCHIST – SC1: metallic grey quartz mica schist pronounced schistocity relative amount of biotite to muscovite varies biotite often altered to chlorite. This is located close to drainage lines.
- GRAVEL – G2: loose fine (less than 19mm) red brown to black moderately sorted pisolitic highly variable content of angular quartz sand. This is located in a small area (~5%) of the site in the southeast corner.
- SANDY SILT – Ms1: brownish yellow firm silt matrix with angular to sub-rounded quartz sand disseminated throughout dispersive in places alluvial origin. This is located along the central drainage line.

Soil mapping is shown on Figure 3.

2.4.2 Geotechnical Investigations

A geotechnical investigation was undertaken by CMW Geosciences in March 2021. The investigation found the underlying soils are generally consistent with regional geology mapping, and can be generalised as being underlain by (in shallow to deep order):

TOPSOIL: GRAVELLY SILT	dark brown; gravel, fine to medium grained, subrounded to rounded; with roots.
CEMENTED CLAYEY GRAVEL (Duricrust)	fine to coarse grained, subrounded to rounded, yellow brown; trace sand, fine grained; trace cobbles.
CLAYEY GRAVEL/SANDY GRAVEL (Residual)	Subrounded to rounded, fine to medium grained clay, medium plasticity, orange brown.
CLAY (Residual Soil)	low to medium plasticity, orange-brown, weakly cemented; overlying.
EXTREMELY WEATHERED SCHIST	well cemented clay, pale red brown.

Clays and duricrust were found at shallow layers (<1.5 m) across most of the site. A band of sandy gravel runs north to south between the delta in the low-lying paddock and the western side of the central hill.

The full geotechnical report has been provided in Appendix 2, with test pit locations displayed on Figure 3.

2.4.3 *Soil Permeability*

Permeability testing was undertaken at 6 test pits during the geotechnical investigation in March 2021 (Figure 3). The strata were too hard to hand-auger boreholes, so the tests were undertaken in shallow hand-dug pits. As such, this did not penetrate the underlying clays, and provides an indication of the permeability of soils on top only.

Although the test results indicate higher levels of permeability (more indicative of sands and gravels), it should be noted that very shallow clay underlie at least half of the site, as well as duricrust in places, both of which have very low permeability and CMW recommend is not suitable for stormwater disposal. The groundwater conditions associated with these soils is discussed further in Section 2.7.

The permeability test results at surface are summarised in Table 3 below.

Table 3: Geotechnical Permeability Test Results

Standpipe	Screen Depth (mbGL)	Strata	Approximate Permeability		Underlain By
			m/sec	m/day	
PERM1	0 to 0.40	GRAVELLY SILT	1.40×10^{04}	12	CLAY at 0.3 m
PERM2	0 to 0.31	CLAYEY GRAVEL	1.76×10^{04}	15	CLAY at 0.3 m
PERM3	0 to 0.31	GRAVELLY SILT	1.09×10^{04}	10	CLAY at 0.1 m
PERM4	0 to 0.35	SANDY GRAVEL	1.32×10^{04}	11	Refusal on Duricrust at 2.0 m
PERM5	0 to 0.33	CLAYEY GRAVEL	1.52×10^{04}	13	Refusal on Duricrust at 1.5 m
PERM6	0 to 0.31	GRAVELLY SILT	1.08×10^{04}	9	CLAY at 0.1 m

The full geotechnical report has been provided in Appendix 2.

2.4.4 *Phosphorus Retention Index*

Phosphorus Retention Index (PRI) soil testing was also undertaken as part of the geotechnical investigation across 10 locations. The results from this testing are provided in Table 4 below. Table 5 indicates the range and effectiveness of adsorption for varying PRI results, and indicates that the sites' soils are likely to be strongly to very strongly adsorbing of phosphorus at most sites. Soils are likely to be moderately adsorbing of phosphorus at sites TP06, 14, 17 and 29.

Table 4: PRI Test Results

Test Location	Depth of Sample (mbgl)	PRI
TP02	0.4 – 0.6	28.5
TP06	0.3 – 0.5	17.8
TP11	0.5 – 0.8	156.6
TP14	0.8 – 1.0	18.1
TP16	0.41 – 0.6	20.8
TP17	0.1 – 0.2	6.2
TP27	0.8 – 1.0	130.6
TP29	0.0 – 0.1	14.5
TP38	1.0 – 1.3	>1000
TP44	0.4 – 0.5	>1000

Table 5: PRI Fixation Properties

PRI (mL/g)	Description
Negative	desorbing
0–2	weakly adsorbing
2–20	moderately adsorbing
20–100	strongly adsorbing
>100	very strongly adsorbing

2.5 Land Capability

Government Sewerage Policy (GSP) (DoH, 2019) mapping indicates the entire site is within the Brockman River catchment and is considered a sewerage sensitive area. Suitability of this site for onsite wastewater disposal has been investigated in Section 3.2.

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LEGEND

- Site Boundary
- Cadastre
- Contour (mAHD)
- Geotech Location
- Geotech Location - Sandy gravel over low permeability material
- Geotech Location - Groundwater encountered at 0.8mbGL
- Permeability Test Pit Location

Geology

- Cm1: SILTY CLAY - grey, micaceous, homogeneous.
- G2: GRAVEL - strong brown, coarse, sub-rounded to rounded lateritised granite pebbles in clay-silt matrix moderately sorted, of colluvial origin.
- LA1: LATERITE - massive and cemented occasionally vesicular; up to 4m in thickness, overlain by a ferruginous gravel set in a clay-sand matrix of residual origin.
- Ms1: SANDY SILT - brownish yellow, firm silt matrix with angular to sub-rounded quartz sand disseminated throughout, dispersive in places, alluvial origin.
- SC1: SCHIST - metallic grey quartz mica schist, pronounced schistocity, relative amount of biotite to muscovite varies, biotite often altered to chlorite.

N

0 25 50 100 150 200 m

Scale: 1:5,000 @ A3

GDA 1994 MGA Zone 50

Source: Contours - DPIRD
Cadastre - Landgate, 2021
Orthophoto - NearMaps, 25.04.21
Geology - DoIR: Geological Survey of W.A., 1999

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TOPOGRAPHY AND SOILS

Figure 3

2.6 Surface Water and Wetlands

There are various existing watercourses and drainage lines mapped from regional mapping located within site boundaries, as shown on Figure 4A. There are two main watercourses/ drainage lines which flow into the Marbling Brook to the north of this site.

Marbling Brook is a tributary of the lower Brockman River, and is within a proclaimed surface water area under the RIWI Act 1914. The Brook is a perennial tributary contributing fresh water to the lower Brockman River, which is mostly brackish and turns saline in summer. During summer, the contribution of fresh water from Marbling Brook is important for downstream water users and the downstream environment as it prevents the Brockman River from becoming too saline (DoW, 2010).

There are no wetlands on site, however there are two earth dams located on two of the watercourses.

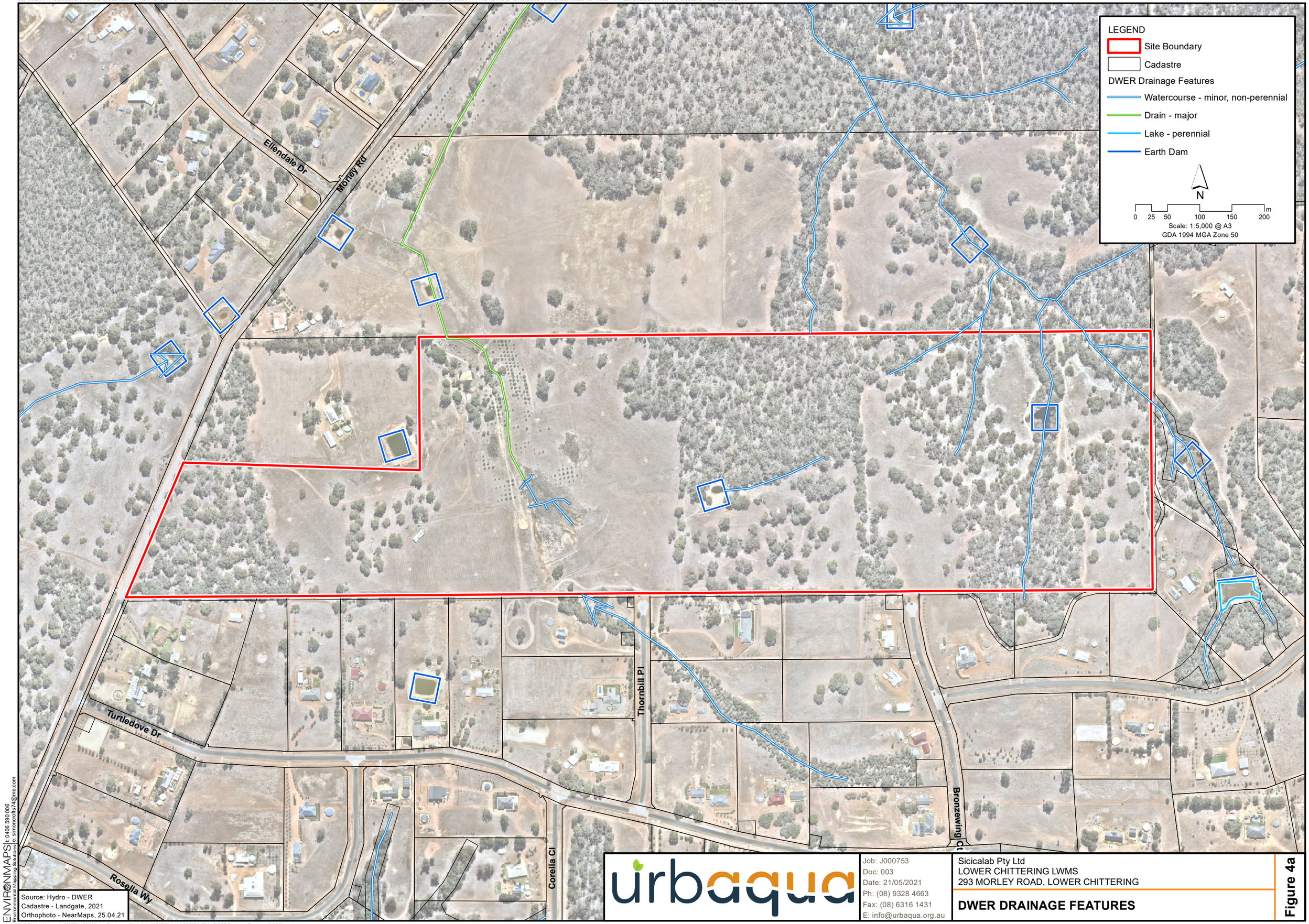
2.6.1 Site Assessment

A site visit was undertaken in December 2020. As part of the site assessment, it was found that the nature and extent of the existing watercourses varied slightly compared to DWER mapping. Figure 4B shows the proposed revisions to the watercourse mapping based on the ground-truthing assessment. Photos from this site visit are shown in Appendix 3, corresponding to the locations shown in Figure 5.

The alterations made to the watercourse mapping are as follows:

- Watercourse 1 (Figure 4b) - DWER mapping shows a drainage line (watercourse) flowing into this site from the southern property (see photo point 8 and 9 on Figure 5). On inspection, it was found that the drain south of the site has been filled and has altered the original catchment in this area. This alteration prevents the southern drainage line.
    - WC1 on this site also extends further south on this site than the DWER mapping portrays (Figure 4B). There is a basin area with rock pitching edges at the start of WC1 (Photo 8, Figure 5).
    - DWER mapping showed perpendicular cross drains across WC1. Further inspection showed that there were drains to the east of WC1 only. These are shown in Photos 5 and 11.
- Watercourse 2 (Photo 16, Figure 4b) - DWER mapping shows a watercourse extending across a small portion in the middle of the site. This watercourse is not hydrologically connected to any of the other watercourses, and it appears to be a localised catchment from a topographical dip in the landscape which collects water for an onsite dam. The length of WC2 was not found to be not as long as the mapping indicates, and the on-ground length observation is shown in Figure 4b.
- Watercourse 3 (Photos 17 and 18, Figure 4b) – WC3 is mapped as extending into the site with two minor tributaries coming off it to the west. The extent of WC3 was found to not extend as far as mapping indicates. Photo 17 show a mound in the upper extent but not a gully or incision. No water was present in the middle of winter. The tributaries shown in the mapping (Figure 4a) were found not to extend into this site (Figure 4b and Appendix 3).
- Watercourses 4 and 5 were found to be the same as the DWER mapping (Figure 4b).

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Source: Hydro - DWER
Cadastre - Landgate, 2021
Orthophoto - NearMaps, 25.04.21

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DWER DRAINAGE FEATURES

Figure 4a

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LEGEND

- Site Boundary
- Cadastre
- Earth Dam
- Drainage Feature
- WC1 - 5 Watercourse 1-5

N

0 25 50 100 150 200 m

Scale: 1:5,000 @ A3

GDA 1994 MGA Zone 50

Ellendale Dr

Morley Rd

WC1

WC2

WC3

WC4

WC5

Thornbill Pl

Bronzewing Ct

Turtledove Dr

Corella Cl

Rosella Wy

Source: Cadastre - Landgate, 2021
Orthophoto - NearMaps, 25.04.21

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SITE ASSESSED DRAINAGE FEATURES

Figure 4b

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LEGEND

- Site Boundary
- Cadastre
- Photograph Exposure Location
- Photograph Exposure Orientation
- 2 Photograph Exposure Number

N

0 25 50 100 150 200 m

Scale: 1:5,000 @ A3

GDA 1994 MGA Zone 50

Ellendale Dr

Morley Rd

Turtledove Dr

Rosella Wy

Corella Cl

Thornbill Pl

Bronzewing Ct

Source: Cadastre - Landgate, 2021

Orthophoto - NearMaps, 25.04.21

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SITE ASSESSMENT PHOTO LOCATIONS

Figure 5

2.7 Groundwater

2.7.1 Regional Information

The soil landscape of the site (Western Darling Scarp) is dominated by fractured rock aquifers (patchy groundwater in rock fissures) which can result in springs and water in valley floors.

A hydrogeological investigation at a site located 3.5 km to the north of this proposed development was undertaken in September 2019 by Rockwater however this does not extend to the south to include our site. That report indicating that that area is underlain by the Marbling Flow detention area.

2.7.2 DWER Bore Data

The Water Information Reporting database was searched for nearby bores which may be useful for determining the underlying groundwater conditions of the site. DWER bore site reference number 61617074 is located within site boundary, however this bore has no useable groundwater level information, only one point of water quality data. A search of useable bores within a 5 km radius of this site was undertaken. Site reference number 61618559 was found to have groundwater level information in mAHD, however this was located within the Superficial Swan Aquifer and therefore not comparable to the hydrogeology of this site.

2.7.3 Geotechnical Groundwater Observations

A geotechnical investigation was conducted at the site in March 2021 and included groundwater observations if, and when, present. This investigation detected groundwater only at one location. Test pit TP28 (Figure 3 - near WC1) recorded water at 0.8 m below ground level (mbGL). However, as the investigation was undertaken in March (a dry period of the year) it is unlikely that there would be signs of perched groundwater/ interflow at that time of year.

Given the investigation noted the presence of a variable and clayey soil profile, and of duricrust in locations (both low permeability), this allows for the potential for the following in wet periods after rains (winter);

- perched groundwater - water infiltrating through the top, more permeable, layers of soil and then perching on top of an impermeable layer such as clay or duricrust; and
- interflow - after infiltration in the topsoil layers, lateral flow of water in the unsaturated zone across an impermeable layer)

3 WATER USE STRATEGY

The proposed development will not have a connection to Water Corporation services for potable water or wastewater disposal. As such, alternative approaches to water supply and wastewater disposal are required for this site and is further discussed in the sections below.

3.1 Water Supply

The proposed development at this site will source water supply via rainwater harvesting and storage in rainwater tanks on individual lots. These tanks will need to supply water to households year-round.

Guidance on use of rainwater tanks (Australian Government, 2011) has been used to estimate the rainwater tank volume for a medium household. Please note: This is an estimation only based on average rainfall, an average roof area (catchment area for the tank) and average resident numbers (water usage demand).

For a medium house with a roof area of 250 m^2 and using the BoM average monthly rainfall statistics (Section 2.2), the estimated tank volume required to supply water for an individual house of 2.5 persons is 58 kL. This assumes water usage of 150 L per person per day and will provide a high supply security level ensuring water is available year-round. Runoff losses have been taken into account, as per guidance recommendations (2 mm loss per month, and with 85% collection efficiency).

3.1.1 Household Water Efficiency and Conservation

Household water use efficiency will be required through compliance with the BCA Energy and Water Efficiency (BCA, 2012).

The following requirements will be mandatory for each dwelling:

- Gas hot water system with a minimum 5 stars WELS rating (or a solar hot water system, or a high energy efficient electric heat pump).
- Water efficient (i.e., 3-star WELS rated) shower heads.
- Water efficient (i.e., 4-star WELS rated) tap fittings in all kitchen sinks, bathroom flow detention areas and vanities.
- Water efficient (i.e., 4-star) dual flush toilets.
- Pool blankets for all new pools to reduce the rate of evaporation.
- Hot water outlets must be located close to the hot water system or a recirculating hot water supply to minimise wastage of energy and water.

In addition, the use of rainwater tanks for water supply will add to water conservation, compared to a traditional development connected to Water Corporation services.

3.2 Wastewater Management

The site will not be provided with a reticulated sewer system and is located within a sewerage sensitive area (discussed in Section 2.5). As such, lots will be required to treat and dispose of wastewater within lot boundaries and meet requirements of the Government Sewerage Policy (GSP) (State Government of Western Australia, 2019).

3.2.1 Assessment Against the Government Sewerage Policy

The Government Sewerage Policy (GSP) (2019) requirements are addressed in Table 6 below.

Table 6: Government Sewerage Policy Criteria

GSP (2019) Criteria	This Site
5.2.1 Lot sizes	
Within sewerage sensitive areas, the minimum lot size must be 1 ha. Land in a sewage sensitive area that is already zoned for urban use with a residential density coding of R 2 to R10 under a local planning scheme or structure plan endorsed by the Western Australian Planning Commission, may be subdivided in accordance with the existing density coding. Where R10 subdivision is proposed, it should be demonstrated that the density coding was assigned with the understanding that reticulated sewerage would not be provided. Smaller lots in sewage sensitive areas may be considered for non-residential, commercial and industrial subdivision on a case-by-case basis where it can be demonstrated that the proposal meet the minimum site requirements and the responsible authority, in consultation with relevant agencies is satisfied that the proposal is consistent with the objectives of this policy.	• This site is located within a sewerage sensitive area (within the Brockman River catchment) • The site is comprised of lots ranging from 2.003 ha to 9.847ha and meets the minimum 1ha lot size requirement.
5.2.2 Separation from water resources	
An on-site sewage system is not to be located within: *a wellhead protection zone or on Crown land within a reservoir protection zone;*	• The site is not within a wellhead protection zone and is therefore compliant with this requirement.
100 metres of the high-water mark of a reservoir or 100 metres of any bore used for public drinking water supply where: — a wellhead protection zone or reservoir protection zone has not been assigned; or — where existing lots would be rendered undevelopable by the wellhead protection zone;	• The site is not within 100 metres of the high-water mark of a reservoir, or 100 metres of any bore used for public drinking water supply and is therefore compliant with this requirement.
30 metres of a private bore used for household/ drinking water purposes	• Drinking water will be supplied by individual rainwater tanks to each lot. A private bore will not be used on this site for drinking water. Therefore, the site is compliant with this requirement.
100 metres of a waterway or significant wetland and not within a waterway foreshore area or wetland buffer. The separation distance should	• A 100m setback from all watercourses will be provided to all onsite wastewater disposal system disposal areas, as discussed in Section 0 below.

GSP (2019) Criteria	This Site
be measured outwards from the outer edge of riparian or wetland vegetation;	Therefore, the development design is compliant with this requirement. • There are no wetlands located within 100m of the site. Therefore, the site is compliant with this requirement.
100 metres of a drainage system that discharges directly into a waterway or significant wetland without treatment.	• Drainage will be managed within the road reserve, which will provide treatment before eventually discharging to watercourses. • There are no drainage systems that discharge to a waterway without treatment. This is discussed further in Section 0.
Any area subject to inundation and/or flooding in a 10 per cent Annual Exceedance Probability (AEP) rainfall event. *Smaller setbacks may be considered where a proponent demonstrates, to the satisfaction of the responsible authority in consultation with the relevant advisory agencies (Department of Water and Environmental Regulation and/or Department of Biodiversity, Conservation and Attractions, Department of Health and/or Local Government) that the reduced setbacks will not have a significant impact on the environment or public health.*	• The development area is not within any regionally mapped 10% AEP flood extents. • All watercourses have been provided with a 100 m wastewater setback and given the ephemeral nature of the watercourses onsite, this is considered sufficient.
5.2.3 Separation from groundwater	
The discharge point of the on-site sewage system should be at least the following distances above the highest groundwater level, taking into account the range of seasonal groundwater conditions in the context of long-term variability and possible groundwater rise following development: • *two metres in public drinking water source areas;* • *1.5 metres in sewage sensitive areas; and* • *0.6 to 1.5 metres in all other areas, depending on soil type and the type of treatment system used (refer to schedule 2).* *Where the use of fill is proposed to achieve separation distances, proponents may be required to provide additional information to demonstrate that solutions are effective, do not impact on other lots through water diversion,*	• This site is located within a sewerage sensitive area (Brockman River Catchment). As such, clearance to groundwater must be a minimum of 1.5 m for ATUs. • Due to the presence of clays, rock and cemented low to impermeable soils close to surface level, these soil layers were determined to be the constraining factor as it is likely these soils will allow minimal infiltration and/or cause groundwater perching across most of the site during wet periods. • As such, some disposal areas may need to receive fill to achieve 1.5 m separation to the impermeable soil layer. This is further discussed in Section 3.2.2 below.

GSP (2019) Criteria	This Site
are not cost prohibitive and will not compromise amenity or landscape values.	
5.2.4 Land application area	
Each lot should be of sufficient size to accommodate development and an unencumbered land application area for the disposal of sewage in accordance with Schedule 2 of this policy.	• The land application area is discussed in Section 3.2.2. The design is compliant.
5.2.5 Type of on-site treatment system required	
Secondary treatment systems with nutrient removal will generally be required in public drinking water source areas and sewage sensitive areas. In all other instances, secondary treatment systems should only be required to address site-specific physical or environmental constraints (refer to Schedule 2). In rural and remote areas, determination of the type of treatment system required should consider the availability of maintenance personnel required to service secondary treatment systems in accordance with Department of Health requirements.	• A secondary treatment system will be chosen from the list of DoH approved systems (Appendix 4)

3.2.2 Clearance Requirements

Point 5.2.3 from Table 6 indicates a minimum clearance of 1.5 m to groundwater must be achieved from the discharge point of onsite sewerage disposal systems. As discussed in Section 2.4.2, a geotechnical investigation was conducted by CMW in April 2021. Groundwater level observations indicate groundwater perching is likely to occur over the shallow clays, rock and cemented layers.

As such, these soil layers have become the constraining factor for ATU disposal area elevation (considered representative of perched groundwater level), and all ATUs disposal areas will require at least 1.5 m above these layers where applicable. The exact fill requirements will be subject to a more detailed assessment undertaken by lot owners when submitting their *Application to Construct or Install an Apparatus for the Treatment of Sewage*.

Overall separation distances to groundwater in lots are discussed further in Section **Error! Reference source not found.**.

3.2.3 Estimated Wastewater Volume and Application Area

The loading rate calculation follows the recommended calculations in Schedule 2 of the GSP and Explanatory Notes, and the land application area requirements are specified in Schedule 2 of the GSP. The following sections are applicable to this site for disposal of treated effluent via drip irrigation:

- Estimated hydraulic load = persons per house (on average) x design loading rate

= 2.5 persons x 150 L/day
= **375 L/day**

The size of the land application area should be determined in accordance with the conversion factors prescribed in Table 2 (provided in our Table 7) *and AS/NZS 1547 On-site domestic wastewater management as follows:*

1. *Estimate hydraulic load (L/day):*
   occupancy rate (persons) x design loading rate (L/person/day)
2. *Calculate land application area (m²):*
   hydraulic load (L/day) x conversion factor from Table 2 (of policy – Table 7 *below)*

Table 7: Conversion Factors

Soil Category	Soil Texture	Conversion Factors	
		Primary Treatment	Secondary Treatment
1	Gravels and Sands	0.377	0.2
2	Sandy Loams	0.377	0.2
3	Loams	0.477	0.25
4	Clay Loams	0.689	0.286
5	Light Clays	1.284	0.333
6	Medium to Heavy Clays	Special design requirements and distribution techniques or soil modification procedures will be necessary.	0.5

The onsite geology was noted as having cemented clayey gravel, clayey gravel/ sandy gravel, clay and schist present onsite. As a worst-case scenario for a planning purposes, the conversion factor for medium to heavy clays was used to determine the disposal area. The wastewater disposal areas indicated on the plan (Figure 6) are to scale based on the calculations below (to allow for the worst-case scenario to show proof on concept):

- Land application area = hydraulic load x conversion factor for secondary treatment systems in medium to heavy clays

  = 375 L/day x 0.5
  = **187.5 m² per dwelling**

As described above, the disposal areas in Figure 6 show an approximate area of 225m3 (15m x 15m) to show that the disposal areas can be accommodated on all lots. This is compliant with *AS/NZS 1547:2012 Onsite domestic wastewater management* for drip irrigation.

However, as discussed in Section 3.2.2, most lots will require fill in the ATU disposal areas. This fill will likely consist of sand and therefore the conversation factor for actual implementation would be 0.2. This would result in the following land application area:

- Land application area = hydraulic load x conversion factor for secondary treatment systems in medium to heavy clays

  = 375 L/day x 0.2

  = **75 m² per dwelling**

The ATU application submitted by lot owners will include detailed soil type assessment in the disposal area, details of fill required, number of occupants (and therefore land application area).

3.2.4 Location of Land Application Areas

The location of land application (ATU disposal) areas on each lot have been chosen based on the following;

- More than 100m from watercourses as per the GSP requirement (Table 6).
- In cleared areas to minimise clearing of existing vegetation.
- As far as possible and practical, set back from the road conveying surface water (with treatment) to the watercourses.

Where building envelopes are outside of the 100 m buffer zone to watercourses, the land application areas have been located within building envelopes.

Where building envelopes are inside the 100 m buffer zone to watercourses, and therefore wastewater disposal is not permissible, a designated disposal area has been assigned to those lots which is outside the 100m setback but still within the lot boundaries. This is applicable to Lots 5, 6, 8, 11 and 14.

This strategy was discussed with the Shire of Chittering and has been accepted by them, with correspondence provided in Appendix 5. **Error! Reference source not found.** below summarises ATU locations.

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LEGEND

- Site Boundary
- Cadastre
- Proposed Lot
- Building Envelope
- Drainage Feature
- 100 m Drainage Feature Buffer
- 30m Setback from Ephemeral Watercourses
- Waste Water Disposal Unit

0 25 50 100 150 200 m

Scale: 1:5,000 @ A3

GDA 1994 MGA Zone 50

N

Ellendale Dr

Morley Rd

Turtledove Dr

Thornbill Pl

Bronzewing Ct

Corella Cl

Rosell

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Source: Cadastre - Landgate, 2015
Orthophoto - NearMaps, 25.04.21
Concept Plan - HATCH | RobertsDay, 04.06.21

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WASTERWATER DISPOSAL LOCATIONS

Figure 6

4 STORMWATER MANAGEMENT

4.1 Principles and Objectives

The site is reflective of typical Hill's formations with steep rocky hills with incised alluvial channels with deposits of clay and gravel.

The stormwater management approach aims to;

- Mimic natural hydrological processes;
- Prevent and reduce water pollution;
- Integrate stormwater management systems into the rural development form to enhance amenity; and
- Design stormwater management systems based on the local site parameters.

There are several existing watercourses/ drainage lines and topographic depressions within site boundaries as discussed in Section 2.6. It is important for the post development hydrology to be maintained as close as possible to the predevelopment conditions to ensure the natural hydrological processes are mimicked. To mimic the natural hydrological processes, the following is proposed;

- Retain and protect water bodies with environmental and social values; The development concept has retained all watercourses in their current locations/ forms, and provided a 30m setback for all building envelopes and a 100m setback for all wastewater disposal areas.

- Retain vegetation wherever possible; Where possible, the development concept has located all building envelopes in areas already predominantly cleared of vegetation. This ensures there would be minimal vegetation clearing requirements and therefore minimal impact on increasing runoff rates. This can be seen in Figure 9.

- Minimise effective impervious area; The development concept has minimised road areas as far as practical.

- Manage small event runoff at-source; The development concept manages the small rainfall events as close to source as possible. This is discussed in Section 4.3.1.

- Provide overland flow paths wherever practical; The development concept has provided direct stormwater flow paths to watercourses through the road reserves or via drainage easements (see Section 4.3.2).

- Incorporate the forms and processes of natural water bodies within stormwater management systems; The development concept has incorporated all the natural watercourses onsite into the stormwater management system.

4.1.1 Describing the Natural Hydrological Processes

Keeping site topographic levels and drainage features as close to predevelopment as possible to mimic and maintain the existing hydrological conditions will help to ensure the surface water flows contributing to the Marbling Brook and Brockman River catchments will be maintained and not impact downstream environments.

The sub-catchments have been maintained pre and post development. The predevelopment sub catchments and flow paths are shown in Figure 7. The post development catchments are shown in Figure 8.

The proposed development is low-density. The addition of roads has the potential to increase runoff, however the management of this is discussed in Section 4.3. The drainage system will manage downstream flooding and erosion, while allowing for safe conveyance of stormwater to existing watercourses.

4.2 Lot Drainage Management

The main change to the impervious areas on the lots post development is the additional roof areas. As discussed in Section 3.1, all roof runoff will be collected and stored in rainwater tanks for household water supply year-round, as there is no Water Corporation potable water connection currently available.

By capturing and reusing all rainwater within the house, this also acts as part of the stormwater management system for the development by effectively "disconnecting" the lots from contributing additional water from the new lot impervious areas to the development/ road drainage system. All other on-lot rainfall runoff will behave as per pre-development flows as the landscape remains unchanged, flowing towards the existing watercourses via overland flow across natural surface levels outside of building envelopes. The post-development overland flow paths have been provided in Figure 8.

4.3 Road Drainage Management

Due to the Hills geology, stormwater management primary objectives vary from the typical Swan Coastal Plain management objectives/measures. Key characteristics of the drainage management systems proposed on this site aim to;

- Reduce flow velocity;
- Reduce sediment load;
- Prevent erosion;
- Improve water quality;
- Improve amenity, aesthetics; and
- Manage overland flow.

4.3.1 Small Storm Events

The BUWM guidelines require stormwater from small rainfall events to be managed (retain and/or detain) and treat (if required). This refers to the stormwater runoff from constructed impervious surfaces generated by the first 15mm of rainfall and managing at-source as much as practical.

Small rainfall events consist of approximately 95% of total rainfall volumes (British Colombia Ministry of Water, 2002) so it is therefore important to focus the stormwater management strategy on managing these rainfall events.

Stormwater will be managed on site through table drains with weir structures to control the velocity and treat the stormwater (treatment discussed further in Section 4.4).

4.3.1.1 Table Drains

Roads will be graded towards table drains, which will convey and manage stormwater. Indicative drawings and cross sections are provided in Appendix 6. The table drain flow paths mimic predevelopment flow paths (Figure 7 and Figure 8).

The grade/fall of the road also mimic pre-development by sloping from the south towards the north of the site. Following the natural contours of the land minimises excavation work which in turn reduces the likelihood of cutting into interflows or springs occurring during or post works.

The table drain side slopes will be between 1:3 and 1:4. Flush kerbing will extend along the road edge adjacent to the table drain to allow sheet flow into the drains.

4.3.1.2 Weirs

Weirs will be dispersed along the length of the table drains to reduce velocity of the peak flows and mimic the natural time of concentration from the catchment (i.e. slowing down flows from the upper extents of the catchment so that all the road drainage runoff does not enter the watercourse all at once). Indicative weir locations along the table drain are shown in Figure 9.

Slowing down the velocity of the flows will manage erosion potential and therefore reduce to potential for mobilising sediments. The Water Corporation Design Standards DS66 – Urban Drainage Standard (Water Corporation, 2019) identifies that the design of steep sided open drains will vary with the type of soil encountered. As a rule, to minimise scour, the range of peak velocities allowable is 1.5m/sec for drains constructed in clay. At detailed design phase, the exact locations and frequency of weirs to meet a velocity of 1.5m/s (dependant of the detailed road gradient/slope) will be determined and will be presented in the UWMP.

DS66 (Water Corporation, 2019) also identifies that for high velocity, large drops, high energy, inlet and outlet structures or significant flow redirection locations, hard engineered scour protection is required in the form of rock armouring, limestone blockwork or reinforced concrete. The weir structures will be constructed of mortar stone with lateritic spalls to ensure scour protection (details are shown in Appendix 6). The same will be constructed at the table drain outlets to WC1 to ensure scour protection. These details will be provided at detailed design and in the UWMP.

The stormwater quality treatment aspect of this weir design is discussed in Section 4.4.

4.3.1.2.1 Alternative to Weir Strategy

Please note: This weir strategy has been discussed with the Shire of Chittering (Peter Stuart and Jim Garrett, pers. comm., 9 June 2021) and DWER (Jim Mackintosh, pers. comm., 9 June 2021) and they provided in theory support subject to the design being presented in this LWMS and the subsequent UWMP.

In the event that weir structures are not considered acceptable, velocity reduction areas offset from the road reserve have also been considered. These areas would be offset from the road and within the lot boundary's, and dispersed intermittently along the length of the road. The stormwater would enter a retention area for small events, which would slow down the velocity of flows. Once stormwater has reached the capacity of the velocity reduction areas, they would overflow back into the road reserve. This option is also presented in Appendix 7 as an alternative and detailed design would be presented in the UWMP if this design was progressed.

4.3.2 *Minor Storm Events and Major Overland Flow Paths*

The primary objective of managing minor storm events (20% AEP and above) is for runoff control and to minimise stream erosion. The primary objective of managing major storm events (1% AEP) is to manage catchment flooding and safely convey runoff in major events.

Runoff from minor and major storm events will be conveyed in the table drains and the road reserves providing overland flow paths for up to the 1 % AEP storms. Management of velocities and erosion is discussed in Section 4.3.1.2. All the proposed roads are located in sub-catchment 2 (with a small portion in sub catchment 1) (Figure 8) and so all road reserves and table drains will therefore all discharge to WC1 as per pre-development.

There is an additional drainage easement on the site for an overland flow path;

- Drainage easement 1 is located between Lot 8 and the northern boundary (Figure 9) – this ensures an overland flow path for drainage from the northern section of the road will be directed towards WC1 as per pre-development conditions, rather than flowing north off site unconstrained.

The peak flow runoff volumes are impacted by;

- Soil types – soil types will remain unchanged post development.
- Slope/gradient – the existing topography and catchments will be maintained post development with the exception of the house area and the roads which will be managed as identified above.
- Introduction of imperviousness – road areas have been minimised and runoff managed.
- Retention of vegetation/ change in land use – retention of existing vegetation has been maximised post development by locating building envelopes within existing majority cleared areas.

Peak flows and runoff volumes are therefore expected to remain similar to pre-development given the minimal changes to the parameters which affect the runoff rates discussed above. Therefore, no further detention basins or structures are proposed beyond the weir system identified in the table drains.

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LEGEND

- Site Boundary
- Cadastre
- Contour (mAHD)
- Flow Path
- Subcatchment 1
- Subcatchment 2
- Subcatchment 3
- Subcatchment 4
- Subcatchment 5

N

0 25 50 100 150 200 m

Scale: 1:5,000 @ A3

GDA 1994 MGA Zone 50

Ellendale Dr

Morley Rd

Turtledove Dr

Thornbill Pl

Corella Cl

Bronzewing Ct

Rosella Wy

Source: Contours - DPIRD
Cadastre - Landgate, 2021
Orthophoto - NearMaps, 25.04.21

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PRE-DEVELOPMENT CATCHMENTS

Figure 7

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LEGEND

- Site Boundary
- Cadastre
- Building Envelope
- Proposed Lot
- Existing Fire Service Access Route
- 6.0m Fire Service Access Route (Alignment TBC)
- Drainage Feature
- Flow Path
- Subcatchment 1
- Subcatchment 2
- Subcatchment 3
- Subcatchment 4
- Subcatchment 5

N

0 25 50 100 150 200 m

Scale: 1:5,000 @ A3
GDA 1994 MGA Zone 50

Ellendale Dr
Morley Rd
Turtledove Dr
Thornbill Pl
Corella Cl
Bronzewing Ct

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Source: Cadastre - Landgate, 2015
Orthophoto - NearMaps, 25.04.21
Concept Plan - HATCH | RobertsDay, 04.06.21

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POST DEVELOPMENT CATCHMENTS

Figure 8

4.4 Water Quality Treatment

Given the nature of the proposed development and the large rural blocks proposed, the primary water quality parameters of concern are as follows;

- Sediments, suspended solids – associated with the in-situ geology and runoff from the natural catchments.
- Hydrocarbons/ heavy metals – associated with roads and vehicular usage.

Other water quality parameters considered but not considered a likely concern are;

- Nutrients – usually associated with fertiliser use, animals, septic tank wastewater disposal.
- Microbial – usually associated with septic tank wastewater.

Lifestyle blocks have some of the lowest nutrient loading rates in comparison to other land uses/ lot sizes as the larger size means that residents tend to maintain the natural vegetation and landscaping styles rather than plant gardens that require more fertiliser and maintenance requirements. Lifestyle blocks have an average phosphorus loading rate of approx. 3kg/ha/yr, compared to large urban lots and various agricultural uses which have a loading rate of approx. 12 - 25kg/ha/yr. Lifestyle blocks have an average nitrogen loading rate of approx. 48kg/ha/yr, compared to large urban lots and various agricultural uses which have a loading rate of approx. 85 - 140kg/ha/yr.

As identified in Section 3.2, wastewater will be managed and treated via ATUs. ATUs treat wastewater to a high quality and are a lot more effective and reliable than old septic tank systems. The DoH approved ATU systems required for this site (Appendix 4) require wastewater effluent to reach a microbial quality of 10 cfu/100ml of *E. Coli*. In addition, further polishing treatment of the effluent will occur in the 1.5m of fill underneath the wastewater disposal area.

Given the reasoning stated above, water quality treatment of stormwater runoff has therefore been aimed at sediments and hydrocarbons/ heavy metals.

4.4.1 Structural Controls

Sediments are managed through two mechanisms; erosion and scour control (ensure further sediments are not mobilised through high velocity water eroding natural soils), this has been addressed in Section 4.3.1.2, and through settlement. The weir system will detain stormwater, holding it back and allowing any unavoidable sediments to settle out.

Petroleum hydrocarbons and heavy metals can bond to sediment or organic matter (adsorption), resulting in their reduction or removal from water as it passes through soils and sediments.

Prior to the lateritic spall of the weir structures, some endemic vegetation will be planted to provide additional water quality treatment. Plant species selection will be based on local sedges (e.g., the species already seen in WC1) as this demonstrates that the species is suitable and able to thrive in the local geology and hydrological conditions. The vegetation will allow additional filtering/adsorption of sediments and hydrocarbons and heavy metals.

4.4.2 Non-Structural Controls

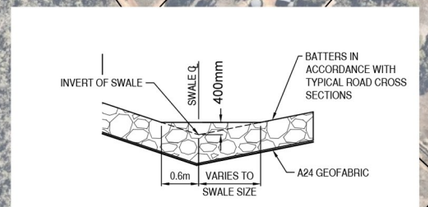
In addition to the stormwater management as described above, the following non-structural controls will be employed at the site:

- Residents will be informed of the need for onsite wastewater disposal requirements, rainwater tank requirements via measures such as information packs included in lot purchase documentation.
- Construction practices such as drainage, erosion, sediment, housekeeping, and dust controls will be employed during construction.

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Legend

- Table Drains with Wiers
- Drainage Easement
- Possible Weir Locations Depending on Grades



Typical Weir Detail

LOT M1942
54.0405ha

MORLEY ROAD

1 2.5475ha
2 2.0091ha
3 2.0025ha
4 2.0029ha
5 2.5526ha
6 2.1077ha
7 2.3295ha
8 2.1675ha
9 2.5915ha
10 2.2941ha
11 2.365ha
12 2.2439ha
13 2.1605ha
14 3.2195ha
15 3.1059ha
16 9.8465ha
17 2.0667ha
18 2.4757ha

25m ROAD RESERVE
20m ROAD RESERVE

MORLEY ROAD
TURTLEDOVE DRIVE
THORNBILL PLACE
BRONZEWING COURT

Morley Road, Chittering - Table Drain Concept Drainage Plan

File No 20-03

14th June 2021

LEGEND

- 196m² WASTE WATER DISPOSAL AREA
- WATER COURSE AND 100m BUFFER

0 metres 25 50 75 100 125

Source: RobertsDay | Hatch, 29.06.21

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DRAINAGE PLAN

Figure 9

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5 GROUNDWATER MANAGEMENT

5.1 Fill Management

Fill is likely to be required within building envelopes on individual lots; however, the aim is to retain as much natural landscape as possible to mimic predevelopment conditions and reduce clearing. Given the fractured rock aquifer hydrogeology, definitive groundwater levels are not determined for the site but the potential for perched groundwater and interflow has been noted.

5.1.1 Lot Clearances

Site specific geotechnical investigations will be required to determine appropriate clearance requirements for building pads and submitted with the building permit application.

Clearances for ATU disposal areas are addressed in Section 3.2.2. The clearances for the disposal areas will achieve 1.5m of separation from any geology with the potential to create perched groundwater.

Any imported fill will be clean, permeable sand with less than 5% fines, and is the responsibility of lot owners.

6 FLOOD MANAGEMENT

Regional flood mapping information is not available for the site.

The watercourses onsite are considered to be predominately surface water fed streams given:

- The ephemeral nature of the watercourses (anecdotal evidence). This was validated during the site visit in December 2020 where water was not observed in most locations, or only stagnant water was present
- The low permeability surface geology.
- The underlying aquifer is fractured rock and is not known to support significant quantities of groundwater.

In accordance with Schedule 2 of the *State Planning Policy 2.9 Water Resources* (WAPC, 2006) and *WAPC Development Control Policy 2.3* a foreshore width of 30 m from the high-water mark may be applied in small watercourses to mitigate flood risk. All building pad envelopes have been located outside of the 30 m setback and this is demonstrated in Figure 6.

7 MONITORING

Post development surface water monitoring will be undertaken to monitor flows and quality in WC1 during the 3 months of winter (June, July, August) when water is anticipated.

- Locations – the top of WC1 (incoming) and the bottom prior to discharge offsite (outgoing).
- Parameters – flow, total suspended solids, heavy metals.

Monitoring will be undertaken for 2 years until handover to council with a report provided at the end of the monitoring period. Although no predevelopment data has been gathered, this information will help to monitor the effectiveness of the weir flow detention and table drain management system.

8 IMPLEMENTATION FRAMEWORK

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

8.1 Construction

Construction activities have the potential to directly and indirectly impact local water resources and water management measures are required.

To ensure downstream waterways are protected, developers, builders and landscapers must implement best management practices to control erosion and sedimentation. Contractors and staff should be notified of specific construction management requirements including appropriate disposal of waste material, erosion control and dust suppression.

8.2 Roles and responsibilities

Key tasks, roles and responsibilities relating to delivery of urban water management objectives are outlined in Table 8.

Table 8: Summary of roles and responsibilities

Principal	Commitment	Responsibility	Timescales
Stormwater Management	Design and construction of stormwater infrastructure	Proponent	Following detailed engineering design
	Maintenance of weirs and table drains	Proponent	Until handover
Groundwater Management	Geotechnical assessment for building pad envelope filling and construction	Lot owners	At construction
Potable Water Supply and Disposal	Application and provision of ATUs and rainwater tanks for individual lots	Lot owners	During construction, house design and installation
	Geotechnical assessment for wastewater disposal area filling and construction	Lot owners	During construction, house design and installation
	Provision of educational material for wastewater, water efficiency measures	Proponent	At point of sale
	Installation of water efficiency and conservation measures	Lot owner	At lot point of sale, house design and installation
Monitoring	Post-development monitoring programme	Proponent	Surface water over winter, for two years post development. Reporting after two years.

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Appendix 1 LWMS Checklist

Local water management strategy Item	Deliverable	☑	Comments
Executive summary			
Summary of the development design strategy, outlining how the design objectives are proposed to be met	Table 1: Design elements & requirements for BMPs and critical control points	☑	
Introduction			
Total water cycle management – principles & objectives Planning background Previous studies		☑	
Proposed development			
Structure plan, zoning and land use. Key landscape features Previous land use	Site context plan Structure plan	☑ ☑	
Landscape – proposed POS areas, POS credits, water source, bore(s), lake details (if applicable)	Landscape Plan		No POS proposed
Design criteria			
Agreed design objectives		☑	
Pre-development environment			
Existing information and more detailed assessments (monitoring). How do the site characteristics affect the design?		☑	
Site Conditions – existing topography/ contours, aerial photo underlay, major physical features	Site condition plan	☑	
Geotechnical – topography, soils including acid sulphate soils and infiltration capacity, test pit locations	Geotechnical plan	☑	

Local water management strategy Item	Deliverable	☑	Comments
Environmental – areas of significant vegetation, wetlands and buffers, waterways and buffers, contaminated sites	Environmental Plan plus supporting data where appropriate	☑	Site Assessment
Surface Water – topography, 100 year floodways and flood fringe areas, water quality of flows entering and leaving (if applicable)	Surface Water Plan	☑	
Groundwater – topography, pre development groundwater levels and water quality, test bore locations	Groundwater Plan plus details of groundwater monitoring and testing	☑	
Water sustainability initiatives			
Water supply & efficiency measures – private and public open spaces		☑	
Fit-for-purpose strategy and agreed actions. If non-potable supply, support with water balance		☑	
Wastewater management		☑	
Stormwater management strategy			
Flood protection – peak flow rates, volumes and top water levels at control points,100 year flow paths and100 year detentions storage areas	Major event Plan Long section of critical points	☑	
Manage serviceability – storage and retention required for the critical 5 year ARI storm events Minor roads should be passable in the 5 year ARI event	Minor event Plan	☑	
Protect ecology – detention areas for the 1 yr 1 hr ARI event, areas for water quality treatment and types of (including indicative locations for) agreed structural and non-structural best management practices and treatment trains. Protection of waterways, wetlands (and their buffers), remnant vegetation and ecological linkages	Small event Plan Typical cross sections	☑	
Groundwater management strategy			
Post development groundwater levels and fill requirements (including existing and likely final surface levels), outlet controls, and any subsoils	Groundwater/subsoil Plan	☑	

Local water management strategy Item	Deliverable	☑	Comments
Actions to address acid sulfate soils or contamination		☑	
The next stage – subdivision and urban water management plans			
Content and coverage of future urban water management plans to be completed at subdivision. Include areas where further investigations are required prior to detailed design.		☑	
Monitoring			
Recommended future monitoring plan including timing, frequency, locations and parameters, together with arrangements for ongoing actions		☑	
Implementation			
Developer commitments		☑	
Roles, responsibilities, funding for implementation		☑	
Review		☑	

Appendix 2 Geotechnical Report (CMW, 2021)

24 May 2021

MORLEY ROAD SUBDIVISION
MORLEY ROAD
LOWER CHITTERING, WA

GEOTECHNICAL INVESTIGATION REPORT

Sicicalab Pty Ltd

PER2020-0500AB Rev1

PER2020-0500AB		
Date	Revision	Comments
18 May 2021	0	Draft Report
24 May 2021	1	Following Client Comments

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Appendix A – Test Pit Logs

Appendix B – In-situ Falling Head Infiltration Test Results

Appendix C – Laboratory Test Results

1 INTRODUCTION

CMW Geosciences Pty Ltd (CMW) was authorised by Sicicalab Pty Ltd to carry out a geotechnical investigation of a site located at Morley Road, Lower Chittering, WA by the way of a signed proposal dated 23 March 2021. The scope of work and associated terms and conditions of our engagement were detailed in our services proposal letter referenced PER2020-0409AA, Rev1 dated 23 March 2021.

The purpose of this report is to describe the investigation completed, the ground conditions encountered, and to provide geotechnical recommendations relating to the site for a proposed rural residential subdivision development.

2 SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The proposed development site comprises an area of approximately 60 ha and is located along Morley Road, Lower Chittering, WA as shown on the attached Drawing 1. It is accessible from Morley Road and bound by existing small acreage residential dwellings.

The elevation profile varies from approximately RL 202 m to 255 m AHD however this has not been confirmed by a site survey. A series of north to south aligned creek systems cut through rolling hills. The highest elevation is located in the south eastern extent of the site. There are 3 areas of dense forest vegetation, these are located along the western boundary, at the top of the central hill and surrounding the deep creek channel at the eastern boundary. The remainder of the site is generally grassed paddocks. The creek channel has formed a delta in the lowest lying paddock and has swamp-like characteristics in some areas. There is evidence the land to the south of the existing homestead has been used for growing vines.

We understand the proposed development includes the subdivision of the land into 18 rural residential lots, similar to that of the surrounding area. 17 of the lots range in size from 2.0025 to 3.2195 ha and the remaining lot is 9.8465ha. The development also comprises the construction of three new access roads which will intersect with the existing Morley Road, Thornbill Place and Bronzewing Court.

3 FIELD INVESTIGATION

Following a dial before you dig search, and onsite service location, the field investigation was carried out between 25 and 26 March 2021. All fieldwork was carried out under the direction of CMW Geosciences Pty Ltd in accordance with AS1726 (2017), Geotechnical Site Investigations. The scope of fieldwork completed was as follows:

- 45 test pits, denoted TP01 to TP45, were excavated using a JCB Backhoe to assess the subsurface profile. TP01, TP07, TP08, TP14, TP26 and TP28 were the only excavations to reach the target depth of 3.0 m. The remaining test pits all refused on hard strata. Representative bulk samples were collected to provide samples for subsequent laboratory testing. Engineering logs and photographs of the test pits are presented in Appendix A;
- Dynamic Cone Penetrometer (DCP) tests were carried out adjacent to each test pit, in general accordance with AS1289.6.3.2, to depths of up to 2.0 m to provide soil density/consistency profiles. Graphical results of the DCP testing are presented on the test pit logs in Appendix A;
- In situ falling head infiltration tests were completed in open hand dug test pits. Results of the permeability tests are presented in Appendix B.

4 LABORATORY TESTING

Laboratory testing was carried out in accordance with the requirements of the current edition of AS 1289 (where applicable). Where a test was not covered by an Australian standard, a local or International standard was adopted and noted on the laboratory test certificate.

All testing was scheduled by CMW and carried out by Western Geotechnical, a NATA registered Testing Authority and CSBP, an ASPAC certified laboratory.

The extent of testing carried out to provide the geotechnical parameters required for this study are presented in Table 1.

Table 1: Laboratory Test Schedule Summary

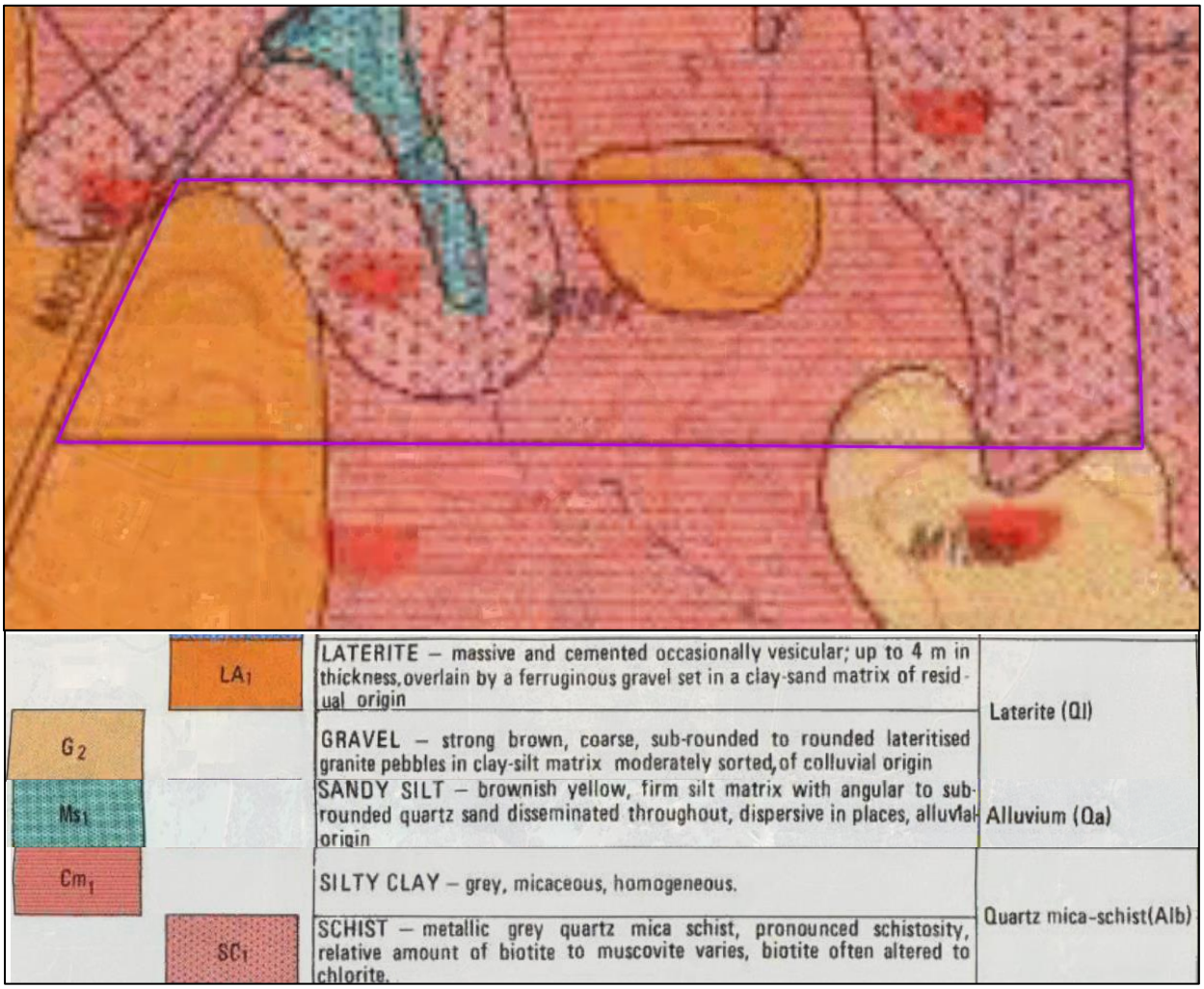
Type of Test	Test Method	Quantity
Particle size distribution	AS1289.3.6.1	2
Atterberg limits	AS1289.3.1.1, 3.2.1, 3.3.1	13
Shrink Swell	AS 1289.7.1.1	3
Subgrade CBR	AS 1289.6.1.1	3
PRI	Allen and Jeffrey method (1990)	10

Certificates for the test results outlined above are presented in Appendix C.

5 GROUND MODEL

5.1 Geology

Published geological maps (Ref. Muchea Sheet 2034 I and part Sheet 2134 IV) and the CMW investigation database for the area indicate the site is underlain by three different strata. These strata include Laterite overlying Quartz mica-schist (weathered to silty Clay), with areas of sandy silt along drainage channels. These geological units are shown in Figure 1 below.



5.2 Subsurface Conditions

The ground conditions encountered and inferred from the investigation are considered to be generally consistent with the published geology for the area and can be generalised according to the following subsurface strata. It is noted that these layers are not necessarily all present or in sequential order.

TOPSOIL: GRAVELLY SILT	dark brown; gravel, fine to medium grained, subrounded to rounded; with roots;
CEMENTED CLAYEY GRAVEL (Duricrust)	fine to coarse grained, subrounded to rounded, yellow brown; trace sand, fine grained; trace cobbles.
CLAYEY GRAVEL/SANDY GRAVEL (Residual)	Subrounded to rounded, fine to medium grained; clay, medium plasticity, orange brown.
CLAY (Residual Soil)	low to medium plasticity, orange-brown, weakly cemented; overlying;
EXTREMELY WEATHERED SCHIST	well cemented clay, pale red brown;

The following table shows the depth that clay strata first occurred and the depth to hard strata causing test pit refusal such as a duricrust layer or the underlying weathered schist.

Table 2: Summary of key strata depth

Test Pit	Lot number	Depth to Clay (m)	Depth to Refusal (m)
TP01	7 BF	1.4	3.0 (target)
TP02	8	-	1.7
TP03	9 BF	-	1.4
TP04	9	-	1.1
TP05	15	0.3	0.8
TP06	7	0.1	2.7
TP07	8 BF	-	3.0 (target)
TP08	10 BF	-	3.0 (target)
TP09	10	-	1.1
TP10	15	-	1.2
TP11	15 BF	0.3	1.9
TP12	16	0.1	1.0
TP13	16	0.1	1.0
TP14	11 BF	-	3.0 (target)
TP15	11	0.8	1.5
TP16	14 BF	0.9	1.0
TP17	1	0.1 (silt)	0.7
TP18	1 BF	0.1 (silt)	1.5
TP19	RR	0.1 (silt) 0.9 (clay)	2.1
TP20	2	0.1 (silt)	1.0
TP21	2 BF	0.1	2.7
TP22	3 BF	0.1 (silt) 0.5 (clay)	2.1
TP23	RR	0.1	2.7
TP24	4 BF	2.5	2.6

Table 2: Summary of key strata depth			
Test Pit	**Lot number**	**Depth to Clay (m)**	**Depth to Refusal (m)**
TP25	4	-	2.4
TP26	6	-	3.0 (target)
TP27	5 BF	-	2.4
TP28	RR	1.8	3.0 (target)
TP29	6 BF	-	2.0
TP30	RR	-	1.3
TP31	RR	0.6	1.1
TP32	12 BF	1.0	1.9
TP33	13 BF	1.5	1.6
TP34	RR	0.3	1.2
TP35	13	-	0.9
TP36	17 BF	0.1	1.4
TP37	17	0.1	2.1
TP38	18 BF	0.8	1.8
TP39	17	0.1	2.3
TP40	16	0.8	2.0
TP41	RR	-	1.5
TP42	RR	-	2.2
TP43	RR	0.9	1.7
TP44	16 BF	0.1	1.6
TP45	RR	0.7	1.9
Note: BF = Building Footprint, RR = Road Reserve			

The Duricrust was identified at relatively shallow levels (<1 .5 m) across much of the site, in particular in Lots 1 and 2, and along the western and eastern flanks of the central hill (e.g. Lots 9, 10 12, 14, 15 16 and 17).

The extremely weathered schist was only encountered within TP37 and TP39 on the slopes either side of the deep creek at the eastern boundary.

The residual soil was generally consistent across the remainder of the site, with a significant clay content but with some variability in the sand content. The test pits undertaken through the centre identified a band of sandy gravel running north to south between the delta in the low-lying paddock and the western side of the central hill.

Of significant to both site classifications and for assessing the potential for stormwater disposal through infiltration is the presence of relatively shallow clay (or silt) strata as Tabulated in Table 2 above. Clay (or silt) is present within 1 m of the surface in over half of the test pits and in many of the test pits is encountered only 0.1 to 0.5 m below the ground surface.

5.3 Laboratory Test Results

5.3.1 Civil Engineering

Results of the laboratory tests provided in Appendix C are summarised in Table 3.

Table 3: Summary of Laboratory Test Results

Test Location	Depth (mbgl)	Gravel (%)	Sand (%)	Fines (%)	LL (%)	PL (%)	PI (%)	LS (%)	OMC (%)	MMDD (t/m^2)	CBR (%)	Shrink-swell
TP01	2.0 – 2.4	-	-	-	**32**	**18**	**14**	**5.0**	-	-	-	-
TP07	0.1 – 1.5	-	-	-	NO	NP	NP	0.0	-	-	-	-
TP08	2.0 – 2.4	74	20	6	-	-	-	-	-	-	-	-
TP13	0.7 – 0.9	-	-	-	28	14	14	6.0	-	-	-	-
TP14	0.8 – 1.0	-	-	-	NO	NP	NP	0.0	-	-	-	-
TP15	1.3 – 1.5	-	-	-	-	-	-	-	7.0	2.26	-	0.1
TP16	0.4 – 0.6	-	-	-	NO	NP	NP	0.0	-	-	-	-
TP17	0.2 – 0.5	-	-	-	-	-	-	-	8.0	2.42	-	0.0
TP21	1.0 – 1.4	-	-	-	37	24	13	6.5	-	-	-	-
TP22	2.0 – 2.5	-	-	-	40	23	17	6.0	-	-	-	-
TP23	0.4 – 0.6	-	-	-	-	-	-	-	7.5	2.30	190	-
TP24	1.5 – 2.0	-	-	-	23	19	4	2.5	-	-	-	-
TP27	0.8 – 1.0	-	-	-	21	13	8	3.0	-	-	-	-
TP29	0.2 – 0.4	-	-	-	NO	NP	NP	0.0	-	-	-	-
TP33	1.0 – 1.3	-	-	-	25	14	11	5.0	-	-	-	-
TP36	0.4 – 0.6	64	28	8	-	-	-	-	-	-	-	-
TP38	1.3 – 1.5	-	-	-	36	22	14	5.0	-	-	-	-
TP42	1.0 – 1.4	-	-	-	-	-	-	-	9.0	2.30	200	-
TP44	0.3 – 0.5	-	-	-	46	27	19	7.5	13.0	1.94	-	0.4
TP45	0.8 – 1.0	-	-	-	-	-	-	-	13.0	2.0	120	-

Note: Gravel, sand and fines percentages are by weight, LL = liquid limit, PL = plasticity limit, PI = plasticity index, LS = linear shrinkage, NO = Not obtainable, NP = Non Plastic, MC = Natural Moisture Content, OMC = Optimum Moisture Content, MMDD = Modified Maximum Dry Density, CBR = California Bearing Ratio.

We were requested to undertake Phosphorus Retention Index (PRI) testing and to provide the results without interpretation. The PRI results are provided below:

Table 4: Summary of PRI Test Results

Test Location	Depth (mbgl)	PRI
TP02	0.4 – 0.6	28.5
TP06	0.3 – 0.5	17.8
TP11	0.5 – 0.8	156.6
TP14	0.8 – 1.0	18.1
TP16	0.41 – 0.6	20.8
TP17	0.1 – 0.2	6.2
TP27	0.8 – 1.0	130.6
TP29	0.0 – 0.1	14.5
TP38	1.0 – 1.3	>1000
TP44	0.4 – 0.5	>1000

5.4 Groundwater

There is no published groundwater data available for this area, e.g. from monitored water bores. There are multiple surface drainage channels that cut across the site that flow south to north. It is important to note that the flow may not be connected to regional groundwater.

Groundwater was only encountered at 0.8 mbgl within TP28 which is situated within a low-lying area of the site. Given the presence of a variable and clayey soil profile, it is possible that perched groundwater may occur during and following periods of rainfall.

It should be noted that the investigation was undertaken in April at a time of the year (end of summer) when groundwater levels are generally towards their lowest levels. More frequent groundwater occurrences and higher elevation for groundwater tables should be expected following rainfall and in particular at the end of winter (e.g. September/October) when groundwater tables have been recharged from winter rainfall.

5.5 Permeability

The results of the falling head permeability tests carried out were used to estimate the soil coefficient of permeability in accordance with the methods described in CIRIA Report No. 113 (falling head test). summarises the results obtained. The strata were generally too hard to hand-auger a borehole in which to conduct the test. The tests were therefore undertaken in shallow hand dug pits, approximately 0.3 x 0.3 m in plan area and 0.3 to 0.4 m deep.

Table 5: Summary of Falling Head Permeability Tests						
Standpipe	**Screen Depth (mbgl)**	**Strata**	**Test Method**	**Approximate Permeability**		**Underlain by**
				(m/sec)	**(m/day)**	
PERM1	0 to 0.4	GRAVELLY SILT	CIRIA 113	$1.40x10^{-04}$	12	CLAY at 0.3 m
PERM2	0 to 0.31	CLAYEY GRAVEL	CIRIA 113	$1.76x10^{-04}$	15	CLAY at 0.3 m
PERM3	0 to 0.31	GRAVELLY SILT	CIRIA 113	$1.09x10^{-04}$	10	CLAY at 0.1 m
PERM4	0 to 0.35	SANDY GRAVEL	CIRIA 113	$1.32x10^{-04}$	11	Refusal on Duricrust at 2.0 m
PERM5	0 to 0.33	CLAYEY GRAVEL	CIRIA 113	$1.52x10^{-04}$	13	Refusal on Duricrust at 1.5 m
PERM6	0 to 0.31	GRAVELLY SILT	CIRIA 113	$1.08x10^{-04}$	9	CLAY at 0.1 m

5.6 Permeability Test Results Discussion

The permeability test results are consistent with what would be expected for the surficial strata tested. It is however noted that very shallow occurrences of clay underlie at least half of the site as well as duricrust, both of which will have extremely low permeabilities and generally render the site unsuitable for stormwater disposal. The above test results indicate the infiltration properties of the surficial gravelly strata only.

6 GEOTECHNICAL CONSIDERATIONS

6.1 Earthworks

Earthworks must be carried out in accordance with the recommendations provided in this report and AS3798-2007 *Guidelines on Earthworks for Commercial and Residential Developments*.

6.1.1 Topsoil Strip and Subgrade Preparation

- All vegetation and topsoil which is approximately 200mm thick, must be stripped and removed from beneath the building envelopes.
- Existing trees within the building envelopes must be removed and their root systems must be completely grubbed out. The soil beneath the root system must be compacted and backfilled to the specifications described below;
  - Any organic (tree roots / stumps) or manmade waste observed should be removed from site.
  - At the completion of excavation to design levels, the upper 300mm of the exposed subgrade must be moisture conditioned and proof-rolled with a suitable roller to achieve at least 95% compaction with respect to Modified Maximum Dry Density (MMDD).

6.1.2 Bulk Earthworks

We recommend the following is undertaken during bulk earthworks:

- To be compatible with the *in situ* soil conditions and the retaining wall and building foundation recommendations provided herein, all bulk general fill material must comprise clean fill that is moisture conditioned to within ± 3% of the soils optimum moisture content and free of organic and other deleterious material. It must have a maximum particle size not exceeding 100mm and be well graded;
- The natural *in situ* soils are considered to meet this definition and are suitable for this purpose. All proposed fill must be moisture conditioned and compacted in layers not exceeding 300mm with suitable plant to achieve at least 95% compaction with respect to MMDD, as defined above. Care must be exercised when compacting in the vicinity of existing structures, particularly if vibratory compaction is being carried out. It is recommended that similar materials are used for similar building platforms or structures;
- If a less severe Site Classification than those discussed in See Section 6.4, then imported sand fill must be used. This must be clean, free draining sand with less than 5% fines and no organic or deleterious materials. Care must be taken prevent creating depressions on the surface of in situ soils below the imported sand fill to prevent water accumulating. Similarly, the *in situ* surface should be bench prior to receiving the fill to prevent erosion of the fill at the interface between the sand fill and the underlying in situ clay soils.

6.1.3 Retaining Wall Backfill

We recommend the following during retaining wall backfilling:

- Backfill layers should be placed in maximum 300mm thick loose layers, moisture conditioned to within ±3% of the optimum moisture content and compacted with a suitable vibrating plate compactor to achieve a dry density ratio of at least 95% based on Modified Compaction (AS1289 5.2.1);
- Adequate drainage must be allowed behind retaining walls to avoid a build-up of excess pore water pressures behind the wall. This can be achieved using imported sand fill as backfill or adequate drains/weep holes.

6.1.4 Excavatability

Firm to stiff clayey gravel was generally encountered across the site should be excavatable within the upper 1.0m using standard mechanical plant (backhoe, excavator, scraper or dozer). It is noted that most of the test pit locations refused using a backhoe. If significant excavation depths (say greater than 1m) are anticipated, it is recommended that a rock breaker/toothed bucket etc. are allowed for in case shallow rock or well cemented laterites or other types of duricrust are encountered.

6.1.5 Trafficability

Clayey materials are present, including clays and silts at shallow levels. Once topsoil has been stripped these materials are likely to soften especially following rain resulting in poor trafficability, especially if earthworks are undertaken during wet periods. Bulk earthworks should be carefully planned to minimise material stripping until required, to maintain generous site falls to prevent water ponding and not to traffic areas following rain if softening and rutting is likely to occur. Temporary sheeting to form tracks in areas of greater site traffic may be required.

6.1.6 Earthworks Monitoring

The investigation has demonstrated the site is highly variable both vertically and laterally. Variations in ground conditions should be expected even across a single lot. If conditions other than those described above are encountered, then further advice should be sought without delay.

We recommend that this work is completed under the direction and control of a suitably experienced Geotechnical Engineer familiar with the contents of this report. CMW would be pleased to perform this function if required. To ensure that topsoil stripping is carried out adequately, proof compaction and cut to fill earthworks are conducted in accordance with AS3798-2007, and to audit the compaction of earthworks. Earthworks control testing should be undertaken in accordance with the guidelines set out in AS3798-2007. CMW would be pleased to perform this function if required.

6.2 Retention Systems

Design parameters for permanent and temporary retaining walls are summarised in Table 6.

Table 6: Retaining Wall Design Parameters

Soil Unit	Ɣ (kN/m^3)	Ø' (deg)	K_0	E' (MPa)	No wall friction		Wall friction = 2/3Ø	
					K_a	K_p	K_a	K_p
Clayey Gravel	19	32	0.47	50	0.307	3.255	0.275	7.333
Clay	18	27	0.55	30	0.376	2.663	0.334	4.754
Extremely Weathered Schist	24	36	0.41	70	0.260	3.852	0.235	11.146

Notes:
1. Refer to Table 2 for definition of soil unit levels
2. Ɣ – soil unit weight; Ø' - angle of internal soil friction; K_0 - coefficient of earth pressure at rest, K_a - coefficient of active earth pressure, K_p - coefficient of passive earth pressure; E' – long term Young's modulus.
3. Values of K_0 are based on initial conditions following construction of the perimeter retention system.
4. The retaining wall designer must adopt the above set of K_a and K_p parameters relevant to the actual construction method adopted
5. The above parameters are based on the condition of a horizontal ground surface behind the retaining structure. Applicable surcharge loads behind the wall must also be considered in the design.

Retaining structures should be designed in accordance with AS 4678-2002 "*Earth Retaining Structures*" or an alternate approved factor of safety approach. The compaction equipment used to compact backfill behind the wall must be carefully selected and preferably light-weight compaction equipment should be used. The load on the retaining wall due to compaction equipment may be estimated from Figure J5 in AS4678-2002 *"Earth Retaining Structures"*.

It is noted that some ground movement will occur behind temporary or permanent retaining walls. By definition, movement of the wall must occur to fully mobilise the active and passive earth pressure coefficients provided in Table 6 above. The extent of this movement is dependent on the height of retaining, type of wall selected and construction methodology. This must be considered during the design and construction of the retaining walls to ensure adjacent facilities are not adversely affected.

Any ground anchors associated with retaining wall construction should be designed based on the above effective stress soil parameters and using appropriate design standards such as BS8081.

6.3 Subsoil Classification

Based on our understanding of the general geology beneath the site, the results of our investigation and the recommendations provided in AS1170.4-2007 a site subsoil class of Ce (shallow soil site) to Section 4.2 of AS1170.4 is recommended for seismic design purposes.

6.4 Preliminary Site Classification

The ground conditions are highly variable, and Site classifications of S (0-20 mm of ground movement) and M (20 to 40 mm of ground movement) are applicable for the site. Those building envelopes underlain by very shallow clay but with the duricrust at depth being potential M classifications whilst those building envelopes with clay being greater than 1 m deep and/or a shallow duricrust layer being S classifications.

The final site classification for individual building envelops will be subject to the bulk earthwork undertaken (e.g. depth to clay and depth to cemented horizon) beneath final earthworks building envelope. Given the variability of the site it is recommended that at least two test pits are undertaken per final building envelope to assess the site classification on a lot by lot basis for final footing design.

6.5 Drainage

The very thin surficial clayey gravel strata occurs above either shallow clay, silt or duricrust render the site generally unsuitable for stormwater disposal by soak well. Whilst pockets of permeable material (e.g. infiltration rates of 5 m /day) may be found in which to situate a soak-well on some lots, the undulating nature of the site and the accumulations of gravelly material over residual clays would mean that stormwater disposed of in this manner might emerge downslope as a spring.

6.6 Subgrade CBR

Based on the variability of soil types across the site, it is recommended that pavements be designed on the basis of a subgrade CBR value of 6%. Where clay is encountered at road subgrade, a subgrade CBR value of 4% should be assumed.

This design CBR value is subject to the exposed subgrade being moisture conditioned and compacted in accordance with the recommendations provided in Section 6.1 above. It is recommended that QA / QC testing be undertaken on subgrade materials during construction.

7 CLOSURE

The findings contained within this report are the result of limited discrete investigations conducted in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, can it be considered that these findings represent the actual state of the ground conditions away from our investigation locations.

If the ground conditions encountered during construction are significantly different from those described in this report and on which the conclusions and recommendations were based, then we must be notified immediately.

This report has been prepared for use by Sicicalab Pty Ltd in relation to the Morley Road Subdivision, Lower Chittering project in accordance with generally accepted consulting practice. No other warranty, expressed or implied, is made as to the professional advice included in this report. Use of this report by parties other than Sicicalab Pty Ltd and their respective consultants and contractors is at their risk as it may not contain sufficient information for any other purposes.

For and on behalf of
CMW Geosciences Pty Ltd



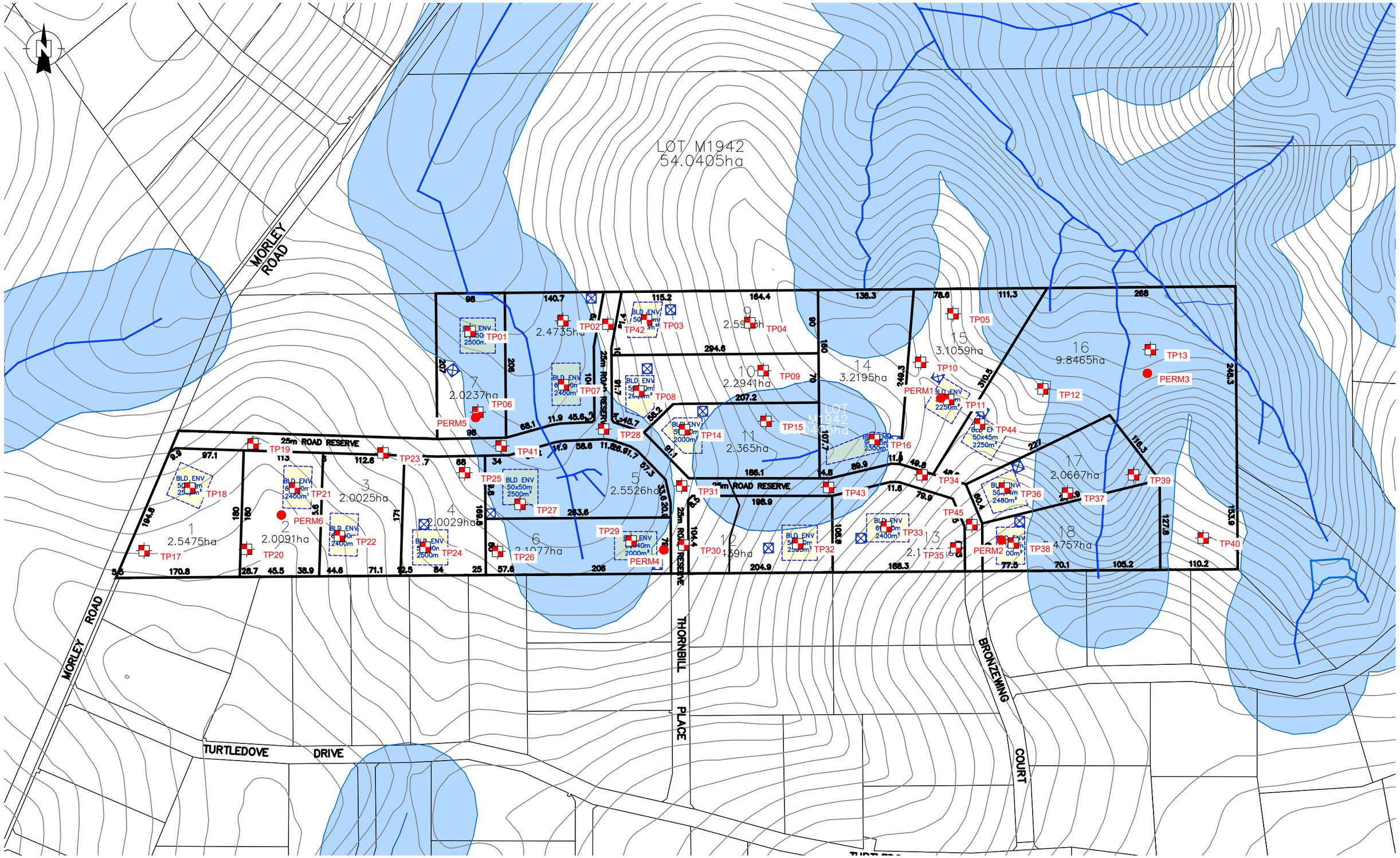


Rebecca Cooke
Project Engineering Geologist

Matt Watts
Associate Engineering Geologist

Distribution: 1 copy to Sicicalab Pty Ltd (electronic)
Original held by CMW Geosciences Pty Ltd

Figures



LEGEND:

- TP01 TEST PIT LOCATION
- PERM01 PERMEABILITY TEST LOCATION

NOTES:

1. BASE PLAN SUPPLIED BY CLIENT "CPGCHI_DES_DWG_002C2[CONCEPT-OPTION 2].DWG"

1:5000 0 50 100 150 200 250 m

CMW Geosciences

CLIENT: COTERRA ENVIRONMENTAL		DRAWN: DE	PROJECT: PER2020-0500
PROJECT: MORLEY ROAD SUBSTATION MORLEY RD, LOWER CHITTERING, WA		CHECKED: RC	DRAWING: 01
		REVISION: B	SCALE: 1:5000
TITLE: SITE INVESTIGATION PLAN		DATE: 18.05.21	SHEET: A3 L

Appendix A
Test Pit Logs

TEST PIT LOG - TP01

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.411868m N.6504561m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.			3	
						GC: CLAYEY GRAVEL: subrounded to rounded, fine to medium grained; clay, medium plasticity, orange brown. (Residual Soil)			5	
									9	
									9	
								D to VD	10	
									11	
				1					20	
									6	
									15	
									24	
						CL: CLAY: low to medium plasticity, orange brown; weakly cemented. (Residual Soil)	D to M			
				2				St to VSt		
				3		Test pit terminated at 3.00 m				
				4						

Termination Reason: Target depth reached

Remarks:





TEST PIT LOG - TP02

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412000m N.6504576m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.	D to M	MD	3, 4, 3, 2, 3	
				1		GP: SANDY GRAVEL: fine to medium grained, rounded; sand, fine grained, orange brown; with clay, low plasticity. (Residual Soil)		D to VD	6, 7, 11, 13, 14, 5, 5, 20, 11, 20	
						Test pit terminated at 1.70 m				
				2						
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP03

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412119m N.6504577m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.	D to M	MD	4, 2, 2, 2, 3	
				1		GP: SANDY GRAVEL: fine to medium grained, rounded; sand, fine grained, orange brown; with clay, low plasticity. (Residual Soil)		D to VD	20, 12, 20	
						Test pit terminated at 1.40 m				
				2						
				3						
				4						

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP04

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

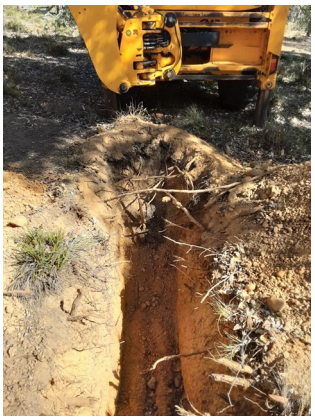
1:30 Sheet 1 of 1

Logged by: RC Position: E.412266m N.6504573m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm) 5 10 15	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.			1	
						GC: CLAYEY GRAVEL: fine to coarse grained, subrounded to rounded, pale yellow brown; trace sand, fine grained; trace cobbles. (Laterite)			4	
						... at 0.30m, Roots no longer present	D to M	D to VD	20	
	0.8 - 1.0	D		1						
						Test pit terminated at 1.10 m			20	
				2						
				3						
				4						

Termination Reason: Refusal on laterite

Remarks:





TEST PIT LOG - TP05

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412555m N.6504586m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
	0.0 - 0.3	D				TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.			3, 5	
						CL: CLAY: low plasticity; with gravel, fine to medium grained, subangular to subrounded; trace sand, fine grained; dark orange brown; weakly cemented. (Residual Soil)	D to M	Vst to H	8, 10, 20	
						Test pit terminated at 0.80 m				
				1						
				2						
				3						
				4						

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP06

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.411879m N.6504446m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.				
				1		CL: CLAY: low plasticity; trace sand, fine grained; trace gravel, fine to medium grained, subangular to subrounded; pale orange brown; weakly cemented. (Residual Soil)	D to M	Vst to H	4, 7, 10, 7, 7, 7, 10, 9, 9, 6, 6, 10	
				2				St to VSt	12, 14, 20, 20	
				3		Test pit terminated at 2.70 m				
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP07

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

1:30 Sheet 1 of 1

Logged by: RC Position: E.412001m N.6504485m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.				
						GP: SANDY GRAVEL: fine to medium grained, rounded; sand, fine grained, orange brown; with clay, low plasticity. (Residual Soil)	D to M	MD	3, 4, 4, 3, 5, 4, 3, 3	
				1					4, 7, 1, 3, 5, 9, 7, 6, 6	
				2				MD to D	20	
				3		Test pit terminated at 3.00 m				
				4						

Termination Reason: Target depth reached

Remarks:





TEST PIT LOG - TP08

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

1:30 Sheet 1 of 2

Logged by: RC Position: E.412108m N.6504476m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description: Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.			4, 5, 8, 3, 6, 24	
						GP: SANDY GRAVEL: fine to medium grained, rounded; sand, fine grained, white brown. (Residual Soil)				
				1					3, 5, 4, 6, 3, 4, 9, 6, 3	
						GC: CLAYEY GRAVEL: fine to medium grained, subangular to subrounded; clay, low to medium plasticity, orange brown; weakly cemented. (Residual Soil)	D to M	MD to D		
				2						
				3		Test pit terminated at 3.00 m				
				4						

Termination Reason: Target depth reached

Remarks:





TEST PIT LOG - TP09

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412285m N.6504505m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
	0.7 - 0.9	D		1		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots. GC: CLAYEY GRAVEL: angular to subangular; soil is gravel, fine to coarse grained, subrounded to rounded; trace sand, fine grained; pale yellow brown; weakly cemented. (Residual Soil) *... at 0.30m, Roots no longer present*	D to M	D to VD	3, 4, 6, 20	
				2		Test pit terminated at 1.10 m			20	
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP10

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412509m N.6504517m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
	0.5 - 0.8	D		1		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots. GC: CLAYEY GRAVEL: clay, low plasticity pale orange brown; trace sand, fine grained; moderately cemented. (Residual Soil) Test pit terminated at 1.20 m	D to M	D to VD	6 5 10 26 20	

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP11

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412549m N.6504464m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.			3	
						CL: CLAY: low plasticity; with gravel, fine to medium grained, subangular to subrounded; trace sand, fine grained; dark orange brown; weakly cemented. (Residual Soil)			4	
	0.5 - 0.8	ES							3	
	0.6 - 0.8	D							3	
									3	
									3	
									2	
							D to M	St to VSt	3	
				1					4	
									20	
				2		CL: CLAY: low plasticity; with sand, fine grained; pale red brown; weakly cemented; With decomposing rootlets, shiny mineral present mica. (Residual Soil)				
						Test pit terminated at 1.90 m				
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP12

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412683m N.6504479m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
	0.3 - 0.5	D		0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.				
						CL: CLAY: low plasticity; trace sand, fine grained; trace gravel, fine to medium grained, subangular to subrounded; pale yellow brown mottled grey; moderately cemented. (Residual Soil)	D to M	St to VSt	5, 6, 3, 5	
								H	12, 20	
				1		Test pit terminated at 1.00 m			20	
				2						
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP13

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412836m N.6504535m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
	0.7 - 0.9	D		0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.			4	
						CL: CLAY: low plasticity; trace sand, fine grained; trace gravel, fine to medium grained, subangular to subrounded; pale yellow brown mottled grey; moderately cemented. (Residual Soil)	D	VSt	5	
									9	
									20	
				1		Test pit terminated at 1.00 m			20	
				2						
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP14

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412173m N.6504421m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description: Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.				
						GP: SANDY GRAVEL: fine to medium grained, rounded; sand, fine grained, white brown; with clay, low plasticity. (Residual Soil)		MD to D	2, 8, 5, 5, 7, 5, 6, 4	
				1					2, 2, 2, 3	
							D to M		8, 9, 10, 15, 16, 17, 14	
				2		GC: CLAYEY GRAVEL: fine to medium grained, rounded; clay, low to medium plasticity, orange brown; with coarse gravel sized pockets of silt; weakly cemented. (strong rust smell) (Residual Soil)		VD	16	
				3		Test pit terminated at 3.00 m				
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP15

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

1:30 Sheet 1 of 1

Logged by: RC Position: E.412289m N.6504433m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.			2	
						GC: CLAYEY GRAVEL: angular to subangular; soil is gravel, fine to coarse grained, subrounded to rounded; trace sand, fine grained; pale yellow brown; weakly cemented. (Residual Soil)		D to VD	5	
						... at 0.30m, Roots no longer present	D to M		5	
									20	
				1		CL: CLAY: low plasticity; trace sand, fine grained; trace gravel, fine to medium grained, subangular to subrounded; pale orange brown; moderately cemented. (Residual Soil)		St	20	
	1.3 - 1.5	D								
						Test pit terminated at 1.50 m				
				2						
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP16

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

1:30 Sheet 1 of 1

Logged by: RC Position: E.412443m N.6504407m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
	0.4 - 0.6 0.4 - 0.6	D ES		0 1 2 3 4		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots. GC: CLAYEY GRAVEL: angular to subangular; soil is gravel, fine to coarse grained, subrounded to rounded; trace sand, fine grained; pale yellow brown; weakly cemented. (Residual Soil) *... at 0.40m, Roots no longer present* CL: CLAY: low plasticity; trace sand, fine grained; trace gravel, fine to medium grained, subangular to subrounded; pale orange brown; moderately cemented. (Residual Soil) Test pit terminated at 1.00 m	D to M	D St to VSt	2, 3, 2, 3, 5, 20 20	

Dynamic Cone Penetrometer (Blows/100mm) scale: 5 10 15

Termination Reason: Refusal on cemented material

Remarks:



TEST PIT LOG - TP17

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

1:30 Sheet 1 of 1

Logged by: RC Position: E.411404m N.6504249m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
	0.1 - 0.2	ES				TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.			3	
	0.2 - 0.5	B				ML: SILT: pale white brown, non plastic; with gravel, fine to coarse grained, subangular to subrounded; trace sand, fine grained; trace cobbles. (Laterite)	D	D	1 5 20	
						GM: SILTY GRAVEL: fine to coarse grained, angular; silt, non-plastic, dark orange brown; moderately cemented. (Laterite)				
						Test pit terminated at 0.70 m				
				1						
				2						
				3						
				4						

Termination Reason: Refusal on laterite

Remarks:





TEST PIT LOG - TP18

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

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Logged by: RC Position: E.411469m N.6504338m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.			2	
						ML: SILT: pale white brown, non plastic; with gravel, fine to coarse grained, subangular to subrounded; trace sand, fine grained; trace cobbles. (Laterite)			4	
									4	
									6	
									6	
									13	
									17	
							D	D to VD	9	
				1		GM: SILTY GRAVEL: fine to coarse grained, angular; silt, non-plastic, dark orange brown; moderately cemented. (Laterite)			16	
									24	
									4	
									4	
									12	
									20	
						Test pit terminated at 1.50 m				
				2						
				3						
				4						

Termination Reason: Refusal on laterite

Remarks:





TEST PIT LOG - TP19

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

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Logged by: RC Position: E.411559m N.6504401m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.			2	
						ML: SILT: pale white brown, non plastic; with gravel, fine to coarse grained, subangular to subrounded; trace sand, fine grained; trace cobbles. (Laterite)		D to VD	4, 4, 6, 6, 13, 17, 9, 16	
				1		CL: CLAY: low plasticity; trace sand, fine grained; trace gravel, fine to medium grained, subangular to subrounded; pale orange brown. (Residual Soil)	D	Vst to H	24, 4, 4, 12, 20	
				2		Test pit terminated at 2.10 m				
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP20

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

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Logged by: RC Position: E.411550m N.6504251m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.			3	
						ML: SILT: pale white brown, non plastic; with gravel, fine to coarse grained, subangular to subrounded; trace sand, fine grained; trace cobbles. (Laterite)	D to M	D to VD	4 6 7 8 14 15	
						GM: SILTY GRAVEL: fine to coarse grained, angular; silt, non-plastic, dark orange brown; moderately cemented. (Laterite)			7 16 21	
				1		Test pit terminated at 1.00 m			3 6 13 14 17 20	
				2						
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:

TEST PIT LOG - TP21

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

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Logged by: RC Position: E.411618m N.6504338m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.			8	
						CL: CLAY: low plasticity; trace sand, fine grained; trace gravel, fine to medium grained, subangular to subrounded; pale orange brown; weakly cemented. (Residual Soil)			10	
									8	
									11	
									13	
									14	
									21	
	1.0 - 1.4	B		1			D to M	Vst to H	9	
									20	
				2		*... from 2.50m to 2.70m, 10mm calcite crystals*				
						Test pit terminated at 2.70 m				
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP22

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

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Logged by: RC Position: E.411682m N.6504270m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.			5	
						ML: SILT: pale white brown, non plastic; with gravel, fine to coarse grained, subangular to subrounded; trace sand, fine grained; trace cobbles. (Laterite)		VD	1, 8, 11, 9	
						CL: CLAY: low plasticity; trace sand, fine grained; trace gravel, fine to medium grained, subangular to subrounded; pale orange brown; weakly cemented. (Residual Soil)			15, 15, 16, 17	
				1			D to M			
								VSt	8, 12, 12, 7, 6, 3, 2, 3, 6, 6	
	2.0 - 2.5	B		2		Test pit terminated at 2.10 m				
	2.9 - 3.0	D		3						2.90m: decomposed roots encountered. there is an old stump next to the pit , possibly related
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP23

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

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Logged by: RC Position: E.411744m N.6504388m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				1		ML: TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots. CL: CLAY: low plasticity; trace sand, fine grained; trace gravel, fine to medium grained, subangular to subrounded; pale orange brown; weakly cemented. (Residual Soil)	D to M	Vst to H	4, 7, 8, 8, 5, 11, 11, 12, 13, 10, 3, 20	
				2						
				3		Test pit terminated at 2.70 m				
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP24

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

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Logged by: RC Position: E.411804m N.6504254m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm) 5 10 15	Structure & other observations
				0		ML: TOPSOIL: SILT: pale white brown, non plastic; with gravel, fine to coarse grained, subangular to subrounded; trace sand, fine grained; trace cobbles.				
						GC: CLAYEY GRAVEL: fine to medium grained, subrounded to rounded; clay, medium plasticity, dark brown; trace sand, fine grained, subrounded; with roots. (Residual Soil)				
				1			D to M			
				2		CL: CLAY: low plasticity; trace sand, fine grained; trace gravel, fine to medium grained, subangular to subrounded; pale orange brown; weakly cemented. (Residual Soil)				
						Test pit terminated at 2.60 m				
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP25

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

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Logged by: RC Position: E.411860m N.6504360m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.				
				1		GC: CLAYEY GRAVEL: fine to medium grained, rounded; clay, low to medium plasticity, orange brown; with coarse gravel sized pockets of silt; weakly cemented. (Residual Soil)	D to M	MD to D	2, 6, 3, 5, 7, 6, 5, 8, 9, 3, 20	
				2		Test pit terminated at 2.40 m				
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:

TEST PIT LOG - TP26

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

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Logged by: RC Position: E.411907m N.6504248m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description: Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		ML: TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.		MD to D	3, 7, 6	
						GP: SANDY GRAVEL: fine to medium grained, rounded; sand, fine grained, white brown; with clay, low plasticity. (Residual Soil)		L to MD	1, 3, 2, 4	
				1			D to M	D to VD	6, 8, 10, 6, 20	
				2		GC: CLAYEY GRAVEL: fine to medium grained, rounded; clay, low to medium plasticity, orange brown; with coarse gravel sized pockets of silt; weakly cemented. (Residual Soil)				
				3		Test pit terminated at 3.00 m				
				4						

Termination Reason: Target depth reached

Remarks:





TEST PIT LOG - TP27

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

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Logged by: RC Position: E.411939m N.6504315m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description: Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				1		ML: TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.	D to M	L to MD	3, 5, 4, 4, 5, 5, 5, 6, 7	
				2		GC: CLAYEY GRAVEL: fine to medium grained, rounded; clay, low to medium plasticity, orange brown; with coarse gravel sized pockets of silt; weakly cemented. (Residual Soil)			2, 4, 20	
						Test pit terminated at 2.40 m				
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP27

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

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Logged by: RC Position: E.411939m N.6504315m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm) 5 10 15	Structure & other observations
				5						
				6						
				7						
				8						

Termination Reason: Refusal on cemented material

Remarks:



TEST PIT LOG - TP28

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

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Logged by: RC Position: E.412058m N.6504422m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		ORGANIC TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.	D to M	D to VD	2, 3, 3, 2, 1, 2, 2, 3, 3, 3, 4, 17, 20, 14, 12, 8, 10	
				1		GC: CLAYEY GRAVEL: fine to medium grained, rounded; low to medium plasticity, orange brown streaked white; weakly cemented. (Residual Soil)				
				2		CL: CLAY: low plasticity, red brown; with coarse gravel sized pockets of silt; weakly cemented. (Residual Soil)		Vst to H	13, 14, 13	
				3		Test pit terminated at 3.00 m				
				4						

Termination Reason: Target depth reached

Remarks:





TEST PIT LOG - TP29

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

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Logged by: RC Position: E.412097m N.6504263m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description: Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.				
						GP: SANDY GRAVEL: fine to medium grained, angular to rounded; sand, fine grained, white brown; with clay, low plasticity. (Residual Soil)	D to M	St to VSt	3, 6, 6, 4, 4, 7, 8, 10, 18, 13, 1, 2, 2, 2, 2, 1, 1, 1, 1	
				2		Test pit terminated at 2.00 m				
				3						
				4						

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP29

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

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Logged by: RC Position: E.412097m N.6504263m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm) 5 10 15	Structure & other observations
				5						
				6						
				7						
				8						

Termination Reason: Refusal on cemented material

Remarks:



TEST PIT LOG - TP30

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

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Logged by: RC Position: E.412172m N.6504257m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.	D	D to VD	4	
						GP: SANDY GRAVEL: fine to medium grained, subrounded to rounded; sand, fine grained, white brown; with clay, low plasticity. (Residual Soil)			4	
									2	
									3	
									3	
									4	
									7	
									6	
				1					7	
									11	
									4	
									20	
						Test pit terminated at 1.30 m				
				2						
				3						
				4						

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP31

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

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Logged by: RC Position: E.412169m N.6504341m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		ML: TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.			3	
						GC: CLAYEY GRAVEL: angular to subangular; soil is gravel, fine to coarse grained, subangular to subrounded; trace sand, fine grained; pale white brown. (Residual Soil)	D	F to St	2 2 3	
	0.8 - 1.0	D		1		CL: CLAY: low plasticity; with gravel, fine to medium grained, subangular to subrounded; trace sand, fine grained; pale orange brown; weakly cemented. (Residual Soil)			3 2 2 2 2	
						Test pit terminated at 1.10 m			5 1 5 6 9 15 12 20	
				2						
				3						
				4						

Termination Reason: Refusal on laterite

Remarks:





TEST PIT LOG - TP31

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

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Logged by: RC Position: E.412169m N.6504341m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description: Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm) 5 10 15	Structure & other observations
				5						
				6						
				7						
				8						

Termination Reason: Refusal on laterite

Remarks:





TEST PIT LOG - TP32

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412334m N.6504259m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm) 5 10 15	Structure & other observations
				0		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.				
						GC: CLAYEY GRAVEL: fine to coarse grained, subangular to subrounded; clay, low plasticity; with sand, fine grained; pale white brown. (Residual Soil)				
				1		CL: CLAY: low plasticity; with gravel, fine to medium grained, subangular to subrounded; trace sand, fine grained; pale orange brown; weakly cemented. (Residual Soil)	D to M			
				2		Test pit terminated at 1.90 m				
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:

TEST PIT LOG - TP33

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412460m N.6504283m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
	1.0 - 1.3	D		1		ML: TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.	D to M	MD to D	5	
						GC: CLAYEY GRAVEL: angular to subangular; soil is low plasticity; gravel, fine to coarse grained, subangular to subrounded; with sand, fine grained; pale orange brown. (Residual Soil)			3	
									4	
									3	
									5	
									9	
									5	
									8	
									23	
						CL: CLAY: low plasticity; with gravel, fine to medium grained, subangular to subrounded; trace sand, fine grained; pale orange brown; weakly cemented. (Residual Soil)		St		
						... at 1.50m, Mineral deposit				
						Test pit terminated at 1.60 m				
				2						
				3						
				4						

Termination Reason: Refusal on laterite

Remarks:





TEST PIT LOG - TP34

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412511m N.6504357m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
	0.3 - 0.5	B		1		ML: TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.		F	3	
						GC: CLAYEY GRAVEL: angular to subangular; soil is gravel, fine to coarse grained, subangular to subrounded; trace sand, fine grained; pale white brown. (Residual Soil)			5	
						CL: CLAY: low plasticity; with gravel, fine to medium grained, subangular to subrounded; trace sand, fine grained; pale orange brown; weakly cemented. (Residual Soil)	D	Vst to H	6	
									11	
									18	
						Test pit terminated at 1.20 m			20	
				2						
				3						
				4						

Termination Reason: Refusal on laterite

Remarks:





TEST PIT LOG - TP35

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412559m N.6504253m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components)	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
	0.7 - 0.9	D		0		ML: TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.			3	
						GC: CLAYEY GRAVEL: angular to subangular; soil is gravel, fine to coarse grained, subangular to subrounded; with sand, fine grained; pale white brown; moderately cemented. (Residual Soil)	D to M	MD to D	3	
									4	
									20	
				1		Test pit terminated at 0.90 m				
				2						
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP36

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412628m N.6504338m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
	0.4 - 0.6	D		1 2 3 4		ML: TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots. CL: CLAY: with sand, fine grained; with gravel, fine to coarse grained, subangular to subrounded; dark orange brown; moderately cemented; Withfine gravel sized peices of decomposing tree roots / coal. CL: CLAY: with sand, fine grained; with gravel, fine to coarse grained, subangular to subrounded; dark orange brown; moderately cemented; With fine gravel sized peices of decomposing tree roots / coal. (Residual Soil) CL: CLAY: low plasticity; with gravel, fine to medium grained, subangular to subrounded; trace sand, fine grained; dark orange brown; weakly cemented. (Residual Soil) Test pit terminated at 1.40 m	D to M	F to St Vst to H	3, 2, 2, 3, 7, 12, 14, 10, 12, 7, 14, 20	

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP37

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412718m N.6504331m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		ML: TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.				
						CL: CLAY: low plasticity; with gravel, fine to medium grained, subangular to subrounded; trace sand, fine grained; dark orange brown; weakly cemented. (Residual Soil)		VSt	5, 4, 6, 12, 20	
	1.0 - 1.3	ES		1			D to M			
	1.3 - 1.5	D						Vst to H	10, 16, 18, 18, 16, 15, 20	
				2		CL: CLAY: low plasticity; with sand, fine grained; pale red brown; weakly cemented; With decomposing rootlets, Mica crystals present. (Residual Soil)				
						Test pit terminated at 2.10 m				
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP38

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

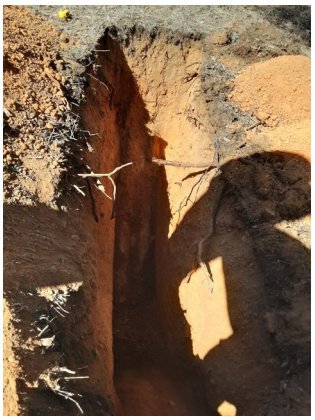
1:30 Sheet 1 of 1

Logged by: RC Position: E.412641m N.6504260m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		ML: TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.				
						GC: CLAYEY GRAVEL: angular to subangular; soil is gravel, fine to coarse grained, subangular to subrounded; with sand, fine grained; dark orange brown; moderately cemented. (Residual Soil)		D to VD	2, 6, 5, 7, 8, 20	
	1.0 - 1.3	ES		1		CL: CLAY: low plasticity; with gravel, fine to medium grained, subangular to subrounded; trace sand, fine grained; dark orange brown; weakly cemented. (Residual Soil)	D to M			
	1.3 - 1.5	D						Vst to H	20	
						... at 1.70m, Strongly cemented				
						Test pit terminated at 1.80 m				
				2						
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP39

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412812m N.6504357m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				0		ML: TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.		St	3, 3	
						CL: CLAY: low plasticity; with gravel, fine to medium grained, subangular to subrounded; trace sand, fine grained; dark orange brown; weakly cemented. (Residual Soil)			7, 6, 17, 20	
				1			D to M			
								Vst to H	12, 20	
	1.8 - 2.0	ES				CL: CLAY: low plasticity; with sand, fine grained; pale red brown; weakly cemented; with decomposing rootlets, Mica crystals present. (Residual Soil)				
	2.0 - 2.2	D		2						
						Test pit terminated at 2.30 m				
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP40

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412911m N.6504267m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
	0.5 - 0.8	B		0		ML: TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.				
						GC: CLAYEY GRAVEL: angular to subangular; soil is gravel, fine to coarse grained, subangular to subrounded; trace sand, fine grained; pale white brown. (Residual Soil)		D to VD	3, 4, 4, 5, 3, 6, 11	
				1		CL: CLAY: low plasticity; with gravel, fine to medium grained, subangular to subrounded; trace sand, fine grained; pale orange brown; weakly cemented. (Residual Soil)	D to M	Vst to H	11, 11, 9, 4, 8, 9, 10, 20	
				2		Test pit terminated at 2.00 m				
				3						
				4						

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP41

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Position: E.411912m N.6504398m
Checked by: Elevation: Dimensions : m x m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description: Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				1		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.	D to M	MD	3, 4, 3, 3, 4, 4	
						GC: CLAYEY GRAVEL: fine to medium grained, subrounded to rounded; clay, medium plasticity, orange brown. (Residual Soil)		D to VD	6, 7, 7, 7, 2, 3, 4, 8, 15	
						Test pit terminated at 1.50 m			20	
				2						
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP42

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 23/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Position: E.412064m N.6504571m
Checked by: Elevation: Dimensions : m x m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description: Soil Type, Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
				1		TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.	D to M	MD to D	3, 6, 4, 2, 2, 4, 20	
				2		GP: SANDY GRAVEL: fine to medium grained, rounded; sand, fine grained, orange brown; with clay, low plasticity. (Residual Soil)		D to VD	3, 9, 13, 14, 17, 15, 12, 20	
						Test pit terminated at 2.20 m				
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP43

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412378m N.6504339m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
	0.5 - 0.8	B		0		ML: TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.			1	
						GC: CLAYEY GRAVEL: angular to subangular; soil is gravel, fine to coarse grained, subangular to subrounded; trace sand, fine grained; pale white brown. (Residual Soil)		D to VD	5, 5, 7, 15, 20, 17	
				1		CL: CLAY: low plasticity; with gravel, fine to medium grained, subangular to subrounded; trace sand, fine grained; pale orange brown; weakly cemented. (Residual Soil)	D	Vst to H	20	
						Test pit terminated at 1.70 m				
				2						
				3						
				4						

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP44

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412593m N.6504429m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
	0.3 - 0.5 0.4 - 0.5	D ES		1 2 3 4		ML: TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots. CL: CLAY: low plasticity; trace sand, fine grained; trace gravel, fine to medium grained, subangular to subrounded; pale yellow brown; moderately cemented. (Residual Soil) Test pit terminated at 1.60 m	D to M	St	4, 3, 6, 5, 19, 13, 12, 20, 20 (5 10 15)	

Termination Reason: Refusal on cemented material

Remarks:





TEST PIT LOG - TP45

Client: Sicicalab Pty Ltd
Project: Morley Road Subdivision
Location: Morley Road, Lower Chittering
Project ID: PER2020-0500
Date: 24/03/2021

CMW Geosciences

1:30 Sheet 1 of 1

Logged by: RC Position: E.412582m N.6504286m Plant: JCB
Checked by: AP Elevation: Contractor: ANH Contracting Dimensions : 2.00m x 1.00m

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)	Structure & other observations
	0.8 - 1.0	B		1		ML: TOPSOIL: GRAVELLY SILT: gravel, fine to medium grained, subrounded to rounded; trace sand, fine grained, subrounded; dark brown, with roots.		MD to D	3, 3, 5, 3, 6, 13	
						GC: CLAYEY GRAVEL: angular to subangular; soil is gravel, fine to coarse grained, subangular to subrounded; with sand, fine grained; pale orange brown. (Residual Soil)				
						CL: CLAY: low plasticity; with gravel, fine to medium grained, subangular to subrounded; trace sand, fine grained; pale orange brown; moderately cemented. (Residual Soil)	D	Vst to H	17, 18, 12, 21, 9, 20	
						... from 1.30m to 1.60m, Weakly cemented				
				2		Test pit terminated at 1.90 m				
				3						
				4						

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15

Termination Reason: Refusal on cemented material

Remarks:





Appendix B
In-situ Permeability Test Results

CMW Geosciences	CLIENT: Coterra Environment	DESIGNER:	JF
	PROJECT: Morley Road Subdivsion Morley Road Subdivsion	CHECKED:	RC
		REVISION:	4
	TITLE: **Falling Head Permeability Test**	DATE:	26/03/2021
		PROJECT:	PER2020-0500

Specifications - Open-Ended Tube

Length L_1:	0.4	m
Diameter:	333	mm
Non-Perm L_2:	0	m
Above Gnd L_3:	0	m

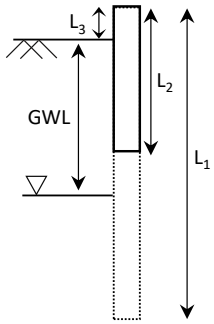
Ground Conditions

GWL: m BGL (Blank = Bottom of hole)

Permeability Anisotropy

m: 1 $m = \sqrt{k_h / k_v}$

Bottom of Test Hole: 0.40 m BGL



Hydraulic Conductivity (k)

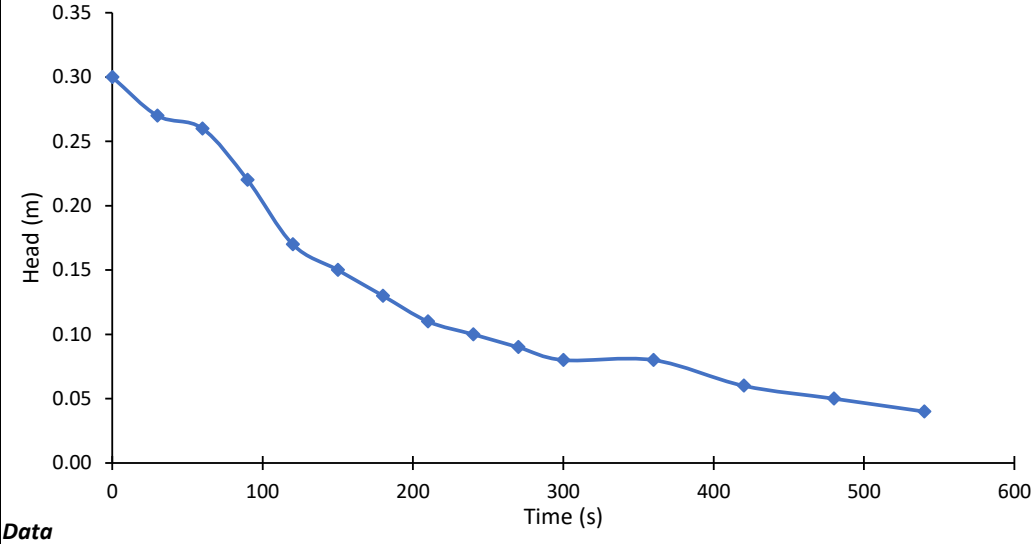
Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

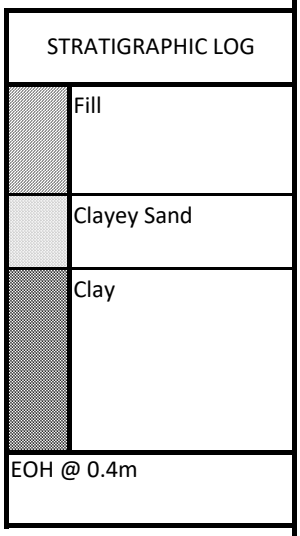
CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

$$k = \left(log\frac{h_1}{h_2} - log\frac{2h_1 + d}{2h_2 + d}\right) \cdot \frac{(h_1 + h_2)}{2(t_2 - t_1)} =$$ 1.26E-04 ms^{-1} = 10.85 m/day

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations* , Fig 18, p49

$$k = \frac{d^2 \ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1}\right)}{2L \ln\frac{H_1}{H_2}} =$$ 1.60E-04 ms^{-1} = 13.81 m/day





Data

Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.100	0.300				
30	0.130	0.270	0.285		1.32E-04	1.60E-04
60	0.140	0.260	0.265		4.80E-05	5.59E-05
90	0.180	0.220	0.240		2.15E-04	2.38E-04
120	0.230	0.170	0.195		3.40E-04	3.37E-04
150	0.250	0.150	0.160		1.68E-04	1.48E-04
180	0.270	0.130	0.140		1.93E-04	1.58E-04
210	0.290	0.110	0.120		2.27E-04	1.69E-04
240	0.300	0.100	0.105		1.30E-04	8.89E-05
270	0.310	0.090	0.095		1.44E-04	9.23E-05
300	0.320	0.080	0.085		1.62E-04	9.60E-05
360	0.320	0.080	0.080		0.00E+00	0.00E+00
420	0.340	0.060	0.070		1.98E-04	1.03E-04
480	0.350	0.050	0.055		1.26E-04	5.46E-05

540	0.360	0.040	0.045		1.54E-04	5.73E-05
600	0.390	0.010	0.025		9.61E-04	2.22E-04

CMW Geosciences	CLIENT: Coterra Environment	DESIGNER:	JF
	PROJECT: Morley Road Subdivsion Morley Road Subdivsion	CHECKED:	RC
		REVISION:	4
	TITLE: **Falling Head Permeability Test**	DATE:	26/03/2021
		PROJECT:	PER2020-0500

Specifications - Open-Ended Tube

Length L_1:	0.31	m
Diameter:	333	mm
Non-Perm L_2:		m
Above Gnd L_3:		m

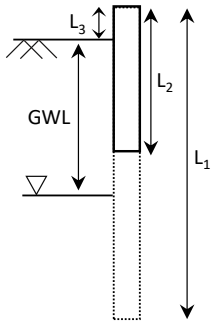
Ground Conditions

GWL: m BGL (Blank = Bottom of hole)

Permeability Anisotropy

m: 1 $m = \sqrt{k_h / k_v}$

Bottom of Test Hole: 0.31 m BGL



Hydraulic Conductivity (k)

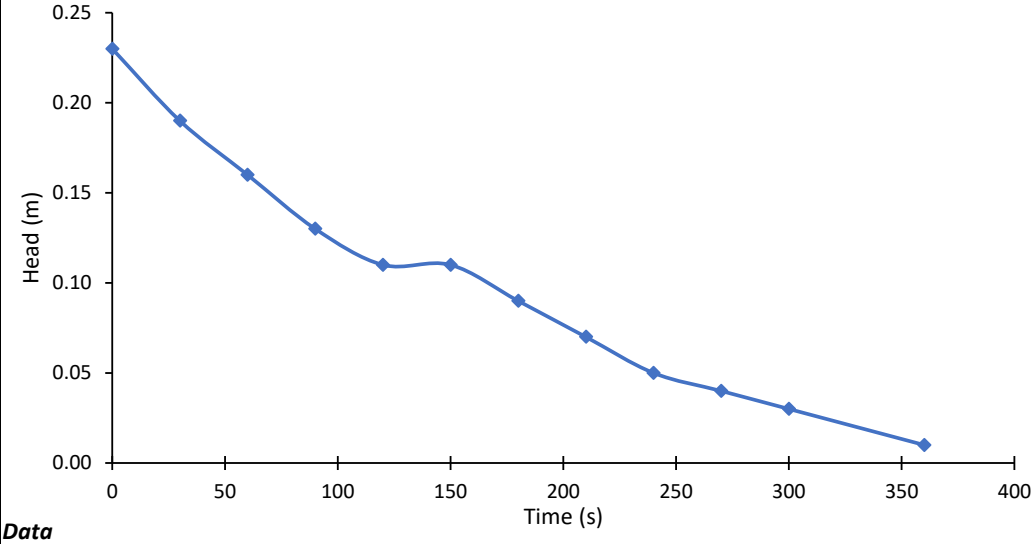
Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

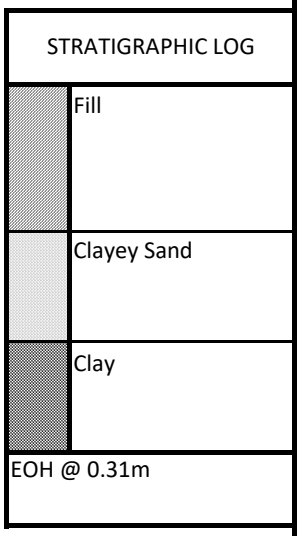
CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

$$k = \left(log\frac{h_1}{h_2} - log\frac{2h_1 + d}{2h_2 + d}\right) \cdot \frac{(h_1 + h_2)}{2(t_2 - t_1)} =$$ 1.68E-04 ms^{-1} = 14.50 m/day

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations* , Fig 18, p49

$$k = \frac{d^2 \ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1}\right)}{2L \ln\frac{H_1}{H_2}} =$$ 3.22E-04 ms^{-1} = 27.79 m/day





Data

Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.080	0.230				
30	0.120	0.190	0.210		2.50E-04	2.58E-04
60	0.150	0.160	0.175		2.29E-04	2.13E-04
90	0.180	0.130	0.145		2.80E-04	2.34E-04
120	0.200	0.110	0.120		2.27E-04	1.69E-04
150	0.200	0.110	0.110		0.00E+00	0.00E+00
180	0.220	0.090	0.100		2.74E-04	1.82E-04
210	0.240	0.070	0.080		3.45E-04	1.97E-04
240	0.260	0.050	0.060		4.64E-04	2.16E-04
270	0.270	0.040	0.045		3.09E-04	1.15E-04
300	0.280	0.030	0.035		3.98E-04	1.21E-04
360	0.300	0.010	0.020		7.62E-04	1.44E-04

CMW Geosciences	CLIENT: Coterra Environment	DESIGNER:	JF
	PROJECT: Morley Road Subdivsion Morley Road Subdivsion	CHECKED:	RC
		REVISION:	4
	TITLE: **Falling Head Permeability Test**	DATE:	26/03/2021
		PROJECT:	PER2020-0500

Specifications - Open-Ended Tube

Length L_1:	0.31	m
Diameter:	333	mm
Non-Perm L_2:		m
Above Gnd L_3:		m

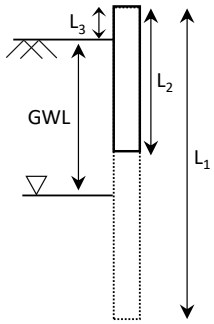
Ground Conditions

GWL: m BGL (Blank = Bottom of hole)

Permeability Anisotropy

m: 1 $m = \sqrt{k_h / k_v}$

Bottom of Test Hole: 0.31 m BGL



Hydraulic Conductivity (k)

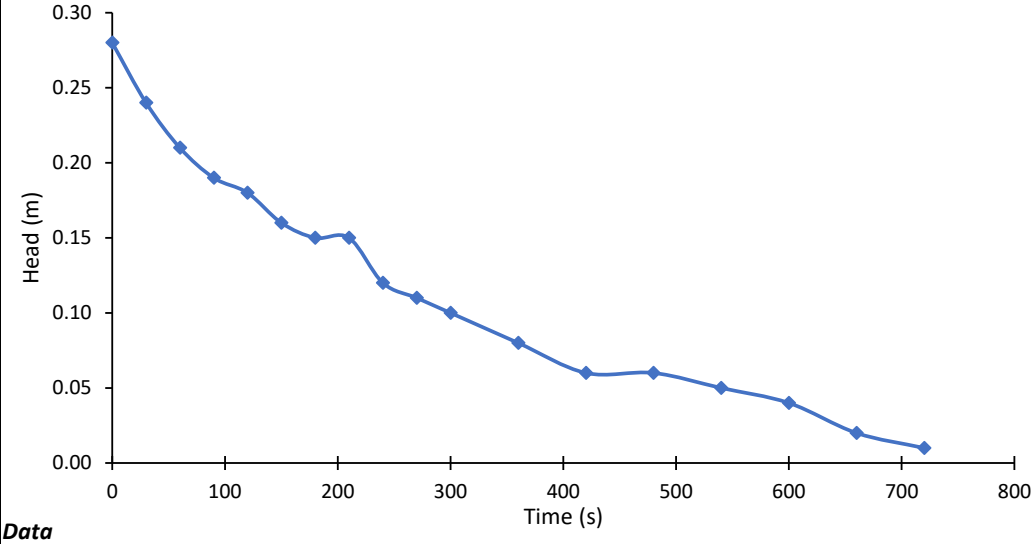
Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

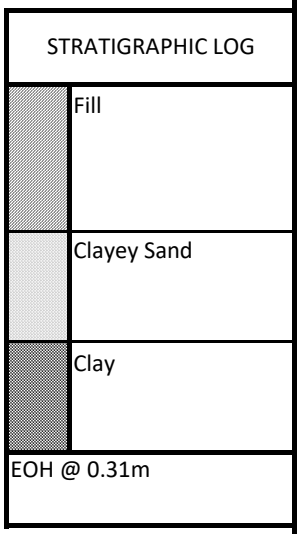
CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

$$k = \left(log\frac{h_1}{h_2} - log\frac{2h_1 + d}{2h_2 + d}\right) \cdot \frac{(h_1 + h_2)}{2(t_2 - t_1)} =$$ 1.03E-04 ms^{-1} = 8.92 m/day

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations* , Fig 18, p49

$$k = \frac{d^2 \ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1}\right)}{2L \ln\frac{H_1}{H_2}} =$$ 1.74E-04 ms^{-1} = 15.04 m/day





Data

Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.030	0.280				
30	0.070	0.240	0.260		1.97E-04	2.27E-04
60	0.100	0.210	0.225		1.73E-04	1.85E-04
90	0.120	0.190	0.200		1.32E-04	1.32E-04
120	0.130	0.180	0.185		7.16E-05	6.86E-05
150	0.150	0.160	0.170		1.57E-04	1.44E-04
180	0.160	0.150	0.155		8.66E-05	7.50E-05
210	0.160	0.150	0.150		0.00E+00	0.00E+00
240	0.190	0.120	0.135		3.02E-04	2.41E-04
270	0.200	0.110	0.115		1.18E-04	8.57E-05
300	0.210	0.100	0.105		1.30E-04	8.89E-05
360	0.230	0.080	0.090		1.53E-04	9.45E-05
420	0.250	0.060	0.070		1.98E-04	1.03E-04
480	0.250	0.060	0.060		0.00E+00	0.00E+00

540	0.260	0.050	0.055		1.26E-04	5.46E-05
600	0.270	0.040	0.045		1.54E-04	5.73E-05
660	0.290	0.020	0.030		4.80E-04	1.28E-04
720	0.300	0.010	0.015		4.81E-04	6.93E-05

CMW Geosciences	CLIENT: Coterra Environment	DESIGNER:	JF
	PROJECT: Morley Road Subdivsion Morley Road Subdivsion	CHECKED:	RC
		REVISION:	4
	TITLE: **Falling Head Permeability Test**	DATE:	26/03/2021
		PROJECT:	PER2020-0500

Specifications - Open-Ended Tube

Length L_1:	0.35	m
Diameter:	333	mm
Non-Perm L_2:		m
Above Gnd L_3:		m

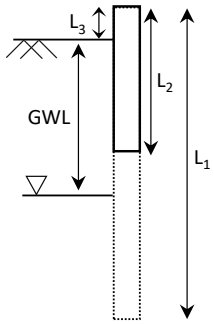
Ground Conditions

GWL: m BGL (Blank = Bottom of hole)

Permeability Anisotropy

m: 1 $m = \sqrt{k_h / k_v}$

Bottom of Test Hole: 0.35 m BGL



Hydraulic Conductivity (k)

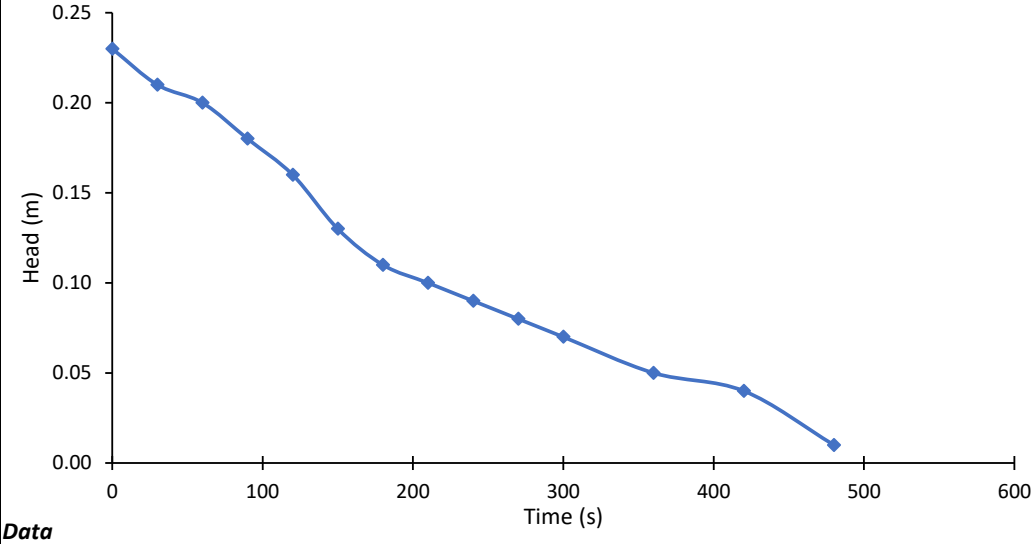
Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

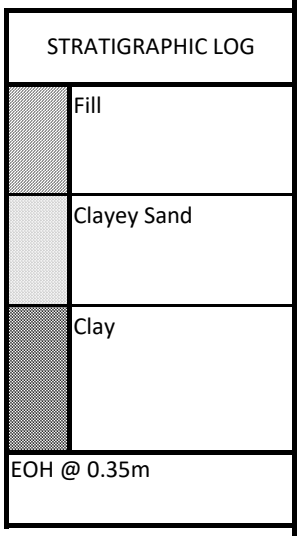
CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

$$k = \left(log\frac{h_1}{h_2} - log\frac{2h_1 + d}{2h_2 + d}\right) \cdot \frac{(h_1 + h_2)}{2(t_2 - t_1)} =$$ 1.26E-04 ms^{-1} = 10.87 m/day

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations* , Fig 18, p49

$$k = \frac{d^2 \ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1}\right)}{2L \ln\frac{H_1}{H_2}} =$$ 2.27E-04 ms^{-1} = 19.62 m/day





Data

Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.120	0.230				
30	0.140	0.210	0.220		1.18E-04	1.25E-04
60	0.150	0.200	0.205		6.40E-05	6.49E-05
90	0.170	0.180	0.190		1.39E-04	1.35E-04
120	0.190	0.160	0.170		1.57E-04	1.44E-04
150	0.220	0.130	0.145		2.80E-04	2.34E-04
180	0.240	0.110	0.120		2.27E-04	1.69E-04
210	0.250	0.100	0.105		1.30E-04	8.89E-05
240	0.260	0.090	0.095		1.44E-04	9.23E-05
270	0.270	0.080	0.085		1.62E-04	9.60E-05
300	0.280	0.070	0.075		1.84E-04	1.00E-04
360	0.300	0.050	0.060		2.32E-04	1.08E-04
420	0.310	0.040	0.045		1.54E-04	5.73E-05
480	0.340	0.010	0.025		9.61E-04	2.22E-04

CMW Geosciences	CLIENT: Coterra Environment	DESIGNER:	JF
	PROJECT: Morley Road Subdivsion Morley Road Subdivsion	CHECKED:	RC
		REVISION:	4
	TITLE: **Falling Head Permeability Test**	DATE:	26/03/2021
		PROJECT:	PER2020-0500

Specifications - Open-Ended Tube

Length L_1:	0.33	m
Diameter:	333	mm
Non-Perm L_2:		m
Above Gnd L_3:		m

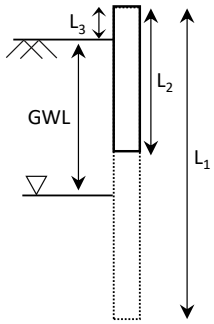
Ground Conditions

GWL: m BGL (Blank = Bottom of hole)

Permeability Anisotropy

m: 1 $m = \sqrt{k_h / k_v}$

Bottom of Test Hole: 0.33 m BGL



Hydraulic Conductivity (k)

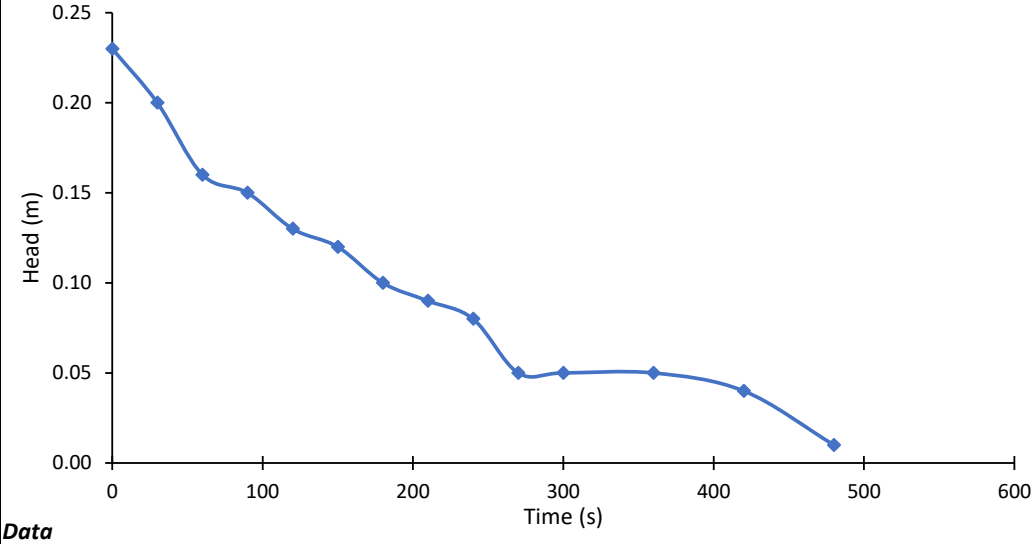
Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

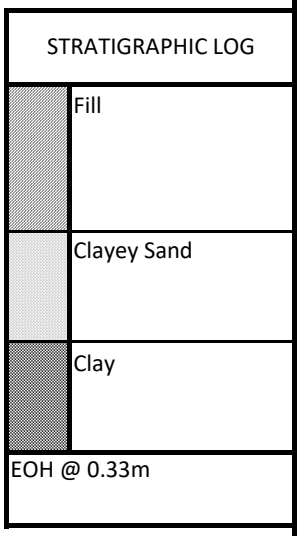
CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

$$k = \left(log\frac{h_1}{h_2} - log\frac{2h_1 + d}{2h_2 + d}\right) \cdot \frac{(h_1 + h_2)}{2(t_2 - t_1)} =$$ 1.35E-04 ms^{-1} = 11.63 m/day

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations* , Fig 18, p49

$$k = \frac{d^2 \, ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1}\right)}{2L \, ln\frac{H_1}{H_2}} =$$ 2.45E-04 ms^{-1} = 21.17 m/day





Data

Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.100	0.230				
30	0.130	0.200	0.215		1.82E-04	1.90E-04
60	0.170	0.160	0.180		2.96E-04	2.80E-04
90	0.180	0.150	0.155		8.66E-05	7.50E-05
120	0.200	0.130	0.140		1.93E-04	1.58E-04
150	0.210	0.120	0.125		1.09E-04	8.28E-05
180	0.230	0.100	0.110		2.49E-04	1.75E-04
210	0.240	0.090	0.095		1.44E-04	9.23E-05
240	0.250	0.080	0.085		1.62E-04	9.60E-05
270	0.280	0.050	0.065		6.48E-04	3.20E-04
300	0.280	0.050	0.050		0.00E+00	0.00E+00
360	0.280	0.050	0.050		0.00E+00	0.00E+00
420	0.290	0.040	0.045		1.54E-04	5.73E-05
480	0.320	0.010	0.025		9.61E-04	2.22E-04

CMW Geosciences	CLIENT: Coterra Environment	DESIGNER:	JF
	PROJECT: Morley Road Subdivsion Morley Road Subdivsion	CHECKED:	RC
		REVISION:	4
	TITLE: Falling Head Permeability Test	DATE:	26/03/2021
		PROJECT:	PER2020-0500

Specifications - Open-Ended Tube

Length L_1:	0.31	m
Diameter:	333	mm
Non-Perm L_2:	0	m
Above Gnd L_3:	0	m

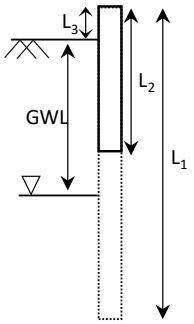
Ground Conditions

GWL: m BGL (Blank = Bottom of hole)

Permeability Anisotropy

m: 1 $m = \sqrt{k_h / k_v}$

Bottom of Test Hole: 0.31 m BGL



Hydraulic Conductivity (k)

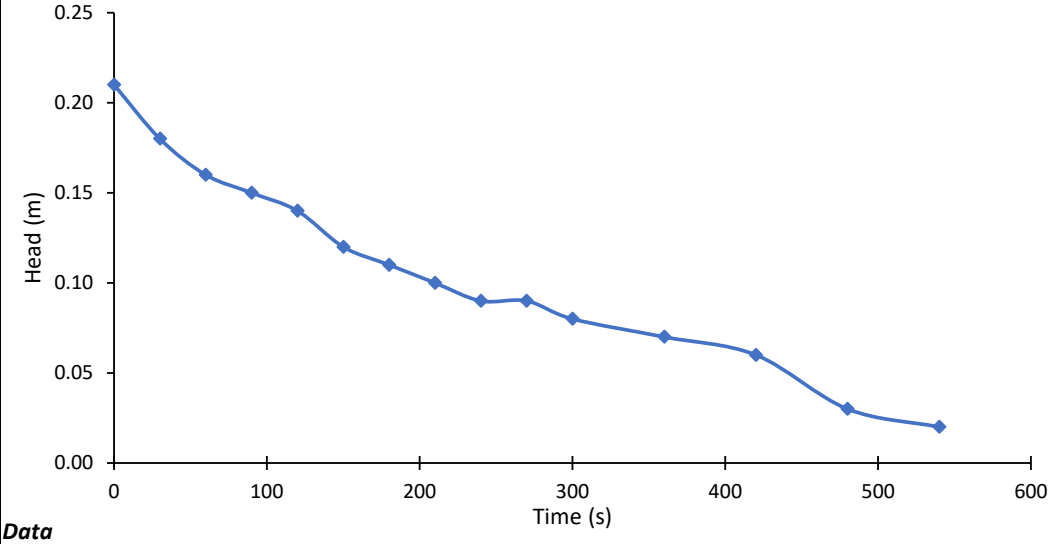
Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

$$k = \left(log\frac{h_1}{h_2} - log\frac{2h_1 + d}{2h_2 + d}\right) \cdot \frac{(h_1 + h_2)}{2(t_2 - t_1)} =$$ 9.77E-05 ms^{-1} = 8.44 m/day

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations* , Fig 18, p49

$$k = \frac{d^2 \, ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1}\right)}{2L} ln\frac{H_1}{H_2} =$$ 1.62E-04 ms^{-1} = 13.96 m/day



STRATIGRAPHIC LOG

- Fill
- Clayey Sand
- Clay

EOH @ 0.31m

Data

Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.100	0.210				
30	0.130	0.180	0.195		2.03E-04	2.01E-04
60	0.150	0.160	0.170		1.57E-04	1.44E-04
90	0.160	0.150	0.155		8.66E-05	7.50E-05
120	0.170	0.140	0.145		9.29E-05	7.74E-05
150	0.190	0.120	0.130		2.09E-04	1.63E-04
180	0.200	0.110	0.115		1.18E-04	8.57E-05
210	0.210	0.100	0.105		1.30E-04	8.89E-05
240	0.220	0.090	0.095		1.44E-04	9.23E-05
270	0.220	0.090	0.090		0.00E+00	0.00E+00
300	0.230	0.080	0.085		1.62E-04	9.60E-05
360	0.240	0.070	0.075		9.19E-05	5.00E-05
420	0.250	0.060	0.065		1.06E-04	5.22E-05
480	0.280	0.030	0.045		4.79E-04	1.79E-04

540	0.290	0.020	0.025		2.81E-04	6.39E-05
600	0.300	0.010	0.015		4.81E-04	6.93E-05

Appendix C
Laboratory Test Results

TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4825_1_PI
Project:	Geotechnical Investigation	*Sample No.*	WG21/4825
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP14 0.8-1.0m	*Date Tested:*	8-04-2021

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 (%)**	**Not Obtainable**
AS 1289.3.2.1	**Plastic Limit (%)**	**Non-Plastic**
AS 1289.3.3.1	**Plasticity Index (%)**	**Non-Plastic**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**0.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**-**

Comments:

Approved Signatory:

Name: Erin Bullen

Date: 09-April-2021

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

Accredited for compliance with ISO/IEC 17025 - Testing

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TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4826_1_PI
Project:	Geotechnical Investigation	*Sample No.*	WG21/4826
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP29 0.2-0.4m	*Date Tested:*	8-04-2021

TEST RESULTS - Consistency Limits (Casagrande)

Sampling Method:	**Sampled by Client, Tested as Received**
History of Sample:	**Oven Dried <50^{o}C**
Method of Preparation:	**Dry Sieved**

AS 1289.3.1.1	**Liquid Limit (%)**	**Not Obtainable**
AS 1289.3.2.1	**Plastic Limit (%)**	**Non-Plastic**
AS 1289.3.3.1	**Plasticity Index (%)**	**Non-Plastic**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**0.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**-**

Comments:

Approved Signatory:

Name: Erin Bullen

Date: 09-April-2021

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

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WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.2, 3.2.1, 3.3.1 & 3.4.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4827_1_PI
Project:	Geotechnical Investigation	*Sample No.*	WG21/4827
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP27 0.8-1.0m	*Date Tested:*	9-04-2021

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 1289.3.1.2	**Liquid Limit (%)**	**21**
AS 1289.3.2.1	**Plastic Limit (%)**	**13**
AS 1289.3.3.1	**Plasticity Index (%)**	**8**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**3.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**125**
AS 1289.3.4.1	**Condition of Dry Specimen**	**Cracked**

Comments:

Approved Signatory:

Name: Erin Bullen

Date: 12-April-2021

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

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TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4808_1_PI
Project:	Geotechnical Investigation	*Sample No.*	WG21/4808
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP22 2.0-2.5m	*Date Tested:*	8-04-2021

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 (%)**	**40**
AS 1289.3.2.1	**Plastic Limit (%)**	**23**
AS 1289.3.3.1	**Plasticity Index (%)**	**17**
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:**	**-**

Comments:

Approved Signatory:

Name: Erin Bullen

Date: 09-April-2021

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SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4809_1_PI
Project:	Geotechnical Investigation	*Sample No.*	WG21/4809
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP16 0.4-0.6m	*Date Tested:*	8-04-2021

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 (%)**	**Not Obtainable**
AS 1289.3.2.1	**Plastic Limit (%)**	**Non-Plastic**
AS 1289.3.3.1	**Plasticity Index (%)**	**Non-Plastic**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**0.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**-**

Comments:

Approved Signatory:

Name: Erin Bullen

Date: 09-April-2021

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TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4812_1_PI
Project:	Geotechnical Investigation	*Sample No.*	WG21/4812
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP38 1.3-1.5m	*Date Tested:*	8-04-2021

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 (%)**	**36**
AS 1289.3.2.1	**Plastic Limit (%)**	**22**
AS 1289.3.3.1	**Plasticity Index (%)**	**14**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**5.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**Curled**

Comments:

Approved Signatory:

Name: Erin Bullen

Date: 09-April-2021

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TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4813_1_PI
Project:	Geotechnical Investigation	*Sample No.*	WG21/4813
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP33 1.0-1.3m	*Date Tested:*	8-04-2021

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 (%)**	**25**
AS 1289.3.2.1	**Plastic Limit (%)**	**14**
AS 1289.3.3.1	**Plasticity Index (%)**	**11**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**5.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**-**

Comments:

Approved Signatory:

Name: Erin Bullen

Date: 09-April-2021

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TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4814_1_PI
Project:	Geotechnical Investigation	*Sample No.*	WG21/4814
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP21 1.0-1.4m	*Date Tested:*	8-04-2021

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 (%)**	**37**
AS 1289.3.2.1	**Plastic Limit (%)**	**24**
AS 1289.3.3.1	**Plasticity Index (%)**	**13**
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**

Comments:

Approved Signatory:

Name: Erin Bullen

Date: 09-April-2021

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TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4816_1_PI
Project:	Geotechnical Investigation	*Sample No.*	WG21/4816
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP44 0.3-0.5m	*Date Tested:*	9-04-2021

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 (%)**	**46**
AS 1289.3.2.1	**Plastic Limit (%)**	**27**
AS 1289.3.3.1	**Plasticity Index (%)**	**19**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**7.5**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**Cracked**

Comments:

Approved Signatory:

Name: Erin Bullen

Date: 12-April-2021

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SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4817_1_PI
Project:	Geotechnical Investigation	*Sample No.*	WG21/4817
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP13 0.7-0.9m	*Date Tested:*	9-04-2021

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 (%)**	**6.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**-**

Comments:

Approved Signatory:

Name: Erin Bullen

Date: 12-April-2021

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SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.2, 3.2.1, 3.3.1 & 3.4.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4819_1_PI
Project:	Geotechnical Investigation	*Sample No.*	WG21/4819
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP24 1.5-2.0m	*Date Tested:*	9-04-2021

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 1289.3.1.2	**Liquid Limit (%)**	**23**
AS 1289.3.2.1	**Plastic Limit (%)**	**19**
AS 1289.3.3.1	**Plasticity Index (%)**	**4**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**2.5**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen**	**Cracked**

Comments:

Approved Signatory:

Name: Erin Bullen

Date: 12-April-2021

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TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4821_1_PI
Project:	Geotechnical Investigation	*Sample No.*	WG21/4821
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP1 2.0-2.4m	*Date Tested:*	9-04-2021

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 (%)**	**32**
AS 1289.3.2.1	**Plastic Limit (%)**	**18**
AS 1289.3.3.1	**Plasticity Index (%)**	**14**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**5.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**-**

Comments:

Approved Signatory:

Name: Erin Bullen

Date: 12-April-2021

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SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4822_1_PI
Project:	Geotechnical Investigation	*Sample No.*	WG21/4822
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP7 1.0-1.5m	*Date Tested:*	8-04-2021

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 (%)**	**Not Obtainable**
AS 1289.3.2.1	**Plastic Limit (%)**	**Non-Plastic**
AS 1289.3.3.1	**Plasticity Index (%)**	**Non-Plastic**
AS 1289.3.4.1	**Linear Shrinkage (%)**	**0.0**
AS 1289.3.4.1	**Length of Mould (mm)**	**250**
AS 1289.3.4.1	**Condition of Dry Specimen:**	**-**

Comments:

Approved Signatory:

Name: Erin Bullen

Date: 09-April-2021

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SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.5.2.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4815_1_MMDD
Project:	Geotechnical Investigation	*Sample No.*	WG21/4815
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP45 0.8-1.0m	*Date Tested:*	12-04-2021

TEST RESULTS - Modified Maximum Dry Density

Sampling Method: Sampled by Client, Tested as Received

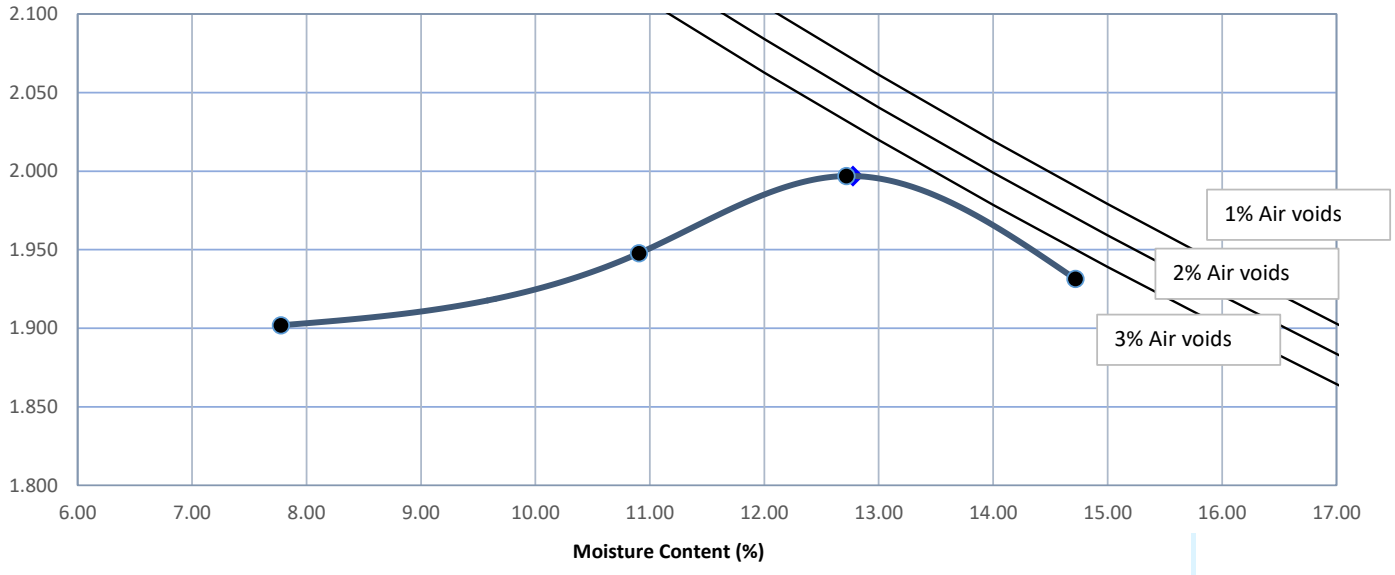
Sample Curing Time: 2HR

Method used to Determine Liquid Limit: Visual / Tactile Assessment by Competent Technician

Material + 19.0mm (%): 0 **Material + 37.5mm (%)** 0

Moisture Content (%)	7.8	10.9	12.7	14.7	
Dry Density (t/m³)	1.902	1.948	1.997	1.931	

Dry Density (t/m³)



Modified Maximum Dry Density (t/m³) **2.00**

Optimum Moisture Content (%) **13.0**

Comments: *The above air void lines are derived from a calculated apparent particle density of 2.855 t/m³*

Approved Signatory:

Name: Brooke Elliott

Date: 13-April-2021

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SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.5.2.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4820_1_MMDD
Project:	Geotechnical Investigation	*Sample No.*	WG21/4820
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP23 0.4-0.6m	*Date Tested:*	12-04-2021

TEST RESULTS - Modified Maximum Dry Density

Sampling Method: Sampled by Client, Tested as Received

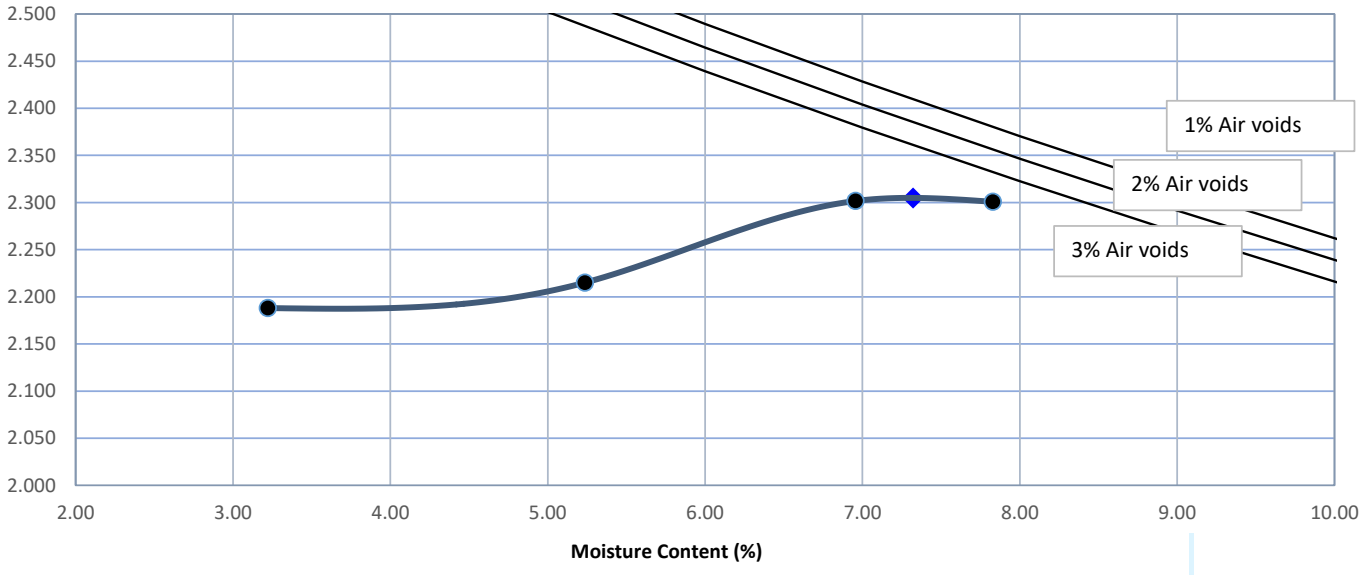
Sample Curing Time: 2HR

Method used to Determine Liquid Limit: Visual / Tactile Assessment by Competent Technician

Material + 19.0mm (%): 15 **Material + 37.5mm (%)** 0

Moisture Content (%)	3.2	5.2	7.0	7.8	
Dry Density (t/m³)	2.188	2.215	2.302	2.301	

Dry Density (t/m³)



Modified Maximum Dry Density (t/m³) **2.30**

Optimum Moisture Content (%) **7.5**

Comments: *The above air void lines are derived from a calculated apparent particle density of 2.962 t/m³*

Approved Signatory:

Name: Brooke Elliott

Date: 13-April-2021

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WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.5.2.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4823_1_MMDD
Project:	Geotechnical Investigation	*Sample No.*	WG21/4823
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP42 1.0-1.4m	*Date Tested:*	12-04-2021

TEST RESULTS - Modified Maximum Dry Density

Sampling Method: Sampled by Client, Tested as Received

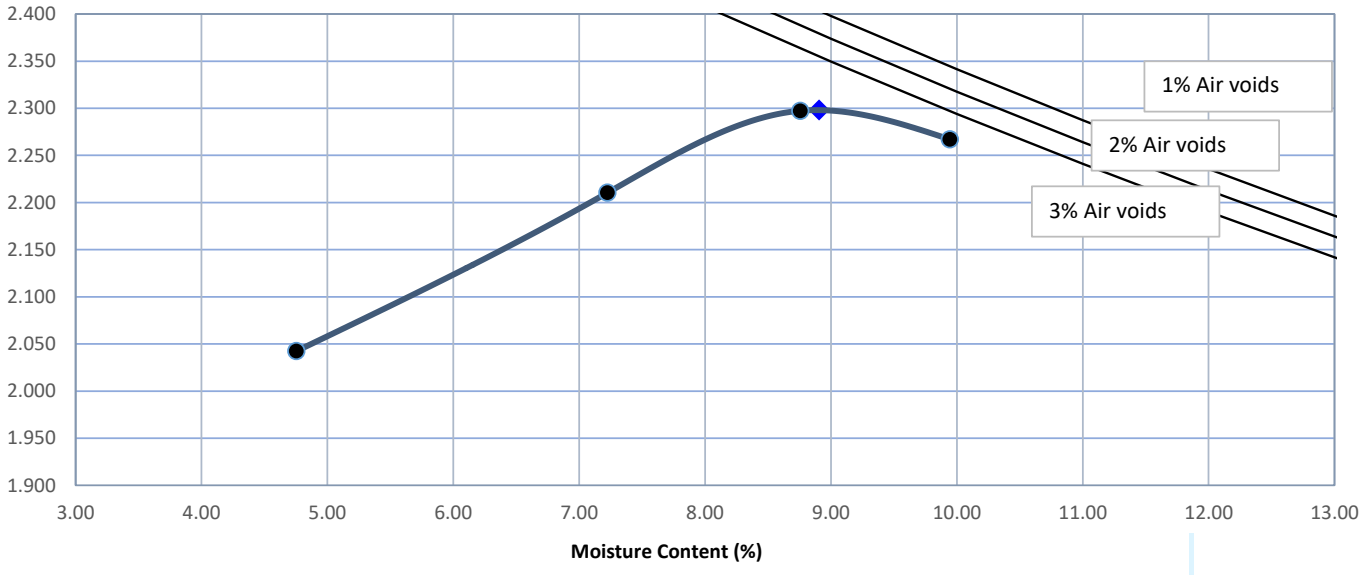
Sample Curing Time: 2HR

Method used to Determine Liquid Limit: Visual / Tactile Assessment by Competent Technician

Material + 19.0mm (%): 17 **Material + 37.5mm (%)** 0

Moisture Content (%)	4.8	7.2	8.8	9.9	
Dry Density (t/m³)	2.042	2.210	2.297	2.267	

Dry Density (t/m³)



Modified Maximum Dry Density (t/m³) **2.30**

Optimum Moisture Content (%) **9.0**

Comments: *The above air void lines are derived from a calculated apparent particle density of 3.097 t/m³*

Approved Signatory:

Name: Brooke Elliott

Date: 13-April-2021

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SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.5.2.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4811_1_MMDD
Project:	Geotechnical Investigation	*Sample No.*	WG21/4811
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP17 0.2-0.5m	*Date Tested:*	7-04-2021

TEST RESULTS - Modified Maximum Dry Density

Sampling Method: Sampled by Client, Tested as Received

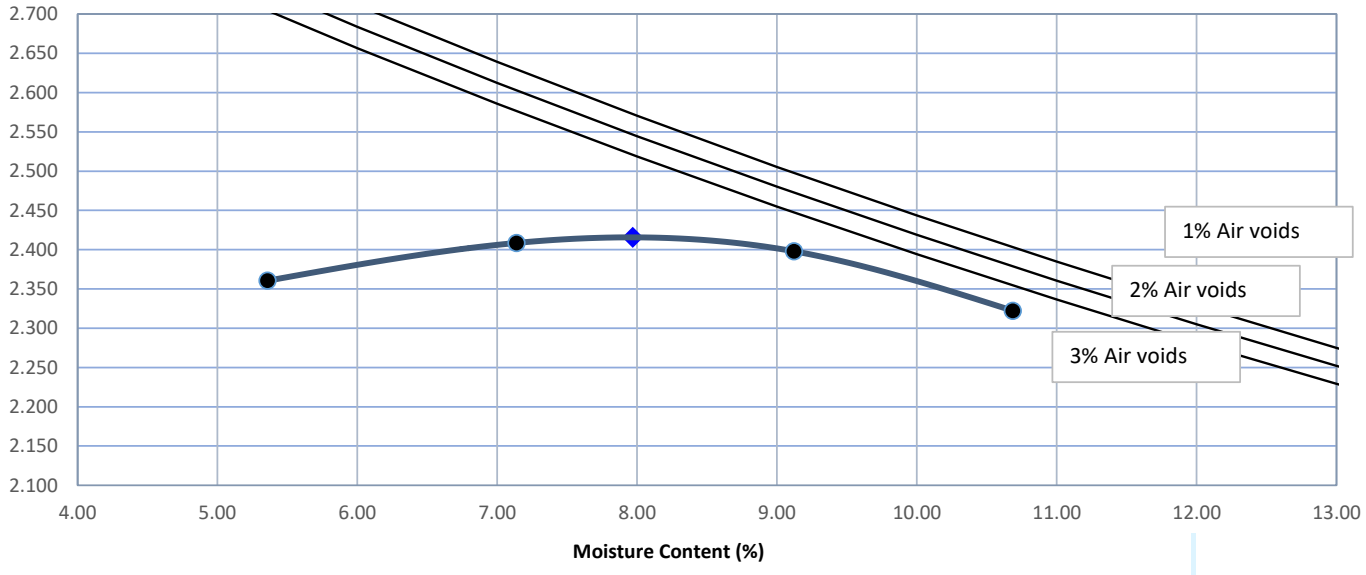
Sample Curing Time: 2 hours

Method used to Determine Liquid Limit: Visual / Tactile Assessment by Competent Technician

Material + 19.0mm (%): 17 **Material + 37.5mm (%)** -

Moisture Content (%)	**5.4**	**7.1**	**9.1**	**10.7**	
Dry Density (t/m³)	**2.360**	**2.409**	**2.398**	**2.322**	

Dry Density (t/m³)



Modified Maximum Dry Density (t/m³) **2.42**

Optimum Moisture Content (%) **8.0**

Comments: *The above air void lines are derived from a calculated apparent particle density of 3.277 t/m³*

Approved Signatory:

Name: Brooke Elliott

Date: 08-April-2021

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SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.5.2.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4816_1_MMDD
Project:	Geotechnical Investigation	*Sample No.*	WG21/4816
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP44 0.3-0.5m	*Date Tested:*	9/04/2021

TEST RESULTS - Modified Maximum Dry Density

Sampling Method: Sampled by Client, Tested as Received

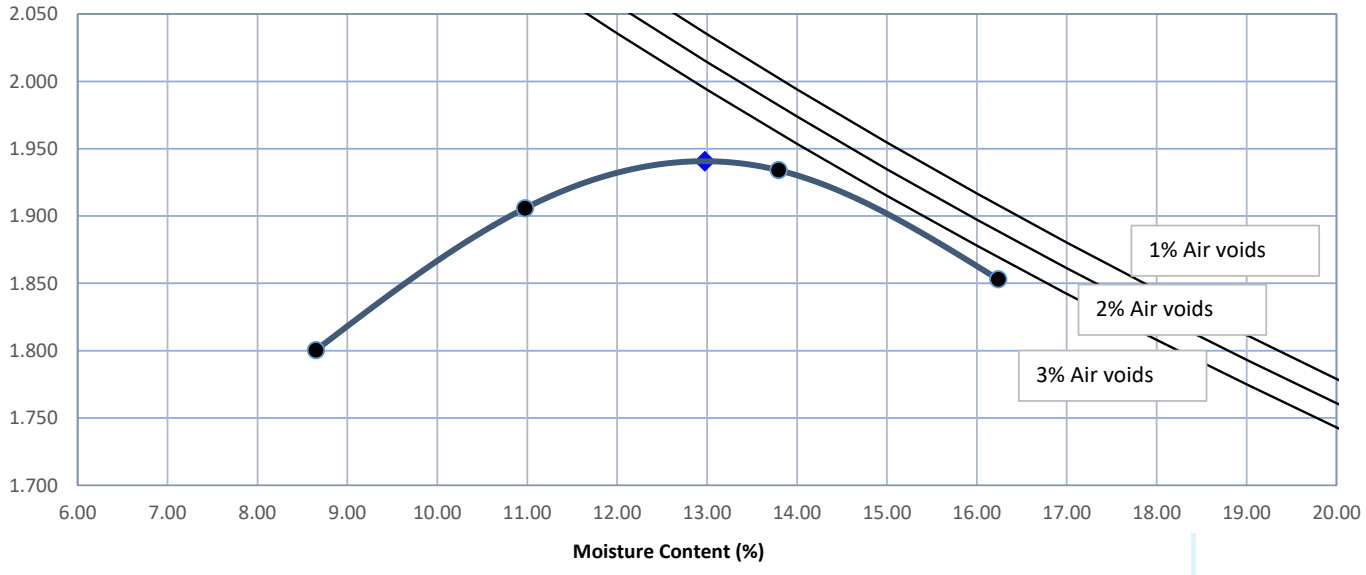
Sample Curing Time: 2 Hours

Method used to Determine Liquid Limit: Visual / Tactile Assessment by Competent Technician

Material + 19.0mm (%): 4 **Material + 37.5mm (%)** 0

Moisture Content (%)	**8.6**	**11.0**	**13.8**	**16.2**	
Dry Density (t/m³)	**1.800**	**1.906**	**1.934**	**1.853**	

Dry Density (t/m³)



Modified Maximum Dry Density (t/m³) **1.94**

Optimum Moisture Content (%) **13.0**

Comments: *The above air void lines are derived from a calculated apparent particle density of 2.805 t/m³*

Approved Signatory: Cody O'Neill

Name: Cody O'Neill

Date: 12/April/2021

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SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.5.2.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4818_1_MMDD
Project:	Geotechnical Investigation	*Sample No.*	WG21/4818
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP15 1.3-1.5m	*Date Tested:*	9/04/2021

TEST RESULTS - Modified Maximum Dry Density

Sampling Method: Sampled by Client, Tested as Received

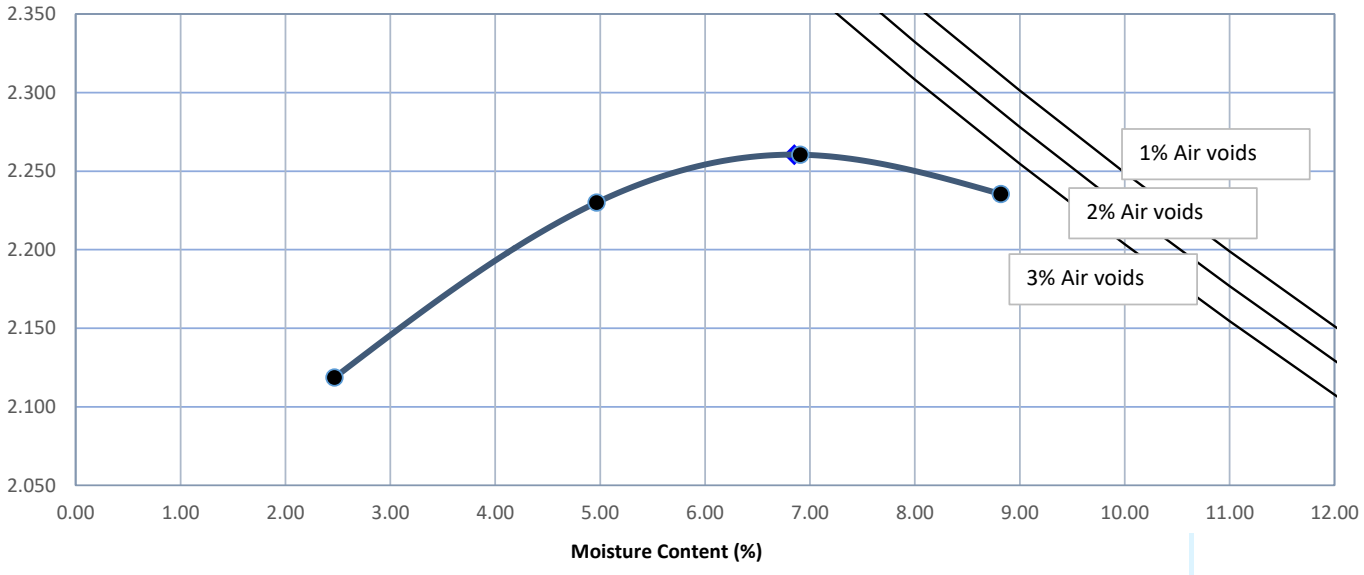
Sample Curing Time: 2 hrs

Method used to Determine Liquid Limit: Visual / Tactile Assessment by Competent Technician

Material + 19.0mm (%): 4 **Material + 37.5mm (%)** 0

Moisture Content (%)	2.5	5.0	6.9	8.8	
Dry Density (t/m³)	2.119	2.230	2.260	2.235	

Dry Density (t/m³)



Modified Maximum Dry Density (t/m³) **2.26**

Optimum Moisture Content (%) **7.0**

Comments: *The above air void lines are derived from a calculated apparent particle density of 2.939 t/m³*

Approved Signatory:

Name: Cody O'Neill

Date: 12/April/2021

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SOIL | AGGREGATE | CONCRETE | CRUSHING

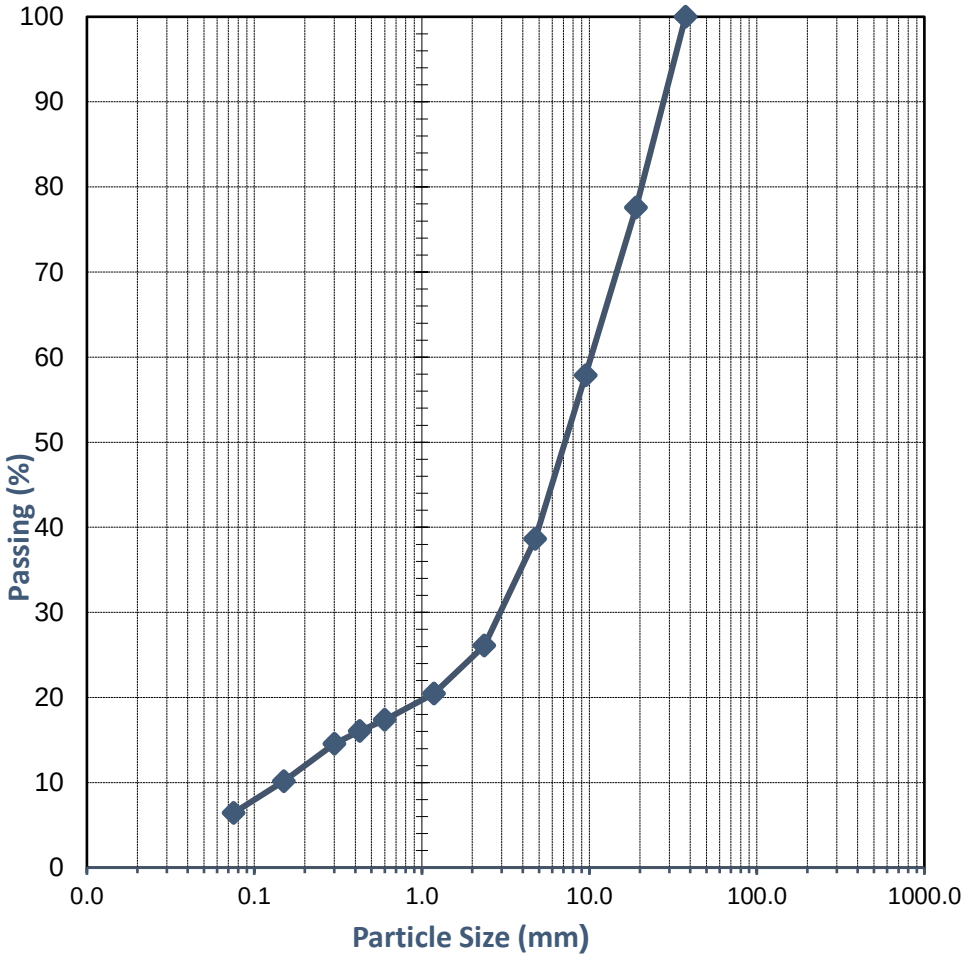
TEST REPORT - *AS 1289.1.1, AS 1289.3.6.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4824_1_PSD
Project:	Geotechnical Investigation	*Sample No.*	WG21/4824
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP8 2.0-2.4m	*Date Tested:*	7/4 - 8/4/2021

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	78
9.5	58
4.75	39
2.36	26
1.18	20
0.600	17
0.425	16
0.300	15
0.150	10
0.075	6



*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: EBullen

Name: Erin Bullen

Date: 08-April-2021

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

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WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

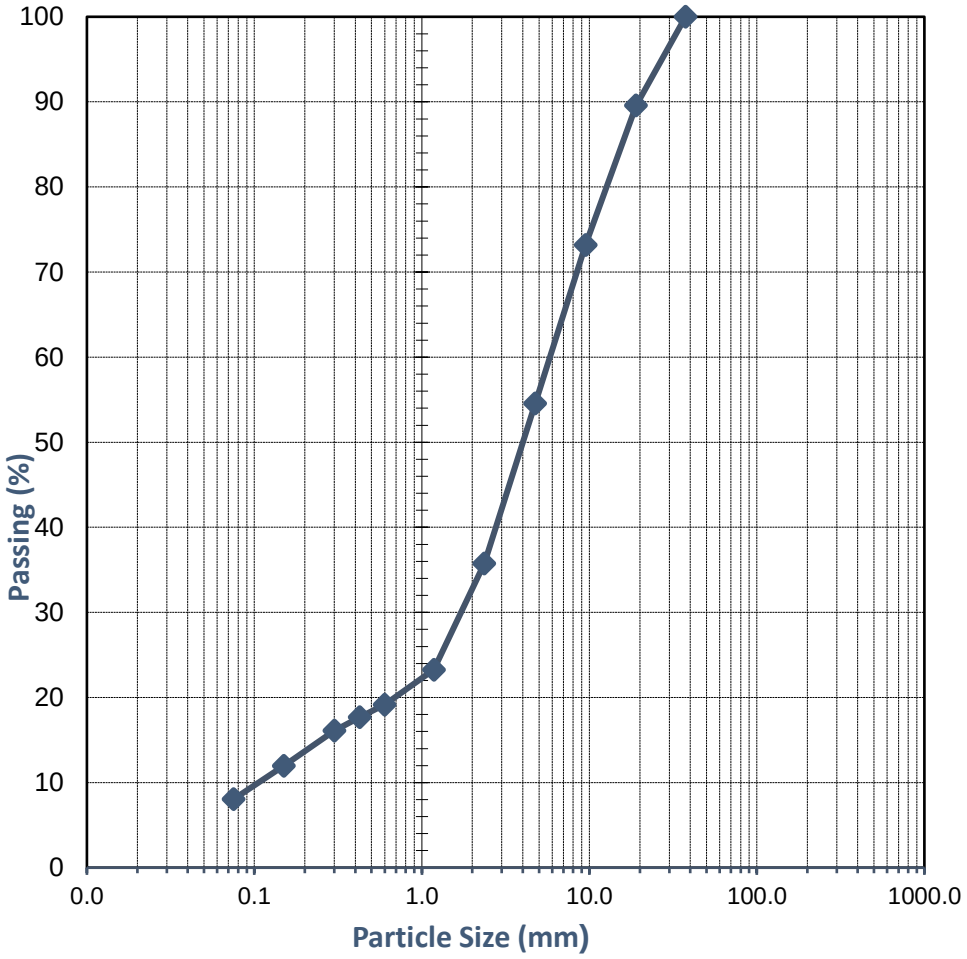
TEST REPORT - *AS 1289.1.1, AS 1289.3.6.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4810_1_PSD
Project:	Geotechnical Investigation	*Sample No.*	WG21/4810
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP36 0.4-0.6m	*Date Tested:*	7/4 - 8/4/2021

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	73
4.75	55
2.36	36
1.18	23
0.600	19
0.425	18
0.300	16
0.150	12
0.075	8



*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: EBullen

Name: Erin Bullen

Date: 08-April-2021

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SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.6.1.1

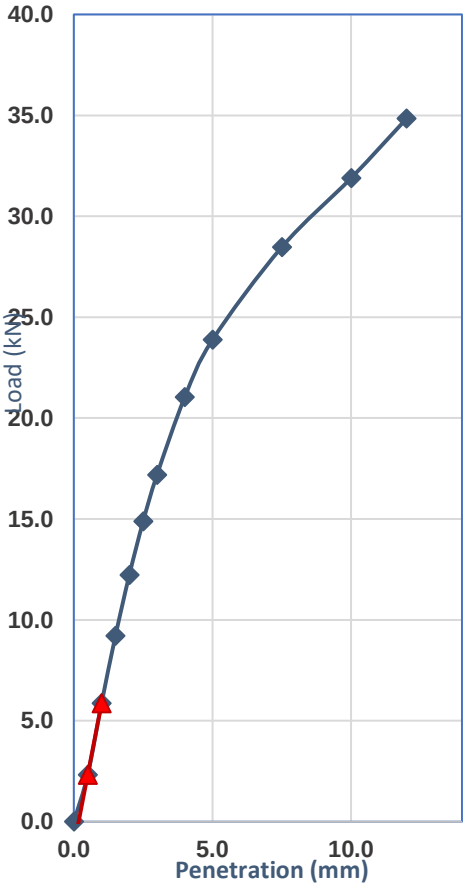
Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4815_1_SCBR
Project:	Geotechnical Investigation	*Sample No.*	WG21/4815
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP45 0.8-1.0m	*Date Tested:*	07/04 - 17/04/2021

TEST RESULTS - CALIFORNIA BEARING RATIO

Sample Description: Sandy Gravel

Sampling Method: Sampled by Client, Tested as Received

Load Penetration Curve



Compaction Details			
Compaction Method	AS 1289.5.2.1	Hammer Type	Modified
Plasticity Determined by	Estimated	Curing Time (Hours)	2.0
% Retained 19.0mm	0	Excluded/Replaced	Excluded
Maximum Dry Density (t/m^3)	2.00	Optimum Moisture (%)	13.0
Target Dry Density Ratio (%)	95	Target Moisture Ratio (%)	100

Specimen Conditions At Compaction			
Dry Density (t/m3)	1.89	Moisture Content (%)	12.9
Density Ratio (%)	95.0	Moisture Ratio (%)	101.0

Specimen Conditions After Soak			
Soaked or Unsoaked	Soaked	Soaking Period (days)	4
Surcharges Applied (kg)	4.50	Measured Swell (%)	0.0
Dry Density (t/m³)	1.89	Dry Density Ratio (%)	94.5
Moisture Content (%)	16.0	Moisture Ratio (%)	124.5

Specimen Conditions After Test			
Top 30mm Moisture (%)	15.7	Remaining Depth (%)	15.9

Correction applied to Penetration: 0.2mm

Determined at a Penetration of: 5.0mm

California Bearing Ratio (CBR): 120%

Comments:

Approved Signatory:

Name: Brooke Elliott

Date: 19-April-2021

NATA WORLD RECOGNISED ACCREDITATION

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WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.6.1.1

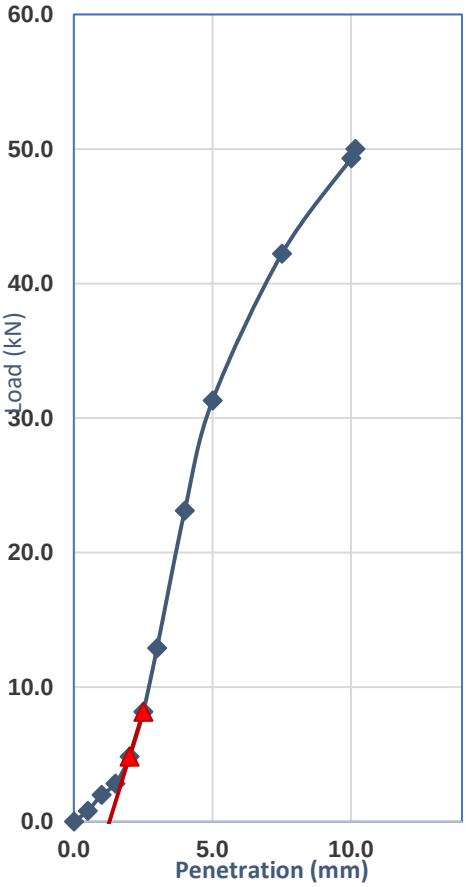
Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4820_1_SCBR
Project:	Geotechnical Investigation	*Sample No.*	WG21/4820
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP23 0.4-0.6m	*Date Tested:*	13/04 - 17/04/2021

TEST RESULTS - CALIFORNIA BEARING RATIO

Sample Description: Sandy Gravel

Sampling Method: Sampled by Client, Tested as Received

Load Penetration Curve



Compaction Details			
Compaction Method	AS 1289.5.2.1	Hammer Type	Modified
Plasticity Determined by	Estimated	Curing Time (Hours)	2.0
% Retained 19.0mm	15	Excluded/Replaced	Excluded
Maximum Dry Density (t/m^3)	2.31	Optimum Moisture (%)	7.5
Target Dry Density Ratio (%)	95	Target Moisture Ratio (%)	100

Specimen Conditions At Compaction			
Dry Density (t/m3)	2.18	Moisture Content (%)	7.6
Density Ratio (%)	94.5	Moisture Ratio (%)	104.5

Specimen Conditions After Soak			
Soaked or Unsoaked	Soaked	Soaking Period (days)	4
Surcharges Applied (kg)	4.50	Measured Swell (%)	0.0
Dry Density (t/m³)	2.18	Dry Density Ratio (%)	94.5
Moisture Content (%)	10.8	Moisture Ratio (%)	147.5

Specimen Conditions After Test			
Top 30mm Moisture (%)	10.0	Remaining Depth (%)	8.7

Correction applied to Penetration: 1.3mm

Determined at a Penetration of: 5.0mm

California Bearing Ratio (CBR): 190%

Comments: Maximum limits of load cell reached.

Approved Signatory:

Name: Brooke Elliott

Date: 19-April-2021

NATA WORLD RECOGNISED ACCREDITATION

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TEST REPORT - AS 1289.6.1.1

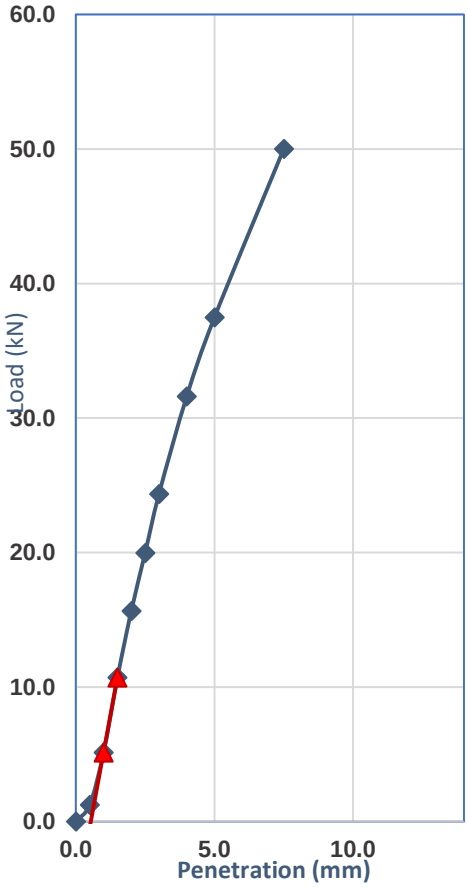
Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4823_1_SCBR
Project:	Geotechnical Investigation	*Sample No.*	WG21/4823
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP42 1.0-1.4m	*Date Tested:*	12/04/ - 17/04/2021

TEST RESULTS - CALIFORNIA BEARING RATIO

Sample Description: Sandy Gravel

Sampling Method: Sampled by Client, Tested as Received

Load Penetration Curve



Compaction Details			
Compaction Method	AS 1289.5.2.1	Hammer Type	Modified
Plasticity Determined by	Estimated	Curing Time (Hours)	2.0
% Retained 19.0mm	17	Excluded/Replaced	Excluded
Maximum Dry Density (t/m^3)	2.30	Optimum Moisture (%)	9.0
Target Dry Density Ratio (%)	95	Target Moisture Ratio (%)	100

Specimen Conditions At Compaction			
Dry Density (t/m3)	2.19	Moisture Content (%)	8.6
Density Ratio (%)	95.0	Moisture Ratio (%)	96.5

Specimen Conditions After Soak			
Soaked or Unsoaked	Soaked	Soaking Period (days)	4
Surcharges Applied (kg)	4.50	Measured Swell (%)	0.0
Dry Density (t/m³)	2.19	Dry Density Ratio (%)	95.0
Moisture Content (%)	10.4	Moisture Ratio (%)	117.0

Specimen Conditions After Test			
Top 30mm Moisture (%)	9.6	Remaining Depth (%)	10.1

Correction applied to Penetration: 0.5mm

Determined at a Penetration of: 5.0mm

California Bearing Ratio (CBR): 200%

Comments: Maximum limits of load cell reached.

Approved Signatory:

Name: Brooke Elliott

Date: 19-April-2021

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599

Accredited for compliance with ISO/IEC 17025 - Testing

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WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.7.1.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4811_1_SSI
Project:	Geotechnical Investigation	*Sample No.*	WG21/4811
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP17 0.2-0.5m	*Date Tested:*	13/4 - 14/4/2021

TEST RESULTS - SHRINK SWELL INDEX

Sampling Method: Sampled by Client, Tested as Received

Material Description: Silty Sandy Gravel

SWELL SPECIMEN	
Moisture Content Initial (%):	8.6
Dry Density - Initial (t/m^3):	2.28
Moisture Content Final (%):	15.1
Estimated Inert Inclusions (%):	60.7

SHRINK SPECIMEN	
Moisture Content Initial (%):	-
Extent of Crumbling:	-
Length/Diameter Ratio:	-
Extent of Cracking:	-

SHRINK SWELL INDEX	
Shrink Swell Index (I_{ss})	-

Comments: Material not suitable for shrinkage test.

Approved Signatory:

Name: Brooke Elliott

Date: 15-April-2021

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WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.7.1.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4816_1_SSI
Project:	Geotechnical Investigation	*Sample No.*	WG21/4816
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP44 0.3-0.5m	*Date Tested:*	13/04 /14/04/2021

TEST RESULTS - SHRINK SWELL INDEX

Sampling Method: Sampled by Client, Tested as Received

Material Description: Sandy Clay, trace Gravel

SWELL SPECIMEN	
Moisture Content Initial (%):	22.2
Dry Density - Initial (t/m^3):	1.80
Moisture Content Final (%):	24.3
Estimated Inert Inclusions (%):	9.8

SHRINK SPECIMEN	
Moisture Content Initial (%):	20.8
Extent of Crumbling:	Moderate
Length/Diameter Ratio:	2.0
Extent of Cracking:	Moderate

SHRINK SWELL INDEX

Shrink Swell Index (Iss) **0.4**

Comments: Sampled placed at 95% of MMDD. Moderate cracking and crumbling observed.

Approved Signatory:

Name: Brooke Elliott

Date: 16-April-2021

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WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.7.1.1

Client:	CMW Geosciences	*Ticket No.*	S2816
Client Address:	Suite 1, Level 3/29 Flynn Street, Wembley WA	*Report No.*	WG21/4818_1_SSI
Project:	Geotechnical Investigation	*Sample No.*	WG21/4818
Location:	Morley Road Subdivision	*Date Sampled:*	Not Specified
Sample Identification:	TP15 1.3-1.5m	*Date Tested:*	15/04 - 19/04/2021

TEST RESULTS - SHRINK SWELL INDEX

Sampling Method: Sampled by Client, Tested as Received

Material Description: Clayey Gravel

SWELL SPECIMEN	
Moisture Content Initial (%):	17.6
Dry Density - Initial (t/m^3):	2.07
Moisture Content Final (%):	26.1
Estimated Inert Inclusions (%):	39

SHRINK SPECIMEN	
Moisture Content Initial (%):	17.7
Extent of Crumbling:	Slight
Length/Diameter Ratio:	2.0
Extent of Cracking:	Moderate

SHRINK SWELL INDEX	
Shrink Swell Index (I_{ss})	**0.1**

Comments: Sampled placed at 95% of MMDD. Moderate cracking and slight crumbling observed.

Approved Signatory:

Name: Brooke Elliott

Date: 19-April-2021

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Analysis Results

CSBP Soil and Plant Laboratory

86780
CMW Geosciences Pty Ltd

	Lab No	TWS21139	TWS21140	TWS21141	TWS21142	TWS21143	TWS21144	TWS21145	TWS21146
	Name	TP17	TP16	TP11	TP38	TP44	TP6	TP2	TP14
	Code	ES	ES	ES	ES	ES	ES	ES	ES
	Customer	CMW Geosciences Pty Ltd	CMW Geosciences Pty Ltd	CMW Geosciences Pty Ltd	CMW Geosciences Pty Ltd	CMW Geosciences Pty Ltd	CMW Geosciences Pty Ltd	CMW Geosciences Pty Ltd	CMW Geosciences Pty Ltd
	Depth	10-20	41-60	50-80	100-130	40-50	30-50	40-60	80-100
Phosphorus Retention Index		6.2	20.8	156.6	> 1000.0	> 1000.0	17.8	28.5	18.1

CSBP Lab. Extract Value.

Analysis Results

CSBP Soil and Plant Laboratory

	Lab No	TWS21147	TWS21148
	Name	TP27	TP29
	Code	ES	ES
	Customer	CMW Geosciences Pty Ltd	CMW Geosciences Pty Ltd
	Depth	80-100	0-10
Phosphorus Retention Index		130.6	14.5

CSBP Lab. Extract Value.

Appendix 3 Site Drainage Assessment Photos

Location	Photo	Observations (Dec 2020 site visit)
PP1		This is the downstream extent of WC1 at photo point 1, showing a depression in the topography following the drainage line. The water runs outside of the site boundaries to the north. No water was present at the time of photographing.
PP2		This shows the upstream extent of WC1 at photo point 2. The topography shows a larger depression, with erosion and some vegetation (sedges) within the drainage line, and some water was present at the time of photographing.

PP3		This displays the upstream extent of WC1 at photo point 3. The topography is deeply incised and eroded, surrounded by grasses and vegetation (sedges). Some standing water was present at the time of photographing.
PP4		This shows the upstream extent of WC1 at photo point 4. The topography is incised and eroded, with some vegetation (sedges) within the drainage line. Some water was present at the time of photographing

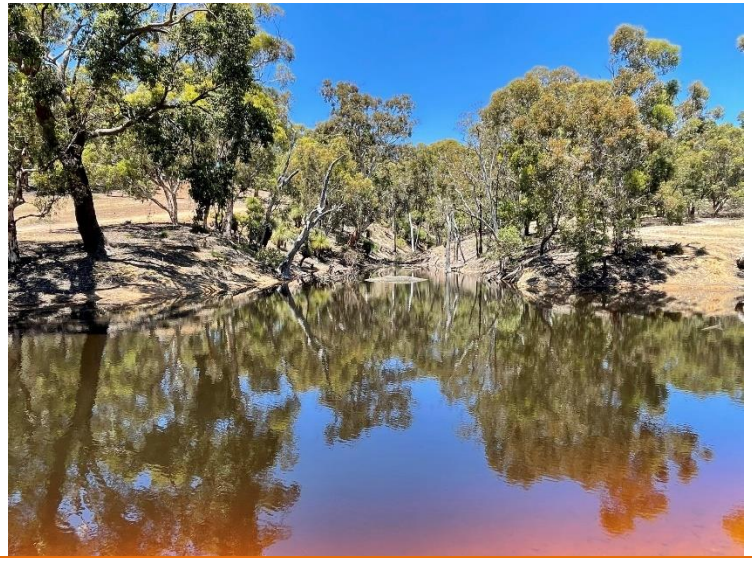
PP5a		This shows the upstream extent of WC1 at photo point 5a. The landscape has been sharply eroded to rock in some places, with medium to dense vegetation within the drainage line. The drainage line fans out at this point and no water was present at the time of photographing
PP5b		This shows a branching section of WC1. It fans out to the east in a small depression in the landscape over a larger area, densely vegetated with sedges. No water was present at the time of photographing.

PP6		This is the upstream extent of WC1 at photo point 6. The drainage line width has increased and the sides are sharply eroded back to rock, with medium cover vegetation within the drainage line. Some water is present.
PP7		This shows the upstream extent of WC1 at photo point 7. The landscape has been sharply eroded to rock, with sparse vegetation and some water present.

PP8		This shows the upstream extent of WC1 at photo point 8 and 9, on the southern border of the site. To the south of this site, the drainage line has been filled and disconnected (PP9) from WC1 although it is assumed that it historically connected into WC1. It has now been planted with trees. The fill prevents direct incoming water flow from the south. The top of WC1 has a man-made depression receiving runoff from the top of this site. The depression has rock sides and a deeper area which is thought to act as a sedimentation pond area. There was some water present at the time of photographing.
PP9		

PP10		This shows the downstream extent of a small branch on the western drainage line at photo point 10. The depression in topography is minimal, with very sparse vegetation.
PP11		This shows the tributaries off WC1 on the eastern side. The drainage lines have eroded the landscape to rock in some areas, with some vegetation within the lines and no water was present at the time of photographing.

PP12		This shows the downstream extent of WC4, on the southern border of the site. There is a deep depression in the topography forming a small valley, and no water was present at the time of photographing.
PP13		This shows the upstream extent of WC4 at photo point 13. The topography is deeply incised, surrounded by trees and no water was flowing at the time of photographing. Some stagnant water was present in places.

PP14		This shows the downstream extent of WC5 at photo point 14. There is a depression in the topography and is more densely vegetated than other areas. This drainage line has a confluence with the other eastern drainage line close to the northern boundary of the site.
PP15		This shows the upstream extent and dam of WC4 at photo point 15. The dam is surrounded by mature trees, and contains a significant amount of water for December, indicating it is likely perennial in nature and acts as a dam.

PP16		This is located at the upper end of WC2. As can be seen, there is a steep mound but this is adjacent to a flat area. There is no gully or incision present at the upper end of the watercourse mapped. No water was present at the time of photo which was June (different time to photos 1-15).
PP17		This is located at the upper end of WC3. As per PP16, as can be seen, there is a steep mound but this is adjacent to a flat area. There is no gully or incision present at the upper end of the watercourse mapped. No water was present at the time of photo which was June (different time to photos 1-15).

PP18		This is located on one of the mapped tributaries stemming from WC3. As can be seen, there is no apparent gully or incision in this locality. No water was present at the time of photo which was June (different time to photos 1-15).

Appendix 4 List of DoH Approved Secondary Treatment Systems (DoH, 2021)

Government of Western Australia
Department of Health

Approved secondary treatment systems and aerated wastewater treatment systems

Secondary treatment systems (STS) are wastewater treatment systems which produce treated effluent of secondary standard, i.e. 20 mg/L of Biochemical Oxygen Demand (BOD), 30 mg/L of Total suspended solids (TSS) and 10 cfu/100 mL of Escherichia (E) coli. Due to the treatment and disinfection process, the treated wastewater from STS systems may be used for garden irrigation.

The STSs systems listed below have been certified to the latest Australian Standard **AS 1546.3:2017- On-site domestic wastewater treatment units.Secondary treatment systems** and approved by the Chief Health Officer for installations in Western Australia. AS 1546.3:2017 sets out requirements for the design, commissioning, performance and conformity testing of **secondary treatment systems**.

Aerated Wastewater Treatment System (AWTS) is a system which uses the processes of aeration followed by clarification to achieve biological treatment of wastewater.The AWTS systems listed below have been certified to the previous Australian Standard **AS 1546.3:2008 - On-site domestic wastewater treatment units. Aerated wastewater treatment systems** and approved by the Chief Health Officer for installations in Western Australia. AS 1546.3:2008 sets out requirements for the design, commissioning, performance and conformity testing of **aerated wastewater treatment systems**.

In some instances the Government Sewerage Policy 2019 (external site) requires installation of STS and not AWTS. For more details please refer to the Government Sewerage Policy 2019 (external site).

STSs and AWTSs are to be installed and operated in accordance with the *Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974*, the *Code of Practice for the Design, Manufacture, Installation and Operation of Aerobic Treatment Units Serving Single Dwellings* and *AS 1547: 2012 On-site domestic wastewater management.*

As the conditions of approval can vary between designs, persons interested in installing a particular STS or AWTS should confirm it meets their needs and discuss site requirements with the local government. For more information on STS and AWTS refer to Secondary Treatment and Aerated Wastewater Treatment Systems.

STSs and AWTSs have regular service requirements (usually quarterly) and maintenance must be through an authorised person or their staff/subcontractors.

Where nutrient retention is required, the local government should be consulted to determine if the nutrient removal capacity of the system will meet their requirements.

Please note that all systems require to be certified to AS1546.3:2017:

- **any new STSs without current certification; and**
- **existing AWTS with current certification to AS 1546.3:2008 (as per table below) by the current certification expiry date.**

Table 1: Approved STS (certified to AS1546.3:2017)

Manufacturer / Distributor	Model	Capacity	Comment / Restrictions	Approval Expiry Date

BioSeptic Pty Ltd (external site) Phone: (02) 4629 6666 or 1300 658 111 Email: sales@bioseptic.com.au	Performa 2020	1500L/day 10EP	Advanced Secondary Treatment System with Chlorine disinfection, 3 Monthly Service and 4.3 yearly sedimentation pump out or as required. Approved for above ground spray irrigation, sub-surface, sub-strata drip irrigation, leach drains and soakwells. The system achieved the following results over testing period to AS 1546.3:2017: • TSS 5.8mg/l • BOD 1.9mg/l • Turbidity 14.5NTU • **E coli <1 CFU/100ml**	Global Certification Number 576 30/06/2025
Everhard Industries Pty Ltd (external site) Phone: (08) 94178222 Email: waorders@everhard.com.au	Aqua Advanced Poly and Concrete	1200L/day 8EP	Advanced Secondary Treatment System with Chlorine disinfection, 3 Monthly Service and 3.3 yearly sedimentation pump out or as required. Approved for above ground spray irrigation, sub-surface, sub-strata drip irrigation, leach drains and soakwells. The system achieved the following results over testing period to AS 1546.3:2017: • TSS 5.4mg/l • BOD 1.25mg/l • Turbidity 7.6NTU • E coli 0.2 CFU/100ml	Global Certification Number 632 28/092025
Biomax Pty Ltd	BioMax-C10 and P10-M		This system is currently undergoing testing to AS1546.3:2017	Preliminary certification number SMK40530
Fuji Clean Australia PTY LTD Phone: 1300 733 619 Email: dwain@fujiclean.com.au WA Distributor: ECOWATER WA Phone: 08 9561 2927 Email: ecowaterwa@bigpond.com Mob: 0417 098 281	FujiClean ACE 1200	1200L/day 8EP	Advanced Secondary Treatment System with Chlorine disinfection, 3 Monthly Service and 5 yearly sedimentation pump out or as required. Approved for above ground spray irrigation, sub-surface, sub-strata drip irrigation, leach drains and soakwells. The system achieved the following results over testing period to AS 1546.3:2017: • TSS 2.9mg/l • BOD <2mg/l • Turbidity 3.63NTU • E coli <1CFU/100ml • Total Nitrogen 14.79mg/l • Phosphorus 10.33mg/l	Global Certification Number 476 15/03/2024

Kingspan Water & Energy Pty Ltd(external site) Phone:1300 736 562 Email:gerry.quinn@kingspan.com	BioFicient Series 1	1500L/day 10EP	Aerated Secondary treatment system certified to AS 1546.3:2017	SMK40710 22/11/2023
	Advanced BioFicient	1200L/day 8EP	Advanced Secondary Treatment System with Chlorine disinfection, 3 Monthly Service and 2 yearly sedimentation pump out or as required. Approved for above ground spray irrigation, sub-surface, sub-strata drip irrigation, leach drains and soakwells.The system achieved the following results over testing period to AS 1546.3:2017: • TSS 4.1mg/l • BOD 1.07mg/l • Turbidity 6.9NTU • E coli <1CFU/100ml	Global Certification Number 581 10/06/2025
Taylex Australia Pty Ltd (external site) Phone: 1300 TAYLEX (1300 829539) Email: info@taylex.com.au	Taylex ABS 1500 (Concrete and plastic)	1500L/day 10EP	Advanced Secondary Treatment System with Chlorine disinfection, 3 Monthly Service and 3.2 yearly sedimentation pump out or as required. Approved for above ground spray irrigation, sub-surface, sub-strata drip irrigation, leach drains and soakwells.The system achieved the following results over testing period to AS 1546.3:2017: • TSS 7.6mg/l • BOD 1.5mg/l • Turbidity 31.1NTU • E coli 1.4 CFU/100ml	Global Certification 40/22 19/08/2025
	Taylex ABS 5000 Concrete	5000L/day 33EP	Advanced Secondary Treatment System with Chlorine disinfection, 3 Monthly Service and 3.2 yearly sedimentation pump out or as required. Approved for above ground spray irrigation, sub-surface, sub-strata drip irrigation, leach drains and soakwells.The system achieved the following results over testing period to AS 1546.3:2017: • TSS 6.12mg/l • BOD 1.07mg/l • Turbidity 8.51NTU • E coli 0.41 CFU/100ml • Nitrogen 45.68mg/l • Phosphorus 9.21mg/l	Global Certification 40/24 16/12/2025

Toowomba Tanks Pty Ltd (external site) Phone: (07) 4634 3860 Email: sales@tanks.com.au WA Distributor: TMC Australasia: 0418 267 959 Email: tony@tmcwaterrecycling.com	TurboJet Single	1500L/day 10 EP	Advanced Secondary Treatment System with Chlorine disinfection, 3 Monthly Service and 3.5 yearly sedimentation pump out or as required.Approved for above ground spray irrigation, sub-surface, sub-strata drip irrigation, leach drains and soakwells. The system achieved the following results over testing period to AS 1546.3:2017: • TSS 9.2mg/l • BOD5 <2mg/l • Total Nitrogen 51.1mg/l • Phosphorus 11.6mg/l • Turbidity 8.8NTU • E coli <1CFU/100ml	Global Certification 567 22/05/2025

Table 2: Approved AWTS (certified to AS1546.3:2008)

Manufacturer / Distributor	Model	Capacity	Comment / Restrictions	Approval Expiry Date
Allied Pumps (external site) Phone: 9350 1000 / 1800 447 777 Email: sales@alliedpumps.com.au	Everhard Aqua-Nova 2000 Model 80100	1800L/day	Aerated Wastewater Treatment System certified to AS1546.3:2008	Global Certification No. 077 16/02/2022
Aquarius Wastewater Systems Pty Ltd (external site) Phone: 9240 8545 Email:admin@aquariuswastewater.com.au	Aquarius O–3	1800L/day	Aerated Wastewater Treatment System with Ozone disinfection and Alum dosing. Nutrient reduction capability: N reduced to <10mg/L. & P reduced to < 1mg/L as per certification SMKH21519 to AS1546.3:2008	SMKH21519 25/03/2026
	Aquarius O–2	1800L/day	Aerated Wastewater Treatment System without disinfection and Alum dosing certified to AS1546.3:2008.	
	Aquarius O–2 NR	1800L/day	Aerated Wastewater Treatment System without disinfection, with Alum dosing. Nutrient reduction capability: N reduced to <10mg/L. & P reduced to < 1mg/L as per certification SMKH21519 to AS1546.3:2008	

Manufacturer / Distributor	Model	Capacity	Comment / Restrictions	Approval Expiry Date
Biolytix Ltd (external site) WA Distributor: Water installations: 9295 6263	BF6 - Mark 2	1600L/day	Aerated Wastewater Treatment System without disinfection,certified to AS1546.3:2008	SMK40499 31/12/2025
Jowa Group Pty Ltd (external site) Phone: 8381 9100 Email: admin@biocycle.com.au WA Distributors: Greg Browden: 0401 967 330	Biocycle BIO-7000	1500L/day 10EP	Aerated Wastewater Treatment System with Chlorine disinfection, certified to AS1546.3:2008	SMKH20266 22/11/2025
Fuji Clean Australia Pty Ltd (external site) WA Distributor: Ecowater WA: 0417 098 281 Email: ecowaterwa@bigpond.com	CE1500EX	1500L/day 10EP	Aerated Wastewater Treatment System with some Nitrogen reduction and 3 monthly service achieving the following average results tested to AS1546.3:2008: • TSS 4.27 mg/L • BOD 2.29 mg/L • E.coli 1.2 cfu /100mL • D.O. 5.07 mg/L • Nitrogen 53% reduction	Global Certification Number 249/6 09/05/2025
Global Roto-Moulding Pty Ltd (external site) Phone: (07) 4697 7099 Email: info@globalwater.com.au	UBI Aqua 6000L	1500L/day	Aerated Wastewater Treatment System with Chlorine disinfection, certified to AS1546.3:2008	SMK40298 10/05/2022
Graf Australia Pty Ltd (external site) Phone: 1300 131 971 Email: info@grafaustralia.com.au WA Distributor: Aquarius Wastewater Systems PL (external site) Phone: 9240 8545 Email: mel@aquariuswastewater.com.au	Graf E-Pro 15-1 Graf E-Pro 15-1C Graf E-Pro 15-1 PAC	1500L/day	Aerated Wastewater Treatment System with some Nitrogen and Phosphorus reduction and 4 monthly service achieving the following average results tested to AS1546.3:2008: TP (% removal): 3 mg/L (54%) TN (% removal): 24 mg/L (50%)	Global certification No. 329, 329/1 & 188 &188/2 26/10/2024

Manufacturer / Distributor	Model	Capacity	Comment / Restrictions	Approval Expiry Date
	Graf E-Pro 15-2 Graf E-Pro 15-2C Graf E-Pro 15-2 PAC	1500L/day	Aerated Wastewater Treatment System with some Nitrogen and Phosphorus reduction and 6 monthly service achieving the following average results tested to AS1546.3:2008: TP (% removal): 3 mg/L (54%) TN (% removal): 24 mg/L (50%)	
	Graf E-Pro 15-3 Graf E-Pro 15-3+O Graf E-Pro 15-3 PAC	1500L/day	Aerated Wastewater Treatment System with some Nitrogen and Phosphorus reduction and 6 monthly service achieving the following average results tested to AS1546.3:2008: TP (% removal): 3 mg/L (54%) TN (% removal): 24 mg/L (50%)	
Suncoast Waste Water Management (external site) Phone: 1800 450 767 Email: info@ozzikleen.com	Ozzi Kleen RP-10	2000L/day	Aerated Wastewater Treatment System with Chlorine disinfection, certified to AS1546.3:2008	SMK02608 14/08/2021
	Ozzi Kleen RP-10A+	2000L/day	Aerated Wastewater Treatment System with Chlorine disinfection and Alum dosing, certified to AS1546.3:2008	
Taylex Australia Pty Ltd (external site) Phone: 1300 TAYLEX (1300 829539) Email: info@taylex.com.au	Taylex ABS 10EP (Concrete and plastic)	2000L/day	Aerated Wastewater Treatment System with some Nitrogen and Phosphorus reduction and 3 monthly service achieving the following average results tested to AS1546.3:2008: TP (% removal): 2.5 mg/L (84.67%) TN (% removal): 24.9 mg/L (53.71)	Global Certification 040/8 & 040/10 11/07/2025

Manufacturer / Distributor	Model	Capacity	Comment / Restrictions	Approval Expiry Date
	Taylex ABS 8EP (Concrete and plastic)	1200L/day	Aerated Wastewater Treatment System with some Nitrogen and Phosphorus reduction and 3 monthly service achieving the following average results tested to AS1546.3:2008: TP (% removal): 2.5 mg/L (84.67%) TN (% removal): 24.9 mg/L (53.71)	

Table 3: Systems assessed and not approved or approval withdrawn

Manufacturer	Model	Reason not approved / Further information
BioSystems 2000 Pty Ltd	Biosystem 2000	Certification is not provided as of 1 July 2015.
Earthsafe Environmental Pty Ltd	Earthsafe Environmental	Certification SMKH20612 is not available online
Fuji Clean Australia Pty Ltd	CE1200	Certification is not provided as of 1 July 2015.
Galvin Concrete & Sheetmetal Pty Ltd	Clearwater 90 Compact	Certification is not provided as of 1 July 2015.
Icon-Septech Pty Ltd	Septech Turbojet 2000	Company liquidated. For further information, visit: Australian Securities and Investments Commission (external site). Systems that have been purchased on or before 27 June 2016 may still be installed.
Jowa Group Pty Ltd	Biocycle 5800	Certification not provided as of 1 July 2015.
Water Gurus Pty Ltd	Novaclear	Company liquidated. For further information, visit: Australian Securities and Investments Commission (external site)

More information

Environmental Health Directorate
Department of Health
Telephone: 9222 2000
Email: ehinfo@health.wa.gov.au

Appendix 5 Correspondence

Rachel Murray

From: Peter Stuart <peter.stuart@chittering.wa.gov.au>
Sent: Thursday, 8 April 2021 9:43 AM
To: Darby, Ryan
Cc: Phil Cuttone; Jake Whistler
Subject: RE: Lot 1942 (293) Morley Road, Lower Chittering
Attachments: image008.wmz

Morning Ryan,

We have previously advised others that the irrigation area can be located outside of the envelope – particularly as we like to err on the side of public health as a priority. We confirm that the Shire would not require irrigation areas to be located entirely within the building envelope.

Hope this helps

Kind regards

Peter Stuart
Executive Manager Development Services

6177 Great Northern Highway
PO Box 70, BINDOON WA 6502
(08) 9576 4600
chatter@chittering.wa.gov.au
www.chittering.wa.gov.au

Shire of Chittering

The Shire of Chittering acknowledges the Aboriginal peoples of Western Australia as the traditional custodians of this land and we pay our respects to their Elders, past and present.

From: Darby, Ryan <ryan.darby@hatch.com>
Sent: Wednesday, 7 April 2021 3:29 PM
To: Peter Stuart <peter.stuart@chittering.wa.gov.au>; Jake Whistler <jake.whistler@chittering.wa.gov.au>
Cc: Phil Cuttone <phil@cuttoneproperty.com.au>
Subject: RE: Lot 1942 (293) Morley Road, Lower Chittering

Hi Peter and Jake

We are currently preparing the building envelope plan to support the scheme amendment and structure plan for the Morley Road site. We obviously need to take a number of factors into consideration when identifying the building envelope locations, including prescribed boundary setbacks, bushfire, access, servicing, retention of vegetation and setbacks to water courses. In order to achieve the ATU irrigation area setbacks from the water courses, the irrigation areas for some of the lots will be outside the proposed building envelopes.

Can you please advise if ATU irrigation areas can be located outside of the buildings envelopes?

Please contact me if you have any queries.

Regards

Ryan Darby
Partner, Urban Solutions

Tel: 08 9213 7300
Mob: 0408 614 346
ryan.darby@hatch.com
Level 2, 442 Murray Street
Perth WA 6000

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From: Peter Stuart <peter.stuart@chittering.wa.gov.au>
Sent: Wednesday, March 17, 2021 4:11 PM
To: Darby, Ryan <ryan.darby@hatch.com>
Cc: Phil Cuttone <phil@cuttoneproperty.com.au>; Jake Whistler <jake.whistler@chittering.wa.gov.au>
Subject: RE: Lot 1942 (293) Morley Road, Lower Chittering

Hi Ryan,

Many thanks for the update. You can find the requirements for Building Envelopes within Clause 4.8 of LPS6.

In all likelihood Jake (principal planner, CC'd in this email) will be taking carriage of this one, though he may delegate it down to the planning officer. I am happy to be the primary point of contact until lodgement no less.

Also by primary contact for this structure plan, I hope you mean scheme amendment also.

Kind regards

Peter Stuart
Executive Manager Development Services

6177 Great Northern Highway
PO Box 70, BINDOON WA 6502
(08) 9576 4612
chatter@chittering.wa.gov.au
www.chittering.wa.gov.au
Sign up for our quarterly e newsletter
Sign up for e rates

Shire of Chittering

From: Darby, Ryan <ryan.darby@hatch.com>
Sent: Wednesday, 17 March 2021 2:56 PM
To: Peter Stuart <peter.stuart@chittering.wa.gov.au>
Cc: Phil Cuttone <phil@cuttoneproperty.com.au>
Subject: RE: Lot 1942 (293) Morley Road, Lower Chittering

Hi Peter

Further to the emails below, we are working on refining the concept lot design and finalising the technical reports to support the scheme amendment. In respect to building envelopes, do the Shire have any minimum or maximum areas or do the envelopes just need to be within the prescribed setbacks and have regards to environmental and other constraints?

Can you please let me know if you are the primary contact for this structure plan or will you delegate to another officer?

Please contact me if you have any queries.

Regards

Ryan Darby
Partner, Urban Solutions

Tel: 08 9213 7331
Mob: 0408 614 346
ryan.darby@hatch.com
Level 2, 442 Murray Street
Perth WA 6000

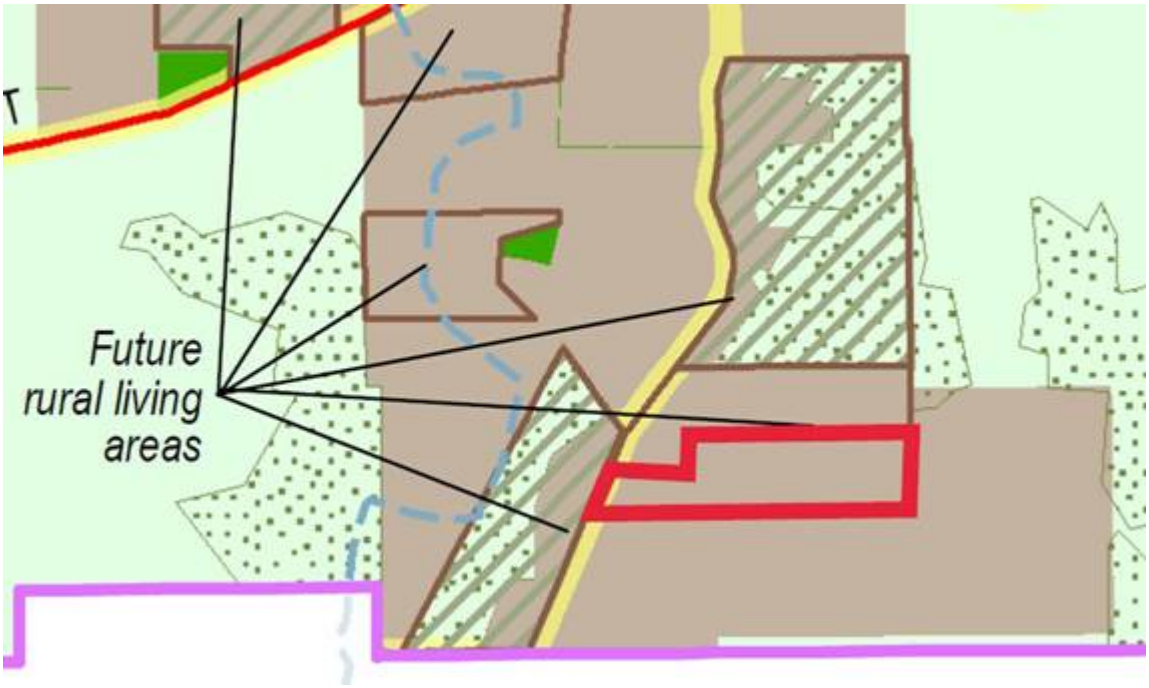
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From: Darby, Ryan
Sent: Friday, 4 December 2020 10:48 AM
To: emds@chittering.wa.gov.au
Cc: Cath Meaghan <Cath.Meaghan@dplh.wa.gov.au>; Phil Cuttone <phil@cuttoneproperty.com.au>
Subject: Lot 1942 (293) Morley Road, Lower Chittering

Hi Peter

Thanks again for coming to the site visit on Wednesday.

As discussed, we will commence preparation of the amendment to Local Planning Scheme No. 6 to rezone the subject site to 'Rural Residential', in accordance with the Shire's Local Planning Strategy (refer to excerpt below). We will also commence preparation of the Local Structure Plan.



Can you please confirm that the following reports are required to support the rezoning and LSP and if the Shire requires anything further:

- Environmental Assessment Report;
- Bushfire Management Plan;
- Engineering Servicing Report; and
- Local Water Management Strategy including Site and Soil Evaluation (SSE).

Further to our discussion at the site visit, can you also please confirm that we can concurrently lodge the scheme amendment and the structure plan.

Once we have refined the design following input from the technical consultants I will arrange a meeting with the you and the DPLH.

Please contact me if you have any queries.

Regards

Ryan Darby
Partner, Urban Solutions

Tel: 08 9213 7300
Mob: 0408 614 346
ryan.darby@hatch.com
Level 2, 442 Murray Street
Perth WA 6000

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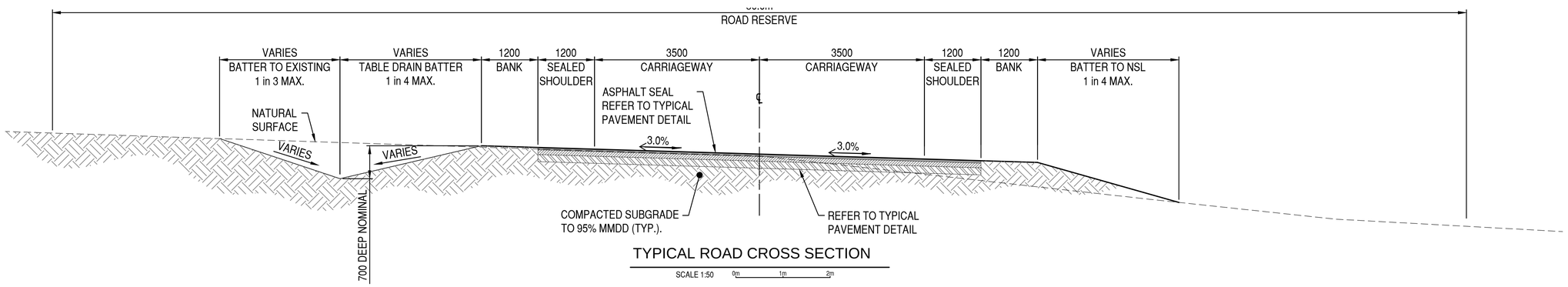
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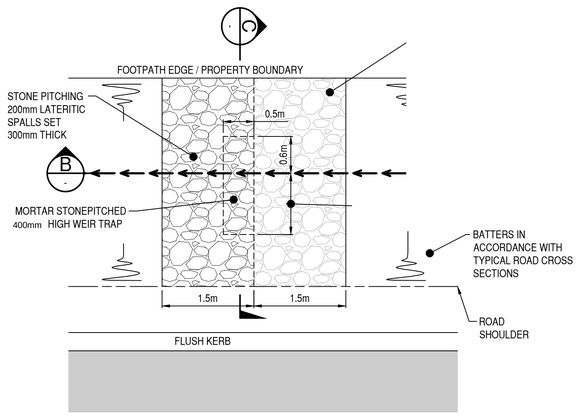
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Appendix 6 Weir Engineering Drawings (Pritchard Francis, 2021)



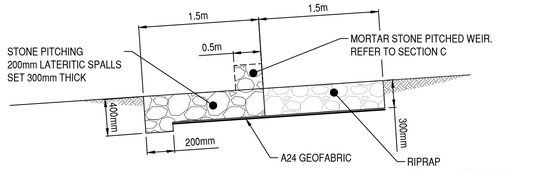
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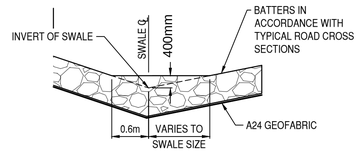
TYPICAL TRAPPED WEIR DETAIL

N.T.S.



SECTION B

N.T.S.



SECTION C

N.T.S.

REV	DATE	DESCRIPTION	BY	CHKR
	15/06/21	INITIAL ISSUE		

pritchard francis lite
civil engineering consultants

DRAWING STATUS: Preliminary Detail Plan

DATE: June 2021 | GRID: LOCAL | DATUM: AHD

DESIGNED | DRAWN | CHECKED | APPROVED ...../ ....

W.A.P.C. | SCALE U.N.O. AS SHOWN @ A1

CLIENT & JOB: Cuttone Property Group

TITLE: Morley Road, Chittering - Development

SHEET SIZE: A1 | DRG No. 20-030 - PFLT - SK -01 | REVISION -

Appendix 7 Alternative Drainage Option – Velocity reduction areas (Pritchard Francis, 2021)

Legend

- Proposed Detention Basins
- 20m — Length of Road
- Drainage Easement
- Fall of Road

Assumptions

1. Detention basins designed to cater for first flush storm run-off from roads based on 15mm per Ha for first flush

2. Catchment are has been based on half road reserve width plus half road pavement and shoulder 18.5m. This assumes lot run-off for will be catered for in Rainwater Tanks

3. Detention basins will be 1.0m deep and contain water to a depth of 0.5m

4. Basin will be constructed with 1:3 side slopes and have 1.0m boom around

LOT M1942
54.0405ha

1. Catchment - 110m x 18.5m
Area - 2,035m2
Volume to be Stored - 31m3

2. Catchment - 230m x 18.5m
Area - 4,255m2
Volume to be Stored - 64m3

3. Catchment - 230m x 18.5m
Area - 4,255m2
Volume to be Stored - 64m3

4. Catchment - 230m x 18.5m
Area - 4,255m2
Volume to be Stored - 64m3

5. Catchment - 110 x 18.5m
Area - 2,035m2
Volume to be Stored - 31m3

6. Catchment - 155m x 18.5m
Area - 2,870m2
Volume to be Stored - 44m3

7. Catchment - 155m x 18.5m
Area - 2,870m2
Volume to be Stored - 44m3

8. Catchment - 210m x 18.5m
Area - 3,885m2
Volume to be Stored - 59m3

9. Catchment - 185 x 18.5m
Area - 3,425m2
Volume to be Stored - 52m3

1. Drainage Basin
Base 7 x 10 (70m2)
Storage Volume at 0.5m depth 50m3
Top Area 17 x 25

2. Drainage Basin
Base 10 x 10 (100m2)
Storage Volume at 0.5m depth 67m3
Top Area 20 x 20

3. Drainage Basin
Base 10 x 10 (100m2)
Storage Volume at 0.5m depth 67m3
Top Area 20 x 20

4. Drainage Basin
Base 10 x 10 (100m2)
Storage Volume at 0.5m depth 67m3
Top Area 20 x 20

5. Drainage Basin
Base 7 x 7 (49m2)
Storage Volume at 0.5m depth 37m3
Top Area 17 x 17

6. Drainage Basin
Base 7 x 10 (70m2)
Storage Volume at 0.5m depth 50m3
Top Area 17 x 25

7. Drainage Basin
Base 8 x 8 (64m2)
Storage Volume at 0.5m depth 46m3
Top Area 18 x 18

8. Drainage Basin
Base 10 x 10 (100m2)
Storage Volume at 0.5m depth 67m3
Top Area 20 x 20

9. Drainage Basin
Base 9 x 9 (81m2)
Storage Volume at 0.5m depth 56m3
Top Area 19 x 19

MORLEY ROAD

TURTLEDOVE DRIVE

THORNBILL PLACE

BRONZEWING COURT

25m ROAD RESERVE

Morley Road, Chittering - Concept Drainage Plan

File No 20-03

29th April 2021

LEGEND

- 196m² WASTE WATER DISPOSAL AREA
- WATER COURSE AND 100m BUFFER

CADASTRAL INFORMATION
SOURCE: LANDGATE
YYMMDD: 201023
DWG REF: CHITTERING_CAD_201023
PROJECTION: GDA94

AERIAL PHOTOGRAPHY
SOURCE: NEARMAP
YYMMDD: 200509

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SIZE A1 1:2500

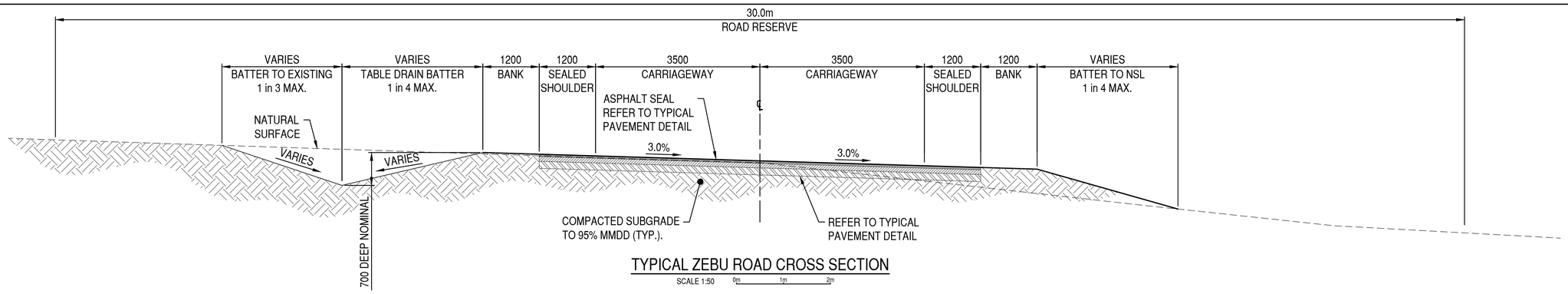
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C3	INCREASE BUILD ENV'S	210324	SB	RDa
C2	ADD WATERCOURSE	210217	SB	RDa
C1	MODIFY LOTS 16-18	210212	SB	RDa
B	REVISE DESIGN & ADDITION ADDED	210204	SB	RDa
B	REVISE DESIGN	210203	SB	RDa
A	DRAFT CONCEPT	201026	LI	DRAFT

DRAFT CONCEPT - OPTION 2
M1942 Morley Road, Lower Chittering
Shire of Chittering

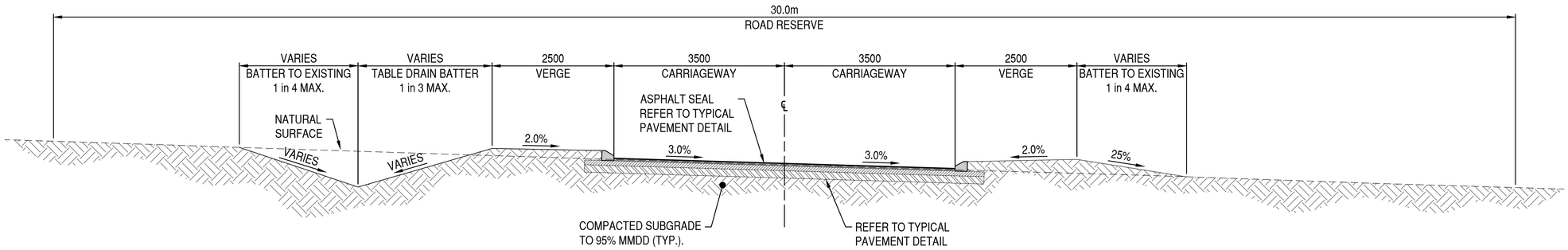
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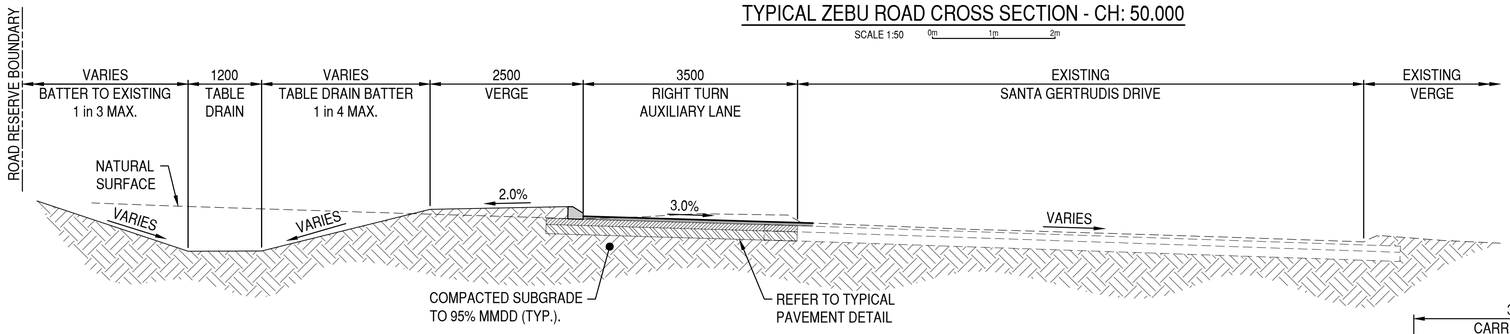
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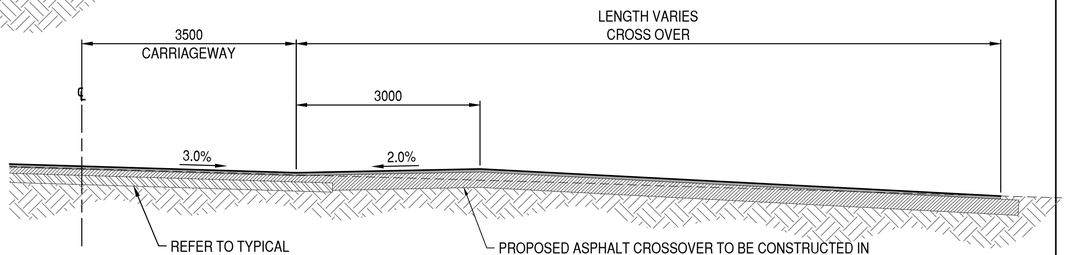
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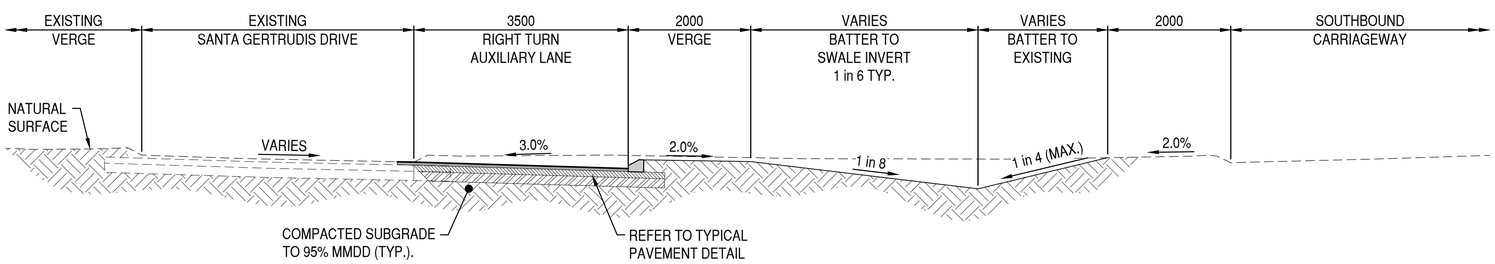
TYPICAL SANTA GERTRUDIS DRIVE SOUTHBOUND AUXILIARY LANE CROSS SECTION

SCALE 1:50 0m 1m 2m



TYPICAL CROSS SECTION THROUGH CROSSOVER

SCALE 1:50 0m 1m 2m



TYPICAL SANTA GERTRUDIS DRIVE NORTHBOUND AUXILIARY LANE CROSS SECTION

SCALE 1:50 0m 1m 2m

REV	DATE	DESCRIPTION	BY	CHKR
1	23/4/2021	ISSUED FOR CONSTRUCTION	RMH	PJP
A	31/01/2021	INITIAL ISSUE	RMH	PJP

pritchard francis lite
civil engineering consultants

DRAWING STATUS: FOR CONSTRUCTION

DATE: JANUARY 2021 | GRID: LOCAL | DATUM: AHD

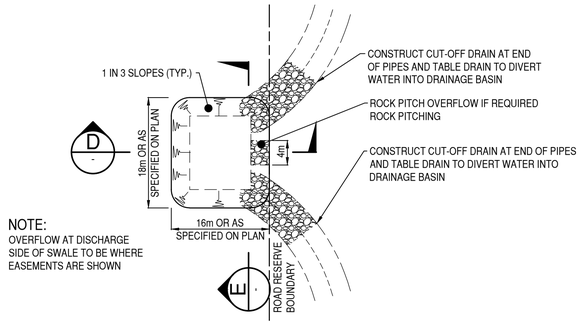
DESIGNED: RMH | DRAWN: RMH | CHECKED: PJP | APPROVED: ..../ ....

W.A.P.C.: 157358 | SCALE U.N.O.: AS SHOWN @ | SHEET SIZE: A1

CLIENT & JOB: MARYVILLE WINES PTY LTD
MARYVILLE ESTATE STAGE 12B

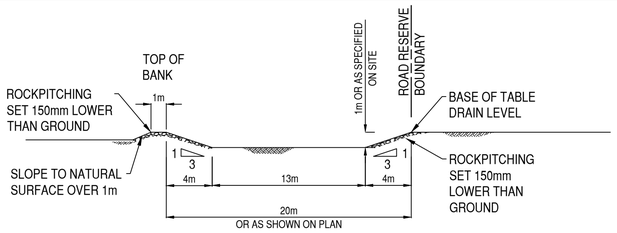
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INTERSECTION TYPICAL CROSS SECTIONS

DRG No.: 21001-PFLT-C7-TD-01 | REVISION: 1

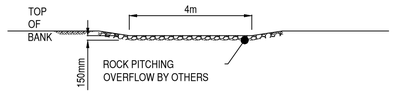


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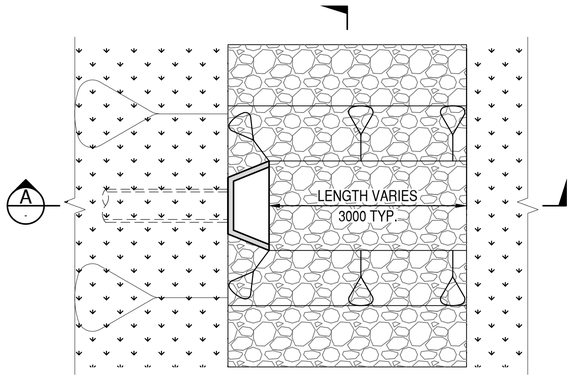
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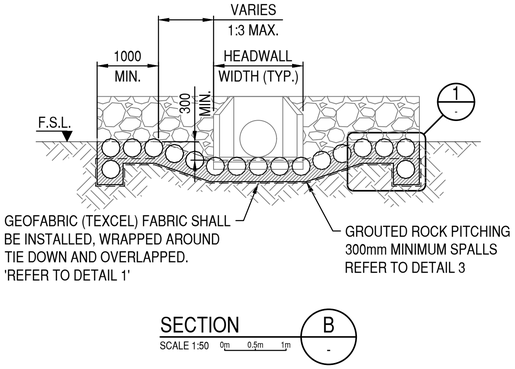
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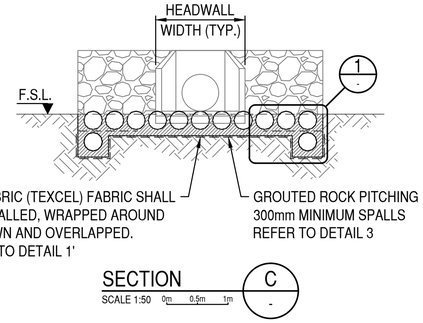
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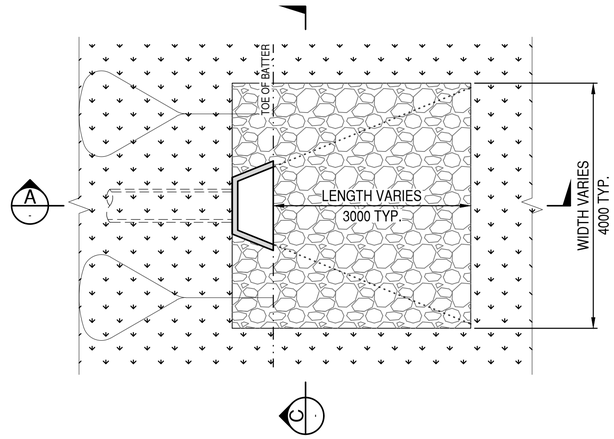
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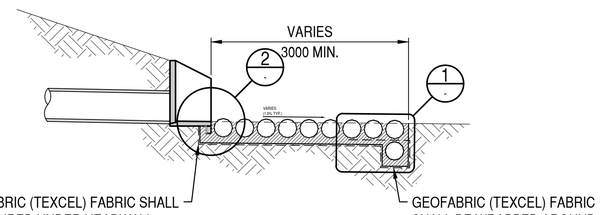
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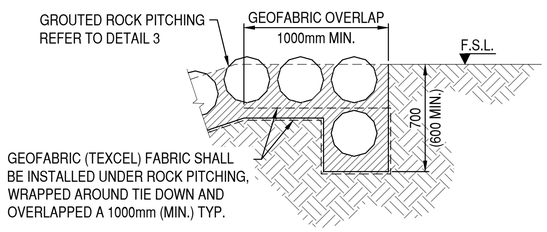
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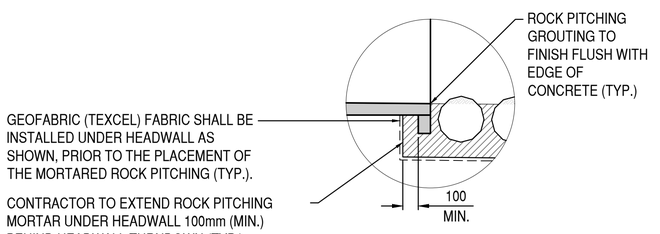
HEADWALL DISCHARGING BASE OF EMBANKMENT



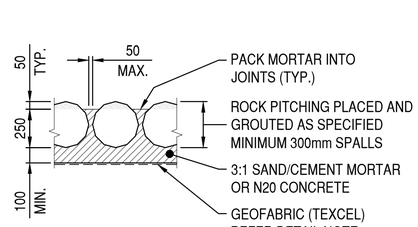
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DETAIL 1
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DETAIL 2
SCALE 1:20 0m 200mm 400mm



DETAIL 3
SCALE 1:20 0m 200mm 400mm

TYPICAL HEADWALL ROCK PITCHING DETAILS

REV	DATE	DESCRIPTION	BY	CHKR
1	23/4/2021	ISSUED FOR CONSTRUCTION	RMH	PJP
A	31/01/2021	INITIAL ISSUE	RMH	PJP

pritchard francis lite
civil engineering consultants

DRAWING STATUS: FOR CONSTRUCTION

DATE: JANUARY 2021 | GRID: LOCAL | DATUM: AHD

DESIGNED: RMH | DRAWN: RMH | CHECKED: PJP | APPROVED: .... / ...

SCALE U.N.O.: AS SHOWN @ A1

TITLE: TYPICAL DETAILS - SHEET 3 OF 5

ORG No.: 21001-PFLT-C7-TD-04

REVISION: 1

Client: Cuttone Property Group

Report	Version	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
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Submission to authorities	Rev 0	REp	REp	Electronic	1 July 2021

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Appendix E

Environmental Assessment Report

(COTERRA)

COTERRA
ENVIRONMENT



Environmental Assessment Report

293 Morley Road, Lower Chittering

Rev 2 November 2021

CALIBRE | COMMITMENT | COLLABORATION

This report was prepared by: Coterra Pty Ltd trading as COTERRA ENVIRONMENT
ABN: ABN: 92 143 411 456
Our Ref: CUTLCI01
Author(s): C. Rea
Reviewer: K. Watts
Report Version: Rev 2
Date: November 2021

This report was prepared for:

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Executive Summary

Sicicalab Pty Ltd is proposing to develop 293 Morley Road, Lower Chittering (the site) for Rural Residential purposes. The site is located in the Shire of Chittering, and extends over an area of 54.03 hectares (ha).

The project is proposing to develop the site into 18 lots, ranging in size from approximately 2 ha to 6.75 ha. Historical aerial photography (Landgate, 2021a) indicates the site may have historically had orchard, vineyard and quarry areas, as well as paddocks used for stock grazing.

Key environmental features of the site include:

- The site is typically undulating, with topography ranging from approximately 200 m Australian Height Datum (mAHD) in the northwest portion of the site, to approximately 258 mAHD in the southeast of the site. Land generally slopes towards existing drainage lines that run south to north through the site.
- Geological maps for the site indicate that underlying geology comprises laterite overlying quartz mica-schist (weathered to silty clay), with areas of sandy silt along drainage channels.
- The site is mapped as having an 'Extremely Low Probability/Very Low Confidence' of containing Acid Sulfate Soils.
- Based on the site geology there is potential for perched groundwater or interflow (lateral flow of water across an impermeable layer) to be present in wet period after rains.
- Several mapped watercourses are located throughout the site, flowing in a northerly direction towards Marbling Brook.
- No mapped geomorphic wetlands are located within or in proximity to the site.
- Key vegetation and flora values are summarised as follows:
  - Vegetation onsite comprised woodland, dampland, drainage line, parkland cleared and planted vegetation types.
  - The majority of the site (85.82%) was found to be in 'Degraded' or poorer condition, on the basis of the highly modified and cleared nature of the site.
  - No species of Threatened or Priority Flora were found onsite during the vegetation survey.
  - No Threatened or Priority Ecological Communities were found to be present within the site.
  - No Regional Ecological Linkages traverse the site. A local ecological linkage is indicatively located in a north-south alignment throughout the site.
- The entire site is mapped as a Bushfire Prone Area. The bushfire assessment of the site found that the vegetation present within and surrounding the site ranged in hazard level from Low to Extreme.
- Key fauna and habitat values are summarised as follows:
  - The fauna assemblage is likely to be depauperate with respect to ground-dwelling species based on the degraded nature of fauna habitat (i.e. lack of understorey).
  - The Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) was the only conservation-significant fauna species that was observed on site.
  - 860 trees onsite were identified as potential black cockatoo habitat trees, with 28 of these containing hollows considered potentially suitable for black cockatoos.
  - One possible Forest Red-tailed Black Cockatoo roosting location was observed in the western portion of the site, however no actual evidence was observed. This location is within vegetation that is proposed for retention, and is not located within a building envelope.

- Quality foraging habitat within the site can be defined as the areas containing marri. This vegetation unit has a total extent of approximately 0.9ha. More expansive foraging areas are likely to occur off site, given there is approximately 22,000 ha of remnant native vegetation within 12 km of the survey area.

Design and management actions proposed for the site include the following:

- Limiting potential vegetation impacts to building envelopes, road reserves and asset protection zones areas which results in:
  - Potential impacts to 2.24 ha (9%) of vegetation within building envelopes and road reserves
  - Potential impact to 4.65 ha (19%) of vegetation within asset protection zones, although the majority of this will likely be retained
  - Retention of a minimum of 18.03 ha (72%) of vegetation located outside of building envelopes, road reserves and asset protection zones.
- Buffer to creek lines to be provided as follows:
  - Minimum 30m buffer to be provided between building envelopes and creek lines
  - 100m buffer to be provided between onsite wastewater disposal areas and creek lines
- Avoiding, or minimising impacts to habitat trees with hollows potentially suitable for black cockatoos (28 trees) as follows:
  - Building envelopes have been sighted to minimise impacts to vegetation and habitat trees
  - Only 3 of the 28 habitat trees with hollows potentially suitable for black cockatoos intersect building envelopes, but retention of these trees will be attempted within those envelopes
  - Asset protection zones have 5 habitat trees with hollows potentially suitable for black cockatoos. These trees will be specifically identified for protection and will not be cleared
  - 20 of the habitat trees with hollows potentially suitable for black cockatoos are located in areas of the site which will not be impacted by the development.
- The design provides for all potential habitat trees (860 trees) to be located as follows:
  - 98 (11%) habitat trees within building envelopes and road reserves, which may be impacted by development of the site
  - 182 (21%) habitat trees within asset protection zones which will be maximised for retention where possible
  - 580 (67%) habitat trees in other portions of the site which will not be impacted by the development
- Bushfire management actions proposed for the site minimise environmental impacts through:
  - Removal of habitat trees with hollows potentially suitable for black cockatoos located within asset protection zones will be avoided.
  - Strategic firebreaks will be utilised to minimise vegetation clearing requirements
- Construction and development protocols to minimise environmental impacts will include:
  - Prior to the commencement of clearing the clearing and construction boundary will be surveyed to ensure it is accurately located and demarcated
  - Potential black cockatoo habitat trees with hollows in asset protection zones (182 trees) will be tagged to ensure maximum retention of these trees

- Clearing will be undertaken in the direction of retained vegetation in order to encourage any remaining fauna to move in this direction
- Any vehicles on site will be restricted to the clearing and construction area footprint to minimise impact to vegetation beyond this boundary
- Vehicle movements will be restricted to speeds of 30 km/hour
- As part of the Sales Contract for the site, the requirement for the installation of fauna permeable fencing will be detailed, which includes provision of a 30 cm gap between ground level and the first rail/wire, to allow for fauna movement.

Based on the above, it is concluded that development of the site as proposed will not result in unacceptable environmental impacts.

1 Introduction

Sicicalab Pty Ltd is proposing to develop 293 Morley Road, Lower Chittering (the site) for Rural Residential purposes. The site is located in the Shire of Chittering, approximately 60 kilometres (km) from Perth (Figure 1). The site covers an area of 54.03 hectares (ha) and is currently used for agricultural purposes (Figure 2).

The project is proposing to develop the site into 18 lots, ranging in size from approximately 2 ha to 6.75 ha (Figure 3).

Historical aerial photography (Landgate, 2021a) indicates the site may have historically had orchard, vineyard and quarry areas.

1.1 Planning and Approvals

1.1.1 Current Planning Status

To progress development at the site, the project will require an amendment to the Shite of Chittering Local Planning Scheme (LPS) No 6 (DPLH, 2019a), preparation of a Local Structure Plan and ultimately subdivision approval.

The site is currently zoned as 'Agricultural Resource' under the Shire of Chittering LPS No. 6 (DPLH, 2019a). The site is identified as 'Rural Residential' for future rural living purposes in the Shire of Chittering Local Planning Strategy (DPLH, 2019b).

The Lower Chittering Planning Precinct is identified as suitable for rural residential subdivision with consideration of biodiversity preservation needs (Shire of Chittering, 2010).

1.1.2 Approval Requirements

An Environmental Assessment Report (EAR) is required to support the scheme amendment documentation which will be reviewed by the Environmental Protection Authority (EPA), Shire of Chittering (SoC), Department of Biodiversity, Conservation and Attractions (DBCA) and the Department of Water and Environmental Regulation (DWER).

1.2 Purpose of this Report

This report is being prepared to support the rezoning of the site. This report describes environmental values of the site, identifies potential environmental impacts, and outlines the design, appropriate management measures and mitigation actions to address these potentials environmental impacts at the site.

This report should be read in conjunction with the Local Water Management Strategy (Urbaqua, 2021) and the Bushfire Management Plan (Strategen-JBS&G, 2021) being prepared for the site.

2 Key Policies and Guidance Documents

The following policies and guidance documents are relevant to development and approvals in this location. A brief description of the policies and guidance documents are provided below, with further reference in the following sections of this report, where relevant.

2.1 Environmental Protection Act 1986

The *Environmental Protection Act 1986* (EP Act) is the pre-eminent environmental legislation in Western Australia. Development projects are regulated under Part IV of the Act.

Assessment opportunities under the Act occur at the rezoning stage (region scheme and/or town planning scheme) under Section 48A of the Act and the subdivision/ development stage under Section 38 of the Act.

The rezoning of 293 Morley Road, Lower Chittering will be reviewed under Section 48A of the Act.

2.2 Town Planning

2.2.1 Shire of Chittering Local Planning Scheme No. 6

The Shire of Chittering Local Planning Scheme No. 6 (LPS 6) details provisions for development within the Shire. LPS 6 details objectives for 'rural residential' zones as follows:

- To designate areas where rural residential developments can be accommodated without detriment to the environment or the rural character of the area
- To meet the demand for a rural lifestyle on small lots, generally in excess of 1 ha
- To maintain and enhance the rural character and amenity of the locality.

Rural Residential subdivisions within the Shire of Chittering will require a Local Development Plan which indicates environmental conditions pertaining to each specific subdivision. Generally, the following requirements must be adhered to within Rural Residential zoned land:

- Only one dwelling will be permitted on any lot, within the designated building envelope, as per the Local Development Plan
- Maximum clearing area on each site is 2,000m²
- All buildings intended for residential use must include provision for the storage of water in tanks of not less than 120,000 litres capacity unless satisfactory arrangements have been made for connection to a reticulated water supply provided by a licensed water provider
- Maintenance of land, watercourses and natural drainage lines is the responsibility of property owners
- The construction of dams and/or the extraction of surface water are not permitted without approval
- Development(s) to be undertaken in a manner which minimises the impact on the natural environment
- Strategic Fire Breaks as shown on the Structure Plan shall be constructed by the developer and maintained to the satisfaction of the local government and the Fire and Emergency Services Authority by the landholder.
- Appropriate Effluent Disposal Systems will need to be installed subject to approval from Shire of Chittering and the Department of Health
- Stocking of Rural Residential properties requires Planning Approval in accordance with Council Policy

- All buildings intended for residential use must include a water re-use/recycling system/s (such as grey water) that is to be installed to the satisfaction of the Shire of Chittering and the appropriate State government environmental agencies
- All buildings intended for residential use are to be located and designed to maximise energy efficiency, including solar orientation
- All buildings intended for residential use must include a solar power system that is to be installed to Shire of Chittering standards.

2.2.2 Shire of Chittering Local Planning Policies

2.2.2.1 Water Supply and Drainage

Local Planning Policy No. 6 (Shire of Chittering, 2009) details objectives in respect of water supply and drainage on private property within the Shire of Chittering. LPP 6 provides guidance on development conditions of any water supply or drainage works on private property in respect of:

- Dams
- Drains and levees
- Watercourse crossings
- Bores and wells
- Windmills
- Water tanks
- Reticulated water supply.

2.2.2.2 Setbacks

Local Planning Policy No. 18 – Setbacks (Shire of Chittering, 2006) details setback requirements for Local Development Plans, where building envelopes are *not* proposed. Given that building envelopes are proposed for this site, parts of LPP 18 are *not* relevant to this development. However, minimum setbacks do apply to bores and wells proposed to be developed as follows:

- Effluent disposal system – 30 m
- Existing property boundary – 3 m
- Existing bore on adjoining property – 10 m
- Proposed road widening – 3 m.

Applications to construct bores or wells must be approved by the Shire of Chittering.

2.3 Land Use Planning

2.3.1 EPA Guidance Statement No. 33 – Environmental Guidance for Planning and Development

This guidance statement provides an overview of environmental protection processes and information, to assist land use planning and development in Western Australia. It provides specific information on (EPA, 2008):

- Environmental protection processes in Western Australia including referral and environmental impact assessment procedures that apply to land use planning and development under the *Environmental Protection Act 1986*

- EPA's advice on protecting a range of biophysical factors, to assist land use planning
- EPA's advice on managing potential pollutants, waste and water (pollution management factors), to assist land use planning
- EPA's advice on protecting aspects of the biophysical environment of cultural and social significance to the community (social surroundings factors), and the EPA's position on risk.

2.3.2 State Planning Policy 2.5 – Rural Planning

State Planning Policy 2.5 – Rural Planning (SPP 2.5) (WAPC, 2016a) has been prepared to both protect and facilitate development of rural land for rural purposes, including primary production, basic raw materials, regional facilities and protection of biodiversity and landscape (WAPC, 2016a).

SPP 2.5 aims to support rural-zoned development under the State and local government planning frameworks for scheme amendments, structure plans and subdivision/development proposals on rural-zoned land (WAPC, 2016a).

The objectives of SPP 2.5, relevant to this site, are to:

- support existing, expanded and future primary production through the protection of rural land, particularly priority agricultural land and land required for animal premises and/or the production of food
- provide investment security for existing, expanded and future primary production and promote economic growth and regional development on rural land for rural land uses
- provide a planning framework that comprehensively considers rural land and land uses, and facilitates consistent and timely decision-making
- avoid and minimise land use conflicts
- promote sustainable settlement in, and adjacent to, existing urban areas
- protect and sustainably manage environmental, landscape and water resource assets.

State Planning Policy 2.5 – Rural Planning Guidelines (SPP 2.5 Guidelines) (WAPC, 2016b) and Development Control Planning Policy 3.4 (DC 3.4) – Subdivision of Rural Land (WAPC, 2016c) have been prepared to guide the implementation of State Planning Policy 2.5 – Rural Planning.

SPP 2.5 Guidelines detail planning requirements for rural-zoned land, and what to consider in respect of potential land use, and development controls associated with mixed land uses allowed within rural-zoned land, such that differing uses can be accommodated in accordance with region and local scheme requirements.

DC 3.4 details appropriate standards for rural subdivisions being planned for other purposes (i.e. not rural living purposes), including, but not limited to, the use of land for processing works and buffers, public utilities and rehabilitation of degraded land.

2.3.3 Shire of Chittering Local Biodiversity Strategy

The Shire of Chittering Local Biodiversity Strategy provides ecological criteria for prioritising local biodiversity assets, with results being available to inform land use planning decisions.

The strategy identifies Indicative High Conservation Value Areas (IHVCA) as well as Regional Ecological Linkages and Local Ecological Linkages within the shire. Retention, protection and management objectives are also discussed within the document.

With respect to biodiversity protection, the Shire of Chittering provides the following guidance/provisions for development that are relevant to the site (Table 1).

Table 1: Zone provisions and biodiversity conservation goals

Zoning		Guidance/provisions
Rural Residential (without approved subdivision plans)	1.6	Encourage cluster style developments that protect significant native vegetation in viable patches, building envelopes utilize any cleared land or degraded sections. Access tracks are to be kept to minimum, fencing placed to protect the remaining vegetation. No other clearing of native vegetation should take place within areas of native vegetation, except for unavoidable clearing for bushfire safety purposes.
	1.7	Ensure any vegetation protection areas are clearly marked on Structure Plans and property plans, to ensure this information is being communicated to subsequent land owners.
Potential Rural Residential (identified in the Local Planning Strategy but not rezoned in the TPS	1.8	Review areas where these zoning categories overlap with IHCVAs, seeking opportunities to accommodate needs for Rural Residential development in areas where impact on native vegetation will be minimal, focusing on cleared or parkland cleared land.
Agricultural Resource	1.16	Amend Scheme provisions to ensure: All future development is to be limited within already cleared areas. Approval for a single dwelling requiring clearing of vegetation within a Local Natural Area is only to be granted where an alternative location is not viable, practical or environmentally acceptable. No additional clearing is to be permitted except for unavoidable clearing necessary for fencing, access or bushfire protection.
	1.17	Within IHCVAs consider requiring conservation covenants where development over and above a single dwelling is being proposed and will impact on the vegetation.
	1.18	Where considering zoning new land for rural residential subdivision, avoid IHCVAs and require subdivision that maximises retention of native vegetation. Cluster forms of subdivision are encouraged. Seek advice from the DEC to identify opportunities for protecting regionally significant vegetation.
	1.19	Support landowners in managing the remaining vegetation for conservation.

Source: Shire of Chittering, 2010

2.3.4 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's key piece of environmental legislation which commenced 16 July 2000. The EPBC Act focuses Australian Government interests on the protection of matters of national environmental significance, with the states and territories having responsibility for matters of state and local significance.

Key Matters of National Environmental Significance (MNES) which may be relevant to development within this area, depending on the specific site features and facility design include:

- Threatened black cockatoo species (i.e. Carnaby's Cockatoo, Baudin's Cockatoo and Forest Red-tailed Black Cockatoo)
- Banksia Woodlands of the Swan Coastal Plain ecological community.

Is it noted that the above list is not exhaustive, and other MNES may be relevant to development of the site. An initial assessment of other MNES has been undertaken using the Protected Matters Search Tool on the EPBC Act website (Appendix 1).

Referrals of projects under this act is proponent driven, as there are no third-party referral mechanisms under this legislation.

2.4 Water Management

2.4.1 State Planning Policy 2.9 Water Resources

State Planning Policy 2.9 (SPP 2.9) contains over-arching water management guidance on planning, protection and management of surface and groundwater catchments, including consideration of availability of water and waterways management, wetlands, waterways and estuaries and their buffers, and implementation of total water cycle management principles in the land use planning system (WAPC, 2006).

The purpose of SPP 2.9 is to integrate planning of water resources in respect of land development between state government agencies (i.e. WAPC, Department of Planning, Lands and Heritage, local government) and also private landowners and developers.

The objectives of SPP 2.9 are to:

- protect, conserve and enhance water resources that are identified as having significant economic, social, cultural and/or environmental values
- assist in ensuring the availability of suitable water resources to maintain essential requirements for human and all other biological life with attention to maintaining or improving the quality and quantity of water resources
- promote and assist in the management and sustainable use of water resources (WAPC, 2006).

2.4.2 Better Urban Water Management

Better Urban Water Management (BUWM) (WAPC, 2008) provides guidance on the implementation of SPP 2.9.

BUWM is designed to facilitate management of urban water resources at relevant stages of the planning system, through the development of various documents, as follows:

- regional management strategies – to assist in regional and sub-regional planning
- district water management strategies – to assist in district planning
- local water management strategies – to assist in local land use planning scheme amendments and local structure planning
- urban water management plans – to assist in subdivision application, development and construction phase planning.

The BUWM framework provides a process for achieving better urban water management through the application of integrated water cycle management, water sensitive urban design and water sensitive urban development (WAPC, 2008).

2.4.3 Interim: Local Water Management Strategies

This guidance document provides guidance on water management strategies that are required for consideration at the local planning stage of the land planning process (DoW, 2008).

A Local Water Management Strategy (LWMS) is required to support rezoning to residential, rural-residential, commercial or industrial developments at the local scheme amendment phase (DoW, 2008).

The LWMS should address the following:

- principles, objectives and design criteria for total water-cycle management
- the proposed development
- existing site characteristics, site constraints and opportunities including the capacity of the land to sustain the proposed land uses based on onsite investigations as appropriate

- conceptual urban water management system
- landscape concept for public open spaces including the purpose and design of any constructed waterbody
- issues to be addressed at subdivision stage
- monitoring and maintenance
- proposed implementation of strategy (WAPC, 2008).

3 Existing Environment

3.1 Climate

The closest weather station to the site is located at Pearce Royal Australian Air Force (RAAF) Base (Pearce), approximately 12 km south of the site. Mean maximum temperatures at Pearce range from 17.9^{o}C in July to 33.5^{o}C in January (BoM, 2021). Mean rainfall at Pearce is highest during winter months (132.8 millimetres (mL) in July), and lowest in summer months (10.3 mL in January), averaging 652.1 mL annually (BoM, 2021).

3.2 Topography, Geology and Soils

3.2.1 Topography

The site is typically undulating, with topography ranging from approximately 200 m Australian Height Datum (mAHD) in the northwest portion of the site, to approximately 258 mAHD in the southeast of the site (Figure 4, Landgate, 2021b). Land generally slopes towards existing drainage lines that run south to north through the site (Section 3.4).

3.2.2 Geology and Soils

Geological maps for the site indicate that underlying geology comprises laterite overlying quartz mica-schist (weathered to silty clay), with areas of sandy silt along drainage channels (CMW Geosciences, 2021).

Soils at the site have been mapped at a regional scale as follows:

- Gabbla 4x Phase – very gentle to gentle (<10%) mid and upper slopes. Shallow sandy and gravelly loams underlain by country rock but with some pockets of deeper sands and clay.
- Gabbla 2 x Phase – gentle to moderate hill slopes (<10%) with some breakaways. Generally not gravelly or steep. Deep yellow and red duplex soils with some uniform fine soils. All soils may be somewhat gravelly and are moderately prone to salinity.
- Gabbla 1x Phase – very gently to moderately sloping valleys (<10-15%). Alluvial and colluvial soils. Yellow, but with some red, duplex soils that are often finely layered and highly prone to salinity.
- Mogumber 4 Subsystem – gently to moderately inclined slopes <10% with shallow gravelly sands and few areas of lateritic outcrop. Low woodland with some *E. calophylla* and *E. marginata* also with *E. todtiana, Dryandra* spp. and A*cacia* spp. (Bessell-Browne, 2004).

CMW (2021) identified the following underlying soil profile at the site:

- topsoil: gravelly silt – dark brown; gravel, fine to medium grained, subrounded to rounded; with roots
- cemented clayey gravel (duricrust) – fine to coarse grained, subrounded to rounded, yellow brown; trace sand, fine grained; trace cobbles
- clayey gravel/sandy gravel (residual) – subrounded to rounded, fine to medium grained clay, medium plasticity, orange brown
- clay (residual soil) – low to medium plasticity, orange-brown, weakly cemented; overlying
- extremely weathered schist – well cemented clay, pale red brown.

Clays and duricrust were found at shallow layers (<1.5 m) across most of the site. A band of sandy gravel runs north to south between the delta (drainage line) and the western side of the central hill (Urbaqua, 2021).

3.3 Acid Sulfate Soils

The site is mapped by the Australian Soil Resource Information System (CSIRO, 2011) as having an 'Extremely Low Probability/Very Low Confidence' of containing Acid Sulfate Soils (ASS).

The site is located outside of the Department of Water and Environmental Regulation (DWER) ASS risk mapping area.

3.4 Hydrogeology and Hydrology

The site is located within the Brockman River catchment (Landgate, 2021b). The Brockman River catchment is underlain by the Darling Plateau in the east, and the Dandaragan Plateau in the west (Ellen Brockman Integrated Catchment Group, 2018). The Darling Fault separates these two regions (Ellen Brockman Integrated Catchment Group, 2018).

3.4.1 Groundwater

Limited regional or site-specific groundwater information is available.

Based on the finding of the geotechnical investigation (CMW, 2021), which identified the presence of a variable and clayey soil profile, and of duricrust in locations (both low permeability), Urbaqua (2021) identified the potential for the following in wet periods after rains (winter):

- perched groundwater - water infiltrating through the top, more permeable, layers of soil and then perching on top of an impermeable layer such as clay or duricrust
- interflow - after infiltration in the topsoil layers, lateral flow of water in the unsaturated zone across an impermeable layer)

3.4.2 Surface Water

Several mapped watercourses are located throughout the site, flowing in a northerly direction towards Marbling Brook (Figure 5). Marbling Brook, which is a tributary of the Brockman River, is located approximately 2.7 km east of the site. The Brockman River is a proclaimed surface water area under the *Rights in Water and Irrigation Act 1914*. Marbling Brook is a perennial tributary contributing fresh water to the lower Brockman River, which is mostly brackish and turns saline in summer (Urbaqua, 2021).

3.4.3 Wetlands

No mapped geomorphic wetland areas are located on the site, or in the vicinity of the site (Landgate, 2021b).

3.5 Vegetation and Flora

3.5.1 Vegetation Associations and Complexes

Regional mapping produced by Beard (1986) indicates the site historically contained vegetation from the East Darling System, described as forest of "mainly Jarrah and Marri – *Eucalyptus marginata, Corymbia calophylla*" (DPIRD, 2018).

Areas of native vegetation present on site represent the Coolakin Complex in low rainfall (Ck), Yalanbee Complex in low rainfall (Y6) and Mogumber Complex – South vegetation complexes, as described by Heddle et al (1980) (Table 2), although much of the vegetation shows signs of disturbance including lack of understorey and historical clearing.

Table 2: Regional vegetation complexes

Vegetation Complex	Description
Coolakin Complex in low rainfall (Ck)	Woodland of *Eucalyptus wandoo* with mixtures of *Eucalyptus patens, Eucalyptus marginata subsp. thalassica* and *Corymbia calophylla* on the valley slopes in arid and perarid zones.
Yalanbee Complex in low rainfall (Y6)	Woodlands of *Eucalyptus wandoo-Eucalyptus accedens*, less consistently open forest of *Eucalyptus marginata subsp. thalassica–Corymbia calophylla* on lateritic uplands and breakaway landscapes in arid and perarid zones.
Mogumber Complex – South	Open woodland of *Eucalyptus calophylla*, with some admixture of *Eucalyptus marginata* (Jarrah) and a second storey of *Eucalyptus todtiana* (Pricklybark) - *Banksia attenuata* - *Banksia menziesii* (Firewood Banksia) - *Banksia ilicifolia* (Holly-leaved Banksia).

Source: Focused Vision Consulting, 2021

The three vegetation complexes found onsite have greater than 30% of their pre-European extent remaining in the region as shown on Table 3. The Shire of Chittering Local Biodiversity Strategy noted that the Coolakin vegetation complex is locally significant (SoC, 2010).

Table 3: Vegetation complex statistics

Vegetation Complex	Pre-European Extent in the region	Current Extent within the Region	Pre-European Extent in the Shire
Coolakin Complex in low rainfall (Ck)	158,380 ha	56,646 ha (36% of pre-European extent)	11,414 ha
Yalanbee Complex in low rainfall (Y6)	188,556 ha	82,905 ha (44% of pre-European extent)	27,581 ha
Mogumber Complex – South	13,720 ha	5,447 ha (40% of pre-European extent)	9,518 ha

Source: Shire of Chittering, 2010

3.5.2 Vegetation Type and Condition

Focused Vision Consulting (2021) undertook a reconnaissance flora and vegetation assessment in March 2021 (Appendix 2) to determine the type and condition of vegetation at the site.

3.5.2.1 Vegetation Type

Twelve vegetation units were identified at the site (Table 4, Figure 6). As can be seen from this table, excluding the cleared and planted areas there is 24.92 ha of vegetation onsite (i.e. 46% of the total site area).

Table 4: Recorded vegetation units

Broad Vegetation Type	Unit Code	Vegetation Unit and Description	Area (ha)	Proportion of Site (%)
Woodland	EmCc	*Eucalyptus marginata* and *Corymbia calophylla* Low Forest over *Xanthorrhoea preissii* Tall Isolated Shrubs.	5.27	9.76
	EmXA	*Eucalyptus marginata* and *Corymbia calophylla* Low Forest over *Xanthorrhoea ?acanthostachya* Sparse Shrubland over *Hakea lissocarpha* Low Sparse Shrubland.	0.42	0.78

Broad Vegetation Type	Unit Code	Vegetation Unit and Description	Area (ha)	Proportion of Site (%)
	EmEw	*Eucalyptus marginata* and *Eucalyptus wandoo* subsp. *wandoo* with occasional *Corymbia calophylla* Low Open Forest over *Hibbertia ?huegellii* and *Hibbertia lasiopus* Low Isolated Shrubs over **Ehrharta calycina* and **Poa annua* Low Sparse Grassland.	10.33	19.12
	EsppXa	*Eucalyptus wandoo* and *Eucalyptus marginata* over *Xanthorrhoea ?acanthostachya* over *Daviesia decurrens, Hakea lissocarpha* and *Hibbertia hypericoides* Low Open Shrubland.	3.51	6.50
	EwBa	*Eucalyptus marginata* and *Eucalyptus wandoo* subsp. *wandoo* Low Woodland over *Xanthorrhoea ?acanthostachya* Open Shrubland over *Banksia armata* subsp. *armata* Low Open Shrubland.	2.50	4.61
	EwEa	*Eucalyptus wandoo* subsp. *wandoo* and *Eucalyptus accedens* Low Open Woodland over *Xanthorrhoea ?acanthostachya* Sparse Shrubland.	0.71	1.31
Dampland	JpCp	*Juncus pallidus* and *Cyperus polystachyos* Tall Sedgeland / Sedgeland over *Gnaphalium indutum* Low Isolated Forbs with occasional patches of *Typha orientalis*.	1.06	1.97
Drainage-line	JpCsp	*Juncus pallidus* and *Cyperaceae* sp. Open Sedgeland over Low Isolated Forbs and Tussock Grasses.	0.12	0.22
Parkland Cleared	EaP	Isolated *Eucalyptus accedens* over **Poa annua, *Avena fatua* and other weeds and introduced grasses.	0.13	0.24
	CcP	Isolated *Corymbia calophylla* over **Poa annua, *Avena fatua* and other weeds and introduced grasses.	0.77	1.43
	EmP	Isolated *Eucalyptus marginata* over **Poa annua, *Avena fatua* and weeds and introduced grasses.	0.10	0.18
Planted	PL	Agricultural areas including an old citrus orchard and scattered plantings of *Schinus molle, Brachychiton acerifolius, Delonix regia* and *Eriobrotya japonica*.	2.27	4.20
Cleared	CC	Completely cleared areas supporting few, if any native species and numerous introduced grasses and forbs.	26.85	49.68
		TOTAL	**54.04**	**100**

3.5.2.2 Vegetation Condition

Vegetation at the site ranged in condition from 'Completely Degraded' to 'Good' according to the Keighery scale for measuring vegetation condition (Keighery, 1994). The majority of the site (85.82%) was found to be in 'Degraded' or poorer condition, on the basis of the highly modified and cleared nature of the site (FVC, 2021; Figure 7).

Table 5: Vegetation condition

Vegetation Condition	Area(ha)	Proportion of Site (%)
Good	0.47	0.86
Degraded-Good	7.20	13.33
Degraded	12.90	23.88
Completely Degraded-Degraded	4.35	8.04
Completely Degraded	29.12	53.89
TOTAL	**54.04**	**100**

3.5.3 Flora

90 flora species were identified at the site, from 67 genera and 31 families (FVC, 2021). The dominant species present, including families of Fabaceae, Poaceae and Cyperaceae, are considered typical of the region (FVC, 2021). None of the recorded flora species represent an extension beyond their current documented range (FVC, 2021).

3.5.3.1 Threatened and Priority Flora

Database searched identified 36 threatened and priority species with the potential to occur, or previously recorded within 10 km of the site (FVC, 2021). Given the timing of the vegetation and flora survey (March 2021), threatened and priority flora were only identified from a desktop assessment, and evaluated as to their potential likelihood of occurrence within the site.

Of the 36 identified threatened and priority species, six conservation significant species were considered 'likely' to occur, and five conservation significant species 'may occur' at the site (Table 6). No species of threatened or priority flora were recorded on site (FVC, 2021).

Table 6: Conservation significant flora species 'likely' to occur or 'may' occur at the site

Species	Conservation Status [1]EPBC Act [2]BC Act/DBCA	Description	Habitat Preference	Likelihood of Occurrence
Hypocalymma sylvestre	Endangered[1,2]	Spreading shrub, 0.6 m high. Flowers yellow, August.	Yellow-brown sandy loam. Woodland on lateritic hilltop. Quartz ridge. Slopes. Powderbark wandoo woodland.	Likely - suitable habitat may occur. Closest record approximately 880m north east of study area
Acacia anomala	Vulnerable [1,2]	Slender, rush-like shrub, 0.2-0.5 m high. Flowers yellow, August to September	Low open woodland of Jarrah, Wandoo and Marri over heath. Lateritic soils. Slopes. Brown sandy loam.	Likely - One cluster of distributions near Chittering. Suitable habitat likely to occur
Hibbertia glomerata subsp. ginginensis	Priority (P)2[2]	Erect shrub, to 0.5 m high. Flowers yellow, July to September.	Sand, brown clay, laterite. Near roadsides.	Likely - suitable habitat may occur. Closest record approximately 700m

Species	Conservation Status [1]EPBC Act [2]BC Act/DBCA	Description	Habitat Preference	Likelihood of Occurrence
				north east of study area
Verticordia serrata var. *linearis*	P3[2]			Likely – suitable habitat likely to occur
Oxymyrrhine coronata	P4[2]	Erect open shrub 40 cm high, flowers pink and white.	Hillslope, laterite	Likely - suitable habitat likely to occur. Numerous records within 4km
Synaphea grandis	P4[2]	Tufted shrub, ca 0.3 m high. Flowers yellow, October to November.	Laterite. Wandoo woodland	Likely - suitable habitat likely to occur
Drosera sewelliae	P2[2]	Fibrous-rooted, rosetted perennial, herb, to 0.06 m high, to 0.025 m wide. Flowers orange, October	Grows in laterite mixed with silica sand soils over sheet laterite rock.	May occur - suitable habitat may occur
Gastrolobium nudum	P2[2]	Spreading, twiggy shrub, to 0.8 m high. Flowers Orange & red, February	Red-brown clay, brown loam, gravel, laterite, granite. Flats, slopes, hilltops, ridges, valleys, breakaways.	May occur - suitable habitat may occur
Grevillea candolleana	P2[2]	Spreading shrub, 0.2-0.8 m high. Flowers white-cream, August to September.	Amongst tall (sclerophyll) shrubland; in rocky or stony soil, or loam.	May occur - suitable habitat may occur
Acacia drummondii subsp. affinis	P3[2]	Erect shrub, 0.3-1 m high. Flowers yellow, July to August	Lateritic gravelly soils.	May occur - suitable habitat may occur
Adenanthos cygnorum subsp. chamaephyton	P3[2]	Prostrate, mat-forming, non-lignotuberous shrub, to 0.3 m high. Flowers white- cream - pink - green, July or September to December or January.	Grey sand, lateritic gravel.	May occur - suitable habitat may occur

Source: Focused Vision Consulting, 2021

3.5.4 Threatened and Priority Ecological Communities

Of the Threatened Ecological Communities (TEC) and Priority Ecological Communities (PEC) identified in database searches, one buffered occurrence of the Commonwealth-listed (Endangered) Banksia Woodlands of the Swan Coastal Plain Ecological Community (Banksia Woodlands TEC) intersects the site (FVC, 2021).

The Banksia Woodlands TEC is described as 'a woodland associated with some soils of the Swan Coastal Plain with a prominent tree layer of Banksia with scattered Eucalypts and other tree species among or emerging

above the canopy. The understorey is comprised of a species rich mix of sclerophyllous shrubs, graminoids and forbs' (Threatened Species Scientific Committee, 2016).

Focused Vision Consulting (2021) determined that the Banksia Woodlands TEC does not occur on the site because:

- no Banksia species aligning with the Banksia TEC's characteristics were recorded during the field survey
- no Banksia woodland units were defined or mapped within the site.

3.5.5 Conservation Areas and Ecological Linkages

No Regional Ecological Linkages traverse the site (Shire of Chittering, 2010). A local ecological linkage is indicatively located in a north-south alignment throughout the site (Shire of Chittering, 2010).

3.5.6 Bushfire Mapping

The entire site is mapped as a Bushfire Prone Area. The bushfire assessment of the site (Strategen JBS&G, 2021) found that the vegetation present within and surrounding the site ranged in hazard level from Low to Extreme.

3.6 Fauna and Habitat

In May 2021, Greg Harewood conducted a fauna and habitat assessment including:

- Level 1 (basic) fauna assessment in accordance with EPA (2020)
- Targeted searches for black cockatoo habitat/site use (habitat trees, existing and potential hollows, foraging and roosting habitat).

Key findings are summarised below.

3.6.1 Fauna Habitat

Eight fauna habitats were identified at the site, including:

- Marri and Jarrah dominated open woodland over grasstree open shrubland
- Wandoo dominated open woodland over grasstree open shrubland bordering seasonal creekline
- Wandoo dominated parkland cleared/open woodland over grassland
- Cleared pasture/grassland
- Planted non-endemic and exotic plant species surrounding abandoned farmhouse
- Seasonal creekline with bordering woodland of Wandoo over grasstree open shrubland
- Highly degraded seasonal creekline bordered by pasture/grassland and scattered trees
- Dam built along seasonal creekline.

The fauna habitats range in condition from highly degraded (pasture) to good/very good (Harewood, 2021). The fauna assemblage is likely to be depauperate with respect to ground-dwelling species based on the degraded nature of fauna habitat (i.e. lack of understorey) (Harewood, 2021).

3.6.1.1 Black Cockatoo Breeding Habitat

Harewood (2021) conducted a Black Cockatoo habitat tree assessment across the site, to identify trees potentially suitable for black cockatoo use as nesting habitat. Trees assessed included:

- Wandoo – *Eucalyptus wandoo*

- Marri – *Corymbia calophylla*
- Jarrah – *Eucalyptus marginata*
- Dead Unidentified – *Eucalyptus* spp
- Non-endemic Eucalypts (planted) – *Eucalyptus* spp.

Criteria used to assess potential habitat were > 30 cm for Wandoo, and> 50 cm for Marri and Jarrah. 860 habitat trees were identified on the site (Table 7; Figure 8 and Figure 9). Of these trees, 28 trees may contain suitable hollows, however no evidence of actual use was observed.

Table 7: Habitat trees

Total Number of Habitat Trees	# Tree with No Hollows Observed	# Trees with Possible Hollows considered Unsuitable for Black Cockatoos	# Trees with Possible Hollows considered Potentially suitable for Black Cockatoos	Tree Species				
				Wandoo	Marri	Jarrah	Dead Unidentified	Non-endemic Eucalyptus
860	737	95	28	590	139	104	26	1

Source: Harewood, 2021

3.6.1.2 Foraging Habitat Assessment

An assessment of black cockatoo foraging habitat was undertaken with respect to plant species (Wandoo, Marri, Jarrah and Grasstree (*Xanthorrhoea preissii*)), that are known to be or potentially used as a direct food source by black cockatoos (Harewood, 2021).

Quality foraging habitat within the site can be defined as the areas containing marri. This vegetation unit has a total extent of approximately 0.9ha. More expansive foraging areas are likely to occur off site, given there is approximately 22,000 ha of remnant native vegetation within 12 km of the survey area (Harewood, 2021).

3.6.1.3 Night Roosting Habitat Assessment

One possible Forest Red-tailed Black Cockatoo roosting location was observed in the western portion of the site (Figure 8 and Figure 9), however no actual evidence was observed (Harewood, 2021).

3.6.2 Threatened and Priority Fauna

Database searches identified multiple species of conservation significance that may occur on the site (Appendix 3). Harewood (2021) assessed the possibility of species occurring on site based on site surveys, documented distribution, and habitat preference of species of concern, and determined that five species may possibly occur on the site, or are known to occur on site (Table 8).

Table 8: Conservation significant fauna species 'likely' to occur at the site

Species	Conservation Status	Habitat Preferences	Habitat Present	Likelihood of Occurrence	Comments/ Possible Impacts
Birds					
Falco peregrinus (Peregrine Falcon)	S7[2]	Diverse from rainforest to arid shrublands, from coastal heath	Yes	Possible	Species is uncommon but survey areas may represent

Species	Conservation Status	Habitat Preferences	Habitat Present	Likelihood of Occurrence	Comments/ Possible Impacts
		to alpine. Mainly about cliffs along coasts, rivers and ranges and about wooded watercourses and lakes.			part of larger home range used by individuals of this species. No significant impact of this species anticipated.
Calyptorhynchus latirostris (Carnaby's Cockatoo)	EN[1] S2[2]	Forests, woodlands, heathlands, farms; feeds on *Banksia, Hakea* and *Marri.*	Yes	Possible	Loss/modification of very small areas of habitat. Negligible impact.
Calyptorhynchus baudinii (Baudin's Black Cockatoo)	EN[1] S2[2]	Mainly *Eucalypt* forests where it feeds primarily on Marri seeds.	Yes	Possible	Loss/modification of very small areas of habitat. Negligible impact.
Calyptorhynchus banksii naso (Red-tailed Black Cockatoo)	VU[1] S3[2]	*Eucalypt* forests; feeds on Marri, Jarrah, Blackbutt, Karri, Sheoak and Snottygobble.	Yes	Known	Loss/modification of very small areas of habitat. Negligible impact.
Mammals					
Phascogale tapoatafa wambenger (South-western Brush-tailed Phascogale)	S6[2]	Dry sclerophyll forests and open woodlands that contain hollow-bearing trees but sparse groundcover.	Yes	Possible	Loss/modification of small areas of habitat. Negligible impact on species status anticipated.

Source: Harewood, 2021

Notes: [1]EPBC Act – EN = Endangered, VU = Vulnerable; [2]WC Act/DBCA – S2 = Endangered, S3 = Vulnerable, S6 = Conservation Dependent, S7= Other specially protected fauna.

3.6.3 Fauna Occurrence

Thirty-three fauna species were observed on site either primarily, or through secondary evidence of their presence (Harewood, 2021). The majority of observed species were common avifauna (Appendix 3).

The Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) was the only conservation-significant fauna species that was observed on site.

3.7 Potential Contamination

No listed contaminated sites are located in the vicinity of the site (Landgate, 2021b).

3.8 Cultural Heritage

3.8.1 Indigenous Heritage

A search of the Aboriginal Heritage Inquiry System identified no indigenous heritage sites over, or adjacent to the site (DPLH, 2021).

3.8.2 Non-indigenous Heritage

A search of the Australian Heritage Database (DAWE, 2021) and the State Heritage Office records (Heritage Council, 2012) indicates no known non-indigenous heritage sites are located on the site.

3.9 Surrounding Land Uses

Rosa Park Estate, a 'Rural Residential'-zoned development, is located to the south and east of the site (Figure 10). The proposed development will connect with the existing road network located in the development directly south of the site.

Land to the north and west of the site are zoned 'Agricultural Resource' and contain rural properties (Figure 10).

The town of Chittering is located approximately 25 km north of the site. The town of Bullsbrook is located approximately 19 km south west of the site.

4 Potential Impacts and Proposed Management

4.1 Biodiversity

4.1.1 Potential Impacts

The Shire of Chittering (2010) identifies several processes that threaten biodiversity within the Shire, including:

- dieback
- weeds and feral animals
- salinity
- erosion
- sedimentation of streams
- eutrophication of wetlands
- grazing
- climate change.

In respect of rural residential subdivisions, the Shire of Chittering acknowledges that it is difficult to maintain biodiversity within a fragmented landscape, where development design encourages small scale clearing (Shire of Chittering, 2010). As such, biodiversity should be maintained through:

- adequate buffers to significant flora, fauna, and ecological communities
- adequate buffers to creeklines
- retention of Black Cockatoo habitat
- patches of native vegetation that form linkages (Shire of Chittering, 2010).

4.1.2 Development Design Considerations

The proposed development design (Figure 11) addresses biodiversity maintenance through several initiatives, in accordance with Shire of Chittering Local Biodiversity Strategy (2010) (

Table 9).

The concept design provides for local ecological linkages through the following design initiatives, including:

- Limiting potential vegetation impacts to building envelopes, road reserves and asset protection zones, including retention of a minimum of 18.03 ha (72%) of vegetation present onsite
- Development within approved building envelopes only
- 30 m buffer between existing watercourses and building envelopes
- 100 m buffer between existing watercourses and wastewater disposal areas
- Avoiding, r minimising impacts to habitat trees with hollos potentially suitable for black cockatoos (28 trees).

Table 9: Development design biodiversity maintenance initiatives

Biodiversity Maintenance Criteria	Current Site Condition	Design Response
Adequate buffers to significant flora, fauna and ecological communities	No significant flora, fauna or ecological communities have been identified on site. No vegetation in 'Good' condition is proposed to be cleared as part of the development (i.e. building envelopes and asset protection zones).	Retention of a minimum of 18.03 ha (72%) of vegetation on site. Residential construction is allowed only within building envelopes.
Adequate buffers to creek lines	4 creek lines occur across the site.	A 30 m buffers have been assigned to creek lines in the respect of building envelopes. A 100 m buffer has been assigned to creek lines in the respect of installation of wastewater treatment systems.
Retention of Black Cockatoo habitat	860 potential black cockatoo habitat trees were present onsite. Of these 28 habitat trees had one of more hollows possible suitable for Black Cockatoos. The majority of these trees occur in the eucalyptus woodland vegetation types, particularly EmEw, EsppXa, EwBa and EmCc.	Building envelopes have been designed to avoid clearing native vegetation where possible, thereby maximising retention of Black Cockatoo habitat trees. Only 3 of the 28 habitat trees with hollows potentially suitable for black cockatoos are located within building envelopes and they are generally positioned in locations where retention is likely to be possible.
Patches of native vegetation that form linkages	The site is broadly mapped within a local ecological linkage.	Residential construction is allowed only within building envelopes. The development design therefore aims to maintain native vegetation linkages throughout the site.

4.2 Vegetation and Flora

No conservation -significant vegetation communities or flora have been identified on site. No vegetation in 'Good' condition is proposed to be cleared as part of the development (i.e. building envelopes and asset protection zones).

Of the 54.04 ha of vegetation on site, 2.24 ha (9%) of the vegetation present is located within building envelopes and road reserves which have the potential to be cleared (Figure 11).

As described in the Bushfire Management Plan (Strategen JBS&G, 2021) vegetation management may occur within asset protection zones which intersects a further 4.65 ha (19%) of the site's vegetation (Section 4.2.2).

Vegetation onsite which is not within building envelopes, road reserves and asset protection zones equates to 18.03 ha (72%).

4.2.1 Clearing

Limited vegetation clearing can be undertaken onsite in accordance with Native Vegetation Clearing Permit exemptions. Exemptions likely to be applicable to the site are outlined in Table 10. Unless a valid exemption

exists, or clearing is approved under the *Environmental Protection act 1986* or the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004,* no other clearing is legally permitted on site.

Table 10 Native Vegetation Clearing Permit exemptions

Clause no.	Wording of exemption	Comment/explanation
1 Clearing that is required under other laws	Clearing that is done in order to give effect to a requirement to clear under a written law.	Section 33 of the *Bush Fires Act 1954* A local government at any time may require an owner or occupier of land in it is boundaries to clear firebreaks in such a manner as the local government may determine and to maintain the firebreaks clear of inflammable matter.
9. Clearing under the Planning and Development Act 2005	Clearing in accordance with a subdivision approval given by the responsible authority under the *Planning and Development Act 2005*, including – a) Clearing for the purposes of any development that is deemed by section 157 of that Act to have been approved by the responsible authority; and b) Clearing in any building envelope described in the approved plan or diagram.	This exemption allows for clearing in accordance with a subdivision deemed approved by the responsible authority under the *Planning and Development Act 2005*. This may include clearing native vegetation for the purposes of: • Constructing roads to provide access to or within the subdivision; • Providing water services to the satisfaction of the Water Corporation • Filling or draining the land in accordance with the specifications of the approval; and • Clearing within any building envelope described in the approved plan or diagram. Most subdivision approvals do not explicitly authorise the clearing of native vegetation other than for the purposes outlined above.

4.2.2 Bushfire Management

The development design has considered the use of strategic firebreaks for the protection of multiple lots, and the use of existing tracks where possible to minimise vegetation clearing requirements.

No fencing is permitted within strategic firebreaks, identified as fire services access routes by Strategen JBS&G (2021), in accordance with the Shire of Chittering Local Planning Policy No. 18 (2006).

The Bushfire Management Plan (Strategen (JBS&G, 2021) details the key actions proposed in respect of trees > 5 M height within asset protection zones relevant to the protection of environmental values of the site include:

- Trunks at maturity should be a minimum distance of 6 m from all elevations of building
- Branches at maturity should not touch or overhang buildings
- Lower branches should be removed to a height of 2 m above the ground and/or surface vegetation
- Canopy cover should be < 15% with tree canopies at maturity well spread to at least 5 m apart as to not form a continuous canopy (Strategen JBS&G, 2021).
- Asset protection zones will be maintained ongoing.

4.3 Fauna and Habitat

The majority of fauna habitat on site will be retained as part of the development design. The following management actions are proposed to minimise potential impacts to fauna.

4.3.1 Habitat tree retention

The number of habitat trees located within development areas onsite is summarised as follows:

Table 11 Habitat Trees

Tree category	Building Envelopes and Road Reserves	Asset protection zones	Areas of retained vegetation
Habitat trees with one or more hollows possibly suitable for Black Cockatoo	3 trees	5 trees	20 trees
Habitat trees with one or more hollows, non suitable for Black Cockatoos	9 trees	17 trees	69 trees
Habitat trees with no hollows seen	86 trees	160 trees	491 trees
Total	**98 trees**	**182 trees**	**580 trees**

In total, 491 trees (57%) are located in areas to be retained with a further 160 trees (18.6%) located within asset protection zones which will also be retained wherever possible (Figure 11).

28 of these trees were found to have one or more hollows possibly suitable for black cockatoo usage. Of these, only 3 were located within building envelopes, and 5 were located within asset protection zones. In addition to the 20 trees with potentially suitable hollows which will not be impacted by the development, the 5 trees within asset protection zones will be identified as 'not to be cleared' to ensure these are not impacted by asset protection zone management actions. Future lot owners will also be made aware of the presence of the 3 additional trees within building envelopes and advised that retention is desired, where possible.

4.3.2 Vegetation Clearing

Given the proposed development aims to retain as much of the natural vegetation as possible, the extent of clearing has been minimised to reflect the character of rural residential subdivisions and retain/maintain aspects of biodiversity within the Shire of Chittering (Section 4.1).

The extent of clearing required to construct the development equates to an approximate area of 2.24 ha (4% of the overall site) (Figure 3). Works will comprise clearing for roads, individual lot access and building envelopes. Vegetation management, potentially including some clearing, may also occur within the asset protection zones around the building envelopes which equates to approximately 4.65 ha of vegetation.

Prior to the commencement of clearing the clearing and construction boundary will be surveyed to ensure it is accurately located and demarcated.

Potential black cockatoo habitat trees with hollows in asset protection zones (182 trees) will be tagged to ensure maximum retention of these trees.

Clearing will be undertaken in the direction of retained vegetation in order to encourage any remaining fauna to move in this direction.

Any vehicles on site will be restricted to the clearing and construction area footprint to minimise impact to vegetation beyond this boundary. Vehicle movements will be restricted to speeds of 30 km/hour.

4.4 Ecological Linkages

A local ecological linkage is mapped as occurring in a north-south alignment through the site (Shire of Chittering, 2010).

The aim of local ecological linkages is to link protected locally significant Local Natural Areas to each other, regionally significant Local Natural Areas and Regional Ecological Linkages (Shire of Chittering, 2010). The Strategy states that local ecological linkages should aim to form continuous vegetated links at least 100 m wide. Where possible, linkages should also avoid crossing major regional roads or transportation routes.

Given a minimum of 18.03 ha (72%) of vegetation will be retained on site, the vegetation present will remain in this local ecological linkage.

4.5 Stormwater, Surface Water and Groundwater

4.5.1 Potential Impacts

Development of the site must be managed to avoid adverse impacts to groundwater and surface water, based on site water use strategies associated with potable water supply and wastewater disposal.

4.5.2 Management Measures

The following key design and management actions are proposed for water supply, wastewater disposal, stormwater, lot drainage, road drainage, water quality treatment, groundwater and flood management. The LWMS should be referred to for further complete details (Urbaqua, 2021).

4.5.2.1 Water Supply

Water supply will be sourced via rainwater harvesting and storage in rainwater tanks on individual lots and mandatory water use efficiency and conservation measures will be installed in all dwellings (Urbaqua, 2021).

4.5.2.2 Wastewater Management

Lots will be required to treat and dispose of wastewater in accordance with the Government Sewerage Policy (Government of Western Australia, 2019). The development design satisfies assessment criteria against the Government Sewerage Policy 2019 (Government of Western Australia, 2019).

The locations of wastewater disposal unit areas have been considered in discussion between Urbaqua and the Shire of Chittering, based on the following:

- more than 100 m from watercourses
- in cleared areas to minimise clearing of existing vegetation
- set back from roads conveying surface water to watercourses.

Based on discussion with the Shire of Chittering, provision has been made for Lots 5, 6, 8, 11 and 14 in respect of designated disposal areas to address the 100 m buffer zone requirement (Urbaqua, 2021).

Most lots will require also fill in wastewater disposal unit areas to achieve required separation distances to groundwater (Urbaqua, 2021).

4.5.2.3 Stormwater Management

Urbaqua (2021) details that the development design has considered stormwater management to mimic natural processes through:

- building envelope (30 m) and wastewater disposal unit (100 m) setbacks – to retain and protect water bodies with environmental and social values
- vegetation retention – to minimise impact on increasing runoff areas

- minimised road areas – to minimise effective impervious areas
- management of small rainfall events – to allow infiltration as close to source as possible
- provision of overland flow paths – to allow for direct flow paths to watercourses
- incorporation of waterbodies into stormwater management system.

4.5.2.4 Lot Drainage Management

All roof runoff will be collected for storage in rainwater tanks for household water supply (Urbaqua, 2021).

All other on-lot rainfall runoff will behave as per pre-development flows given this landscape will remain unchanged (Urbaqua, 2021).

4.5.2.5 Road Drainage Management

The road drainage management system proposes different management systems with the aim of:

- reducing flow velocity
- reducing sediment load
- preventing erosion
- improving water quality
- improving amenity, aesthetics
- managing overland flow.

4.5.2.6 Water Quality Treatment

Water quality treatment will be managed in respect of sediments and hydrocarbons entering the existing watercourses/groundwater, as lifestyle blocks are considered to contribute low nutrient loading in comparison to other land uses (Urbaqua, 2021).

4.5.2.7 Groundwater Management

Fill is likely to be required within building envelopes on individual blocks. Site-specific geotechnical investigations will be required to determine appropriate groundwater clearance requirements for building pads, to be submitted with building permit applications (Urbaqua, 2021).

Clearances for ATU disposal areas will achieve 1.5 m of separation from any geology with the potential to create perched groundwater (Urbaqua, 2021).

Any imported fill will be clean, permeable sand with less than 5% fines, and is the responsibility of lot owners (Urbaqua, 2021).

4.5.2.8 Flood Management

To mitigate flood risk, a foreshore width of 30 m has been applied to watercourses on the site, and building envelopes and wastewater disposal areas are located outside of the 30 m setback to watercourses (Urbaqua, 2021).

5 Conclusion

As described in the report, the development proposed will impact a maximum of 2.24 ha (9% of the site) for road reserve and building envelopes and 4.65 ha (19% of the site) for asset protection zones. As such the majority of the site will not be impacted.

The vegetation onsite shows significant evidence of historical disturbed as can be seen from the condition assessment. Key fauna habitat values are associated with the presence of potential black cockatoo habitat trees, of which 25 of the 28 trees are located outside of building envelopes and road reserves.

Based on the design and management actions proposed it is concluded that development of the site as proposed will not result in unacceptable environmental impacts.

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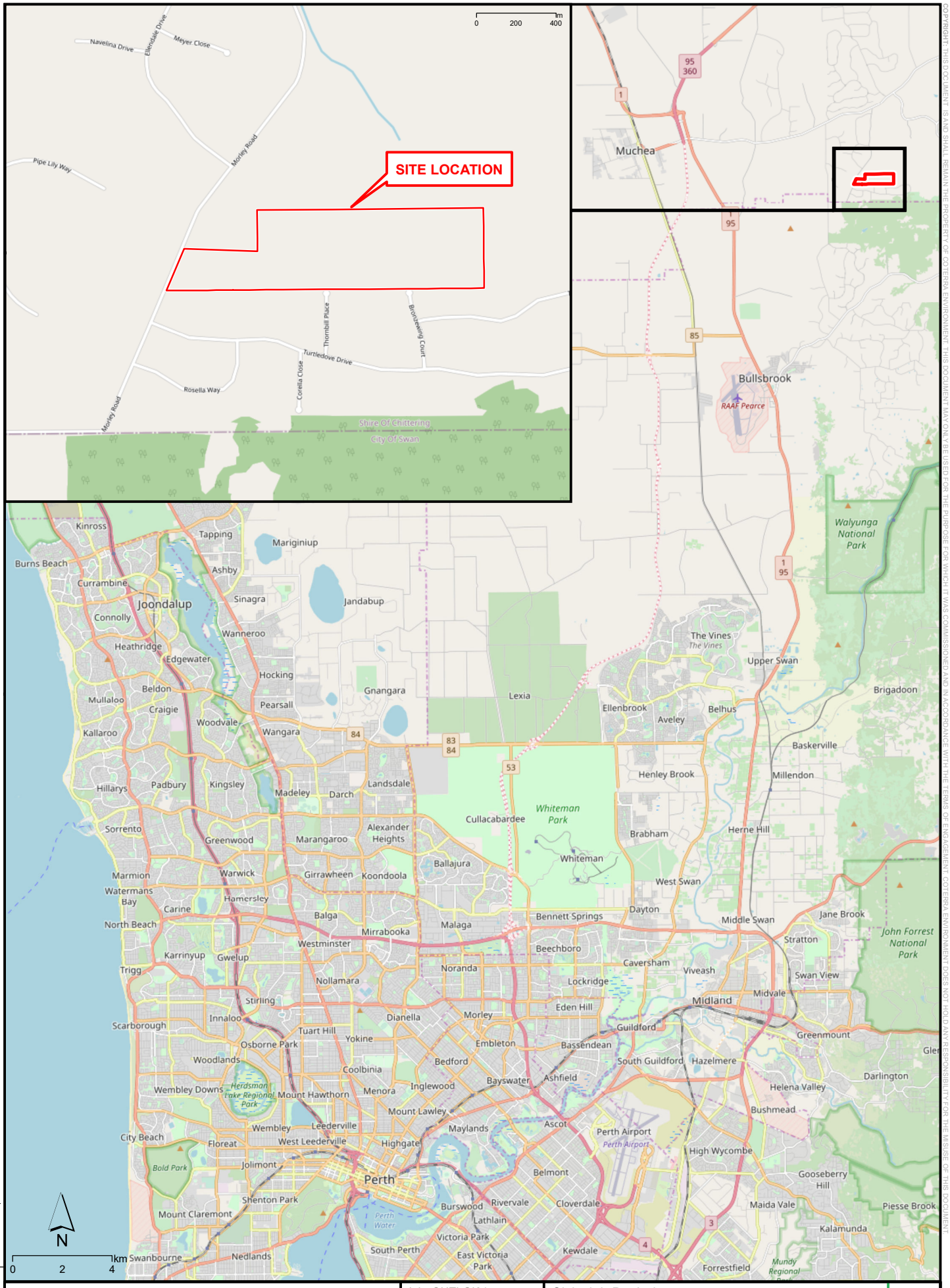
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Figures



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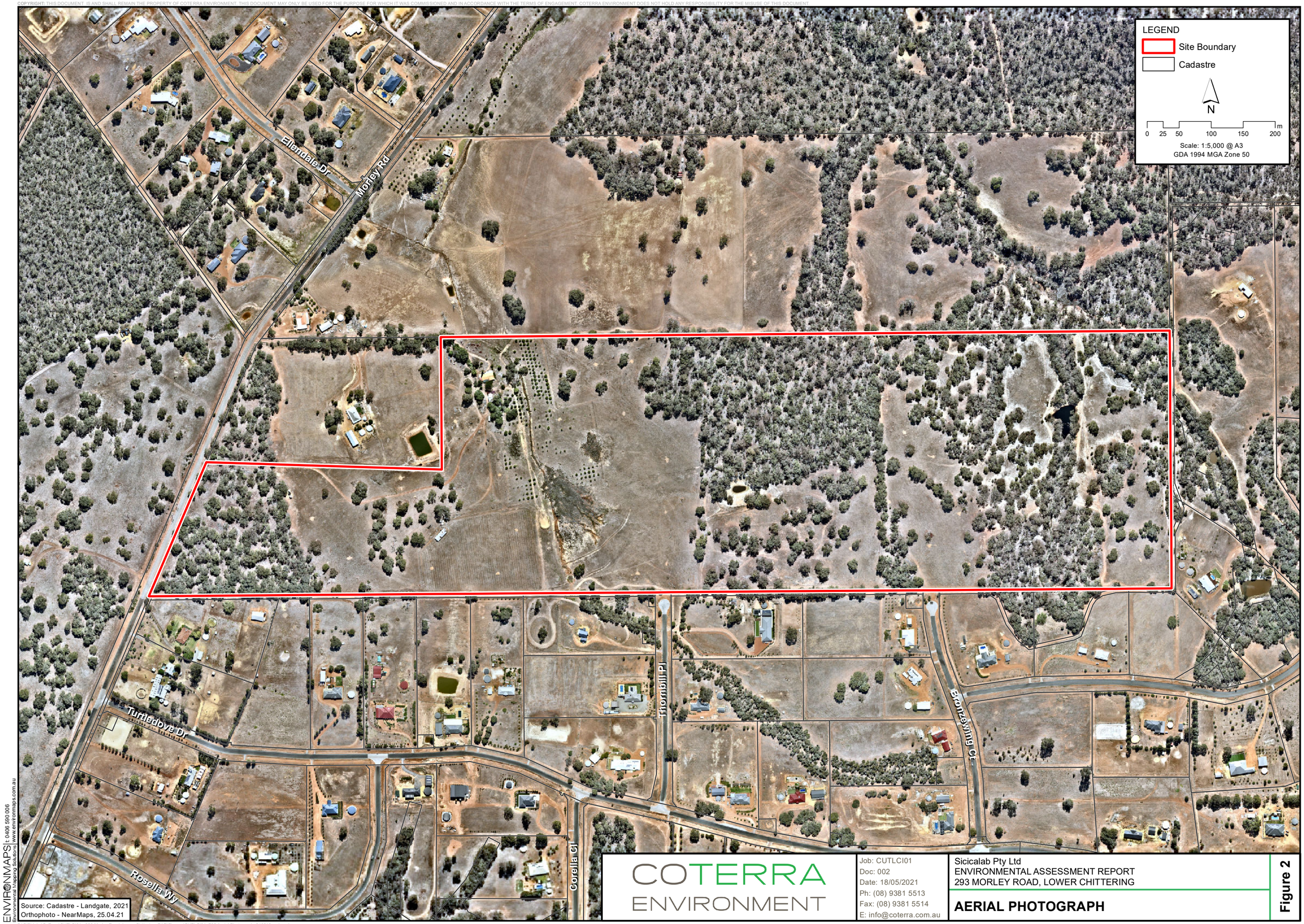
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SITE LOCATION

Figure 1

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AERIAL PHOTOGRAPH

Figure 2

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LEGEND

- Site Boundary
- Cadastre
- Proposed Lot
- Building Envelope
- Water Tank Site
- Waste Water Disposal Unit
- Existing Fire Service Access Route
- 6.0m Fire Service Access Route (Alignment TBC)

N

0 25 50 100 150 200 m

Scale: 1:5,000 @ A3
GDA 1994 MGA Zone 50

Ellendale Dr
Morley Rd
Turtledove Dr
Roselle Wy
Corella Cl
Thornbill Pl
Bronzewing Ct

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

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Source: Cadastre - Landgate, 2021
Orthophoto - NearMaps, 25.04.21
Concept Plan - HATCH | RobertsDay, 06.07.21

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CONCEPT PLAN

Figure 3

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LEGEND

- Site Boundary
- Cadastre
- Contour (mAHD)

Geology

- Cm1: SILTY CLAY - grey, micaceous, homogeneous.
- G2: GRAVEL - strong brown, coarse, sub-rounded to rounded lateritised granite pebbles in clay-silt matrix moderately sorted, of colluvial origin.
- LA1: LATERITE - massive and cemented occasionally vesicular; up to 4m in thickness, overlain by a ferruginous gravel set in a clay-sand matrix of residual origin.
- Ms1: SANDY SILT - brownish yellow, firm silt matrix with angular to sub-rounded quartz sand disseminated throughout, dispersive in places, alluvial origin.
- SC1: SCHIST - metallic grey quartz mica schist, pronounced schistocity, relative amount of biotite to muscovite varies, biotite often altered to chlorite.

N

0 25 50 100 150 200 m

Scale: 1:5,000 @ A3
GDA 1994 MGA Zone 50

Source: Contours - DPIRD
Cadastre - Landgate, 2021
Orthophoto - NearMaps, 25.04.21
Geology - DoIR: Geological Survey of W.A., 1999

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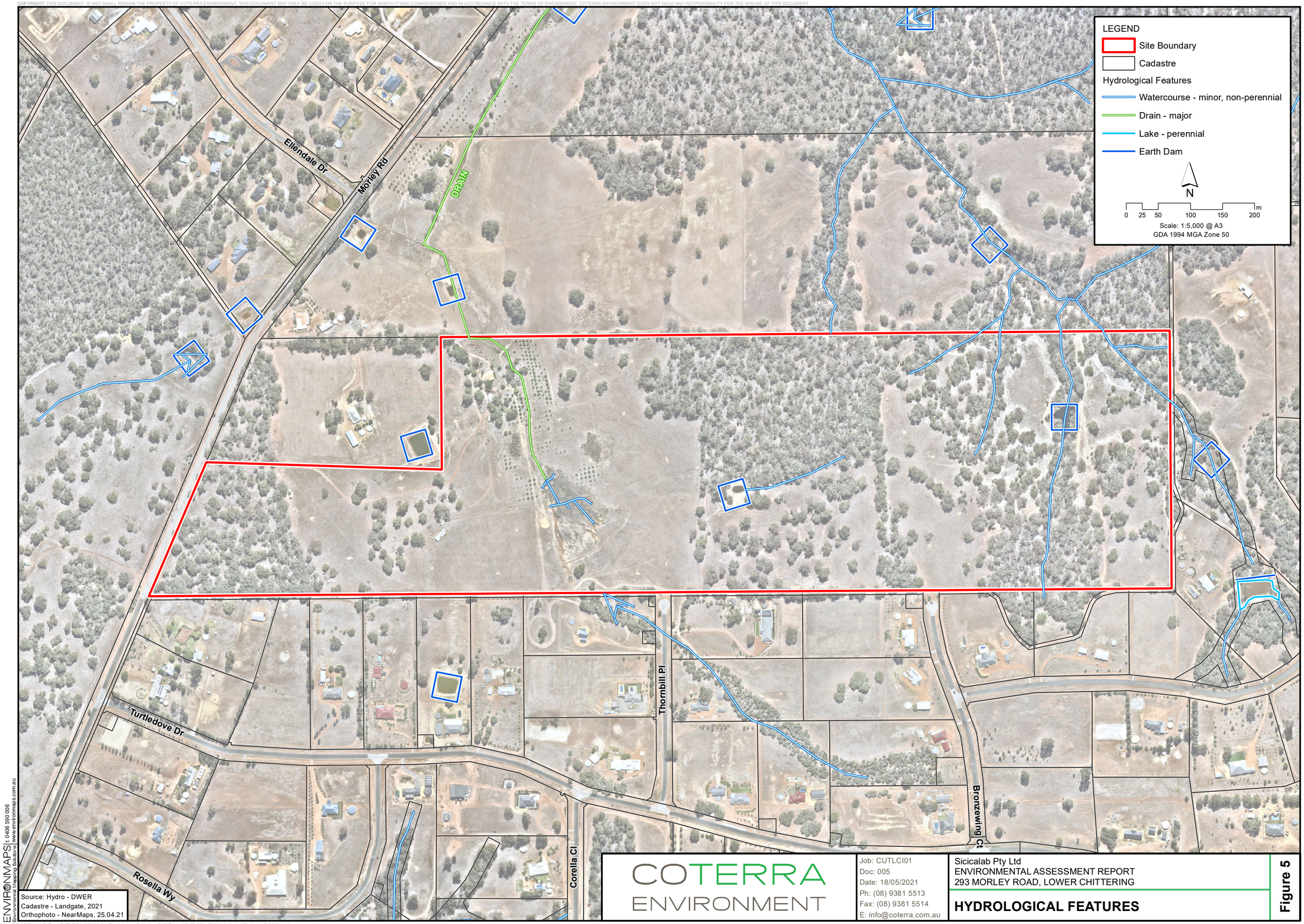
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TOPOGRAPHY AND SOILS

Figure 4

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HYDROLOGICAL FEATURES

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LEGEND

- Site Boundary
- Cadastre

Vegetation Units

- 1: Agricultural areas including an old citrus orchard and scattered plantings of *Schinus molle, Brachychiton acerifolius, Delonix regia* and *Eriobrotya japonica.*
- 2: Completely cleared areas supporting few, if any native species and numerous introduced grasses and forbs.
- 3: *Eucalyptus marginata* and *Corymbia calophylla* Low Forest over *Xanthorrhoea ?acanthostachya* Sparse Shrubland over *Hakea lissocarpha* Low Sparse Shrubland.
- 4: *Eucalyptus marginata* and *Corymbia calophylla* Low Forest over *Xanthorrhoea preissii* Tall Isolated Shrubs.
- 5: *Eucalyptus marginata* and *Eucalyptus wandoo* subsp. wandoo Low Woodland over *Xanthorrhoea ?acanthostachya* Open Shrubland over *Banksia armata* subsp. *armata* Low Open Shrubland.
- 6: *Eucalyptus marginata* and *Eucalyptus wandoo* subsp. *wandoo* with occasional *Corymbia calophylla* Low Open Forest over *Hibbertia ?huegellii* and *Hibbertia lasiopus* Low Isolated Shrubs over **Ehrharta calycina* and **Poa annua* Low Sparse Grassland.
- 7: *Eucalyptus wandoo* and *Eucalyptus marginata* over *Xanthorrhoea ?acanthostachya* over *Daviesia decurrens, Hakea lissocarpha* and *Hibbertia hypericoides* Low Open Shrubland.
- 8: *Eucalyptus wandoo* subsp. *wandoo* and *Eucalyptus accedens* Low Open Woodland over *Xanthorrhoea ?acanthostachya* Sparse Shrubland.
- 9: Isolated *Corymbia calophylla* over **Poa annua, *Avena fatua* and other weeds and introduced grasses.
- 10: Isolated *Eucalyptus accedens* over **Poa annua, *Avena fatua* and other weeds and introduced grasses.
- 11: Isolated *Eucalyptus marginata* over **Poa annua, *Avena fatua* and weeds and introduced grasses
- 12: *Juncus pallidus* and *Cyperaceae sp.* Open Sedgeland over Low Isolated Forbs and Tussock Grasses.

Ellendale Dr
Morley Rd
Turtledove Dr
Thornbill Pl
Corella Cl
Bronzewing Ct

Source: Vegetation - FVC, 2021
Cadastre - Landgate, 2021
Orthophoto - NearMaps, 25.04.21

0 25 50 100 150 200 m

Scale: 1:5,000 @ A3
GDA 1994 MGA Zone 50

N

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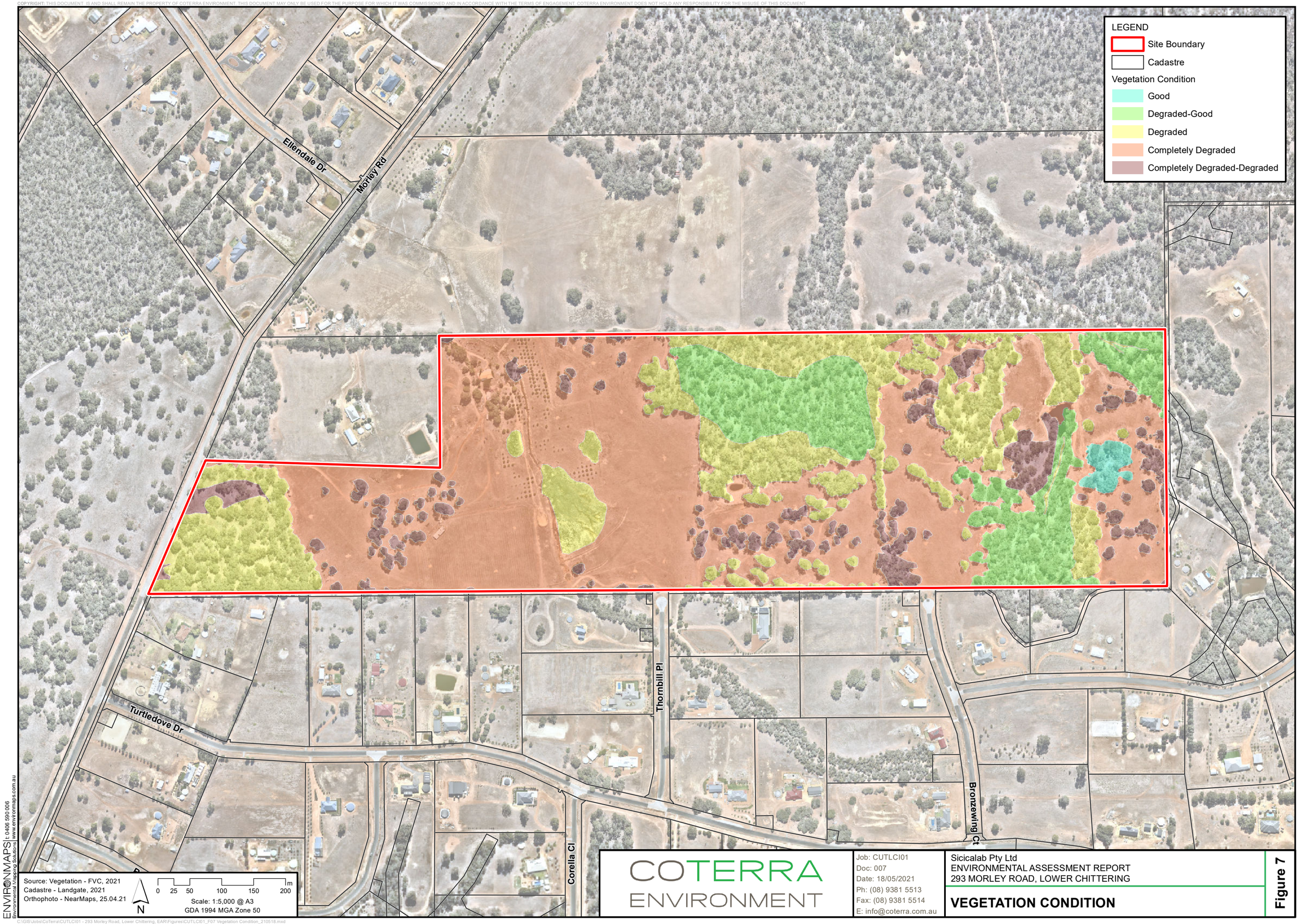
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VEGETATION UNITS

Figure 6

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Orthophoto - NearMaps, 25.04.21

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GDA 1994 MGA Zone 50

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VEGETATION CONDITION

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LEGEND

- Site Boundary
- Cadastre
- Potential Black Cockatoo Roosting Site
- Habitat Tree - One Or More Possible Hollows, Suitable for Black Cockatoos (28)
- Habitat Tree - One Or More Possible Hollows, None Suitable for Black Cockatoos (95)
- Habitat Tree - No Hollows Seen (737)

N

0 25 50 100 150 200 m

Scale: 1:5,000 @ A3
GDA 1994 MGA Zone 50

Ellendale Dr
Morley Rd
Turtledove Dr
Rosella Wy
Corella Cl
Thornbill Pl
Bronzewing Ct

Source: Cadastre - Landgate, 2021
Orthophoto - NearMaps, 25.04.21

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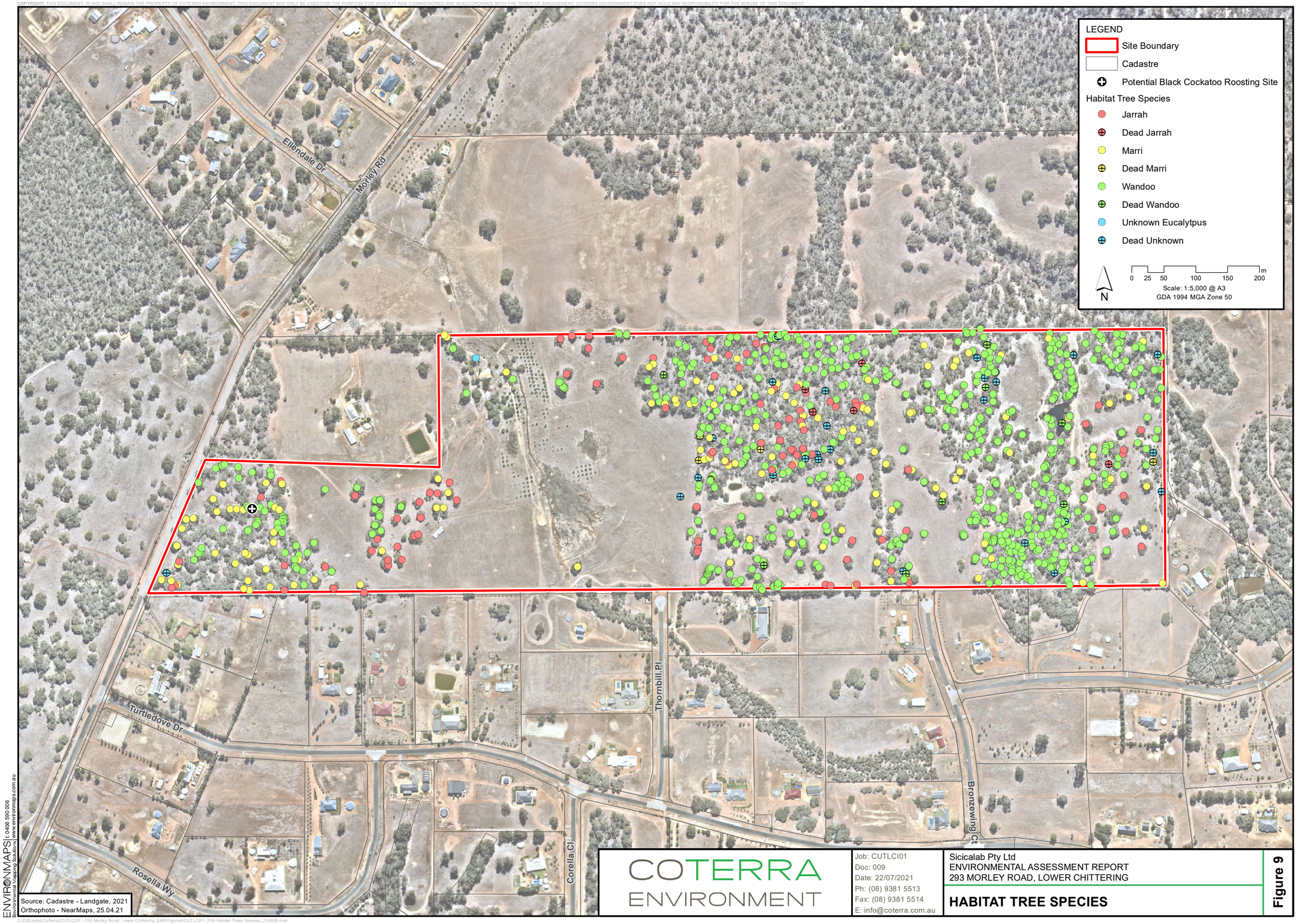
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POTENTIAL BLACK COCKATOO HABITAT TREES

Figure 8

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HABITAT TREE SPECIES

Figure 9

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Muchea East Rd
Citron Wy
Sandow Rd
Brockman River
Chittering Rd
Buckthorn Dr
Honeypot Rd
Tassel Ct
SEMI RURAL
RURAL
Navelina Dr
Meyer Cl
SEMI RURAL
LOWER CHITTERING
Ellendale Dr
Morley Rd
Pipe Lily Wy
SEMI RURAL
Blue Squill Dr
Polinelli Rd
RURAL
RURAL
RURAL
RURAL
Thornbill Pl
SEMI RURAL
Turtledove Dr
Bronzewing Ct
Rosella Wy
Corella Cl
RURAL
QUARRY
BULLSBROOK
QUARRY
Jenkins Rd

LEGEND
Site Boundary
Cadastre
N
0 75 150 300 450 600 m
Scale: 1:15,000 @ A3
GDA 1994 MGA Zone 50
Source: Cadastre - Landgate, 2021
Orthophoto - NearMaps, 25.04.21

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SURROUNDING LAND USES

Figure 10

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- Site Boundary
- Cadastre
- Proposed Lot
- Building Envelope
- APZ
- Waste Water Disposal Unit
- Water Tank Site
- Existing Fire Service Access Route
- 6.0m Fire Service Access Route (Alignment
- Hydrological Features
- Potential Black Cockatoo Roosting Site
- Habitat Tree - One Or More Possible Hollows, Suitable for Black Cockatoos
- Habitat Tree - One Or More Possible Hollows, None Suitable for Black Cockatoos
- Habitat Tree - No Hollows Seen

Vegetation Units

- 3: *Eucalyptus marginata* and *Corymbia calophylla* Low Forest over *Xanthorrhoea ?acanthostachya* Sparse Shrubland over *Hakea lissocarpha* Low Sparse Shrubland.
- 4: *Eucalyptus marginata* and *Corymbia calophylla* Low Forest over *Xanthorrhoea preissii* Tall Isolated Shrubs.
- 5: *Eucalyptus marginata* and *Eucalyptus wandoo* subsp. wandoo Low Woodland over *Xanthorrhoea ?acanthostachya* Open Shrubland over *Banksia armata* subsp. *armata* Low Open Shrubland.
- 6: *Eucalyptus marginata* and *Eucalyptus wandoo* subsp. *wandoo* with occasional *Corymbia calophylla* Low Open Forest over *Hibbertia ?huegellii* and *Hibbertia lasiopus* Low Isolated Shrubs over **Ehrharta calycina* and **Poa annua* Low Sparse Grassland.
- 7: *Eucalyptus wandoo* and *Eucalyptus marginata* over *Xanthorrhoea ?acanthostachya* over *Daviesia decurrens, Hakea lissocarpha* and *Hibbertia hypericoides* Low Open Shrubland.
- 8: *Eucalyptus wandoo* subsp. *wandoo* and *Eucalyptus accedens* Low Open Woodland over *Xanthorrhoea ?acanthostachya* Sparse Shrubland.
- 9: Isolated *Corymbia calophylla* over **Poa annua, *Avena fatua* and other weeds and introduced grasses.
- 10: Isolated *Eucalyptus accedens* over **Poa annua, *Avena fatua* and other weeds and introduced grasses.
- 11: Isolated *Eucalyptus marginata* over **Poa annua, *Avena fatua* and weeds and introduced grasses
- 12: *Juncus pallidus* and *Cyperaceae sp.* Open Sedgeland over Low Isolated Forbs and Tussock Grasses.

N

0 25 50 100 150 200 m

Scale: 1:4,100 @ A3
GDA 1994 MGA Zone 50

Source: Cadastre - Landgate, 2021
Orthophoto - NearMaps, 25.04.21
Concept Plan - HATCH | RobertsDay, 06.07.21

Morley Rd
Turtledove Dr
Rosella Wy
Thornbill Pl
Bronzewing Ct
Turtledove Dr

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293 MORLEY ROAD, LOWER CHITTERING

KEY ENVIRONMENTAL FEATURES AND CONCEPT PLAN

Figure 11

Appendix 1 EPBC Protected Matters Search Results

Australian Government

Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

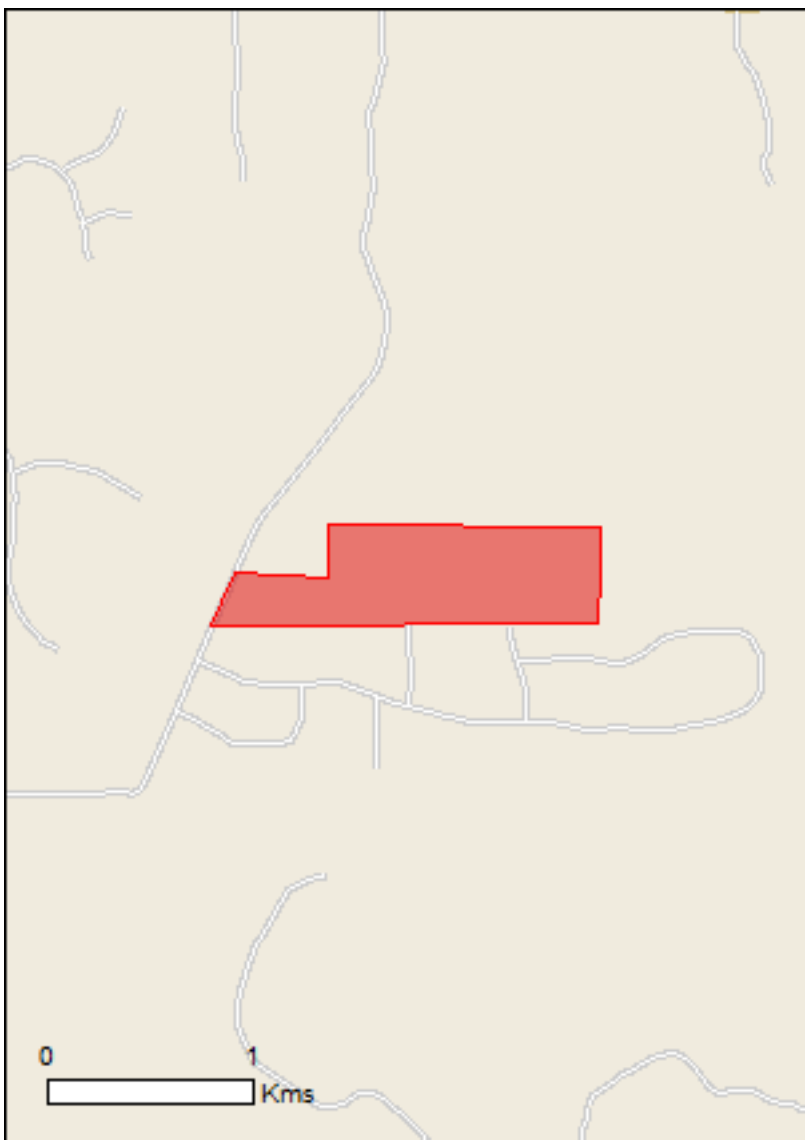
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 22/04/21 14:59:03

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

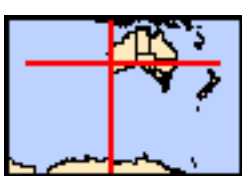
Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

Coordinates

Buffer: 0.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	15
Listed Migratory Species:	8

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	12
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	1
Invasive Species:	28
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Other		
Westralunio carteri Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat may occur within area
Plants		
Acacia anomala Grass Wattle, Chittering Grass Wattle [8153]	Vulnerable	Species or species habitat may occur within area
Diplolaena andrewsii [6601]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
Grevillea corrugata a shrub [65445]	Endangered	Species or species habitat likely to occur within area
Grevillea curviloba subsp. curviloba Curved-leaf Grevillea [64908]	Endangered	Species or species habitat may occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat may occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Extra Information

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel		Species or species

Name	Status	Type of Presence
[129]		habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-31.590118 116.070632,-31.590191 116.082562,-31.593847 116.082476,-31.59392 116.065482,-31.591946 116.066512,-31.592092 116.070632,-31.590155 116.070675,-31.590118 116.070632

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix 2 Flora and Vegetation Assessment – Lower Chittering (Focused Vision Consulting, 2021)



FLORA AND VEGETATION ASSESSMENT
LOWER CHITTERING

COTERRA ENVIRONMENT

MAY 2021

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Document History

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0	Jeni Alford Senior Botanist Lisa Chappell Senior Botanist/Environmental Scientist	Kellie Bauer-Simpson Principal Ecologist/ Environmental Manager	Kellie Bauer-Simpson Principal Ecologist/ Environmental Manager	06/05/2021

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EXECUTIVE SUMMARY

Coterra Environment (Coterra) is assisting a client with the development of a site in Lower Chittering for a future rural-residential subdivision.

The scope of work was as follows:

- Undertake a desktop assessment of flora and vegetation values relevant to the site.
- Undertake an out of season, reconnaissance flora and vegetation assessment, in accordance with Environmental Protection Authority (EPA) (2016) - *Technical Guidance for Flora and Vegetation Assessments.*
- Report on the findings of the desktop and field assessment, in accordance with EPA (2016), including making any recommendations for further studies that may be required to meet regulatory expectations.

A desktop and field assessment was carried out by experienced personnel, which included a one-day site visit conducted by Lisa Chappell and Jeni Alford (Senior Botanists) on 10 March 2021. The survey was undertaken and reported in accordance with EPA (2016), *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*. The purpose of the survey was to assess the vegetation types and condition of remnant vegetation within the study area.

The key findings arising from the flora and vegetation assessment of the study area are as follows:

- No Threatened or Priority flora species were recorded within the study area during the March field survey. The vegetation described as in 'Good' condition may support some of the species that occur in upland, lateritic woodlands, although these were not detected during the survey. The swampland vegetation may also support some conservation significant species but are less likely due to the levels of disturbance.
- The study area was found to support 12 vegetation units of varying condition, comprising six Woodlands, one Dampland, one Drainge-line, three Parkland and one Planted vegetation unit. None are considered to be representative of any Threatened or Priority Ecological Community identified through desktop database searches.

The following recommendation is provided which is based on the key results and findings of the assessment:

- A follow-up targeted flora survey during early spring is recommended to confirm that no species of conservation-significance occur within the better-quality vegetation remnants of the study area.

1 INTRODUCTION

1.1 BACKGROUND

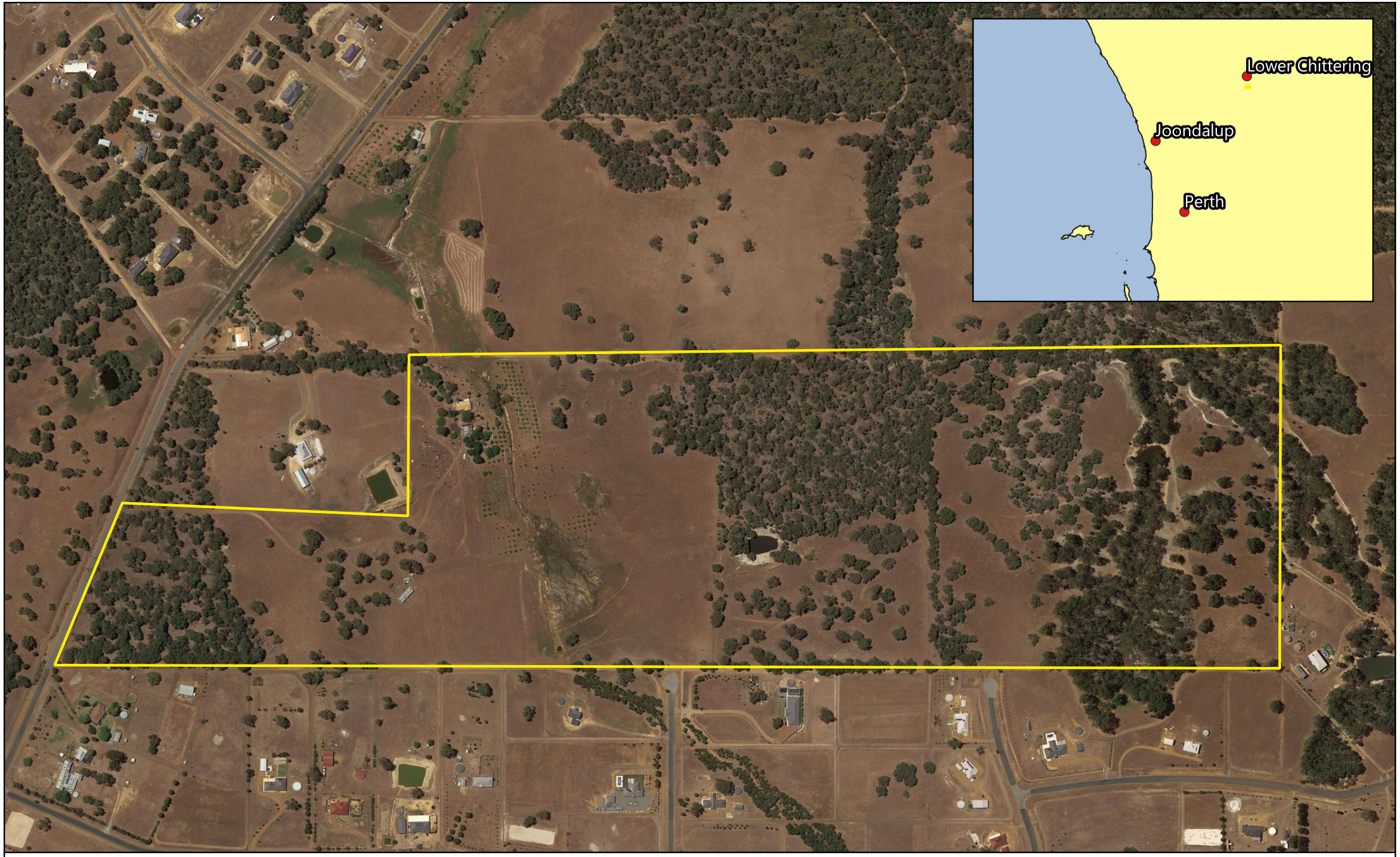
Coterra Environment (Coterra) is assisting a client with the development of a site in Lower Chittering for future rural residential subdivision. In order to better understand the flora and vegetation values of the site, Focused Vision Consulting Pty Ltd (FVC) was commissioned by Coterra to conduct an initial reconnaissance assessment for flora and vegetation values of the site.

The land proposed for future subdivision is located at 293 Morley Road, Lower Chittering, within the Shire of Chittering, approximately 53 kilometres (km) north-east of Perth. The site is adjacent to Rosa Park Estate, Lower Chittering (**Figure 1**) and occupies an area of approximately 54.04 hectares (ha).

1.2 SCOPE OF WORK

The scope of work was as follows:

- Undertake a desktop assessment of flora and vegetation values relevant to the site.
- Undertake an out of season, reconnaissance flora and vegetation assessment, in accordance with EPA (2016) - *Technical Guidance for Flora and Vegetation Assessments.*
- Report on the findings of the desktop and field assessment, in accordance with EPA (2016), including making any recommendations for further studies that may be required to meet regulatory expectations.



0 75 150 225 300 m

GDA 94 / MGA Zone 50

Figure 1 - Study Area

Legend

Study Area

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COT20021 08 April 2021

2 EXISTING ENVIRONMENT

2.1 CLIMATE

The study area occurs within the Northern Jarrah Forest, which has a warm Mediterranean climate, characterised by hot, dry summers and cool to mild wet winters (Williams and Mitchell 2001). The Bureau of Meteorology (BoM) Pearce RAAF weather station (Site 009053) is the closest to the study area, operating since 1937. Average annual long-term rainfall recorded at the station is 652.1 mm. Annual mean maximum temperatures range from 17.9°C in winter to 33.5°C in summer (BoM 2021) (**Figure 2**).

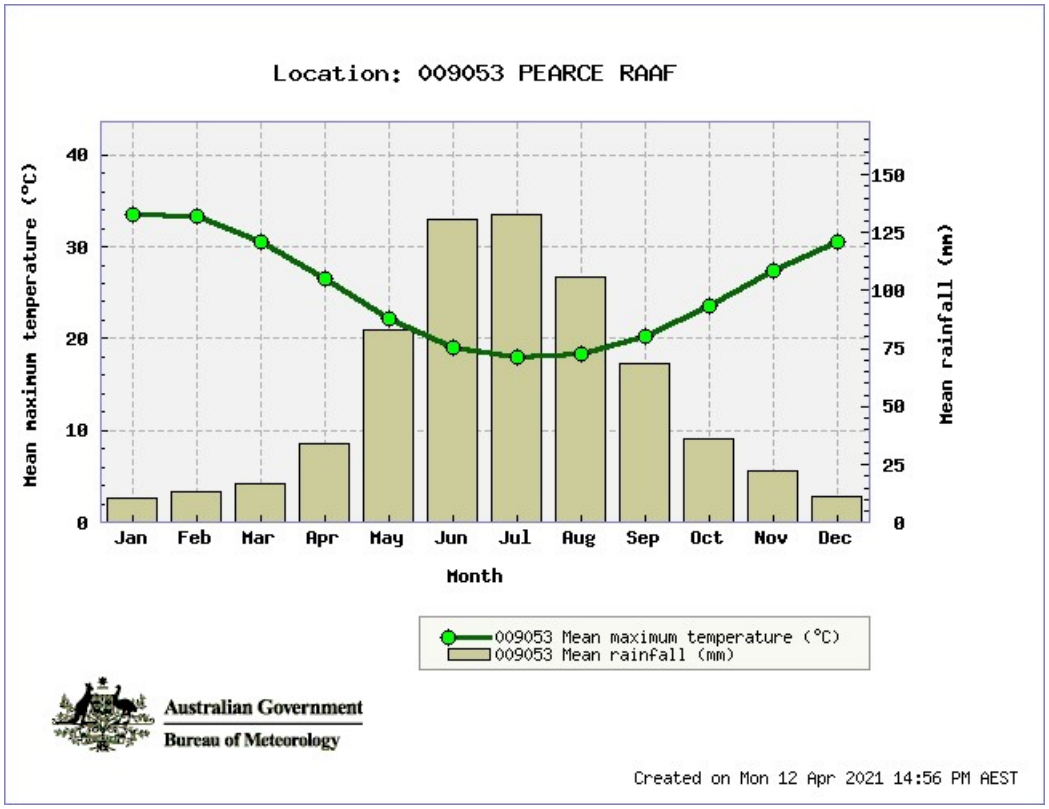


Figure 2 - Climate Data for Pearce RAAF (Site 009053) (BoM 2021)

2.2 IBRA REGION

There are 89 recognised Interim Biogeographic Regionalisation for Australia (IBRA) regions across Australia that have been defined based on climate, geology, landforms and characteristic vegetation and fauna (DAWE 2020a). The study area lies within the Jarrah Forest (JF) IBRA region, and at a finer scale within the Northern Jarrah Forrest Sub-Region (JF1) (Williams and Mitchell 2001).

The Northern Jarrah Forest sub-region is described as a duricrusted plateau of the Yilgarn Craton and is broadly characterised by Jarrah and Marri woodlands on lateritic, gravelly soils to the west and Wandoo and Marri on clayey soils , with Powderbark wandoos occurring on breakaways to the east (Williams and Mitchell 2001).

2.3 GEOLOGY AND SOILS

Soil-landscape mapping across Western Australia has been compiled by the Department of Agriculture and Food WA (DAFWA) (2018) using various surveys at different scales varying between 1:20,000 and 1:3,000,000.

At the system scale, the study area traverses two regional soil-landscape mapping systems, as summarised in **Table 1**, with their extent in the study area shown in **Figure 3**.

Table 1 - Summary of Soil-Landscape Systems within the Study Area (DAFWA 2018)

Map Unit	Soil System	Description
222Mb	Mogumber System	Gentle to moderate sloping sandplain, varying from pale to yellow clayey sand with gravel and laterised ridges. Low woodland and shrubland of, *C. calophylla, Banksia* and *Acacia* spp. Some tall *C. calophylla* and *E. marginata*.
253Ga	Gabbla System	Western boundary of the Darling Plateau to the east of the Dandaragan plateau. Gently to moderately slopes. Yellow, red and grey loams and clays, with gravel common and sand pockets. *E. wandoo* and *E. loxophleba* on clay.

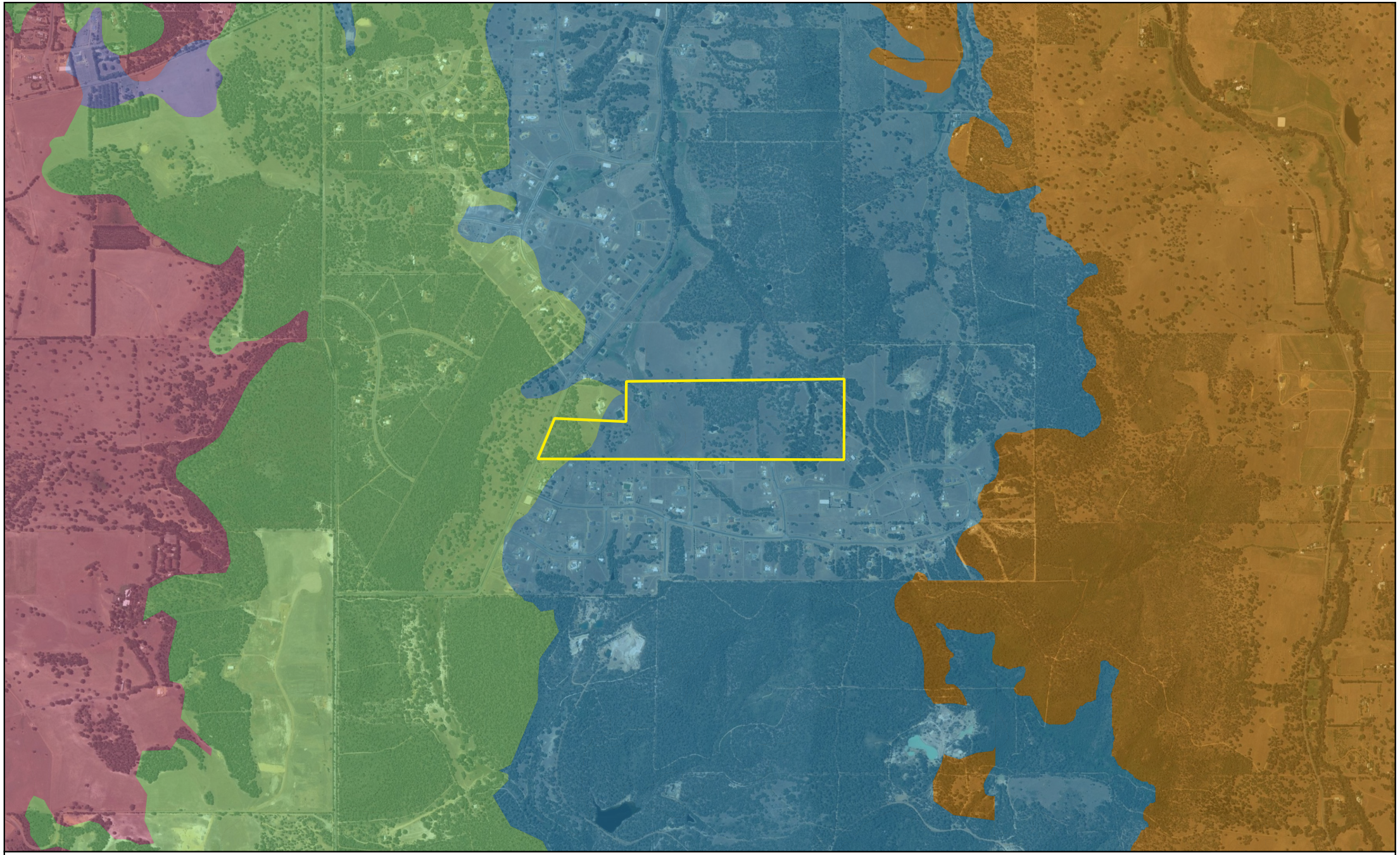


Figure 3 - Soils of the Study Area

2.4 VEGETATION

The objective of the Environmental Protection Authority (EPA) in relation to flora and vegetation is: *To protect flora and vegetation so that biological diversity and ecological integrity are maintained* (EPA 2016). The EPA considers it is important that vegetation associations are maintained above a threshold level of 30% for unconstrained areas and 10% for constrained areas, of the original pre-clearing extent of each association (EPA 2008). Species loss appears to accelerate exponentially at the ecosystem level (EPA 2008) once the extent of vegetation associations drops below 30%.

The following key criteria are applied to vegetation clearing from a biodiversity perspective, which justifies the retention targets (EPA 2000):

- the 'threshold level' below which species loss appears to accelerate exponentially within an ecosystem level, is regarded as being at a level of 30% (of the pre-European, i.e. pre-1750 extent of the vegetation type)
- a level of 10% of the original extent of a vegetation community is regarded as being a level representing Endangered
- clearing which would increase the threat level to a vegetation community should be avoided.

Vegetation associations have been broadly characterised by Beard (1990) according to structure, physiognomy and floristics. The Beard vegetation associations supported by the study area and their remaining extent across a range of contexts are presented in **Table 2** and spatially in **Figure 4**.

Table 2 - Pre-European Vegetation of the Study Area (Beard 1990, DBCA 2019)

Extent Context	Veg. Association No.	Broad Vegetation Description	Pre–European Extent (ha)	Current Extent (ha)	% Pre-European Extent Remaining	% Current Extent in DBCA Managed Lands *
Western Australia	3	Medium forest; Jarrah-Marri	2,661,404.62	1,803,437.48	67.76	55.23
	4	Medium woodland; Marri & Wandoo	1,054,279.89	284,102.41	26.95	6.43
Jarrah Forest IBRA Region	3	Medium forest; Jarrah-Marri	2,390,591.54	1,604,101.56	67.10	54.35
	4	Medium woodland; Marri & Wandoo	1,022,712.69	277,087.18	27.09	6.45
Northern Jarrah Forest Sub-Region	3	Medium forest; Jarrah-Marri	908,099.69	723,445.91	79.67	66.95
	4	Medium woodland; Marri & Wandoo	614,200.82	197,903.81	32.22	9.85
Shire of Chittering	3	Medium forest; Jarrah-Marri	7,102.72	3,363.02	47.35	0
	4	Medium woodland; Marri & Wandoo	54,209.63	13,971.91	25.77	1.26

*Proportion of pre-European extent

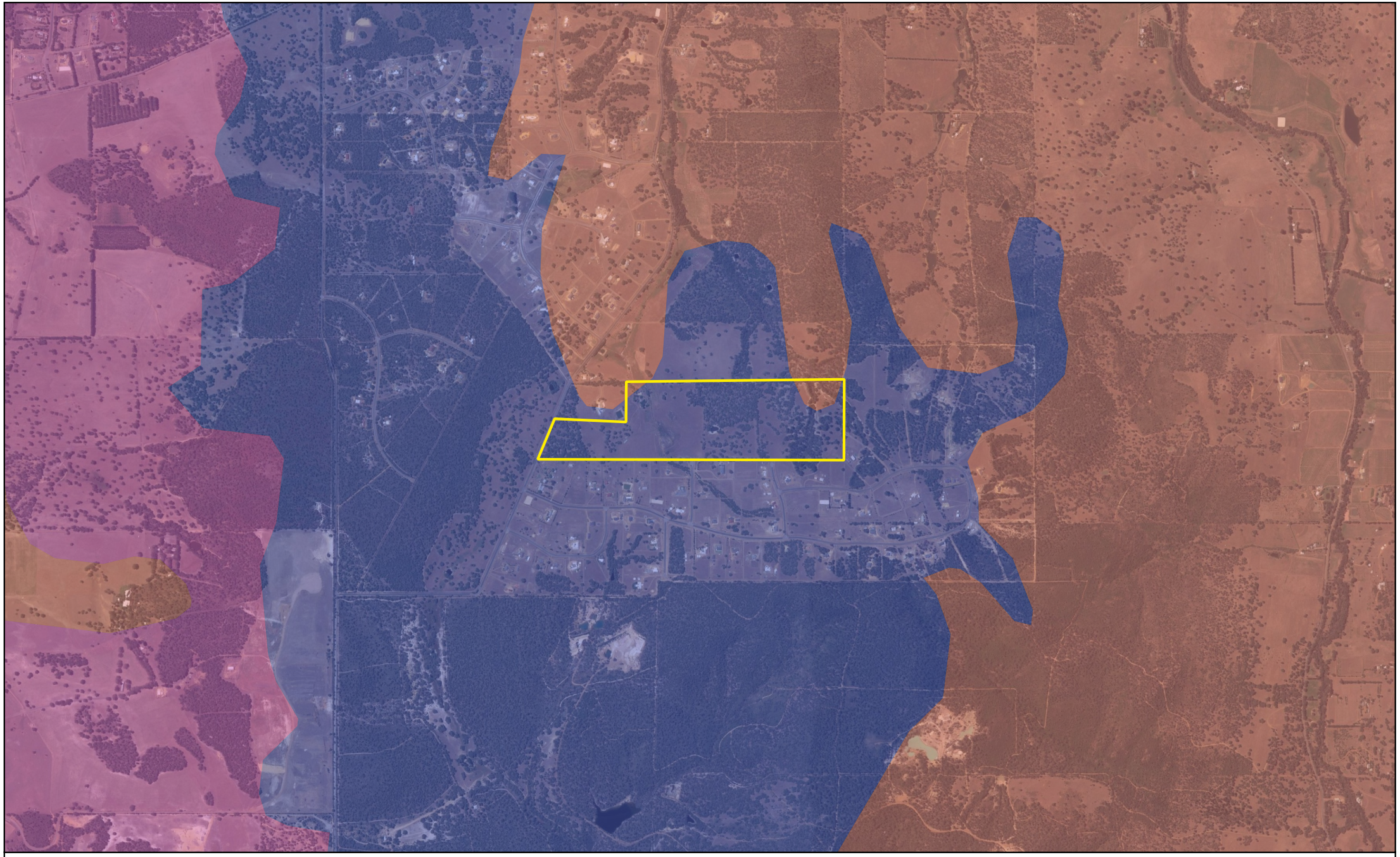


Figure 4 - Pre-European Vegetation

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Vegetation complexes within the study area have also been defined by Heddle *et al.* (1980) and are based on vegetation in association with landforms and underlying geology (**Figure 5**). Three of these vegetation complexes as defined by Heddle *et al.* (1980), the Coolakin Complex in low rainfall, Mogumber Complex – south and the Yalanbee Complex in low rainfall (Heddle *et al.* 1980) occur within the study area. These are described in **Table 3** and presented in **Figure 5**.

Table 3 - Vegetation Complexes Within the Study Area (Heddle *et al.* 1980, Mattiske and Havel 1998)

Extent Context	Vegetation Complex	Description	Pre–European Extent (ha)	Current Extent (ha)	% Remaining
Western Australia	Coolakin Complex in low rainfall	Woodland of *Eucalyptus wandoo* with mixtures of *Eucalyptus patens, Eucalyptus marginata* subsp. *thalassica* and *Corymbia calophylla* on the valley slopes in arid and perarid zones.	163,991.68	64,204.65	39.15
	Mogumber Complex – south	Open woodland of *Eucalyptus calophylla*, with some admixture of *Eucalyptus marginata* (Jarrah) and a second storey of *Eucalyptus todtiana* (Pricklybark) - *Banksia attenuata* - *Banksia menziesii* (Firewood Banksia) - *Banksia ilicifolia* (Holly-leaved Banksia).	14,821.71	5,720.70	38.60
	Yalanbee Complex in low rainfall	Woodlands of *Eucalyptus wandoo-Eucalyptus accedens*, less consistently open forest of *Eucalyptus marginata* subsp. *thalassica–Corymbia calophylla* on lateritic uplands and breakaway landscapes in arid and perarid zones.	126,609.77	83,829.11	66.21
Shire of Chittering	Coolakin Complex in low rainfall	Woodland of *Eucalyptus wandoo* with mixtures of *Eucalyptus patens, Eucalyptus marginata* subsp. *thalassica* and *Corymbia calophylla* on the valley slopes in arid and perarid zones.	11,439.10	3,048.70	26.65
	Mogumber Complex – south	Open woodland of *Eucalyptus calophylla*, with some admixture of *Eucalyptus marginata* (Jarrah) and a second storey of *Eucalyptus todtiana* (Pricklybark) - *Banksia attenuata* - *Banksia menziesii* (Firewood Banksia) - *Banksia ilicifolia* (Holly-leaved Banksia).	11,778.55	4,510.73	38.30
	Yalanbee Complex in low rainfall	Woodlands of *Eucalyptus wandoo-Eucalyptus accedens*, less consistently open forest of *Eucalyptus marginata* subsp. *thalassica–Corymbia calophylla* on lateritic uplands and breakaway landscapes in arid and perarid zones.	27,643.32	8,411.35	30.43

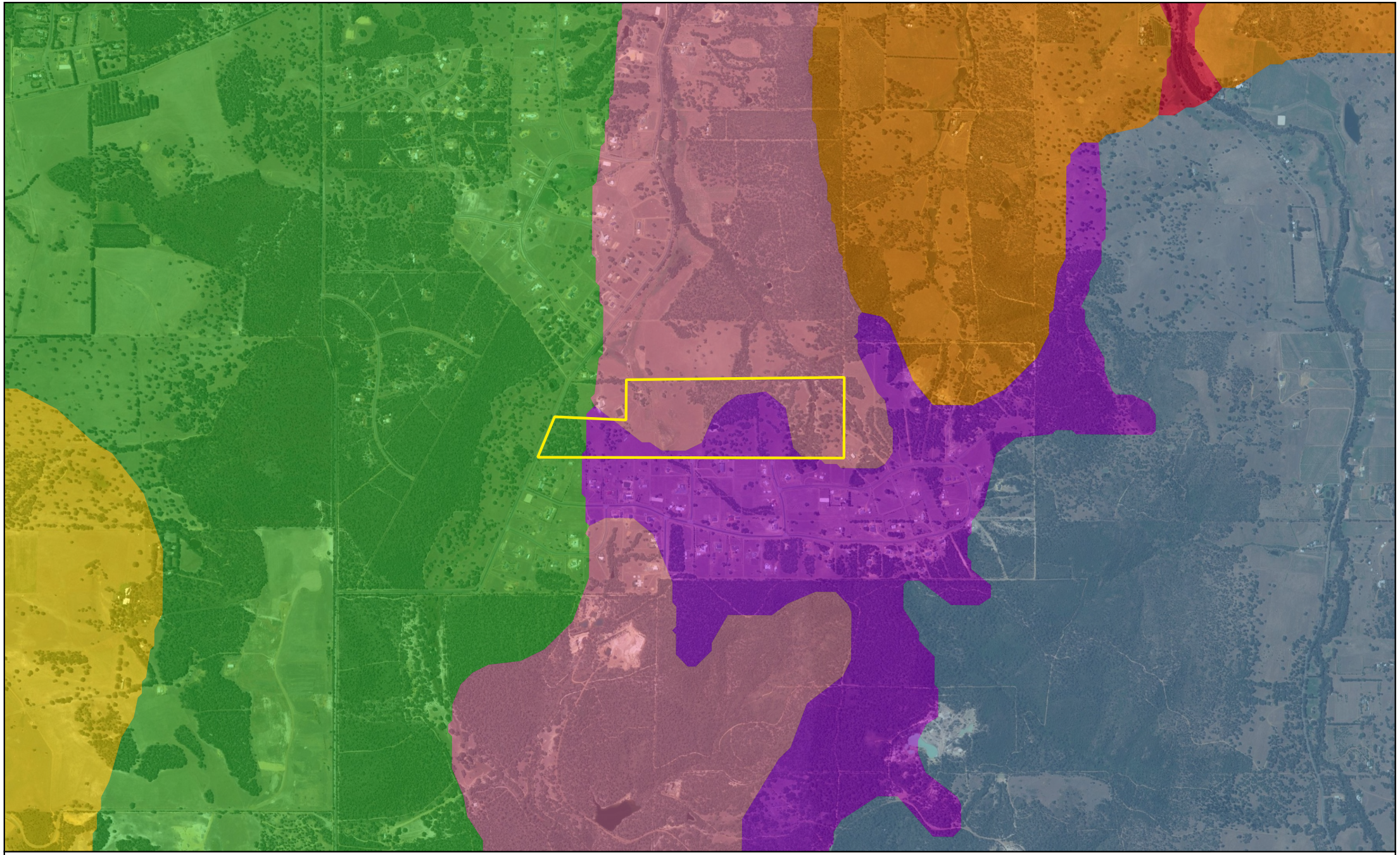


Figure 5 - Vegetation Complexes

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3 METHODOLOGY

3.1 DESKTOP REVIEW

A desktop assessment for Threatened and Priority flora potentially occurring within the study area was undertaken prior to the field studies. The desktop assessment consisted of database searches using NatureMap (DBCA 2021a) (**Appendix A**), DBCA Threatened and Priority flora (DBCA 2021b) and ecological communities (DBCA 2021c) databases and the Commonwealth Protected Matters Search Tool (PMST) for Matters of National Environmental Significance (MNES) (DAWE 2021a) (**Appendix B**). All search tools were based on the approximate centre of the study area, being -31.59192 latitude, 116.07578 longitude with a 2 km buffer (radius) search area.

Threatened and Priority flora identified from the desktop assessment were evaluated for their potential likelihood of occurring within the study area. Most of the study area has been cleared for agriculture and is highly modified.

Potential habitats occurring within the study area were anticipated to be: seasonally inundated low-lying depressions, pasture, flats, trees over pasture and Jarrah-Marri-Wandoo woodlands on laterite and clay loam soils.

The likelihood of occurrence of Threatened and Priority flora was based on four factors: suitable habitat within the study area, age of previous records, proximity of previous records to the study area and current condition of the study area.

Suitable habitat:

- The likelihood of suitable habitat being present within the study area was based on known habitat information gathered from FloraBase (Western Australian Herbarium (WAH) 2021) and literature sourced from the Species Profile and Threats Database (SPRAT) (DAWE 2020b) (e.g. recovery plans, conservation advice).

Age of previous records:

- The age of previous records for significant species recorded within the study area was evaluated to determine how likely the species was to still occur in the area (i.e. habitat of species recorded decades ago may no longer occur or a species may be locally extinct).

Proximity of previous records:

- Species recorded closer to the study area are considered to have a higher likelihood of occurrence. It is noted that species identified using the PMST have not necessarily been recorded within 2 km of the study area and may have resulted in the search due to habitat possibly occurring within the general vicinity.

Current condition of study area:

- The study area is highly modified, having been previously cleared for primarily agricultural and semi-rural residential land-uses, and has been subject to routine vegetation modification for firebreak maintenance and other human disturbances. The highly modified and degraded nature of the study area suggests a relatively low likelihood of any significant flora occurring.

3.2 FIELD ASSESSMENT

The field assessment consisted of a one-day site visit on 10 March 2021 which is considered sub-optimal for surveys for any potential Threatened and Priority flora (July, September and October) but adequate to provide an overview of the vegetation communities and condition.

3.2.1 Reconnaissance Flora and Vegetation Assessment

A reconnaissance flora and vegetation assessment was undertaken by Lisa Chappell and Jeni Alford (Senior Botanists) on 10 March 2021. The survey was undertaken and reported in accordance with the Environmental Protection Authority's (EPA) (2016) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*. The purpose of the survey was to assess the vegetation types and condition of remnant vegetation within the study area.

A range of relevés (sample sites) were used to verify and determine vegetation types and condition and to collect flora species inventories. In total, ten relevés were selected in the field and assessed within the study area (**Figure 6**). Sample sites were selected to provide representative samples of each vegetation unit. Field data were collected using an electronic tablet with customised data forms and mobile spatial mapping capability, within the software program, Mappt™.

The following data were collected from each site:

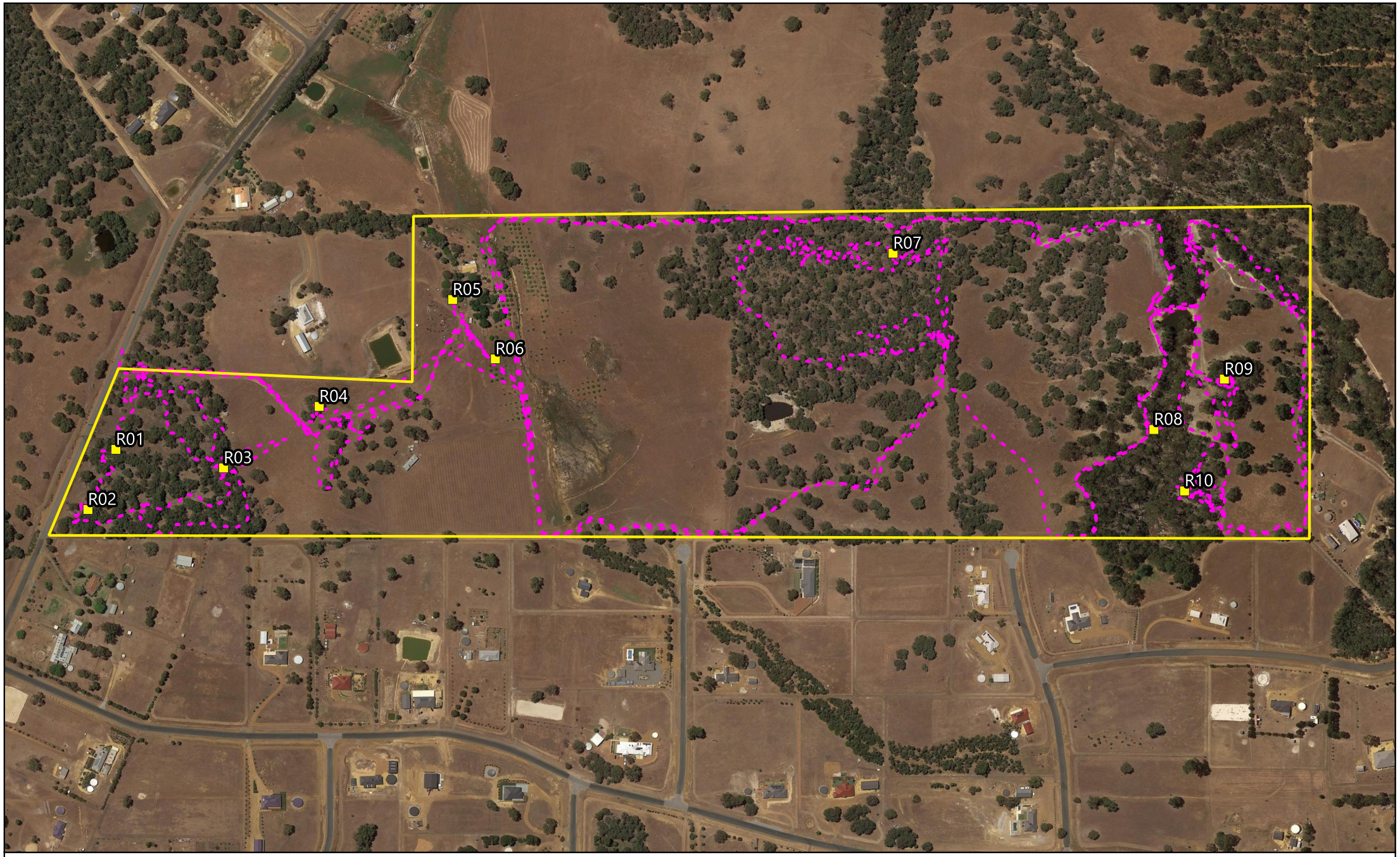
- observer
- date
- site
- GPS location (GDA94; zone 50)
- representative photograph
- soil type and colour
- topography
- flora species observed, including average height and projected foliage cover of dominant species within each stratum
- vegetation condition assessed against the currently accepted condition scale of Keighery (1994).

EPA (2016) Guidance incorporates limiting quadrat sampling to areas of vegetation in 'Good' or better condition. However, for this assessment, quadrats were not sampled, as reconnaissance assessments do not incorporate quadrat sampling, the timing of the survey was not optimal and the majority of the vegetation was not found to be in 'Good' or better condition.

The reconnaissance field assessment also included targeted searches for Threatened and Priority flora within areas of suitable habitat as identified through the desktop assessment. The study area was traversed on foot and survey effort is displayed in **Figure 6**. It was not anticipated that any conservation significant flora would be recorded at the time of the survey, although some of the woody species may be identified outside of their flowering period.

Where suspected Threatened or Priority flora were observed, the following data was recorded:

- GPS location of each individual plant allowing an inventory of the plants/population size
- vegetation type and condition at the recorded location
- condition of plants
- reproductive status
- selection of representative photographs.



0 75 150 225 300 m

GDA 94 / MGA Zone 50

Figure 6 - Relevé Locations and Survey Effort

Legend

- Study Area
- Relevé Location
- Walked Traverse

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3.3 STUDY LIMITATIONS

The limitations of the flora and vegetation assessment have been considered in accordance with the Technical Guidance (EPA 2016) and are summarised in **Table 4**.

Table 4 – Study Limitations

Aspect	Constraint?	Commentary
Availability of local and regional contextual information	No	The study area is within the Northern Jarrah Forest, a relatively well-understood region in terms of ecological values. Numerous studies have been completed within the vicinity of the study area and wider region, including by FVC. Regional data relating to soils, vegetation and biological values of conservation significance are also available in public databases and in the literature, all included in the desktop assessment.
Competency of field personnel	No	The personnel undertaking the field studies both have significant experience in biological assessments in the Perth region. Lisa Chappell, who oversaw and was present during all stages of the field surveys, has 17 years of experience in surveys in the greater Perth region. Jeni Alford have more than 30 years experienced in conducting flora and vegetation assessments, including in the Perth region. Personnel with relevant qualifications and experience contributed to the various study tasks, such as flora identifications and floristic analysis.
Selected scope, survey methods and level of survey detail/ intensity	No	The scope of the biological assessment was an out-of-season, reconnaissance flora and vegetation assessment with targeted survey for species and ecological communities of conservation significance. A large proportion of the study area is significantly degraded from historical clearing and frequent disturbance during agricultural and rural-residential activities. While it is unlikely the study area would support the majority of Threatened and Priority flora identified from the desktop assessment given the degradation, the entirety of study area, where remnant vegetation remains was searched for Threatened and Priority flora.
Seasonal timing and climatic conditions	No	The field assessment for flora and vegetation was conducted on 10 March, which is considered sub-optimal timing for recording biological values in the region, including the majority of potentially occurring Threatened and Priority flora. However, despite the sub-optimal timing, given the high level of degradation within the study area and surrounds, it is considered unlikely that floristic values of significance would have been omitted from survey results. Similarly, it is considered that the values recorded during the March field survey would have been adequate to define the vegetation sufficiently to determine its conservation-significance.
Accessibility	No	The entirety of the study area was readily accessible by vehicle and on foot and all locations were able to be adequately surveyed.
Mapping reliability/ proportion of values identified/recorded based on survey extent	No	Mapping within the study area is at a scale based on ground-truthed areas, with limited extrapolation, given the good accessibility. Mapping reliability and the proportion of values identified and recorded based on scale and the extent of survey is considered high.
Disturbances that may have affected survey results	No	While much of the study area is highly degraded and subject to regular human disturbance, this is not considered a constraint, as regular activities would not further impact the current vegetation.
Survey completeness	No	The study area was thoroughly surveyed and only one area was found to support vegetation in 'Good' condition and thus the vegetation within the entire area was described using relevés and mapping notes. Most of the study area supports vegetation in poorer than 'Good' condition, that does not warrant quadrat sampling. Given that the 'Good' vegetation within the study area aligns well with the descriptions of habitat for several conservation significant flora, it is recommended that a follow-up targeted survey during a suitable season be carried out to determine whether any of the species occur there.

4 RESULTS

4.1 DESKTOP REVIEW

4.1.1 Threatened and Priority Flora

The DBCA database, NatureMap and DAWE EPBC Protected Matters search report identified 36 Threatened and Priority flora species with the potential to occur or previously recorded within 10 km of the study area (**Table 5**). These species comprise 13 Threatened flora pursuant to the Commonwealth EPBC Act and State *Biodiversity Conservation Act 2016* (BC Act), six Priority 2 species, ten Priority 3 species and seven Priority 4 species. Six conservation significant species (two Threatened species, one Priority 2, one Priority 3 and two Priority 4 species) were considered 'likely' to occur in the study area due to having been recorded in similar habitat and within proximity to the study area. Five species 'may occur' and the remaining 27 are considered 'unlikely' to occur in the study area (**Table 5**).

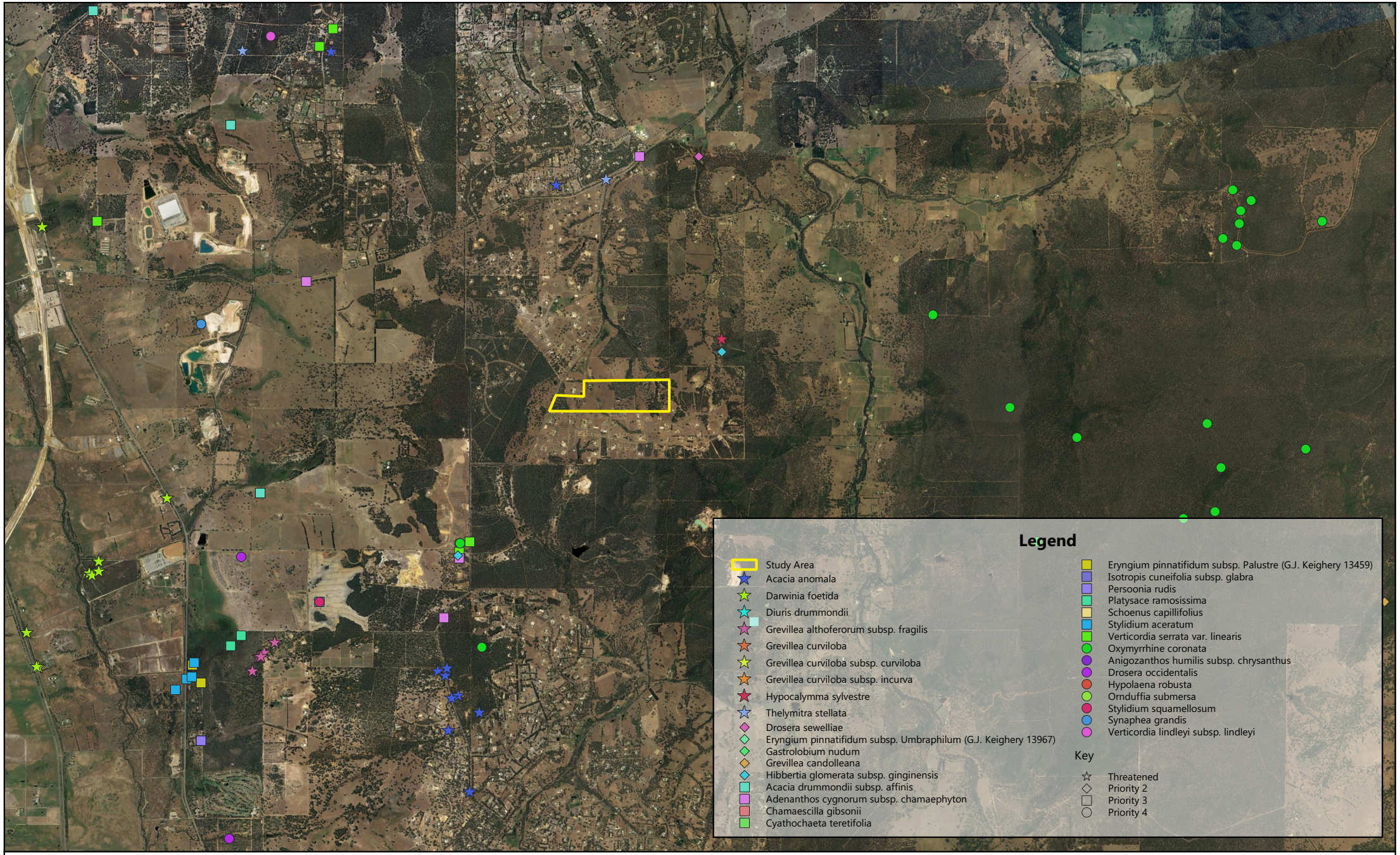
Table 5 - Threatened and Priority Flora with the Potential to Occur within the Study Area

Species	EPBC Act Conservation Status	BC Act/DBCA Conservation Status	Description	Habitat Preference	Likelihood of Occurrence	Source of Record
Darwinia foetida	Critically Endangered	Endangered	Erect or spreading shrub, 0.7 m high. Flowers green brown.	Brown sandy loam	Unlikely - due to natural population extent. Habitat may be present but likely to be degraded.	DBCA
Grevillea althoferorum subsp. *fragilis*	Endangered	Critically Endangered	Bluish-green shrub about 0.3 m high by 0.4 to 1 m wide. Flowers yellow	Open Jarrah/Marri Woodland	Unlikely - suitable habitat unlikely to occur	DBCA
Grevillea curviloba	Endangered	Critically Endangered	Prostrate to erect shrub, 0.1-2.5 m high. Flowers white-cream, October	Grey sand. Winter-wet heath. Open woodland *Melaleuca rhaphiophylla* to 4 m	Unlikely - suitable habitat unlikely to occur	EPBC DBCA
Thelymitra dedmaniarum	Endangered	Critically Endangered	Tuberous, perennial, herb, to 0.8 m high. Flowers yellow, November to December or January	Granite	Unlikely - suitable habitat unlikely to occur	EPBC
Diplolaena andrewsii	Endangered	Endangered	Erect shrub, 0.5-1 m high, inner involucral bracts glabrous, leaves broadly cordate. Flowers red, July to October	Loam, clay. Granite outcrops & hillsides.	Unlikely - suitable habitat unlikely to occur	EPBC
Diuris purdiei	Endangered	Endangered	Tuberous, perennial, herb, 0.15-0.35 m high. Flowers yellow, September to October	Grey-black sand, moist. Winter-wet swamps.	Unlikely - suitable habitat unlikely to occur	EPBC
Grevillea christineae	Endangered	Endangered	Erect, wiry shrub, 0.5-0.6 m high. Flowers white-cream, August to September	Clay loam, sandy clay, often moist.	Unlikely - suitable habitat unlikely to occur	EPBC
Hypocalymma sylvestre	Endangered	Endangered	Spreading shrub, 0.6 m high. Flowers yellow, August.	Yellow-brown sandy loam. Woodland on lateritic hilltop. Quartz ridge. Slopes. Powderbark wandoo woodland.	Likely - suitable habitat may occur. Closest record approximately 880 m north east of study area	DBCA
Thelymitra stellata	Endangered	Endangered	Tuberous, perennial, herb, 0.15-0.25 m high. Flowers yellow & brown, October to November	Sand, gravel, lateritic loam	Unlikely - suitable habitat unlikely to occur	EPBC DBCA
Chamelaucium lullfitzii (formerly *Chamelaucium* sp. Gingin (N.G. Marchant 6)	Endangered	Vulnerable	Erect branching shrub to 1.8m	Banksia Woodland. White/grey sand.	Unlikely - suitable habitat unlikely to occur	EPBC
Grevillea corrugata	Endangered	Vulnerable	Shrub, 1.5-2.5 m high. Flowers white, August to September	Gravelly loam. Roadsides.	Unlikely - suitable habitat unlikely to occur	EPBC

Species	EPBC Act Conservation Status	BC Act/DBCA Conservation Status	Description	Habitat Preference	Likelihood of Occurrence	Source of Record
Acacia anomala	Vulnerable	Vulnerable	Slender, rush-like shrub, 0.2-0.5 m high. Flowers yellow, August to September	Low open woodland of Jarrah, Wandoo and Marri over heath. Lateritic soils. Slopes. Brown sandy loam.	Likely - One cluster of distributions near Chittering. Suitable habitat likely to occur	EPBC DBCA
Diuris drummondii	Vulnerable	Vulnerable	Tuberous, perennial, herb, 0.5-1.05 m high. Flowers yellow, November to December or January	Low-lying depressions, swamps.	Unlikely - suitable habitat unlikely to occur	DBCA
Drosera sewelliae		P2	Fibrous-rooted, rosetted perennial, herb, to 0.06 m high, to 0.025 m wide. Flowers orange, October	Grows in laterite mixed with silica sand soils over sheet laterite rock.	May occur - suitable habitat may occur	DBCA
Eryngium pinnatifidum subsp. *umbraphilum*		P2	Tuberous herb. Flowers white; in flower.	Winter wet flats. Grey sandy clay.	Unlikely - suitable habitat unlikely to occur	DBCA
Gastrolobium nudum		P2	Spreading, twiggy shrub, to 0.8 m high. Flowers Orange & red, February	Red-brown clay, brown loam, gravel, laterite, granite. Flats, slopes, hilltops, ridges, valleys, breakaways.	May occur - suitable habitat may occur	DBCA
Grevillea candolleana		P2	Spreading shrub, 0.2-0.8 m high. Flowers white-cream, August to September.	Amongst tall (sclerophyll) shrubland; in rocky or stony soil, or loam.	May occur - suitable habitat may occur	DBCA
Hibbertia glomerata subsp. *ginginensis*		P2	Erect shrub, to 0.5 m high. Flowers yellow, July to September.	Sand, brown clay, laterite. Near roadsides.	Likely - suitable habitat may occur. Closest record approximately 700 m north east of study area	DBCA NatureMap
Stylidium squamellosum		P2	Caespitose perennial, herb, 0.12-0.35 m high. Flowers yellow, October to November	Brown to red-brown clay loam. Winter-wet habitats	Unlikely - suitable habitat unlikely to occur	DBCA
Acacia drummondii subsp. *affinis*		P3	Erect shrub, 0.3-1 m high. Flowers yellow, July to August	Lateritic gravelly soils.	May occur - suitable habitat likely to occur	DBCA
Adenanthos cygnorum subsp. *chamaephyton*		P3	Prostrate, mat-forming, non-lignotuberous shrub, to 0.3 m high. Flowers white-cream-pink-green/green, July or September to December or January.	Grey sand, lateritic gravel.	May occur - suitable habitat likely to occur	DBCA
Chamaescilla gibsonii		P3	Clumped tuberous, herb. Flowers blue, September.	Clay to sandy clay. Winter-wet flats, shallow water-filled claypans.	Unlikely - closest occurrence approx. 9 km west	DBCA

Species	EPBC Act Conservation Status	BC Act/DBCA Conservation Status	Description	Habitat Preference	Likelihood of Occurrence	Source of Record
Cyathochaeta teretifolia		P3	Rhizomatous, clumped, robust perennial, grass-like or herb (sedge), to 2 m high, to 1.0 m wide. Flowers brown.	Grey sand, sandy clay. Swamps, creek edges.	Unlikely - suitable habitat unlikely to occur	DBCA
Eryngium pinnatifidum subsp. *palustre* (G.J. Keighery 6686)		P3	Tuberous perennial herb. Leaves mostly tubular.	Seasonally wet poorly drained flat. Black sand.	Unlikely - suitable habitat unlikely to occur	DBCA
Isotropis cuneifolia subsp. *glabra*		P3	Prostrate to ascending, spreading perennial, herb or shrub, 0.05-0.15 m high. Flowers yellow/orange & red, September	Sand, clay loam. Winter-wet flats	Unlikely - suitable habitat unlikely to occur	DBCA
Persoonia rudis		P3	Erect, often spreading shrub, 0.2-1 m high. Flowers yellow, September to December or January	White, grey or yellow sand, often over laterite.	Unlikely - suitable habitat unlikely to occur	DBCA
Platysace ramosissima		P3	Perennial, herb, to 0.3 m high. Flowers white-cream, October to November.	Sandy soils.	Unlikely - suitable habitat unlikely to occur	DBCA
Schoenus capillifolius		P3	Semi-aquatic tufted annual, grass-like or herb (sedge), 0.05 m high. Flowers green, October to November.	Brown mud. Claypans. Seasonal Wetland.	Unlikely - suitable habitat unlikely to occur	DBCA
Stylidium aceratum		P3	Fibrous rooted annual, herb, 0.05-0.09 m high, leaves spathulate. Flowers pink/white, October to November	Sandy soils. Swamp heathland.	Unlikely - suitable habitat unlikely to occur	DBCA
Verticordia serrata var. *linearis*		P3	Shrub, to 1 m high, differs from other varieties in the linear acuminate leaves 6-20 mm long; cilia to 1.2 mm long. Flowers other, September to October.	White sand, gravel. Open woodland.	Likely - suitable habitat unlikely to occur	DBCA
Anigozanthos humilis subsp. *chrysanthus*		P4	Rhizomatous, perennial, herb, 0.2-0.4(-0.8) m high. Flowers yellow, July to October.	*Corymbia calophylla* mid open woodland. Low Banksia spp. woodland. Grey or yellow sand.	Unlikely - suitable habitat unlikely to occur	DBCA
Drosera occidentalis		P4	Fibrous-rooted, rosetted perennial, herb, to 0.025 m high. Flowers pink/white, October to December or January.	Swampy flats. White/black sand over yellow clay.	Unlikely - suitable habitat unlikely to occur	DBCA
Hypolaena robusta		P4	Dioecious rhizomatous, perennial, herb, ca 0.5 m high. Flowers September to October	White sand. Sandplains.	Unlikely - suitable habitat unlikely to occur	DBCA
Ornduffia submersa		P4	Aquatic annual, 0.3 cm high..	Winter wetland	Unlikely - suitable habitat unlikely to occur	DBCA

Species	EPBC Act Conservation Status	BC Act/DBCA Conservation Status	Description	Habitat Preference	Likelihood of Occurrence	Source of Record
Oxymyrrhine coronata		P4	Erect open shrub 40 cm high, flowers pink and white.	Hillslope, laterite	Likely - suitable habitat likely to occur. Numerous records within 4 km	DBCA
Synaphea grandis		P4	Tufted shrub, ca 0.3 m high. Flowers yellow, October to November.	Laterite. Wandoo woodland	Likely - suitable habitat likely to occur	DBCA
Verticordia lindleyi subsp. *lindleyi*		P4	Erect shrub, 0.2-0.75 m high. Flowers pink, May or November to December or January	Winter-wet depressions. Grey - brown sandy clay, swamp.	Unlikely - suitable habitat unlikely to occur	DBCA



GDA 94 / MGA Zone 50

Figure 7 - Previously Recorded Threatened and Priority Flora

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4.1.2 Threatened Ecological Communities

A review of the DBCA Threatened and Priority Ecological Communities (TECs and PECs) database and the EPBC PMST database (DAWE 2021a) identified nine Threatened or Priority Ecological Communities that are known to occur within 10 km of the study area (**Table 6**). Results comprised nine Commonwealth-listed TECs, six State-listed TECs and three communities listed as Priority 3 PECs. The TECs and PECs identified through the database searches are described in **Table 6** and the known extent of the State-listed TECs and PECs returned from DBCA database searches is presented in **Figure 8**.

Table 6 – Summary of TECs and PECs Occurring Within the Study Area

Abbreviation	Community Name	EPBC Cons. Status	WA Cons. Status
Banksia Woodlands TEC	Banksia Woodlands of the Swan Coastal Plain IBRA region ecological community (Banksia woodlands TEC)	Endangered	Priority 3
SCP07	Herb rich saline shrublands in clay pans (floristic community type 7 as originally described in Gibson *et al.* (1994))	Critically Endangered	Vulnerable
SCP08	Herb rich shrublands in clay pans (floristic community type 8 as originally described in Gibson *et al.* (1994))	Critically Endangered	Vulnerable
SCP3c	*Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain (floristic community type 3c as originally described in in Gibson *et al.* (1994))	Endangered	Critically Endangered
Mound Springs SCP	Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain)	Endangered	Critically Endangered
Muchea Limestone	Shrublands and woodlands on Muchea Limestone of the Swan Coastal Plain	Endangered	Endangered
SCP3a	*Corymbia calophylla - Kingia australis* woodlands on heavy soils, Swan Coastal Plain (floristic community type 3a as originally described in Gibson *et al.* (1994))	Endangered	Critically Endangered
SCP23b	Swan Coastal Plain *Banksia attenuata - Banksia menziesii* woodlands	Endangered (part of Banksia WL TEC)	Priority 3
SCP25	Southern *Eucalyptus gomphocephala-Agonis flexuosa* woodlands	Endangered (part of Banksia WL TEC)	Priority 3

Of the TECs and PECs listed in **Table 6**, one buffered occurrence of the Commonwealth-listed (Endangered) Banksia Woodlands of the Swan Coastal Plain IBRA region ecological community (Banksia woodlands TEC) intersects the study area (**Figure 8**).

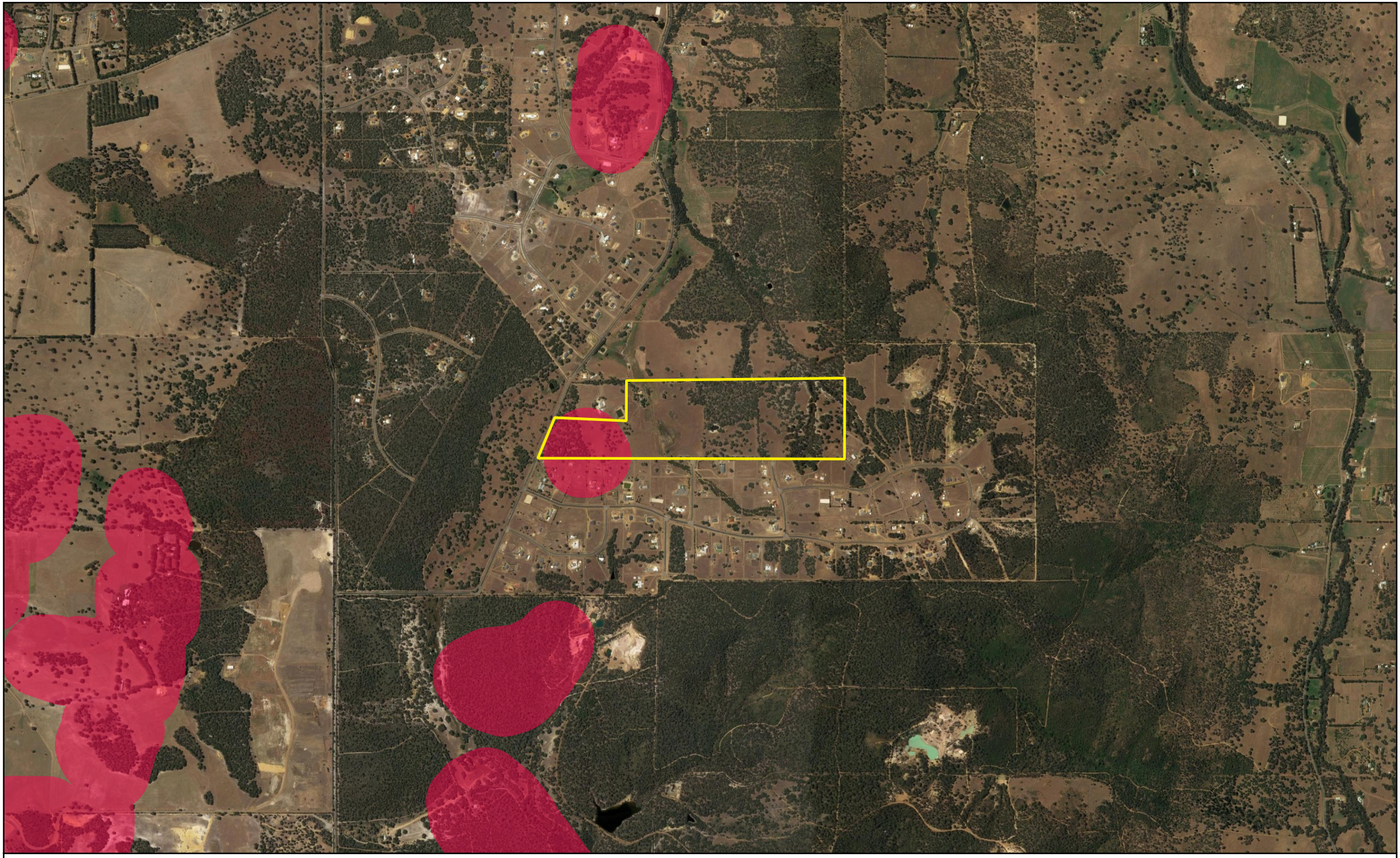


Figure 8 - Threatened Ecological Communities

4.1.2.1 ***Banksia Woodlands of the Swan Coastal Plain TEC***

The *Banksia Woodlands of the Swan Coastal Plain Ecological Community* (Banksia woodlands TEC) was approved for inclusion as Endangered under the EPBC Act on 16 September 2016. The ecological community is a woodland associated with some soils of the Swan Coastal Plain with a prominent tree layer of Banksia with scattered Eucalypts and other tree species among or emerging above the canopy. The understorey is comprised of a species rich mix of sclerophyllous shrubs, graminoids and forbs (Threatened Species Scientific Committee 2016).

The Banksia woodlands TEC is largely restricted to the Swan Coastal Plain IBRA bioregion, within the Perth (SWA02) and Dandaragan (SWA01) sub-regions. It extends into the adjacent Jarrah Forrest IBRA region (JF01 and JF02 sub-regions) and areas of the Whicher and Darling escarpments where pockets of Banksia woodland may occur. This TEC mainly occurs on deep Bassendean and Spearwood sands or occasionally on Quindalup sands at the eastern edge (Threatened Species Scientific Committee 2016).

Twenty-one Floristic Community Types (FCTs) (broad plant communities) described by Gibson *et al*. (1994), in Bush Forever (Government of Western Australia 2000), Keighery *et al*. (2008) and Urban Bushland Council (2011) best correspond to the Banksia woodlands TEC (Threatened Species Scientific Committee 2016) and these are summarised in **Table 7**.

Table 7 - Floristic Community Types corresponding to the Banksia Woodlands TEC

FCT	FCT Name	WA TEC/PEC	EPBC TEC
Supergroup 3 – Uplands centred on Bassendean Dunes and Dandaragan Plateau			
20a	*Banksia attenuata* woodlands over species rich dense shrublands	Endangered	
20b	Eastern *Banksia attenuata* and/or *Eucalyptus marginata* woodlands	Endangered	
20c	Eastern shrublands and woodlands	Critically Endangered	Endangered
21a	Central *Banksia attenuata* - *Eucalyptus marginata* woodlands		
21b	Southern *Banksia attenuata* woodlands	P3	
21c	Low lying *Banksia attenuata* woodlands or shrublands	P3	
22	*Banksia ilicifolia* woodlands	P2	
23a	Central *Banksia attenuata* - *Banksia menziesii* woodlands		
23b	Northern *Banksia attenuata* - *Banksia menziesii* woodlands	P3	
23c	North-eastern *Banksia attenuata* - *Banksia menziesii* woodlands		
S09	*Banksia attenuata* woodlands over dense low shrublands		
Supergroup 4 – Uplands centred on Spearwood and Quindalup Dunes			
24	Northern Spearwood shrublands and woodlands	P3	
25	Southern *Eucalyptus gomphocephala – Agonis flexuosa* woodlands	P3	
28	Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus* woodlands		
Whicher Scarp FCTs (Keighery *et al.* 2008)			
A1	Central Whicher Scarp Mountain Marri Woodland WHSFCT_A1	P1	
A2	North Whicher Scarp Jarrah and Woody Pear woodland WHSFCT_A2		
A3	North Whicher Scarp *Banksia* and Woody Pear woodland WHSFCT_A3		
A4	Whicher Scarp *Banksia grandis*, Jarrah and Marri woodland WHSFCT_A4		
B1	Swan Coastal Plain /North Whicher Scarp *Banksia attenuata* woodland WHSFCT_B1		
B2	West Whicher Scarp *Banksia attenuata* woodland WHSFCT_B2		
C2	Whicher Scarp Jarrah woodland on deep coloured sands WHSFCT_C2		

4.2 FIELD ASSESSMENT

4.2.1 Flora

A total of 90 flora species were recorded within the study area, from 67 genera and 31 families. The dominant families were found to be Fabaceae (10 taxa), Poaceae (10 taxa) and Cyperaceae (7 taxa). The total includes 70 (77.78%) native species and 20 (22.22%) introduced (weed) species. Individual relevé data is presented in **Appendix C** and the full list of vascular flora recorded is presented in **Appendix D**.

No species of Threatened or Priority flora were recorded during the March field assessment.

None of the recorded weeds are listed as Weed of National Significance (WoNS) nor are any Declared Pests (plants) listed under the *Biosecurity and Agricultural Management Act* (BAM Act) (Department of Primary Industries and Regional Development (DPIRD) 2020).

None of the recorded flora species are exhibiting an extension beyond their current documented range, in accordance with records of the WA Herbarium (WAH 2020).

4.2.2 Vegetation Units

Twelve vegetation units were defined and mapped within the study area. This comprised of six Woodlands, one Dampland, one Drainage-line, three Parkland units and one Planted (non-endemic) unit. Each vegetation unit is described in **Table 8** and their spatial extents within the study area are presented in **Figure 9**.

Table 8 – Summary of Recorded Vegetation Units

Broad Vegetation Type	Unit Code	Vegetation Unit and Description	Representative Relevé	Area (ha)	Proportion of Study Area (%)
Woodland	**EmCc**	*Eucalyptus marginata* and *Corymbia calophylla* Low Forest over *Xanthorrhoea preissii* Tall Isolated Shrubs.	R01	5.27	9.76
	EmXa	*Eucalyptus marginata* and *Corymbia calophylla* Low Forest over *Xanthorrhoea* ?*acanthostachya* Sparse Shrubland over *Hakea lissocarpha* Low Sparse Shrubland.	R02	0.42	0.78
	EmEw	*Eucalyptus marginata* and *Eucalyptus wandoo* subsp. *wandoo* with occasional *Corymbia calophylla* Low Open Forest over *Hibbertia* ?*huegellii* and *Hibbertia lasiopus* Low Isolated Shrubs over **Ehrharta calycina* and **Poa annua* Low Sparse Grassland.	R03	10.33	19.12
	EsppXa	*Eucalyptus wandoo* and *Eucalyptus marginata* over *Xanthorrhoea* ?*acanthostachya* over *Daviesia decurrens, Hakea lissocarpha* and *Hibbertia hypericoides* Low Open Shrubland.	R07	3.51	6.50
	EwBa	*Eucalyptus marginata* and *Eucalyptus wandoo* subsp. *wandoo* Low Woodland over *Xanthorrhoea* ?*acanthostachya* Open Shrubland over *Banksia armata* subsp. *armata* Low Open Shrubland.	R09	2.50	4.61
	EwEa	*Eucalyptus wandoo* subsp. *wandoo and Eucalyptus accedens* Low Open Woodland over *Xanthorrhoea* ?*acanthostachya* Sparse Shrubland.	R10	0.71	1.31
Dampland	**JpCp**	*Juncus pallidus* and *Cyperus polystachyos* Tall Sedgeland / Sedgeland over *Gnaphalium indutum* Low Isolated Forbs with occasional patches of *Typha orientalis.*	R06	1.06	1.97
Drainage-line	**JpCsp**	*Juncus pallidus* and Cyperaceae sp. Open Sedgeland over Low Isolated Forbs and Tussock Grasses.	R08	0.12	0.22
Parkland Cleared	**EaP**	Isolated *Eucalyptus accedens* over **Poa annua*, **Avena fatua* and other weeds and introduced grasses.	R04	0.13	0.24
	CcP	Isolated *Corymbia calophylla* over **Poa annua, *Avena fatua* and other weeds and introduced grasses.	NA	0.77	1.43
	EmP	Isolated *Eucalyptus marginata* over **Poa annua, *Avena fatua* and weeds and introduced grasses.	NA	0.10	0.18
Planted	**PL**	Agricultural areas including an old citrus orchard and scattered plantings of *Schinus molle, Brachychiton acerifolius, Delonix regia* and *Eriobrotya japonica.*	R05	2.27	4.20
Cleared	**CC**	Completely cleared areas supporting few, if any native species and numerous introduced grasses and forbs.	NA	26.85	49.68
			Total	**54.04**	**100**

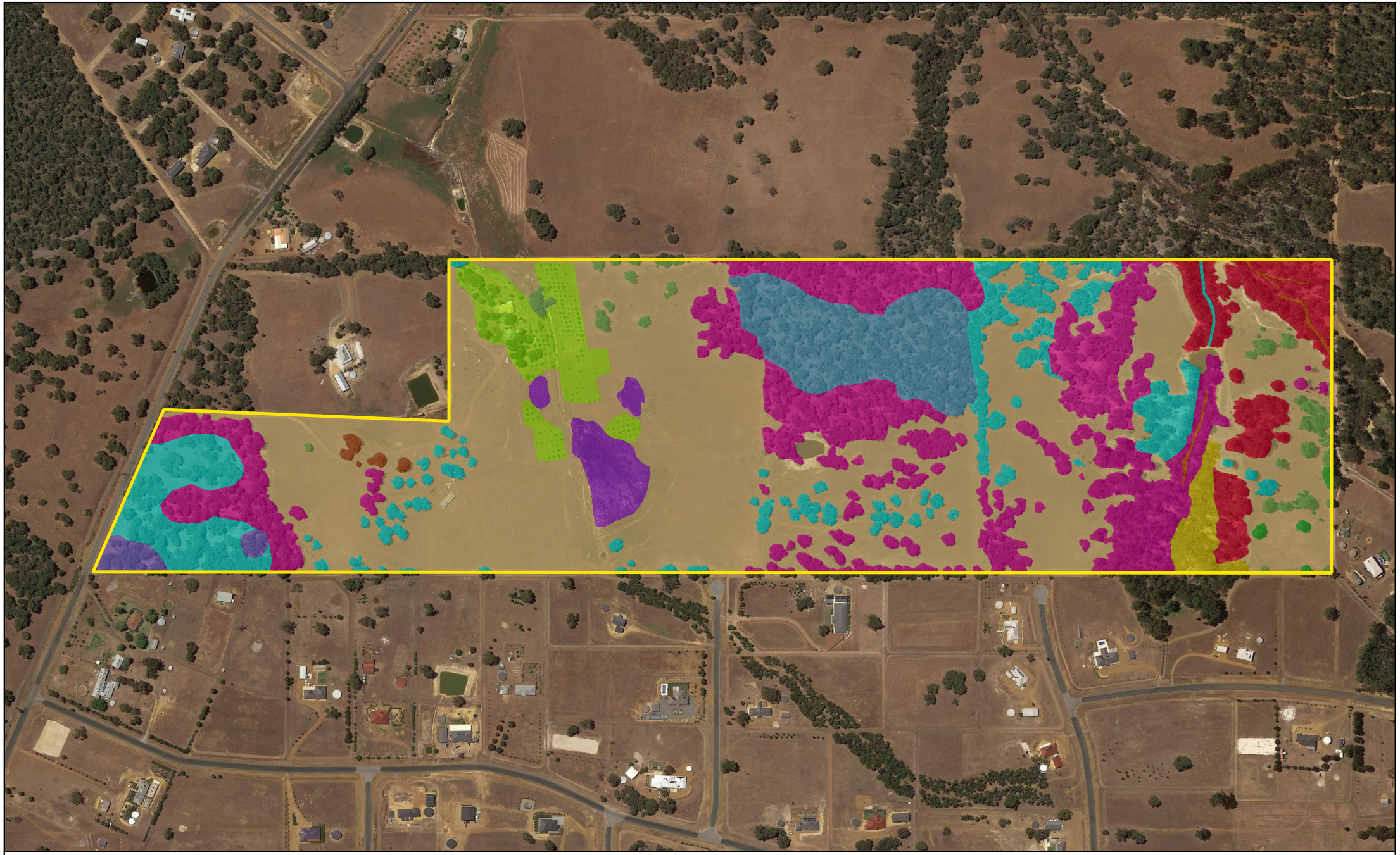


Figure 9 - Vegetation Units

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4.2.3 Vegetation Condition

The vegetation condition of the study area was found to range from 'Completely Degraded' (CD) to 'Good' (G), with the majority of the study area (85.82%) found to be in 'Degraded' (D) or poorer condition. The majority of the study area has been highly modified, and a large proportion of the study area (at least 53.89%) has previously been cleared. The spatial extent of the varying vegetation condition across the project area is presented in the **Figure 10** and the areas of each condition category are presented in **Table 8**.

Table 9 – Summary of Vegetation Condition

Vegetation Condition	Area (ha)	Area (%)
Good	0.47	0.86
Degraded - Good	7.20	13.33
Degraded	12.90	23.88
Completely Degraded - Degraded	4.35	8.04
Completely Degraded	29.12	53.89
Total	**54.04**	**100**

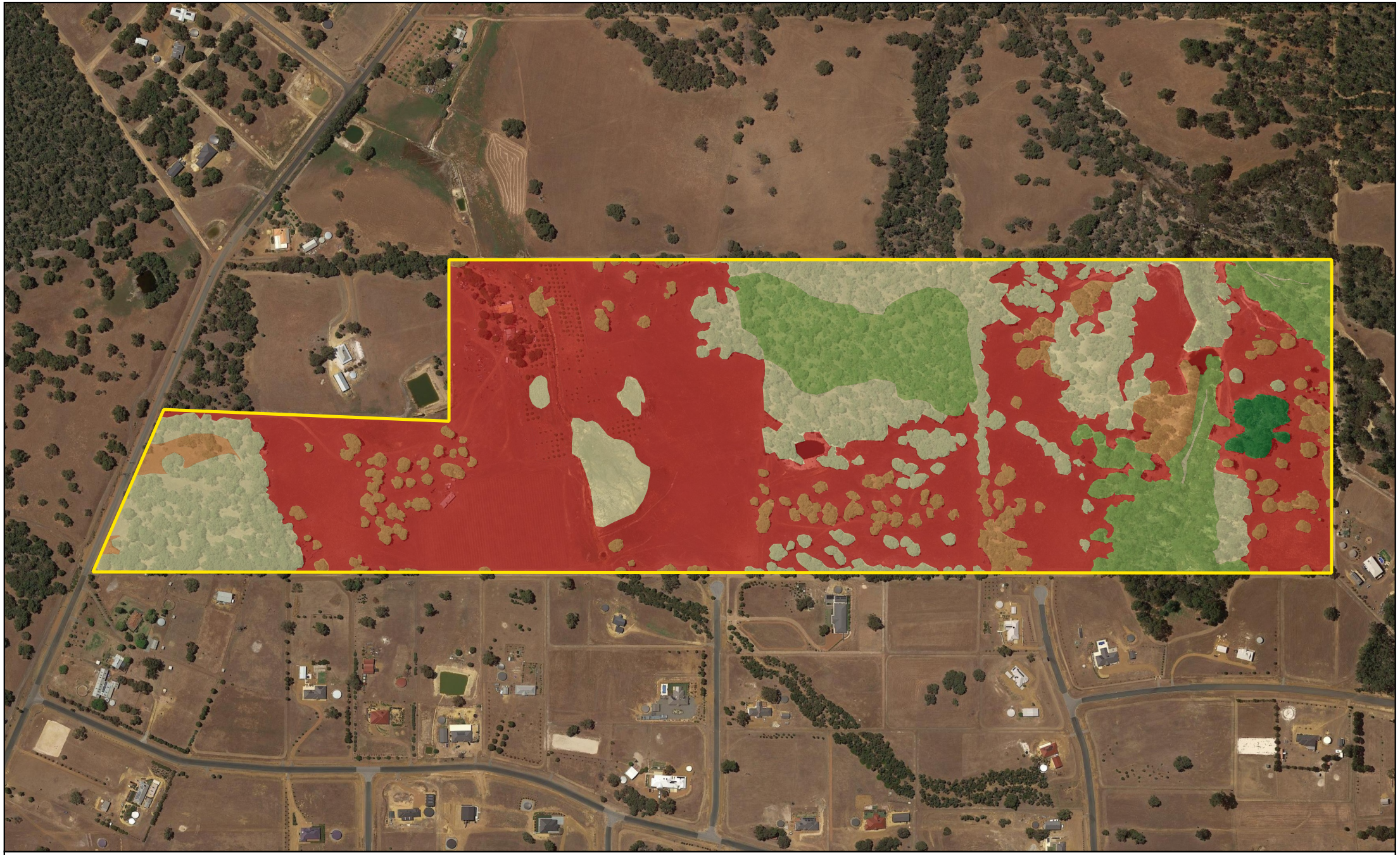


Figure 10 - Vegetation Condition

5 DISCUSSION

5.1 FLORA

A total of 90 flora species were recorded within the study area, from 67 genera and 31 families. Six taxa could only be identified to family and eight to genus due to poor material, although not unexpected for the seasonal conditions. The dominant families of Fabaceae, Poaceae and Cyperaceae are considered typical for the region. The total includes 77.78% native species and 22.22% introduced (weed) species, based on data collected within areas supporting at least some native vegetation.

No species of Threatened or Priority flora were recorded during the out-of-season field assessment, although a follow-up survey within the better-condition areas of vegetation, during spring is recommended.

None of the recorded flora species are exhibiting an extension beyond their current documented range, in accordance with records of the WA Herbarium (WAH 2020).

The relatively high proportion of weeds can be attributed to the highly disturbed and cleared nature of the majority of the study area. None of the recorded weeds are listed as Weed of National Significance (WoNS) or are Declared Pests (plants) listed under the *Biosecurity and Agricultural Management Act* (BAM Act) (Department of Primary Industries and Regional Development (DPIRD) 2020).

Two habitats within the study area, the low-lying swamps and the upland lateritic woodlands, are considered to potentially provide habitat for Threatened or Priority Flora, based on habitat preferences. However, following the field survey, it was ascertained that the majority of the low-lying swamp areas are highly modified and disturbed and are therefore actually considered unlikely to provide suitable habitat for Threatened or Priority Flora.

The Jarrah, Marri and Wandoo woodlands of the study area, especially the areas mapped as 'Good' condition are considered to potentially support six conservation significant species including two Threatened species (*Hypocalymma sylvestre* and *Acacia anomala*), one Priority 2 species (*Hibbertia glomerata* subsp. *ginginensis*), one Priority 3 species (*Verticordia serrata* var. *linearis*) and two Priority 4 flora (*Oxymyrrhine coronata* and *Verticordia lindleyi* subsp. *lindleyi*).

Hypocalymma sylvestre (Endangered EPBC Act; Endangered BC Act) is considered likely to be present within the study area and flowers in August. However, given its relatively distinct vegetative form, this species is likely to have been evident and identifiable in the field during the March survey, even in the absence of flowering material. The habitat recorded in 'Good' condition (vegetation unit EwBa) is considered to potentially support this species, and therefore, further survey to target this species during suitable seasonal timing may be justified.

Acacia anomala potentially occurs within vegetation unit EwBa. However given the species' slender, rush-like form, this species would be less easily detected outside the peak flowering period (August to September), further survey to target this species during suitable seasonal timing may be justified.

5.2 VEGETATION

The project area supports 12 vegetation units of varying condition, comprised of six Woodlands, one Dampland, one Drainage-line, three Parkland units and one Planted (non-endemic) unit. A large proportion of the study area has been previously cleared for farming and grazing. The areas of remnant vegetation occur mostly in the eastern portion of the study area, higher in the landscape, whilst the planted vegetation occurs in flatter areas, adjacent to an abandoned farm dwelling.

The vegetation condition of the study area was found to range from 'Completely Degraded' (CD) to 'Good' (G), with the majority of the study area (85.82%) found to be in 'Degraded' (D) or poorer condition. Such results are typical of highly modified sites such as the study area, with a large proportion (53.89%) that has been previously cleared.

Most of the study area has been subject to clearing and agricultural use. Areas of better condition vegetation are limited to the north and eastern fringes of the study area and surrounds, mostly adjacent to fire breaks. The intact nature and better condition vegetation in the areas where this persists is attributed to the reduced edge effect from weeds and disturbance from adjacent infrastructure and other land uses.

5.2.1 Threatened and Priority Ecological Communities

A review of the DBCA Threatened and Priority Ecological Communities (TECs and PECs) database and the EPBC PMST database (DAWE 2021a) identified nine Threatened or Priority Ecological Communities that are known to occur within 10 km of the study area. Of these, the DBCA database desktop assessment revealed one buffered occurrence of the Commonwealth-listed Banksia Woodland TEC within the study area.

The occurrence or potential occurrence of these TECs and PECs within the study area is discussed in the following sections.

5.2.1.1 *Banksia Woodlands TEC*

The Banksia woodlands TEC is associated with some soils of the Swan Coastal Plain and has a prominent tree layer of Banksia with other tree species and an understorey of sclerophyllous shrubs, graminoids and forbs (DEE 2016). The desktop assessment indicated that the TEC buffer intersects with the study area.

DBCA (2021) data shows that this vegetation unit may occur within the western boundary of the study area, however, no Banksia species aligning with the TEC's characteristics were recorded during the field survey. No Banksia woodland units were defined or mapped within the study area and therefore, it can be concluded that this TEC does not occur within the study area.

5.2.1.2 *SCP 23b- Swan Coastal Plain Banksia attenuata – Banksia menziesii Woodlands (part of Banksia woodlands TEC)*

The SCP 23b community is characterised by a woodland of *Banksia attenuata* with *Banksia menziesii* and occurs on the Bassendean soils system (DEE 2016).

There were no *Banksia attenuata* or *Banksia menziesii* recorded within the study area and as for the Banksia woodland TEC discussed above, it can be concluded that this PEC does not occur within the study area.

5.2.1.3 *Herb Rich Saline Shrublands in Clay Pans (Community Type 7 (SCP07))*

This ecological community occurs on heavy clay soils that are generally inundated from winter to mid-summer. In early spring, many of the sites in this vegetation community are covered by free water up to 30 cm deep. Aquatic species are common in this vegetation community early in the growing season. *Cotula coronopifolia* (water buttons) can form yellow floating mats in some pools while others are dominated by *Ornduffia submersa*. As the wetland dries, a succession of species such as *Centrolepis* spp. and annual *Stylidium* spp. (trigger plants) successively germinate, grow and flower, resulting in an extended flowering period of over three months (DPaW 2015).

Structurally, this vegetation community type is quite variable, ranging from woodlands to herblands, the most common overstorey taxa being *Melaleuca viminea*, *Melaleuca uncinata* (broom bush), *Melaleuca cuticularis* (saltwater paperbark) or *Casuarina obesa* (swamp sheoak). The species saltwater paperbark and swamp sheoak may indicate some saline influence for at least some part of the year (DPaW 2015).

Typical species in the understorey include the common herbs, *Brachyscome bellidioides*, *Centrolepis polygyna* (wiry centrolepis), *Pogonolepis stricta* and water buttons (*Cotula* spp.). In addition, species such as *Angianthus* aff. *drummondii*, *Eryngium pinnatifidum* subsp. *palustre* and *Blennospora drummondii* occur in low frequency (<50%) and are absent from the other four constituent vegetation community types of the TEC (SCP08, SCP09, SCP10a and 117) (DPaW 2015).

There are no wetlands or areas of inundation typical of this ecological community within the study area. Furthermore, none of the defined vegetation units support a species assemblage that would suggest representation of this TEC within the study area.

5.2.1.4 *Herb Rich Shrublands in Clay Pans (Community Type 8 (SCP08))*

This vegetation community type occurs in low lying flats with a clay impeding layer allowing seasonal inundation. While aquatic annuals are common, the pools are probably not inundated to the same depth or for the same length of time as in ecological community type 7 (DPaW 2015). This vegetation community type is dominated by one or more of the shrubs: *Viminaria juncea*, *Melaleuca viminea*, *Melaleuca lateritia*, *Kunzea micrantha* or *Kunzea recurva* with occasional emergents of *Eucalyptus wandoo* (wandoo). Species such as *Hypocalymma angustifolium*, *Acacia lasiocarpa* var. *bracteolata* and *Verticordia huegelii* occur at moderate frequencies. This vegetation community type has a high percentage of weeds and appears to be the clay pan vegetation community type that has the greatest disturbance (DPaW 2015).

There are no inundated clay flats typical of this ecological community within the study area. Furthermore, none of the defined vegetation units support a species assemblage that would suggest representation of this TEC within the study area.

5.2.1.5 *SCP 3a - Corymbia calophylla - Kingia australis woodlands on heavy soils, Swan Coastal Plain*

This community is found on heavy soils on the eastern side of the Swan Coastal Plain between Waroona and Forrestfield. It is dominated by *Corymbia calophylla* and often supports *Banksia* (was *Dryandra*) *nivea, Philotheca spicata* (was *Eriostemon spicataus*), *Kingia australis* and *Xanthorrhoea preissii* (CALM 2000).

This TEC has not been previously mapped within proximity to the study area. *Corymbia calophylla* woodlands were recorded within the study area in association with *Xanthorrhoea preissii* but none with *Kingia australis* and any of the other species typical for this community. Due to a lack of relevant dominant species combinations unsuitable soils that could represent this TEC, it is considered highly unlikely that SCP 3a is represented within the study area.

5.2.1.6 *SCP 3c - Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands, Swan Coastal Plain*

The SCP 3c community is found on heavy soils on the eastern side of the Swan Coastal Plain between Bullsbrook and Stratham. It is dominated by *Corymbia calophylla* and *Xanthorrhoea preissii* occasionally with *Eucalyptus wandoo*. The most common shrub species are *Gompholobium marginatum, Hypocalymma angustifolium* and *Banksia dallanneyi* (DBCA 2021d).

Some of the mapped vegetation types support *Corymbia calophylla* and *Xanthorrhoea preissii,* however, none of the extents of such vegetation have been mapped on the Swan Coastal Plain and none are on heavy (clay or clayey sands) soils as are characteristic of this TEC. Therefore, it can be concluded that the SCP 3c community is unlikely to be represented in the study area.

5.2.1.7 *Mound Springs SCP*

The Mound Springs SCP TEC is characterised by a continuous discharge of groundwater in raised areas of peat. Flora species recorded in this community include *Banksia littoralis, Melaleuca preissiana* and *Eucalyptus rudis* with *Agonis linearifolia, Pteridium esculentum, Astartea fascicularis* and *Cyclosorus interruptus*. Several non-vascular plants are also associated with this community (CALM 2006). The known locations of this community are in Bullsbrook, Ellenbrook and Muchea.

None of the flora species typical of this TEC were recorded during the field assessment and therefore, it can be concluded that this TEC is not represented within the study area.

5.2.1.8 ***SCP 25 - Southern Eucalyptus gomphocephala - Agonis flexuosa Woodlands***

The Southern *Eucalyptus gomphocephala - Agonis flexuosa* woodlands (SCP 25) is centred on the Spearwood and Quindalup system (DBCA 2020d). The study area occurs on the Mogumber and Gabbla systems and none of the characteristic dominant species were recorded during the field surveys, therefore, this community is not considered to be supported by the study area.

5.2.1.9 ***Shrublands and Woodlands on Muchea Limestone***

The Shrublands and Woodlands on Muchea Limestone occurs on the heavy soils of the eastern side of the Swan Coastal Plain. Where the best developed limestone occurs, near Gingin, the plant community is located on shallow black clay or sandy clay soils on limestone. Typical and common native species are *Casuarina obesa, Eucalyptus decipiens, Eucalyptus foecunda, Melaleuca huegelii, Alyogyne huegelii* var. *huegelii, Grevillea curviloba, Grevillea evanescens, Melaleuca acerosa, Melaleuca huegelii* and *Thysanotus arenarius*. The following weeds are also common; *Hypochaeris glabra, Sonchus asper, Briza maxima, Briza minor, Anagallis arvensis* and *Centaurium erythraea* (English and Blyth 2000).

None of the characteristic species were recorded during the field surveys, therefore, this TEC is not considered to be represented within the study area.

5.2.2 Vegetation Representation

The Environmental Protection Authority's (EPA) Position Statement No. 2 lists a series of objectives which relate to biodiversity (EPA 2000). One of them is to protect at least 30% of the original extent of vegetation complexes in unconstrained areas and 10% in constrained areas (i.e. urban regions).

The EPA considers it is important that vegetation associations are maintained above a threshold level of 30% for unconstrained areas and 10% for constrained areas, of the original pre-clearing extent of each association (EPA 2008). Species loss appears to accelerate exponentially at the ecosystem level (EPA 2008) once the extent of vegetation associations drops below 30%.

Beard (1990) vegetation association 4 is represented by less than 30% of its original Pre-European extent within Western Australia (26.95%), the Jarrah Forest IBRA Region (27.09%) and the Shire of Chittering (25.77%). Similarly, in the Shire of Chittering, the Coolakin Complex in low rainfall in represented by less than 30% (26.65%). The areas that support these vegetation associations and complexes do not meet the EPA objective of vegetation retention for the purpose of biodiversity conservation.

6 CONCLUSIONS

The key findings arising from the flora and vegetation assessment of the study area are as follows:

- No Threatened or Priority flora species were recorded within the study area during the March field survey. The vegetation described as in 'Good' condition may support some of the species that occur in upland, lateritic woodlands, although these were not detected during the survey. The swampland vegetation may also support some conservation significant species but are less likely due to the levels of disturbance.
- The study area was found to support 12 vegetation units of varying condition, comprising six Woodlands, one Dampland, one Drainge-line, three Parkland and one Planted vegetation unit. None are considered to be representative of any TEC or PEC identified through desktop database searches.

The following recommendation is provided which is based on the key results and findings of the assessment:

- A follow-up targeted flora survey during early spring is recommended to confirm that no species of conservation-significance occur within the better-quality vegetation remnants of the study area.

7 LIST OF PARTICIPANTS

The FVC personnel who contributed to the project are summarised in **Table 10**.

Table 10 – Project Team

Name	Qualification	Years of Relevant Experience	Role
Kellie Bauer–Simpson Principal Ecologist/Botanist	BSc. (Biological Science)	21	Project manager, report technical and authorisation review
Lisa Chappell Senior Botanist/Environmental Scientist	BEnvSc. (Hons) (Environmental Science)	18	Flora and vegetation field assessment, data analysis, report preparation
Jeni Alford Senior Botanist	BEnvSc. (Hons) (Applied Science)	40	Flora and vegetation field assessment, data analysis, report preparation
Margaret Collins Taxonomist	BSc. (Organic Chemistry and Microbiology) Masters (Biotechnology and Molecular Biology)	30	Flora identifications
Will Bauer–Simpson Technician/Advisor	Cert IV (Health and Safety)	9	Field safety and logistics planning, GIS and mapping
Megan Meadowcroft Administration		3	Data entry, report compilation

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APPENDIX A - DBCA NATURE MAP SEARCH REPORT

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 13/04/2021

Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	116° 04' 33" E,31° 35' 31" S
Buffer	2km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	3410	*Acacia lateriticola*			
2.	6314	*Andersonia lehmanniana*			
3.	6323	*Astroloma ciliatum (Candle Cranberry)*			
4.	6337	*Astroloma stomarrhena (Red Swamp Cranberry)*			
5.		*Cercophonius granulosus*			
6.	19775	*Hibbertia glomerata subsp. ginginensis*		P2	
7.	6374	*Leucopogon conostephioides*			
8.	8133	*Olearia elaeophila*			
9.	32716	*Olearia lehmanniana*			
10.	1318	*Thysanotus arbuscula*			
11.	4839	*Trymalium angustifolium*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

APPENDIX B - EPBC PROTECTED MATTERS SEARCH REPORT

Australian Government

Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

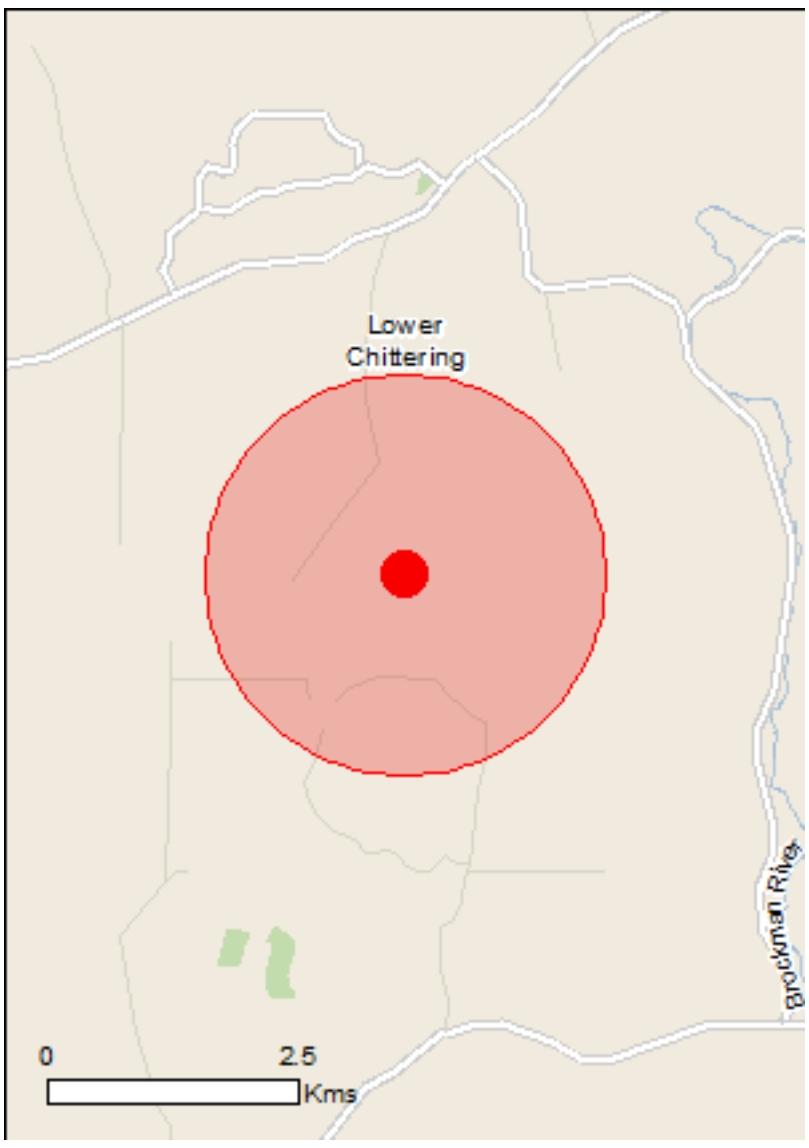
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 13/04/21 11:34:03

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

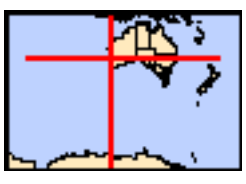
Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

Coordinates

Buffer: 2.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	18
Listed Migratory Species:	8

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	13
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	1
Invasive Species:	28
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Other		
Westralunio carteri Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat may occur within area
Plants		
Acacia anomala Grass Wattle, Chittering Grass Wattle [8153]	Vulnerable	Species or species habitat may occur within area
Chamelaucium sp. Gingin (N.G.Marchant 6) Gingin Wax [88881]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Diplolaena andrewsii [6601]	Endangered	Species or species habitat may occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
Grevillea christineae Christine's Grevillea [64520]	Endangered	Species or species habitat likely to occur within area
Grevillea corrugata a shrub [65445]	Endangered	Species or species habitat likely to occur within area
Grevillea curviloba subsp. curviloba Curved-leaf Grevillea [64908]	Endangered	Species or species habitat may occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat may occur within area
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Extra Information

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel		Species or species

Name	Status	Type of Presence
[129]		habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-31.5919 116.0758

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX C - RELEVÉ DATA

Site R01

Date	10 March 2021
Botanist	Lisa Chappell and Jeni Alford
Quadrat Size	10 x 10 m
NW Corner Coordinates	411445mE 6504320mN
Vegetation Unit	**EmCc** - *Eucalyptus marginata* and *Corymbia calophylla* Low Forest over *Xanthorrhoea preissii* Tall Isolated Shrubs
Slope	Gentle
Landform	Upper Slope
Soil Colour	Grey
Soil Type	Sand with laterite gravel
Litter	90%
Bare Ground	5%
Fire Age	>10 Years
Vegetation Condition	Degraded
Disturbances/Impacts	Historic clearing



Species	Height (m)	% Cover
Eucalyptus marginata	10	30
Corymbia calophylla	15	20
Xanthorrhoea preissii	2.2	1
Acacia pulchella var. *pulchella*		+
Adenanthos cygnorum subsp. indet.		+
Aira caryophyllea		+
Austrostipa x exilis		+
Boronia ovata		+
**Briza maxima*		+
Conostylis sp.		+
Drosera sp.		+
Hibbertia huegelii		+
Hibbertia lasiopus		+
Lepidosperma squamatum		+
Lomandra hermaphrodita		+
**Ursinia anthemoides*		+

Site R02

Date	10 March 2021
Botanist	Lisa Chappell and Jeni Alford
Quadrat Size	10 x 10 m
NW Corner Coordinates	411411mE 6504244mN
Vegetation Unit	**EmXa** - *Eucalyptus marginata* and *Corymbia calophylla* Low Forest over *Xanthorrhoea ?acanthostachya* Tall Isolated Shrubs
Slope	Moderate
Landform	Mid Slope
Soil Colour	Grey
Soil Type	Sand loam
Litter	20%
Bare Ground	1%
Fire Age	>10 Years
Vegetation Condition	Degraded
Disturbances/Impacts	Historic clearing



Species	Height (m)	% Cover
Corymbia calophylla	13	5
Eucalyptus marginata	10	25
Xanthorrhoea ?acanthostachya	2.2	4
Hakea lissocarpha	1.2	5
Avena fatua	0.15	10
**Romulea rosea*	0.10	5
Poaceae sp.	0.08	20
Acacia pulchella		Associated
Acacia pulchella var. *pulchella*		Associated
Agropyron scabrum		Associated
Astartea affinis		Associated
Banksia dallanneyi subsp. *dallanneyi* var. *dallanneyi*		Associated
Bossiaea eriocarpa		Associated
**Briza maxima*		Associated
Burchardia congesta		Associated
Cyperaceae sp.		Associated
Daviesia preissii		Associated
Dysphania pumilio		Associated
**Ehrharta calycina*		Associated
Ericaceae sp.		Associated
Haemodorum sp.		Associated
Hibbertia ? huegelii		Associated
Hibbertia commutata		Associated
Hibbertia hypericoides		Associated
Hibbertia hypericoides subsp. *septentrionalis*		Associated
Hibbertia lasiopus		Associated
Hovea trisperma		Associated
Hypochaeris glabra		Associated
Lagenifera huegelii		Associated
Lechenaultia biloba		Associated
Lechenaultia sp.		Associated
Lepidosperma tenue		Associated
Lomandra sp.		Associated
Olea europaea		Associated
Schoenus clandestinus		Associated
Solanum nigrum		Associated
Styphelia nitens		Associated
Tetraria octandra		Associated
Trifolium angustifolium var. *angustifolium*		Associated
Trymalium angustifolium		Associated
**Ursinia anthemoides*		Associated
Xanthorrhoea ?acanthostachya		Associated
Xanthorrhoea preissii		Associated

Site R03

Date	10 March 2021
Botanist	Lisa Chappell and Jeni Alford
Quadrat Size	10 x 10 m
NW Corner Coordinates	411583mE 6504298mN
Vegetation Unit	**EmEw** - *Eucalyptus marginata* and *Eucalyptus wandoo* with occasional *Corymbia calophylla* Low Open Forest over *Hibbertia ?huegelii* and *H. lasiopus* Low Isolated Shrubs over **Ehrharta calycina* and **Poa annua* Low Sparse Grassland.
Slope	Moderate
Landform	Upper Slope
Soil Colour	Brown
Soil Type	Sand loam
Litter	90%
Bare Ground	3%
Fire Age	>10 Years
Vegetation Condition	Completely Degraded - Degraded
Disturbances/Impacts	Historic clearing



Species	Height (m)	% Cover
Eucalyptus wandoo	15	20
Corymbia calophylla	15	10
Eucalyptus marginata	12	20
Hibbertia ? huegelii	0.3	1
Hibbertia lasiopus	0.3	1
**Ehrharta calycina*	0.08	1
**Romulea rosea*	0.08	1
**Poa annua*	0.06	1
Aira caryophyllea		+
Chamaecytisus palmensis		+
Cyperaceae sp.		+
Stipa elegantissima		+
Eucalyptus accedens		Associated
Xanthorrhoea ?acanthostachya		Associated

Site R04

Date	10 March 2021
Botanist	Lisa Chappell and Jeni Alford
Quadrat Size	10 x 10 m
NW Corner Coordinates	411704mE 6504377mN
Vegetation Unit	**EaP** - Isolated *Eucalyptus accedens* over **Poa annua, *Avena fatua* and other introduced weeds and grasses
Slope	Moderate
Landform	Mid Slope
Soil Colour	Brown
Soil Type	Loam
Litter	30%
Bare Ground	1%
Fire Age	>10 Years
Vegetation Condition	Completely Degraded - Degraded
Disturbances/Impacts	Historic clearing



Species	Height (m)	% Cover
Eucalyptus accedens	13	12
**Avena fatua*	0.10	10
**Poa annua*	0.10	5
**Romulea rosea*	0.08	10

Site R05

Date	10 March 2021
Botanist	Lisa Chappell and Jeni Alford
Quadrat Size	10 x 10 m
NW Corner Coordinates	411872mE 6504514mN
Vegetation Unit	**Planted** - Agricultural pursuits including an old citrus orchard and scattered plantings surrounding a farmhouse of **Schinus molle, *Brachychiton acerifolius, *Delonix regia* and *Eriobrotya japonica*
Slope	Gentle
Landform	Lower Slope
Soil Colour	Grey
Soil Type	Sand
Litter	20%
Bare Ground	50%
Fire Age	>10 Years
Vegetation Condition	Completely Degraded
Disturbances/Impacts	Historic clearing



Species	Height (m)	% Cover
**Schinus molle*	12	+
**Brachychiton acerifolius*	10	+
**Delonix regia*	10	+
**Eriobotrya japonica*	8	+
? *Euphorbiaceae* sp.		+
**Bougainvillea spectabilis*		+
Chenopodium sp.		+
**Citrus* x *lemon*		+
**Citrus* x *sinensis*		+
**Cucumis myriocarpus*		+
**Eragrostis curvula*		+
**Hibiscus rosa-sinensis*		+
**Poa annua*		+
**Cucumis* sp.		Associated
**Solanum nigrum*		Associated

Site R06

Date	10 March 2021
Botanist	Lisa Chappell and Jeni Alford
Quadrat Size	10 x 10 m
NW Corner Coordinates	411927mE 6504439mN
Vegetation Unit	**JpCp** - *Juncus pallidus* and *Cyperus polystachyos* Tall Sedgeland / Sedgeland over *Gnaphalium indutum* Low Isolated Forbs with occasional patches of *Typha orientalis*
Slope	Flat
Landform	Swamp
Soil Colour	Brown orange
Soil Type	Sand loam
Litter	30%
Bare Ground	10%
Fire Age	>10 Years
Vegetation Condition	Degraded
Disturbances/Impacts	Historic clearing



Species	Height (m)	% Cover
Junus pallidus	1.3	70
Cyperus polystachyos	0.8	15
Gnaphalium indutum		+
**Dittrichia graveolens*		+
Lobelia anceps		+
Typha orientalis		+

Site R07

Date	10 March 2021
Botanist	Lisa Chappell and Jeni Alford
Quadrat Size	10 x 10 m
NW Corner Coordinates	412432mE 6504577mN
Vegetation Unit	**EsppXa** - *Eucalyptus wandoo* subsp. *wandoo* and *Eucalyptus marginata* over *Xanthorrhoea ?acanthostachya* over *Daviesia decurrens, Hakea lissocarpha* and *Hibbertia hypericoides* Low Open Shrubland
Slope	Moderate
Landform	Upper Slope
Soil Colour	Brown
Soil Type	Loam
Litter	60%
Bare Ground	5%
Fire Age	>10 Years
Vegetation Condition	Degraded - Good
Disturbances/Impacts	Tracks



Species	Height (m)	% Cover
Eucalyptus wandoo subsp. *wandoo*	12	25
Eucalyptus marginata	8	10
Xanthorrhoea ? acanthostachya	2.2	10
Daviesia decurrens	0.6	10
Hakea lissocarpha	0.6	10
Hibbertia hypericoides	0.4	5
Banksia sessilis		+
Bossiaea eriocarpa		+
Conostylis aculeata		+
Hibbertia commutata		+
Hibbertia hypericoides subsp. *septentrionalis*		+
Petrophile striata		+
Banksia armata subsp. *armata*		Associated
Corymbia calophylla		Associated
Eucalyptus accedens		Associated
Macrozamia riedlei		Associated

Site R08

Date	10 March 2021
Botanist	Lisa Chappell and Jeni Alford
Quadrat Size	10 x 10 m
NW Corner Coordinates	412765mE 6504357mN
Vegetation Unit	**JpCsp** - *Juncus pallidus* and Cyperaceae sp. (sterile) Open Sedgeland over Low Isolated Forbs and Tussock Grasses
Slope	Flat
Landform	Valley Floor
Soil Colour	Pale orane
Soil Type	Sand
Litter	40%
Bare Ground	20%
Fire Age	>10 Years
Vegetation Condition	Degraded
Disturbances/Impacts	



Species	Height (cm)	% Cover
Juncus pallidus	1.1	10
Cyperaceae sp.	1.1	10
Cotula coronopifolia		+
Isolepis cernua var. *setiformis*		+
Lobelia anceps		+
Poa annua		+
Trifolium angustifolium var. *angustifolium*		+

Site R09

Date	10 March 2021
Botanist	Lisa Chappell and Jeni Alford
Quadrat Size	10 x 10 m
NW Corner Coordinates	412854 mE 6504421mN
Vegetation Unit	**EwBa** - *Eucalyptus marginata* and *Eucalyptus wandoo* Low Woodland over *Xanthorrhoea ?acanthostachya* Open Shrubland over *Banksia armata* subsp. *armata* Low Open Shrubland
Slope	Moderate
Landform	Upper Slope
Soil Colour	Brown
Soil Type	Sand
Litter	20%
Bare Ground	30%
Fire Age	5-10 Years
Vegetation Condition	Good
Disturbances/Impacts	Tracks, historic clearing



Species	Height (m)	% Cover
Eucalyptus marginata	8	10
Eucalyptus wandoo	14	10
Xanthorrhoea ? acanthostachya	2.3	10
Banksia armata var. *armata*	1.1	15
Hibbertia hypericoides	0.6	5
Hakea lissocarpha	0.5	10
Hibbertia lasiopus	0.2	2
Acacia pulchella		+
Acacia teretifolia		+
Boronia ovata		+
Conostylis aculeata		+
Cyperaceae sp.		+
Hibbertia ? huegelii		+
Myrtaceae sp.		+
Styphelia tenuiflora		+
Tetraria octandra		+

Site R10

Date	10 March 2021
Botanist	Lisa Chappell and Jeni Alford
Quadrat Size	10 x 10 m
NW Corner Coordinates	412805mE 6504279mN
Vegetation Unit	**EwEa** - *Eucalyptus wandoo* subsp. *wandoo and Eucalyptus accedens* Low Open Woodland over *Xanthorrhoea ?acanthostachya* Sparse Shrubland
Slope	Steep
Landform	Mid Slope
Soil Colour	pale brown
Soil Type	sand
Litter	50%
Bare Ground	10%
Fire Age	>10 Years
Vegetation Condition	Degraded - Good
Disturbances/Impacts	



Species	Height (m)	% Cover
Eucalyptus accedens	12	25
Eucalyptus wandoo subsp. *wandoo*	10	10
Xanthorrhoea ?acanthostachya		2

APPENDIX D – FLORA SPECIES BY VEGETATION UNIT

*denotes introduced (weed) species; DP denoted Declared Pest plant

Family Name	Species	EmCc	EmEw	EmXa	EsppXa	EwBa	EwEa	JpCsp	JpCp	Planted	CcP	EaP	EmP
Anacardiaceae	**Schinus* sp.									+			
Asparagaceae	*Lomandra hermaphrodita*	+											
Asparagaceae	*Lomandra* sp.			+									
Asteraceae	**Cotula coronopifolia*							+					
Asteraceae	**Dittrichia graveolens*								+				
Asteraceae	*Gnaphalium indutum*												
Asteraceae	**Hypochaeris glabra*			+									
Asteraceae	*Lagenifera huegelii*			+									
Asteraceae	**Ursinia anthemoides*	+		+									
Campanulaceae	*Lobelia anceps*							+	+				
Chenopodiaceae	*Chenopodium* sp.									+			
Chenopodiaceae	*Dysphania pumilio*			+									
Colchicaceae	*Burchardia congesta*			+									
Cucurbitaceae	**Cucumis myriocarpus*									+			
Cucurbitaceae	*Cucumis* sp.									+			
Cyperaceae	Cyperaceae sp.		+	+		+		+					
Cyperaceae	**Cyperus polystachyos*								+				
Cyperaceae	*Isolepis cernua* var. *setiformis*							+					
Cyperaceae	*Lepidosperma squamatum*	+											
Cyperaceae	*Lepidosperma tenue*			+									
Cyperaceae	*Schoenus clandestinus*			+									
Cyperaceae	*Tetraria octandra*			+		+							
Dasypogonaceae	*Kingia australis*		+	+									
Dilleniaceae	*Hibbertia ? huegelii*		+	+		+							
Dilleniaceae	*Hibbertia commutata*			+	+								
Dilleniaceae	*Hibbertia huegelii*	+											
Dilleniaceae	*Hibbertia hypericoides*			+	+	+							
Dilleniaceae	*Hibbertia hypericoides* subsp. *Septentrionalis*			+	+								
Dilleniaceae	*Hibbertia lasiopus*	+	+	+		+							
Droseraceae	*Drosera* sp.	+											
Ericaceae	Ericaceae sp.			+									
Ericaceae	*Styphelia nitens*			+									
Ericaceae	*Styphelia tenuiflora*					+							

Family Name	Species	EmCc	EmEw	EmXa	EsppXa	EwBa	EwEa	JpCsp	JpCp	Planted	CcP	EaP	EmP
Euphorbiaceae	?Euphorbiaceae sp.									+			
Fabaceae	*Acacia pulchella*			+		+							
Fabaceae	*Acacia pulchella* var. *pulchella*	+		+									
Fabaceae	*Acacia teretifolia*					+							
Fabaceae	*Bossiaea eriocarpa*			+	+								
Fabaceae	**Chamaecytisus palmensis*		+										
Fabaceae	*Daviesia decurrens*				+								
Fabaceae	*Daviesia preissii*			+									
Fabaceae	**Delonix regia*									+			
Fabaceae	*Hovea trisperma*			+									
Fabaceae	**Trifolium angustifolium* var. *angustifolium*			+				+					
Goodeniaceae	*Lechenaultia biloba*			+									
Goodeniaceae	*Lechenaultia* sp.			+									
Haemodoraceae	*Conostylis aculeata*				+	+							
Haemodoraceae	*Conostylis* sp.	+											
Haemodoraceae	*Haemodorum* sp.			+									
Iridaceae	**Romulea rosea*		+	+							+	+	+
Juncaceae	*Juncus pallidus*							+	+				
Malvaceae	*Brachychiton acerifolius*									+			
Malvaceae	*Brachychiton* sp.									+			
Malvaceae	*Hibiscus rosa-sinensis*									+			
Myrtaceae	*Astartea affinis*			+									
Myrtaceae	*Corymbia calophylla*	+	+	+	+						+		
Myrtaceae	*Eucalyptus accedens*		+		+		+						
Myrtaceae	*Eucalyptus marginata*	+	+	+	+	+							+
Myrtaceae	*Eucalyptus wandoo*		+		+	+							
Myrtaceae	*Eucalyptus wandoo* subsp. *wandoo*						+						
Myrtaceae	*Myrtaceae* sp.					+							
Nyctaginaceae	*Bougainvillea spectabilis*									+			
Oleaceae	**Olea europaea*			+									
Poaceae	*Agropyron scabrum*			+									
Poaceae	**Aira caryophyllea*	+	+										
Poaceae	*Austrostipa* x *exilis*	+											
Poaceae	**Avena fatua*			+							+	+	+
Poaceae	**Briza maxima*	+		+									
Poaceae	**Ehrharta calycina*		+	+									

Family Name	Species	EmCc	EmEw	EmXa	EsppXa	EwBa	EwEa	JpCsp	JpCp	Planted	CcP	EaP	EmP
Poaceae	**Eragrostis curvula*									+			
Poaceae	**Poa annua*		+					+		+	+	+	+
Poaceae	*Poaceae* sp.			+									
Poaceae	*Stipa elegantissima*		+										
Proteaceae	*Adenanthos cygnorum* subsp. indet.	+											
Proteaceae	*Banksia armata* var. *armata*					+							
Proteaceae	*Banksia cirsioides*				+								
Proteaceae	*Banksia dallanneyi* subsp. *dallanneyi* var. *dallanneyi*			+									
Proteaceae	*Banksia sessilis*				+								
Proteaceae	*Hakea lissocarpha*			+	+	+							
Proteaceae	*Petrophile striata*				+								
Rhamnaceae	*Trymalium angustifolium*			+									
Rosaceae	**Eriobotrya japonica*									+			
Rutaceae	*Boronia ovata*	+				+							
Rutaceae	**Citrus* x *lemon*									+			
Rutaceae	**Citrus* x *sinensis*									+			
Solanaceae	**Solanum nigrum*			+						+			
Typhaceae	*Typha orientalis*								+				
Xanthorrhoeaceae	*Xanthorrhoea ?acanthostachya*			+	+	+	+						
Xanthorrhoeaceae	*Xanthorrhoea preissii*	+		+									
Zamiaceae	*Macrozamia riedlei*				+								

Appendix 3 Fauna Assessment (Harewood, 2021)

Fauna Assessment



Lot M1942
Morley Road

Lower Chittering

July 2021
V2

On behalf of:
Coterra Environment
Level 3, 25 Prowse Street
WEST PERTH WA 6005

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TABLE 1: Conservation significant fauna previously recorded or potentially occurring within in the general vicinity of survey area

TABLE 2: Example images of the fauna habitats within the survey area

TABLE 3: Summary of habitat trees (DBH ≥50cm) within the survey area

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APPENDIX C: Observed Fauna Listing

APPENDIX D: Habitat Tree Details

SUMMARY

This report details the results of a fauna assessment over Lot M1942 Morley Road, Lower Chittering (the survey area) (Figure 1 and 2).

The landowners are proposing to subdivide the existing Lot into 18 smaller land parcels and the removal/modification of small areas of vegetation potentially in use by native fauna will be required in some areas.

The main aim of the fauna assessment is to provide information on the fauna values of the survey area so that management measures can be employed to minimise impacts on fauna which may result during clearing operations and subsequent construction.

The assessment has included a literature review and a series of daytime reconnaissance surveys. Field survey work at the site was carried out over several days in May and June 2021. All survey work was carried out by Greg Harewood (Zoologist).

Key Findings

The survey area has a total extent of about 54 ha and contains a mosaic of cleared, partly cleared and uncleared land. The property appears to have historically been used partly as an orchard and partly to graze livestock with unrestricted access to vegetated areas. The survey area is situated on the face of the Darling Scarp, up off the nearby Swan Coastal Plain.

The majority of the remnant native vegetation present consists of various densities and combinations of wandoo (*Eucalyptus wandoo*), marri (*Corymbia calophylla*) and jarrah (*E. marginata*) on gravel/gravelly loam. Presumably as a consequence of historical clearing, livestock grazing, logging and frequent fires native understory (midstorey and ground cover) vegetation is generally absent or very sparse with introduced weeds and pasture grasses dominating.

The survey area contains a small number of minor seasonal creek lines which ultimately coalesce and flow into Marbling Brook and then the Brockman River. Two small dams are also present.

The fauna habitats present range from highly degraded (cleared pasture) to good/very good. Given the degree of disturbance the original fauna assemblage within the survey area is likely to be depauperate in some aspects, in particular with respect to ground dwelling species which rely on dense understory (midstorey and ground cover) vegetation which is generally absent or very sparse in most areas.

Nonetheless the areas of more coherent remnant vegetation are still likely to be utilised in some fashion be a reasonably wide range of species though most would be relatively common and widespread bird species. Thirty three fauna species (mainly common bird species) were observed or secondary evidence of their presence recorded during the field survey.

One fauna species of conservation significance was recorded, this being the forest red-tailed black cockatoo, small flocks of which were heard and seen on several occasions. Foraging debris attributed to this species was also observed at several locations and some possible roosting activity was also recorded at one location.

No evidence of any other fauna species of conservation significance was observed. This does not however eliminate the potential for some species to still occur, if only infrequently.

A total of 860 potential black cockatoo breeding "habitat trees" were identified within the survey area. The majority of these trees (737) did not appear to contain hollows of any size. Ninety five (95) trees contained apparent or obvious hollows, all of which were assessed as being unlikely to be suitable for black cockatoos to currently use for nesting purposes, due to the hollows apparent small size, unsuitable orientation and/or height above ground level. Twenty eight (28) trees were assessed as having or possibly have large hollows suitable for black cockatoos to use for nesting purposes.

A high percentage of the native vegetation within the survey area represents potential foraging habitat for this species (i.e. areas of marri and/or jarrah). Evidence of a potential black cockatoo roost site was recorded at one location.

In summary one vertebrate fauna species of conservation significance were positively identified as utilising the survey area:

- Forest Red-tailed Black Cockatoo – Vulnerable (WA/Federal).

Several additional species of conservation significance may also utilise the survey area, though, as no evidence of their presence was identified during the field survey, their status in the area remains uncertain:

- Peregrine Falcon – Schedule 7 (WA);
- Baudin's Black Cockatoo – Endangered (WA/Federal);
- Carnaby's Black Cockatoo – Endangered (WA/Federal);
- South-western Brush-tailed Phascogale - Schedule 6 (WA).

Potential impacts on these fauna species and fauna in general are anticipated to be low primarily due to the relatively small area of clearing required. Nonetheless ongoing planning should consider the potential presence of fauna and in particular habitat trees so that any impacts can be further minimised where considered reasonable and practicable.

1. INTRODUCTION

This report details the results of a fauna assessment over Lot M1942 Morley Road, Lower Chittering (the survey area) (Figure 1). The survey area is approximately 54 hectares (ha) in size and contains and contains a mosaic of cleared, partly cleared and uncleared land (Figure 2).

The landowners are proposing to subdivide the area into 18 smaller lots and the removal/modification of small areas of vegetation potentially in use by native fauna will be required.

Information obtained as part of this fauna assessment report will be used in conjunction with other environmental investigations to guide project planning and will also be used in the formulation of management plans, both of which will aim to minimise potential environmental impacts. The information presented may also be used by regulatory authorities to assess the potential impact of the proposal on fauna and fauna habitats at the site during the project evaluation and approval process if required.

2. SCOPE OF WORKS

The scope of works is to conduct a level 1 fauna assessment and carry out a targeted survey of black cockatoo habitat. The assessment will therefore involve:

1. A Level 1(basic) Fauna Assessment (EPA 2020);

2. Targeted searches for black cockatoo habitat/site use (habitat trees, existing and potential nest hollows, foraging and roosting habitat) over the entire Lot; and

3. Concise report for summarising methods and results.

Note: For the purposes of this report the term black cockatoo is in reference to Baudin's black cockatoo *Calyptorhynchus baudinii*, Carnaby's black cockatoo *Calyptorhynchus latirostris* and the forest red-tailed black cockatoo *Calyptorhynchus banksii naso.*

3. METHODS

3.1 LITERATURE REVIEW – FAUNA SPECIES OF CONSERVATION SIGNIFICANCE

A list of conservation significant fauna recorded or likely to occur within the survey area has been compiled by a review of available databases and literature including, but not limited to the following data sources:

- Department of Biodiversity, Conservation and Attractions (DBCA) Threatened Fauna Database (NatureMap) (DBCA 2021). A 20 km buffer around the survey area was applied to capture previous fauna records within the immediate vicinity;
- *EPBC Act* Protected Matters database for fauna of national environmental significance (DAWE 2021). The minimum buffer (1 km) was applied to this search as the databases contains distribution data (areas) and not actual fauna records; and
- Literature search and review of other fauna surveys in the vicinity.

The conservation status of each species has been based on current lists produced under Federal and State Acts (EPBC Act and the *Biodiversity Conservation Act 2016* (*BC Act*)), those species recognised under international treaties (CAMBA, JAMBA and the Bonn Convention) and Priority Fauna (as listed by the DBCA).

3.2 FIELD SURVEYS

The field component of the fauna assessment was carried out over several days in May and June 2021 by Greg Harewood (Zoologist) and consisted of a series of daytime surveys as described in the sections below.

3.2.1 FAUNA HABITAT ASSESSMENT

The objective of the habitat assessment was to assess if it were likely that species of conservation significance would utilise the habitats identified within the survey area.

During the field survey, fauna habitats within the survey area were assessed, and specific elements identified, which informed the likelihood of listed conservation significant species utilising the area and fauna habitat significance.

Vegetation units, landforms and soils observed during the site reconnaissance survey were used to define broad fauna habitat types across the survey area.

3.2.2 FAUNA OBSERVATIONS

The aim of this part of the assessment was to obtain enough information to assess the likely significance of the survey area to fauna species of conservation significance.

Based on the results of the literature review, evidence of the presence or likely presence of fauna species of conservation significance known to or likely to frequent the general area was searched for and recorded during the field survey.

This included but was not limited to:

- Undertaking a series of transects across the survey area.
- Searching for evidence (i.e. individuals, tracks, scats, calls) of potential conservation significant species under logs, rocks and leaf litter.
- Observing bird species with binoculars.

3.2.3 BLACK COCKATOO HABITAT ASSESSMENT

The following methods were employed to comply with the defined scope of works and are based on Commonwealth of Australia (2012) guidelines which state that surveys for Carnaby's, Baudin's and forest red-tailed black cockatoo habitat should:

- be done by a suitably qualified person with experience in vegetation or cockatoo surveys, depending on the type of survey being undertaken;
- maximise the chance of detecting the species' habitat and/or signs of use;
- determine the context of the site within the broader landscape—for example, the amount and quality of habitat nearby and in the local region (for example, within 10 km);
- account for uncertainty and error (false presence and absences); and
- include collation of existing data on known locations of breeding and feeding birds and night roost locations.

The Commonwealth of Australia (2012) places habitats used by Black Cockatoos into the following three categories:

- Breeding Habitat;
- Foraging Habitat; and
- Night Roosting Habitat.

3.2.3.1 Breeding Habitat Assessment

The black cockatoo breeding habitat assessment identified all suitable breeding tree species within the survey area that have a diameter at breast height (DBH) equal to or greater than 50cm (Note 30cm was used for wandoo). The DBH of each tree was estimated using pre-made "calipers".

Target tree species included wandoo, marri, jarrah and flooded gum and any other *Corymbia/Eucalyptus* species of a suitable size that was present. Peppermints, *Banksia*, sheoak and *Melaleuca* tree species (for example) were not assessed as they typically do not develop hollows used by black cockatoos.

The location of each tree identified as being over the threshold DBH will be recorded with a GPS and details on tree species, number and size of hollows (if any) noted. Trees observed to contain hollows (of any size/type) will be marked with "H" using spray paint.

Hollow/potential hollows were placed into one of four categories, based on the size of the apparent hollow entrance, these being:

- Small = ~<5cm diameter (i.e. entrance too small for a black cockatoo);
- Medium = ~5cm-10cm diameter (i.e. entrance too small for a black cockatoo);
- Large = ~>10cm diameter (entrance large enough for a black cockatoo but hollow appears unsuitable for nesting i.e. wrong orientation, appears too small, too low or too shallow); or
- Large (cockatoo) = ~>10cm diameter (entrance appears big enough for a black cockatoo to use for nesting).

Based on this assessment, trees present within the survey area were placed into one of four categories:

- Tree <50cm DBH or an unsuitable species (these were not assessed/recorded);
- Tree ≥50cm DBH, no hollows seen;
- Tree ≥50cm DBH, one or more hollows seen, none of which were considered suitable for black cockatoos to use for nesting; or
- Tree ≥50cm DBH, one or more hollows seen, with at least one considered suitable for black cockatoos to use for nesting.

For the purposes of this assessment, a tree containing a potential black cockatoo nest hollow was defined as:

Generally, any tree which is alive or dead that contains one or more visible hollows (cavities within the trunk or branches) or possible hollows suitable for occupation by black cockatoo for the purpose of nesting/breeding. Hollows that had an entrance greater than about 10cm in diameter and would allow the entry of a black cockatoo into a suitably orientated and sized branch/trunk, were recorded as a "potential nest hollow".

Identified hollows were examined using binoculars for evidence of actual use by black cockatoos (e.g. chewing around hollow entrance, scarring and scratch marks on trunks and branches). Details recorded included hollow size, height, type, orientation, comments on suitability and any evidence of use

A review of available literature was carried out to determine the location/extent of any known/likely black cockatoo breeding habitat areas in the vicinity of the survey area.

3.2.3.2 Foraging Habitat Assessment

The location and nature of black cockatoo foraging evidence (e.g. chewed fruits around base of trees) observed during the field survey was recorded. The nature and extent of potential foraging habitat present was also documented irrespective of the presence of any actual foraging evidence. Foraging habitat is represented by plant species that are known to provide a food source for black cockatoos. This can be in the form of seeds, flowers and also boring grubs that are extracted from some plant species.

A review of available literature was carried out to determine the location/extent of any known/likely Black Cockatoo foraging habitat areas in the vicinity.

3.2.3.3 Night Roosting Habitat Assessment

Direct and indirect evidence of black cockatoos roosting within trees on site was noted where observed (e.g. branch clippings, droppings or moulted feathers).

A review of available literature was carried out to determine the location/extent of any known/likely black cockatoo roosting habitat areas in the vicinity.

4. SURVEY LIMITATIONS

No seasonal sampling was carried out as part of this fauna assessment. The conclusions presented are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of the field assessments. It should be recognised that site conditions can change with time.

Lack of observational data on some species should also not necessarily be taken as an indication that a species is absent from the site or does not utilise it for some purpose at times.

During the survey, habitat trees with hollows were searched for. It should be noted that identifying hollows suitable for fauna species from ground level has limitations. Generally, the full characteristics of any hollow seen are not fully evident (e.g. internal dimensions). It is also difficult to locate all hollows within all trees as some are not observable from ground level.

The location of observations was recorded using a handheld GPS. The accuracy of the GPS cannot be guaranteed above a level of about 5 to 10 metres, though it should be noted that in some circumstance the accuracy can increase or decrease beyond this range.

5. RESULTS

5.1 LITERATURE REVIEW – FAUNA SPECIES OF CONSERVATION SIGNIFICANCE

The literature review identified multiple fauna species of conservation significance as potentially occurring in the general area as listed in Table 1. The NatureMap (DBCA 2021) and Protected Matter Search Tool (DAWE 2021) results, used as a primary source for compiling this listing, are held within Appendix B. Because of the proximity of the survey area to the ocean a small number of conservation significant marine species have appeared in database searches (Appendix B). These species have been excluded from the assessment as they would not under normal circumstance occur within the survey area.

Table 1: Conservation significant fauna previously recorded or potentially occurring within the general vicinity of survey area.

Species	Conservation Status[1]	
	BC Act/ DBCA Priority	*EPBC Act*
Carter's Freshwater Mussel *Westralunio carteri*	S3	VU
Inornate Trapdoor Spider *Euoplos inornatus*	P3	-
a short-tongued bee *Leioproctus contrarius*	P3	-
a short-tongued bee *Leioproctus douglasiellus*	EN	CR
Graceful Sunmoth *Synemon gratiosa*	P4	-
Mud Minnow *Galaxiella munda*	S3	-
Western Swamp Tortoise *Pseudemydura umbrina*	S1	CR
Woma *Aspidites ramsayi (SW subsp)*	P1	-
Black-striped Snake *Neelaps calonotos*	P3	-
Malleefowl *Leipoa ocellata*	S3	VU
Australasian Bittern *Botaurus poiciloptilus*	S2	EN
Migratory Shorebirds/Wetland Species	Various	Various
Eastern Osprey *Pandion cristatus*	S5	Mig, Ma
Peregrine Falcon *Falco peregrinus*	S7	-

[1] See Appendix A for conservation status codes

Species	Conservation Status[1]	
	BC Act/ DBCA Priority	*EPBC Act*
Blue-billed Duck *Oxyura australis*	P4	-
Carnaby`s Black Cockatoo *Calyptorhynchus latirostris*	S2	EN
Baudin`s Black Cockatoo *Calyptorhynchus baudinii*	S2	EN
Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*	S3	VU
Muir's Corella *Cacatua pastinator pastinator*	S6	-
Fork-tailed Swift *Apus pacificus*	S5	Mig
Grey Wagtail *Motacilla cinerea*	S5	Mig
Chuditch *Dasyurus geoffroii*	S3	VU
Bilby *Macrotis lagotis*	S3	VU
Numbat *Myrmecobius fasciatus*	S3	VU
Quenda *Isoodon fusciventer*	P4	-
South-western Brush-tailed Phascogale *Phascogale tapoatafa wambenger*	S6	-
Quokka *Setonix brachyurus*	S3	VU
Woylie *Bettongia penicillate ogilbyi*	S1	EN
Tammar Wallaby *Notamacropus eugenii derbianus*	P4	-
Western Brush Wallaby *Notamacropus irma*	P4	-
Black-flanked Rock-wallaby *Petrogale lateralis*	S2	EN
Water Rat *Hydromys chrysogaster*	P4	-

5.2 FIELD SURVEYS

5.2.1 FAUNA HABITAT ASSESSMENT

The survey area has a total extent of about 54 ha and contains a mosaic of cleared, partly cleared and uncleared land. The property appears to have historically been used partly as an orchard and partly to graze livestock with unrestricted access to vegetated areas. An abandoned farmhouse and associated infrastructure are present in the northwest corner of the property. The survey area is situated on the face of the Darling Scarp, up off the nearby Swan Coastal Plain.

The majority of the remnant native vegetation present consists of various densities and combinations of wandoo (*Eucalyptus wandoo),* marri *(Corymbia calophylla)* and jarrah *(E. marginata)* on gravel/gravelly loam*.* The variations in the distribution and densities of trees can be seen in Figure 2 and Figure 3. Presumably as a consequence of historical clearing, livestock grazing, logging and frequent fires native understory (midstorey and ground cover) vegetation is generally absent or very sparse with introduced weeds and pasture grasses dominating.

Vegetation around the abandoned farmhouse is comprised of a small range of planted non-endemic and exotic plant species.

The survey area contains a small number of minor seasonal creek lines which ultimately coalesce and flow into Marbling Brook and then the Brockman River. Two small dams are also present.

Example images of the various fauna habitats present are provided in Table 2.

Table 2: Example images of the fauna habitats within the survey area

Fauna Habitat Description	Example Image
Marri and jarrah dominated open woodland over grasstree open shrubland.	
Wandoo dominated open woodland over grasstree open shrubland bordering seasonal creekline.	

Fauna Habitat Description	Example Image
Wandoo dominated parkland cleared/ open woodland over grassland.	
Cleared pasture/grassland.	
Planted non-endemic and exotic plant species surrounding abandoned farmhouse.	

Fauna Habitat Description	Example Image
Seasonal creekline with bordering woodland of wandoo over grasstree open shrubland.	
Highly degraded seasonal creekline bordered by pasture/grassland and scattered trees	
Dam built along seasonal creekline	

The fauna habitats present range from highly degraded (cleared pasture) to good/very good. Given the degree of disturbance the original fauna assemblage within the survey area is likely to be depauperate in some aspects, in particular with respect to ground dwelling species which rely on dense understory (midstorey and ground cover) vegetation which is generally absent or very sparse in most areas. Nonetheless the areas of more coherent remnant vegetation are still likely to be utilised in some fashion be a reasonably wide range of species though most would be relatively common and widespread bird

species. Exceptions to this generalised statement would include black cockatoos, some species of which utilise the area for foraging and possibly nesting a roosting (see section 5.2.3)

5.2.2 FAUNA OBSERVATIONS

Thirty three fauna species (mainly common bird species) were observed or secondary evidence of their presence recorded during the field survey. A full listing of the species observed is held on Appendix C.

One fauna species of conservation significance was recorded, this being the forest red-tailed black cockatoo, small flocks of which were heard and seen on several occasions. Foraging debris attributed to this species was also observed at several locations. Some possible roosting activity (dense "whitewash" of droppings around the base of a tree) attributed to the forest red-tailed black cockatoo was also recorded at one location.

No evidence of any other fauna species of conservation significance was observed. This does not however eliminate the potential for some species to still occur, if only infrequently.

5.2.3 BLACK COCKATOO HABITAT ASSESSMENT

5.2.3.1 Breeding Habitat Assessment

Trees considered potentially suitable for black cockatoos to use as nesting habitat (subject to a suitable hollow being present and other factors) found within the survey area comprised the following species:

- Wandoo – *Eucalyptus wandoo;*
- Marri – Corymbia calophylla;
- Jarrah – *Eucalyptus marginata*;
- Dead Unidentified - *Eucalyptus* spp*.;* and
- Non-endemic eucalypts (planted) - *Eucalyptus* spp*.*

A summary of the habitat trees observed is provided in Table 3. The locations of habitat trees are shown in Figure 3.

Table 3: Summary of potential habitat trees within the survey area

Total Number of Habitat Trees	Number of Habitat Trees with No Hollows Observed	Number of Habitat Trees with Possible Hollows considered Unsuitable for Black Cockatoos	Number of Habitat Trees with Possible Hollows considered Potentially suitable for Black Cockatoos	Tree Species				
				Wandoo	Marri	Jarrah	Dead Unidentified	Non-Endemic Eucalyptus
860	737	95	28	590	139	104	26	1

The assessment identified 860 trees within the survey area with a DBH of ≥30cm (wandoo) of ≥50cm (marri, jarrah). The majority of these trees (737) did not appear to contain hollows of any size. Ninety five (95) trees contained apparent or obvious hollows, all of which were assessed as being unlikely to be suitable for black cockatoos to currently use for nesting purposes, due to the hollows apparent small size, unsuitable orientation and/or height above ground level. Twenty eight (28) trees were assessed as having or possibly have large hollows suitable for black cockatoos to use for nesting purposes.

It should be noted that the majority of these trees are to be retained wherever possible.

Additional details on each habitat tree observed can be found in Appendix D.

Based on available mapping, there is approximately 22,200 ha of remnant native vegetation within 12 km of the survey area (DPIRD 2020). Much of this is likely to contain "potential" breeding habitat as defined by DAWE (i.e. suitable tree species with a DBH ≥30cm/50cm).

5.2.3.2 Foraging Habitat Assessment

The following flora species are known to be or are potentially used as a direct food source (e.g. seeds, flowers, nectar, bark or grubs) by one or more species of black cockatoo were recorded within the survey area:

- Wandoo – *Eucalyptus wandoo;*
- Marri – *Corymbia calophylla*;
- Jarrah – *Eucalyptus marginata*;
- Grasstree – *Xanthorrhoea preissii.*

It should be noted that some of the above-mentioned species (e.g. wandoo and grasstrees) while foraged upon on occasions would make up only a small proportion of any one bird's diet relative to more favoured plant species such as marri. Some plant

species are also only represented by a small number of specimens (e.g. grasstrees) and therefore do not contribute to the overall foraging resource to a significant degree.

Evidence of black cockatoos foraging was observed during the field survey at a small number of locations. The evidence was mainly in the form of chewed fruits from marri and was attributed to the forest red-tailed black cockatoo, several small groups of which were observed during the survey period. Examples of the foraging debris observed are provided in Table 4.

Table 4: Foraging Evidence Examples

Foraging Evidence Description	Example Image
Marri fruits – foraging activity attributed to the Forest Red-tailed Black Cockatoo.	
Marri fruits – foraging activity attributed to the Forest Red-tailed Black Cockatoo.	

Quality foraging habitat within the survey area can be defined as the areas containing marri. This vegetation unit has a total extent of about 0.9 ha.

Based on available mapping there is about 22,200 ha of remnant native vegetation within 12 km of the survey area (DPIRD 2020). Much of this is likely to represent black cockatoo foraging habitat of some type.

5.2.3.3 Night Roosting Habitat Assessment

Possible evidence of black cockatoos roosting activity was observed at one location in the western section of the survey area (see Figure 3). This activity was attributed to forest

red-tailed black cockatoos given they were the only species recorded over the survey period.

It is difficult to determine if other trees or groves of trees within the survey area represent potential roosting habitat as a range of factors, not all of which can be observed, determine suitability. Some of the larger trees may be suitable for roosting but as indicated no actual evidence of use was seen except at one location.

A review of the 2019 Great Cocky Count database shows no documented roost sites within the survey area. The 2019 Great Cocky Count recorded the closest active roost, approximately 5.3 kilometres south of the survey area (Site ID: SWABULR002). This roost was being used by 172 “White-tailed Black Cockatoos” during the April 2019 survey (Peck *et al.* 2019). Another four “confirmed roost” sites (but not necessarily in current use) occur within 12 km of the survey area.

6. CONSERVATION SIGNIFICANT FAUNA SPECIES

Based on the information gathered during the site reconnaissance survey and the documented distribution and habitat preferences of the species of conservation significance identified as potentially being present in the general area, their likelihood of occurrence has been assessed. A summary of this assessment is presented in Table 5.

Table 5: Likelihood of Occurrence – Fauna Species of Conservation Significance

Species	Conservation Status		Habitat Preferences	Habitat Present	Likelihood of Occurrence	Comments/Possible Impacts
	BC Act/ DBCA Priority	EPBC Act				
Carter's Freshwater Mussel *Westralunio carteri*	S3	VU	Occurs in greatest abundance in slower flowing streams with stable sediments that are soft enough for burrowing amongst woody debris and exposed tree roots.	No	Would Not Occur.	No suitable habitat. No impact on this species will occur.
Inornate Trapdoor Spider *Euoplos inornatus*	P3	-	Habitat requirements poorly documented. Appears to require woodlands or forests in good condition to persist.	No/Marginal	Unlikely to Occur.	No suitable habitat. No recent nearby records. No impact on this species will occur.
a short-tongued bee *Leioproctus douglasiellus*	EN	CR	This species of native bee appears to be dependent on the flowers of *Goodenia filiformis.*	No	Would Not Occur.	No suitable habitat. No impact on this species will occur.
a short-tongued bee *Leioproctus contrarius*	P3	-	This species of native bee is apparently dependent on flowers of Goodeniaceae and possibly *Lechenaultia stenosepala.*	No	Would Not Occur.	No suitable habitat. No impact on this species will occur.
Graceful Sunmoth *Synemon gratiosa*	P4	-	In the northern suburbs of Perth on the Swan Coastal Plain - Banksia woodland/woolly bush on deep sands, in the northern suburbs of Perth on the Swan Coastal Plain. Breeds on *Lomandra hermaphrodita.*	No	Would Not Occur.	No suitable habitat. No impact on this species will occur.
Mud Minnow *Galaxiella munda*	S3	-	Typically found in small flowing streams near submerged vegetation, occasionally in still water of ponds, swamps and roadside drains. Water is usually darkly tannin stained and acidic (pH 3.0 – 6.0)	No	Would Not Occur.	No suitable habitat. Seasonal creek lines unsuitable. No impact on this species will occur.
Western Swamp Tortoise *Pseudemydura umbrina*	S1	CR	Clay based ephemeral swamps	No	Would Not Occur.	No suitable habitat. No impact on this species will occur.
Woma *Aspidites ramsayi (SW subsp)*	P1	-	Woodlands, heaths and shrublands	No/Marginal	Would Not Occur.	Locally extinct. No impact on this species will occur.
Black-striped Snake *Neelaps calonotos*	P3	-	This species of snake favours sandy soils supporting heath and banksia/eucalypt woodland.	No	Would Not Occur.	No suitable habitat. No impact on this species will occur.
Malleefowl *Leipoa ocellata*	S3	VU	Mainly scrubs and thickets of mallee *Eucalyptus* spp., boree *Melaleuca lanceolata* and bowgada *Acacia linophylla*, also dense litter forming shrublands.	No	Would Not Occur.	Regionally extinct. No impact on this species will occur.
Australasian Bittern *Botaurus poiciloptilus*	S1	EN	Freshwater wetlands, occasionally estuarine; prefers heavy vegetation such as beds of tall dense *Typha, Baumea* and sedges in freshwater swamps.	No	Would Not Occur.	No suitable habitat. No impact on this species will occur.
Migratory Shorebirds/Wetland Species/Marine Species (various reptiles, birds and mammals)	S5, Various	Ma, Mig, Various	Varies between species but includes open ocean, and permanent/temporary wetlands varying from billabongs, swamps, lakes, floodplains, sewerage farms, saltwork ponds, estuaries, lagoons, mudflats sandbars, pastures, airfields, sports fields and lawns.	No	Would Not Occur.	No suitable habitat. No impact on these species will occur.

Blue-billed Duck *Oxyura australis*	P4	-	Well vegetated freshwater swamps, large dams and lakes, winters on more open water. Occasionally salt lakes and estuaries freshened by floodwaters.	No	Would Not Occur.	No suitable habitat. No impact on this species will occur.
Eastern Osprey *Pandion haliaetus*	S5	Ma, Mig	Coasts, estuaries, bays, inlets, islands, and surrounding waters, coral atolls, reefs, lagoons, rock cliffs and stacks. Ascends larger rivers.	No	Would Not Occur (Flyover only on very rare occasions.)	No suitable habitat. No impact on this species will occur.
Peregrine Falcon *Falco peregrinus*	S7	-	Diverse from rainforest to arid shrublands, from coastal heath to alpine Mainly about cliffs along coasts, rivers and ranges and about wooded watercourses and lakes.	Yes	Possibly Occurs.	This species is uncommon but the survey area may represent part of a larger home range used by individuals of this species. No significant impact on this species anticipated.
Carnaby`s Black Cockatoo *Calyptorhynchus latirostris*	S2	EN	Forests, woodlands, heathlands, farms; feeds on *Banksia*, *Hakea* and Marri.	Yes	Possibly Occurs.	Loss/modification of very small areas of habitat. Negligible impact
Baudin`s Black Cockatoo *Calyptorhynchus baudinii*	S2	EN	Mainly eucalypt forests where it feeds primarily on the Marri seeds.	Yes	Possibly Occurs.	Loss/modification of very small areas of habitat. Negligible impact
Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*	S3	VU	Eucalypt forests, feeds on Marri, Jarrah, Blackbutt, Karri, Sheoak and Snottygobble.	Yes	Known to Occur.	Loss/modification of very small areas of habitat. Negligible impact
Muir's Corella *Cacatua pastinator pastinator*	S6	-	Mainly partly cleared eucalypt forests. Attracted to bulbs of guildford grass, *Drosera* spp, orchids, seeding oats and clover. Largely dependent on farming	No	Would Not Occur.	Outside of current documented range. No impact on this species will occur.
Fork-tailed Swift *Apus pacificus*	S5	Mig, Ma	Low to very high airspace over varied habitat from rainforest to semi desert.	Yes	Unlikely to Occur, Flyover only on very rare occasions.	May occur very occasionally for brief periods. Entirely aerial. No impact on this species will occur.
Grey Wagtail *Motacilla cinerea*	S5	Mig, Ma	In Australia, near running water in disused quarries, sandy, rocky streams in escarpments and rainforest, sewerage ponds, ploughed fields and airfields.	No	Would Not Occur.	No suitable habitat. No impact on this species will occur.
Chuditch *Dasyurus geoffroii*	S3	VU	Forest, mallee shrublands, woodland and desert. The densest populations have been found in riparian jarrah forest.	No/Marginal	Unlikely to Occur.	Very rare in this general area, Restricted to larger bush remnants Possible occasional transients No significant impact on this species anticipated.
Bilby *Macrotis lagotis*	S3	VU	Current habitat included Acacia shrublands, spinifex and hummock grassland	No	Would Not Occur.	Locally extinct. No impact on this species will occur.
Numbat *Myrmecobius fasciatus*	S3	VU	Generally found in habitats dominated by eucalypts that provide hollow logs and branches for shelter and termites for food.	No	Would Not Occur.	Locally extinct. No impact on this species will occur.
Quenda *Isoodon fusciventer*	P4	-	Dense scrubby, often swampy, vegetation with dense cover.	No/Marginal	Unlikely to Occur.	Lack of dense ground cover in most areas suggests this species is unlikely to persist. No impact on this species anticipated.

South-western Brush-tailed *Phascogale Phascogale tapoatafa wambenger*	S6	-	Dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover.	Yes/Marginal	Possibly Occurs.	Loss/modification of small areas of habitat. Negligible impact on species status anticipated.
Quokka *Setonix brachyurus*	S3	VU	Currently restricted to densely vegetated coastal heaths, swamps, riverine habitats including tea-tree thickets on sandy soils along creek systems.	No	Would Not Occur.	No suitable habitat. No impact on this species will occur.
Woylie *Bettongia penicillata ogilbyi*	S1	EN	Open sclerophyll forest and woodland with a low, dense, understorey of tussock grasses or woody scrub.	No	Would Not Occur.	This species is locally extinct. No impact on this species will occur.
Tammar Wallaby *Notamacropus eugenii derbianus*	P4	-	Inhabits dense coastal heath and scrub and some dry sclerophyll forest with dense patches of cover.	No	Would Not Occur.	This species is locally extinct. No impact on this species will occur.
Western Brush Wallaby *Notamacropus irma*	P4	-	Open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets.	Yes/Marginal	Unlikely to Occur.	Fragmented/degraded nature of bushland in the general area suggests this species is unlikely to persist. No impact on this species anticipated.
Black-flanked Rock-wallaby *Petrogale lateralis*	S2	EN	Granite outcrops, sandstone cliffs and scree slopes in ranges with hummock grassland and occasional fig trees and low shrubs, caves, and coastal limestone cliffs.	No	Would Not Occur.	No suitable habitat. No impact on this species will occur.
Water Rat *Hydromys chrysogaster*	P4	-	Permanent water, fresh, brackish or marine.	No	Would Not Occur.	There is no suitable habitat for this species in the survey area. No impact on this species will occur.

See Appendix A for conservation status codes

The following vertebrate fauna species of conservation significance (listed as State or Federal threatened/migratory species or as DBCA priority species) were positively identified as utilising the survey area for some purpose during the survey period:

- Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* – S3 (*BC Act*), Vulnerable (*EPBC Act*). Several individuals and some foraging evidence (chewed marri fruits) attributed to this species was observed during the survey period. The survey area contains potential black cockatoo breeding habitat (trees with a DBH ≥30/50cm), some with possible large hollows. A high percentage of the native vegetation within the survey area represents potential foraging habitat for this species. Possible evidence of roosting activity also observed.

Several additional species of conservation significance may utilise the survey area for some purpose at times, but their status on-site and/or in the general area is difficult to determine because they were not sighted during the field survey, or evidence of use was not observed:

- Peregrine Falcon *Falco peregrinus* – S7 (*BC Act*)
  This species potentially utilises some sections of the survey area as part of a much larger home range though only likely to occur infrequently. All areas represent potential foraging habitat for this species. Listed as a potential species based on available information.

- Baudin's Black-Cockatoo *Calyptorhynchus baudinii* – S2 (*BC Act*), Endangered (*EPBC Act*).
  Possibly occurs. The survey area contains potential black cockatoo breeding habitat (trees with a DBH >30/50cm), some with possible large hollows. A high percentage of the native vegetation within the survey area represents potential foraging habitat for this species. No evidence of roosting observed. Listed as a potential species based on available information.

- Carnaby`s Black-Cockatoo Calyptorhynchus latirostris – S2 (*BC Act*), Endangered (*EPBC Act*).
  Possibly occurs. The survey area contains potential black cockatoo breeding habitat (trees with a DBH >30/50cm), some with possible large hollows. A high percentage of the native vegetation within the survey area represents potential foraging habitat for this species. No evidence of roosting observed. Listed as a potential species based on available information.

- South-western Brush-tailed Phascogale *Phascogale tapoatafa wambenger* – S6 (*BC Act*)
  Status of this species within the survey area is difficult to determine without a detailed survey, however, despite the lack of recent records in the general area it must be assumed to be present, albeit at low densities and possibly only occasionally. Listed as a potential species based on available information.

A number of other species of conservation significance (as listed in Table 5), while possibly present in the larger bush remnants in the wider area (e.g. Moondyne Nature Reserve, Julimar State Forest and Walyunga National Park) are not listed as potentially occurring

within the survey area primarily due to a complete lack of suitable habitat (quality and extent) and/or known local/regional extinction.

In cases where some habitat is present and where available information indicates at least some probability of the species occurrence, likely impacts of the proposed development are anticipated to be low primarily due to the localised and limited extent of proposed clearing. No overall change in the conservation status of any fauna species currently utilising the survey area is therefore anticipated. While some small, localised residual loss of fauna habitat may occur for some species, regional impacts on the status of any one species are anticipated to be negligible/non-existent.

7. CONCLUSION

The fauna assessment within the survey area was primarily undertaken to determine the presence/potential presence of fauna species of conservation significance and/or their habitat and in particular black cockatoo habitat.

The fauna habitats present range from highly degraded (cleared pasture) to good/very good. Given the degree of disturbance the original fauna assemblage within the survey area is likely to be depauperate in some aspects, in particular with respect to ground dwelling species which rely on dense understory (midstorey and ground cover) vegetation which is generally absent or very sparse in most areas.

Nonetheless the areas of more coherent remnant vegetation are still likely to be utilised in some fashion be a reasonably wide range of species though most would be relatively common and widespread bird species. Thirty three fauna species (mainly common bird species) were observed or secondary evidence of their presence recorded during the field survey.

One fauna species of conservation significance was recorded, this being the forest red-tailed black cockatoo, small flocks of which were heard and seen on several occasions. Foraging debris attributed to this species was also observed at several locations and some possible roosting activity was also recorded at one location.

No evidence of any other fauna species of conservation significance was observed. This does not however eliminate the potential for some species to still occur, if only infrequently.

A total of 860 potential black cockatoo breeding “habitat trees” were identified within the survey area. The majority of these trees (737) did not appear to contain hollows of any size. Ninety five (95) trees contained apparent or obvious hollows, all of which were assessed as being unlikely to be suitable for black cockatoos to currently use for nesting purposes, due to the hollows apparent small size, unsuitable orientation and/or height above ground level. Twenty eight (28) trees were assessed as having or possibly have large hollows suitable for black cockatoos to use for nesting purposes.

A high percentage of the native vegetation within the survey area represents potential foraging habitat for this species (i.e. areas of marri and/or jarrah). Evidence of a potential black cockatoo roost site was recorded at one location.

In summary one vertebrate fauna species of conservation significance were positively identified as utilising the survey area:

- Forest Red-tailed Black Cockatoo – Vulnerable (WA/Federal).

Several additional species of conservation significance may also utilise the survey area, though, as no evidence of their presence was identified during the field survey, their status in the area remains uncertain:

- Peregrine Falcon – Schedule 7 (WA);
- Baudin's Black Cockatoo – Endangered (WA/Federal);
- Carnaby's Black Cockatoo – Endangered (WA/Federal);
- South-western Brush-tailed Phascogale - Schedule 6 (WA).

Potential impacts on these fauna species and fauna in general are anticipated to be low primarily due to the relatively small area of clearing required. Nonetheless ongoing planning should consider the potential presence of fauna and in particular habitat trees so that any impacts can be further minimised where considered reasonable and practicable.

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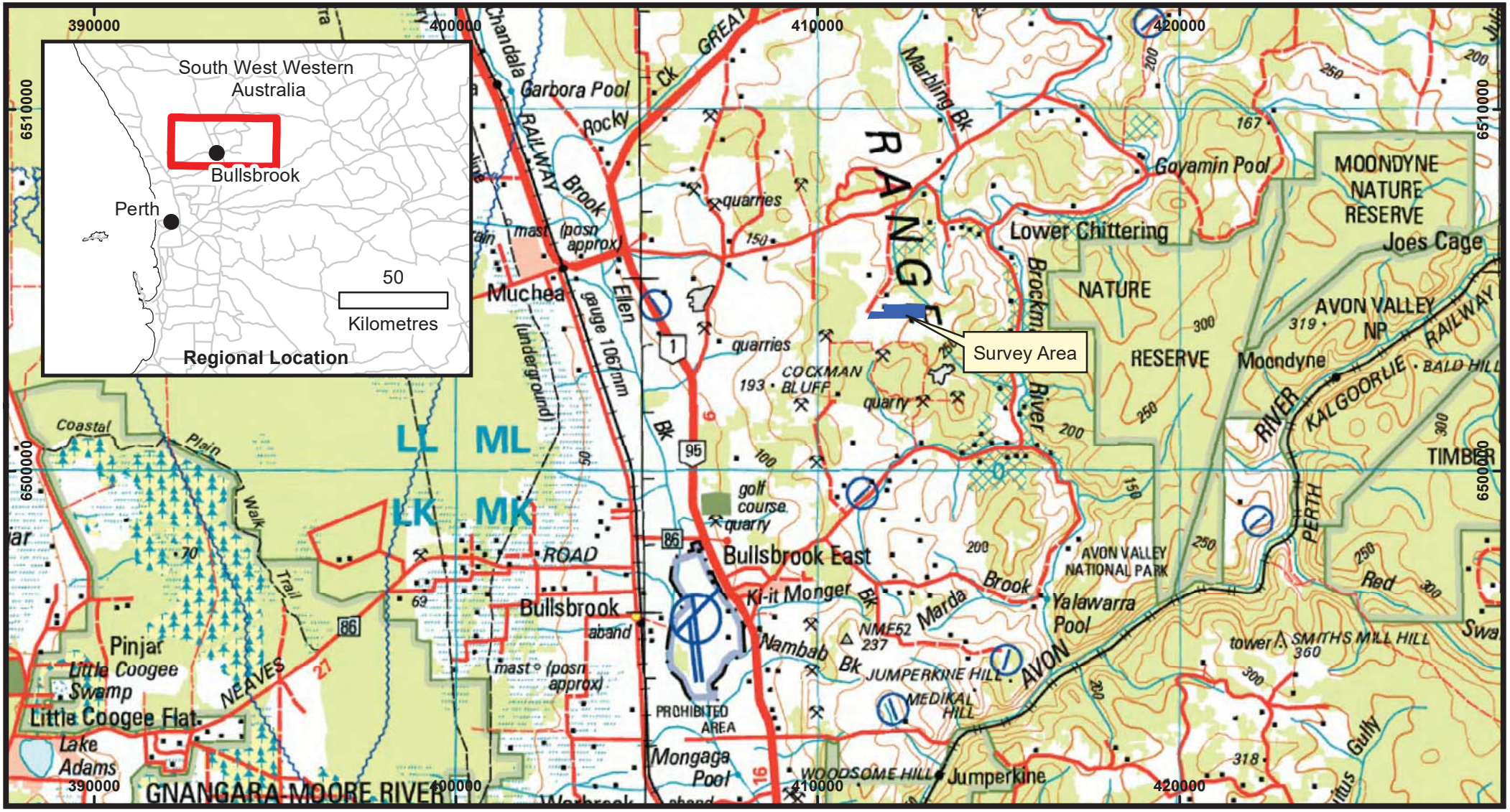
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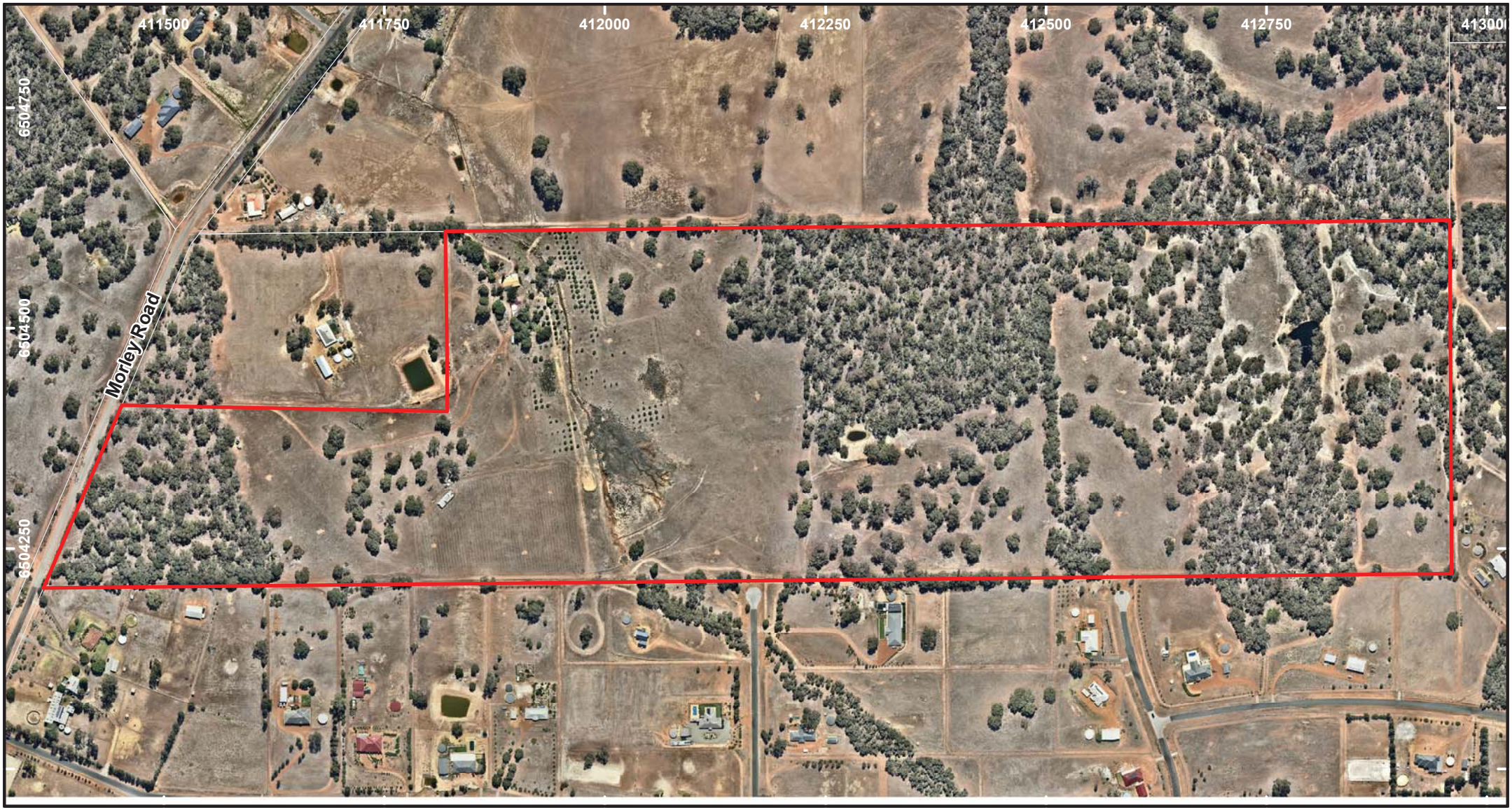
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FIGURES


South West Western Australia
Bullsbrook
Perth
50
Kilometres
Regional Location
Survey Area
390000
400000
410000
420000
6510000
6500000
Garbora Pool
Rocky Brook
RAILWAY
Muchea
gauge 1067mm
(underground)
mast (posn approx)
quarries
Ellen Bk
Marbling Bk
GREAT
RANGE
Goyamin Pool
Lower Chittering
NATURE RESERVE
MOONDYNE NATURE RESERVE
Joes Cage
AVON VALLEY NP
Moondyne
KALGOORLIE
BALD HILL
TIMBER
RIVER
PERTH
Brockman River
COCKMAN BLUFF
quarry
golf course
LL
ML
LK
MK
ROAD
Bullsbrook East
Bullsbrook
abandoned
Ki-it Monger Bk
Marda Brook
Yalawarra Pool
AVON VALLEY NATIONAL PARK
NME52 237
Nambab Bk
JUMPERKINE HILL
MEDIKAL HILL
SMITHS MILL HILL
tower
Red Gully
AVON
PROHIBITED AREA
Mongaga Pool
WOODSOME HILL
Jumperkine
Coastal Plain
Walk Trail
NEAVES
Pinjar
Little Coogee Swamp
Little Coogee Flat
Lake Adams
GNANGARA-MOORE RIVER
Legend
Survey Area
0 2 4 6 8 10
Kilometres
Fauna Survey
Lot M1942 Morley Road
Lower Chittering
Survey Area and Surrounds
Drawn: G Harewood
Date: June 2021
Scale: 1: 250,000
Projection/Coordinate System: UTM/MGA Zone 50
Figure: 1



Legend

- Cadastral Boundaries (Existing)
- Survey Area

0 100 200 300 400 500

Metres

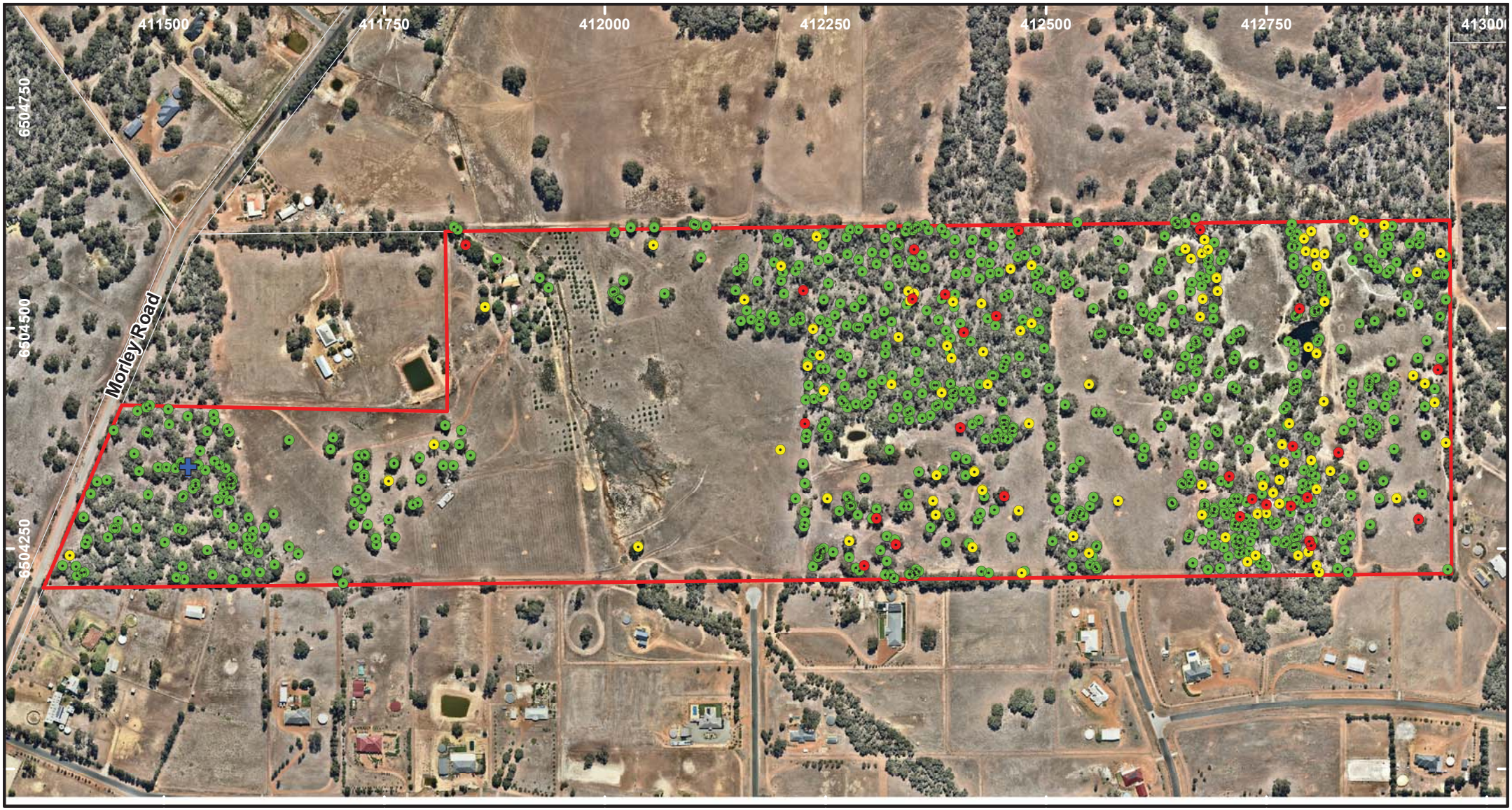
Fauna Survey

Lot M1942 Morley Road
Lower Chittering

Survey Area Aerial Photograph

Drawn: G Harewood
Date: June 2021
Scale: 1:6,000
Projection/Coordinate System: UTM/MGA Zone 50

Figure: 2



Legend

- Cadastral Boundaries (Existing)
- Survey Area
- Possible BC Roost Site
- Habitat Tree - One or more hollows possibly suitable for Black Cockatoos (28)
- Habitat Tree - One or more possible hollows, none suitable for Black Cockatoos (95)
- Habitat Tree - No Hollows Seen (737)

N

0 100 200 300 400 500

Metres

Fauna Survey

Drawn: G Harewood

Date: June 2021

Scale: 1:6,000

Projection/Coordinate System: UTM/MGA Zone 50

Lot M1942 Morley Road Lower Chittering

Habitat Trees & Possible Roost Site

Figure: 3

APPENDIX A

CONSERVATION CATEGORIES

***EPBC Act (1999)* Threatened Fauna Categories**

Threatened fauna may be listed under Section 178 of the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*) in any one of the following categories:

Category	Code	Description
Extinct	E	There is no reasonable doubt that the last member of the species has died.
*Extinct in the wild	EW	A species (a) is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
*Critically Endangered	CE	A species is facing an extremely high risk of extinction in the wild in the immediate future.
*Endangered	EN	A species: (a) is not critically endangered; and (b) is facing a very high risk of extinction in the wild in the near future.
*Vulnerable	VU	A species (a) is not critically endangered or endangered; and (b) is facing a high risk of extinction in the wild in the medium-term future.
Conservation Dependent	CD	A species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered
*Migratory	Migratory	(a) all migratory species that are: (i) native species; and (ii) from time to time included in the appendices to the Bonn Convention; and (b) all migratory species from time to time included in annexes established under JAMBA, CAMBA and ROKAMBA; and (c) all native species from time to time identified in a list established under, or an instrument made under, an international agreement approved by the Minister.
Marine	Ma	Species in the list established under s248 of the *EPBC Act*

Note: Only species in those categories marked with an asterix are matters of national environmental significance (NES) under the *EPBC Act*.

Wildlife Conservation (Specially Protected Fauna) Notice 2018 Categories

Published as Specially Protected under the *Wildlife Conservation Act 1950*, and listed under Schedules 1 to 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

Category	Code	Description
Schedule 1 (S1) Critically Endangered species	CR	Threatened species considered to be facing an extremely high risk of extinction in the wild in the immediate future.
Schedule 2 (S2) Endangered species	EN	Threatened species considered to be facing a very high risk of extinction in the wild in the near future.
Schedule 3 (S3) Vulnerable species	VU	Threatened species considered to be facing a high risk of extinction in the wild in the medium-term future.
Schedule 4 (S4) Presumed extinct species	EX	Species which have been adequately searched for and there is no reasonable doubt that the last member of the species has died.
Schedule 5 (S5) Migratory birds protected under an international agreement	MI	Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds.
Schedule 6 (S6) Fauna that is of special conservation need as conservation dependent fauna	CD	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
Schedule 7 (S7) Other specially protected fauna.	OS	Fauna otherwise in need of special protection to ensure their conservation.

Western Australian DBCA Priority Fauna Categories

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

Category	Code	Description
Priority 1 (P1) Poorly Known Species.	P1	Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2 (P2) Poorly Known Species.	P2	Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3 (P3) Poorly Known Species.	P3	Species that are known from several locations and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4 (P4) Rare, Near Threatened and other species in need of monitoring.	P4	(a) Rare: Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened: Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

*Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

***IUCN Red List* Threatened Species Categories**

The *IUCN Red List of Threatened Species*™ is a checklist of taxa that have undergone an extinction risk assessment using the *IUCN Red List Categories and Criteria*.

Categories are summarized below.

Category	Code	Description
Extinct	EX	Taxa for which there is no reasonable doubt that the last individual has died.
Extinct in the Wild	EW	Taxa which is known only to survive in cultivation, in captivity or and as a naturalised population well outside its past range and it has not been recorded in known or expected habitat despite exhaustive survey over a time frame appropriate to its life cycle and form.
Critically Endangered	CR	Taxa facing an extremely high risk of extinction in the wild.
Endangered	EN	Taxa facing a very high risk of extinction in the wild.
Vulnerable	VU	Taxa facing a high risk of extinction in the wild.
Near Threatened	NT	Taxa which has been evaluated but does not qualify for CR, EN or VU now but is close to qualifying or likely to qualify in the near future.
Least Concern	LC	Taxa which has been evaluated but does not qualify for CR, EN, VU, or NT but is likely to qualify for NT in the near future.
Data Deficient	DD	Taxa for which there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status.
Not Evaluated	NE	Taxa which has not been evaluated.

A full list of categories and their meanings are available at:

http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria

APPENDIX B

NATUREMAP DATABASE SEARCH
AND
PROTECTED MATTERS SEARCH TOOL RESULTS

NatureMap
Mapping Western Australia's biodiversity

NatureMap - Chittering

Created By Guest user on 30/06/2021

Kingdom	Animalia
Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	116° 04' 29" E,31° 35' 32" S
Buffer	20km
Group By	Species Group

Species Group	Species	Records
Amphibian	17	460
Bird	173	6951
Fish	11	20
Invertebrate	119	382
Mammal	40	776
Reptile	78	1347
TOTAL	**438**	**9936**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Amphibian					
1.	25398	*Crinia georgiana (Quacking Frog)*			
2.	25399	*Crinia glauerti (Clicking Frog)*			
3.	25400	*Crinia insignifera (Squelching Froglet)*			
4.	25401	*Crinia pseudinsignifera (Bleating Froglet)*			
5.	25404	*Geocrinia leai (Ticking Frog)*			
6.	25408	*Heleioporus albopunctatus (Western Spotted Frog)*			
7.	25409	*Heleioporus barycragus (Hooting Frog)*			
8.	25410	*Heleioporus eyrei (Moaning Frog)*			
9.	25411	*Heleioporus inornatus (Whooping Frog)*			
10.	25412	*Heleioporus psammophilus (Sand Frog)*			
11.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
12.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
13.	25388	*Litoria moorei (Motorbike Frog)*			
14.	25420	*Myobatrachus gouldii (Turtle Frog)*			
15.	25425	*Neobatrachus kunapalari (Kunapalari Frog)*			
16.	25426	*Neobatrachus pelobatoides (Humming Frog)*			
17.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			
Bird					
18.	24559	*Acanthagenys rufogularis (Spiny-cheeked Honeyeater)*			
19.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
20.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
21.	24262	*Acanthiza inornata (Western Thornbill)*			
22.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
23.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
24.	25536	*Accipiter fasciatus (Brown Goshawk)*			
25.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
26.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
27.	25544	*Aegotheles cristatus (Australian Owlet-nightjar)*			
28.	24310	*Anas castanea (Chestnut Teal)*			
29.	24312	*Anas gracilis (Grey Teal)*			
30.	24313	*Anas platyrhynchos (Mallard)*			
31.		*Anas platyrhynchos subsp. domesticus*			
32.	24315	*Anas rhynchotis (Australasian Shoveler)*			
33.	24316	*Anas superciliosa (Pacific Black Duck)*			
34.	47414	*Anhinga novaehollandiae (Australasian Darter)*			
35.	24561	*Anthochaera carunculata (Red Wattlebird)*			
36.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
37.	25670	*Anthus australis (Australian Pipit)*			
38.	24599	*Anthus australis subsp. australis (Australian Pipit)*			
39.	24285	*Aquila audax (Wedge-tailed Eagle)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
40.	41324	*Ardea modesta (great egret, white egret)*			
41.	24340	*Ardea novaehollandiae (White-faced Heron)*			
42.	24341	*Ardea pacifica (White-necked Heron)*			
43.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
44.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
45.	24356	*Artamus personatus (Masked Woodswallow)*			
46.	24318	*Aythya australis (Hardhead)*			
47.		*Barnardius zonarius*			
48.	24319	*Biziura lobata (Musk Duck)*			
49.	24345	*Botaurus poiciloptilus (Australasian Bittern)*		□	
50.	25713	*Cacatua galerita (Sulphur-crested Cockatoo)*			
51.	24721	*Cacatua galerita subsp. galerita (Sulphur-crested Cockatoo)*	Y		
52.	25714	*Cacatua pastinator (Western Long-billed Corella)*			
53.	24724	*Cacatua pastinator subsp. pastinator (Muir's Corella, Muir's Corella (Western Corella SW WA))*		S	
54.	25715	*Cacatua roseicapilla (Galah)*			
55.	25716	*Cacatua sanguinea (Little Corella)*			
56.	24729	*Cacatua tenuirostris (Eastern Long-billed Corella)*	Y		
57.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
58.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
59.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
60.	24731	*Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black Cockatoo)*		□	
61.	24733	*Calyptorhynchus baudinii (Baudin's Cockatoo, White-tailed Long-billed Black Cockatoo)*		□	
62.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo, White-tailed Short-billed Black Cockatoo)*		□	
63.	48400	*Calyptorhynchus sp. (white-tailed black cockatoo)*		□	
64.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
65.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
66.	24431	*Chrysococcyx basalis (Horsfield's Bronze Cuckoo)*			
67.	25601	*Chrysococcyx lucidus (Shining Bronze Cuckoo)*			
68.	24432	*Chrysococcyx lucidus subsp. plagosus (Shining Bronze Cuckoo)*			
69.	24288	*Circus approximans (Swamp Harrier)*			
70.	24774	*Cladorhynchus leucocephalus (Banded Stilt)*			
71.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
72.	24399	*Columba livia (Domestic Pigeon)*	Y		
73.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
74.	24416	*Corvus bennetti (Little Crow)*			
75.	25592	*Corvus coronoides (Australian Raven)*			
76.	24417	*Corvus coronoides subsp. perplexus (Australian Raven)*			
77.	24671	*Coturnix pectoralis (Stubble Quail)*			
78.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
79.	25595	*Cracticus tibicen (Australian Magpie)*			
80.	25596	*Cracticus torquatus (Grey Butcherbird)*			
81.	24322	*Cygnus atratus (Black Swan)*			
82.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
83.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
84.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
85.	24470	*Dromaius novaehollandiae (Emu)*			
86.		*Egretta novaehollandiae*			
87.		*Elanus axillaris*			
88.	24290	*Elanus caeruleus subsp. axillaris (Australian Black-shouldered Kite)*			
89.	47937	*Elseyornis melanops (Black-fronted Dotterel)*			
90.		*Eolophus roseicapillus*			
91.	24567	*Epthianura albifrons (White-fronted Chat)*			
92.	24570	*Epthianura tricolor (Crimson Chat)*			
93.	24379	*Erythrogonys cinctus (Red-kneed Dotterel)*			
94.	25621	*Falco berigora (Brown Falcon)*			
95.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
96.	25623	*Falco longipennis (Australian Hobby)*			
97.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
98.	25677	*Falcunculus frontatus (Crested Shrike-tit)*			
99.	24616	*Falcunculus frontatus subsp. leucogaster (Western Shrike-tit, Crested Shrike-tit)*			
100.	25727	*Fulica atra (Eurasian Coot)*			
101.	24761	*Fulica atra subsp. australis (Eurasian Coot)*			
102.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
103.	24763	*Gallinula tenebrosa subsp. tenebrosa (Dusky Moorhen)*			
104.	42314	*Gavicalis virescens (Singing Honeyeater)*			
105.	25530	*Gerygone fusca (Western Gerygone)*			
106.	47962	*Glyciphila melanops (Tawny-crowned Honeyeater)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
107.	24443	*Grallina cyanoleuca (Magpie-lark)*			
108.	24295	*Haliastur sphenurus (Whistling Kite)*			
109.	47965	*Hieraaetus morphnoides (Little Eagle)*			
110.	25734	*Himantopus himantopus (Black-winged Stilt)*			
111.	24491	*Hirundo neoxena (Welcome Swallow)*			
112.	24511	*Larus novaehollandiae subsp. novaehollandiae (Silver Gull)*			
113.	25661	*Lichmera indistincta (Brown Honeyeater)*			
114.		*Lophoictinia isura*			
115.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
116.	25650	*Malurus elegans (Red-winged Fairy-wren)*			
117.	25651	*Malurus lamberti (Variegated Fairy-wren)*			
118.	25652	*Malurus leucopterus (White-winged Fairy-wren)*			
119.	24551	*Malurus pulcherrimus (Blue-breasted Fairy-wren)*			
120.	25654	*Malurus splendens (Splendid Fairy-wren)*			
121.	24583	*Manorina flavigula (Yellow-throated Miner)*			
122.	25758	*Megalurus gramineus (Little Grassbird)*			
123.	47997	*Melanodryas cucullata (Hooded Robin)*			
124.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
125.	24736	*Melopsittacus undulatus (Budgerigar)*			
126.	24598	*Merops ornatus (Rainbow Bee-eater)*			
127.		*Microcarbo melanoleucos*			
128.	24446	*Myiagra cyanoleuca (Satin Flycatcher)*			
129.	25610	*Myiagra inquieta (Restless Flycatcher)*			
130.	24738	*Neophema elegans (Elegant Parrot)*			
131.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
132.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
133.	24328	*Oxyura australis (Blue-billed Duck)*		□4	
134.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
135.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
136.	24626	*Pardalotus punctatus subsp. xanthopyge (Yellow-rumped Pardalote)*			
137.	25682	*Pardalotus striatus (Striated Pardalote)*			
138.	24630	*Pardalotus striatus subsp. westraliensis (Striated Pardalote)*			
139.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
140.	48060	*Petrochelidon ariel (Fairy Martin)*			
141.	48061	*Petrochelidon nigricans (Tree Martin)*			
142.	48066	*Petroica boodang (Scarlet Robin)*			
143.	24659	*Petroica goodenovii (Red-capped Robin)*			
144.	25697	*Phalacrocorax carbo (Great Cormorant)*			
145.	25698	*Phalacrocorax melanoleucos (Little Pied Cormorant)*			
146.	24666	*Phalacrocorax melanoleucos subsp. melanoleucos (Little Pied Cormorant)*			
147.		*Phalacrocorax sp.*			
148.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
149.	25699	*Phalacrocorax varius (Pied Cormorant)*			
150.	24409	*Phaps chalcoptera (Common Bronzewing)*			
151.	48071	*Phylidonyris niger (White-cheeked Honeyeater)*			
152.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
153.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
154.	25720	*Platycercus icterotis (Western Rosella)*			
155.	24747	*Platycercus spurius (Red-capped Parrot)*			
156.	25721	*Platycercus zonarius (Australian Ringneck, Ring-necked Parrot)*			
157.	24750	*Platycercus zonarius subsp. semitorquatus (Twenty-eight Parrot)*			
158.	24751	*Platycercus zonarius subsp. zonarius (Port Lincoln Parrot)*			
159.	24843	*Plegadis falcinellus (Glossy Ibis)*		IA	
160.	25703	*Podargus strigoides (Tawny Frogmouth)*			
161.	24679	*Podargus strigoides subsp. brachypterus (Tawny Frogmouth)*			
162.	25704	*Podiceps cristatus (Great Crested Grebe)*			
163.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
164.	25722	*Polytelis anthopeplus (Regent Parrot)*			
165.	30854	*Polytelis anthopeplus subsp. westralis (Regent Parrot)*			
166.	24683	*Pomatostomus superciliosus (White-browed Babbler)*			
167.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
168.	24767	*Porphyrio porphyrio subsp. bellus (Purple Swamphen)*			
169.		*Purpureicephalus spurius*			
170.	24776	*Recurvirostra novaehollandiae (Red-necked Avocet)*			
171.	48096	*Rhipidura albiscapa (Grey Fantail)*			
172.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
173.	48237	*Rostratula australis (Australian Painted Snipe)*		□	
174.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
175.	30948	*Smicrornis brevirostris (Weebill)*			
176.	24645	*Stagonopleura oculata (Red-eared Firetail)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
177.	25597	*Strepera versicolor (Grey Currawong)*			
178.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
179.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
180.	24682	*Tachybaptus novaehollandiae subsp. novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
181.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
182.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
183.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
184.	48141	*Tribonyx ventralis (Black-tailed Native-hen)*			
185.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
186.	24808	*Tringa nebularia (Common Greenshank, greenshank)*		IA	
187.	48147	*Turnix varius (Painted Button-quail)*			
188.	24851	*Turnix velox (Little Button-quail)*			
189.	24852	*Tyto alba subsp. delicatula (Barn Owl)*			
190.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			
□ish					
191.		*Atherinosoma wallacei*			
192.		*Bostockia porosa*			
193.		*Carassius auratus*			
194.		*Cyprinus carpio*			
195.		*Edelia vittata*			
196.	34028	*Galaxias occidentalis (Western Minnow)*			
197.	34026	*Galaxiella munda (mud minnow, western dwarf galaxias)*		□	
198.		*Gambusia affinis*			
199.		*Gambusia sp.*			
200.		*Nannoperca vittata*			
201.		*Pseudogobius olorum*			
Invertebrate					
202.		*Acariformes sp.*			
203.		*Acercella falcipes*			
204.		*Aeshnidae sp.*			
205.		*Allothereua maculata*			
206.		*Amblyomma triguttatum*			
207.		*Amphisopodidae sp.*			
208.		*Aname mainae*			
209.		*Aname tepperi*			
210.		*Ancylidae sp.*			
211.		*Anopheles atratipes*			
212.		*Araneus cyphoxis*			
213.		*Araneus senicaudatus*			
214.		*Aurecocrypta lugubris*			
215.		*Austracantha minax*			
216.		*Backobourkia brounii*			
217.		*Backobourkia heroine*			
218.		*Badumna insignis*			
219.		*Baetidae sp.*			
220.		*Baiami volucripes*			
221.		*Caenidae sp.*			
222.		*Carabidae sp.*			
223.		*Ceinidae sp.*			
224.		*Ceratopogonidae sp.*			
225.		*Cercophonius granulosus*			
226.		*Cercophonius sulcatus*			
227.		*Cherax preissii*			
228.		*Cherax quinquecarinatus*			
229.		*Cherax sp.*			
230.		*Chironominae sp.*			
231.		*Chironomus aff. alternans (V24) (CB)*			
232.		*Corduliidae sp.*			
233.		*Corixidae sp.*			
234.		*Cormocephalus aurantiipes*			
235.		*Cormocephalus strigosus*			
236.		*Cormocephalus turneri*			
237.		*Cryptochironomus griseidorsum*			
238.		*Culex (Culex) australicus*			
239.		*Culicidae sp.*			
240.		*Culiseta atra*			
241.		*Curculionidae sp.*			
242.		*Dingosa serrata*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
243.		*Dugesiidae sp.*			
244.		*Dytiscidae sp.*			
245.		*Enchytraeidae sp.*			
246.		*Ephydridae sp.*			
247.		*Eriophora biapicata*			
248.		*Eucyclops edytae*			Y
249.	48579	*Euoplos inornatus (inornate trapdoor spider (northern Jarrah Forest))*		□3	
250.		*Gripopterygidae sp.*			
251.		*Gyrinidae sp.*			
252.		*Harpacticoida sp*			
253.		*Hebridae sp.*			
254.		*Hemicorduliidae sp.*			
255.		*Henicops dentatus*			
256.		*Holconia westralia*			
257.		*Holoplatys julimarina*			Y
258.		*Hydraenidae sp.*			
259.		*Hydridae sp.*			
260.		*Hydrobiosidae sp.*			
261.		*Hydrophilidae sp.*			
262.		*Hydroptilidae sp.*			
263.		*Idiommata blackwalli*			
264.		*Isopeda leishmanni*			
265.		*Karaops ellenae*			
266.		*Lagynochthonius australicus*			
267.	33982	*Leioproctus contrarius (a short-tongued bee)*		□3	
268.	33983	*Leioproctus douglasiellus (a short-tongued bee)*		□	
269.		*Leptoceridae sp.*			
270.		*Leptophlebiidae sp.*			
271.		*Longepi woodman*			
272.		*Lymnaeidae sp.*			
273.		*Mesamphisopodidae sp.*			
274.		*Mesostigmata sp.*			
275.		*Microvelia sp.*			
276.		*Missulena granulosa*			
277.		*Mituliodon tarantulinus*			
278.		*Mixocyclops sp.*			
279.		*Nematoda sp.*			
280.		*Nephila edulis*			
281.		*Notonectidae sp.*			
282.		*Oligochaeta sp.*			
283.		*Ommatoiulus moreleti*			
284.		*Oniscidae sp.*			
285.		*Oribatida sp.*			
286.		*Orthocladiinae sp.*			
287.		*Palaemonidae sp.*			
288.		*Paracyclops intermedius*			
289.		*Paracymus pygmaeus*			
290.		*Paralimnophyes pullulus (V42)*			
291.		*Paramerina levidensis*			
292.		*Parastacidae sp.*			
293.		*Pedidromus velox*			Y
294.		*Pholcus phalangioides*			
295.		*Physidae sp.*			
296.		*Piona murleyi*			
297.		*Planorbidae sp.*			
298.		*Raveniella peckorum*			
299.		*Richardsonianidae sp.*			
300.		*Rotifera sp.*			
301.		*Scolopendra laeta*			
302.		*Simuliidae sp.*			
303.		*Staphylinidae sp.*			
304.		*Sternopriscus browni*			
305.		*Storena formosa*			
306.		*Supunna funerea*			
307.	33992	*Synemon gratiosa (Graceful Sunmoth)*		□4	
308.		*Synothele lowei*			Y
309.		*Synothele taurus*			Y
310.		*Tanypodinae sp.*			
311.		*Tasmanicosa leuckartii*			
312.		*Tipulidae sp.*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
313.		*Trichocyclus nullarbor*			
314.		*Unixenus attemsi*			
315.		*Urodacus novaehollandiae*			
316.		*Urodacus woodwardii*			
317.		*Veliidae sp.*			
318.		*Venator immansueta*			
319.		*Venator koyuga*			
320.	34113	*Westralunio carteri (Carter's Freshwater Mussel)*		□	
Mammal					
321.	47713	*Austronomus australis (White-striped Free-tailed Bat)*			
322.	24162	*Bettongia penicillata subsp. ogilbyi (Woylie, Brush-tailed Bettong)*		□	
323.	24086	*Cercartetus concinnus (Western Pygmy-possum, Mundarda)*			
324.	24149	*Chaeropus ecaudatus (Pig-footed Bandicoot, kantjilpa)*		□	
325.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
326.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		□	
327.	24041	*Felis catus (Cat)*	Y		
328.	24215	*Hydromys chrysogaster (Water-rat, Rakali)*		□4	
329.	24150	*Isoodon auratus subsp. auratus (Golden Bandicoot (mainland), Wintarru)*		□	
330.	24151	*Isoodon auratus subsp. barrowensis (Barrow Island Golden Bandicoot)*		□	
331.	48588	*Isoodon fusciventer (Quenda, southwestern brown bandicoot)*		□4	
332.	24152	*Isoodon macrourus (Northern Brown Bandicoot)*			
333.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
334.	24135	*Macropus robustus subsp. erubescens (Euro, Biggada)*			
335.	24168	*Macrotis lagotis (Bilby, Dalgyte, Ninu)*		□	
336.	24223	*Mus musculus (House Mouse)*	Y		
337.	24146	*Myrmecobius fasciatus (Numbat, Walpurti)*		□	
338.	48024	*Notamacropus eugenii subsp. derbianus (Tammar Wallaby, Tammar)*		□4	
339.	48022	*Notamacropus irma (Western Brush Wallaby)*		□4	
340.	24229	*Notomys mitchellii (Mitchell's Hopping-mouse)*			
341.	48027	*Nyctophilus geoffroyi subsp. geoffroyi (Lesser Long-eared Bat)*			
342.	24195	*Nyctophilus gouldi (Gould's Long-eared Bat)*			
343.	24085	*Oryctolagus cuniculus (Rabbit)*	Y		
344.	25506	*Petrogale lateralis (Black-footed Rock-wallaby, Black-flanked Rock-wallaby)*		□	
345.	24143	*Petrogale lateralis subsp. hacketti (Recherche Black-footed Rock-wallaby, Recherche rock-wallaby)*		□	
346.	24142	*Petrogale lateralis subsp. lateralis (Black-flanked Rock-wallaby, Black-footed Rock-wallaby)*		□	
347.	24144	*Petrogale rothschildi (Rothschild's Rock-wallaby)*			
348.	48070	*Phascogale tapoatafa subsp. wambenger (South-western Brush-tailed Phascogale, Wambenger)*		S	
349.	24230	*Pseudomys albocinereus (Ash-grey Mouse)*			
350.	24243	*Rattus fuscipes (Western Bush Rat)*			
351.	24245	*Rattus rattus (Black Rat)*	Y		
352.	24145	*Setonix brachyurus (Quokka)*		□	
353.	24111	*Sminthopsis gilberti (Gilbert's Dunnart)*			
354.	25515	*Sminthopsis griseoventer (Grey-bellied Dunnart)*			
355.	24207	*Tachyglossus aculeatus (Short-beaked Echidna)*			
356.	24167	*Tarsipes rostratus (Honey Possum, Noolbenger)*			
357.	25521	*Trichosurus vulpecula (Common Brushtail Possum)*			
358.	24158	*Trichosurus vulpecula subsp. vulpecula (Common Brushtail Possum)*			
359.	24206	*Vespadelus regulus (Southern Forest Bat)*			
360.	24040	*Vulpes vulpes (Red Fox)*	Y		
Reptile					
361.	42368	*Acritoscincus trilineatus (Western Three-lined Skink)*			
362.	44629	*Anilios australis*			
363.	44650	*Anilios waitii*			
364.	25241	*Antaresia stimsoni subsp. stimsoni (Stimson's Python)*			
365.	24990	*Aprasia pulchella (Granite Worm-lizard)*			
366.	24991	*Aprasia repens (Sand-plain Worm-lizard)*			
367.	47673	*Aspidites ramsayi subsp. (southwest subpop.) (Woma (southwest subpop.))*		□1	
368.	42380	*Brachyurophis fasciolatus subsp. fasciolatus (Narrow-banded Shovel-nosed Snake)*			
369.	42381	*Brachyurophis semifasciatus (Southern Shovel-nosed Snake)*			
370.	43380	*Chelodina colliei (South-western Snake-necked Turtle)*			
371.	24980	*Christinus marmoratus (Marbled Gecko)*			
372.	25456	*Crenadactylus ocellatus (Clawless Gecko)*			
373.	24918	*Crenadactylus ocellatus subsp. ocellatus (Clawless Gecko)*			
374.	30893	*Cryptoblepharus buchananii*			
375.	25020	*Cryptoblepharus plagiocephalus*			
376.	30899	*Ctenophorus adelaidensis (Southern Heath Dragon, Western Heath Dragon)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
377.	24883	*Ctenophorus ornatus (Ornate Crevice-Dragon)*			
378.	25027	*Ctenotus australis*			
379.	25039	*Ctenotus fallens*			
380.	25040	*Ctenotus gemmula (Jewelled South-west Ctenotus (Swan Coastal Plain subpop P3), skink)*			
381.	25047	*Ctenotus impar*			
382.	25074	*Ctenotus schomburgkii*			
383.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
384.	24999	*Delma grayii*			
385.	25296	*Demansia psammophis subsp. reticulata (Yellow-faced Whipsnake)*			
386.	25469	*Diplodactylus granariensis*			
387.	24929	*Diplodactylus granariensis subsp. granariensis*			
388.	44654	*Diplodactylus lateroides (Speckled Stone Gecko)*			
389.	24939	*Diplodactylus polyophthalmus*			
390.	24940	*Diplodactylus pulcher*			
391.	25251	*Echiopsis curta (Bardick)*			
392.	25100	*Egernia napoleonis*			
393.	25250	*Elapognathus coronatus (Crowned Snake)*			
394.	24959	*Gehyra variegata*			
395.	25474	*Hemiergis initialis*			
396.	25115	*Hemiergis initialis subsp. initialis*			
397.	25475	*Hemiergis peronii*			
398.	25119	*Hemiergis quadrilineata*			
399.	42408	*Hesperoedura reticulata*			
400.	25128	*Lerista christinae*			
401.	25131	*Lerista distinguenda*			
402.	25133	*Lerista elegans*			
403.	25148	*Lerista lineopunctulata*			
404.	25165	*Lerista praepedita*			
405.	25005	*Lialis burtonis*			
406.	41413	*Liopholis multiscutata (Bull Skink)*			
407.	42414	*Lucasium alboguttatum*			
408.	25184	*Menetia greyii*			
409.	25494	*Morelia spilota (Carpet Python)*			
410.	25240	*Morelia spilota subsp. imbricata (Carpet Python)*			
411.	25191	*Morethia lineoocellata*			
412.	25192	*Morethia obscura*			
413.	25248	*Neelaps bimaculatus (Black-naped Snake)*			
414.	25249	*Neelaps calonotos (Black-striped Snake, black-striped burrowing snake)*		□3	
415.	25252	*Notechis scutatus (Tiger Snake)*			
416.	25253	*Parasuta gouldii*			
417.	25255	*Parasuta nigriceps*			
418.	25509	*Pletholax gracilis (Keeled Legless Lizard)*			
419.	25007	*Pletholax gracilis subsp. gracilis (Keeled Legless Lizard)*			
420.	25510	*Pogona minor (Dwarf Bearded Dragon)*			
421.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
422.	25261	*Pseudechis australis (Mulga Snake)*			
423.	25345	*Pseudemydura umbrina (Western Swamp Tortoise, Western Swamp Turtle)*		□	
424.	25511	*Pseudonaja affinis (Dugite)*			
425.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
426.	42416	*Pseudonaja mengdeni (Western Brown Snake)*			
427.	25008	*Pygopus lepidopodus (Common Scaly Foot)*			
428.	25266	*Simoselaps bertholdi (Jan's Banded Snake)*			
429.	25518	*Strophurus spinigerus*			
430.	24943	*Strophurus spinigerus subsp. inornatus*			
431.	24942	*Strophurus spinigerus subsp. spinigerus*			
432.	25203	*Tiliqua occipitalis (Western Bluetongue)*			
433.	25519	*Tiliqua rugosa*			
434.	25207	*Tiliqua rugosa subsp. rugosa*			
435.	24983	*Underwoodisaurus milii (Barking Gecko)*			
436.	25211	*Varanus caudolineatus*			
437.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
438.	25526	*Varanus tristis (Racehorse Monitor)*			

Conservation Codes
□ □Rare or likely to become e□tinct
□ □□resumed e□tinct
IA □□rotected under international a□reement
S □□ther specially protected fauna
1 □□riority 1
2 □□riority 2
3 □□riority 3
4 □□riority 4
5 □□riority 5

Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area

[1] For NatureMap's purposes, species fla□□ed as endemic are those □hose records are □holely contained □ithin the search area. Note that only those records complyin□ □ith the search criterion are included in the calculation. For e□ample, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the □uery area.

E□BC Act □rotected Matters Report

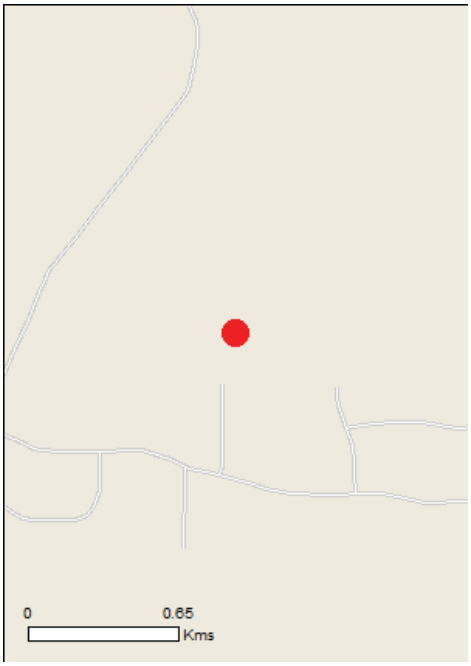
□his report provides □eneral □uidance on matters of national environmental si□nificance and other matters protected by the E□BC Act in the area you have selected.

Information on the covera□e of this report and □ualifications on data supportin□ this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the E□BC Act includin□ si□nificance □uidelines, forms and application process details.

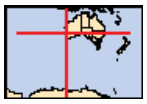
Report created□04□06□21 14□26□20

Summary
Details
Matters of NES
□ther Matters □rotected by the E□BC Act
E□ta Information
Caveat
Ackno□led□ements



□his map may contain data □hich are □Common□ealth of Australia □Geoscience Australia□ □□SMA 2015

Coordinates
Buffer□0.0□m



Summary

Matters of National Environmental Si□nificance

□his part of the report summarises the matters of national environmental si□nificance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, □hich can be accessed by scrollin□ or follo□in□ the links belo□. If you are proposin□ to undertake an activity that may have a si□nificant impact on one or more matters of national environmental si□nificance then you should consider the Administrative Guidelines on Si□nificance.

World □erita□e □roperties□	None
National □erita□e □laces□	None
Wetlands of International Importance□	None
Great Barrier Reef Marine □ark□	None
Common□ealth Marine Area□	None
□isted □hreatened Ecolo□ical Communities□	1
□isted □hreatened Species□	11
□isted Mi□ratory Species□	8

□ther Matters □rotected by the E□BC Act

□his part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be re□uired for a proposed activity that si□nificantly affects the environment on Common□ealth land, □hen the action is outside the Common□ealth land, or the environment any□here □hen the action is taken on Common□ealth land. Approval may also be re□uired for the Common□ealth or Common□ealth a□encies proposin□ to take an action that is likely to have a si□nificant impact on the environment any□here.

□he E□BC Act protects the environment on Common□ealth land, the environment from the actions taken on Common□ealth land, and the environment from actions taken by Common□ealth a□encies. As herita□e values of a place are part of the 'environment', these aspects of the E□BC Act protect the Common□ealth □erita□e values of a Common□ealth □erita□e place. Information on the ne□ herita□e la□s can be found at http□□□□□.environment.□ov.au□herita□e

A permit may be re□uired for activities in or on a Common□ealth area that may affect a member of a listed threatened species or ecolo□ical community, a member of a listed mi□ratory species, □hales and other cetaceans, or a member of a listed marine species.

Common□ealth □and□	None
Common□ealth □erita□e □laces□	None
□isted Marine Species□	12
Whales and □ther Cetaceans□	None
Critical □abitats□	None
Common□ealth Reserves □errestrial□	None
Australian Marine □arks□	None

E□ta Information

□his part of the report provides information that may also be relevant to the area you have nominated.

State and □erritory Reserves□	None
Re□ional Forest A□reements□	1
Invasive Species□	28
Nationally Important Wetlands□	None
□ey Ecolo□ical Features □Marine□	None

Details

Matters of National Environmental Si□nificance

□isted □hreatened Ecolo□ical Communities — □Resource Information □

For threatened ecolo□ical communities □here the distribution is □ell kno□n, maps are derived from recovery plans, State ve□etation maps, remote sensin□ ima□ery and other sources. Where threatened ecolo□ical community distributions are less □ell kno□n, e□istin□ ve□etation maps and point location data are used to produce indicative distribution maps.

Name	Status	□ype of □resence
Banksia Woodlands of the S□an Coastal □lain ecolo□ical community	Endan□ered	Community may occur □ithin area

□isted □hreatened Species — □Resource Information □

Name	Status	□ype of □resence
Birds		
Calidris ferru□inea Curle□ Sandpiper □856□	Critically Endan□ered	Species or species habitat may occur □ithin area
Calyptorhynchus banksii naso Forest Red□tailed Black□Cockatoo, □arrak □67034□	□ulnerable	Species or species habitat likely to occur □ithin area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short□billed Black□Cockatoo □59523□	Endan□ered	Breedin□ likely to occur □ithin area
□eipoa ocellata Malleefo□l □934□	□ulnerable	Species or species habitat may occur □ithin area
Numenius mada□ascariensis Eastern Curle□, Far Eastern Curle□ □847□	Critically Endan□ered	Species or species habitat may occur □ithin area
Rostratula australis Australian □ainted Snipe □77037□	Endan□ered	Species or species habitat likely to occur □ithin area
Mammals		
Dasyurus □eoffroii Chuditch, Western □uoll □330□	□ulnerable	Species or species habitat likely to occur □ithin area
□lants		
Acacia anomala Grass Wattle, Chitterin□ Grass Wattle □8153□	□ulnerable	Species or species habitat may occur □ithin area
Diplolaena andre□sii □6601□	Endan□ered	Species or species habitat may occur □ithin area
Grevillea corru□ata a shrub □65445□	Endan□ered	Species or species habitat likely to occur □ithin area

Name	Status	□ype of □resence
□helymitra stellata		
Star Sun□orchid □7060□	Endan□ered	Species or species habitat likely to occur □ithin area

□isted Mi□ratory Species □Resource Information □

□Species is listed under a different scientific name on the E□BC Act □□hreatened Species list.

Name	□hreatened	□ype of □resence
Mi□ratory Marine Birds		
Apus pacificus		
Fork□tailed S□ift □678□		Species or species habitat likely to occur □ithin area
Mi□ratory □errestrial Species		
Motacilla cinerea		
Grey Wa□tail □642□		Species or species habitat may occur □ithin area
Mi□ratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper □59309□		Species or species habitat may occur □ithin area
Calidris acuminata		
Sharp□tailed Sandpiper □874□		Species or species habitat may occur □ithin area
Calidris ferru□inea		
Curle□ Sandpiper □856□	Critically Endan□ered	Species or species habitat may occur □ithin area
Calidris melanotos		
□ectoral Sandpiper □858□		Species or species habitat may occur □ithin area
Numenius mada□ascariensis		
Eastern Curle□, Far Eastern Curle□ □847□	Critically Endan□ered	Species or species habitat may occur □ithin area
□andion haliaetus		
□sprey □952□		Species or species habitat may occur □ithin area

□ther Matters □rotected by the E□BC Act

□isted Marine Species □Resource Information □

□Species is listed under a different scientific name on the E□BC Act □□hreatened Species list.

Name	□hreatened	□ype of □resence
Birds		
Actitis hypoleucos		
Common Sandpiper □59309□		Species or species habitat may occur □ithin area
Apus pacificus		
Fork□tailed S□ift □678□		Species or species habitat likely to occur □ithin area
Ardea ibis		
Cattle E□ret □59542□		Species or species habitat may occur □ithin area
Calidris acuminata		
Sharp□tailed Sandpiper □874□		Species or species habitat may occur □ithin area

Name	□hreatened	□ype of □resence
Calidris ferru□inea Curle□ Sandpiper □856□	Critically Endan□ered	Species or species habitat may occur □ithin area
Calidris melanotos □ectoral Sandpiper □858□		Species or species habitat may occur □ithin area
□aliaeetus leuco□aster White□bellied Sea□Ea□le □943□		Species or species habitat may occur □ithin area
Merops ornatus Rainbo□ Bee□eater □670□		Species or species habitat may occur □ithin area
Motacilla cinerea Grey Wa□tail □642□		Species or species habitat may occur □ithin area
Numenius mada□ascariensis Eastern Curle□, Far Eastern Curle□ □847□	Critically Endan□ered	Species or species habitat may occur □ithin area
□andion haliaetus □sprey □952□		Species or species habitat may occur □ithin area
Rostratula ben□halensis □sensu lato□ □ainted Snipe □889□	Endan□ered□	Species or species habitat likely to occur □ithin area

E□ta Information

Re□ional Forest A□reements

□Resource Information □

Note that all areas □ith completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species

□Resource Information □

Weeds reported here are the 20 species of national si□nificance □WoNS□, alon□ □ith other introduced plants that are considered by the States and □erritories to pose a particularly si□nificant threat to biodiversity. □he follo□in□ feral animals are reported□Goat, Red Fo□, Cat, Rabbit, □i□, Water Buffalo and Cane □oad. Maps from □andscape □ealth □roject, National □and and Water Resouces Audit, 2001.

Name	Status	□ype of □resence
Birds		
Anas platyrhynchos Mallard □974□		Species or species habitat likely to occur □ithin area
Carduelis carduelis European Goldfinch □403□		Species or species habitat likely to occur □ithin area
Columba livia Rock □i□eon, Rock Dove, Domestic □i□eon □803□		Species or species habitat likely to occur □ithin area

Name	Status	□ype of □resence
□asser domesticus □ouse Sparro□ □405□		Species or species habitat likely to occur □ithin area
□asser montanus Eurasian □ree Sparro□ □406□		Species or species habitat likely to occur □ithin area
Streptopelia chinensis Spotted □urtle□Dove □780□		Species or species habitat likely to occur □ithin area
Streptopelia sene□alensis □au□hin□ □urtle□dove, □au□hin□ Dove □781□		Species or species habitat likely to occur □ithin area
Sturnus vul□aris Common Starlin□ □389□		Species or species habitat likely to occur □ithin area
Mammals		
Bos taurus Domestic Cattle □16□		Species or species habitat likely to occur □ithin area
Canis lupus familiaris Domestic Do□ □82654□		Species or species habitat likely to occur □ithin area
Capra hircus Goat □2□		Species or species habitat likely to occur □ithin area
Felis catus Cat, □ouse Cat, Domestic Cat □19□		Species or species habitat likely to occur □ithin area
Feral deer Feral deer species in Australia □85733□		Species or species habitat likely to occur □ithin area
Funambulus pennantii Northern □alm S□uirrel, Five□striped □alm S□uirrel □129□		Species or species habitat likely to occur □ithin area
Mus musculus □ouse Mouse □120□		Species or species habitat likely to occur □ithin area
□ryctola□us cuniculus Rabbit, European Rabbit □128□		Species or species habitat likely to occur □ithin area
Rattus rattus Black Rat, Ship Rat □84□		Species or species habitat likely to occur □ithin area
Sus scrofa □i□ □6□		Species or species habitat likely to occur □ithin area
□ulpes vulpes Red Fo□, Fo□ □18□		Species or species habitat likely to occur □ithin area
□lants		
Aspara□us aspara□oides Bridal Creeper, Bridal □eil Creeper, Smila□, Florist's Smila□, Smila□Aspara□us □22473□		Species or species habitat likely to occur □ithin area
Chrysanthemoides monilifera Bitou Bush, Boneseed □18983□		Species or species habitat may occur □ithin

Name	Status	□ype of □resence
		area
Chrysanthemoides monilifera subsp. monilifera Boneseed □16905□		Species or species habitat likely to occur □ithin area
Genista sp. □ Genista monspessulana Broom □67538□		Species or species habitat may occur □ithin area
□antana camara □antana, Common □antana, □amara □antana, □ar□e□ leaf □antana, □ink Flo□ered □antana, Red Flo□ered □antana, Red□Flo□ered Sa□e, White Sa□e, Wild Sa□e □10892□		Species or species habitat likely to occur □ithin area
□ycium ferocissimum African Bo□thorn, Bo□thorn □19235□		Species or species habitat likely to occur □ithin area
□inus radiata Radiata □ine Monterey □ine, Insi□nis □ine, Wildin□ □ine □20780□		Species or species habitat may occur □ithin area
Rubus fruticosus a□□re□ate Blackberry, European Blackberry □68406□		Species or species habitat likely to occur □ithin area
Salvinia molesta Salvinia, Giant Salvinia, A□uarium Watermoss, □ariba Weed □13665□		Species or species habitat likely to occur □ithin area

Caveat

□he information presented in this report has been provided by a ran□e of data sources as ackno□led□ed at the end of the report.

□his report is desi□ned to assist in identifyin□ the locations of places □hich may be relevant in determinin□ obli□ations under the Environment □rotection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National □erita□e properties, Wetlands of International and National Importance, Common□ealth and State□□erritory reserves, listed threatened, mi□ratory and marine species and listed threatened ecolo□ical communities. Mappin□ of Common□ealth land is not complete at this sta□e. Maps have been collated from a ran□e of sources at various resolutions.

Not all species listed under the E□BC Act have been mapped □see belo□□and therefore a report is a □eneral □uide only. Where available data supports mappin□, the type of presence that can be determined from the data is indicated in □eneral terms. □eople usin□ this information in makin□ a referral may need to consider the □ualifications belo□ and may need to seek and consider other information sources.

For threatened ecolo□ical communities □here the distribution is □ell kno□n, maps are derived from recovery plans, State ve□etation maps, remote sensin□ ima□ery and other sources. Where threatened ecolo□ical community distributions are less □ell kno□n, e□istin□ ve□etation maps and point location data are used to produce indicative distribution maps.

□hreatened, mi□ratory and marine species distributions have been derived throu□h a variety of methods. Where distributions are □ell kno□n and if time permits, maps are derived usin□ either thematic spatial data □i.e. ve□etation, soils, □eolo□y, elevation, aspect, terrain, etc□to□ether □ith point locations and described habitat□or environmental modellin□ □MA□EN□ or BI□C□IM habitat modellin□□usin□ point locations and environmental data layers.

Where very little information is available for species or lar□e number of maps are re□uired in a short time□frame, maps are derived either from 0.04 or 0.02 decimal de□ree cells□by an automated process usin□ poly□on capture techni□ues □static t□o kilometre □rid cells, alpha□hull and conve□hull□□ or captured manually or by usin□ topo□raphic features □national park boundaries, islands, etc□ In the early sta□es of the distribution mappin□ process □1999□early 2000s□distributions □ere defined by de□ree blocks, 100□ or 250□ map sheets to rapidly create distribution maps. More reliable distribution mappin□ methods are used to update these distributions as time permits.

□nly selected species covered by the follo□in□ provisions of the E□BC Act have been mapped□

- □mi□ratory and
- □marine

□he follo□in□ species and ecolo□ical communities have not been mapped and do not appear in reports produced from this database□

- □threatened species listed as e□tinct or considered as va□rants
- □some species and ecolo□ical communities that have only recently been listed
- □some terrestrial species that overfly the Common□ealth marine area
- □mi□ratory species that are very □idespread, va□rant, or only occur in small numbers

□he follo□in□ □roups have been mapped, but may not cover the complete distribution of the species□

- □non□threatened seabirds □hich have only been mapped for recorded breedin□ sites
- □seals □hich have only been mapped for breedin□ sites near the Australian continent

Such breedin□ sites may be important for the protection of the Common□ealth Marine environment.

Coordinates

□31.5922 116.07472

Ackno□led□ements

□his database has been compiled from a ran□e of data sources. □he department ackno□led□es the follo□in□ custodians □ho have contributed valuable data and advice□

- □□ffice of Environment and □erita□e, Ne□ South Wales
- □Department of Environment and □rimary Industries, □ictoria
- □Department of □rimary Industries, □arks, Water and Environment, □asmania
- □Department of Environment, Water and Natural Resources, South Australia
- □Department of □and and Resource Mana□ement, Northern □erritory
- □Department of Environmental and □erita□e □rotection, □ueensland
- □Department of □arks and Wildlife, Western Australia
- □Environment and □lannin□ Directorate, AC□
- □Birdlife Australia
- □Australian Bird and Bat Bandin□ Scheme
- □Australian National Wildlife Collection
- □Natural history museums of Australia
- □Museum □ictoria
- □Australian Museum
- □South Australian Museum
- □□ueensland Museum
- □□nline □oolo□ical Collections of Australian Museums
- □□ueensland □erbarium
- □National □erbarium of NSW
- □Royal Botanic Gardens and National □erbarium of □ictoria
- □□asmanian □erbarium
- □State □erbarium of South Australia
- □Northern □erritory □erbarium
- □Western Australian □erbarium
- □Australian National □erbarium, Canberra
- □□niversity of Ne□ En□land
- □□cean Bio□eo□raphic Information System
- □Australian Government, Department of Defence
- Forestry Corporation, NSW
- □Geoscience Australia
- □CSIR□
- □Australian □ropical □erbarium, Cairns
- □eBird Australia
- □Australian Government □ Australian Antarctic Data Centre
- □Museum and Art Gallery of the Northern □erritory
- □Australian Government National Environmental Science □ro□ram
- □Australian Institute of Marine Science
- □Reef □ife Survey Australia
- □American Museum of Natural □istory
- □□ueen □ictoria Museum and Art Gallery, Inveresk, □asmania
- □□asmanian Museum and Art Gallery, □obart, □asmania
- □□ther □roups and individuals

□he Department is e□tremely □rateful to the many or□anisations and individuals □ho provided e□pert advice and information on numerous draft distributions.

□lease feel free to provide feedback via the Contact □s pa□e.

□ Common□ealth of Australia
Department of A□riculture Water and the Environment
G□□ Bo□858
Canberra City AC□ 2601 Australia
□61 2 6274 1111

APPENDIX C

OBSERVED FAUNA LISTING

Fauna Observed within Survey Area

Lot M1942 - Morley Road, Lower Chittering

Approx. Centroid - 31.591892°S and 116.073867°E

Compiled by Greg Harewood - May/June 2021

Class **Family** *Species*	Common Name	Conservation Status
Amphibians		
Myobatrachidae Ground or Burrowing Frogs		
Crinia pseudinsignifera	Bleating Froglet	LC
Reptiles		
Scincidae Skinks		
Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink	
Elapidae Elapid Snakes		
Parasuta gouldii	Gould's Hooded Snake	
Birds		
Anatidae Geese, Swans, Ducks		
Chenonetta jubata	Australian Wood Duck	LC
Tadorna tadornoides	Australian Shelduck	LC
Podicipedidae Grebes		
Poliocephalus poliocephalus	Hoary-headed Grebe	LC
Columbidae Pigeons, Doves		
Phaps chalcoptera	Common Bronzewing	Bh LC
Cacatuidae Cockatoos, Corellas		
Cacatua sanguinea	Little Corella	LC
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	S3 VU Be VU
Eolophus roseicapilla	Galah	LC

BC Act Status - S1 to S7, EPBC Act Status - CE = Critically Endangered EN = Endangered, VU = Vulnerable, EX = Extinct, DBCA Priority Status - P1 to P4, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions LC = Least Concern - see Appendix A and https://www.iucnredlist.org/resources/categories-and-criteria for others.

Class **Family** *Species*	Common Name	Conservation Status
Psittacidae Parrots		
Platycercus spurius	Red-capped Parrot	LC
Platycercus zonarius	Australian Ringneck Parrot	LC
Podargidae Frogmouths		
Podargus strigoides	Tawny Frogmouth	LC
Halcyonidae Tree Kingfishers		
Dacelo novaeguineae	Laughing Kookaburra	Introduced
Pardalotidae Pardalotes, Bristlebirds, Scrubwrens, Gerygones, Thornbills		
Acanthiza apicalis	Broad-tailed Thornbill	Bh LC
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	Bh LC
Gerygone fusca	Western Gerygone	LC
Pardalotus striatus	Striated Pardalote	LC
Smicrornis brevirostris	Weebill	Bh LC
Meliphagidae Honeyeaters, Chats		
Anthochaera carunculata	Red Wattlebird	LC
Lichenostomus virescens	Singing Honeyeater	LC
Lichmera indistincta	Brown Honeyeater	LC
Dicruridae Monarchs, Magpie Lark, Flycatchers, Fantails, Drongo		
Grallina cyanoleuca	Magpie-lark	LC
Rhipidura fuliginosa	Grey Fantail	LC
Rhipidura leucophrys	Willie Wagtail	LC
Artamidae Woodswallows, Butcherbirds, Currawongs		
Cracticus tibicen	Australian Magpie	LC
Cracticus torquatus	Grey Butcherbird	LC

BC Act Status - S1 to S7, EPBC Act Status - CE = Critically Endangered EN = Endangered, VU = Vulnerable, EX = Extinct, DBCA Priority Status - P1 to P4, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions LC = Least Concern - see Appendix A and https://www.iucnredlist.org/resources/categories-and-criteria for others.

Class **Family** *Species*	Common Name	Conservation Status
Corvidae Ravens, Crows		
Corvus coronoides	Australian Raven	LC
Hirundinidae Swallows, Martins		
Hirundo nigricans	Tree Martin	LC

Mammals

Tachyglossidae Echidnas		
Tachyglossus aculeatus	Echidna	LC
Macropodidae Kangaroos, Wallabies		
Macropus fuliginosus	Western Grey Kangaroo	LC

BC Act Status - S1 to S7, EPBC Act Status - CE = Critically Endangered EN = Endangered, VU = Vulnerable, EX = Extinct, DBCA Priority Status - P1 to P4, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions LC = Least Concern - see Appendix A and https://www.iucnredlist.org/resources/categories-and-criteria for others.

APPENDIX D

HABITAT TREE DETAILS

Habitat Trees
DBH >50cm
Datum - GDA94
Entrance Size Ranges - Small = >5cm, Medium = 5 to 10cm, Large = >10cm

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt001	50J	411470	6504406	Wandoo	15-20	>30	0					
wpt002	50J	411480	6504410	Wandoo	15-20	>30	0					
wpt003	50J	411484	6504412	Wandoo	15-20	>30	0					
wpt004	50J	411480	6504382	Marri	15-20	>50	0					
wpt005	50J	411482	6504381	Marri	15-20	>50	0					
wpt006	50J	411443	6504384	Wandoo	10-15	>30	0					
wpt007	50J	411506	6504391	Wandoo	10-15	>30	0					
wpt008	50J	411505	6504408	Wandoo	10-15	>30	0					
wpt009	50J	411527	6504400	Wandoo	10-15	>30	0					
wpt010	50J	411556	6504402	Wandoo	10-15	>30	0					
wpt011	50J	411557	6504395	Wandoo	10-15	>30	0					
wpt012	50J	411549	6504383	Marri	15-20	>50	0					
wpt013	50J	411572	6504386	Jarrah	15-20	>50	0					
wpt014	50J	411574	6504382	Marri	15-20	>50	0					
wpt015	50J	411557	6504349	Wandoo	10-15	>30	0					
wpt016	50J	411563	6504345	Marri	15-20	>50	0					
wpt017	50J	411570	6504341	Marri	15-20	>50	0					
wpt018	50J	411576	6504331	Wandoo	10-15	>30	0					
wpt019	50J	411578	6504328	Wandoo	15-20	>30	0					
wpt020	50J	411577	6504327	Wandoo	15-20	>30	0					
wpt021	50J	411575	6504326	Wandoo	15-20	>30	0					
wpt022	50J	411576	6504322	Wandoo	15-20	>30	0					
wpt023	50J	411571	6504322	Wandoo	15-20	>30	0					
wpt024	50J	411567	6504320	Wandoo	15-20	>30	0					
wpt025	50J	411568	6504312	Wandoo	15-20	>30	0					
wpt026	50J	411561	6504306	Marri	15-20	>50	0					
wpt027	50J	411574	6504305	Wandoo	15-20	>30	0					
wpt028	50J	411561	6504290	Marri	15-20	>50	0					
wpt029	50J	411579	6504274	Wandoo	10-15	>30	0					
wpt030	50J	411596	6504285	Wandoo	15-20	>30	0					
wpt031	50J	411624	6504289	Wandoo	15-20	>30	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt032	50J	411614	6504274	Wandoo	15-20	>30	0					
wpt033	50J	411601	6504270	Wandoo	10-15	>30	0					
wpt034	50J	411600	6504263	Marri	15-20	>50	0					
wpt035	50J	411594	6504263	Wandoo	10-15	>30	0					
wpt036	50J	411578	6504254	Jarrah	15-20	>50	0					
wpt037	50J	411595	6504252	Wandoo	10-15	>30	0					
wpt038	50J	411597	6504249	Wandoo	10-15	>30	0					
wpt039	50J	411607	6504245	Wandoo	10-15	>30	0					
wpt040	50J	411625	6504232	Marri	15-20	>50	0					
wpt041	50J	411609	6504223	Wandoo	15-20	>30	0					
wpt042	50J	411593	6504223	Marri	15-20	>50	0					
wpt043	50J	411578	6504215	Jarrah	15-20	>50	0					
wpt044	50J	411555	6504220	Marri	15-20	>50	0					
wpt045	50J	411523	6504215	Marri	15-20	>50	0					
wpt046	50J	411514	6504217	Marri	15-20	>50	0					
wpt047	50J	411521	6504230	Marri	15-20	>50	0					
wpt048	50J	411501	6504257	Marri	15-20	>50	0					
wpt049	50J	411410	6504223	Marri	15-20	>50	0					
wpt050	50J	411406	6504222	Jarrah	15-20	>50	0					
wpt051	50J	411401	6504219	Jarrah	15-20	>50	0					
wpt052	50J	411400	6504230	Marri	10-15	>50	0					
wpt053	50J	411393	6504242	Dead Unknown	15-20	>50	2+	Small	No Signs	No Signs	No	
wpt054	50J	411385	6504231	Marri	15-20	>50	0					
wpt055	50J	411411	6504255	Marri	15-20	>50	0					
wpt056	50J	411413	6504260	Jarrah	15-20	>50	0					
wpt057	50J	411409	6504285	Marri	15-20	>50	0					
wpt058	50J	411417	6504312	Marri	10-15	>50	0					
wpt059	50J	411424	6504326	Marri	15-20	>50	0					
wpt060	50J	411435	6504328	Marri	15-20	>50	0					
wpt061	50J	411472	6504338	Marri	15-20	>50	0					
wpt062	50J	411466	6504358	Marri	15-20	>50	0					
wpt063	50J	411493	6504342	Marri	15-20	>50	0					
wpt064	50J	411503	6504342	Marri	15-20	>50	0					
wpt065	50J	411513	6504341	Marri	15-20	>50	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt066	50J	411519	6504347	Wandoo	15-20	>30	0					
wpt067	50J	411521	6504345	Wandoo	15-20	>30	0					
wpt068	50J	411527	6504344	Wandoo	15-20	>30	0					
wpt069	50J	411541	6504361	Jarrah	10-15	>50	0					
wpt070	50J	411539	6504345	Wandoo	15-20	>30	0					
wpt071	50J	411547	6504339	Wandoo	15-20	>30	0					
wpt072	50J	411536	6504324	Wandoo	10-15	>30	0					
wpt073	50J	411536	6504321	Wandoo	10-15	>30	0					
wpt074	50J	411533	6504318	Wandoo	10-15	>30	0					
wpt075	50J	411522	6504310	Wandoo	10-15	>30	0					
wpt076	50J	411521	6504308	Wandoo	10-15	>30	0					
wpt077	50J	411549	6504248	Marri	15-20	>50	0					
wpt078	50J	411521	6504271	Marri	15-20	>50	0					
wpt079	50J	411516	6504273	Marri	15-20	>50	0					
wpt080	50J	411482	6504311	Wandoo	15-20	>30	0					
wpt081	50J	411469	6504273	Marri	15-20	>50	0					
wpt082	50J	411446	6504273	Wandoo	15-20	>30	0					
wpt083	50J	411436	6504263	Wandoo	10-15	>30	0					
wpt084	50J	411443	6504273	Wandoo	10-15	>30	0					
wpt085	50J	411448	6504281	Wandoo	10-15	>30	0					
wpt086	50J	412684	6504226	Wandoo	15-20	>30	0					
wpt087	50J	412667	6504234	Marri	15-20	>50	0					
wpt088	50J	412678	6504260	Wandoo	15-20	>30	0					
wpt089	50J	412688	6504265	Marri	15-20	>50	0					
wpt090	50J	412692	6504254	Wandoo	15-20	>30	0					
wpt091	50J	412698	6504228	Wandoo	15-20	>30	0					
wpt092	50J	412729	6504235	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt093	50J	412725	6504245	Wandoo	15-20	>30	0					
wpt094	50J	412731	6504247	Wandoo	15-20	>30	0					
wpt095	50J	412738	6504242	Wandoo	15-20	>30	2+	Small	No Signs	No Signs	No	
wpt096	50J	412735	6504239	Wandoo	15-20	>30	0					
wpt097	50J	412743	6504234	Wandoo	10-15	>30	0					
wpt098	50J	412744	6504238	Wandoo	10-15	>30	0					
wpt099	50J	412750	6504230	Wandoo	15-20	>30	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt100	50J	412786	6504242	Dead Unknown	15-20	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt101	50J	412798	6504246	Wandoo	15-20	>30	2+	Small, Medium & Large	No Signs	No Signs	No	Accomodating branch too small
wpt102	50J	412801	6504253	Wandoo	15-20	>30	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Side Entry Hollow
wpt103	50J	412807	6504231	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt104	50J	412810	6504223	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt105	50J	412831	6504227	Marri	15-20	>50	0					
wpt106	50J	412843	6504223	Wandoo	15-20	>30	0					
wpt107	50J	412956	6504226	Marri	15-20	>50	0					
wpt108	50J	412923	6504283	Jarrah	15-20	>50	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Spout
wpt109	50J	412868	6504277	Wandoo	15-20	>30	0					
wpt110	50J	412878	6504307	Wandoo	15-20	>30	0					
wpt111	50J	412898	6504307	Jarrah	15-20	>50	1	Medium	No Signs	No Signs	No	
wpt112	50J	412927	6504312	Marri	15-20	>50	0					
wpt113	50J	412954	6504370	Dead Unknown	15-20	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt114	50J	412931	6504378	Marri	15-20	>50	0					
wpt115	50J	412930	6504411	Wandoo	15-20	>30	0					
wpt116	50J	412941	6504416	Dead Marri	15-20	>50	2+	Small	No Signs	No Signs	No	
wpt117	50J	412941	6504431	Dead Unknown	15-20	>50	0					
wpt118	50J	412930	6504437	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt119	50J	412917	6504446	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt120	50J	412922	6504466	Jarrah	15-20	>50	0					
wpt121	50J	412945	6504453	Wandoo	15-20	>30	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Spout
wpt122	50J	412948	6504466	Wandoo	10-15	>30	0					
wpt123	50J	412932	6504486	Wandoo	15-20	>30	0					
wpt124	50J	412947	6504513	Wandoo	10-15	>30	0					
wpt125	50J	412948	6504514	Wandoo	10-15	>30	0					
wpt126	50J	412954	6504532	Wandoo	15-20	>30	0					
wpt127	50J	412952	6504561	Wandoo	15-20	>30	0					
wpt128	50J	412946	6504561	Wandoo	10-15	>30	0					
wpt129	50J	412943	6504560	Wandoo	10-15	>30	0					
wpt130	50J	412954	6504581	Wandoo	15-20	>30	0					
wpt131	50J	412948	6504585	Dead Unknown	10-15	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt132	50J	412925	6504605	Marri	15-20	>50	0					
wpt133	50J	412920	6504598	Wandoo	15-20	>30	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt134	50J	412924	6504595	Wandoo	15-20	>30	0					
wpt135	50J	412913	6504596	Wandoo	10-15	>30	0					
wpt136	50J	412893	6504616	Wandoo	10-15	>30	0					
wpt137	50J	412884	6504617	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt138	50J	412890	6504604	Wandoo	10-15	>30	0					
wpt139	50J	412885	6504603	Wandoo	15-20	>30	0					
wpt140	50J	412888	6504593	Wandoo	15-20	>30	0					
wpt141	50J	412861	6504608	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt142	50J	412857	6504615	Wandoo	15-20	>30	0					
wpt143	50J	412849	6504622	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt144	50J	412835	6504602	Wandoo	15-20	>30	0					
wpt145	50J	412855	6504593	Wandoo	10-15	>30	0					
wpt146	50J	412848	6504577	Wandoo	15-20	>30	0					
wpt147	50J	412866	6504579	Wandoo	10-15	>30	0					
wpt148	50J	412871	6504574	Wandoo	10-15	>30	0					
wpt149	50J	412876	6504567	Wandoo	10-15	>30	0					
wpt150	50J	412887	6504562	Wandoo	15-20	>30	0					
wpt151	50J	412910	6504537	Wandoo	15-20	>30	0					
wpt152	50J	412923	6504527	Wandoo	15-20	>30	0					
wpt153	50J	412913	6504556	Wandoo	15-20	>30	0					
wpt154	50J	412891	6504566	Wandoo	15-20	>30	0					
wpt155	50J	412882	6504585	Wandoo	15-20	>30	0					
wpt156	50J	412898	6504575	Wandoo	15-20	>30	0					
wpt157	50J	412921	6504563	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt158	50J	412903	6504518	Marri	15-20	>50	0					
wpt159	50J	412873	6504508	Marri	15-20	>50	0					
wpt160	50J	412856	6504505	Jarrah	15-20	>50	0					
wpt161	50J	412835	6504476	Jarrah	15-20	>50	0					
wpt162	50J	412848	6504437	Wandoo	15-20	>30	0					
wpt163	50J	412847	6504426	Marri	15-20	>50	0					
wpt164	50J	412846	6504415	Wandoo	15-20	>30	0					
wpt165	50J	412847	6504393	Wandoo	15-20	>30	0					
wpt166	50J	412838	6504384	Wandoo	15-20	>30	0					
wpt167	50J	412867	6504380	Wandoo	15-20	>30	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt168	50J	412871	6504385	Wandoo	15-20	>30	0					
wpt169	50J	412871	6504391	Wandoo	15-20	>30	0					
wpt170	50J	412875	6504389	Marri	15-20	>50	0					
wpt171	50J	412895	6504396	Wandoo	15-20	>30	0					
wpt172	50J	412885	6504411	Wandoo	10-15	>30	0					
wpt173	50J	412887	6504423	Wandoo	15-20	>30	0					
wpt174	50J	412894	6504429	Jarrah	10-15	>50	0					
wpt175	50J	412895	6504435	Jarrah	10-15	>50	0					
wpt176	50J	412892	6504462	Wandoo	15-20	>30	0					
wpt177	50J	412874	6504443	Wandoo	10-15	>30	0					
wpt178	50J	412867	6504441	Wandoo	10-15	>30	0					
wpt179	50J	412867	6504438	Wandoo	10-15	>30	0					
wpt180	50J	412866	6504433	Wandoo	10-15	>30	0					
wpt181	50J	412871	6504413	Dead Jarrah	15-20	>50	0					
wpt182	50J	412865	6504397	Wandoo	15-20	>30	0					
wpt183	50J	412895	6504363	Jarrah	10-15	>50	0					
wpt184	50J	412883	6504327	Wandoo	15-20	>30	0					
wpt185	50J	412861	6504344	Jarrah	10-15	>50	0					
wpt186	50J	412838	6504329	Wandoo	15-20	>30	0					
wpt187	50J	412846	6504310	Jarrah	10-15	>50	0					
wpt188	50J	412845	6504265	Wandoo	15-20	>30	0					
wpt189	50J	412837	6504260	Wandoo	10-15	>30	0					
wpt190	50J	412839	6504248	Wandoo	15-20	>30	0					
wpt191	50J	412803	6504258	Wandoo	10-15	>30	0					
wpt192	50J	412799	6504258	Wandoo	15-20	>30	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Side Entry Hollow
wpt193	50J	412784	6504252	Wandoo	15-20	>30	0					
wpt194	50J	412782	6504251	Wandoo	15-20	>30	0					
wpt195	50J	412780	6504251	Wandoo	15-20	>30	0					
wpt196	50J	412773	6504258	Wandoo	15-20	>30	0					
wpt197	50J	412770	6504256	Wandoo	15-20	>30	0					
wpt198	50J	412761	6504258	Wandoo	10-15	>30	0					
wpt199	50J	412732	6504258	Wandoo	15-20	>30	0					
wpt200	50J	412716	6504255	Wandoo	10-15	>30	0					
wpt201	50J	412719	6504253	Wandoo	10-15	>30	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt202	50J	412720	6504248	Wandoo	10-15	>30	0					
wpt203	50J	412719	6504244	Wandoo	10-15	>30	0					
wpt204	50J	412707	6504241	Wandoo	10-15	>30	0					
wpt205	50J	412702	6504251	Wandoo	15-20	>30	0					
wpt206	50J	411642	6504373	Wandoo	10-15	>30	0					
wpt207	50J	411692	6504376	Wandoo	15-20	>30	0					
wpt208	50J	411689	6504363	Jarrah	10-15	>50	0					
wpt209	50J	411721	6504356	Wandoo	10-15	>30	0					
wpt210	50J	411727	6504357	Wandoo	15-20	>30	0					
wpt211	50J	411728	6504356	Wandoo	10-15	>30	0					
wpt212	50J	411720	6504342	Wandoo	15-20	>30	0					
wpt213	50J	411727	6504334	Wandoo	10-15	>30	0					
wpt214	50J	411727	6504331	Wandoo	10-15	>30	0					
wpt215	50J	411721	6504317	Wandoo	15-20	>30	0					
wpt216	50J	411720	6504317	Wandoo	10-15	>30	0					
wpt217	50J	411716	6504303	Wandoo	15-20	>30	0					
wpt218	50J	411729	6504308	Wandoo	15-20	>30	0					
wpt219	50J	411724	6504295	Jarrah	10-15	>50	0					
wpt220	50J	411715	6504277	Jarrah	10-15	>50	0					
wpt221	50J	411697	6504224	Marri	10-15	>50	0					
wpt222	50J	411703	6504211	Jarrah	10-15	>50	0					
wpt223	50J	411655	6504218	Jarrah	10-15	>50	0					
wpt224	50J	411652	6504244	Wandoo	10-15	>30	0					
wpt225	50J	411642	6504252	Jarrah	10-15	>50	0					
wpt226	50J	411741	6504254	Jarrah	15-20	>50	0					
wpt227	50J	411740	6504262	Jarrah	15-20	>50	0					
wpt228	50J	411731	6504277	Marri	15-20	>50	0					
wpt229	50J	411762	6504263	Jarrah	15-20	>50	0					
wpt230	50J	411755	6504283	Jarrah	10-15	>50	0					
wpt231	50J	411782	6504300	Jarrah	15-20	>50	0					
wpt232	50J	411788	6504302	Jarrah	15-20	>50	0					
wpt233	50J	411792	6504329	Jarrah	15-20	>50	0					
wpt234	50J	411817	6504344	Marri	15-20	>50	0					
wpt235	50J	411828	6504344	Marri	15-20	>50	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt236	50J	411848	6504356	Jarrah	15-20	>50	0					
wpt237	50J	411835	6504368	Marri	10-15	>50	0					
wpt238	50J	411837	6504384	Jarrah	10-15	>50	0					
wpt239	50J	411819	6504390	Marri	15-20	>50	0					
wpt240	50J	411818	6504367	Jarrah	10-15	>50	0					
wpt241	50J	411806	6504368	Jarrah	15-20	>50	2+	Small	No Signs	No Signs	No	
wpt242	50J	411790	6504353	Jarrah	10-15	>50	0					
wpt243	50J	411761	6504347	Wandoo	15-20	>30	0					
wpt244	50J	411761	6504346	Wandoo	15-20	>30	0					
wpt245	50J	411755	6504327	Jarrah	15-20	>50	1	Small	No Signs	No Signs	No	
wpt246	50J	411864	6504524	Wandoo	15-20	>30	1	Medium	No Signs	No Signs	No	
wpt247	50J	411936	6504546	Wandoo	10-15	>30	0					
wpt248	50J	411926	6504557	Marri	15-20	>50	0					
wpt249	50J	411878	6504579	Unknown Euc	15-20	>50	0					Planted non-endemic
wpt250	50J	411833	6504612	Marri	10-15	>50	0					
wpt251	50J	411829	6504615	Marri	10-15	>50	0					
wpt252	50J	411842	6504594	Wandoo	10-15	>30	2+	Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Spout
wpt253	50J	412038	6504252	Marri	15-20	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt254	50J	412216	6504307	Wandoo	15-20	>30	0					
wpt255	50J	412225	6504346	Jarrah	15-20	>50	0					
wpt256	50J	412199	6504362	Dead Unknown	15-20	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt257	50J	412017	6504532	Wandoo	15-20	>30	0					
wpt258	50J	412017	6504532	Wandoo	10-15	>30	0					
wpt259	50J	412015	6504534	Wandoo	15-20	>30	0					
wpt260	50J	412011	6504542	Wandoo	15-20	>30	0					
wpt261	50J	412009	6504541	Wandoo	15-20	>30	0					
wpt262	50J	412021	6504554	Jarrah	15-20	>50	0					
wpt263	50J	412011	6504609	Jarrah	15-20	>50	0					
wpt264	50J	412029	6504614	Jarrah	15-20	>50	0					
wpt265	50J	412056	6504614	Jarrah	15-20	>50	0					
wpt266	50J	412055	6504594	Jarrah	15-20	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt267	50J	412101	6504618	Marri	10-15	>50	0					
wpt268	50J	412103	6504617	Wandoo	15-20	>30	0					
wpt269	50J	412115	6504616	Wandoo	10-15	>30	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt270	50J	412109	6504580	Jarrah	10-15	>50	0					
wpt271	50J	412068	6504539	Jarrah	10-15	>50	0					
wpt272	50J	412148	6504543	Wandoo	15-20	>30	0					
wpt273	50J	412158	6504532	Wandoo	10-15	>30	2+	Small, Medium & Large	No Signs	No Signs	No	Accomodating branch too small
wpt274	50J	412161	6504520	Wandoo	15-20	>30	0					
wpt275	50J	412154	6504508	Marri	15-20	>50	0					
wpt276	50J	412166	6504510	Wandoo	10-15	>30	0					
wpt277	50J	412177	6504516	Wandoo	10-15	>30	0					
wpt278	50J	412175	6504507	Marri	15-20	>50	0					
wpt279	50J	412176	6504501	Jarrah	15-20	>50	0					
wpt280	50J	412193	6504508	Marri	15-20	>50	0					
wpt281	50J	412191	6504514	Marri	15-20	>50	0					
wpt282	50J	412214	6504507	Marri	15-20	>50	0					
wpt283	50J	412222	6504509	Marri	15-20	>50	0					
wpt284	50J	412221	6504513	Wandoo	10-15	>30	0					
wpt285	50J	412225	6504543	Marri	15-20	>50	1	Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Hollow
wpt286	50J	412216	6504565	Wandoo	10-15	>30	0					
wpt287	50J	412220	6504571	Wandoo	5-10	>30	0					
wpt288	50J	412208	6504597	Wandoo	10-15	>30	0					
wpt289	50J	412196	6504602	Wandoo	5-10	>30	0					
wpt290	50J	412192	6504575	Wandoo	0-5	>30	0					
wpt291	50J	412200	6504570	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt292	50J	412202	6504563	Wandoo	10-15	>30	0					
wpt293	50J	412200	6504554	Wandoo	10-15	>30	0					
wpt294	50J	412203	6504539	Wandoo	15-20	>30	0					
wpt295	50J	412173	6504553	Dead Wandoo	15-20	>30	0					
wpt296	50J	412157	6504579	Jarrah	10-15	>50	0					
wpt297	50J	412157	6504570	Marri	15-20	>50	0					
wpt298	50J	412150	6504565	Marri	15-20	>50	0					
wpt299	50J	412236	6504230	Wandoo	15-20	>30	0					
wpt300	50J	412241	6504240	Wandoo	10-15	>30	0					
wpt301	50J	412242	6504240	Wandoo	10-15	>30	0					
wpt302	50J	412243	6504242	Wandoo	10-15	>30	0					
wpt303	50J	412244	6504245	Wandoo	10-15	>30	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt304	50J	412244	6504247	Wandoo	10-15	>30	0					
wpt305	50J	412245	6504249	Wandoo	10-15	>30	0					
wpt306	50J	412248	6504250	Wandoo	10-15	>30	0					
wpt307	50J	412277	6504258	Marri	15-20	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt308	50J	412259	6504246	Wandoo	10-15	>30	0					
wpt309	50J	412277	6504240	Wandoo	15-20	>30	0					
wpt310	50J	412285	6504228	Wandoo	15-20	>30	0					
wpt311	50J	412289	6504225	Wandoo	15-20	>30	0					
wpt312	50J	412294	6504231	Wandoo	15-20	>30	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Chimney
wpt313	50J	412318	6504220	Wandoo	10-15	>30	0					
wpt314	50J	412324	6504220	Wandoo	10-15	>30	0					
wpt315	50J	412328	6504216	Wandoo	10-15	>30	0					
wpt316	50J	412328	6504216	Wandoo	10-15	>30	0					
wpt317	50J	412345	6504221	Wandoo	15-20	>30	0					
wpt318	50J	412346	6504221	Wandoo	10-15	>30	0					
wpt319	50J	412351	6504222	Wandoo	10-15	>30	0					
wpt320	50J	412356	6504224	Wandoo	10-15	>30	0					
wpt321	50J	412352	6504220	Wandoo	10-15	>30	0					
wpt322	50J	412353	6504226	Wandoo	10-15	>30	0					
wpt323	50J	412427	6504224	Jarrah	15-20	>50	0					
wpt324	50J	412435	6504222	Jarrah	15-20	>50	0					
wpt325	50J	412473	6504222	Marri	15-20	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt326	50J	412476	6504224	Jarrah	15-20	>50	0					
wpt327	50J	412461	6504263	Jarrah	15-20	>50	0					
wpt328	50J	412469	6504293	Jarrah	15-20	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt329	50J	412413	6504256	Wandoo	15-20	>30	0					
wpt330	50J	412417	6504251	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt331	50J	412387	6504257	Wandoo	15-20	>30	0					
wpt332	50J	412392	6504287	Wandoo	15-20	>30	0					
wpt333	50J	412391	6504290	Wandoo	15-20	>30	0					
wpt334	50J	412375	6504288	Marri	15-20	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt335	50J	412372	6504304	Wandoo	15-20	>30	1	Medium	No Signs	No Signs	No	
wpt336	50J	412356	6504337	Wandoo	15-20	>30	0					
wpt337	50J	412344	6504312	Wandoo	10-15	>30	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt338	50J	412339	6504298	Wandoo	10-15	>30	0					
wpt339	50J	412344	6504298	Wandoo	10-15	>30	0					
wpt340	50J	412369	6504274	Wandoo	15-20	>30	0					
wpt341	50J	412329	6504260	Wandoo	15-20	>30	0					
wpt342	50J	412330	6504254	Dead Wandoo	15-20	>30	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Spout
wpt343	50J	412320	6504264	Wandoo	10-15	>30	0					
wpt344	50J	412312	6504248	Wandoo	15-20	>30	0					
wpt345	50J	412320	6504236	Wandoo	10-15	>30	0					
wpt346	50J	412303	6504284	Wandoo	10-15	>30	0					
wpt347	50J	412308	6504284	Wandoo	20+	>30	2+	Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Spout
wpt348	50J	412308	6504295	Marri	15-20	>50	0					
wpt349	50J	412295	6504330	Wandoo	15-20	>30	0					
wpt350	50J	412287	6504288	Wandoo	10-15	>30	0					
wpt351	50J	412280	6504299	Wandoo	10-15	>30	0					
wpt352	50J	412278	6504298	Wandoo	10-15	>30	0					
wpt353	50J	412278	6504300	Wandoo	10-15	>30	0					
wpt354	50J	412277	6504306	Wandoo	10-15	>30	0					
wpt355	50J	412275	6504309	Wandoo	15-20	>30	0					
wpt356	50J	412266	6504293	Wandoo	15-20	>30	0					
wpt357	50J	412252	6504307	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt358	50J	412227	6504324	Wandoo	10-15	>30	0					
wpt359	50J	412227	6504292	Jarrah	15-20	>50	0					
wpt360	50J	412227	6504280	Jarrah	15-20	>50	0					
wpt361	50J	412226	6504275	Jarrah	15-20	>50	0					
wpt362	50J	412453	6504309	Marri	15-20	>50	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Side Entry
wpt363	50J	412442	6504294	Wandoo	10-15	>30	0					
wpt364	50J	412426	6504290	Wandoo	10-15	>30	0					
wpt365	50J	412423	6504283	Marri	10-15	>50	0					
wpt366	50J	412430	6504309	Wandoo	10-15	>30	0					
wpt367	50J	412428	6504316	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt368	50J	412419	6504337	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt369	50J	412409	6504333	Jarrah	0-5	>50	0					
wpt370	50J	412384	6504339	Wandoo	15-20	>30	0					
wpt371	50J	412376	6504333	Wandoo	15-20	>30	2+	Small	No Signs	No Signs	No	

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt372	50J	412398	6504355	Wandoo	15-20	>30	0					
wpt373	50J	412410	6504351	Marri	15-20	>50	0					
wpt374	50J	412403	6504387	Wandoo	15-20	>30	1	Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Chimney
wpt375	50J	412417	6504391	Wandoo	10-15	>30	0					
wpt376	50J	412424	6504396	Wandoo	15-20	>30	0					
wpt377	50J	412451	6504417	Marri	15-20	>50	0					
wpt378	50J	412453	6504391	Wandoo	15-20	>30	0					
wpt379	50J	412452	6504396	Wandoo	15-20	>30	0					
wpt380	50J	412454	6504396	Wandoo	15-20	>30	0					
wpt381	50J	412455	6504387	Wandoo	15-20	>30	0					
wpt382	50J	412463	6504387	Wandoo	15-20	>30	0					
wpt383	50J	412462	6504386	Wandoo	15-20	>30	0					
wpt384	50J	412462	6504381	Wandoo	15-20	>30	0					
wpt385	50J	412457	6504374	Wandoo	15-20	>30	0					
wpt386	50J	412452	6504376	Wandoo	15-20	>30	0					
wpt387	50J	412446	6504381	Wandoo	15-20	>30	0					
wpt388	50J	412443	6504374	Wandoo	15-20	>30	0					
wpt389	50J	412441	6504375	Wandoo	15-20	>30	0					
wpt390	50J	412432	6504374	Marri	15-20	>50	0					
wpt391	50J	412481	6504392	Jarrah	15-20	>50	1	Large	No Signs	No Signs	No	Too shallow
wpt392	50J	412522	6504413	Marri	15-20	>50	0					
wpt393	50J	412506	6504366	Marri	10-15	>50	0					
wpt394	50J	412539	6504349	Wandoo	15-20	>30	0					
wpt395	50J	412531	6504341	Marri	15-20	>50	0					
wpt396	50J	412554	6504308	Jarrah	15-20	>50	0					
wpt397	50J	412228	6504375	Wandoo	10-15	>30	0					
wpt398	50J	412229	6504380	Wandoo	15-20	>30	0					
wpt399	50J	412227	6504392	Dead Unknown	5-10	>50	1	Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Chimney
wpt400	50J	412228	6504419	Dead Marri	15-20	>50	0					
wpt401	50J	412237	6504420	Marri	15-20	>50	0					
wpt402	50J	412245	6504422	Marri	15-20	>50	0					
wpt403	50J	412231	6504435	Marri	15-20	>50	0					
wpt404	50J	412230	6504457	Dead Marri	15-20	>50	2+	Small	No Signs	No Signs	No	
wpt405	50J	412230	6504461	Wandoo	10-15	>30	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt406	50J	412236	6504469	Wandoo	15-20	>30	0					
wpt407	50J	412235	6504471	Wandoo	10-15	>30	0					
wpt408	50J	412236	6504499	Wandoo	20+	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt409	50J	412244	6504509	Wandoo	10-15	>30	0					
wpt410	50J	412248	6504532	Marri	15-20	>50	0					
wpt411	50J	412253	6504551	Jarrah	10-15	>50	0					
wpt412	50J	412253	6504579	Marri	10-15	>50	0					
wpt413	50J	412242	6504577	Jarrah	10-15	>50	0					
wpt414	50J	412247	6504594	Jarrah	10-15	>50	0					
wpt415	50J	412240	6504604	Jarrah	10-15	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt416	50J	412248	6504608	Wandoo	10-15	>30	0					
wpt417	50J	412274	6504603	Wandoo	15-20	>30	0					
wpt418	50J	412278	6504612	Wandoo	15-20	>30	0					
wpt419	50J	412288	6504612	Wandoo	15-20	>30	0					
wpt420	50J	412325	6504616	Wandoo	15-20	>30	0					
wpt421	50J	412341	6504610	Wandoo	15-20	>30	0					
wpt422	50J	412343	6504615	Wandoo	15-20	>30	0					
wpt423	50J	412349	6504611	Wandoo	10-15	>30	0					
wpt424	50J	412352	6504613	Dead Unknown	5-10	>50	0					
wpt425	50J	412355	6504615	Wandoo	10-15	>30	0					
wpt426	50J	412363	6504617	Wandoo	15-20	>30	0					
wpt427	50J	412367	6504611	Wandoo	10-15	>30	0					
wpt428	50J	412382	6504613	Wandoo	10-15	>30	0					
wpt429	50J	412386	6504607	Wandoo	10-15	>30	0					
wpt430	50J	412397	6504600	Wandoo	10-15	>30	0					
wpt431	50J	412417	6504600	Wandoo	10-15	>30	0					
wpt432	50J	412440	6504593	Wandoo	10-15	>30	0					
wpt433	50J	412432	6504609	Wandoo	10-15	>30	0					
wpt434	50J	412460	6504594	Wandoo	10-15	>30	0					
wpt435	50J	412461	6504607	Wandoo	10-15	>30	0					
wpt436	50J	412469	6504611	Wandoo	15-20	>30	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Side Entry
wpt437	50J	412489	6504588	Wandoo	15-20	>30	0					
wpt438	50J	412484	6504571	Dead Jarrah	10-15	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt439	50J	412492	6504565	Wandoo	15-20	>30	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt440	50J	412488	6504561	Wandoo	15-20	>30	0					
wpt441	50J	412490	6504548	Wandoo	15-20	>30	0					
wpt442	50J	412494	6504545	Marri	15-20	>50	0					
wpt443	50J	412506	6504543	Wandoo	15-20	>30	0					
wpt444	50J	412491	6504518	Wandoo	10-15	>30	0					
wpt445	50J	412484	6504505	Jarrah	5-10	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt446	50J	412486	6504501	Marri	10-15	>50	0					
wpt447	50J	412493	6504498	Marri	10-15	>50	0					
wpt448	50J	412498	6504477	Marri	15-20	>50	0					
wpt449	50J	412504	6504432	Marri	15-20	>50	0					
wpt450	50J	412478	6504449	Marri	15-20	>50	0					
wpt451	50J	412453	6504459	Marri	15-20	>50	0					
wpt452	50J	412452	6504455	Wandoo	15-20	>30	0					
wpt453	50J	412441	6504446	Wandoo	10-15	>30	0					
wpt454	50J	412439	6504447	Wandoo	15-20	>30	0					
wpt455	50J	412434	6504436	Dead Unknown	0-5	>50	1	Large	No Signs	No Signs	No	Too shallow
wpt456	50J	412425	6504436	Wandoo	15-20	>30	0					
wpt457	50J	412414	6504428	Dead Unknown	0-5	>50	0					
wpt458	50J	412416	6504420	Dead Unknown	15-20	>50	0					
wpt459	50J	412406	6504428	Jarrah	10-15	>50	0					
wpt460	50J	412397	6504429	Wandoo	15-20	>30	0					
wpt461	50J	412395	6504427	Wandoo	10-15	>30	0					
wpt462	50J	412395	6504427	Wandoo	10-15	>30	0					
wpt463	50J	412395	6504421	Dead Unknown	15-20	>50	0					
wpt464	50J	412390	6504412	Wandoo	15-20	>30	0					
wpt465	50J	412378	6504413	Marri	10-15	>50	0					
wpt466	50J	412375	6504411	Jarrah	15-20	>50	0					
wpt467	50J	412369	6504401	Wandoo	10-15	>30	0					
wpt468	50J	412360	6504398	Wandoo	15-20	>30	0					
wpt469	50J	412346	6504406	Wandoo	10-15	>30	0					
wpt470	50J	412345	6504396	Dead Unknown	0-5	>50	0					
wpt471	50J	412343	6504404	Jarrah	15-20	>50	0					
wpt472	50J	412332	6504410	Wandoo	15-20	>30	0					
wpt473	50J	412327	6504398	Marri	15-20	>50	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt474	50J	412323	6504362	Wandoo	15-20	>30	0					
wpt475	50J	412250	6504394	Wandoo	15-20	>30	0					
wpt476	50J	412247	6504389	Dead Marri	15-20	>50	0					
wpt477	50J	412246	6504387	Wandoo	15-20	>30	0					
wpt478	50J	412253	6504378	Wandoo	10-15	>30	0					
wpt479	50J	412253	6504376	Wandoo	15-20	>30	0					
wpt480	50J	412248	6504429	Jarrah	5-10	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt481	50J	412250	6504432	Jarrah	0-5	>50	0					
wpt482	50J	412250	6504454	Dead Unknown	10-15	>50	0					
wpt483	50J	412245	6504454	Marri	15-20	>50	0					
wpt484	50J	412244	6504469	Wandoo	5-10	>30	1	Large	No Signs	No Signs	No	Too shallow
wpt485	50J	412247	6504487	Wandoo	15-20	>30	0					
wpt486	50J	412256	6504496	Wandoo	15-20	>30	0					
wpt487	50J	412252	6504506	Marri	15-20	>50	0					
wpt488	50J	412261	6504515	Wandoo	0-5	>30	0					
wpt489	50J	412267	6504528	Wandoo	15-20	>30	0					
wpt490	50J	412288	6504578	Marri	15-20	>50	0					
wpt491	50J	412275	6504584	Jarrah	10-15	>50	0					
wpt492	50J	412303	6504586	Jarrah	10-15	>50	0					
wpt493	50J	412318	6504602	Jarrah	10-15	>50	0					
wpt494	50J	412331	6504597	Jarrah	10-15	>50	0					
wpt495	50J	412333	6504596	Jarrah	10-15	>50	0					
wpt496	50J	412334	6504594	Wandoo	15-20	>30	0					
wpt497	50J	412351	6504589	Wandoo	15-20	>30	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Spouts
wpt498	50J	412360	6504583	Wandoo	15-20	>30	0					
wpt499	50J	412396	6504584	Wandoo	10-15	>30	0					
wpt500	50J	412396	6504585	Wandoo	10-15	>30	0					
wpt501	50J	412415	6504585	Wandoo	10-15	>30	0					
wpt502	50J	412427	6504575	Wandoo	15-20	>30	0					
wpt503	50J	412436	6504574	Wandoo	15-20	>30	0					
wpt504	50J	412447	6504563	Wandoo	15-20	>30	0					
wpt505	50J	412460	6504567	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt506	50J	412468	6504581	Wandoo	10-15	>30	0					
wpt507	50J	412476	6504583	Wandoo	15-20	>30	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt508	50J	412458	6504538	Wandoo	15-20	>30	0					
wpt509	50J	412453	6504535	Wandoo	15-20	>30	0					
wpt510	50J	412444	6504514	Wandoo	15-20	>30	1	Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Chimney
wpt511	50J	412443	6504503	Jarrah	10-15	>50	0					
wpt512	50J	412474	6504510	Jarrah	10-15	>50	0					
wpt513	50J	412476	6504504	Jarrah	10-15	>50	0					
wpt514	50J	412471	6504497	Dead Jarrah	10-15	>50	2+	Small	No Signs	No Signs	No	
wpt515	50J	412470	6504468	Marri	15-20	>50	0					
wpt516	50J	412455	6504464	Marri	15-20	>50	0					
wpt517	50J	412429	6504473	Dead Unknown	10-15	>50	2+	Small	No Signs	No Signs	No	
wpt518	50J	412415	6504485	Marri	15-20	>50	0					
wpt519	50J	412407	6504493	Jarrah	15-20	>50	0					
wpt520	50J	412407	6504495	Dead Jarrah	5-10	>50	2+	Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Chimney
wpt521	50J	412392	6504489	Marri	15-20	>50	0					
wpt522	50J	412387	6504497	Jarrah	15-20	>50	0					
wpt523	50J	412388	6504480	Jarrah	15-20	>50	2+	Small	No Signs	No Signs	No	
wpt524	50J	412391	6504473	Marri	15-20	>50	0					
wpt525	50J	412393	6504466	Jarrah	15-20	>50	2+	Small	No Signs	No Signs	No	
wpt526	50J	412392	6504437	Wandoo	10-15	>30	0					
wpt527	50J	412392	6504437	Jarrah	15-20	>50	0					
wpt528	50J	412376	6504435	Jarrah	15-20	>50	0					
wpt529	50J	412373	6504435	Jarrah	15-20	>50	0					
wpt530	50J	412382	6504427	Jarrah	0-5	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt531	50J	412360	6504426	Jarrah	15-20	>50	0					
wpt532	50J	412343	6504424	Marri	10-15	>50	0					
wpt533	50J	412325	6504436	Dead Marri	15-20	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt534	50J	412314	6504441	Wandoo	15-20	>30	0					
wpt535	50J	412303	6504436	Wandoo	15-20	>30	0					
wpt536	50J	412303	6504425	Wandoo	15-20	>30	0					
wpt537	50J	412298	6504416	Wandoo	15-20	>30	0					
wpt538	50J	412295	6504413	Wandoo	15-20	>30	0					
wpt539	50J	412285	6504414	Marri	15-20	>50	0					
wpt540	50J	412275	6504410	Marri	15-20	>50	0					
wpt541	50J	412271	6504416	Jarrah	15-20	>50	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt542	50J	412269	6504418	Marri	10-15	>50	0					
wpt543	50J	412272	6504434	Wandoo	20+	>30	0					
wpt544	50J	412268	6504448	Wandoo	15-20	>30	0					
wpt545	50J	412267	6504471	Wandoo	10-15	>30	0					
wpt546	50J	412275	6504467	Wandoo	10-15	>30	0					
wpt547	50J	412274	6504503	Wandoo	15-20	>30	0					
wpt548	50J	412289	6504501	Wandoo	10-15	>30	0					
wpt549	50J	412286	6504501	Wandoo	10-15	>30	0					
wpt550	50J	412283	6504524	Marri	15-20	>50	0					
wpt551	50J	412292	6504532	Marri	10-15	>50	0					
wpt552	50J	412292	6504564	Jarrah	10-15	>50	0					
wpt553	50J	412308	6504573	Wandoo	10-15	>30	0					
wpt554	50J	412317	6504585	Wandoo	10-15	>30	0					
wpt555	50J	412331	6504578	Wandoo	15-20	>30	0					
wpt556	50J	412333	6504574	Wandoo	10-15	>30	0					
wpt557	50J	412348	6504577	Wandoo	10-15	>30	0					
wpt558	50J	412352	6504570	Wandoo	10-15	>30	0					
wpt559	50J	412363	6504568	Wandoo	10-15	>30	0					
wpt560	50J	412398	6504561	Wandoo	15-20	>30	0					
wpt561	50J	412410	6504563	Wandoo	10-15	>30	0					
wpt562	50J	412425	6504556	Wandoo	10-15	>30	0					
wpt563	50J	412437	6504562	Wandoo	10-15	>30	0					
wpt564	50J	412427	6504528	Dead Unknown	15-20	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt565	50J	412434	6504511	Jarrah	10-15	>50	0					
wpt566	50J	412403	6504505	Wandoo	15-20	>30	0					
wpt567	50J	412396	6504524	Jarrah	15-20	>50	0					
wpt568	50J	412386	6504538	Marri	0-5	>50	1	Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Chimney
wpt569	50J	412395	6504530	Dead Jarrah	5-10	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt570	50J	412397	6504538	Wandoo	10-15	>30	0					
wpt571	50J	412382	6504533	Jarrah	5-10	>50	0					
wpt572	50J	412349	6504533	Marri	15-20	>50	1	Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Hollow
wpt573	50J	412351	6504539	Marri	5-10	>50	1	Large	No Signs	No Signs	No	Too shallow
wpt574	50J	412346	6504531	Jarrah	5-10	>50	2+	Small	No Signs	No Signs	No	
wpt575	50J	412342	6504527	Marri	15-20	>50	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt576	50J	412344	6504542	Dead Unknown	5-10	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt577	50J	412322	6504548	Wandoo	10-15	>30	0					
wpt578	50J	412317	6504519	Wandoo	15-20	>30	0					
wpt579	50J	412325	6504507	Jarrah	10-15	>50	0					
wpt580	50J	412315	6504497	Wandoo	10-15	>30	0					
wpt581	50J	412306	6504493	Wandoo	15-20	>30	0					
wpt582	50J	412298	6504511	Wandoo	10-15	>30	0					
wpt583	50J	412319	6504480	Wandoo	15-20	>30	0					
wpt584	50J	412318	6504471	Marri	10-15	>50	0					
wpt585	50J	412292	6504449	Wandoo	15-20	>30	0					
wpt586	50J	412326	6504446	Jarrah	15-20	>50	0					
wpt587	50J	412352	6504439	Wandoo	10-15	>30	0					
wpt588	50J	412356	6504450	Jarrah	5-10	>50	0					
wpt589	50J	412370	6504484	Jarrah	15-20	>50	0					
wpt590	50J	412378	6504509	Marri	15-20	>50	0					
wpt591	50J	412365	6504520	Marri	15-20	>50	0					
wpt592	50J	412333	6504490	Wandoo	20+	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt593	50J	412353	6504473	Jarrah	15-20	>50	0					
wpt594	50J	412516	6504294	Jarrah	10-15	>50	0					
wpt595	50J	412511	6504307	Marri	15-20	>50	0					
wpt596	50J	412531	6504288	Wandoo	10-15	>30	0					
wpt597	50J	412530	6504285	Wandoo	10-15	>30	0					
wpt598	50J	412538	6504290	Wandoo	10-15	>30	0					
wpt599	50J	412539	6504293	Wandoo	10-15	>30	0					
wpt600	50J	412550	6504298	Wandoo	10-15	>30	0					
wpt601	50J	412582	6504304	Wandoo	20+	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt602	50J	412543	6504287	Wandoo	10-15	>30	0					
wpt603	50J	412531	6504264	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt604	50J	412557	6504252	Wandoo	10-15	>30	0					
wpt605	50J	412558	6504253	Wandoo	10-15	>30	0					
wpt606	50J	412549	6504245	Dead Unknown	20+	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt607	50J	412553	6504241	Dead Wandoo	15-20	>30	0					
wpt608	50J	412556	6504230	Marri	15-20	>50	0					
wpt609	50J	412558	6504227	Jarrah	15-20	>50	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt610	50J	412550	6504232	Wandoo	10-15	>30	0					
wpt611	50J	412530	6504229	Marri	15-20	>50	0					
wpt612	50J	412530	6504245	Jarrah	15-20	>50	0					
wpt613	50J	412508	6504258	Marri	15-20	>50	0					
wpt614	50J	412643	6504302	Wandoo	10-15	>30	0					
wpt615	50J	412643	6504303	Wandoo	10-15	>30	0					
wpt616	50J	412644	6504301	Wandoo	10-15	>30	0					
wpt617	50J	412610	6504354	Dead Wandoo	15-20	>30	0					
wpt618	50J	412612	6504364	Marri	15-20	>50	0					
wpt619	50J	412600	6504375	Marri	10-15	>50	0					
wpt620	50J	412582	6504385	Wandoo	10-15	>30	0					
wpt621	50J	412563	6504404	Marri	15-20	>50	0					
wpt622	50J	412557	6504404	Jarrah	15-20	>50	0					
wpt623	50J	412549	6504436	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt624	50J	412782	6504263	Wandoo	15-20	>30	0					
wpt625	50J	412785	6504264	Wandoo	15-20	>30	0					
wpt626	50J	412788	6504272	Wandoo	15-20	>30	0					
wpt627	50J	412777	6504291	Wandoo	15-20	>30	0					
wpt628	50J	412819	6504280	Wandoo	0-5	>30	0					
wpt629	50J	412799	6504284	Wandoo	15-20	>30	0					
wpt630	50J	412802	6504302	Wandoo	15-20	>30	0					
wpt631	50J	412807	6504317	Wandoo	15-20	>30	1	Medium	No Signs	No Signs	No	
wpt632	50J	412806	6504332	Wandoo	15-20	>30	0					
wpt633	50J	412823	6504338	Wandoo	15-20	>30	2+	Small	No Signs	No Signs	No	
wpt634	50J	412832	6504359	Wandoo	15-20	>30	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Spout
wpt635	50J	412803	6504344	Wandoo	15-20	>30	0					
wpt636	50J	412801	6504350	Dead Wandoo	15-20	>30	2+	Small	No Signs	No Signs	No	
wpt637	50J	412806	6504372	Wandoo	10-15	>30	0					
wpt638	50J	412798	6504377	Wandoo	15-20	>30	0					
wpt639	50J	412815	6504417	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt640	50J	412807	6504471	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt641	50J	412798	6504478	Dead Wandoo	5-10	>30	2+	Small, Medium & Large	No Signs	No Signs	No	Accomodating branch too small
wpt642	50J	412808	6504485	Marri	15-20	>50	0					
wpt643	50J	412810	6504488	Wandoo	10-15	>30	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt644	50J	412805	6504518	Wandoo	15-20	>30	0					
wpt645	50J	412805	6504520	Wandoo	15-20	>30	0					
wpt646	50J	412809	6504520	Wandoo	15-20	>30	0					
wpt647	50J	412810	6504522	Wandoo	15-20	>30	0					
wpt648	50J	412816	6504530	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt649	50J	412818	6504537	Wandoo	20+	>30	0					
wpt650	50J	412813	6504542	Wandoo	15-20	>30	0					
wpt651	50J	412813	6504546	Wandoo	15-20	>30	0					
wpt652	50J	412813	6504550	Wandoo	15-20	>30	0					
wpt653	50J	412811	6504557	Wandoo	15-20	>30	0					
wpt654	50J	412812	6504559	Wandoo	15-20	>30	0					
wpt655	50J	412807	6504570	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt656	50J	412816	6504584	Dead Unknown	15-20	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt657	50J	412805	6504585	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt658	50J	412795	6504587	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt659	50J	412801	6504610	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt660	50J	412793	6504601	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt661	50J	412785	6504607	Wandoo	15-20	>30	0					
wpt662	50J	412782	6504602	Wandoo	15-20	>30	0					
wpt663	50J	412779	6504618	Wandoo	15-20	>30	0					
wpt664	50J	412777	6504610	Marri	20+	>50	0					
wpt665	50J	412785	6504593	Wandoo	15-20	>30	0					
wpt666	50J	412779	6504592	Wandoo	15-20	>30	0					
wpt667	50J	412779	6504593	Wandoo	15-20	>30	0					
wpt668	50J	412781	6504579	Wandoo	15-20	>30	0					
wpt669	50J	412781	6504572	Wandoo	15-20	>30	0					
wpt670	50J	412796	6504565	Wandoo	15-20	>30	0					
wpt671	50J	412790	6504556	Wandoo	15-20	>30	0					
wpt672	50J	412790	6504556	Wandoo	15-20	>30	0					
wpt673	50J	412793	6504551	Wandoo	15-20	>30	0					
wpt674	50J	412788	6504522	Wandoo	15-20	>30	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Spout
wpt675	50J	412786	6504517	Wandoo	10-15	>30	0					
wpt676	50J	412785	6504516	Wandoo	10-15	>30	0					
wpt677	50J	412783	6504514	Wandoo	10-15	>30	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt678	50J	412796	6504448	Wandoo	20+	>30	0					
wpt679	50J	412776	6504392	Wandoo	15-20	>30	2+	Small	No Signs	No Signs	No	
wpt680	50J	412780	6504366	Wandoo	15-20	>30	2+	Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Chimney
wpt681	50J	412784	6504358	Wandoo	15-20	>30	0					
wpt682	50J	412793	6504339	Wandoo	15-20	>30	0					
wpt683	50J	412801	6504336	Wandoo	15-20	>30	0					
wpt684	50J	412803	6504323	Dead Unknown	0-5	>50	0					
wpt685	50J	412798	6504322	Wandoo	15-20	>30	0					
wpt686	50J	412792	6504324	Wandoo	15-20	>30	0					
wpt687	50J	412791	6504317	Wandoo	15-20	>30	0					
wpt688	50J	412797	6504308	Wandoo	15-20	>30	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large hollows
wpt689	50J	412793	6504301	Wandoo	15-20	>30	0					
wpt690	50J	412784	6504305	Wandoo	15-20	>30	0					
wpt691	50J	412778	6504298	Wandoo	15-20	>30	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Chimney
wpt692	50J	412774	6504303	Wandoo	15-20	>30	0					
wpt693	50J	412765	6504301	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt694	50J	412758	6504313	Wandoo	15-20	>30	2+	Small	No Signs	No Signs	No	
wpt695	50J	412766	6504328	Wandoo	15-20	>30	0					
wpt696	50J	412765	6504328	Wandoo	15-20	>30	1	Medium	No Signs	No Signs	No	
wpt697	50J	412770	6504347	Wandoo	15-20	>30	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	No	Possible Large Side Entry
wpt698	50J	412768	6504368	Wandoo	15-20	>30	2+	Small	No Signs	No Signs	No	
wpt699	50J	412774	6504390	Wandoo	15-20	>30	0					
wpt700	50J	412773	6504390	Wandoo	15-20	>30	0					
wpt701	50J	412773	6504411	Wandoo	10-15	>30	0					
wpt702	50J	412781	6504429	Wandoo	10-15	>30	0					
wpt703	50J	412784	6504431	Wandoo	15-20	>30	0					
wpt704	50J	412785	6504437	Wandoo	10-15	>30	0					
wpt705	50J	412780	6504457	Wandoo	15-20	>30	0					
wpt706	50J	412782	6504474	Wandoo	15-20	>30	0					
wpt707	50J	412781	6504482	Wandoo	15-20	>30	0					
wpt708	50J	412775	6504485	Wandoo	0-5	>30	0					
wpt709	50J	412781	6504436	Wandoo	15-20	>30	0					
wpt710	50J	412770	6504408	Wandoo	15-20	>30	0					
wpt711	50J	412756	6504381	Wandoo	15-20	>30	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt712	50J	412760	6504351	Wandoo	15-20	>30	0					
wpt713	50J	412748	6504328	Wandoo	15-20	>30	0					
wpt714	50J	412744	6504332	Wandoo	15-20	>30	0					
wpt715	50J	412746	6504321	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt716	50J	412745	6504312	Wandoo	15-20	>30	0					
wpt717	50J	412750	6504300	Wandoo	15-20	>30	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Chimney
wpt718	50J	412750	6504290	Wandoo	15-20	>30	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	No	Possible Large Hollows
wpt719	50J	412740	6504289	Dead Unknown	10-15	>50	2+	Small & Medium	No Signs	No Signs	No	
wpt720	50J	412752	6504283	Wandoo	15-20	>30	0					
wpt721	50J	412759	6504277	Wandoo	15-20	>30	0					
wpt722	50J	412762	6504279	Wandoo	15-20	>30	0					
wpt723	50J	412737	6504267	Wandoo	15-20	>30	0					
wpt724	50J	412721	6504261	Wandoo	15-20	>30	0					
wpt725	50J	412720	6504261	Wandoo	15-20	>30	0					
wpt726	50J	412715	6504262	Wandoo	15-20	>30	0					
wpt727	50J	412704	6504263	Wandoo	20+	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt728	50J	412714	6504276	Wandoo	15-20	>30	0					
wpt729	50J	412715	6504280	Wandoo	15-20	>30	0					
wpt730	50J	412718	6504275	Wandoo	10-15	>30	0					
wpt731	50J	412726	6504276	Wandoo	15-20	>30	0					
wpt732	50J	412734	6504274	Wandoo	15-20	>30	0					
wpt733	50J	412735	6504279	Wandoo	15-20	>30	0					
wpt734	50J	412728	6504284	Wandoo	15-20	>30	0					
wpt735	50J	412720	6504286	Wandoo	20+	>30	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Swide Entry
wpt736	50J	412734	6504306	Wandoo	15-20	>30	2+	Small, Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Chimney
wpt737	50J	412728	6504303	Wandoo	15-20	>30	0					
wpt738	50J	412718	6504307	Wandoo	15-20	>30	0					
wpt739	50J	412714	6504307	Wandoo	15-20	>30	0					
wpt740	50J	412702	6504301	Wandoo	15-20	>30	0					
wpt741	50J	412710	6504302	Wandoo	15-20	>30	0					
wpt742	50J	412713	6504291	Wandoo	15-20	>30	0					
wpt743	50J	412705	6504288	Wandoo	15-20	>30	0					
wpt744	50J	412703	6504292	Wandoo	15-20	>30	0					
wpt745	50J	412691	6504296	Wandoo	15-20	>30	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt746	50J	412691	6504294	Wandoo	15-20	>30	0					
wpt747	50J	412690	6504291	Wandoo	15-20	>30	0					
wpt748	50J	412682	6504291	Wandoo	15-20	>30	0					
wpt749	50J	412679	6504291	Wandoo	15-20	>30	0					
wpt750	50J	412680	6504298	Wandoo	10-15	>30	0					
wpt751	50J	412680	6504301	Wandoo	15-20	>30	0					
wpt752	50J	412677	6504288	Marri	10-15	>50	1	Medium	No Signs	No Signs	No	
wpt753	50J	412685	6504279	Wandoo	15-20	>30	0					
wpt754	50J	412662	6504263	Wandoo	15-20	>30	0					
wpt755	50J	412663	6504266	Wandoo	15-20	>30	0					
wpt756	50J	412656	6504323	Wandoo	10-15	>30	0					
wpt757	50J	412654	6504324	Wandoo	10-15	>30	0					
wpt758	50J	412631	6504389	Marri	10-15	>50	0					
wpt759	50J	412638	6504401	Marri	10-15	>50	0					
wpt760	50J	412648	6504425	Wandoo	10-15	>30	0					
wpt761	50J	412656	6504430	Wandoo	15-20	>30	0					
wpt762	50J	412653	6504456	Wandoo	15-20	>30	0					
wpt763	50J	412658	6504468	Wandoo	15-20	>30	0					
wpt764	50J	412616	6504471	Wandoo	15-20	>30	0					
wpt765	50J	412594	6504498	Marri	10-15	>50	0					
wpt766	50J	412592	6504498	Wandoo	15-20	>30	0					
wpt767	50J	412588	6504499	Wandoo	10-15	>30	0					
wpt768	50J	412563	6504494	Marri	10-15	>50	0					
wpt769	50J	412560	6504493	Marri	10-15	>50	0					
wpt770	50J	412554	6504522	Wandoo	10-15	>30	0					
wpt771	50J	412538	6504540	Wandoo	10-15	>30	0					
wpt772	50J	412523	6504550	Wandoo	10-15	>30	0					
wpt773	50J	412527	6504553	Wandoo	10-15	>30	0					
wpt774	50J	412521	6504560	Wandoo	10-15	>30	0					
wpt775	50J	412536	6504620	Wandoo	15-20	>30	0					
wpt776	50J	412582	6504599	Marri	10-15	>50	0					
wpt777	50J	412635	6504605	Wandoo	10-15	>30	0					
wpt778	50J	412647	6504621	Wandoo	10-15	>30	0					
wpt779	50J	412650	6504618	Wandoo	10-15	>30	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt780	50J	412649	6504618	Wandoo	10-15	>30	0					
wpt781	50J	412658	6504619	Wandoo	10-15	>30	0					
wpt782	50J	412670	6504625	Wandoo	10-15	>30	0					
wpt783	50J	412675	6504612	Wandoo	20+	>30	1	Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Chimney
wpt784	50J	412691	6504597	Wandoo	15-20	>30	0					
wpt785	50J	412702	6504584	Marri	15-20	>50	0					
wpt786	50J	412699	6504577	Wandoo	15-20	>30	0					
wpt787	50J	412694	6504557	Dead Unknown	10-15	>50	2+	Small	No Signs	No Signs	No	
wpt788	50J	412693	6504557	Wandoo	15-20	>30	0					
wpt789	50J	412695	6504542	Dead Unknown	5-10	>50	1	Medium	No Signs	No Signs	No	
wpt790	50J	412690	6504523	Wandoo	15-20	>30	0					
wpt791	50J	412690	6504511	Wandoo	10-15	>30	0					
wpt792	50J	412684	6504496	Wandoo	10-15	>30	0					
wpt793	50J	412673	6504465	Wandoo	15-20	>30	0					
wpt794	50J	412667	6504459	Wandoo	15-20	>30	0					
wpt795	50J	412671	6504451	Wandoo	10-15	>30	0					
wpt796	50J	412667	6504433	Wandoo	10-15	>30	0					
wpt797	50J	412665	6504478	Wandoo	10-15	>30	0					
wpt798	50J	412671	6504483	Wandoo	15-20	>30	0					
wpt799	50J	412670	6504486	Wandoo	10-15	>30	0					
wpt800	50J	412675	6504513	Dead Unknown	15-20	>50	2+	Small, Medium & Large	No Signs	No Signs	No	Accomodating branch too small
wpt801	50J	412678	6504533	Dead Wandoo	10-15	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt802	50J	412677	6504548	Dead Unknown	15-20	>50	0					
wpt803	50J	412675	6504559	Wandoo	0-5	>30	0					
wpt804	50J	412682	6504556	Wandoo	15-20	>30	0					
wpt805	50J	412687	6504566	Wandoo	10-15	>30	0					
wpt806	50J	412684	6504573	Wandoo	15-20	>30	0					
wpt807	50J	412684	6504578	Wandoo	10-15	>30	0					
wpt808	50J	412685	6504580	Wandoo	15-20	>30	0					
wpt809	50J	412684	6504589	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt810	50J	412677	6504585	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt811	50J	412680	6504600	Dead Wandoo	15-20	>30	2+	Small	No Signs	No Signs	No	
wpt812	50J	412658	6504590	Wandoo	15-20	>30	2+	Small & Medium	No Signs	No Signs	No	
wpt813	50J	412665	6504579	Dead Unknown	15-20	>50	2+	Small & Medium	No Signs	No Signs	No	

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt814	50J	412652	6504587	Marri	10-15	>50	0					
wpt815	50J	412632	6504575	Marri	10-15	>50	0					
wpt816	50J	412628	6504566	Marri	10-15	>50	0					
wpt817	50J	412588	6504567	Marri	10-15	>50	0					
wpt818	50J	412587	6504538	Wandoo	15-20	>30	0					
wpt819	50J	412608	6504524	Wandoo	15-20	>30	0					
wpt820	50J	412611	6504518	Wandoo	10-15	>30	0					
wpt821	50J	412618	6504501	Wandoo	10-15	>30	0					
wpt822	50J	412621	6504498	Wandoo	10-15	>30	0					
wpt823	50J	412629	6504496	Wandoo	10-15	>30	0					
wpt824	50J	412621	6504513	Wandoo	10-15	>30	0					
wpt825	50J	412624	6504517	Wandoo	10-15	>30	0					
wpt826	50J	412632	6504524	Wandoo	10-15	>30	0					
wpt827	50J	412644	6504537	Wandoo	10-15	>30	0					
wpt828	50J	412666	6504552	Wandoo	10-15	>30	0					
wpt829	50J	412664	6504542	Wandoo	10-15	>30	0					
wpt830	50J	412654	6504521	Wandoo	10-15	>30	0					
wpt831	50J	412646	6504505	Wandoo	10-15	>30	0					
wpt832	50J	412710	6504487	Marri	10-15	>50	0					
wpt833	50J	412716	6504494	Wandoo	10-15	>30	0					
wpt834	50J	412720	6504496	Wandoo	10-15	>30	0					
wpt835	50J	412715	6504469	Wandoo	10-15	>30	0					
wpt836	50J	412713	6504464	Wandoo	10-15	>30	0					
wpt837	50J	412698	6504451	Wandoo	10-15	>30	0					
wpt838	50J	412696	6504449	Wandoo	10-15	>30	0					
wpt839	50J	412697	6504448	Wandoo	10-15	>30	0					
wpt840	50J	412712	6504434	Wandoo	15-20	>30	0					
wpt841	50J	412716	6504431	Marri	15-20	>50	0					
wpt842	50J	412736	6504459	Wandoo	10-15	>30	0					
wpt843	50J	412684	6504421	Wandoo	10-15	>30	0					
wpt844	50J	412692	6504385	Wandoo	10-15	>30	0					
wpt845	50J	412695	6504382	Wandoo	10-15	>30	0					
wpt846	50J	412719	6504373	Wandoo	10-15	>30	0					
wpt847	50J	412730	6504363	Wandoo	15-20	>30	0					

Waypoint Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Estimate Hollow Entrance Size	Occupancy	Chew Marks	Potential Cockatoo Nest	Comments
wpt848	50J	412708	6504332	Wandoo	20+	>30	2+	Medium & Large (Cockatoo)	No Signs	No Signs	Yes	Possible Large Chimney
wpt849	50J	412707	6504325	Wandoo	10-15	>30	0					
wpt850	50J	412699	6504327	Wandoo	15-20	>30	0					
wpt851	50J	412690	6504343	Wandoo	10-15	>30	0					
wpt852	50J	412680	6504345	Wandoo	10-15	>30	0					
wpt853	50J	412685	6504367	Wandoo	10-15	>30	0					
wpt854	50J	412669	6504375	Wandoo	10-15	>30	0					
wpt855	50J	412669	6504368	Wandoo	10-15	>30	0					
wpt856	50J	412667	6504357	Wandoo	15-20	>30	0					
wpt857	50J	412677	6504322	Wandoo	20+	>30	2+	Small & Medium	No Signs	Galahs	No	
wpt858	50J	412662	6504334	Wandoo	10-15	>30	0					
wpt859	50J	412665	6504328	Wandoo	15-20	>30	0					
wpt860	50J	412663	6504324	Wandoo	15-20	>30	0		No Signs	No Signs	No	

DISCLAIMER

This fauna assessment report ("the report") has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Greg Harewood ("the Author"). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints. In accordance with the scope of services, the Author has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

The conclusions are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of preparing the report. Also it should be recognised that site conditions, can change with time.

Within the limitations imposed by the scope of services, the field assessment and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

In preparing the report, the Author has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise stated in the report, the Author has not verified the accuracy of completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. The Author will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to the Author.

The report has been prepared for the benefit of the Client and no other party. The Author assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of the Author or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

The Author will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

Appendix F

Bushfire Management Plan

(STRATEGEN JBS&G)

FPA AUSTRALIA | Fire Protection Association Australia
Life. Property. Environment.

BPAD Bushfire Planning & Design

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 M1942 Morley Road

Suburb: Lower Chittering **State:** WA **P/code:** 6084

Local government area: Shire of Chittering

Description of the planning proposal: Scheme Amendment and Structure Plan application

BMP Plan / Reference Number: 60073/136,397 **Version:** R001 Rev 0 **Date of Issue:** 07/07/2021

Client / Business Name: Sicicalab Pty Ltd

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.)?

Scheme Amendment and Structure Plan application

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
Louisa Robertson	Level 3	BPAD 36748	28/02/2022
Company		**Contact No.**	
Strategen-JBS&G		08 9792 4797	

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

LMRobertson

Signature of Practitioner Date 07/07/2021

Sicicalab Pty Ltd

Bushfire Management Plan (Scheme Amendment and Structure Plan application)

Lot M1942 Morley Road
Lower Chittering, WA

7 July 2021

60073/136,397 (Rev 0)

JBS&G Australia Pty Ltd T/A Strategen-JBS&G

BPAD Bushfire Planning & Design Accredited Practitioner Level 3

www.jbsg.com.au

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Appendix D Vehicular access technical standards of the Guidelines
Appendix E Water technical standards of the Guidelines

1. Proposal details

1.1 Background

Sicicalab Pty Ltd, is preparing documentation for a Local Planning Scheme Amendment and Structure Plan application to guide future rural-residential development within Lot M1942 (No. 293) Morley Road, Lower Chittering (the project area), located in the Shire of Chittering . The Concept Plan (Figure 1; Roberts Day 2021) identifies that the proposed development will comprise 18 rural-residential lots ranging from 2 ha to 9.8 ha in area, with an internal public road network. A building envelope and associated Asset Protection Zone (APZ) has been nominated within each proposed lot, with Lot 16 being provided with two alternative building envelope locations.

1.2 Site description

The subject site is approximately 54 ha in area and comprises land that has been cleared for past agricultural and horticultural purposes (approximately 54% of the site), along with a significant proportion of remnant native vegetation, which is in a modified state due to past grazing and clearing. A gully with steep sides exists in the south-eastern portion of the site and several tributary creek lines have been identified as occurring within the project area (see Figure 1).

An existing residence is located within the project area which will be removed during subdivision constructions works.

The project area is surrounded by (see Figure 2):

- pasture land and fragmented remnant native forest vegetation within Lot 5 to the north
- a rural-residential property comprising cleared pasture and remnant native forest within Lot 13 to the northwest
- Morley Road and pasture land with modified and intact forest vegetation to the west
- recently subdivided and developed rural-residential properties to the south
- rural-residential land with patches of remnant native forest vegetation to the east.

The project area is designated as bushfire prone on the *Map of Bush Fire Prone Areas* (DFES 2019; see Plate 1).

1.3 Purpose

This Bushfire Management Plan (BMP) has been prepared to address requirements under *Policy Measure 6.3 of State Planning Policy 3.7 Planning in Bushfire-Prone Areas* (SPP 3.7; WAPC 2015) and *Guidelines for Planning in Bushfire-Prone Areas* (the Guidelines; WAPC 2017).

1.4 Other plans/reports

Relevant environmental reports that have been prepared for the project area include:

- Environmental Assessment Report (Coterra 2021)
- Local Water Management Strategy (Urbaqua 2021)
- Flora and Vegetation Assessment (Focused Vision 2021)
- Fauna Assessment (Greg Harewood 2021)
- Geotechnical Report (CMW 2021).

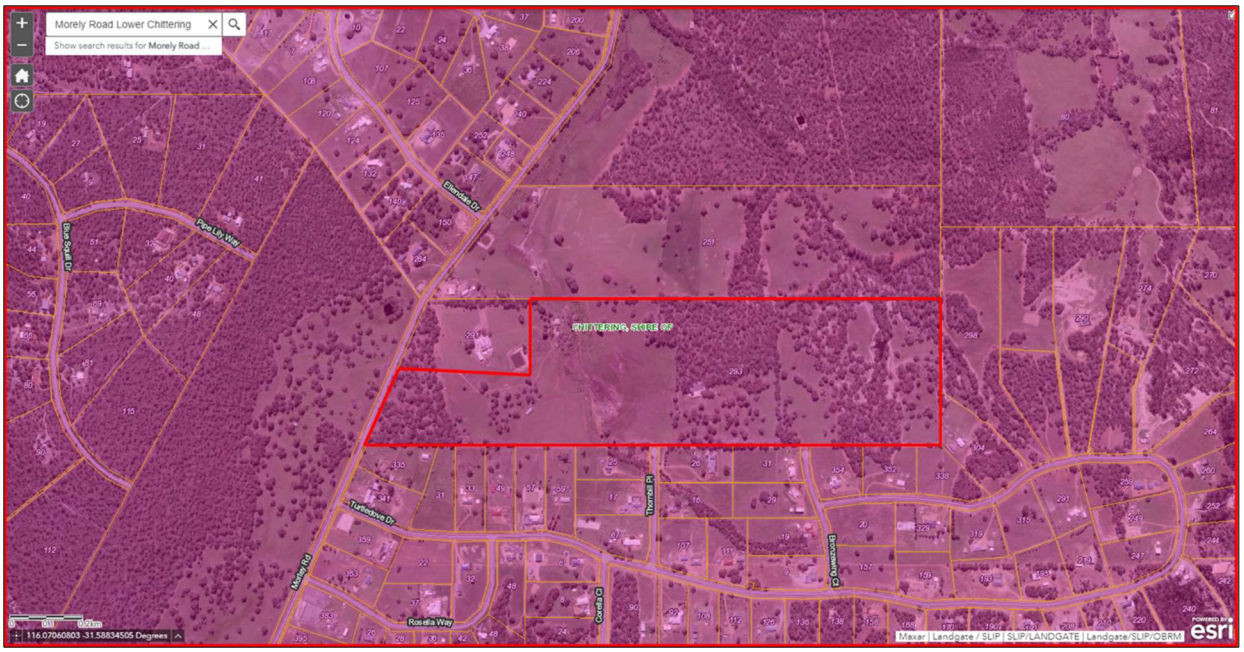
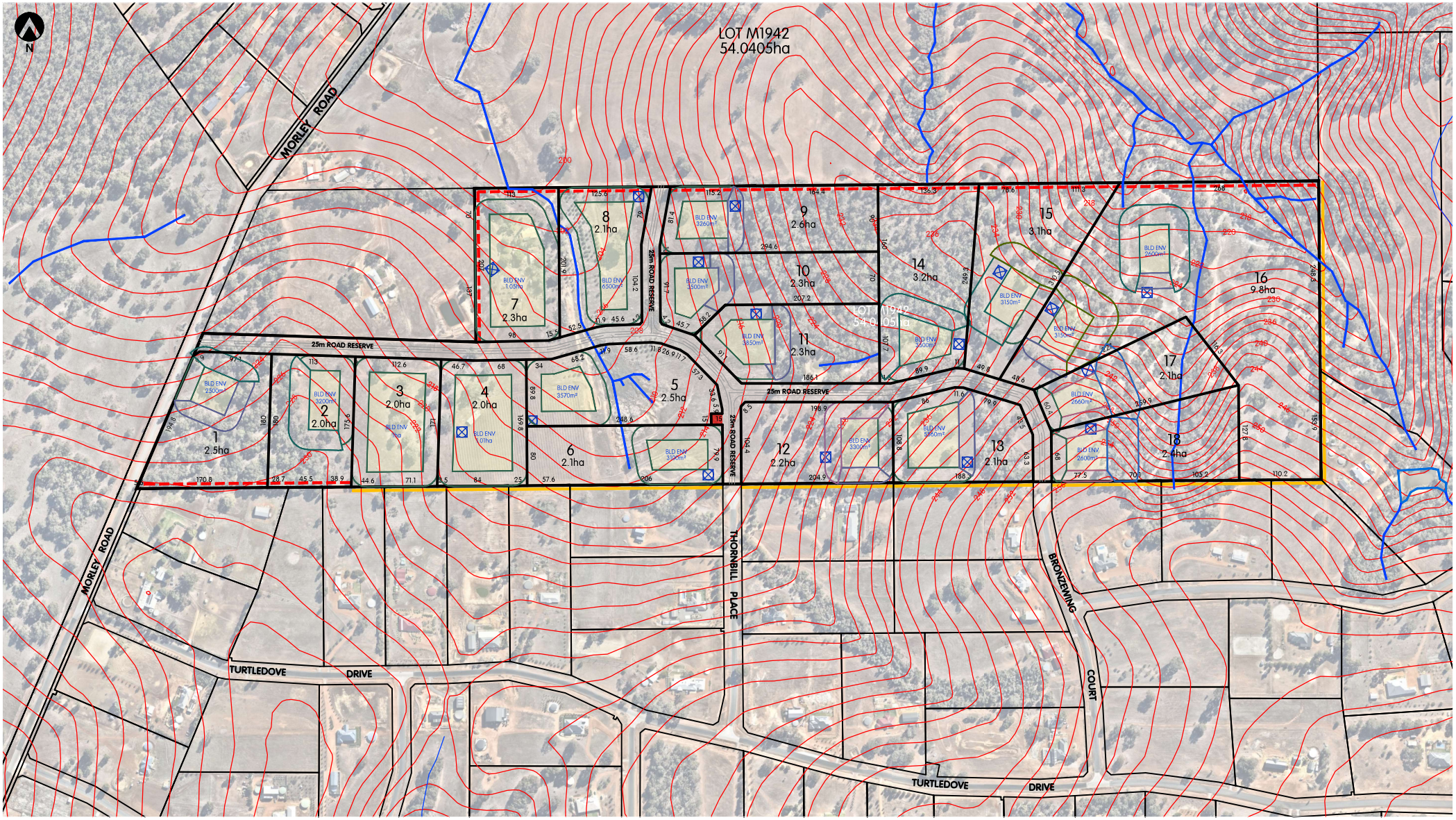


Plate 1: Map of Bush Fire Prone Areas (DFES 2019)



LEGEND

- 196m² WASTE WATER DISPOSAL AREA
- WATER COURSE
- BLD ENV — BUILDING ENVELOPE
- 6.0m FIRE SERVICE ACCESS ROUTE (ALIGNMENT TBC)
- EXISTING FIRE SERVICE ACCESS ROUTE
- WATER TANK SITE

APZs

- 15m
- 20m
- 21m
- 22m
- 27m
- 33m
- 42m

CADASTRAL INFORMATION
SOURCE: LANDGATE
YYMMDD: 201023
DWG REF: CHITTERING_CAD_201023
PROJECTION: GDA94
AERIAL PHOTOGRAPHY
SOURCE: NEARMAP
YYMMDD: 200509

HATCH | RobertsDay

SIZE A3 1:5000

0 metres 50 100 150 200 250

DRAFT

REV	DESCRIPTION	YYMMDD	DRAWN	APPR'D
A	BASE CPGCHI_DES_DWG_002G.1	210706	SB	RDa

JOB CODE	SERVICE	DOC.TYPE	DRAW NO.	REV.
CPGCHI	DES	DWG	004	A

SUBDIVISION CONCEPT PLAN
M1942 Morley Road, Lower Chittering
Shire of Chittering

DISCLAIMER: ISSUED FOR DESIGN INTENT ONLY. ALL AREAS AND DIMENSIONS ARE SUBJECT TO DETAIL DESIGN AND SURVEY

MUCHEA

MUCHEA EAST RD

POLINELLI RD

LOWER CHITTERING

MORLEY RD

CHITTERING VALLEY RD

CHITTERING RD

BULLSBROOK

JENKINS RD

WILSON RD

Legend

- Project area
- Cadastral boundary
- Suburb boundary
- Regional ecological linkages
- Bush Forever site (DOP)
- Environmentally sensitive areas (DWER)
- Nature reserve
- Terrestrial Conservation Reserves CAPAD 2018
- Roads (MRWA)

strategen JBS&G

Job No: 60073

Client: Cuttone Property Group

Version: A	Date: 07-May-2021
Drawn By: jcrute	Checked By: CT

Scale 1:30,000 at A3

0 500 1,000
metres

Coord. Sys. GDA 1994 MGA Zone 50

Lot M1942 Morley Road, Lower Chittering, WA

SITE OVERVIEW

FIGURE 2

File Name: W:\Projects\1)Open\Cuttone Property Group\60073 Lot M1942 Morley Rd Lower Chittering rezoning BMP\GIS\Maps\R01_Rev_A\60073_02_SiteOverview.mxd
Image Reference: SLIP Locate 2021.

2. Environmental considerations

2.1 Native vegetation - modification and clearing

The project area contains remnant native treed vegetation predominantly within the central and eastern portions of the site and within the western corner. This vegetation is in a modified condition, having been subject to previous grazing and orchard land uses. To reduce the environmental impacts of clearing, the lot and road layout and location of building envelopes have been designed to reduce clearing/vegetation modification requirements to accommodate the building envelopes and associated Asset Protection Zones (APZs), as far as possible.

Any environmental impacts resulting from implementation of the proposal will need to be addressed under standard State and Federal environmental assessment and referral requirements under the *Environmental Protection Act 1986* and *Environment Protection and Biodiversity Conservation Act 1999.*

Results of a search of publicly available environmental information and recent environmental surveys are displayed in Table 1. Environmental values within proximity to the project area are depicted in Figure 2.

Table 1: Summary of environmental values

Environmental value	Potential to occur within or adjacent to the project area		Description
	Within	Adjacent	
Environmentally Sensitive Area	✗	✓	There are numerous Environmentally Sensitive Areas to the southwest of the project area (nearest is approximately 750 m). The proposed development is not expected to affect this vegetation.
Swan Bioplan Regionally Significant Natural Area	✗	✗	N/A.
Ecological linkages	✗	✓	Regional Ecological Linkages are located within 500 m to the south of the project area. As the linkages do not extend to within the project area, any modification of vegetation is not expected to impact these linkages.
Wetlands	✗	✗	N/A.
Waterways	✓	✓	As depicted in Figure 1, five creek lines have been identified within the project area. Construction of the proposed building envelopes and APZs will not result in clearing of vegetation in direct proximity to the identified creek lines.
Threatened Ecological Communities listed under the EPBC Act	✗	✓	A buffered occurrence of the Commonwealth listed Banksia Woodland TEC is mapped within the project area, however, field investigations determined that this TEC is not present (Focused Vision 2021).
Threatened and priority flora	✗	N/A	No Threatened or Priority Flora species were recorded during a survey in March 2021 (Focused Vision 2021).

Environmental value	Potential to occur within or adjacent to the project area		Description
	Within	Adjacent	
Fauna habitat listed under the EPBC Act	✓	✓	Remnant vegetation within the project is area mapped as being potential foraging habitat for the endangered Carnaby's Black Cockatoo and this was confirmed during the fauna survey with the presence of Marri and Jarrah trees. Potential Black Cockatoo habitat trees (trees with hollows) were observed on-site. Forest Red-tailed Black Cockatoo were observed on-site; presence of Carnaby's has not been confirmed but may occur due to the presence of suitable habitat (Greg Harewood 2021). Habitat trees can be retained within building envelopes and Asset Protection Zones, where practicable.
Threatened and priority fauna	✓	N/A	The Fauna Assessment considers that the site may be used by Peregrine Falcon (Schedule 7, WA), Baudin's Black Cockatoo (Endangered, WA/Federal), Carnaby's Black Cockatoo (Endangered, WA/Federal), South-Western Brush-tailed Phascogale (Schedule 6, WA). In addition, Forest Red-tailed Black Cockatoo were observed on-site (Vulnerable, WA/Federal) (Greg Harewood 2021).
Bush Forever Site	✗	✓	There are numerous Bush Forever sites to the southwest of the project area (nearest is approximately 750 m). The proposed development is not expected to affect this vegetation.
DBCA managed lands and waters (includes legislated lands and waters and lands of interest)	✗	✗	N/A.
Conservation covenants	✗	✗	The nearest conservation covenants are mapped as being located approximately 3 km to the east of the project area.

2.2 Revegetation / Landscape Plans

No revegetation is expected to occur as part of the proposal. Any future landscaping will likely consist of low threat and managed gardens and street scaping in accordance with AS 3959 Clause 2.2.3.2 (f) which will be demonstrated in a future Landscape Plan, if required.

3. Bushfire assessment results

3.1 Assessment inputs

3.1.1 Vegetation classification

Strategen-JBS&G assessed classified vegetation and exclusions within 150 m of the project area through on-ground verification on 2 December 2020 in accordance with *AS 3959—2018 Construction of Buildings in Bushfire-Prone Areas* (AS 3959; SA 2018) and the *Visual Guide for Bushfire Risk Assessment in Western Australia* (DoP 2016).

Georeferenced site photos and a description of the pre-development vegetation classifications and exclusions are contained in Appendix A. Pre-development vegetation classification is depicted in Figure 3 and anticipated post-development vegetation classification is shown in Figure 4. A summary of pre and post-development vegetation inputs is provided in Table 2 and Table 3 respectively.

3.1.2 Effective slope

Strategen-JBS&G assessed effective slope under classified vegetation through on-ground verification on 2 December 2020 in accordance with AS 3959. Results were cross-referenced with DPIRD 2m contour data and are depicted in Figure 3 and discussed below.

Site topography is variable within the project area and surrounds. The land within the site slopes gradually from the central north-south creekline toward the west from 200 m AHD to 230 m AHD over approximately 600 m (effective slope >0-5°). From the east of this creekline, the land slopes toward the northeast and northwest, with a depression in the middle containing a further creekline. A deep gully and creekline is located in the far east of the project area, which slopes from the north to the south with steep slopes either side. Effective slope in relation to the adjacent proposed building envelopes is estimated to be >10-15°. The remainder of the eastern portion of the project area is undulating in nature with a network of creek beds and effective slopes of >0-10° in relation to the proposed building envelopes.

Topography adjoining the project area is similarly variable, with effective slopes ranging from >0-10° under Class A Forest, Class B Woodland and Class G Grassland plots to the north, west and east of the project area.

Due to the variable topography, the vegetation plots assigned within the pre-and post-development BHL assessments have not been further classified in accordance with effective slope. This is because each vegetation plot will have a different effective slope, depending on which building envelope is the subject of the assessment. Further detailed investigations during preparation of the subdivision stage BMP will include the provision of lot specific BAL Contour assessments, where the effective slope of each vegetation plot will be defined for each building envelope accordingly.

3.1.3 Pre-development inputs

A summary of the assessed pre-development classified vegetation, exclusions and effective slope within the assessment area and adjacent 150 m are listed in Table 2 and illustrated in Figure 3.

As discussed above, the vegetation plots have not been classified according to effective slope due to the varied topography within the assessment area. This level of lot-specific detail will be determined during preparation of the subdivision stage BMP.

Table 2: Pre-development vegetation classifications/exclusions and effective slope

Vegetation plot	Vegetation classification	Effective slope	Comments
1	Class A Forest	Varied (Flat/upslope ranging to >0-15° downslope)	All existing Class A Forest plots within the assessment area.
2	Class B Woodland	Varied (Flat/upslope ranging to >0-10° downslope)	All existing Class B Woodland plots within the assessment area.
3	Class C Shrubland	Varied (Flat/upslope ranging to >0-5° downslope)	All existing Class C Shrubland plots within the assessment area.
4	Class G Grassland	Varied (Flat/upslope ranging to >0-10° downslope)	All existing Class G Grassland plots within the assessment area.
5	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])	N/A	All land that is currently being managed in a low threat or non-vegetated state.

3.1.4 Post-development inputs

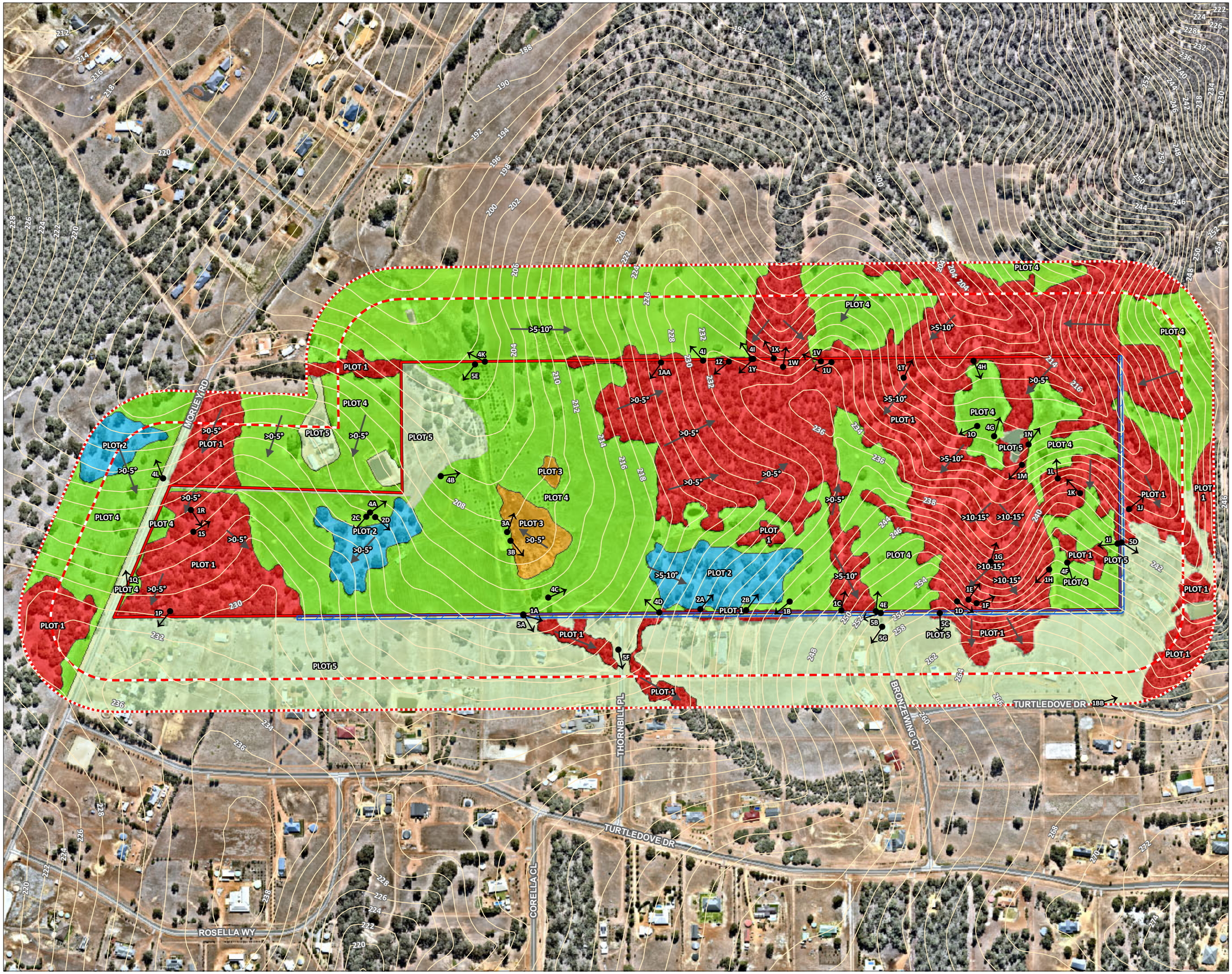
A summary of the potential post-development classified vegetation, exclusions and effective slope within the project area and adjacent 150 m are listed in Table 3 and illustrated in Figure 4.

As with the pre-development assessment, vegetation plots have not been classified in accordance with the variable effective slopes. This level of lot-specific detail will be determined during preparation of the subdivision stage BMP.

If external vegetation is altered prior to future planning stages, the change in vegetation condition is to be captured through a future BHL or BAL contour assessment at the next planning stage.

Table 3: Post-development vegetation classifications/exclusions and effective slope

Vegetation plot	Vegetation classification	Effective slope	Comments
1	Class A Forest	Varied (Flat/upslope ranging to >0-15° downslope)	All post-development Class A Forest plots within the assessment area.
2	Class B Woodland	Varied (Flat/upslope ranging to >0-10° downslope)	All post-development Class B Woodland plots within the assessment area.
3	Class C Shrubland	Varied (Flat/upslope ranging to >0-5° downslope)	All post-development Class C Shrubland plots within the assessment area.
4	Class G Grassland	Varied (Flat/upslope ranging to >0-10° downslope)	All post-development Class G Grassland plots within the assessment area.
5	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])	N/A	All land that is currently being managed in a low threat or non-vegetated state.
6	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])	N/A	All land that will be modified to a low threat state as part of the proposed development, including proposed building envelopes, APZs and grassland managed in accordance with firebreak notice requirements.



Legend

- Project area
- 100m assessment area
- 150m assessment area
- Existing 6m wide FSAR

Vegetation classification

- Class A Forest
- Class B Woodland
- Class C Shrubland
- Class G Grassland
- Clause 2.2.3.2 (e) & (f)
- Photo point directions
- Effective slope
- Topographic contour (mAHD)
- Roads (MRWA)

strategen JBS&G

Job No: 60073	
Client: Cuttone Property Group	
Version: A	Date: 05-May-2021
Drawn By: jcrute	Checked By: CT

Scale 1:5,500 at A3

0 100 200
metres

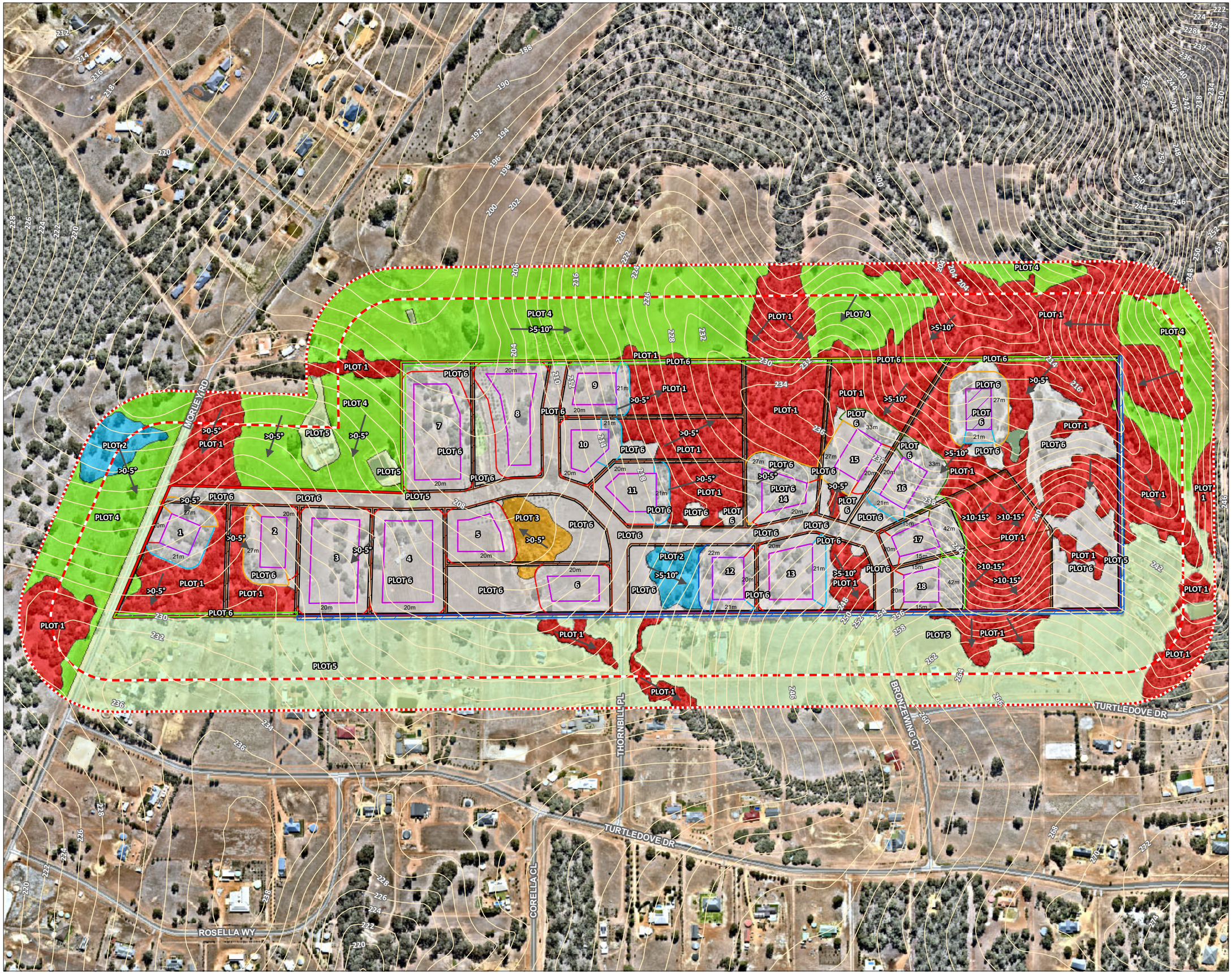
Coord. Sys. GDA 1994 MGA Zone 50

Lot M1942 Morley Road, Lower Chittering, WA

PRE-DEVELOPMENT VEGETATION CLASSIFICATION AND EFFECTIVE SLOPE

FIGURE 3

File Name: W:\Projects\1)Open\Cuttone Property Group\60073 Lot M1942 Morley Rd Lower Chittering rezoning BMP\GIS\Maps\R01_Rev_A\60073_03_PreDevVegClass.mxd
Image Reference: www.nearmap.com© - Imagery Date: 10. April 2021.



Legend

- Project area
- 100m assessment area
- 150m assessment area
- Existing 6m wide FSAR
- Proposed 6m wide FSAR
- 3m wide firebreak
- Proposed building envelope
- Lot 16 alternative
- Proposed lots

APZs

- 15m wide
- 20m wide
- 21m wide
- 22m wide
- 27m wide
- 33m wide
- 42m wide

Vegetation classification

- Class A Forest
- Class B Woodland
- Class C Shrubland
- Class G Grassland
- Clause 2.2.3.2 (e) & (f)
- Area to be modified to non-vegetated and low threat state

- Effective slope
- Topographic contour (mAHD)
- Roads (MRWA)

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Job No: 60073	
Client: Cuttone Property Group	
Version: A	Date: 25-Jun-2021
Drawn By: jcrute	Checked By: CT

Scale 1:5,500 at A3

0 100 200
metres

Coord. Sys. GDA 1994 MGA Zone 50

Lot M1942 Morley Road, Lower Chittering, WA

POST-DEVELOPMENT VEGETATION CLASSIFICATION AND EFFECTIVE SLOPE

FIGURE 4

File Name: W:\Projects\1)Open\Cuttone Property Group\60073 Lot M1942 Morley Rd Lower Chittering rezoning BMP\GIS\Maps\R01_Rev_A\60073_04_PostDevVegClass.mxd
Image Reference: www.nearmap.com© - Imagery Date: 10. April 2021.

3.2 Assessment outputs

3.2.1 Bushfire Hazard Level (BHL) assessment

Pre and post-development vegetation extents have been assigned a bushfire hazard level in accordance with the methodology detailed in Appendix Two of the Guidelines as outlined in Table 4.

Table 4: Bushfire hazard levels and characteristics

Bushfire hazard level	Characteristics*
Extreme	• Class A Forest • Class B Woodland (05) • Class D Scrub • Any classified vegetation with a greater than 10° slope.
Moderate	• Class B Low woodland (07) • Class C Shrubland • Class E Mallee/Mulga • Class G Grassland, including sown pasture and crops • Class G Grassland: Open woodland (06), Low open woodland (08), Open shrubland (09) • Vegetation that has a low hazard level but is within 100 metres of vegetation classified as a moderate or extreme hazard, is to adopt a moderate hazard level.
Low	• Low threat vegetation may include areas of maintained lawns, golf courses, public recreation reserves and parklands, vineyards, orchards, cultivated gardens, commercial nurseries, nature strips and windbreaks • Managed grassland in a minimal fuel condition (insufficient fuel is available to significantly increase the severity of the bushfire attack). For example, short-cropped grass to a nominal height of 100 millimetre • Non-vegetated areas including waterways, roads, footpaths, buildings and rock outcrops.
*Vegetation classifications from AS 3959-2018 Table 2.3.	

3.2.1.1 Pre-development

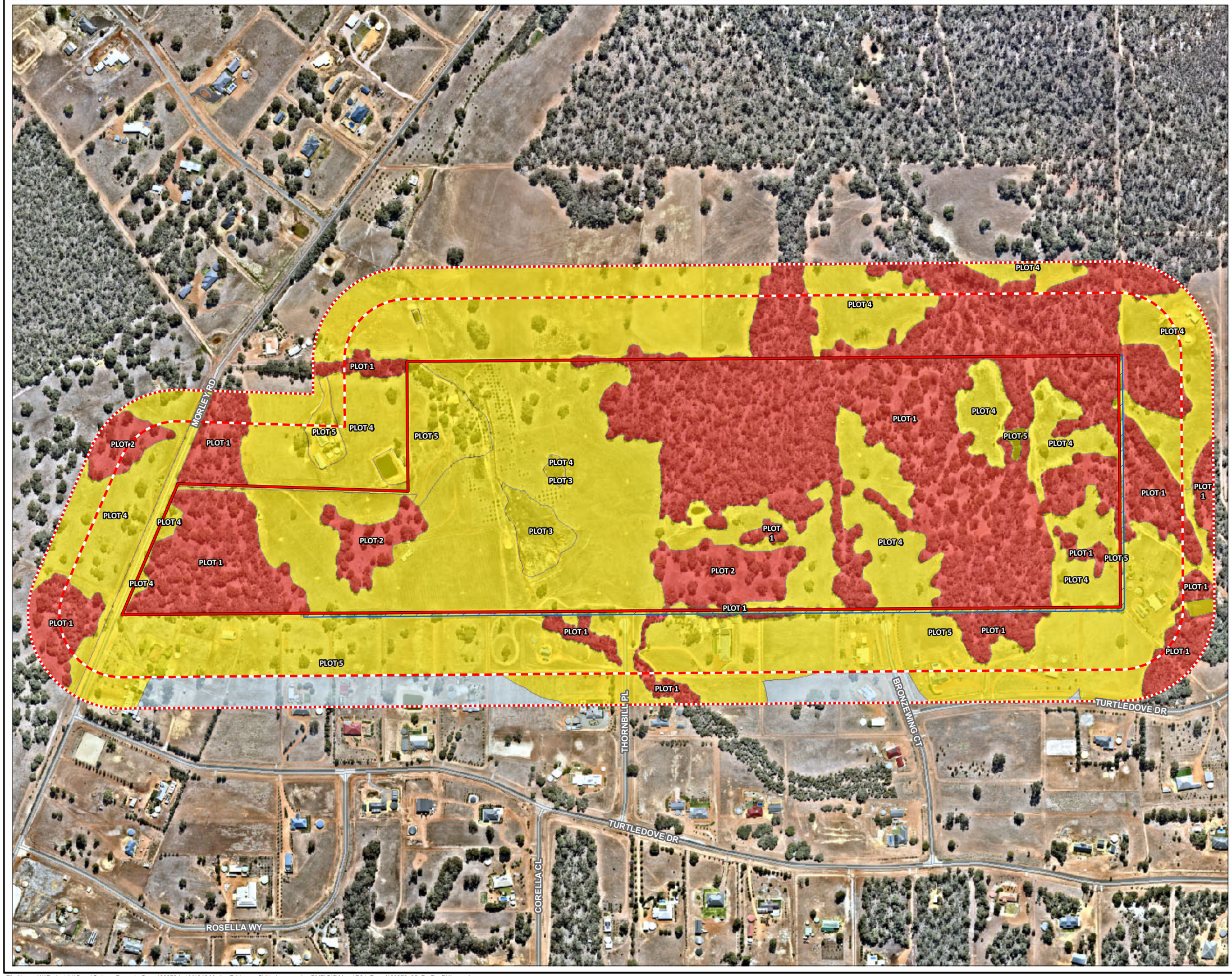
Strategen-JBS&G has mapped the pre-development bushfire hazard levels within the project area and adjacent 150 m wide assessment area. The bushfire hazard levels have been assessed on the basis of the vegetation discussed in Section 3.1.3 (i.e. the current pre-development extent of vegetation within and surrounding the project area).

The pre-development BHL assessment (refer to Figure 5) shows that based on the existing vegetation, the project area contains land with Moderate and Extreme bushfire hazard levels.

3.2.1.2 Post-development

Strategen-JBS&G has mapped the potential post-development bushfire hazard levels to demonstrate that the future bushfire hazard levels will be acceptable for future development to occur within the project area. The bushfire hazard levels have been assigned on the basis of the vegetation discussed in Section 3.1.4 and the future expected vegetation extent within and surrounding the project area.

The post-development BHL assessment (refer to Figure 6) demonstrates that all proposed building envelopes, and therefore all future habitable development, will be located on land with either a Low or Moderate bushfire hazard level.



Legend

- Project area
- 100m assessment area
- 150m assessment area
- Existing 6m wide FSAR

Hazard level

- Extreme
- Moderate
- Low
- Roads (MRWA)

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Job No: 60073	
Client: Cuttone Property Group	
Version: A	Date: 05-May-2021
Drawn By: jcrute	Checked By: CT

Scale 1:5,500 at A3

0 100 200
metres

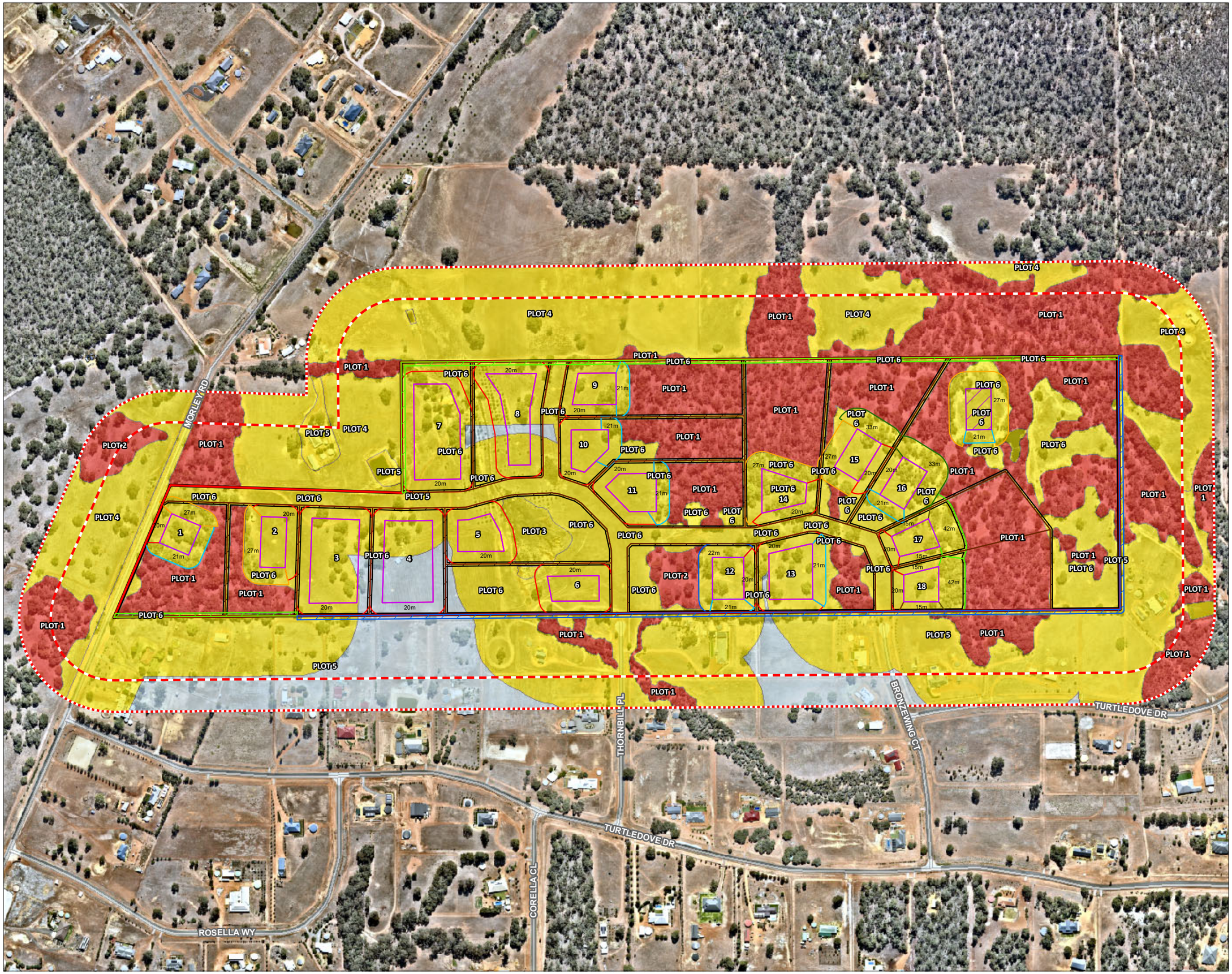
Coord. Sys. GDA 1994 MGA Zone 50

Lot M1942 Morley Road, Lower Chittering, WA

PRE-DEVELOPMENT BUSHFIRE HAZARD LEVEL ASSESSMENT

FIGURE 5

File Name: W:\Projects\1)Open\Cuttone Property Group\60073 Lot M1942 Morley Rd Lower Chittering rezoning BMP\GIS\Maps\R01_Rev_A\60073_05_PreDevBHLs.mxd
Image Reference: www.nearmap.com© - Imagery Date: 10. April 2021.



Legend

- Project area
- 100m assessment area
- 150m assessment area
- Existing 6m wide FSAR
- Proposed 6m wide FSAR
- 3m wide firebreak
- Proposed building envelope
- Lot 16 alternative
- Proposed lots

APZs

- 15m wide
- 20m wide
- 21m wide
- 22m wide
- 27m wide
- 33m wide
- 42m wide

Hazard level

- Extreme
- Moderate
- Low
- Roads (MRWA)

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Job No: 60073	
Client: Cuttone Property Group	
Version: A	Date: 25-Jun-2021
Drawn By: jcrute	Checked By: CT

Scale 1:5,500 at A3

0 100 200
metres

Coord. Sys. GDA 1994 MGA Zone 50

Lot M1942 Morley Road, Lower Chittering, WA

POST-DEVELOPMENT BUSHFIRE HAZARD LEVEL ASSESSMENT

FIGURE 6

File Name: W:\Projects\1)Open\Cuttone Property Group\60073 Lot M1942 Morley Rd Lower Chittering rezoning BMP\GIS\Maps\R01_Rev_A\60073_06_PostDevBHLs.mxd
Image Reference: www.nearmap.com© - Imagery Date: 10. April 2021.

4. Identification of bushfire hazard issues

4.1 Bushfire context

The project area is situated within a landscape of rural-residential properties and open farmland, intermingled with patches of remnant native forest as well as large intact areas of forest vegetation.

Under typical summer wind conditions, a bushfire is most likely to threaten the project area from the east (northeast to southeast) during the morning and from the south/southwest in afternoon. Atypical, but adverse, strong northerly wind conditions may result in bushfire spread from the north under elevated fire weather conditions. Based on the location and extent of surrounding bushfire prone vegetation, the project area has potential to be impacted by a bushfire under a range of wind conditions, as discussed below.

Avon Valley National Park contains large areas of remnant forest vegetation and is located approximately 3.5 km to the east of the project area. This vegetation presents a landscape scale bushfire risk from the northeast, east and southeast due to potential fire runs of more than 20 km, over varied terrain. This scenario is most likely to occur during the morning during the bushfire season under predominant winds. A fire originating within the National Park has potential to reach the project area through fire spread over paddocks and vegetated land, including remnant patches immediately to the east of the project area, similar to that which occurred in the February 2021 Wooroloo bushfire.

Private vegetated land to the south of project area also presents a landscape scale bushfire risk due to potential fire runs through forest vegetation of up to 3 km. This fire scenario would be expected to occur during morning and afternoon wind conditions during the summer. The project area is somewhat buffered from the south by the existing rural-residential development “Rosa Park Estate” where vegetation consists predominantly of managed grass and gardens.

Land directly north of the project area is predominantly pasture land, however, the vegetated creek lines within this land link vegetation that will be retained within the project area with significant vegetation extents further to the north. This vegetation has potential to support bushfire spread within the bounds of the project area in the event of a bushfire travelling from the north under potentially strong summer wind conditions.

There are significant areas of native forest vegetation within rural-residential and rural landholdings to the west (northwest to southwest). Bushfire spread is most likely from the southwest during afternoon summer wind conditions, where the vegetation is more fragmented, however, the bushfire risk is still significant due to fire runs over 2 km through forest and grassland.

On-site bushfire hazards will exist post-development in the form of retained vegetation within the various rural-residential lots. To reduce bushfire impacts to future habitable development, APZs will be nominated for each building envelope to ensure that the bushfire exposure is a maximum of BAL-29 (moderate levels of radiant heat and ember attack) and the building envelopes have been located in proximity to the proposed roads to facilitate access to and egress from the future lots for both residents and attending firefighters. The proposed development is also considered to enhance access options for the local community of Rosa Park Estate through the extension of the existing cul-de-sacs and an additional access/egress route to Morley Road.

Bushfire mitigation strategies designed in consideration of the above discussed local bushfire context are addressed in Section 5 of this BMP.

4.2 Bushfire hazard issues

Examination of the bushfire context and strategic development design in accordance with the Structure Plan concept and pre and post-development bushfire hazard levels has identified the following bushfire hazard issues to be considered at future planning stages:

1. Building envelope locations and Asset Protection Zones

Due to the extent of on-site vegetation, APZs will be required for each building envelope to:

i. achieve compliance with the Shire of Chittering Firebreak Notice

ii. ensure that all future habitable development is subject to BAL-29, or lower.

The final extent of the APZs will need to be confirmed at subdivision stage through the more detailed location and alignment of building envelope and will depend primarily on the classification of the adjacent vegetation (which is predominantly Class A Forest for this site) and the effective slope of land beneath the vegetation hazards, which varies through the project area and adjoining 150 m assessment area.

The building envelopes and associated APZs are to be created as part of subdivisional works, prior to clearance of the future subdivision conditions in accordance with Schedule 1 of the Guidelines (Appendix C) to ensure that the vegetation hazards are removed as provided for within the future subdivision stage BMP. This is especially relevant to Lots 6 and 15-18, where the APZs are overlapping, and therefore dependent on the adjoining land being modified and managed in a low threat state in accordance with the future BAL contour map.

Relevant provisions of Schedule 1 of the Guidelines include:

- 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.

Lot 16 contains two possible building envelope locations. Provisions will need to be made within the future subdivision stage BMP to ensure that the building envelopes for adjacent Lots 15 and 17 can achieve BAL-29 if the southern building envelope is not selected as the final building envelope location. This may require external APZs to be established within the front of Lot 16 and a legal enforcement mechanism provided to ensure that this land will be managed as an APZ on an ongoing basis. Alternatively, habitable building setbacks may be nominated within the building envelopes for Lots 15 and 17 to ensure no habitable development occurs within areas of BAL-40/FZ. This would be enforced through a restrictive covenant placed on the title of the affected lots.

2. Vehicular access

Two access routes are to be provided during all stages of development. If subdivision construction is staged, public roads will either need to be created during the first stage of construction, or temporary compliant Emergency Access Ways (EAWs) will need to be provided from the terminus of any temporary cul-de-sac heads to the existing cul-de-sac heads of Thornbill Place or Bronzewing Court to the south.

Fire Service Access Routes (FSARs) exists around the southern and eastern boundaries of the project area and enable perimeter lot access for firefighting purposes. FSARs proposed for the remaining perimeter of the proposed development should connect into the existing FSAR network to create a coordinated approach to bushfire management and mitigation within the local area.

Where a private driveway is longer than 50 m, this will be required to meet technical requirements under the Guidelines.

Internal perimeter firebreaks will be required for each lot in accordance with the Shire's firebreak notice. Due to the steep topography in some areas and on-site native vegetation, firebreak locations may need to be varied in consultation with the Shire.

3. **Firefighting water**

   A firefighting water supply is to be provided within the project area commensurate with the scale of development. A community firefighting water tank will provide the necessary supply and has been indicatively sited at a central location, away from the retained bushfire hazards, within the south-eastern corner of Lot 5 (see Figure 1).

4. **Landscaping/revegetation**

   The Concept Plan does not include any POS or drainage areas at this stage and does not propose any rehabilitation of vegetation along the creek lines, given the extent of forest that will be retained adjacent to the eastern creek lines. If revegetation is required at future planning stages, the mature vegetation state will need to be factored into the design and location of building envelopes and APZs through preparation of a BAL contour map.

Based on the above, Strategen-JBS&G considers the bushfire hazards within and adjacent to project area and the associated bushfire risks are manageable through standard, acceptable solution management responses outlined in the Guidelines and AS 3959. These responses will be factored into proposed development as early as possible at all stages of the planning process to ensure a suitable, compliant and effective bushfire management outcome is achieved for protection of future life, property and environmental assets. Bushfire mitigation strategies for the proposed development are addressed in Section 5 of this BMP.

5. Assessment against the bushfire protection criteria

5.1 Compliance table

An acceptable solutions assessment against the bushfire protection criteria is provided in Table 5.

Table 5: Compliance with the bushfire protection criteria of the Guidelines

Bushfire protection criteria	Method of compliance Acceptable solutions	Proposed bushfire management strategies	Compliance achievable at future planning stages
Element 1: Location	A1.1 Development location	The post-development BHL assessment (Figure 6) identifies that on completion of development, all building envelopes will be located on land with either a Low or Moderate bushfire hazard level. This satisfies A1.1 at this strategic planning stage. In order to ensure that each proposed building envelope is located in a position where it is possible for BAL-29 to be achieved, APZs have been assigned based on the vegetation classifications and effective slope relevant to each building envelope (refer to Figure 4 and Figure 6). The BALs applicable to each building envelope will be further investigated at the subdivision stage of planning to demonstrate that each lot can achieve BAL-29 (or lower) based on the final building envelope location. This will achieve the intent of A1.1 at subdivision stage.	✓
Element 2: Siting and design	A2.1 Asset Protection Zone	The post-development Vegetation Classification and BHL Assessment maps (refer to Figure 4 and Figure 6) depict an APZ around each proposed building envelope. The APZ widths are based on: • the Shire of Chittering Firebreak Notice (Appendix B), which requires all dwellings to be provided with a 20 m APZ • a detailed assessment of vegetation type and slope, which has determined that an APZ greater than 20 m is required for the proposed building envelopes to achieve BAL-29. The APZs within Lots 15-18 are unable to be entirely located within each respective lot. In this regard, the APZs will extend over the adjoining property boundaries to facilitate a coordinated approach to vegetation management for the affected lots. This approach enables the building envelopes to be clustered at the front of the proposed lots in predominantly cleared areas, which will reduce the bushfire risk to future dwellings, enhance access/egress opportunities and will also reduce the clearing of on-site native vegetation. Overlapping APZs are acceptable under A2.1 where the lots will be maintained in a low threat state in perpetuity. This will be detailed further within the future subdivision/development stage BMPs, with compliance being driven through Clause 3 of the Shire's Firebreak Notice which states that BMPs are to be complied within throughout the year and every year. All APZs are to be implemented and maintained in accordance with Schedule 1 of the Guidelines (Appendix C).	✓

Bushfire protection criteria	Method of compliance Acceptable solutions	Proposed bushfire management strategies	Compliance achievable at future planning stages
Element 3: Vehicular access	A3.1 Two access routes	The proposed internal road network will connect to the existing dead-end roads within the rural-residential development immediately south of the project area, which will enhance access options for the surrounding area and local community in comparison to the existing, non-compliant situation. On completion of development, the project area will be provided with direct access to Morley Road in the northwest via the proposed internal public roads. Access will be provided to the south via proposed connections to Thornbill Place and Bronzewing Court. These roads on-connect to Turtledove Drive, which facilitates access to Morley Road in the southwest both directly and via Rosella Way. On this basis, the project area is provided with at least two access routes to at least two different destinations. Two access routes are to be provided during staging of development, which will be addressed at the subdivision or BMP compliance stage.	✓
	A3.2 Public road	All public roads are to be constructed to the relevant technical requirements of the Guidelines (see Appendix D).	✓
	A3.3 Cul-de-sac (including a dead-end-road)	A dead-end road is proposed adjacent to Lots 8-10 along the northern boundary of the project area. This road will be approximately 183 m in length, which complies with Guideline requirements. The road will be provided with a compliant cul-de-sac head and will meet all other technical requirements of A3.3 (see Appendix D). This dead-end road is considered to be temporary in nature and has been designed at this location to enable future extension of the public road network into the adjoining land to the north, should it be subdivided at a later time. Due to the function of the cul-de-sac to enhance vehicular access networks within the surrounding area, the cul-de-sac is considered to be an unavoidable aspect of the proposed development design. Any temporary cul-de-sacs required through staging of subdivision are to comply with Guideline requirements, including being less than 200 m in length with a minimum 17.5 m diameter turn-around head.	✓
	A3.4 Battle-axe	No battle-axes are proposed as part of the development and the project area is not serviced by an existing battle-axe.	**N/A**
	A3.5 Private driveway longer than 50 m	All private driveways longer than 50 m are to be constructed to the relevant technical requirements of the Guidelines (see Appendix D), including turn-around areas within 50 m of each building, passing bays if driveways are longer than 200 m and additional turn-around areas for fire appliances every 500 m.	✓
	A3.6 Emergency access way	Based on the conceptual development design, the proposed development would not require Emergency Access Ways (EAWs) to provide through access to a public road. However, if development and vehicular access construction is to be staged, any proposed temporary EAW is to be constructed to the relevant technical requirements of the Guidelines (see Appendix D).	✓

Bushfire protection criteria	Method of compliance Acceptable solutions	Proposed bushfire management strategies	Compliance achievable at future planning stages
	A3.7 Fire service access routes (perimeter roads)	The existing rural-residential developments to the south and east are provided with an existing fire service access route (FSAR) which enables firefighters to access the rear perimeter of these properties. FSARs are also proposed for the current development with connections on to the surrounding FSAR network. The proposed FSARs are depicted on Figure 1 and Figure 4 and will be located as follows: • along the internal southern boundary (rear) of Lots 1 and 2, with connections to Morley Road in the west and on to the existing FSAR within Lots 103/104 Turtledove Drive to the south. The existing FSAR then extends to the external southern and eastern boundaries of the project area to the northeast corner of Lot 16 • along the internal northern boundary of Lots 16, 15, 14, 9, 8 and 7 (heading west) and then along the western internal boundary of Lot 7 to connect the external FSAR at the northeast corner of Lot 16 to the internal public roads. The proposed FSARs are to be constructed to the relevant technical requirements of the Guidelines (see Appendix D) and will need to be signposted. Gates may be locked with a common key. Each respective landowner will be responsible for maintaining the FSAR where it occurs on their land, or, following establishment, the Shire will responsible for maintaining the FSAR (to be determined in consultation with the Shire). The FSAR is to be no further than 600 m from a public road at any single point, which is able to be achieved given the site parameters and proposed public road layout.	✓
	A3.8 Firebreak width	The Shire of Chittering Firebreak Notice (Appendix B) requires 3 m wide by 4 m high firebreaks along the inside of property boundaries for Rural-Residential properties greater than 5,000 m^2 (0.5 ha). Where it is impractical to clear firebreaks, alternative locations may be considered in consultation with the Shire's fire officers. The above firebreak notice provisions apply at all stages of the proposed development, including provision of firebreaks on balance land.	✓

Bushfire protection criteria	Method of compliance Acceptable solutions	Proposed bushfire management strategies	Compliance achievable at future planning stages
Element 4: Water	A4.1 Reticulated areas	The proposed development is not located within an existing reticulated area; A4.2 applies.	**N/A**
	A4.2 Non-reticulated areas	A dedicated 50,000 L community firefighting water tank is to be located at a central location within the proposed subdivision area. It is suggested that the tank is located in a relatively flat area and away from the bushfire hazards (for example, adjacent to Lot 5, as shown indicatively in Figure 1). The road could be widened at this point to accommodate the structure and turnaround area, or a separate portion of land could be ceded to the Shire. The tank location will be confirmed at the subdivision stage of planning in consultation with the Shire. The water supply tank is to meet the following requirements: • equipped with a suitable hydrant or standpipe • provided with a hardstand and turn-around area suitable for a type 3.4 fire appliance (i.e. kerb to kerb 17.5 m) within 3 m • located no more than 2 km from the furthest house within the proposed subdivision area. The tank is to be installed by the developer and vested in and maintained by the Shire.	✓
	A4.3 Individual lots within non-reticulated areas (Only for use if creating 1 additional lot and cannot be applied cumulatively)	A community firefighting tank will be provided; A4.2 applies.	**N/A**

6. Responsibilities for implementation and management of the bushfire measures

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. Aside from the preparation of future BMPs to accompany future subdivision and development applications where appropriate, there are no further items to implement, enforce or review at this strategic stage of the planning process.

Future BMPs prepared for subsequent subdivision and development applications are to meet the relevant commitments outlined in this strategic level BMP, address the relevant requirements of SPP 3.7 (i.e. Policy Measures 6.4 and 6.5 respectively) and demonstrate in detail how the proposed development will incorporate the relevant acceptable solutions or meet the performance requirements of the Guidelines. Future BMPs are to include the following detailed information:

- final lot layout, including detailed building envelope design and location
- detailed landscaping design/plans, if relevant
- post development classified vegetation extent and effective slope
- individual lot BAL contour maps demonstrating that proposed building envelopes will achieve BAL–29 or lower
- confirmation of width and alignment of compliant APZs/setbacks
- confirmation of how bushfire management compliance will be delivered during development staging
- vehicular access provisions, including demonstration that a minimum of two access routes will be achieved for each stage of development in accordance with Acceptable Solution A3.1
- vehicular access provisions and technical compliance with regards to public roads, temporary cul-de-sacs/EAWs (if required as part of development staging), private driveways, FSARs and firebreaks
- water supply provisions with regards to a community water tank for firefighting purposes
- provisions for notification on Title for any future lots with a rating of BAL–12.5 or greater as a condition of subdivision
- compliance requirements with the current Shire's annual firebreak notice as amended
- construction of Class 1, 2, 3 or associated 10a buildings in accordance with AS 3959 to the assessed BAL rating
- requirements for BMP compliance reports as conditions of subdivision
- compliance with acceptable solutions of the bushfire protection criteria
- proposed implementation and audit program outlining all measures requiring implementation and the appropriate timing and responsibilities for implementation.

On the basis of the information contained in this BMP, Strategen-JBS&G considers the bushfire hazards within and adjacent to the project area and the associated bushfire risks are manageable through standard, acceptable solution management responses outlined in the Guidelines and AS 3959. Strategen-JBS&G considers that on implementation of the proposed management measures, the project area will be able to be developed with a manageable level of bushfire risk whilst maintaining full compliance with the Guidelines and AS 3959.

7. References

CMW 2021, *Geotechnical Report*, CMW Perth.

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Standards Australia (SA) 2018, *Australian Standard AS 3959–2018 Construction of Buildings in Bushfire-prone Areas*, Standards Australia, Sydney.

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Western Australian Planning Commission (WAPC) 2017, *Guidelines for Planning in Bushfire Prone Areas*, Version 1.3 August 2017, Western Australian Planning Commission, Perth.

Urbaqua 2021, *Local Water Management Strategy*, Urbaqua, Perth.

8. Limitations

Scope of services

This report ("the report") has been prepared by Strategen-JBS&G in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen-JBS&G. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, Strategen-JBS&G has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, Strategen-JBS&G has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen-JBS&G has also not attempted to determine whether any material matter has been omitted from the data. Strategen-JBS&G will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen-JBS&G. The making of any assumption does not imply that Strategen-JBS&G has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen-JBS&G disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

Strategen-JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by Strategen-JBS&G, and should not be relied upon by other parties, who should make their own enquiries.

Appendix A Vegetation plot photos and description

Plot number		Plot 1
Vegetation classification	**Pre-development**	Class A Forest
	Post-development	Class A Forest, Excluded as non-vegetated areas or low threat vegetation under Clauses 2.2.3.2 [e] & [f]

Description / justification

Class A Forest vegetation within and adjacent to the project area is generally in a modified state, with minimal ground fuels present. As grazing pressures are expected to cease once the lots are developed, a tiered forest profile does have potential to re-occur. Where Class A Forest exists within proposed APZs, this will be modified to a low threat state post-development, in accordance with Schedule 1 of the Guidelines and Clauses 2.2.3.2 [e] & [f] of AS 3959.



Photo ID: 1a



Photo ID: 1b



Photo ID: 1c



Photo ID: 1d



Photo ID: 1e



Photo ID: 1f



Photo ID: 1g



Photo ID: 1h



Photo ID: 1i



Photo ID: 1j



Photo ID: 1k



Photo ID: 1l



Photo ID: 1m



Photo ID: 1n



Photo ID: 1o



Photo ID: 1p



Photo ID: 1q



Photo ID: 1r



Photo ID: 1s



Photo ID: 1t



Photo ID: 1u



Photo ID: 1v



Photo ID: 1w



Photo ID: 1x



Photo ID: 1y



Photo ID: 1z



Photo ID: 1aa



Photo ID: 1bb

Plot number		Plot 2
Vegetation classification	**Pre-development**	Class B Woodland
	Post-development	Class B Woodland, Excluded as non-vegetated areas or low threat vegetation under Clauses 2.2.3.2 [e] & [f]

Description / justification

Vegetation comprises tall Eucalypts over grassland, with canopy coverage less than 30%. Woodland vegetation will be modified/partially modified to a non-vegetated/low threat state within the Lot 3, 4, 12 and 13 building envelopes and APZs.



Photo ID: 2a



Photo ID: 2b



Photo ID: 2c



Photo ID: 2d

Plot number		Plot 3
Vegetation classification	**Pre-development**	Class C Shrubland
	Post-development	Class C Shrubland, Excluded as non-vegetated areas or low threat vegetation under Clauses 2.2.3.2 [e] & [f]

Description / justification

Vegetation consists of rushes/reeds less than 2 m in height growing alongside the creekline/wetland area in the central portion of the site. Post-development, a small portion of vegetation will be modified to a non-vegetated/low threat state to accommodate the APZ for Lots 5 and 6.



Photo ID: 3a



Photo ID: 3b

Plot number		Plot 4
Vegetation classification	**Pre-development**	Class G Grassland
	Post-development	Class G Grassland, Excluded as non-vegetated areas or low threat vegetation under Clauses 2.2.3.2 [e] & [f]

Description / justification

Although the Shire of Chittering firebreak notice (Appendix B) requires grassland on all properties to be maintained at ≤50 mm through summer (as far as reasonably practical), all pastureland within existing rural landholdings, including the project area, has been precautionarily classified as Class G Grassland. This is in acknowledgement that it may not be practical for large landholders to maintain all areas of grassland slashed/grazed throughout summer. In addition, some areas of grassland >100 mm were observed during the December 2020 site investigation. It has been assumed that grassland on surrounding rural-residential properties would be maintained throughout bushfire seasons in accordance with firebreak notice requirements. On completion of development, no grassland hazards are expected to remain within the project area as the proposed rural-residential properties will meet firebreak notice requirements (i.e. slashing to ≤50 mm).



Photo ID: 4a



Photo ID: 4b



Photo ID: 4c



Photo ID: 4d



Photo ID: 4e



Photo ID: 4f



Photo ID: 4g



Photo ID: 4h



Photo ID: 4i



Photo ID: 4j



Photo ID: 4k



Photo ID: 4l

Plot number		Plot 5
Vegetation classification	**Pre-development**	Excluded as non-vegetated areas or low threat vegetation under Clauses 2.2.3.2 [e] & [f]
	Post-development	Excluded as non-vegetated areas or low threat vegetation under Clauses 2.2.3.2 [e] & [f]

Description / justification

Plot 5 consists of all currently non-vegetated and managed vegetation within the project area and adjoining 150 m assessment area. Includes managed grassland (<100 mm) and gardens on adjacent rural-residential properties, the area around the existing on-site residence, and the surrounding road network and fire service access routes.



Photo ID: 5a



Photo ID: 5b



Photo ID: 5c



Photo ID: 5d



Photo ID: 5e



Photo ID: 5f


E
SE
S
SW
60
90
120
150
180
210
240
BRG: 151°SE (T) POS: 31°35.628'S, 116°4.354'E ±5m ALT: 215m
02 Dec 2020, 10:49:28

Photo ID: 5g

Appendix B Shire of Chittering Firebreak Notice (2020/21)

Shire of Chittering



FIREBREAK & BUSHFIRE HAZARD REDUCTION NOTICE 2020/21

SHIRE OF CHITTERING
FIREBREAK AND BUSHFIRE HAZARD REDUCTION NOTICE 2020/21

Notice to all owners and occupiers of land situated in the Shire of Chittering.
For the Protection of the Community from Bushfire

As a measure to assist in the control of bushfires and pursuant to the powers contained in Section 33 of the *Bush Fires Act 1954*, all owners and occupiers of land within the Shire's district are required before the 16th day of October in each year or within 14 days of becoming the owner or occupier of land if after that date, to clear firebreaks and/or take measures in accordance with this notice and to maintain those firebreaks and measures in accordance with this notice up to and including the 31st day of May in the following year.

Please Note: Where the owner and/or occupier of the land fails or neglects to comply with the requisitions of this Notice within the specified time, the Shire of Chittering may by its Authorised Officers and such servants, workmen and contractors enter upon the land and carry out the requisitions of this Notice which have not been complied with. The amount of any costs and expenses incurred will be recovered from the owner and/or occupier of the land by the Shire of Chittering.

1. ALL PROPERTIES OF ANY SIZE

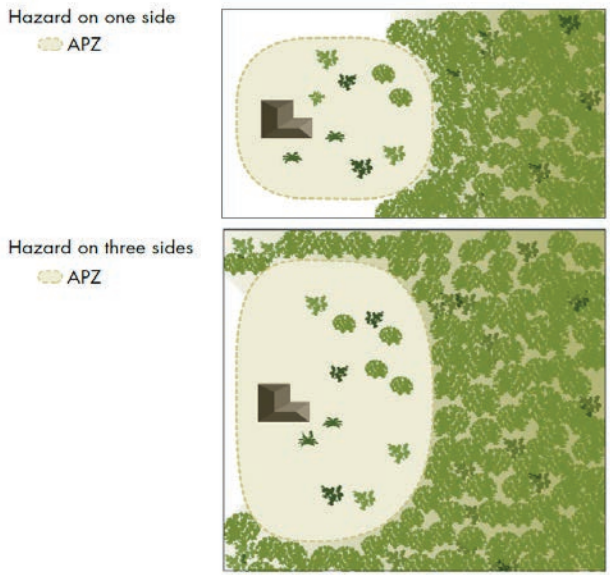
Including Rural Residential and Town Site lots

- All owners or occupiers of land are required to reduce fire hazards on their property prior to the summer season maintaining grassed areas to a height of no more than 50mm, as far as reasonably practicable, by slashing / mowing or grazing by livestock.
- You must create an **ASSET PROTECTION ZONE (APZ)** by Installing and maintaining a 20m fuel reduced zone around all buildings or an asset of value, whether residential, rural, commercial or industrial.

Note: "Fuel reduced" is a reduction in the vegetation so as to reduce the impact of a bushfire onto that asset.

- Trees over 5m in height within the APZ, must be under pruned to a clearance of 2m from the ground.
- Trees and shrubs within 2m of the asset, must not exceed 2m in height.
- Ensure the roofs, gutters and walls of all buildings on the land are free of flammable matter.
- Clear a bare earth firebreak, not less than 5 metres wide, with a 4 metre vertical clearance completely surrounding haystacks and fuel storage areas within the property.

Firebreaks may be constructed by one or more of the following methods: PLOUGHING, CULTIVATING, SCARIFYING, RAKING, BURNING, CHEMICAL SPRAYING OR OTHER APPROVED METHOD.



NOTE: In addition to the requirements of this notice, regardless of land size and location, you may be required to carry out further fire prevention works to reduce hazards considered necessary by an Authorised Officer. Any further requirements would be specified by way of a "work order" forwarded to the address of the owner/s and or occupier.

2. PROPERTIES 5000 M² (½ HECTARE) AND LARGER

Including Rural Residential and Town Site lots

INSTALL AND/OR UPGRADE FIREBREAKS

- Clear a bare earth firebreak by removing all flammable material. The firebreak should be 3 metres wide, with a 4 metre vertical clearance (trafficable) along the inside of the property boundaries.
- Properties with an area of 120 hectares or more must have a firebreak in such a position which divides the land into areas not exceeding 120 hectares.
- If it is impractical for you to clear a firebreak along your boundary, you may request permission from the Shire to install a firebreak in an alternative location, or of a different nature. All requests must be in writing to the Shire and received by 1st October.



FIREBREAK & VEHICLE ACCESS REQUIREMENTS





3. BUSHFIRE AND EMERGENCY MANAGEMENT PLANS

All properties with a Bushfire Management Plan, Emergency Management Plan, or an approved Bushfire Attack Level assessment (BAL), approved as part of a Town Planning Scheme, subdivision approval, development approval or a building permit for an individual, or group of properties, shall comply with the plan in its entirety.

All bushfire management plan requirements are in addition to the requirements of this notice. Compliance is required throughout the year, each and every year.

4. PLANTATIONS

In accordance with the requirements of a Fire Management Plan approved in writing by the Shire; Install and maintain external perimeter and internal firebreaks that form compartment cells, and engage in hazard reduction measures that reduce fuel loads so as to protect neighbouring communities and essential infrastructure, Or;

Meet requirements and specifications set out within the Department of Fire & Emergency Services *Guidelines for Plantation Fire Protection 2011* publication.

If, for any reason, it is considered impractical to carry out the requirements as outlined above, plantation owners and managers may apply in writing to the Shire for permission to implement an alternative plan. A Fire Management Plan may be required to be developed and submitted.

5. CONTROL OF OPERATIONS LIKELY TO CAUSE A FIRE

Hot works including the operation of welding equipment and angle grinders, are activities likely to create a fire danger when used in the open air.

A person shall provide at least one fire extinguisher at the place where welding or cutting operations are carried out and surround this place with a firebreak which is at least 5 metres wide.

A ban on hot works, harvesting and movement of machinery and vehicles is likely to be imposed on days of adverse fire weather conditions.

For updates on these bans please ring the information line on 9576 4666 (recorded message) or register with the SMS warning system with the Shire to receive a text when a ban is implemented.

HOT WORKS, HARVEST AND MOVEMENT OF MACHINERY BANS WILL BE IN PLACE ON CHRISTMAS DAY, BOXING DAY AND NEWS YEARS DAY

6. HARVESTING OPERATIONS (INCLUDING STUBBLE PROCESSING)

The Shire will permit harvesting operations, including stubble processing, during the Restricted and Prohibited Burning Times on the following conditions:

- That a fully operational firefighting unit (inclusive of associated pump, hose system and a minimum of 600 litres of water is present) at all times.
- Harvesting operations, and stubble processing, are not permitted when the Shire has declared a Harvest and Vehicle Movement Ban, including Hot Works Activities.

IN ADDITION TO THE CONDITIONS ABOVE HARVESTING OPERATIONS (including stubble processing) ON SUNDAYS AND PUBLIC HOLIDAYS, EXCEPT CHRISTMAS DAY, BOXING DAY AND NEW YEAR'S DAY, WILL BE PERMITTED ON THE FOLLOWING CONDITIONS,

- The local Fire Control Officer (FCO) is notified.
- Two able-bodied adult persons are present during the harvesting operations, only one of whom may be harvesting.

7. RESTRICTED AND PROHIBITED BURNING TIMES

Burning is prohibited from 1st December to 31st March.
Burning is restricted from 1st October to 30th November, and 1st April to 31st May, and a permit to burn is required. Dates may be adjusted for seasonal conditions.

8. FIRE DANGER RATING

No fire of any kind may be lit on a day when the forecast Fire Danger Rating for the district is **Very High, Severe, Extreme or Catastrophic**.

The Fire Danger Rating is supplied daily by the Bureau of Meteorology (BoM). This information is also available from the Shire, DFES and Emergency WA web sites, Telstra Weather service on Ph: 1196, The Bureau of Meteorology website (www.bom.gov.au) and is displayed on the information boards located at: Great Northern Highway, Muchea; John Glenn Park, Muchea; Muchea East Road, Lower Chittering; Great Northern Highway, Bindoon; Corner of Crest Hill and Mooliabeenee Roads, Bindoon. The Chittering fire weather district is within the *Lower West Inland.*

9. BURNING OF GARDEN REFUSE, CAMPING & COOKING FIRES

Pursuant to Section 24G(2) and Section 25(1a) of the *Bush Fires Act 1954* and applicable to all persons, the burning of garden refuse and lighting of camping or cooking fires **is prohibited within the Shire of Chittering during the Prohibited Burning Time**.

Furthermore, pursuant to Section 24G(2) of the Bush Fires Act 1954 and applicable to all persons, the burning of garden refuse is prohibited within the Shire of Chittering during the Restricted Burning Times unless a valid permit to burn has been obtained from a Fire Control Officer.

Other than during the RESTRICTED or PROHIBITED Burning Times, garden refuse may be burnt at any time, but care must be exercised. Excessive smoke from the burning of garden refuse may cause nuisance and annoyance to neighbours, other residents and danger to motorists. Do not burn damp, wet or green material at any time as this will cause excessive smoke. Please consider this and plan to minimise smoke.

Wood fired pizza ovens and solid fuel BBQs in the open air may NOT be used in the restricted burning times unless the following conditions are met:

1. The Bureau of Meteorology Fire Danger Rating forecast is not Very High, Severe, Extreme or Catastrophic - at any time over the whole day.
2. The fire is only burning between 6pm and midnight, and completely extinguished when finished.
3. There is a minimum 5 metre firebreak, clear of flammable material surrounding the pizza oven or BBQ. (10 metre diameter).
4. At least 1 adult person is in attendance at all times.
5. The wood fired pizza oven or solid fuel BBQ is fitted with a spark arrester to the chimney and the door to the oven mouth (if specified and fitted by the manufacturer) is used to prevent the escape of embers and burning material.
6. There is a means of extinguishing a fire available at all times (e.g. garden hose, knapsack spray or fire unit).

All hazard reduction burns are to be registered with DFES Communications Centre on 9395 9209.

Volunteers Needed

Joining your local Volunteer Bush Fire Brigade is a great way to meet people, gain training and experience while contributing to your community.

The Shire of Chittering has six volunteer fire brigades, Muchea, Lower and Upper Chittering, Bindoon, Wannamal and the Incident Support Brigade as well as the St John Ambulance.

If interested in contributing, please call the Shire of Chittering on **9576 4600** to be put in touch with your nearest brigade, or visit **https://www.chittering.wa.gov.au/services/fire-emergency/join-a-brigade**

PREPARE YOUR HOME AND PROPERTY CHECKLIST

Here's a checklist of things to do. Details about most of them are given elsewhere in this book.

LONG-TERM PRECAUTIONS

- Prepare firebreaks. ☐
- Make the house safe—fit wire screens and shutters and fill gaps. ☐
- Develop and maintain a minimum 20-metre asset protection zone. ☐
- Develop and maintain a suitable hazard separation zone. ☐
- Provide an emergency water supply. ☐
- Discuss fire prevention with your neighbours—is your locality safe? ☐
- Discuss your preparedness with your neighbours. ☐

AUTUMN AND WINTER (MAY–AUGUST)

- Tree pruning—remove lower branches, check that powerlines are clear. ☐
- Reduce fuel levels around the house—clear long grass, leaves, twigs and flammable shrubs. ☐
- Petrol and other fuels—store in a suitable shed away from the home. ☐
- Make sure your personal and home protection equipment is in good order. Overhaul the emergency water pump. ☐
- Make sure everyone in the family knows what to do in a fire. ☐

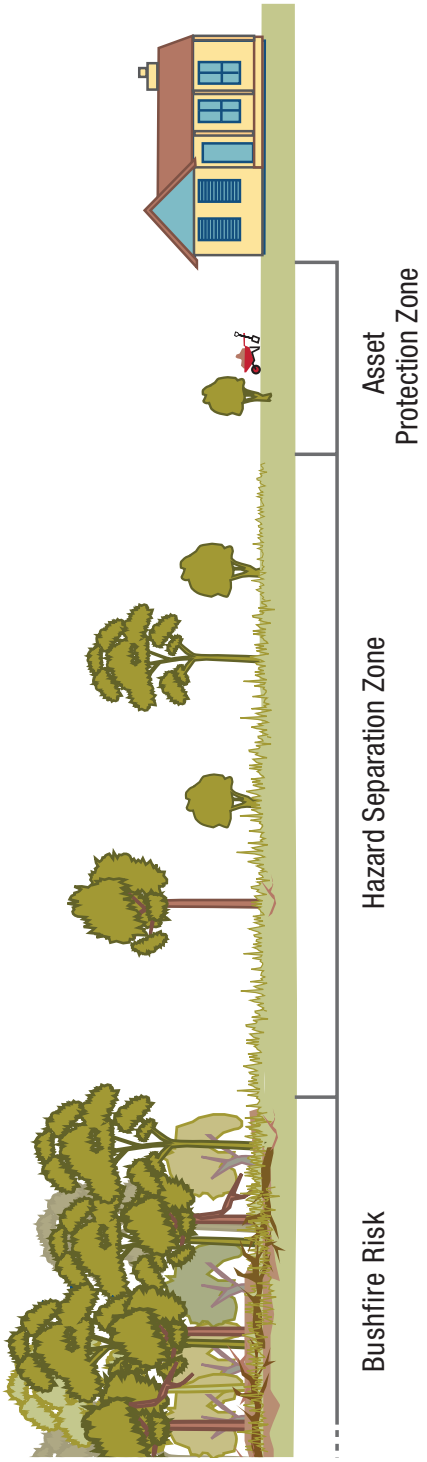
SPRING (SEPTEMBER–NOVEMBER)

- Move woodpile and stacked timber away from the house. ☐
- Keep the grass short—on farms, keep grazing pressure high on areas near the house. ☐
- Prune the dead material from the shrubs in the asset protection zone. ☐
- Clean out gutters, remove debris from roof. ☐
- Create firebreaks. ☐
- Prepare an emergency kit, including a plan. ☐
- Decide whether to stay and actively defend your property in the event of a fire or leave for a safer place. ☐

EARLY SUMMER (DECEMBER ONWARDS)

- Water lawns, trees and shrubs near the house to keep them green. ☐
- Re-check personal and home protection gear, screens, water supplies and gutters. ☐





LOCAL BUSH FIRE CONTROL OFFICERS

Fire Control Officers are not obliged to issue permits and may advise on alternatives to burning. Please remember Fire Control Officers are volunteers and their availability to issue permits may vary, assist them by planning in advance. Permits cannot be issued over the phone and should a Fire Control Officer refuse to issue a permit, it is a breach of the Act to request a permit from another Fire Control Officer.

MUCHEA
Shelly Pannell 0417 982 159
Shane Robertson 0400 998 588

LOWER CHITTERING
Max Brown 0427 089 677
Johan Rossouw 0439 162 000

UPPER CHITTERING
Aaron Cover 0410 594 221
Gordon Carter 9576 0902 / 0429 784 831

BINDOON
Dennis Badcock 0428 947 853
Nic Walter 0436 857 529

WANNAMAL
Kim Haeusler 9655 9043 / 0428 559 043
Clayton Smith 0427 090 548

DEPUTY CHIEF (SOUTH)
David Wilson 0412 716 577

DEPUTY CHIEF (CENTRAL)
Phill Humphry 9576 1050 / 0427 761 050

DEPUTY CHIEF (NORTH)
Kim Haeusler 9655 9043 / 0428 559 043

SHIRE FIRE CONTROL OFFICERS
Rangers 9576 4600

COMMUNITY EMERGENCY SERVICES MANAGER
CHIEF BUSH FIRE CONTROL OFFICER
David Carroll 9576 4600



FIREBREAKS MUST BE CLEARED BY 16 OCTOBER AND REMAIN CLEARED UNTIL 31 MAY

BURNING IS PROHIBITED BETWEEN 1 DECEMBER TO 31 MARCH

BURNING PERMITS ARE REQUIRED BETWEEN 1 OCTOBER TO 30 NOVEMBER AND 1 APRIL TO 31 MAY

Permits are not valid on any Sunday or Public Holiday, or when the Fire Danger Rating is **Very High, Severe, Extreme or Catastrophic.**

Burning of road side verges is prohibited without written approval from the Shire of Chittering or other authorities. Approvals are only available between June and September each year where no alternative method exists to reduce the hazard.

Wood fired pizza ovens, solid fuel BBQs, camp fires or any uncontrolled flame in the open air must not be used during the Prohibited Burning Time, and conditions apply during the Restricted Burning Times. ("Open Air" means any open place, yard, field or construction area which is not completely enclosed by a building or structure).

PENALTIES

Failure to comply with this Firebreak Notice may result in fines ranging from $250 to $250,000 or imprisonment.

FOR ALL FIRES, CALL 000

HOT WORKS, HARVEST AND MOVEMENT OF MACHINERY BANS INFORMATION LINE 9576 4666

FOR FURTHER INFORMATION ON THIS NOTICE CONTACT THE SHIRE OF CHITTERING

Phone: 9576 4600

Email: chatter@chittering.wa.gov.au

Facebook: www.facebook.com/groups/chitteringbushfireready

Web Site: www.chittering.wa.gov.au

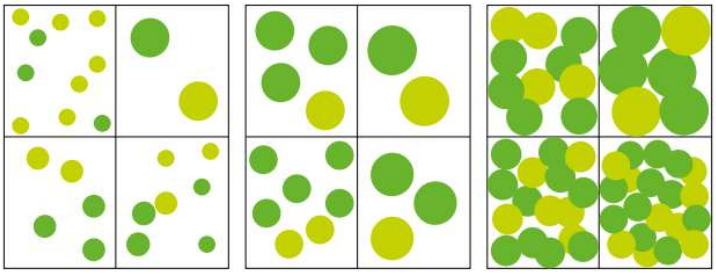
By order of the Shire of Chittering
Matthew Gilfellon
Chief Executive Officer

Shire of Chittering

Appendix C APZ standards (Schedule 1 of the Guidelines)

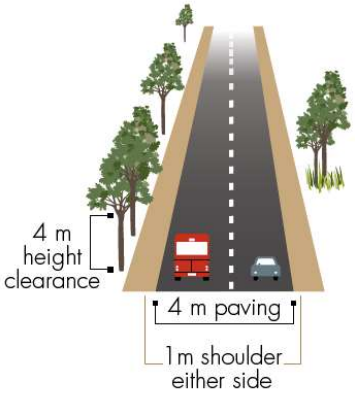
Schedule 1: Standards for Asset Protection Zones

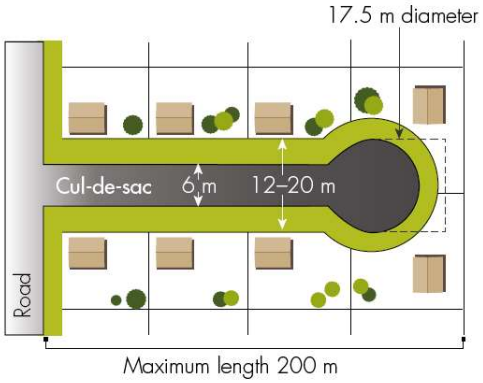
- **Fences:** within the APZ are constructed from non-combustible materials (e.g. iron, brick, limestone, metal post and wire). It is recommended that solid or slatted non-combustible perimeter fences are used.
- **Objects:** within 10 metres of a building, combustible objects must not be located close 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.

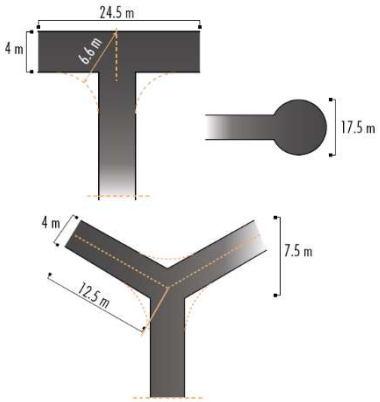


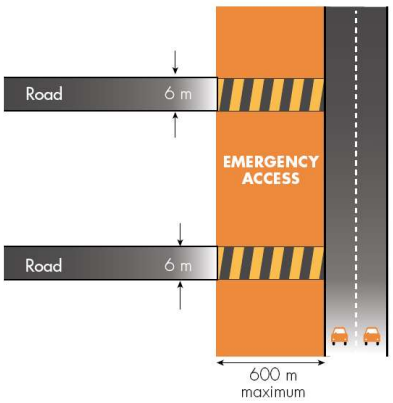
- **Shrubs (0.5 metres to 5 metres in height):** should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m2 in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than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

Appendix D Vehicular access technical standards of the Guidelines

Public roads	
Acceptable solution A3.2	A public road is to meet the requirements in Table 1, Column 1.
Explanatory note E3.2	Trafficable surface: Widths quoted for access routes refer to the width of the trafficable surface. A six metre trafficable surface does not necessarily mean paving width. It could, for example, include four metre wide paving one metre wide constructed road shoulders. In special circumstances, where eight lots or less are being serviced, a public road with a minimum trafficable surface of four metres for a maximum distance of 90 metres may be provided subject to the approval of both the local government and Department of Fire and Emergency Services. Public road design: All roads should allow for two-way traffic to allow conventional two-wheel drive vehicles and fire appliances to travel safely on them. 

Cul-de-sac (including a dead-end road)	
Acceptable solution A3.3	A cul-de-sac and/ or a dead end road should be avoided in bushfire prone areas. Where no alternative exists (i.e. the lot layout already exists and/ or will need to be demonstrated by the proponent), the following requirements are to be achieved: • Requirements in Table 1, Column 2 • Maximum length: 200 metres (if public emergency access is provided between cul-de-sac heads maximum length can be increased to 600 metres provided no more than eight lots are serviced and the emergency access way is no more than 600 metres) • Turn-around area requirements, including a minimum 17.5 metre diameter head.
Explanatory note E3.3	In bushfire prone areas, a cul-de-sac subdivision layout is not favoured because they do not provide access in different directions for residents. In some instances it may be possible to provide an emergency access way between cul-de-sac heads to a maximum distance of 600 metres, so as to achieve two-way access. Such links must be provided as right of ways or public access easements in gross to ensure accessibility to the public and fire services during an emergency. A cul-de-sac in a bushfire prone area is to connect to a public road that allows for travel in two directions in order to address Acceptable Solution A3.1. 

Private driveway longer than 50 metres	
Acceptable solution A3.5	A private driveway is to meet all of the following requirements: • Requirements in Table 1, Column 3 • Required where a house site is more than 50 metres from a public road • Passing bays: every 200 metres with a minimum length of 20 metres and a minimum width of two metres (i.e. the combined width of the passing bay and constructed private driveway to be a minimum six metres) • Turn-around areas designed to accommodate type 3.4 fire appliances and to enable them to turn around safely every 500 metres (i.e. kerb to kerb 17.5 metres) and within 50 metres of a house • Any bridges or culverts are able to support a minimum weight capacity of 15 tonnes • All-weather surface (i.e. compacted gravel, limestone or sealed).
Explanatory note E3.5	For a driveway shorter than 50 metres, fire appliances typically operate from the street frontage however where the distance exceeds 50 metres, then fire appliances will need to gain access along the driveway in order to defend the property during a bushfire. Where house sites are more than 50 metres from a public road, access to individual houses and turnaround areas should be available for both conventional two-wheel drive vehicles of residents and type 3.4 fire appliances. Turn-around areas should be located within 50 metres of a house. Passing bays should be available where driveways are longer than 200 metres and turn-around areas in driveways that are longer than 500 metres. Circular and loop driveway designs may also be considered. These criteria should be addressed through subdivision design. Passing bays should be provided at 200 metre intervals along private driveways to allow two-way traffic. The passing bays should be a minimum length of 20 metres, with the combined width of the passing bay and the access being a minimum of six metres. Turn-around areas should allow type 3.4 fire appliances to turn around safely (i.e. kerb to kerb 17.5 metres) and should be available at the house sites and at 500 metre intervals along the driveway. 

Emergency access way	
Acceptable solution A3.6	An access way that does not provide through access to a public road is to be avoided in bushfire prone areas. Where no alternative exists (this will need to be demonstrated by the proponent), an emergency access way is to be provided as an alternative link to a public road during emergencies. An emergency access way is to meet all of the following requirements: • Requirements in Table 1, Column 4 • No further than 600 metres from a public road • Provided as right of way or public access easement in gross to ensure accessibility to the public and fire services during an emergency • Must be signposted.
Explanatory note E3.6	An emergency access way is not a preferred option however may be used to link up with roads to allow alternative access and egress during emergencies where traffic flow designs do not allow for two-way access. Such access should be provided as a right-of-way or easement in gross to ensure accessibility to the public and fire emergency services during an emergency. The access should comply with minimum standards for a public road and should be signposted. Where gates are used to control traffic flow during non-emergency periods, these must not be locked. Emergency access ways are to be no longer than 600 metres and must be adequately signposted where they adjoin public roads. Where an emergency access way is constructed on private land, a right of way or easement in gross is to be established. 

Fire service access routes (perimeter roads)	
Acceptable solution A3.7	Fire service access routes are to be established to provide access within and around the edge of the subdivision and related development to provide direct access to bushfire prone areas for fire fighters and link between public road networks for firefighting purposes. Fire service access routes are to meet the following requirements: • Requirements in Table 1, Column 5 • Provided as right of ways or public access easements in gross to ensure accessibility to the public and fire services during an emergency • Surface: all-weather (i.e. compacted gravel, limestone or sealed) • Dead end roads are not permitted • Turn-around areas designed to accommodate type 3.4 appliances and to enable them to turn around safely every 500 metres (i.e. kerb to kerb 17.5 metres) • No further than 600 metres from a public road • Allow for two-way traffic • Must be signposted.
Explanatory note E3.7	Fire service access routes should be established to separate bushfire prone areas from developed areas, and to provide access within and around the edge of subdivisions and related development. Fire service access is used during bushfire suppression operations but can also be used for fire prevention work. Fire service access routes should: • Link up with the road network at regular intervals - the development and road network forms part of the fire service access system • Be adequately signposted • Allow for two-way traffic - that is, two fire appliances must be able to safely pass each other • Have an all-weather surface (i.e. compacted gravel, limestone or sealed) • Have erosion control measures in place. Driveways may be used as part of the designated fire service access system, provided they meet the minimum standard for fire service access routes. It is beneficial to link the fire service access routes with individual driveways to allow quick access to properties and houses during fire emergencies. Where gates are used, these should be wide enough to accommodate type 3.4 fire appliances (minimum width of 3.6m) with the design and construction to be approved by the relevant local government. Gates on fire service access routes may be locked to restrict access provided that a common key system is used and such keys are made available for fire appliances and designated fire officers within the local government area and/or surrounding district. Gates should be installed where fences cross fire service access routes. Management and access arrangements should be in place to ensure that the maintenance of fire service access routes will occur in the long term after an area has been subdivided. A number of options can be used to achieve this, including but not limited to: • Individual property owners being responsible for maintaining fire service access routes where these fall on their property • Providing such access as a right-of-way or easement in gross to ensure accessibility to fire services during an emergency; and/or • A levy system administered by local government to cover the cost of maintaining fire service access routes. Such arrangements should be documented in the relevant planning application (such as a structure plan, subdivision plan or development plan) and should be agreed to by local government.

Technical requirement	1	2	3	4	5
	Public road	Cul-de-sac	Private driveway longer than 50 m	Emergency access way	Fire service access routes
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					

Appendix E Water technical standards of the Guidelines

Non-reticulated areas	
Acceptable solution A4.2	Water tanks for firefighting purposes with a hydrant or standpipe are provided and meet the following requirements: • Volume: minimum 50,000 litres per tank • Ratio of tanks to lots: minimum one tank per 25 lots (or part thereof) • Tank location: no more than two kilometres to the further most house site within the residential development to allow a 2.4 fire appliance to achieve a 20 minute turnaround time at legal road speeds • Hardstand and turn-around areas suitable for a type 3.4 fire appliance (i.e. kerb to kerb 17.5 metres) are provided within three metres of each water tank • Water tanks and associated facilities are vested in the relevant local government.
Explanatory note E4.2	A procedure must be in place to ensure that water tanks are maintained at or above the designated capacity, including home tanks on single lots, at all times. This could be in the form of an agreement with the local government and the fire service.

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