Onsite Wastewater Management Plan 2025 – 2030

Technical Document

Macedon Ranges Shire Council

Document Control Sheet

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Synopsis:	This document has been developed to accompany and direct the OWMP Operational Plan and to assist with detailed assessment of unsewered development lots within the Shire with regard to their ability to sustainably to accommodate wastewater onsite. Together, the Operational Plan and Technical Document form the 2025-2030 Onsite Wastewater Management Plan (OWMP). This document provides additional detail on the procedural methods used to identify, assess and quantify the range of site-specific and regional constraints which influence the performance of onsite wastewater management systems (OWMS) in the Shire. The document has been updated to reflect recent legislative and regulatory changes for Onsite Wastewater Management in Victoria and to align with a standardised risk-based assessment approach.
Client Details	
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Disclaimer

The information contained in this document is based on independent research undertaken by Whitehead & Associates Environmental Consultants Pty Ltd (W&A). To our knowledge, it does not contain any false, misleading or incomplete information. Recommendations are based on an appraisal of site-specific environmental conditions, subject to the limited scope and resources available for this project, and follow relevant industry standards.

The work performed by W&A included a limited site and soil investigation in addition to a desktop review, and the conclusions made in this report are based on the information gained and the assumptions as outlined. Under no circumstances, can it be considered that these results represent the actual conditions throughout the entire Shire due to the regional scale of this study.

Acknowledgement of Funding Support

Macedon Ranges Shire Council acknowledges funding support provided by the Victorian State Government to develop this plan.

Document Certification

This Onsite Wastewater Management Plan (OWMP) has been prepared and conforms with standards and guidelines as set out in the following documents, where applicable:

- Department of Energy, Environment and Climate Action (2024), *Planning Permit Applications in Special Water Supply Catchment areas* (DEECA, 2024);
- Department of Environment, Land, Water and Planning (2022), *Risk Assessment Guidance Report* (DELWP, 2022);
- EPA Victoria (2024), *Guideline for Onsite Wastewater Effluent Dispersal and Recycling Systems* (EDRS, 2024);
- EPA Victoria (2024), *Guideline for Onsite Wastewater Management* (GOWM, 2024);
- Municipal Association of Victoria & Department of Sustainability and Environment (2014), *Victoria Land Capability Assessment Framework, 2nd Ed* (MAV & DSE, 2014);
- Standards Australia / Standards New Zealand (2012), *Onsite Domestic Wastewater Management (AS/NZS 1547:2012)*; and
- Victoria Audit General's Office (2018), *Managing the Environmental Impacts of Domestic Wastewater* (VAGO, 2018).

Acknowledgement of Country

Macedon Ranges Shire Council acknowledges the Dja Dja Wurrung, Taungurung and Wurundjeri Woi Wurrung Peoples as the Traditional Owners and Custodians of this land and waterways. Council recognises their living cultures and ongoing connection to Country and pays respect to their Elders past, present and emerging. Council also acknowledges local Aboriginal and/or Torres Strait Islander residents of Macedon Ranges for their ongoing contribution to the diverse culture of our community.

List of Acronyms

Term	Definition
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AWTP	Aerated Wastewater Treatment Plant
CMA	Catchment Management Authority
CA	Certificate of Approval
DEM	Digital Elevation Model
DEECA	Department of Energy, Environment, and Climate Action (formerly DELWP)
DELWP	Department of Environment, Land, Water, and Planning (now DEECA)
DIR	Design Irrigation Rate
DLR	Design Loading Rate
DSE	Department of Sustainability and the Environment (former)
EDS	Effluent Dispersal System
EPA	Environment Protection Authority
GED	General Environmental Duty
GIS	Geographic Information System
GMA	Groundwater Management Area
LCA	Land Capability Assessment
LGA	Local Government Area
LPED	Low-Pressure Effluent Distribution System
LRA	Land Resource Assessment
MAV	Municipal Association of Victoria
OWM	Onsite Wastewater Management
OWMP	Onsite Wastewater Management Plan
RAF	Risk Assessment Framework
SILO	Scientific Information for Land Owners
MRS	Macedon Ranges Shire
MRSC	Macedon Ranges Shire Council
SWSC	Special Water Supply Catchment
VCAT	Victorian Civil and Administrative Tribunal
VPP	Victoria Planning Provisions
VVG	Visualising Victoria's Groundwater (Project)
WC	Water Corporation
WCT	Waterless Composting Toilet
WMIS	Water Measurement Information System
WSPA	Water Supply Protection Area

Table of Contents

1 Introduction

This document, together with the Operational Plan, forms the 2025-2030 Onsite Wastewater Management Plan (OWMP) and has been prepared to assist with detailed assessment of unsewered development lots within the Shire with regard to their ability to sustainably accommodate wastewater onsite.

It provides additional detail and guidance on relevant background documents; an overview of onsite wastewater management (OWM) within the Shire and outlines the procedural methods used to identify, assess and quantify the range of site-specific and regional constraints which influence the performance of onsite wastewater management systems (OWMS) in the Macedon Ranges Shire (the Shire). The 2025-2030 OWMP adopts a risk-based approach to analysing the suitability, design, management and monitoring of OWMS in the Shire.

The *Environment Protection Act 2017* (*EP Act 2017*) and *Regulations* (*EP Regulations 2021*) has established a new framework for environment protection in Victoria. It includes a new approach to the prevention of environmental harm under 'General Environmental Duty' (GED). As such, there are ongoing consequential changes to the management of OWM in Victoria.

The 2025-2030 OWMP has been updated to reflect recent legislative and regulatory changes to OWM in Victoria and to align with the risk-based management approach promoted in the *EP Act 2017*.

2 Council Policies and Plans

The 2025-2030 OWMP has been developed to complement other Council policies and plans through the actions identified in the Operational Plan. The following is a brief outline of the various Council plans which have been considered in the development of this OWMP.

2.1 Community Vision 2021 – 2031

The MRS Community Vision statement is as follows: "With our unique regional identity, Macedon Ranges Shire embodies a caring, resilient approach to community through our robust local economy, protection of the natural environment and a collaborative commitment to inclusivity for all". The vision is supported by a total of four (4) themes, with Theme 2 (healthy environment, healthy people) specifically relating to the OWMP. The implementation of the OWMP will ensure the effective management of OWM in the Shire, supporting Theme 2.

2.2 Council Plan 2021 – 2031

The MRS Council Plan details the strategic direction for the future of the Shire, outlining key priorities for the period of the plan and supporting the achievement of the Community Vision through planned objectives and strategies. The implementation of the OWMP will ensure the effective management of OWM in the Shire, supporting strategic objective 2 (healthy environment, healthy people).

2.3 Municipal Health and Wellbeing Plan 2021 – 2025

The MRS Municipal Public Health and Wellbeing Plan (2021 – 2025) aims to enhance the health and wellbeing of the residents of MRS. The goals that specifically relate to this OWMP is Goal 5 (an environment that reduces potential public health risk to our people). The implementation of the OWMP will ensure the effective management of OWM in the Shire, supporting Goal 5.

2.4 Settlement Strategy 2011

The MRS Settlement Management Plan 2011 establishes a series of broad directions for settlement patterns in the Shire and makes specific recommendations to manage population growth in a sustainable manner. The plan also included a review of the necessary infrastructure investment expected to be required to achieve the recommended actions. The strategy of settlement development has been considered in the OWMP.

2.5 Macedon Ranges Planning Scheme

The Macedon Ranges Planning Scheme, approved under the *Planning and Environment Act 1987*, sets out planning policies for the municipality and contains information about zones, overlays and other provisions which affect how land can be used and developed in MRS.

It identifies triggers for planning permit applications and outlines application requirements and decision guidelines for the use, subdivision and development of land in the different zones.

On land where OWM is required, a planning application may need supporting information such as a Land Capability Assessment (LCA) to show that the lot can accommodate an OWMS. All applications within Special Water Supply Catchment (SWSC) areas must be referred to the relevant Water Corporation (WC). If the WC objects to the application, it must be refused by Council.

Under Section 173 of the *Planning and Environment Act 1987*, Council can enter into a legal agreement with the owner of land, with the agreement binding the owner to the covenants specified in the agreement. Such agreements can be used to prohibit, restrict or regulate the use of land, or can relate to conditions subject to which the land may be used or developed for specified purposes. A Planning Permit condition can require the owner to enter such a legal agreement, which is subsequently registered on the title of the property.

Such a legal agreement may be required by Council or the WC when planning applications are located within a SWSC. In such cases, Section 173 agreements often contain maintenance requirements for OWMS, which on the sale of a property, transfer to an incoming owner.

2.6 Council Budget

The Council Budget sets out finances for all Council projects and their management. To implement the OWMP, the budget will need to provide scope for the management of the audit and inspection program recommended.

The budget currently allocates fees and charges for Septic Tank Permits. These fees and charges cover resources required to assess, discuss / permit the installation, inspection and approval to use new and modified OWMS.

Council will need to determine and implement appropriate ongoing fees and charges for all unsewered properties to provide resources to undertake Action Items and programs within the Operational Plan.

3 Legislation and Regulation

3.1 Legislation

3.1.1 Local Government Act 2020

The *Local Government Act 2020* received Royal Assent on the 1989 Act. The Act improves local government democracy, accountability and service delivery for all Victorians. The Act outlines the provisions under which Council operates and empowers Councils to have local laws and regulations for OWM.

The Act empowers Council to enact local laws and set special charges for Council activities. Council can use these powers to develop local regulations for OWM, as long as these regulations are consistent with state policy and legislation and to raise revenue for its wastewater management programs.

3.1.2 Environment Protection Act 2017 and Regulations 2021

The *EP Act 2017* replaced the *Environment Protection Act 1970* on 1 July 2021, as is used to regulate OWMS within Victoria. Council will utilise the EPA '*Regulating onsite wastewater management systems: local government toolkit'* (publication 1974: 2021) to assist in regulating OWMS within the Shire and adhering to the Act.

The main change that the Act brings is the prevention of harm, whereas the superseded 1970 Act focused on the consequences of harm. The pollution offences will be replaced by the GED which is the primary way the EPA will achieve a prevention to harm approach. The GED makes it clear that it is the owner or authorised or unauthorised entities responsibility to reduce the risk to the environment. A delegation of functions and powers from EPA to Council under the Act will allow for Council to take action under the GED. The following sections outline the requirements specific to OWM within the Act:

- Part 3.2 – General Environmental Duty (Sections 25 to 27);
- Part 4.5 – Permits (Sections 81 to 84);
- Part 7.3 – Obligations for Managers of Land or Infrastructure (Section 156); and
- Part 9.3 – Inspections and inquiry powers (Section 246 to 258).

The Act is supported by the *EP Regulations 2021*, which provide criteria for Council to consider when assessing OWM permit applications and enforcement. The Regulations outline the specific requirements for matters relating to obtaining a permit to construct, install or alter an OWMS, as well as the operation and maintenance of an OWMS. The following outlines the requirements specific to OWM within the Regulations:

- Part 3.3 – Permits (Regulations 25 to 35); and
- Part 5.7 – Onsite wastewater management systems (Regulations 159 to 163).

3.1.3 Water Act 1989

Section 183 of the *Water Act 1989*, provides a WC with the power to inspect and monitor existing OWMS within their sewerage district, and if the system does not comply with the *EP Act 2017* and the *Public Health and Wellbeing Act 2008*, then (if feasible) the WC can require the owner to connect to the sewer where it is available under Section 147 of the *Water Act 1989*.

3.1.4 Safe Drinking Water Act 2003 and Regulations 2015

The *Safe Drinking Water Act 2003,* and the supporting *Regulation 2015*, requires a catchment to apply a multi-barrier approach to managing risks to water quality. This applies to both water suppliers and water storage managers, whom are required to:

- Ensure that drinking water meets quality standards specified by the Regulators;
- Prepare and implement a risk management plan;
- Provide independent audits of their performance in implementing the plans;
- Disclose various types of information relation to the quality of the drinking water they supply to the consumers; and
- Report any known or suspected contamination of the drinking water to the Secretary of the Department of Health.

3.1.5 Planning and Environment Act 1987

The *Planning and Environment Act 1987* is 'enabling' legislation, with more detailed planning matters dealt with by subordinate instruments under the Act, such as the Victorian Planning Provisions (VPP), planning schemes, regulations and Ministerial Directions.

Key components of the planning framework established by the Act include:

- The system of planning schemes that sets out how the land may be used and developed;
- The VPP, which provide the template for the construction and layout of planning schemes;
- The procedures for preparing and amending the VPP and planning schemes;
- The procedures for obtaining planning permits under planning schemes; and
- The procedures for settling disputes, enforcing compliance with planning schemes and other administrative procedures.

Planning schemes set out how land may be used and developed, including the requirements for obtaining planning permits. Where OWM is required, a planning permit may need supporting information such as an LCA to show that the development can accommodate an OWMS. All applications within a SWSC must be referred to the applicable WC. If the referral authority objects to the application it must be refused by Council.

Under Section 173 of the *Planning and Environment Act 1987,* Council can require the preparation of a legal agreement. These agreements are often requested by Council or the WC when planning applications are located within a SWSC.

3.1.6 Public Health and Wellbeing Act 2008

The *Public Health & Wellbeing Act 2008* lists types of nuisances which may be dangerous to health or offensive; these nuisances include those arising from water or any matter which is dangerous to health or offensive, including wastewater.

Council has a duty under the Act to remedy as far as is reasonably possible all nuisances arising in the Shire, and it is an offence to cause or allow a nuisance to occur. Under the Act, Council must investigate all complaints relating to a nuisance or the illegal management of domestic wastewater and take action to rectify the nuisance where necessary.

3.1.7 Catchment and Land Protection Act 1994

The *Catchment and Land Protection Act 1994* requires a Catchment Management Authority (CMA) to prepare and implement a Regional Catchment Management Strategy, which includes:

- An assessment of long term requirements and the prioritisation of these requirements;
- Identification of threats to environmental, economic and soil values; and
- Identification of opportunities for improving natural resource management processes.

The Act empowers CMAs and defines their powers and functions. The developed strategy influences and informs planning processes. SWSC areas are declared under Schedule 5 of this Act, with planning applications referred to the relevant WC. The Act also requires property owners to take reasonable steps to protect the catchment, with particular regards to water resources, avoid soil disturbance, weed growth, and pests.

3.1.8 Victorian Building Regulations 2018

Under Part 8 Division 2 of the *Victorian Building Regulations 2018* (Building work in special areas), Regulation 132 (Septic tank systems) applies as follows:

1) The report and consent of the relevant council must be obtained to an application for a building permit that requires:
    a) The installation or alteration of a septic tank system; or
    b) The construction of a building over an existing septic tank system.
2) The report and consent of the relevant council need not be obtained to an application for a building permit referred to in sub-regulation (1) if a permit for the construction, installation or alteration of the septic tank system that is relevant to the application has been issued under Section 53M(5) of the *EP Act 2017*.

3.2 Regulatory Authorities

3.2.1 Macedon Ranges Shire Council

Under the *EP Act 2017*, Council is responsible for assessing permit applications; issuing permits for new and altered OWMS; monitoring of existing systems; and ensuring compliance with Council, EPA and policy / legislative requirements (as outlined in Section 3 of the Operational Plan). Council is responsible for all OWMS generating <5,000L/day. The legal requirements of Council include:

- Council must issue a permit to install / alter before an OWMS can be installed;
- Application for a permit to install / alter must be completed by the owner / builder / installer and submitted to Council for assessment;
- A Council officer assesses application and plans and conducts site inspections;
- Permit to install issued with approved plan and conditions;
- System must comply with permit conditions and relevant EPA Certificate(s) of Approval;
- System is inspected by a Council officer during installation; and
- Council must issue a certificate to use before the system can be operated.

In addition, Council can enforce upgrades of systems which are failing and potentially causing impacts to public health and the environment. This is discussed further in the Operational Plan.

3.2.2 EPA Victoria

EPA Victoria (EPA) regulate what types of OWMS are approved for use under the *EP Act 2017*. OWM treatment system brands and models will need to be certified by an accredited conformity assessment body as conforming to the relevant Australian Standard. This accreditation will be given by the Joint Accreditation System of Australia and New Zealand or any other accreditation body approved by the Authority (assessment body). The assessment body must certify the treatment system as conforming to the relevant Australian and New Zealand Standard. The appropriate standards for the different types of treatment systems is as follows:

- Septic tanks (and vermiculture systems) – AS/NZS 1546.1:2008, onsite domestic wastewater treatment units, Part 1: Septic Tanks.
- Waterless composting toilets – AS/NZS 1546.2:2008, onsite domestic wastewater treatment units, Part 2: Waterless Composting Toilets.
- Secondary treatment systems – AS 1546.3:2017, onsite domestic wastewater treatment units, Part 3: Secondary Treatment Systems.
- Domestic greywater treatment systems – AS 1546.4:2016, onsite domestic wastewater treatment units, Part 4: Domestic Greywater Treatment Systems.

EPA holds a register of the OWMS with valid Certificates of Conformance within Victoria, which can be found at:

Onsite wastewater treatment systems with valid certificates | Environment Protection Authority Victoria (epa.vic.gov.au)

The EPA has developed policies and Guidelines to regulate the use of OWMS. These include:

- EPA Victoria (2024), *Guideline for Onsite Wastewater Management* (GOWM, 2024); and
- EPA Victoria (2024), *Guideline for Onsite Wastewater Effluent Dispersal and Recycling Systems* (EDRS, 2024).

The EPA is responsible for the following activities related to wastewater management:

- Regulate the issuing of Certificates of Conformance for each OWMS type;
- Approval of commercial wastewater management systems with wastewater loading in the range of 5,000 – 100,000L/day (A03 Approval);
- Licencing commercial wastewater management systems with wastewater loading above 100,000L/day, and systems which discharge effluent to surface waters;
- Inspection of licenced commercial wastewater management systems and review of Annual Performance Statements for licenced commercial wastewater management systems;
- Compliance and enforcement activities for commercial wastewater systems;
- Developing policies and guidelines;
- Provision of technical advice to Councils, owners and installers; and
- Possible referral authority for subdivisions.

3.2.3 Victorian Building Authority

Formerly the Plumbing Industry Commission, the Victorian Building Authority licenses all plumbers, drainers and septic tank installers across Victoria; and regulates the installation of all plumbing works including internal plumbing works on septic tank systems.

3.2.4 Municipal Association of Victoria

The Municipal Associated of Victoria (MAV) has developed a model LCA report and procedures for undertaking an LCA, to assist land capability assessors and regulators. This has been developed in accordance with EPA Guidelines and *AS/NZS 1547:2012*. It is understood that a review of these LCA guidelines are currently underway.

3.2.5 Water Corporations

Water and sewerage services within the Shire are provided by Coliban Water and Goulburn Valley Water, with water also supplied by Goulburn-Murray Water and Southern Rural Water. This OWMP covers areas where reticulated sewer service is not provided by WCs.

WCs have an interest in protecting SWSCs that are susceptible to impact from OWMS. WCs are a statutory referral authority under the *Planning and Environment Act 1987* for planning applications in SWSCs throughout the Shire. Where specified development or subdivision is proposed within a SWSC, the proposal must be referred to the relevant WC for assessment prior to Council issuing a planning permit.

According to Clause 66 of the MRS Planning Scheme, there are two (2) types of referral authorities – a determining referral authority, which has the power to require a permit application to be refused or for certain conditions to be included in a permit, and a recommending referral authority, which can only comment on an application. Responsible authorities must consider the comments made by a recommending authority, but are not obliged to refuse the application or to include any conditions required by the authority. However, a recommending referral authority is able to seek a review at VCAT if it objects or it requests conditions that are not included by the responsible authority in the permit. WCs are listed as determining referred authorities within SWSC areas under the MRS Planning Scheme.

Where existing OWMS are located in an area that has sewer available, the WC can require the property be connected to sewer if the system is found to be causing a health or environmental risk.

3.2.6 Department of Energy, Environment and Climate Action

DEECA is responsible for the management of water resources, climate change, bushfires, public land, forests, and ecosystems in Victoria. DEECA may be consulted by Council for specialist advice where an OWMS may impact on land or water resources.

3.2.7 Catchment Management Authority

MRS falls within the Goulburn Broken Catchment Management Authority (CMA), Melbourne Water CMA and North Central CMA, and has a large catchment area for a number of different water resources. Where OWMS exist within sensitive catchments, close examination of a system, its operation and performance must be undertaken to ensure the protection of the asset. The CMA has policies and management tools to assist with the management of the waterways. The role of the CMA is:

- To ensure the sustainable development of natural resource based industries;
- To maintain and where possible, improve the quality of land and water resources;

- To conserve natural and cultural heritage;
- To involve the community in decisions relating to natural resource management within their region;
- To advise on matters relating to catchment management and land protection and the condition of land and water resources in the region; and
- To promote community awareness and understanding of the importance of land and water resources, their suitable use, conservation and rehabilitation.

3.3 Administrative Authorities

The Victorian Civil and Administrative Tribunal (VCAT) is a tribunal at which civil disputes, administrative decisions and appeals can be heard before a Judge or Tribunal Member. It provides a dispute resolution service for both government and individuals within Victoria.

In recent cases throughout Victoria, VCAT has questioned the quality of LCAs for OWM, particularly where a site is located within a SWSC. VCAT has also questioned the rigour of some Council's evaluation of these LCAs, and how the minimum development guideline of one (1) dwelling per 40 hectares should be applied in the SWSC.

3.4 Standards and Guidelines

3.4.1 EPA Victoria – Guideline for Onsite Wastewater Management (2024)

The EPA (2024), *Guideline for Onsite Wastewater Management* (GOWM, 2024) is a reference document designed to support the environment protection regulatory framework within Victoria. The guideline provides information on the minimisation of the risks to public health and the environment for OWMS within unsewered and sewered areas, as well as single or multi-dwelling premises.

3.4.2 EPA Victoria – Guideline for Onsite Wastewater Effluent Dispersal and Recycling Systems (2024)

The EPA (2024), *Guideline for Onsite Wastewater Effluent Dispersal and Recycling Systems* (EDRS, 2024) is designed to support the environmental protection regulatory framework, and contains guidance for best practice for the design and operation of an Effluent Dispersal System (EDS). This guideline is complementary to the GOWM (2024) document.

3.4.3 Municipal Association of Victoria & Department of Sustainability and Environment – Model Land Capability Assessment (2014)

The Municipal Association of Victoria & Department of Sustainability and Environment (2014), *Model Land Capability Assessment* (MAV & DSE, 2014) reflects the requirements of EPA Guidelines and also provides further details on in-soil effluent assimilation processes and their influence on system design. It is understood that these guidelines are currently being reviewed. Once published, the new document will take precedence.

3.4.4 Standards Australian / Standards New Zealand – *AS/NZS 1547:2012* Onsite Domestic Wastewater Management

AS/NZS 1547:2012 provides standardised guidance for the sizing, design and construction of EDS. If there is an inconsistency between *AS/NZS 1547:2012* and the current EPA Guidelines, the EPA Guidelines takes precedence. Where the current EPA Guidelines are silent on a topic, *AS/NZS 1547:2012* should be followed. *AS/NZS 1547:2012* will be used to inform the selection of a suitable EDS, and where the EDS sizing tables are not used, will inform the sizing of EDS.

3.4.5 Standards Australian / Standards New Zealand – AS/NZS 1546.1-2 Onsite Domestic Wastewater Treatment Units (2008)

AS/NZS 1546.1:2008- Part 1: Septic tanks:

Specifies performance requirements and performance criteria for septic tanks, technical means of compliance and provides test specifications that enable septic tanks to be manufactured to comply with the performance requirements and performance criteria.

AS/NZS 1546.2:2008 – Part 2: Waterless composting toilets:

Aims to: 1. Provide a set of performance statements that form a base against which any waterless composting toilet (WCT), conventional or innovative, may be assessed. 2. Provide manufacturers of WCTs with a performance evaluation test that will confirm the conditions under which it will function best. 3. Ensure that the operation and maintenance of the WCT is done in a safe manner that meets basic health requirements given that it involves the removal or composted or partially composted material.

3.4.6 Standards Australian – AS 1546.3-4 Onsite Domestic Wastewater Treatment Units (2016-2017)

AS 1546.3:2017 – Part 3: Secondary treatment systems:

Sets out the requirements for the design, commissioning, performance and compliance testing of secondary treatment systems and advanced secondary treatment systems designed to treat domestic wastewater up to 5,000L/day. Guidance on installation, operation and maintenance is also provided.

AS 1546.4:2016 – Part 4: Domestic greywater treatment systems:

Specifies requirements for the performance, design, installation and testing of domestic greywater treatment systems and associated fittings for single domestic dwellings where adequate backflow protection is provided in accordance with *AS/NZS 3500.1.*

3.4.7 Standards Australian / Standards New Zealand – AS/NZS 3500.1-4:2021 Plumbing and Drainage

The Plumbing and Drainage Standard *AS/NZS 3500.1-4:2021* must be complied with for the installation of all plumbing work conducted on site. Any design solution should be fitted and installed by a licensed plumbing contractor in compliance with the requirements of the Australian Standard (2021).

3.4.8 Department of Environment, Land, Water and Planning – Guidelines for Development in Flood Affected Areas (DELWP, 2019)

The Guidelines for Development in Flood Affected Areas (DELWP, 2019) provide an assessment framework and method to assist decisions on development proposals in flood affected areas. Floodplain management authorities have the discretion to vary from the Guideline to accommodate local floodplain issues. Any development proposal should consider these Guidelines, with the design solution to meet the current EPA Guideline requirements in relation to flood prone land.

3.4.9 Victorian Auditor General's Office – Managing the Environmental Impacts of Domestic Wastewater (2018)

The Victorian Auditor General's Office (2018), *Managing the Environmental Impacts of Domestic Wastewater* (VAGO, 2018) acts as further stimulus in reducing the number of failing septic tanks throughout Victoria.

There is a historical legacy associated with failing OWMS across the state which poses a threat to public health and the environment. An OWMS backlog program was generated, with rural Victoria falling under the Country Towns Water Supply and Sewerage Program (2005) initiated by DEECA. The audit focused on the management of domestic wastewater in high risk parts of metropolitan Melbourne (the Yarra Ranges and Mornington Peninsula).

The audit found that these areas were not adequately managing the individual and cumulative risk and impacts from poorly performing onsite systems due to information gaps about OWMS in high risk unsewered townships due to limitations in their risk assessment process.

The audit recommends the following for the mitigation of environmental impacts caused by OWMS:

- Develop and implement a data management plan to collect accurate information on the number, location, and performance of OWMS;
- Rolling annual program of compliance inspections;
- Develop an educational plan to inform property owners of their responsibilities and requirements to maintain and upgrade their OWMS as required; and
- Consult with WCs, EPA, DEECA and other key stakeholders in undertaking integrated water cycle management planning processes for their municipalities.

3.4.10 Department of Environment, Land, Water and Planning – Risk Assessment Guidance Report (2022)

In response to the VAGO (2018) report, DELWP developed the Risk Assessment Guidance report (DELWP, 2022) to assist Council's in the determination of OWM risk and to help standardise the development of OWMPs. The document provides "guidance for undertaking an OWMP risk assessment, including risk identification, analysis and evaluation components of the ISO 31000 risk management process". The document was published with a 'Risk Calculation' spreadsheet (DELWP Tool, 2022), which can be used to assess the cumulative risk of OWMS at the catchment scale.

3.4.11 Department of Energy, Environment and Climate Action – Planning Permit Applications in Special Water Supply Catchment Areas (DEECA, 2024)

The DEECA (2024), *Planning Permit Applications in Special Water Supply Catchments* (DEECA, 2024) outline the requirements for development in SWSC areas, where a planning permit is required to use land for a dwelling or to subdivide land or to develop land pursuant to a schedule to the Environmental Significance Overlay (ESO) that has a catchment or water quality protection as an object.

Policy 1 requires that the density of dwellings should be no greater than one (1) dwelling per 40 hectares and each lot created in a subdivision should be at least 40 hectares in area. The dwelling density is established by calculating the number of dwellings within a one (1) kilometre radius of the site of the proposed dwelling. The density requirement of Policy 1 does not apply where:

- Category 1: A permit is not required (i.e. outside of the SWSC area / ESO);
- Category 2: If the dwelling is connected to reticulated sewerage;
- Category 3: If the development is consistent with a Catchment Policy that has been prepared for the catchment and endorsed by the relevant Water Corporation following consultation with relevant stakeholders; and

- Category 4: The WC is satisfied that Council has prepared, adopted and is implementing an OWMP in accordance with requirements.

The preparation and implementation of this OWMP will allow MRSC to demonstrate that it has fulfilled the requirements of Policy 1. Once the Category 4 criterion is met, the WC has the ability to consider applications that would result in a higher density of development than would otherwise be permitted by Policy 1. In order to relax this density requirement, all conditions of Policy 1, as follows, are to be met:

- The minimum lot size area specified in the zone for subdivision is met in respect of each lot (for subdivision applications only);
- The WC is satisfied that the Council has prepared, adopted and is implementing an OWMP in accordance with the OWMP requirements; and
- The proposal does not present an unacceptable risk to the catchment having regard to:
  a) The proximity and connectivity of the proposal site to a waterway or a potable water supply source (including reservoir);
  b) The slope of the land;
  c) The quality of the soil;
  d) The existing lot and dwelling pattern in the vicinity of the site;
  e) The existing condition of the catchment and evidence of unacceptable water quality impacts;
  f) The link between the proposal and the use of the land for a productive agricultural purpose;
  g) Any site remediation and / or improvement works that form part of the application; and
  h) The intensity or size of the development or use proposed and the amount of run-off that is likely to be generated.

Items a-c are addressed through the Risk Analysis as detailed in Section 4.1 of the Operational Plan. Items d-e are addressed through the Cumulative Risk Assessment (CRA) component of the RAF or other methods as determined by the Council or WC. The remaining items (f-h) will be dealt with under other respective planning controls.

The preparation, adoption and implementation of an OWMP is required for the relaxation of Policy 1. Many of the items for compliance with Policy 1 will form part of the Operational Plan. These actions are identified in the OWMP and will result in the adoption of the OWMP by Council, and endorsement by the relevant stakeholders. Table 1 of the Operational Plan outlines how this will be achieved.

For the OWMP to be considered for endorsement by the WC, Council is also required to demonstrate that suitable resourcing for implementation, including monitoring, enforcement, review, and auditing is available.

A working / reference group comprising Council and WC delegates will be formed to discuss OWMS applications, ensuring that requests for information remain uniform, and to help ensure the implementation of this plan.

4 Overview of Onsite Wastewater Management

4.1 The Local Environment

Macedon Ranges Shire is located between Bendigo and Melbourne in the North Central region, and covers approximately 1,747km^2. The Shire is characterised by a unique environment including 13 SWSC areas (23 individual catchments) covering approximately 57% of the Shire (refer Section 4.1.1). The Shire encompasses four (4) defined river basins with the Campaspe River in the West and Maribynong River in the East, with small inclusions of the Goulburn River in the north and Werribee River in the south.

The Shire contains three (3) groundwater catchments, with the Campaspe catchment in the west and West Port Phillip Bay catchment in the east, with an inclusion of the Goulburn-Broken catchment in the north. There are three (3) Groundwater Management Areas (GMA) throughout the Shire, with the Central Victorian Mineral Springs GMA in the west, Lancefield GMA in the northeast, and West Goulburn GMA in the north and northeast.

The Shire's major urban centres are Gisborne and Kyneton, with smaller settlement areas of Lancefield, Macedon, Malmsbury, Mount Macedon, Riddells Creek, Romsey, and Woodend. Most development outside of these towns exists within small towns, the majority of which are unsewered.

The majority of the Shire consists of four (4) zonings; the Farming Zone in the east and north of the municipality, Rural Living and Rural Conservation throughout the centre, Public Conservation and Resource Zone the southwest, and Residential Zones throughout.

The diverse landscapes of the Shire present different opportunities and challenges for OWM. The constraints analysis (refer Section 6.2) describes in detail the different physical characteristics which are of most importance for sustainably managing treated effluent onsite, namely: climate, soils, slope, and useable lot area.

4.1.1 Special Water Supply Catchments

A number of waterways drain throughout the Shire, some of which enter the main drinking water supply for the Shire and surrounding regions. The active management of OWMS in these areas can help minimise any impacts on the surrounding environment. The following SWSCs are located in Shire:

1. Djerriwarrh;
2. Eppalock (Eppalock and Newham Parrish – Woodend East and West);
3. Gisborne-Sunbury (Barringo);
4. Lake Merrimu (Lake Merrimu, Goodmans Creek and Lerderderg River);
5. Lancefield (Deep Creek);
6. Macedon (Bawden Creek, Kitty English Reservoir, Stony Creek);
7. Mollison Creek (Pyalong);
8. Monument Creek;
9. Mount Macedon (Stony Creek and Turitable Creek);
10. Riddells Creek (Main Creek);
11. Romsey (Upper Bollinda Creek);

12. Rosslynne Reservoir (Jackson Cree and, Riddells Creek); and
13. Sunbury (Bollinda Creek, Cherlies Creek and Main Creek).

These SWSCs provide drinking water to supply systems that are managed by Coliban Water, Goulburn Valley Water, Goulburn-Murray Water and Southern Rural Water. The SWSCs are proclaimed under Section 5 of the *Catchment and Land Protection Act 1994*.

4.1.2 Soils

There is a variability of landforms within the Shire. The geology and inherent soils of the Shire are separated into three (3) distinct regions;

- Undulating Plains throughout the centre of the Shire;
- Small area of Stony Undulating Plains in the northwest in proximity to Metcalfe East; and
- West Victorian Dissected Uplands throughout the remainder of the Shire.

4.1.3 Climate

Climate, specifically rainfall and evaporation, plays a significant role in determining the appropriate loading rates of effluent and associated sizing of EDS. The Shire was found to consists of three (3) distinct climate zones based on the climate analysis detailed in Section 6.2.4. Higher rainfall combined with low evaporation in cooler months makes OWM problematic in certain areas. Areas of high rainfall are identified in higher elevation regions throughout the centre of the Shire, with low rainfall and high evaporation identified in the southwest. Moderate climate conditions are identified throughout the rest of the Shire.

4.1.4 Bushfire

Bushfire risk areas are not incompatible with OWM; however, bushfire risk has implications for planning town areas or allowing single dwellings, and can preclude residential intensification in certain areas. The requirements set out in Section 13.02 'Bushfire' of the Planning Scheme and Bushfire Management Overlay (BMO/WMO) overlay must be met.

4.2 OWMS and Trends in Macedon Ranges Shire

There are approximately 32,290 lots within the Shire as of September 2024. There are a total of 5,719 non-developable lots (i.e. Crown Land, National Park, State Forest, waterway or road, lots <400m^2) that were not included in the unsewered lot count and subsequent analyses. Therefore, there are a total of 26,571 developable lots within the Shire.

Areas which are currently sewered are Malmsbury, Kyneton, Woodleigh Heights, Tylden, Woodend, Macedon, Gisborne, Riddells Creek, Romsey and Lancefield, resulting in approximately 14,548 lots located within sewered areas. Therefore, there are approximately 12,023 unsewered developable lots which are not located within reasonable distance to a sewer, or to which no sewer connection exists.

Of those lots, there are approximately 8,000 OWMS registered on Council's permit management system (Pathway), with approximately 4,500 of these systems within SWSC areas. It is expected that there are a number of lots within the Shire which have OWMS which are unknown to MRSC, either constructed without a permit, before permits were required or where continuity of records has been interrupted during the amalgamation of the Shire in 1995. It is also expected that there are some lots with OWMS with permits which are not recorded in the Council's current record system. Therefore, all of these numbers are approximate.

Historically, greywater was managed separately to blackwater and permitted to discharge off-site. Council no longer permits off-site discharge of greywater; however, there will be a number of systems still operating in this manner. The majority of older systems include a conventional septic tank (typically cylindrical and laid horizontally) with conventional absorption trenches. These can operate effectively in many cases; however, they do require regular maintenance. Common practice with these systems in Victoria is to bury the septic tank underground. Thus, the septic tanks are often difficult to locate and many property owners cannot locate them.

This typically results in inadequate maintenance of the septic tank and in particular inadequate desludging. Without periodic desludging (every 3-5 years depending on occupancy), tanks become overloaded with solids and do not provide adequate residence time for effluent to enable suspended solids to settle out. These solids then carry over to the EDS (typically an absorption trench) and usually cause the soil to block up over time, causing failure of the trench and surcharge of effluent to the ground surface.

Newer systems installed in MRSC tend to provide higher levels of treatment through the use of AWTPs, sand filters or greywater treatment systems, and no longer discharge greywater separately. These systems provide secondary treatment of the wastewater before discharging to irrigation systems. These systems require more maintenance than a septic tank and servicing every three (3) months is a requirement for EPA approval.

5 Preliminary Data Collection

5.1 Data Acquisition

Geographic Information System (GIS) data, covering a wide variety of physical and planning components has been acquired. The primary sources of this data include the Department of Energy, Environment and Climate Action (DEECA) 'Datashare' portal, MRSC, Coliban Water, Goulburn Valley Water, Goulburn-Murray Water, Southern Rural Water, and the former Department of Sustainability and the Environment (DSE) / Department of Primary Industries (DPI).

The data obtained included: cadastre information (parcel / property), roads, Local Government Area (LGA) / locality / town boundaries, sewer network, OWMS information, topography, LIDAR, planning scheme zonings and overlays, hydrology / drainage, potable reservoirs / offtake points, climate data (including rainfall), flood prone land (land subject to inundation), 1 in 100 year annual recurrence interval (ARI) (1% AEP) flood level, soil units, lithology / land system information, groundwater bore locations / information, and SWSC boundaries. All data is up to date as of September 2024. Some of the data, in particular the land system data, was used in the development of the 2013 DWMP. The GIS data was used for the development of individual constraint and informative maps of the Shire. This information provided a comprehensive basis for the Risk Analysis.

5.2 Lot Characterisation

Using cadastral data supplied by the Council, the analysis identified approximately 32,290 parcels within the Shire. Parcels were used for the risk assessment analysis mapping. The cadastre which consists of parcels is commonly referred to as 'lot(s)' throughout the OWMP, whereas property is used when discussed in terms of ownership.

All non-developable lots (5,719 lots), such as Public Land Management, Crown Land, Crown Land Roads, and Parks and Reserves, were not included in the unsewered lot count and subsequent analyses. Parcels that were less than 400m^2 were also excluded from the analysis as they represent an area too small to sustainably accommodate both development (including a building and associated improvements) and OWM. These lots most likely represent Council or utility easements.

The areas which currently have sewer available are Malmsbury, Kyneton, Woodleigh Heights, Tylden, Woodend, Macedon, Gisborne, Riddells Creek, Romsey and Lancefield, resulting in approximately 14,548 sewered lots that were excluded from further analysis.

Based on the raw dataset, and the exclusions described above, there are approximately 12,023 unsewered developable parcels which are not located within a reasonable distance to a sewer (or are yet to connect to sewer if they are located within the sewered districts), or to which no sewer connection exists; although it is not known how many of these are developed.

Some discrepancies may be found between other published total parcel numbers and those used, due to issues associated with lot amalgamation and subdivision over time and the current version of cadastre provided by the Council. The cadastre data set used in this analysis will be progressively updated by Council to include the changes made to the parcels within the Shire overtime.

6 GIS Data Analysis

6.1 OWM Constraint Mapping

6.1.1 Methodology and Rational

The following algorithm was developed using professional judgement and reviews of current literature. The algorithm generally follows the rationale developed for the Mansfield Domestic Wastewater Management Plan Pilot Project (Mansfield Shire Council, 2014); with adaptation by W&A to reflect specific concerns in the Shire. It details how the individual constraints were combined to determine the final Risk Rating for each unsewered lot within the Shire:

((Soil Suitability + Slope) x ((2 x Useable Lot Area) + Climate)) / 10

The algorithm incorporates the constraints imposed by landform and soil characteristics, as well as the local climate which will impact on the selection and sizing of OWMS for any given location. Detail on the individual constraints at outlined in the following Sections.

The final risk value (number) derived from the algorithm for each lot was assessed to determine the appropriate 'Risk Rating' ranges. The following outlines the respective ranges and associated final Risk Rating classes:

- Very High: > 5.5;
- High: 4 ≥ and ≤ 5.5;
- Moderate: 2 ≥ and < 2; and
- Low: < 2.

These values were determined via a statistical analysis of the constraint parameters, based on assessment of the worst case and best case combination of site and soil conditions.

Further, all lots were identified as being located within, or outside, a SWSC area. This step was included to ensure that all lots located within SWSC areas are subject to an LCA prior to development as per Policy 1 of DEECA (2024), *Planning Permit Applications in Special Water Supply Catchment Areas*. For example, for a 'Low Risk' Rating lot within a SWSC area, the algorithm automatically increases the risk rating to 'Moderate Risk' to ensure that an LCA is undertaken.

6.1.2 Constraint Classification Framework

For each of the constraints, the degree of constraint in relation to OWM for all lots within the Shire was assessed and individually assigned a constraint class that is then used as an input into the Risk Analysis. The criteria used to determine constraint categories were based on previous constraint assessments for unsewered towns in Australia undertaken by W&A and relevant Australian and Victorian guidelines for OWM.

Table 1 provides a rationale for the interpretations used to derive the risk ratings. The ratings give guidance towards the OWM requirements as stipulated by Council. For existing OWMS, the level of constraint may reflect the level of challenge that has been experienced in managing the system. This information will provide a guide in the ongoing management of systems.

Table 1: Rationale for OWM Constraint Ratings

Risk Rating	Description
Very High	Constraints are present at a very high level and this significantly restricts opportunities for sustainable OWM. Traditional primary treatment systems (i.e. septic tanks and trenches) are not appropriate and a detailed land capability assessment would be required to determine if OWM is achievable at all. If achievable, specialised, advanced treatment and EDS may be required to overcome the identified constraints.
High	Constraints are present at a high level and this substantially restricts opportunities for sustainable OWM. Traditional primary treatment systems are not likely appropriate and an LCA may be required to determine if they are supported. Otherwise, advanced treatment and EDS may be required to overcome the identified constraints.
Moderate	Constraints are present at a moderate level and this limits the range of OWMS options that are appropriate for the lot. An LCA may be required to identify the most appropriate OWMS solution, along with any mitigation measures to be employed.
Low	Constraints are present at a low level and are unlikely to substantially limit opportunities for OWM. In most cases appropriately designed and managed traditional systems will be accepted.

6.2 Wastewater Management Constraints

The individual constraint maps were created using GIS, specifically QGIS™, which applied constraint classes for a number of built constraints and land capability constraints, including site and soil parameters.

Five (5) constraints were selected, which when consolidated, contribute to assessing the overall land capability for OWMS, and were used as an input into the Risk Analysis. These were selected based on the availability of digital data, and in the light of experience gained in designing and auditing OWMS. The constraints selected were:

- Soil Suitability;
- Surface Slope;
- Useable Lot Area;
- Climate; and
- Location (within SWSC areas).

Thematic informative maps were generated for each OWM constraint. The maps have been produced for use at a broad scale (~1:220,000) and the limitations of the data used in the creation of these maps for input in the Risk Analysis must be recognised and is detailed in Section 4.3 in the Operational Plan.

The risk bandings for each constraint have been informed by Table 3-2 of DELWP (2022). Where risk bands are modified to address specific constraint parameter characteristics, they have been inferred from relevant guidelines and W&A experience. All constraints range from Low to High Risk, with useable lot area the only constraint to contain a Very High Risk rating.

6.2.1 Soil Suitability

Geology was used as a reference towards the understanding of the soil and landform characteristics of the Shire. The soil type and its absorption capabilities refer to effluent treatment quality and the type of wastewater system. Soil that is not suitable for effluent treatment may be ideal for other uses (such as agriculture).

Soils and landform elements, along with associated lithology, play a vital role in the design, operation and performance of OWMS. Key soil properties can be evaluated to assess a soil's capacity for the absorption of wastewater, including soil texture, structure, depth, permeability, drainage characteristics, and depth to limiting layers such as bedrock, hardpan or watertable.

The surface geology of the Shire is shown in Figure A1, with geological units based on the 'Surface Geology of Victoria' dataset (1:250,000) obtained from GeoSciences Victoria (DEPI, 2011). The Shire is underlain by 55 different surface lithological groups, highlighting the variability of landforms within the Shire. The Shire consists of granites / gneisses in the north, with metamorphic rock in adjacent areas. There are inclusions of basaltic rocks in the north and east, with rhyolite in proximity to Mount Macedon. Sedimentary rocks make up the remaining areas of the Shire.

Soil landform data 'Lsys' (DPI, 2006) were used in the soil suitability constraints analysis. There were 32 different soil landform units identified within the Shire. Figure A2 of Appendix A thematically identifies the different soil landform units and their associated locations. Refer to the accompanying land system reports for additional detailed descriptions on each of the soil landform units[1].

It is important to note that soil landform units are not homogeneous. Further, soil attributes are expected to vary within soil landform units due to the mapping at this scale. Due to the degree of variances within each soil landform unit (e.g. due to the soil catena), the soil characteristics of the most dominant landform element proportion (e.g. greatest percentage) were used as a representation for that soil landform unit. Site specific investigations are required to confirm the broad scale assessment of the soil landform units, as the presence of a minor soil landform component could result in varying attributes to the predominant component used for the soil suitability constraint analysis.

The soil landform unit dataset was analysed to determine the key soil attributes that relate to soil suitability for OWM. There is a significant inter-relationship that exists between various soil attributes, resulting in depth, hydraulic and limitation hazards used to assess the final soil suitability with the Shire. The degree of constraint, or constraint class, was assigned to each soil landform unit within the Shire based on available data and the professional judgement, skills and experience of the project team.

The depth constraint of the soil was based on the depth of the soil profile to the limiting horizon (i.e. hardpan, groundwater, bedrock) for each soil landform unit. The depth constraint classes were determined based on the minimum depth requirements for sustainable OWM and considering the minimum separation requirements of 600mm (*AS/NZS 1547:2012*) from the base of the EDS to the limiting layer. This benchmark depth was based on the most constraining EDS, in terms of depth, being absorption systems (trenches and beds). Soil absorption systems require 0.3m – 0.6m depth from the surface for utilisation and also need to adhere to the minimum 0.6m separation to the limiting layer requirements. Therefore, the minimum depth required for the sustainable installation of an absorption system is approximately 1m depth, based on an absorption system at 0.4m depth. Greater depths of unsaturated soil provide increased treatment of effluent and reduced potential for lateral water movement.

The hydraulic constraint of the soil was determined based on limiting soil texture, structure and permeability. An OWMS should be sized according to the most limiting soil horizon to ensure that an appropriate effluent loading rate is applied. In most cases, this will be the subsoil horizon as

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[1] https://vro.agriculture.vic.gov.au/dpi/vro/vrosite.nsf/pages/landform_land_systems_vic

the soils within the Shire predominantly consist of gradational and texture contrast soils with clay subsoils. The constraint criterion for the hydraulic hazard parameter was based on the soil category of the limiting soil horizon for each soil landform unit. Indicative permeability was taken from Table 4-8 of GOWM (2024), but this may be superseded if in-situ permeability testing data can be provided.

A limitation constraint of the soil was also considered, which was based on qualitative descriptions provided within the individual soil landform unit reports. The limitations include both physical and chemical characteristics of the soil. Soil limitation is difficult to quantify, as most limitations can be overcome by amending the soil or introducing a management practice. The following limitations were considered with regards to OWM; waterlogging, mass movement, compaction, drainage, acidity, water erosion and wind erosion.

A significance weighting was applied to each of the soil constraint parameters to reflect the influence that each parameter has on the design, construction and operation of OWMS. The significance weighting was determined through discussion with project team members and coordination with the Stakeholder Working Group. The following significance weightings were applied:

- Depth Hazard: 1.2;
- Texture Parameter: 1.4;
- Structure Parameter: 0.8;
- Indicative Permeability Parameter: 1.0;
- Limitation Hazard: 0.6.

Where soil landform unit information was not available or was incomplete, the characteristic was conservatively inferred using professional judgement and available information. Most importantly, some of the soil landform units associated with the targeted localities were cross referenced with site and soil investigations (ground truthing) undertaken by W&A. Generally, the observed soil characteristics were the same as the literature documented in Lsys250.

Although the soil suitability constraint for a particular soil landform unit may be high, it does not necessarily mean that wastewater could not be sustainably managed onsite. It gives guidance to the loading rate and type of system(s) that could be suitable. It is important to note that site specific investigation is still necessary to confirm the regional constraint assessment and to determine the appropriate method for sustainable OWM.

The overall soil risk was based on the combined (depth, hydraulic and limitation) constraint parameters, with the previously discussed significance weighting applied. Risk bandings were based on a statistical analysis of soil variability.

The following criteria were used to determine the OWM constraint classification, based on the total soil suitability value:

- High: Value of >13;
- Moderate: Value of 9 – 13; and
- Low: Value of <9.

The soil suitability for lots within the Shire predominantly resulted in Moderate to High Risk ratings due to the presence of clay subsoils.

For lots constrained by unfavourable soil, it may be possible to mitigate the limitation by:

- Secondary treatment;
- Apply a lower (soil) loading rate; or
- Improving soil by amelioration or importation of good quality soil.

The associated Soil Suitability constraint map for the Shire is provided as Figure 1. A summary of soil risk throughout the Shire has been presented in Table 2.

Table 2: Soil Risk

Risk Rating	Count
High	7,775
Moderate	4,248
Low	0

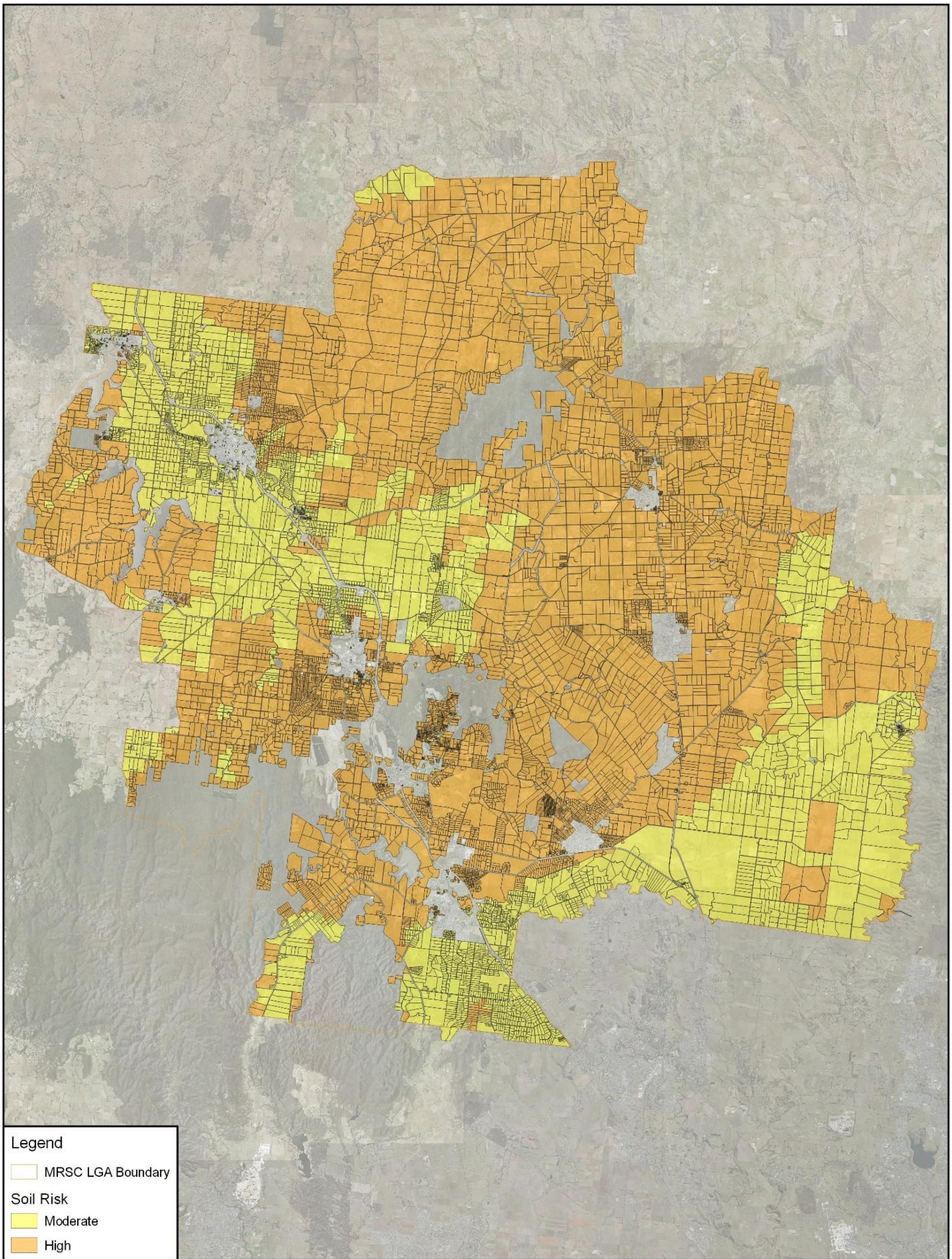

Figure 1: Soil Risk

MRSC OWMP 2025 - 2030

Whitehead & Associates Environmental Consultants	0 5 10 15 20 km (Approx Scale)	Revision	001
		Drawn	CM
		Approved	MS

6.2.2 Slope

The slope of the land affects what type (or whether you can have) any effluent disposal on the land. This is closely linked to the soil type and the absorption capabilities. *AS/NZS 1547:2012* (Table K1) details a range of factors likely to limit the selection and applicability of EDS, with slope gradient identified as one critical factor.

Steep slopes, particularly when combined with shallow or poorly drained soils, can lead to surface breakout of effluent downslope of the EDS. Conventional OWMS are likely to be unsuitable and these lots will require a detailed site assessment and specific system design to produce a sustainable outcome. These steeply sloping sites are generally unsuitable for absorption systems, and can also be problematic for surface irrigation techniques. Conversely, flat and gently sloping sites are less likely to experience such problems and are considered lower risk.

A 10m Digital Elevation Model (DEM) was obtained from the 'Elvis Elevation and Depth' website, which has been sourced as 'Vicmap Elevation' RASTER layer. Surface elevation for the Shire was gridded with a maximum cell size of 10m for the entire Shire, with no vertical exaggeration to create a DEM as shown in Figure A3 of Appendix A. The surface elevation for the Shire ranges from approximately 156m to 1,003m Australian Height Datum (AHD). Gridded slope data was derived from the DEM, as shown in Figure A4, and combined with the cadastre data set to calculate the average slope as percent grade for each lot within the Shire. The slope constraint was based on the average slope of each lot, with the slope ranging from 0 – 119% for the Shire. The most significant slopes are identified in the southwest and central regions of the Shire.

The following criteria were used to determine the OWM constraint classification on the average lot slope:

- High: Lot slope of >10%;
- Moderate: Lot slope of 6% – 10%; and
- Low: Lot slope of <6%.

For lots constrained by steep slope, it may be possible to mitigate the limitation by:

- Applying a lower soil (effluent) loading rate over a larger area;
- Designing an irrigation system to ensure even distribution of effluent over the slope; or
- Terracing to create a level EDS.

The associated Slope constraint map for the Shire is provided as Figure 2. A summary of slope risk throughout the Shire has been presented in Table 3.

Table 3: Slope Risk

Risk Rating	Count
High	2,795
Moderate	2,742
Low	6,486

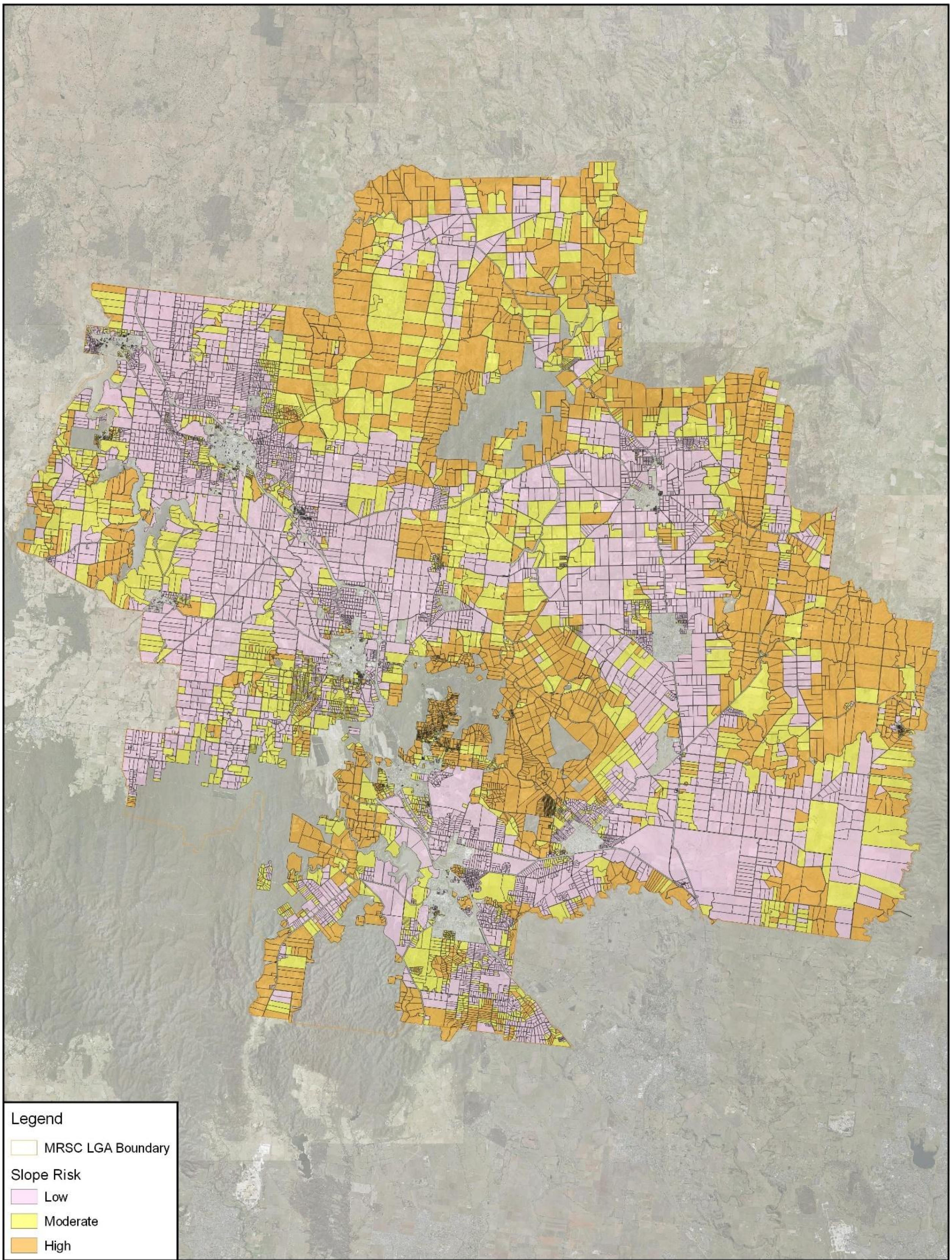

Figure 2: Slope Risk

MRSC OWMP 2025 - 2030

Whitehead & Associates Environmental Consultants	0 5 10 15 20 km (Approx Scale)	Revision: 001
		Drawn: CM
		Approved: MS

6.2.3 Useable Lot Area

The potential for sustainable OWM and the determination of suitable OWMS options is dependent on the amount of adequate area available for OWM. This useable lot area for effluent management broadly refers to available area (i.e. not built out or used for a conflicting purpose) where OWM will not be unduly constrained by site and soil characteristics.

The smaller the lot, the more difficult it is to treat and retain wastewater onsite in accordance with legislative requirements. A properly sized EDS provides for long-term, sustainable effluent loading rates that match the assimilative capacity of the soil and vegetation systems. Conversely, improperly designed or undersized EDS are more likely to fail and lead to potential adverse impacts on public health and the environment. In recent years, understanding of sustainable effluent loading rates has improved and it is now commonly identified that many older existing systems, such as septic tanks and absorption systems, are undersized by today's standards.

Useable lot area, irrespective of total lot size, plays a key role in determining a lot's capacity for sustainable long-term OWM and influences the selection of appropriate OWMS. However, as a general rule, the smaller the lot, the less land that will be available for effluent management after allowing for other development on the land. Older development controls and design standards did not always consider site-specific land capability constraints and, as a consequence, many existing and vacant residential lots may be too small to accommodate sustainable OWMS, particularly by today's more informed standards.

There is no defined rule about what constitutes an appropriate minimum effluent management area, or in fact minimum useable lot area that is capable of providing such areas. This will vary depending on the physical constraints present on the lot, the nature of the development, as well as the type of treatment and EDS used. The constraint class boundaries reflect the likelihood of a lot having sufficient effluent management area available after allowing for typical improvements.

There are many factors that determine the available area on any given lot, including:

- Maintenance of appropriate setback buffers from lot boundaries, buildings, driveways / paths, groundwater bores, dams, and waterways; and
- Total development area (including the dwelling, sheds, pools, driveways and garden paths, gardens unsuitable for effluent reuse, and any other hardstand areas, etc.).

Available areas may be unsuitable or constrained for OWM due to other factors, including (but not limited to):

- Excessive slope;
- Shallow soils;
- Heavy (clay) soils with low permeability;
- Climate in regards to the degree of soil moisture surplus;
- Excessively poor drainage and/or stormwater run-on; and
- Excessive shading by vegetation.

For this study, useable lot area was determined by the setbacks to surface waterways, groundwater bores and land subject to inundation. The following sections detail the methodology and results for each analysis and the determination of the final useable lot area.

6.2.3.1 Proximity to Surface Waters

This section seeks to explain how the distance to surface water features (waterways, lakes, dams, and drinking water catchments) influences the useable lot area which forms part of the constraint mapping. This is of particular importance for lots within SWSC areas.

The Shire is located in the North Central CMA in the west, Melbourne Water CMA in the east and an inclusion of the Goulburn Broken CMA in the north. The Shire is made up of four (4) river basins; Campaspe River in the west, Goulburn River in the north, Maribynong River in the east and Werribee River in the south.

A large portion (57%) of the Shire is located within SWSC areas, with 13 SWSCs located across the Shire (refer Section 4.1.1 of this Technical Document). These SWSC areas are detailed on the proximity to surface waterways informative map in Appendix A as Figure A5.

Setback distances are usually provided between EDS and sensitive receptors such as surface watercourses to help prevent adverse impacts on water quality, particularly should the OWMS fail. There is no simple and defined method for objectively determining safe buffer distances, so regulators often recommend conservative, minimum setback distances that would be expected to satisfy the objective in the majority of situations.

The GOWM (2024) recommends two (2) tiers of setback distances from surface waterway, based on their location within or outside a SWSC area. Further, the GOWM (2024) specifies differing setback distances for primary (i.e. septic / trench) systems and secondary (or greywater) systems. The following (primary) setbacks have been conservatively adopted and applied to the appropriate surface watercourse / waterway using data (1:25,000 scale) obtained by the DEECA 'Datashare' portal.

- 60m for waterways[2], wetlands, estuaries, dams, reservoirs, and lakes outside of SWSC areas (including the mean coastal high-tide mark and dams);
- 100m for waterways, wetlands, estuaries, dams, reservoirs, and lakes within SWSC areas; and
- 300m for dams, lakes, and reservoirs within SWSC areas.

300m setbacks, similar to those applied for potable reservoirs, were also applied to the WC source points (i.e. offtake points) to ensure that the sensitivity of these local environments are accounted for. No setbacks were applied to man-made drains or waterfalls, which would likely be accounted for within other watercourse / waterway setbacks.

Intuitively, the risk of OWMS impacting on nearby receiving areas increases with decreasing separation distance. For a broad-scale risk assessment, it is appropriate to analyse the separation distances that are available on a lot by lot basis and assign constraint classes accordingly.

AS/NZS 1547:2012 details instances where recommended setbacks from sensitive receptors can be relaxed to accommodate certain types of systems where standard buffer distances cannot be achieved. These systems would require individual assessment and design in order to meet the requirements of *AS/NZS 1547:2012*.

[2] It should be noted that the surface water map does not distinguish between permanent and intermittent watercourses. Diversion channels have been defined as a watercourse for this particular purpose.

For lots constrained by proximity to surface waters, it may be possible to mitigate the limitation by:

- Upgrading to secondary treatment; or
- Relocating the EDS to increase buffer distance.

6.2.3.2 Proximity to Groundwater Bores

This section seeks to explain how the distance from OWMS to groundwater bores can affect the quality of groundwater.

The principle groundwater resources in Victoria fall south of the Great Dividing Range and are generally contained in Tertiary or younger unconsolidated sediments. The Shire is located across three (3) groundwater management basin: Campaspe in the west, West Port Phillips Bay in the east and Goulburn-Broken in the north. There are two (2) groundwater basins within the Shire, with the Campaspe in the west and West Port Phillips Bay in the east.

A Groundwater Management Unit refers to either a Groundwater Management Area (GMA) or Water Supply Protection Area (WSPA) as determined within the groundwater catchment. A GMA is defined as an area where groundwater of a suitable quality for irrigation, commercial or domestic and stock use is available or expected to be available. There are three (3) GMAs located within the Shire: Central Victorian Mineral Springs GMA in the west; Lancefield GMA in proximity to Lancefield; and West Goulburn GMA in the north. No WSPAs are identified within the Shire.

The location of EDS in close proximity to groundwater bores increases the potential for contamination of groundwater. When water is extracted from the groundwater bores a zone of influence is created, whereby the head level of the groundwater is altered. Setbacks are recommended between EDS and groundwater bores. The GOWM (2024) recommends a 50m setback (for Category 1 and 2a soils) and 20m setback[3] (for Category 2b to 6 soils) be maintained from such resources to protect public health. A conservative approach was taken when developing this OWMP and a setback distance of 50m was used for domestic groundwater bores within the Shire.

The spatial data of the domestic groundwater bore locations within the Shire was provided by MRSC. Using GIS, the recommended groundwater setback was applied to all domestic bores within the Shire. There are a total of 1,493 domestic groundwater bores identified within the Shire. The resultant map is appended as Figure A6 in Appendix A.

As previously mentioned, *AS/NZS 1547:2012* details instances where recommended setbacks can be relaxed to accommodate certain types of systems where standard buffer distances cannot be achieved. In most cases, the preferred result would be to have the identified bores condemned and capped to prevent further use, negating the need for setbacks from these resources. However, it is acknowledged that this outcome would not be acceptable to some owners who utilise the resource.

For lots constrained by proximity to domestic groundwater bores, it may be possible to mitigate the limitation by:

- Upgrading to secondary treatment (AWTP or sand filter); or
- Relocating the EDS to increase buffer distance.

[3] For secondary sewage and greywater effluent.

If the soil is saturated and the groundwater depth is shallow, then there is a greater possibility of contaminating groundwater and increasing surface water runoff. This is particularly important in selecting the type of OWMS.

The depth to groundwater has direct implications on future development opportunities and can constrain the use of an OWMS. The location and type of EDS that can be installed on an individual lot will be limited by the depth to groundwater at the site.

If applied effluent moves into saturated soils, i.e. shallow groundwater located beneath an EDS, then potential contamination of the groundwater, aquifer and / or surface waters could occur. Saturated subsurface conditions are considered to be the most conducive to pathogen transport.

The EPA Guidelines states that a minimum depth of 1.5m must remain between the base of the EDS and the seasonal watertable. The greatest depth to groundwater from the natural ground surface would be required for trenches and beds, which are generally built to 0.5-0.6m depth. Therefore, the minimum required depth to groundwater from the natural ground surface would be 2.1m. If this setback cannot be maintained, a detailed OWMS design would be required. This calculated minimum depth to groundwater vertical setback distance is conservative; however, soil type would be the defining characteristic. For example, if the soil beneath the base of the EDS is sand, then the associated hydraulic conductivity would be high, with treated effluent reaching the groundwater table at a much quicker rate than if the soil was clay. Therefore, site specific OWM design is required in regions where the depth to groundwater may be an issue, and the appropriateness of the required vertical setback distance to groundwater will need to be assessed.

Due to the constraints of this study, no groundwater depth information was obtained. The depth to groundwater will need to be assessed on a site-by-site basis during the relevant LCA. Information on the groundwater depth can be obtained from the Water Management Information System (WMIS) Database Interface as managed by DEECA, which contains time-series monitoring data as part of the State Observation Bore Network (SOBN). Large scale groundwater depth mapping can be obtained via the ‘Visualising Victoria’s Groundwater’ website.

For lots constrained by groundwater depth (shallow groundwater), it may be possible to mitigate the limitation by:

- Upgrading to secondary treatment (AWTP or sand filter) followed by subsurface irrigation; or
- Increasing the vertical separation between point of effluent application and the watertable using a ‘raised’ EDS design (e.g. sand mound).

6.2.3.3 Land Subject to Inundation

The OWMS, including any tanks, fields or trenches should be sited above any land subject to inundation.

Land that is subjected to frequent or intermittent inundation by floodwater has a significantly higher constraint for effective OWM. Effluent management areas should not be located within flood prone regions as floodwaters have a higher probability of inundation leading to insufficient treatment of the effluent and an increase in potential environmental and public health risks.

Flood prone land, in the case of this OWMP, is defined as land that is subject to inundation based on the 1 in 100 year flood level that delineates the areas likely to be inundated through statistical modelling or as determined by the floodplain management authority. Land subject to inundation was removed from the useable lot area.

It may be possible to mitigate the lots constrained by flood prone land by:

- Secondary treatment with an AWTP or sand filter;
- Use pressure compensating subsurface irrigation; or
- Raise level of effluent application by constructing a raised EDS.

6.2.3.4 Useable Lot Area Analysis

The cadastre data set supplied by Council was queried to determine the spatial relationship between each parcel and its existing size and the buffer zones (cohesively) to determine the useable area for each parcel within the Shire; whether developed or not. The following criterion was used to determine the useable area classification with regards to OWM suitability:

- Very High: Useable lot area <0.4ha;
- High: Useable lot area ≥0.4 - <2ha;
- Moderate: Useable lot area ≥2 – <10ha; and
- Low: Useable lot area ≥10ha.

Lots containing less than 0.4ha of useable area invariably have a limited available effluent management area, so OWM contained entirely onsite is in most cases unsustainable. Site specific hydraulic design for wastewater management may be necessary. If OWM is to be provided, it will be necessary to provide a high level of treatment and specialised EDS design using systems such as sand mounds or pressurised subsurface irrigation, to ensure long term sustainability. Other mitigation measures like the adoption of water conserving practices will be important in ensuring the system's effectiveness. Such systems are likely to have limited opportunity for expansion, as may be required if the household wastewater load changes in response to increased occupancy, or if a new reticulated water supply becomes available. It should be taken into consideration that a lot with <0.4ha of useable land will not necessarily be totally unsuitable for OWM or currently be serviced by a failing system; however, it is likely to contain a number of significant limitations to the safe operation of OWMS assessed at a broad scale.

In the case of lots with useable areas between 0.4ha and 2ha, and in the absence of any other significant physical constraints, the availability of land for effluent management usually increases proportionately with a corresponding improvement in the potential for sustainable OWM. The choice of options is likely to be slightly greater than that available for lots with useable area less than 0.4ha; however, detailed site and soil investigation is still important to identify the most appropriate solution as other bio-geophysical constraints may limit opportunities for sustainable OWM. Again, conventional systems may not be appropriate for these sites.

In most cases, lots larger than 2ha will have far fewer problems providing sufficient space for sustainable OWM. Overall constraint for OWM for these lots will be determined by the land capability constraints.

For lots constrained by useable area, it may be possible to mitigate the limitation by:

- Upgrading to secondary treatment (AWTP or sand filter);
- Secondary treatment with effluent dispersal to trenches at higher loading rates as outlined in *AS/NZS 1547:2012*; or
- Increasing loading rate by use of sand mound.

The associated Useable Lot Area constraint map for the Shire is provided as Figure 3. A summary of useable lot area risk throughout the Shire has been presented in Table 4.

Table 4: Useable Lot Area Risk

Risk Rating	Count
Very High	2,649
High	3,485
Moderate	3,444
Low	2,445

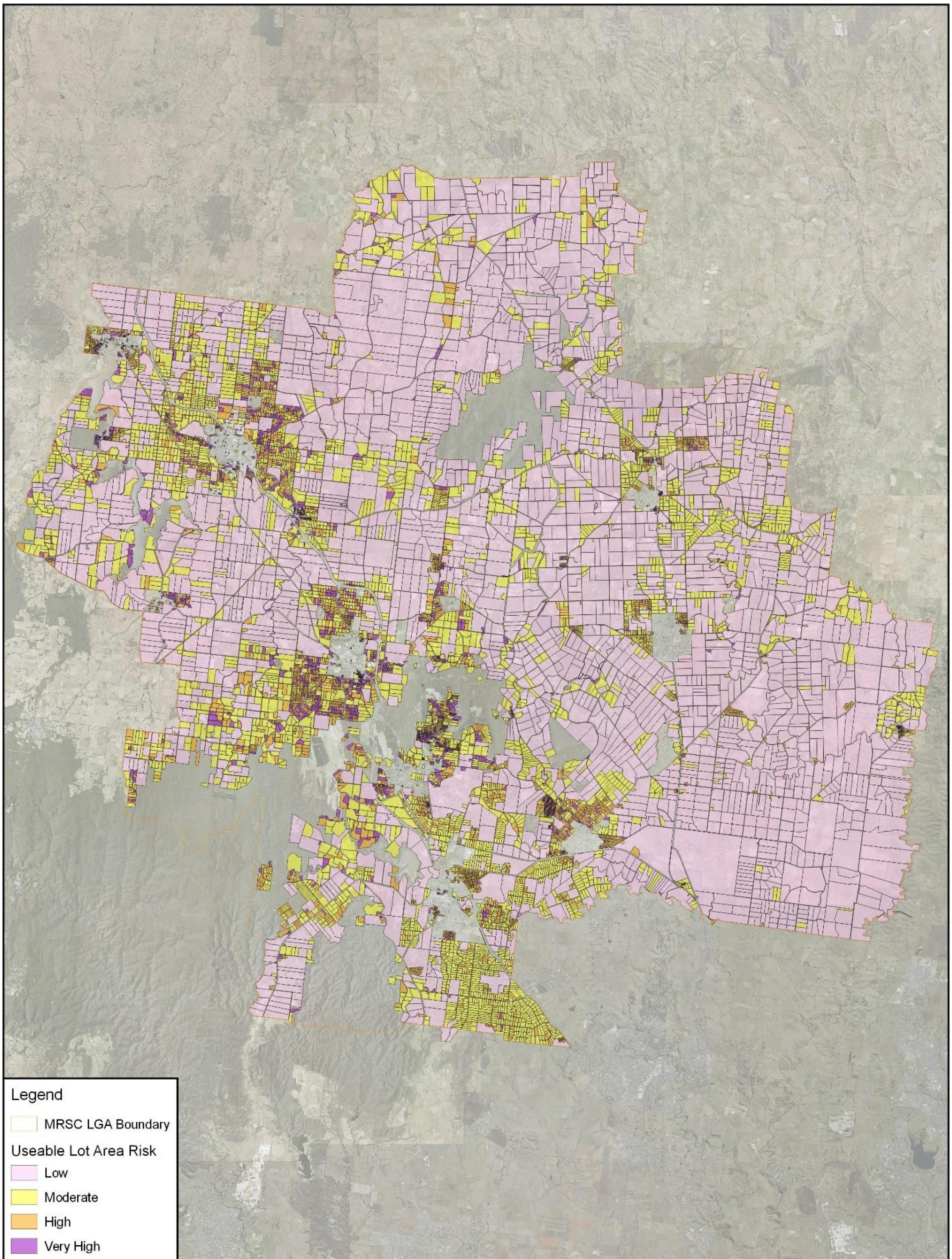

Figure 3: Useable Lot Area Risk

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Whitehead & Associates Environmental Consultants	0 5 10 15 20 km (Approx Scale)	Revision	001
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6.2.4 Climate

Climate plays a significant role in determining the appropriate loading rates of effluent and associated sizing of EDS. The climate feature of most interest in the Risk Analysis is the excess of rainfall over evaporation, which is denoted as "moisture surplus". Moisture surplus can result in surface runoff, increase in soil moisture storage (up to saturation point) and increasing deep infiltration to groundwater.

Climate data was obtained from the Scientific Information for Land Owners (SILO) Data Drill. SILO is a climate and meteorological data service developed and hosted by the Queensland Government, which provides representative data for the entire continent, produced using real climate data collected over long time periods by the BoM. The service provides a realistic representation of a broad range of climate statistics (including rainfall and evapotranspiration) for areas which are not serviced by local BoM stations.

Monthly rainfall and potential evaporation data for 122 SILO data points at approximately 0.05 degree (~4.4km) grid spacings was collected for the Shire. Figure A7 shows the rainfall distribution pattern throughout the Shire, based on the annual median rainfall for each data point. Figure A8 shows the potential evaporation distribution patter throughout the Shire, based on the annual average evaporation for each data point. Each dataset was interpolated using GIS across the Shire to produce a grid with approximately 50m cell size. The data is considered to be a realistic representation of climate patterns throughout the Shire on a long-term basis, suitable for use in OWM investigations and designs.

For each SILO data point for each year, the monthly water 'excess' totals were calculated by subtracting the total monthly rainfall from total monthly potential evapotranspiration. When a water excess occurs within any given month, the rainfall exceeds the evaporation, resulting in meteorological water being retained within the soil profile. From this, the total number of 'wet' months for each year were calculated and the median taken for each SILO data point. The number of 'wet' months has been gridded and the interpolated values have been converted to the nearest integer. The distribution of the number of 'wet' months throughout the Shire is shown in Figure A9. From this, three (3) distinct Climate Zones were identified based on the number of months where rainfall exceeds evapotranspiration and were categorised as detailed in the following. Each lot within the Shire was assigned to a Climate Zone as shown in Figure A9.

- Climate Zone 3 (High): >5 soil moisture surplus months per year;
- Climate Zone 2 (Moderate): 3 – 5 soil moisture surplus months per year; and
- Climate Zone 1 (Low): <3 soil moisture surplus months per year.

A lot is assigned as the Climate Zones that comprises a majority of the parcel. Figure 4 and Table 5 details the results of the Climate Zone constraint analysis for the Shire.

It is noted that higher rainfall areas are identified in to the north of Mount Macedon and the southwest of the Shire, with moderate rainfall throughout the rest of the municipality. Low rainfall is identified in the southeast of the Shire. The acquired climate data obtained for the analysis is available to Council and will provide a useful resource in the preparation and review of LCAs in the future. Climate data used in the development of the System Sizing Tables (refer Appendix B) is available as Appendix C.

Table 5: Climate Zone Risk

Risk Rating	Count
Climate Zone 3 (High)	4,165
Climate Zone 2 (Moderate)	7,018
Climate Zone 1 (Low)	840

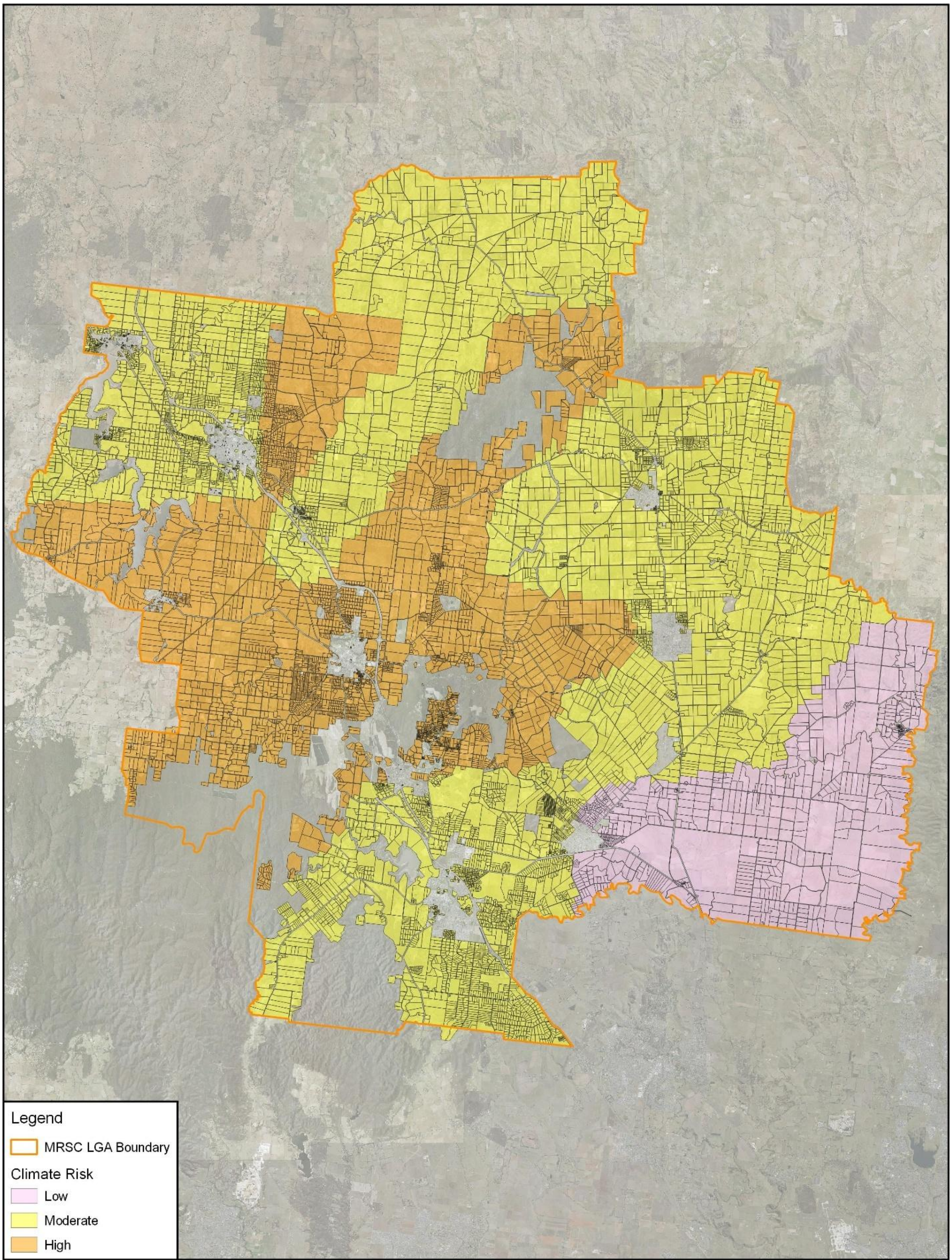

Figure 4: Climate Risk

MRSC OWMP 2025 - 2030

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0 5 10 15 20 km

(Approx Scale)

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6.3 Risk Analysis Summary

A summary of the Risk Analysis can be found as Table 8, Figure 3, and Section 4.1.2 of the Operational Plan. It is evident that variability in constraint exists between the targeted localities within the Shire.

6.4 Cumulative Risk Assessment of OWM

A CRA is an indicative risk assessment tool used to identify potential risks associated with existing or proposed development in unsewered areas, and provides a means of quantifying risks within a specific 'Area of Interest' (AOI).

A CRA looks at OWMS within an AOI, and determines the risk posed from OWM to public and environmental health endpoints, with the potential to be used to assess the impact of increasing the number of OWMS within a particular AOI as a result of development.

In 2018, the Victorian Auditor General's Office (VAGO) released the 'Managing the Environmental Impacts of Domestic Wastewater' report. In response to the VAGO report (2018), DELWP (now DEECA) developed an OWM 'Risk Assessment Framework' in 2022 to assist Council's in the standardised development of OWMPs. The framework includes the 'Risk Assessment Guidance' report (DELWP Report, 2022) and 'Risk Calculation' spreadsheet tool (DELWP Tool, 2022).

The DELWP Report (2022) provides "guidance for undertaking an OWM risk assessment, including risk identification, analysis, and evaluation components of the ISO 31000 risk management process". The DELWP Tool (2022) provides a worked example of the risk evaluation process, outlined in Section 3.3 of the DELWP Report (2022). The framework is designed to evaluate the level of risk associated with existing and proposed OWMS within an AOI, and to identify appropriate management strategies.

The DELWP Tool (2022) assesses risk as the potential for OWMS to result in contamination of surface water and groundwater resources in regards to public and environmental health, based on the 'likelihood' and 'consequence' of contamination.

The 'likelihood' of contamination is defined as the probability of transfer of wastewater off-site towards a defined endpoint (i.e. watercourse, potable water reservoir, groundwater bore, or sensitive environmental area). The 'consequence' of contamination is defined as the contaminant load once wastewater has reached the defined endpoint, taking the distance to the endpoints into consideration. This considers reduction factors, specifically OWM treatment type and soil type. Further information on how the DELWP Tool (2022) calculates likelihood and consequence can be found in Section 3 of the DELWP Report (2022).

The key OWMS attributes used to assess OWM risk within an area of concern are outlined in the following, with further detail found in Section 3.2.1 of the DELWP Report (2022).

- Lot size[4];
- Topography;
- Soil type;
- Proximity of onsite systems to watercourse, potable water supply offtake in SWSCs, flood plains;

[4] After discussion with EPA and DEECA, it was decided that 'usable lot area' was to be used in place of lot area to ensure large lots with significant constraining features (i.e. waterways) were not overlooked.

- Proximity to / density of groundwater bores;
- Groundwater depth and quality;
- Weather conditions (rainfall);
- Number of OWMS; and
- Ongoing performance of systems (type and age of systems).

The CRA was carried out for the following AOIs within the Shire. These areas were selected by Council due to current development pressures, OWM issues / complaints, controls in place to minimise OWM impacts, and location within / proximity to sensitive areas.

- Bullengarook / Macedon;
- Lauriston;
- Malmsbury;
- Mount Macedon / Macedon; and
- Woodend.

6.4.1 Catchment Delineation

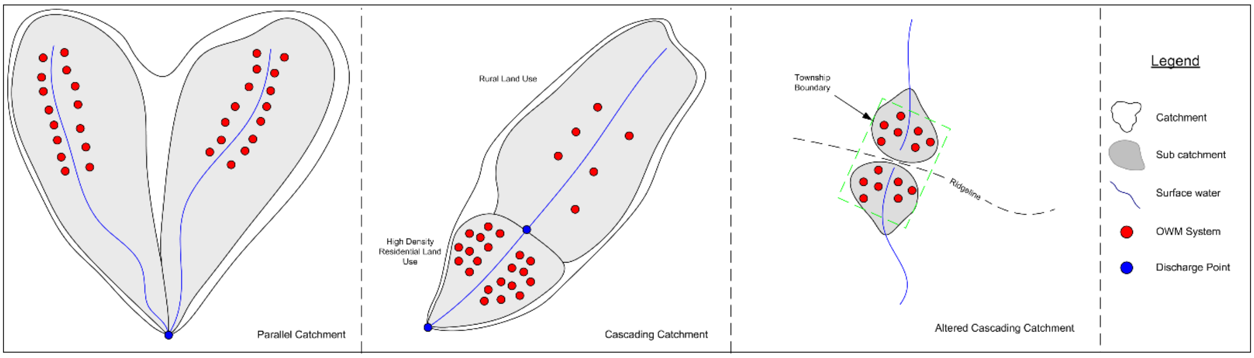
Drainage catchment boundary delineation is a crucial factor of the risk assessment procedure, quantifying the number of OWMS to be assessed. A drainage catchment is defined as 'an area of land that collects rainfall and contributes to surface water (streams, rivers, wetlands) or to groundwater', as per the Australian Drinking Water Guidelines (2021).

Once the AOIs were selected, drainage catchments were defined within GIS, with catchments broken into sub-catchments for assessment (refer Section 6.4.2). Previously, W&A discussed how this may be done with DEECA and EPA, where it was decided that drainage catchments can be defined as 'parallel' or 'cascading' catchments.

Parallel sub-catchments consist of adjacent drainage catchments that make up part of a larger catchment, draining to a common endpoint. These sub-catchments represent the traditional view of drainage catchments.

Cascading sub-catchments drain to a defined endpoint, with upslope land area partitioned from further analysis, with analysis continued until all sub-catchments are assigned, and the entire catchment area is captured. This form of catchment is best applied when a drainage catchment consists of multiple land-use types (low-medium density residential, rural) and OWMS risk profiles (system density, treatment type) are present.

Where a conventional hydrological catchment approach cannot adequately capture the entire area of interest, such as a township area, a modification of the 'cascading' sub-catchment delineation approach is considered suitable. In this instance, each sub-catchment would represent a portion of the area of interest, delineated to a separate endpoint. The following graphic illustrate each catchment methodology.



6.4.2 Study Catchments

Drainage channels were generated throughout the Shire using publicly available DEM data, with channels identified within the AOIs. Discharge point were defined along these drainage channels at the nearest practical location downstream of the AOI. Preliminary catchment boundaries were defined as the upslope area that logically drained to the defined discharge points using a terrain analysis tool in GIS (SAGA).

The AOIs were further broken into sub catchments for assessment. In the case that multiple drainage channels within an AOI discharged to a common endpoint, the ‘parallel’ sub catchment approach was used. If only a single drainage channel was identified, the ‘cascading’ sub catchment approach was used.

When a portion of a lot fell within the defined catchment boundary, the entire lot was included to prevent partial lots from being incorporated in the assessment. However, if only a minor portion of a lot was included and the development was outside the catchment boundary, it was excluded from the assessment to avoid unnecessary catchment enlargement. The final study catchments are shown in Figures 5 – 9.

OWM information (i.e. septic permits) was obtained for each lot included in the catchments. A number of developed lots did not have any OWM details on record. To allow for the inclusion of these systems in the CRA, it was assumed these lots were serviced by primary treatment and subsoil absorption system (as this was the most common approach before the wide scale implementation of permits).

The location of the EDS was identified via aerial imagery, defined by areas of increased soil moisture or vegetation growth (i.e. darker coloured vegetation). When the location of the EDS could not be defined, assumptions of their locations were made, as follows:

- Primary Treatment: EDS located 20m downslope of the development area; and
- Secondary Treatment: EDS located 50m downslope of the development area.

As primary treatment systems rely on gravity transfer; a shorter distance to the EDS was anticipated. Secondary treatment system transfer effluent to the EDS under pressure (pump); therefore, a greater travel distance was assumed. Proximity of EDS to sensitive features were allocated using GIS analysis, and were applied to the relevant lots. All relevant information was exported from GIS, and applied to the DELWP Tool (2022).

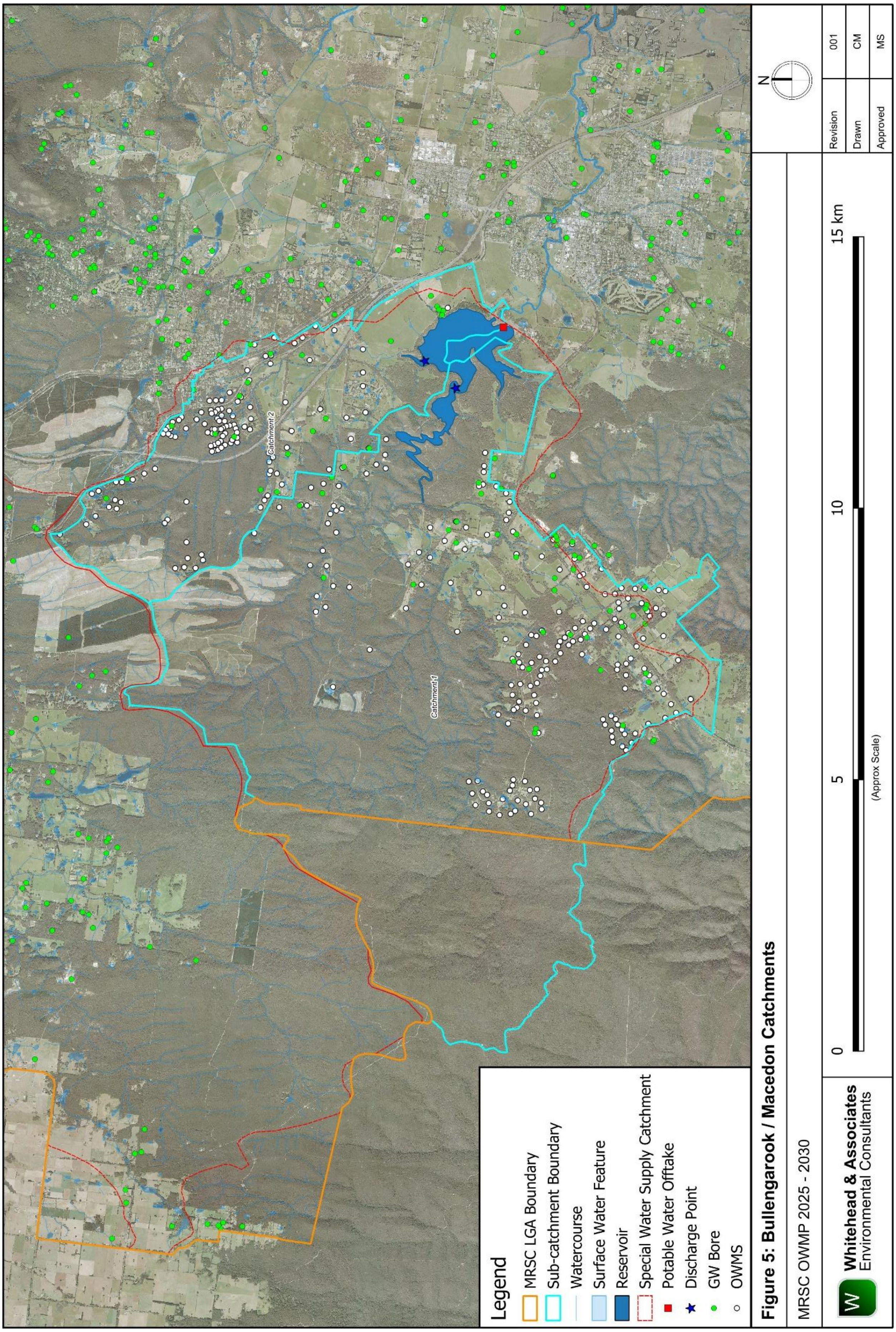


Figure 5: Bullengarook / Macedon Catchments

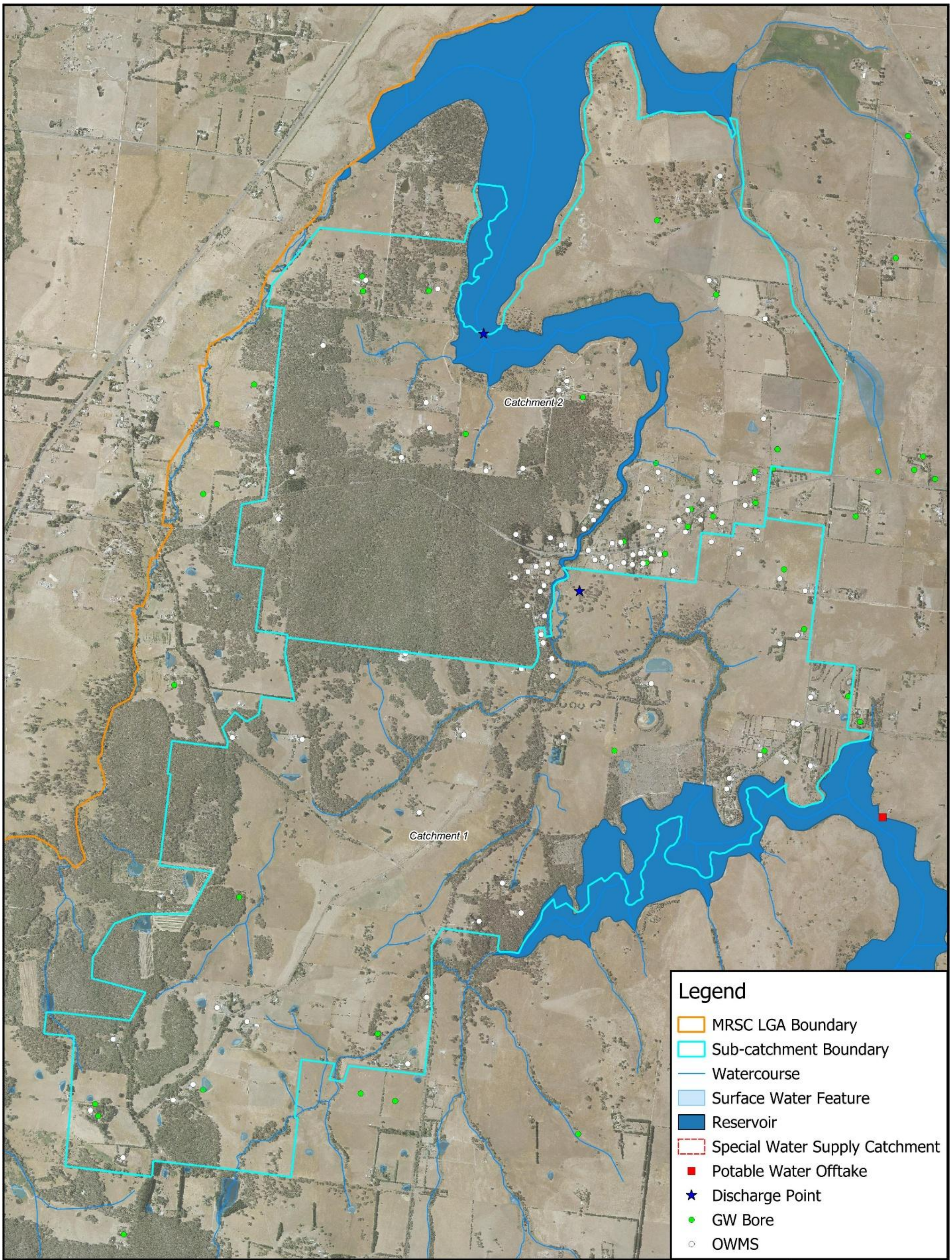


Figure 6: Lauriston Catchments		N
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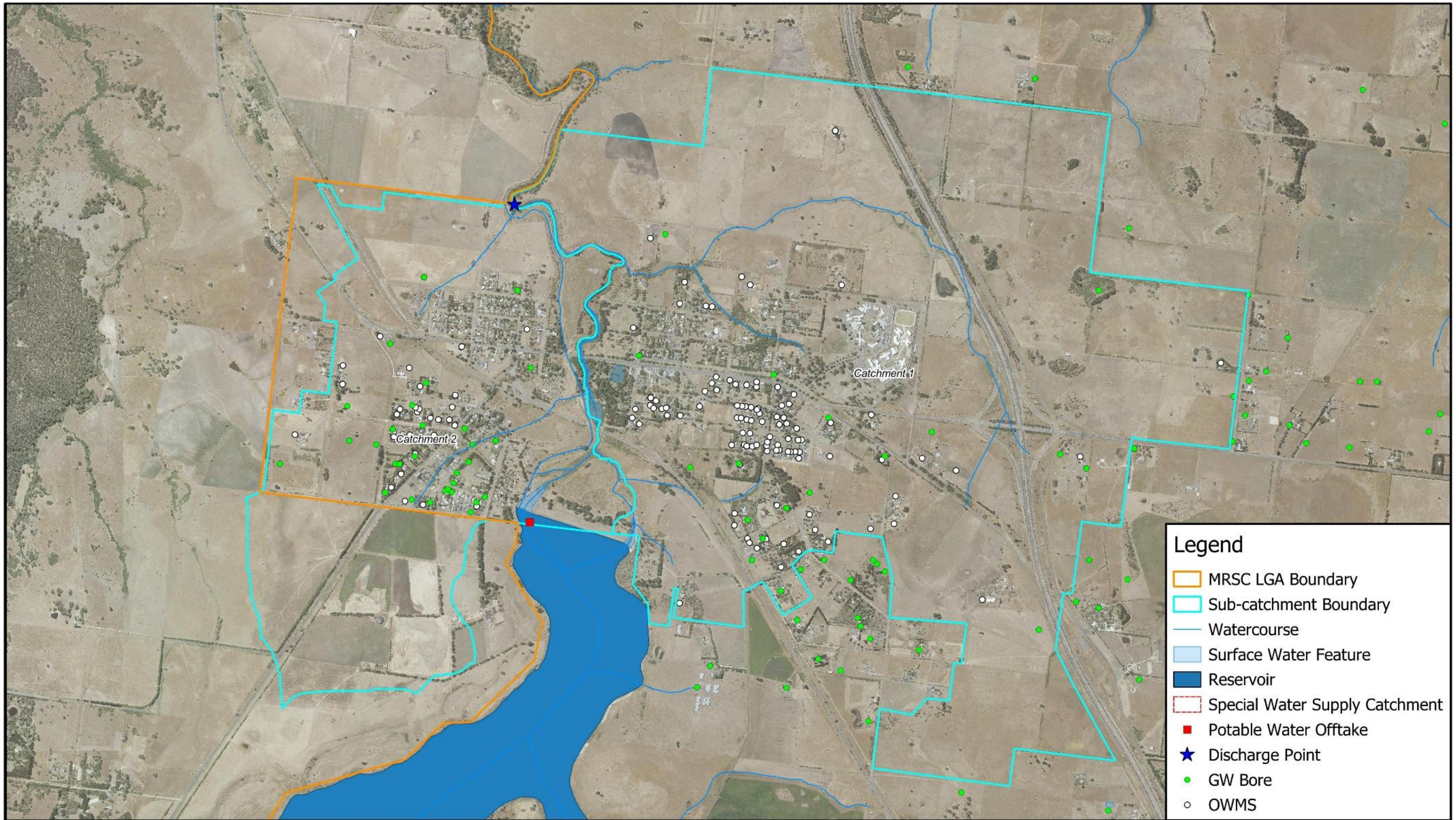

Figure 7: Malmsbury Catchments

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Environmental Consultants

0 1 2 3 4 km
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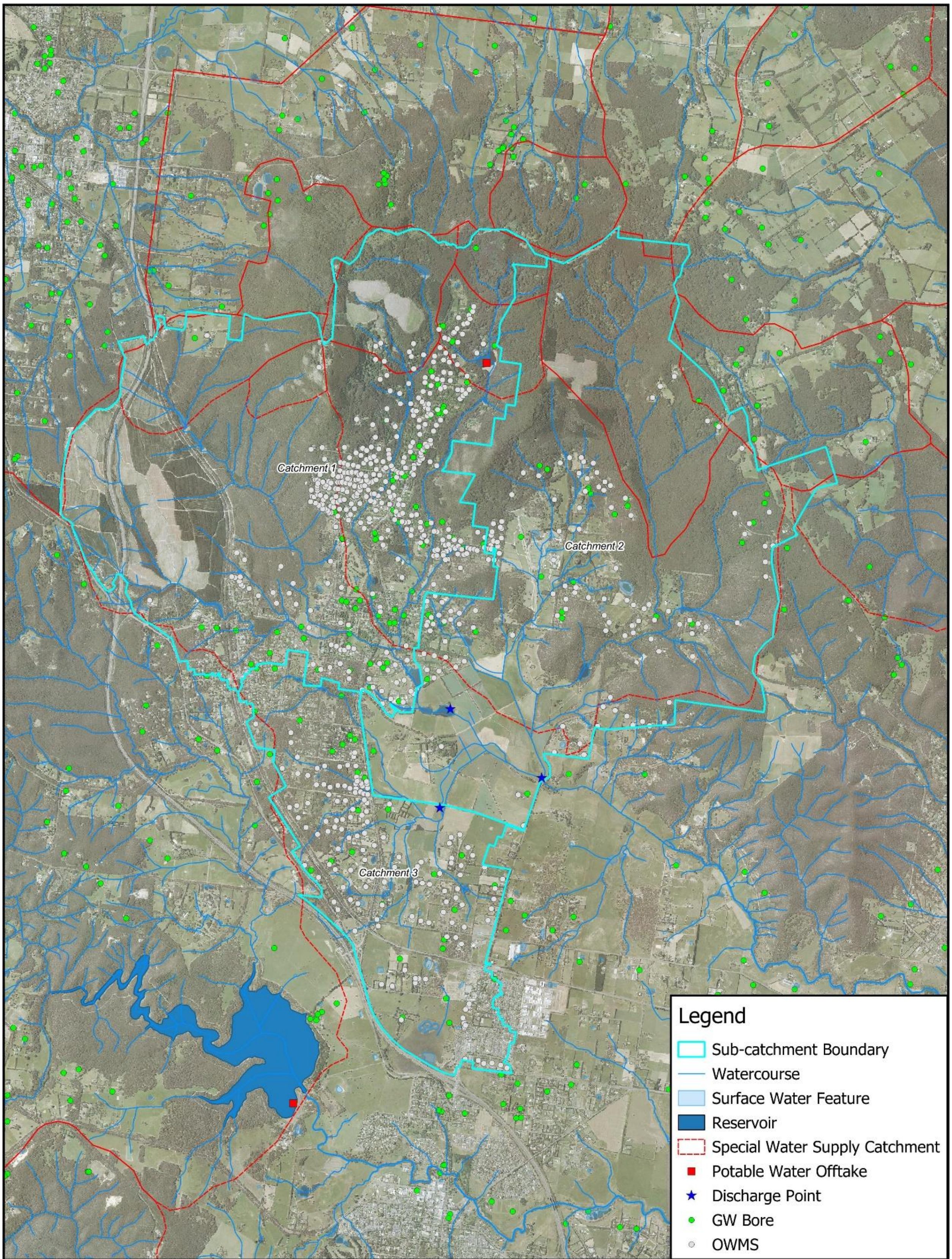

Figure 8: Mount Macedon / Macedon Catchments

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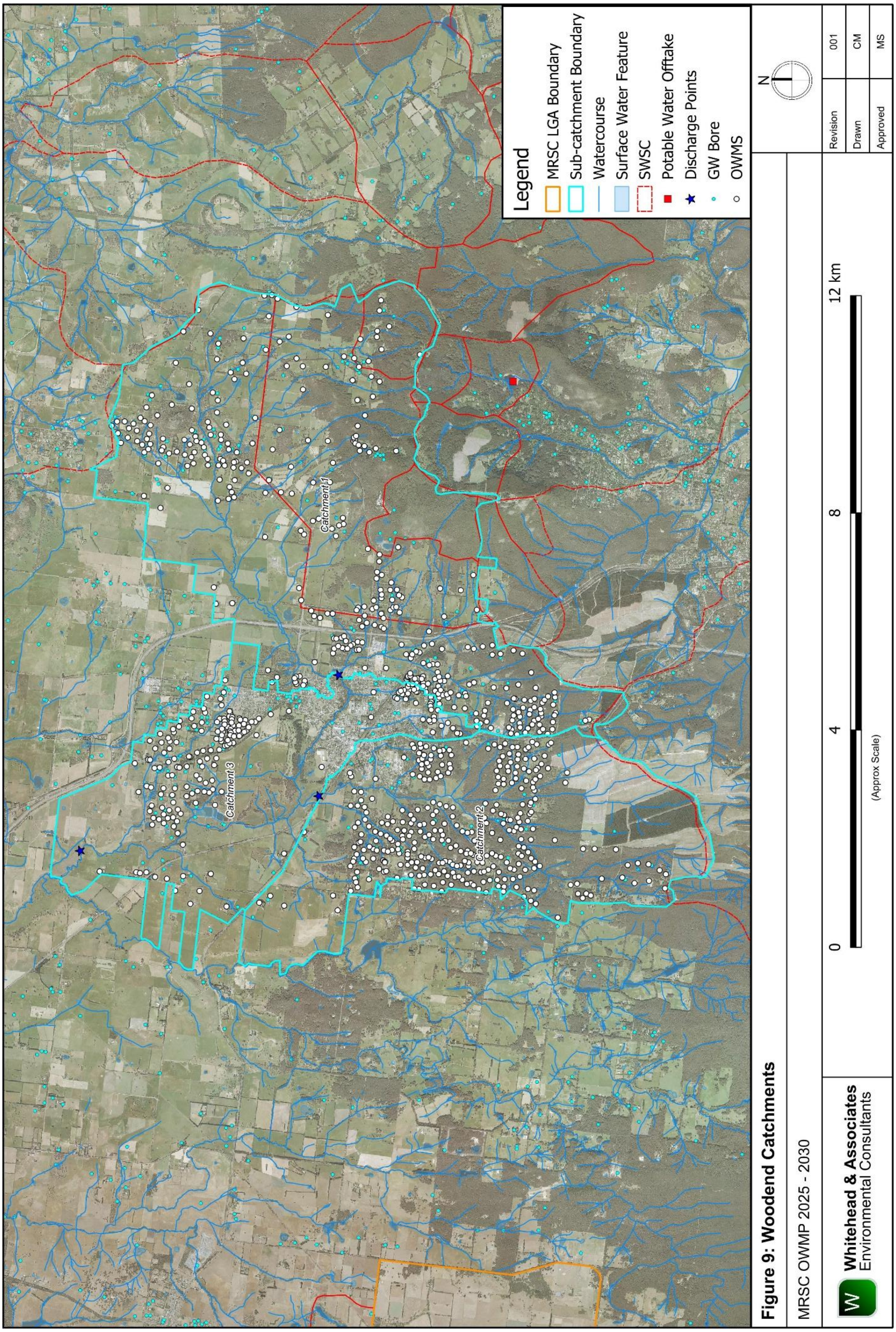

Figure 9: Woodend Catchments

6.4.3 Study Catchment OWM Information

The following tables detail the CRA inputs and outputs, as outlined in Section 6.4 of this document and 3-2 of the DELWP Report (2022). An evaluation of the CRA results has been presented in Section 4.2.1 of the Operational Plan.

Table 6a: Bullengarook / Macedon Cumulative Risk Assessment Inputs

Treatment System		Sub Catchment 1	Sub Catchment 2
OWM Systems		186	121
Primary Treatment		161	93
Secondary Treatment	All	25	28
	<5 years	8	3
	5-15 years	10	9
	>15 years	7	16
Catchment Size (ha)		7,059.4	1,939.3
OWM Density (system / ha)		0.03	0.06

Table 6b: Bullengarook / Macedon Cumulative Risk Factors

Risk Factor	Low Risk	Moderate Risk	High Risk
Soil	0 (0%)	0 (0%)	307 (100%)
Slope	86 (28%)	177 (56%)	44 (14%)
Proximity to Watercourse	165 (54%)	78 (25%)	64 (21%)
Proximity to Potable Offtake	306 (99.7%)	1 (0.3%)	0 (0%)
Proximity to Floodplain	307 (100%)	0 (0%)	0 (0%)
Proximity to Groundwater Bores	182 (59%)	88 (29%)	37 (12%)
Groundwater Depth	229 (75%)	78 (25%)	0 (0%)

Table 6c: Bullengarook / Macedon CRA Results

Risk	Sub Catchment 1	Sub Catchment 2	Cumulative
Surface Water (Human Health)	M	M	Moderate
Surface Water (Environmental)	L	L	Moderate
Potable Water (Human Health)	M	M	Moderate
Groundwater (Human Health)	L	M	N/A
Groundwater (Environmental)	L	L	
Flooding (Human Health)	L	L	
Flooding (Environmental)	L	L	

Table 7a: Lauriston Cumulative Risk Assessment Inputs

Treatment System		Sub Catchment 1	Sub Catchment 2
OWM Systems		38	66
Primary Treatment		33	53
Secondary Treatment	All	5	13
	<5 years	0	1
	5-15 years	0	1
	>15 years	5	11
Catchment Size (ha)		1,130.0	969.8
OWM Density (system / ha)		0.03	0.07

Table 7b: Lauriston Cumulative Risk Factors

Risk Factor	Low Risk	Moderate Risk	High Risk
Soil	0 (0%)	0 (0%)	104 (100%)
Slope	30 (29%)	66 (63%)	8 (8%)
Proximity to Watercourse	74 (71%)	16 (15%)	14 (14%)
Proximity to Potable Offtake	92 (89%)	12 (11%)	0 (0%)
Proximity to Floodplain	96 (92%)	0 (0%)	8 (8%)
Proximity to Groundwater Bores	53 (51%)	26 (25%)	25 (24%)
Groundwater Depth	78 (75%)	26 (25%)	0 (0%)

Table 7c: Lauriston CRA Results

Risk	Sub Catchment 1	Sub Catchment 2	Cumulative
Surface Water (Human Health)	M	M	Moderate
Surface Water (Environmental)	L	L	Moderate
Potable Water (Human Health)	M	M	Moderate
Groundwater (Human Health)	L	M	N/A
Groundwater (Environmental)	L	L	
Flooding (Human Health)	L	L	
Flooding (Environmental)	L	L	

Table 8a: Malmsbury Cumulative Risk Assessment Inputs

Treatment System		Sub Catchment 1	Sub Catchment 2
OWM Systems		101	31
Primary Treatment		91	23
Secondary Treatment	All	10	8
	<5 years	0	0
	5-15 years	3	4
	>15 years	7	4
Catchment Size (ha)		805.4	341.0
OWM Density (system / ha)		0.13	0.09

Table 8b: Malmsbury Cumulative Risk Factors

Risk Factor	Low Risk	Moderate Risk	High Risk
Soil	0 (0%)	0 (0%)	132 (100%)
Slope	96 (73%)	36 (27%)	0 (0%)
Proximity to Watercourse	125 (95%)	3 (2%)	4 (3%)
Proximity to Potable Offtake	124 (94%)	7 (5%)	1 (1%)
Proximity to Floodplain	129 (98%)	0 (0%)	3 (2%)
Proximity to Groundwater Bores	29 (22%)	65 (49%)	38 (29%)
Groundwater Depth	84 (64%)	48 (36%)	0 (0%)

Table 8c: Malmsbury CRA Results

Risk	Sub Catchment 1	Sub Catchment 2	Cumulative
Surface Water (Human Health)	M	M	Moderate
Surface Water (Environmental)	L	L	Moderate
Potable Water (Human Health)	M	M	Moderate
Groundwater (Human Health)	L	M	N/A
Groundwater (Environmental)	L	L	
Flooding (Human Health)	L	L	
Flooding (Environmental)	L	L	

Table 9a: Mount Macedon / Macedon Cumulative Risk Assessment Inputs

Treatment System		Sub Catchment 1	Sub Catchment 2	Sub Catchment 3
OWM Systems		387	129	141
Primary Treatment		227	96	113
Secondary Treatment	All	160	33	28
	<5 years	12	4	2
	5-15 years	82	12	14
	>15 years	66	17	12
Catchment Size (ha)		2,601.0	2,595.8	986.3
OWM Density (system / ha)		0.15	0.05	0.14

Table 9b: Mount Macedon / Macedon Cumulative Risk Factors

Risk Factor	Low Risk	Moderate Risk	High Risk
Soil	0 (0%)	32 (5%)	625 (95%)
Slope	132 (20%)	236 (36%)	288 (44%)
Proximity to Watercourse	419 (64%)	120 (18%)	118 (18%)
Proximity to Potable Offtake	657 (100%)	0 (0%)	0 (0%)
Proximity to Floodplain	650 (99%)	0 (0%)	7 (1%)
Proximity to Groundwater Bores	224 (34%)	297 (45%)	136 (21%)
Groundwater Depth	498 (76%)	159 (24%)	0 (0%)

Table 9c: Mount Macedon / Macedon CRA Results

Risk	Sub Catchment 1	Sub Catchment 2	Sub Catchment 3	Cumulative
Surface Water (Human Health)	M	M	M	Moderate
Surface Water (Environmental)	L	L	L	Moderate
Potable Water (Human Health)	M	M	M	Moderate
Groundwater (Human Health)	M	M	M	N/A
Groundwater (Environmental)	L	L	L	
Flooding (Human Health)	L	L	L	
Flooding (Environmental)	L	L	L	

Table 10a: Woodend Cumulative Risk Assessment Inputs

Treatment System		Sub Catchment 1	Sub Catchment 2	Sub Catchment 3
OWM Systems		362	338	199
Primary Treatment		268	297	153
Secondary Treatment	**All**	94	41	46
	<5 years	5	7	2
	5-15 years	42	13	11
	>15 years	47	21	33
Catchment Size (ha)		4,202.9	2,234.0	1,840.1
OWM Density (system / ha)		0.09	0.15	0.07

Table 10b: Woodend Cumulative Risk Factors

Risk Factor	Low Risk	Moderate Risk	High Risk
Soil	6 (1%)	0 (0%)	893 (99%)
Slope	451 (50%)	410 (46%)	38 (4%)
Proximity to Watercourse	436 (49%)	192 (21%)	271 (30%)
Proximity to Potable Offtake	899 (100%)	0 (0%)	0 (0%)
Proximity to Floodplain	859 (96%)	0 (0%)	40 (4%)
Proximity to Groundwater Bores	506 (56%)	242 (27%)	151 (17%)
Groundwater Depth	433 (48%)	466 (52%)	0 (0%)

Table 10c: Woodend CRA Results

Risk	Sub Catchment 1	Sub Catchment 2	Sub Catchment 3	Cumulative
Surface Water (Human Health)	M	M	M	Moderate
Surface Water (Environmental)	L	L	L	Moderate
Potable Water (Human Health)	M	M	M	Moderate
Groundwater (Human Health)	M	M	M	N/A
Groundwater (Environmental)	L	M	M	
Flooding (Human Health)	L	L	L	
Flooding (Environmental)	L	L	L	

7 Wastewater Generation

7.1 Wastewater Flow Rates

Wastewater flow rates are to be based on the GOWM (2024), as reproduced in Tables 11 and 12. In the case that metered water data and site attendance has been recorded for a period of more than one (1) year, this may be used in place of the standard flow rates. Further details can be found in Section 4.2 of the GOWM (2024).

Table 11: Residential Wastewater Flow Rates

Wastewater Source (per person)	Wastewater Flow Rate (L/person/day)	
Water Supply	**Reticulated Supply**	**Onsite Roof Supply**
Residential premises with standard water fixtures.	180	150
Residential premises with extra sewage-producing facilities[5].	220	190
Residential premises with WELS scheme fixtures and fittings[6].	150	120

Table 12: Commercial Wastewater Flow Rates

Wastewater Source (per person)	Wastewater Flow Rate (L/person/day)	Organic Material Loading Rate (g BOD /person/day)
Motel / Hotel / Guesthouse:		
• Bar trade customer:	7	8
• Bar meals per diner:	10	10
• Residential guests / staff (with in-house laundry):	150	80
• Residential guest / staff (with out-soruced laundry):	100	80
Restaurant:		
• Premises <50 seats:	40	50
• Premises >50 seats:	30	40
• Tearoom / café:	10	10
• Conference facility:	25	30
• Function centre:	30	35
• Take-away food shop:	10	40
Public area (toilet, no shower or café):		
• Public toilet:	6	3
• Theatre, art gallery, museum:	3	2
• Meeting hall with kitchenette:	10	5
Premises with shows and toilets:		
• Golf club, gym, pool, etc.:	50	10
Hospital (per bed):	350	150

[5] Could include, but not limited to, spa baths.

[6] Water efficiency labelling scheme. Requires 4 Stars or higher for dual-flush toilets, shower-flow restrictors, aerator taps, flow/pressure control valves, and 3 Stars or higher for all appliances (for example. clothes washing machines).

Wastewater Source (per person)	Wastewater Flow Rate (L/person/day)	Organic Material Loading Rate (g BOD /person/day)
Shops / shopping centre: • Employee: • Public access:	15 5	10 3
School (child care): • Pupil or staff: • Resident staff / boarder:	20 150	20 80
Factories / office / day training centre / medical centre: • No showers: • With showers:	20 50	15 30
Camping grounds: • Fully serviced: • Recreation areas with showers and toilets:	150 150	60 40

8 Modification / Replacement of Existing System

8.1 Modification for Existing Systems

Required modifications should be determined on a case-by-case basis, and discussed with Council prior to implementation. Systems that are to be modified or repaired must be structurally sound and adequately sized for the development.

8.1.1 Minor Repairs

The structural integrity and design of the septic tank determine its suitability for continued use. Generally, the older a septic tank, the more likely it is to be damaged (i.e. cracks, missing components, etc.). Rectification of these minor damages is possible to mitigate or repair these issues.

Repairing cracks will need to be done when the tank is empty, with care taken to ensure that all cracks are identified and repaired. AWTP and sand filter components can often require repair or replacement following flooding, electrical faults or pump failure. Pumps can be removed and replaced when necessary and internal pipes can be replaced where necessary if they have been dislodged or damaged. A suitably qualified service agent or the system manufacturer should undertake these repairs.

8.1.2 Septic Tank Outlet Filters

The simplest way to improve the performance of a standard septic tank is to retrofit the outlet pipe with an outlet filter. Filters of various designs are commercially available and can provide significant solids retention. Filters can reduce the impacts of solids carry over to the EDS or secondary treatment system, and should be removed and cleaned and replaced in the septic tank at least twice per year.

8.1.3 Septic Tank Access Service Riser

Inaccessible tanks are highly unlikely to be desludged as regularly as is required for optimum system performance. Tanks are often installed completely below ground to achieve minimum fall for gravity drainage; however, this often result in the inability to locate the tank.

Non-accessible tanks commonly present issues to OWM due to the likelihood that the tank had not been adequately managed.

Service risers are typically made from concrete or high density plastic and must be installed by a suitably experienced professional (i.e. plumber). The tank and riser lids should be protected from groundwater and stormwater ingress.

8.2 Replacement of Existing Systems

Replacement of systems and components should be carried out according to the site-specific conditions and requirements of the lot, and by an appropriately qualified and experienced person. Common upgrade and replacement options for OWMS are discussed in the following sections.

8.2.1 Septic Tanks Replacement

It is envisaged that where simple repairs and pump-outs fail to meet compliance standards, existing septic tanks will require complete replacement due to being undersized, structurally unsound, and / or discharging effluent inappropriately.

Where appropriate, septic tanks can be replaced with another septic tank. However, for permanently-occupied premises, it is likely that an upgrade to a secondary treatment system will be required. Both outcomes must be in accordance with a site-specific LCA and design report by an appropriately qualified professional. All proprietary treatment systems must have current Certificate of Conformance from the EPA.

Secondary treatment systems allow greater flexibility for EDS options. Existing trenches may be used to receive the secondary effluent from, with or without trench rejuvenation as required. Alternatively, the existing trenches can be decommissioned and rehabilitated with clean soil where required, and replaced with a different EDS.

8.2.2 Upgrades, Extensions, and Replacements for Absorption Systems

Absorption systems have relatively small footprint with high loading rates on the soil when compared to other EDS, resulting in an increased risk of systems being overloaded and failing hydraulically in the long term.

Furthermore, prolonged effluent application through absorption systems increases the risk of soil degradation by increasing salinity and sodicity, as well as the development of a 'clogging layer.' A range of options for upgrading absorption systems is provided in the following. Site constraints, particularly available suitable space, will determine what options are feasible, and will be determined on a case by case basis as part of the recommended servicing strategy.

8.2.3 Absorption System Rejuvenation

It is possible to 'rejuvenate' existing system by oxidising the clogging layer, either using an oxidising chemical, physical aeration (compressed air blowers), or both. This technique in combination with septic tank pump-out and installation of an outlet filter has good potential to improve overall system performance, and is relatively low-cost.

This solution will only be appropriate as a long-term solution on lots with adequate available space for effluent dispersal and if the existing absorption system is appropriately sized for the number of occupants or number of bedrooms.

8.2.3.1 Replace, Replicate, or Expand Absorption Systems

Where rejuvenation is not an option, systems may be excavated and replaced in-situ, using imported materials including topsoil and improving the existing subsoils. This is the most feasible option for small lots, or where other areas have been used for other improvements.

If there is adequate available space elsewhere on the lot that has not been used for absorption systems previously, it is likely to be more straightforward and cost-effective to replicate the system in this area.

If the existing absorption system is undersized, and there is adequate suitable space adjacent to the terminal ends of the system, then the system can be extended to the minimum required size (as described in the Sizing Tables, or determined by an LCA).

8.2.3.2 Soil Amelioration

Heavily textured clay subsoils are commonly the most limiting layer to water movement. Quite often, the soil chemistry of this layer is dominated by adsorbed sodium / magnesium ions, causing the clay dispersion when in contact with water. When used for effluent dispersal these clay particles move down with the percolating water and clog up the fine pores, thus reducing the soil's permeability over time. Subsoil clay that is dispersive should be treated with gypsum to counteract the excessive sodium and magnesium and bring about a strong flocculated condition of the clay particles. As per Appendix 2 of the EDRS (2024), a gypsum application rate of 1kg/m^2 of gypsum is recommended.

Lack of topsoil material also presents a limitation of effluent dispersal. As per the Standard and EPA Guidelines, EDS are to be covered with a minimum 100mm – 150mm of 'good quality' topsoil material, with irrigation systems to be installed within 250mm of topsoil. Therefore, the importation of topsoil material may be required. To achieve this, it is recommended that the natural soil surface of the EDS is scarified / lightly tilled to a depth of 150mm, with the imported topsoil material applied to the EDS. It is recommended the imported material is finished with a batter slope of 1 (vertical): 3 (horizontal) to allow for management of the vegetation (i.e. mowing).

8.2.3.3 Alternative Trench Designs

Over the years there have been various modifications to conventional absorption trenches and beds, some of which have been developed into proprietary 'off-the-shelf' products including various brands of self-supporting arch drains and the *Advanced Enviro-Septic*™ modular trench.

Other modified designs are based on existing technologies which, although not all are formally approved, have been shown to enhance performance. One recent example of this is the 'Wick' trench developed for use in clay soils as an alternative to standard absorption trenches, referred to as 'Wick Trenches' in the EPA Guidelines.

Further details can be found in Section 10.4.3 of this Technical Document.

9 Effluent Dispersal System Sizing (Water Balance)

9.1 Overview

Water balance modelling was undertaken to determine the minimum area (footprint) required for a range of EDS options considered suitable for use in unsewered areas of the Shire. The EDS options included in the Sizing Tables include subsurface irrigation, conventional absorption systems (trenches and beds), ETA systems (trenches and beds) and LPED irrigation systems. No EDS sizing is provided for Mounds or Wick Trench systems as they require site-specific design and suitability information, including investigation by a suitably qualified person.

Further explanation of the identified EDS types is provided in Section 11.4 of this Technical Document and Section 2.4 of the *Guideline for Onsite Wastewater Effluent Dispersal and Recycling Systems* (EDRS, 2024). Appendix 1 of EDRS (2024) presents example drawings for common EDS designs.

All six (6) of the *AS/NZS 1547:2012* soil categories were used in the modelling, for three (3) household sizes based on number of bedrooms and likely maximum occupancy rate, for domestic dwellings. The results are provided in the EDS sizing tables in the Town Reports (refer Appendix B), which summarise the minimum basal (or 'wetted') area for the different systems.

The EDS sizing tables are applicable for Low and Moderate Risk properties only.

Where the EPA Guidelines state that the EDS type is not suitable for the type of soil; or the soil and climate characteristics of the location render the system type unsuitable, 'not applicable' (NA) is shown in the Sizing Table. 'Impractical' is noted when the system type can be used, but the resultant size of the EDS would not be practical primarily due to associated costs with construction.

9.2 Water Balance Methodology

A water balance is a means of incorporating the impact of rainfall, evapotranspiration and plant and soil moisture fluxes into the design of EDS. Water balance is a critical factor in the effective design and operation of EDS. This is particularly relevant for the higher rainfall areas in the southern half of the Shire. A simplistic water balance is expressed by the following equation:

Precipitation + Applied Effluent = Evapotranspiration + Percolation + Runoff

On the left hand side of the equation are the water INPUTS, factors that add to the moisture within an EDS. On the right hand side of the equation are the water LOSSES, factors that reduce the moisture content within an EDS. For an EDS to be balanced hydraulically the INPUTS should be equal to or less than the LOSSES, otherwise hydraulic overloading and failure may result if the inherent moisture storage capacity of the EDS is subsequently exceeded.

Rainfall data can be obtained from the BoM or SILO and commonly water balances are undertaken using median monthly rainfall data for a local weather station. Pan evaporation (Class A Pan) is less readily available, and usually is only available for selected weather stations. Evapotranspiration is the combination of evaporation and transpiration of moisture from the soil through the open pores in the leaves of plants.

Evapotranspiration rates vary with changes to soil and air moisture as well as season, but can be estimated by applying appropriate monthly crop factors to pan evaporation data. Crop factors have been adopted from Table 20 of EDRS (2024).

Percolation is equivalent to the rate of deep drainage of both rainfall and applied effluent through the soil and is controlled mainly by soil properties, but also in part by slope and other factors. The runoff factor allows for the fact that not all rainfall that falls on a ground surface will actually infiltrate the EDS and so contribute to soil moisture. During periods of high rainfall, the soil becomes saturated and excess rainfall runs off as it cannot percolate into the soil.

If all factors in the water balance are expressed in terms of millimetres (mm) per month, then it is possible to solve the equation to determine a minimum EDS (footprint) such that the LOSSES match or exceed the INPUTS. This is usually done using pre-prepared spreadsheets to simplify the numerous calculations involved in running the balance for each month of the year. The water balance methodology used for the Sizing Tables is the same as that described in MAV & DSE (2014). Specific inputs are discussed in the following sections.

9.3 Water Balance Inputs

9.3.1 Daily Wastewater Load

The daily wastewater load is the product of the design occupancy rate and the wastewater generation in litres per person per day (L/person/day).

Section 4.2 of the GOWM (2024) specifies that the design occupancy rate is the number of bedrooms (including any rooms that could be used as a bedroom, such as a study or library) plus one (1). For example, a four (4) bedroom home is expected to accommodate up to five (5) persons in the normal course of events (this does not include accommodation, businesses or holiday homes). This considers the future potential occupancy, not just the current occupancy (which may be much smaller).

Table 4-1 of the GOWM (2024) specifies a wastewater generation rate of 180L/person/day for households with standard water fixtures. The water balance uses this figure. However, where it can be demonstrated that full-reduction fixtures have been, or will be, installed in the household and will remain in place, then a design loading rate of 150L/person/day, in accordance with *AS/NZS 1547:2012* can be adopted for a site-specific OWM design. Alternatively, if tank water is the only water source onsite, then a design loading rate of 120L/person/day, can be used in accordance with *AS/NZS 1547:2012*, and the results in the EDS sizing tables will not apply.

The design wastewater loads used in water balance modelling are shown in Table 13.

Table 13: Design Wastewater Loads for Water Balance Modelling

No. Bedrooms	Design Occupancy	L/person/day	L/household/day
3	4	180	720
4	5		900
5	6		1,080

9.3.2 Climate Data

For this project, the median rainfall and average evaporation data (SILO) (refer Appendix C) were used to create unique water balances for each system type for each priority locality. The data point closest to the town was used for the water balance.

9.3.3 Runoff Factor

Conservative annual runoff factors of 10% (90% infiltration of rainfall) have been adopted for soil absorption systems (e.g. trench, bed etc.) and 20% (80% infiltration) for irrigation systems in the

Shire. The difference in runoff factors is due to absorption systems being finished with a flat surface, whereas irrigation systems may be installed on sloping ground along contours.

9.3.4 Soil Type and Design Loading Rate or Design Irrigation Rate

The Design Loading Rate/s (DLR/s) and Design Irrigation Rate/s (DIR/s) for the commonly used EPA accepted methods of effluent dispersal, as listed in Tables 4-8 and 4-9 of the GOWM (2024), were used as the basis of water balance modelling and the sizing of the EDS for all systems. All listed systems except for mounds were modelled, as mounds require a site-specific design which accounts for site factors (including, but not limited to ground slope).

For simplicity, every soil category (and subcategories depending on soil structure), have been modelled, regardless of whether they are observed in the locality. It is noted that most towns will only have two (2) or three (3) soil types, and that the system sizing's provided for the other soil types are irrelevant for that location (unless a significant amount of topsoil is imported for the construction of the EDS, which is not common).

The DLR or DIR should be selected for the most limiting soil layer (usually the heavier-textured subsoil horizons). Where data was absent from the current EPA Guidelines, average values were selected from Table 5.2 of *AS/NZS 1547:2012*. For instance, the EPA Guidelines do not specify DLRs for absorption or evapotranspiration (ETA) beds for gravels, sands or weakly structured sandy loams, but acknowledges that these systems may be appropriate if the soil does not have a high perched or seasonal groundwater table.

9.4 Water Balance Implications for High Rainfall Areas

The water balance is highly sensitive to the DLR or DIR selected. The DLR and DIR are considered to be conservative or 'safe' deep drainage percolation rates for EDS that are sustainable for the long term. However, deep drainage percolation in an EDS is not widely understood and the high variability of soil dynamics across regions means that a 'one size fits all' approach may not be the most appropriate method for designing an EDS for a particular site.

If the selected DLR or DIR taken from the GOWM (2024) is low due to heavy-textured soils and the site is in a high rainfall region, then the required minimum EDS is proportionately large. This can pose difficulties for design and installation, particularly for systems that use gravity dosing (which is far less effective for large systems compared to pumped dosing). EDS that were deemed as not likely to be practical are highlighted in the Sizing Tables.

Some locations within the Shire may feature areas of particularly high rainfall and low winter evapotranspiration, which presents a case whereby the water balance, is unresolvable and therefore cannot produce consequential data. For these areas, denoted as "N/A[7]" in the Sizing Tables, the water balance method as described above cannot be used to predict the minimum required area for effluent land application, and a site-specific, detailed system design is required, and therefore the Sizing Tables are not applicable.

Furthermore, the water balance and prescribed DLRs and DIRs do not take into consideration the possibility that the soil and / or bedrock in some high rainfall areas may have a natural permeability that is higher than that assumed from its textural category. In such instances, the DLR or DIR could be sustainably increased, thereby allowing for a smaller system footprint. A site-specific water balance would require detailed soil testing (including constant-head permeameter testing) to clearly demonstrate that the soil can sustainably accommodate a higher effluent loading, year-round.

In these high rainfall areas, site-specific design is recommended to select and size an appropriate EDS to ensure that OWM is sustainable with no off-lot discharge. Innovative designs may be required and overarching measures to assist in managing the wastewater in these regions may include minimising wastewater generation, increasing reuse and increasing the EDS footprint. It should be noted that there may be cases in which an appropriate solution cannot be devised or in which costs are prohibitive.

9.5 Footprint Area of Effluent Dispersal Areas

The size of an EDS depends not only on the volume of the effluent to be applied, the quality of the soil and on local rainfall, but also on how the system is laid out and on the spacing of components (e.g. trenches) and the width of mandatory setbacks.

In a subsurface irrigation system, the drip-lines are often closely spaced and the land may be considered to have an even loading. Therefore, the total EDS is the required area as specified by the water balance (plus any setbacks which must be maintained). Irrigation systems can be designed to best fit the most suitable area, provided that the pump is capable of delivering effluent evenly throughout the entire system.

For absorption and ETA trenches and beds, wick trenches and Low Pressure Effluent Distribution (LPED) systems, a minimum spacing between trenches or beds must be observed to prevent overloading of the soil between them. The GOWM and EDRS (2024) or *AS/NZS 1547:2012* specifies minimum spacing, which have been used to estimate a typical footprint area of the system, on the assumption that the longest acceptable trench or bed length has been used. The Sizing Tables only indicate basal area and the final footprint of the EDS will need to be calculated based on these spacing requirements. The final area must be determined by the system designer / installer as part of the final OWM design (for all risk category lots).

10 Evaluation of Wastewater Management Systems

10.1 Overview

This appendix provides a review of the range of accredited wastewater treatment systems and EDS for domestic and commercial application.

EPA Victoria will continue to regulate what types of OWMS are approved for use under the *EP Act 2017*. OWM treatment system brands and models will need to be certified by an accredited conformity assessment body as conforming to the relevant Australian Standard. This accreditation will be given by the Joint Accreditation System of Australia and New Zealand or any other accreditation body approved by the Authority (assessment body). The assessment body must certify the treatment system as conforming to the relevant Australian and New Zealand Standard. The appropriate standards for the different types of treatment systems are outlined in Section 2.3 of the Operational Plan.

EPA holds a register of the OWMS with valid Certificates of Conformance within Victoria, with the EPA website to be regularly consulted for an up-to-date list of accredited systems. Please note that Council approval is required prior to the installation, alteration, or rectification of any OWMS.

10.1.1 Exclusions and Variations

These guidelines do not relate to the mass production of manufactured proprietary treatment systems approved by EPA Victoria. Information and standards for the internal design and manufacturing of such units should be obtained from EPA Victoria and the relevant Australian / New Zealand Standard.

However, these guidelines do address the design and installation of onsite wastewater management components that are subject to meeting the system type EPA Victoria Certificate of Conformance. Some aspects of this document vary from the standard requirements of the relevant Certificates of Conformance. These variations are considered appropriate because:

- They represent a higher standard of practice than that included in the Certificates of Conformance that can be justified by current best practice from around the world;
- They may reduce risk to public health and the environment in comparison to current practice;
- They will increase the capacity for achieving the performance objectives set out in the *EP Act 2017*; and
- They reflect a more site specific approach utilising local conditions to set requirements.

A proposed installation or rectification that does not conform to the standard drawings contained in this guideline may be acceptable, providing it is assessed by, and deemed acceptable to, Council. It is recommended that Council be consulted on any variation from this document in the installation of OWMS components.

10.1.2 Plumbing and Drainage Work

This appendix does not address standards of work for plumbing and drainage as they relate to OWM components. The Plumbing Regulations 2018 set out these requirements and generally require plumbing and drainage work to be carried out in accordance with AS/NZS 3500. A licensed plumber is required to carry out all plumbing and drainage work up to the connection point to the treatment system. This document does not eliminate any requirement to comply with the EPA Guidelines.

10.2 Pump-out Systems

Pump-out systems convey raw wastewater or septic tank effluent to a holding tank (pump-out tank or collection well) for removal by licenced pump-out contractor for dispersal in an approved sewer main access hatch or municipal sewage treatment plant (under contract). They are generally regarded as a last resort, typically used to service properties where:

- There is inadequate available space to sustainably land apply effluent;
- Existing EDS have failed and cannot be safely used to apply effluent; or
- The lot will be connected to sewer in future (i.e. an interim solution).

Adequate sizing of holding tanks is important to ensure that adequate storage capacity is provided to allow lead time to arrange a licenced pump-out contractor. Further details for the design of pump-out systems can be found as Section 4.6.3 of the GOWM (2024). Holding tanks should be fitted with high water level alarms and must incorporate both audible (buzzer) and visual (strobe) alarm components. The following minimum standards are required for high water alarm systems:

- A muting facility for the audible alarm is to be incorporated into the alarm design;
- The muting facility shall reset to audible after 24-hours;
- The alarm panel shall be located in a visible position within the building or other location approved by Council;
- The alarm system float switch shall be set at a level such that on activation, two (2) days storage remains within the collection well; and
- Provision of an information sign that provides contact names and telephone numbers should the alarm be activated.

All wastewater or effluent holding tanks should be installed with adequately sealed lids, and positioned so that they do not impact on existing structures or neighbouring properties and stormwater is diverted around the tanks. Stormwater ingress must be avoided, as it can result in excessive pump out costs and may result in displacement of raw wastewater to the ground surface. The tanks must be positioned to allow access by a pump-truck and its vacuum hose attachment. Pump-out tanks should comply with the applicable setback distances for primary treatment, as outlined in Table 4 – 10 of the GOWM (2024).

10.3 Wastewater Treatment Systems

There are currently four (4) broad categories of wastewater treatment system types that are accredited by the EPA:

1. *AS/NZS 1546.1* – Septic Tanks (and vermiculture systems);
2. *AS/NZS 1546.2* – Waterless Composting Toilets (and dry composting toilets);
3. *AS 1546.3* – Secondary Treatment Systems; and
4. *AS 1546.4* – Domestic Greywater Treatment Systems.

A brief summary of each is provided in the following. For more detailed information, consult the current EPA Guidelines and the EPA website –

https://www.epa.vic.gov.au/for-community/environmental-information/water/about-wastewater/onsite-wastewater-systems

10.3.1 Greywater Treatment Systems

Greywater treatment systems are accredited to treat laundry, shower, bath, and hand-basin greywater only. Blackwater (toilet and kitchen waste) must never be treated in greywater treatment systems.

Kitchen water should be kept separate from the greywater stream and treated with blackwater as kitchen greywater can be relatively high in contaminants compared to other greywater streams. Greywater treatment systems can be useful for upgrading direct-diversion greywater systems where blackwater is to be kept separate, particularly if kitchen wastewater can be re-plumbed to the blackwater septic tank to prevent it entering the greywater treatment system.

If a greywater treatment system is utilised at a site, the blackwater also needs to be treated and disposed of onsite in an appropriately designed and accredited system. A justification is required within the LCA by the assessor. Greywater typically accounts for 65% of the total wastewater load for a domestic development, with the blackwater stream accounting for the remaining 35%, or appropriate leachate if opting for a waterless blackwater system (i.e. composting toilet).

Greywater that is treated to 'advanced' secondary standard, in accordance with the GOWM (2024) and *AS 1546.4*, can be used for toilet flushing, cold water supply to clothes washing machines, and surface and subsurface irrigation. Advanced secondary effluent must achieve the following criteria:

- Biochemical Oxygen Demand (BOD_5): <10mg/L.
- Total Suspended Solids (TSS): <10mg/L.
- E. coli or faecal coliforms (if disinfected): <10cfu/100mL.

This is also referred to as the 10/10/10 standard by EPA Victoria. The nutrient removal performance varies considerably between and within advanced secondary treatment system types.

10.3.2 Collection / Pump Wells and Wastewater Pumps

Collection / pump wells must be designed and constructed to comply with AS/NZS 1546:2008. The capacity of domestic collection / pump wells shall be calculated based on the dosing requirements of the downstream component (e.g. subsurface irrigation area, trench or additional treatment system such as a sand filter).

A minimum of 12 hours retention time must be provided above the operating level of the flat switch for emergency storage. The storage capacity of a pump well must also be adequate to handle the peak hourly flow form the system (when considering pump capacities). All pump wells must have a minimum capacity of 1,000L.

Collection / pump wells installed in commercial or industrial premises shall be designed and sized according to the projected demand by a suitably qualified person. A high level alarm light (strobe) and / or audible device (buzzer) must be located on the premises so that failure of the pump set is easily detected.

Pump wells may be configured as demand dosing or timer dosing. This will depend on the need for flow balancing / equalisation. Float switches do not provide any flow balancing capabilities to a system.

- Tank size for timer dosing systems must be calculated using a cumulative storage assessment to make sure flow balancing can be sustained. Consideration will need to be given to variations in incoming hydraulic load and the maximum daily loading rate of the receiving component;

- A high level alarm light (strobe) and/or audible device (buzzer) must be located on the premises so that failure of the pump set is easily detected;
- Standby pumps which incorporate automatic cut-in devices must be installed in all systems except those serving single dwelling houses or premises where the daily flow is less than 1,500 litres; and
- Pump sets and control switches shall be installed in accordance with the manufacturer's specifications and to the requirements of the electricity supply authority.

10.3.3 Pumps

Pumps must be designed and warranted by the manufacturer for use in wastewater and should have a design life of at least five (5) years. Components will need to be corrosion resistant and capably of transferring wastewater with characteristics that match the job. Typically, a pump will be designed to convey wastewater with predicted characteristics, including raw wastewater (significantly large solids), primary treated effluent (some solids), secondary treated effluent ('dirty water') or advanced secondary treated effluent ('clean water').

Systems that utilise chlorine for disinfection will have a greater potential for pump corrosion. Domestic wastewater pumps must be warranted by the manufacturer to operate at the duty required for the job (i.e. frequently but for short periods, or constantly). Pumps must be capable of delivering wastewater at simultaneous flow rate and pressure that matches the hydraulic characteristics of the target component. The required flow rate and total dynamic head must be calculated for all pressurised components (i.e. dosing manifolds). The total dynamic head must be calculated for all non-pressurised components (i.e. transfer pumps between non-pressurised treatment components and pump dosed trenches and beds).

10.3.4 Dosing Siphon

If there is a desire to avoid the use of electricity and mechanical devices, a dosing siphon can be used to pressure dose system components. Automatic dosing siphons consist of a single apparatus with no moving parts installed in a collection tank that can trigger a siphon action when effluent rises to a predetermined level. The siphon resets itself when the level drops to a predetermined level prior to the next cycle. Requirements for the use of dosing siphons include:

- Dosing siphons for single domestic houses should be installed in a 250L collection well;
- Alternative sizes for the collection well will be necessary if doses that are larger or smaller than typical domestic loads are required; and
- A minimum fall of 0.5m will be required between the outlet of this well and the distribution manifold of the pressurised component.

10.3.5 Primary Treatment Systems

According to the EPA, there are two (2) broad categories of primary treatment systems for use with combined wastewater, blackwater only, or as pre-treatment for greywater treatment systems:

1. Septic tanks;
2. Aerobic biological filters (wet composting or vermiculture).

Primary-treated effluent quality can vary considerably, depending on a broad range of factors, and there are no minimum standards specified by EPA Victoria, however, primary effluent is anticipated to fall into the following ranges.

- Biochemical Oxygen Demand (BOD_5): 150-250mg/L.
- Total Suspended Solids (TSS): <40-140mg/L.
- E. coli or faecal coliforms (if disinfected): $<10^6$cfu/100mL.

Incinerating toilets do not produce effluent and dry composting toilets produce a concentrated leachate, to which effluent quality standards do not apply.

10.3.5.1 Septic Tanks

Septic tanks are traditionally the most common type of treatment system in established localities without reticulated sewerage. The technology is passive, where wastewater is gravity fed to a single tank, ideally fitted with a baffle and inlet and outlet 'T-pieces' to prevent extrusion of solids into the trenches or backflow to the inlet.

All new septic tanks should be fitted with an effluent outlet filter that fits into the outlet of the tank to reduce BOD_5, TSS, and fat / oil / grease content of effluent. Some tanks may require minor modification of the access hole to allow for maintenance of the filter. Where possible, an outlet filter shall be installed on existing septic tanks during rectification or modification works.

Dense solids settle to the bottom of the tank to form sludge, while a lower-density scum forms at the surface. Anaerobic digestion of colloidal and dissolved organic solids occurs, and some nitrogen and phosphorus is also removed. The primary-treated effluent is discharged by gravity for further treatment in a secondary treatment system, or to an EDS suitable for primary effluent (such as trenches, beds, or a mound).

Septic tanks should be pumped out before sludge build-up or scum thickness reduces the available capacity for wastewater detention to the point where treatment efficacy is being impacted. Depending on tank capacity, household occupancy and influent strength, the pump-out period would be required every three (3) to five (5) years for combined wastewater and blackwater septic tanks, and about 10-15 years for greywater only.

Septic tanks are subject to AS 1546.1:2008 as well as the EPA Guidelines and current system type EPA Certificate of Conformance.

10.3.5.2 Aerobic Biological Filters

Aerobic biological filters (wet composting or vermiculture systems) are also known as 'worm farms' and have increased in popularity over the past decade. Raw wastewater is discharged directly to the top of the filter (contained in a plastic tank similar to a septic tank) and a rich humus layer develops that separates the solids from liquid prior to composting the solids with the aid of soil micro and macro fauna, including earthworms.

The liquid is discharged by gravity to an EDS suitable for primary effluent and the composted solids are periodically removed by property owners or maintenance staff. Unless otherwise directed by Council, the composted humus material is to be buried within the confines of the premises. The cover of soil over the deposited humus must be at last 300mm deep, as per the GOWM (2024).

Compost must not be buried in an area used for the cultivation of crops for human consumption, unless: compost is placed in a separate lidded composting bin providing aeration for at least three (3) months with no further addition; or compost has been seasoned underground for at least three

(3) months. The system is a passive, biologically-driven treatment process that mimics processes occurring in nature.

Wet composting toilets (or vermiculture systems) are subject to AS 1546.1:2008 as well as the EPA Guidelines and current system type EPA Certificate of Conformance.

10.3.5.3 Dry Composting Toilets (waterless or low-flush)

Composting toilets are generally installed for water saving or lifestyle reasons (e.g. ‘eco homes’ or remote homes with limited water supply). They are very rarely retrofitted into existing homes, and require a separate greywater treatment system to treat all greywater streams (including kitchen greywater).

Any liquid in the system (i.e. urine) forms a concentrated leachate which is disposed of by gravity drainage to a small absorption trench, which has long-term sustainability implications and is not suitable for areas with shallow soils, heavy-textured soils, or high water tables.

Waterless composting toilets are subject to AS 1546.2:2008 as well as the EPA Guidelines and current system type EPA Certificate of Conformance.

10.3.6 Combined Wastewater Secondary Domestic Treatment Systems

According to the EPA, there are three (3) broad categories of domestic secondary treatment systems:

- Aerated wastewater treatment plants (AWTP);
- Sand and media filters; and
- Membrane bioreactors.

The technologies used in domestic-scale systems are also often used in commercial systems. The minimum standards for secondary effluent quality in Victoria as per Table 4-5 of the GOWM (2024), as follows:

- Biochemical Oxygen Demand (BOD_5): <20mg/L.
- Total Suspended Solids (TSS): <30mg/L.
- E. coli or faecal coliforms (if disinfected): <10cfu/100mL.

Nutrient removal performance varies considerably between secondary treatment systems and largely depends on design and operation (as well as influent nutrient concentrations).

10.3.6.1 Aerated Wastewater Treatment Plants

Domestic AWTPs are pre-fabricated, mechanically aerated treatment systems designed to treat wastewater flows of <2,000L/day. They are tank-based systems, comprising either one (1) or two (2) discrete tanks that typically employ the following processes:

- Settling of solids and flotation of scum in an anaerobic primary chamber or separate primary tank (effectively operating as a septic tank). This stage is omitted in some models.
- Oxidation and consumption of organic matter through aerobic biological processes using (active or passive) mechanical aeration.
- Clarification – secondary settling of solids.
- Disinfection – usually by chlorination but occasionally using ultraviolet irradiation.
- Regular removal of sludge to maintain the process.

AWTPs are typically supplied as stand-alone, proprietary systems. They require regular maintenance in accordance with the EPA Certificate of Conformance for the specific model (usually quarterly) to ensure satisfactory performance and adequate disinfection. The operating (power) costs of AWTPs are relatively high compared to more passive systems such as trickling filters and reed beds, as the aerobic treatment phase requires air blowers to be run for several hours each day.

AWTPs are generally not suitable for premises with intermittent use or surge loads, such as holiday homes and commercial premises with very low flow / high flow wastewater cycles. AWTP must not be switched off when not in use as the deprivation of oxygen will kill the aerobic bacteria within a few days and populations can take weeks to be re-established when the system is turned on and wastewater supply resumes. Some AWTP models have a low-flow switch which re-circulates effluent to keep aerobic bacteria alive when not in use.

All AWTPs must be installed with an alarm that has visual and audible components to indicate mechanical and electrical malfunctions. The alarm shall have one (1) signal next to it and another in a suitable position attached to the house. The alarm shall incorporate a warning lamp, which may be reset only by the service agent. Prior to the installation of a system, the owner must enter into an annual service contract for the AWTP with a service agent authorised by MPSC.

AWTP are subject to *AS1546.3:2017* as well as the EPA Guidelines and current system type EPA Certificate of Conformance.

10.3.6.2 Sand and Media Filters

For all sand and media filters, the influent must first undergo a minimum of primary treatment (e.g. a septic tank). Sand and media filters are configured to provide a very large surface area to volume ratio, which hosts aerobic microorganisms that treat the effluent as it passes over the media, usually by gravity. Proprietary filter systems typically incorporate the primary treatment tank into a stand-alone unit and recirculate a proportion of the treated effluent through the filter to improve effluent quality. The system is typically located below or at ground level. Media filters can also be single-pass (i.e. non-recirculating) and therefore require a larger surface area to ensure adequate hydraulic residence time (HRT) of effluent.

Media filters are generally more resilient to intermittent flows and shock loading than AWTPs, and can have significantly lower operating costs. Recirculating systems have a relatively small footprint (and demand for materials) compared to single-pass sand filters; however, single pass filters can be designed with passive (gravity) dosing, requiring no electricity to operate.

Site-specific hydraulic designs are required to support passive dosing systems. For consistently high-strength influent wastewater (such as food or dairy processing premises), an additional primary treatment stage or secondary pre-treatment stage may be required, with the filter providing final effluent ‘polishing’.

10.3.6.3 Membrane Filters

Membrane filters provide advanced secondary treated effluent using microfiltration or reverse osmosis membranes, usually following primary and secondary treatment in separate chambers or tanks. Use of membranes requires high energy use and therefore the ongoing costs as well as upfront costs of membranes systems which are high when compared to other systems. Furthermore, the systems require regular, ongoing maintenance to ensure membranes are not damaged or remain fouled.

10.3.7 Combined Wastewater Secondary Commercial Treatment Systems

These systems are for predominantly human waste (minimal trade wastes) with flows 2,000-5,000L/day (in accordance with EPA regulations). The treatment technologies used are broadly similar to those used in domestic wastewater treatment systems, but are expanded in scale.

Some systems are modular in design, using numerous small treatment units either in series or in parallel, allowing expansion of treatment capacities where required. In many cases, companies will provide systems to both the domestic and the commercial market.

10.3.8 Key Issues for Wastewater Treatment System Selection and Design

For domestic and commercial wastewater management systems alike, the key issues that determine the selection of wastewater treatment systems are:

- Flow volumes / loads;
- Flow rates and peaks, including intermittent usage;
- Wastewater strength (particularly organics); and
- The degree of constraint of the site for land application of effluent.

Depending on the nature of the development, these aspects of wastewater management can vary significantly and pose challenges to the system designer and owner. Specialist design is typically required for commercial wastewater streams and for seasonal fluctuations in flows (such as holiday rental properties).

10.4 Effluent Dispersal Systems

The range of available EDS options are discussed in the following sections. The location of the EDS and the preferred EDS option must be determined based on the outcomes of the appropriate level of LCA as per Section 6.2 of the Operational Plan. The Table 4-8 of the GOWM (2024) and Table 5.2 of *AS/NZS 1547:2012* provide the recommended DLRs / DIRs for EDS, based on soil type.

10.4.1 Absorption Trenches / Beds

Absorption trenches / beds have conventionally been used for land application of septic tank effluent. These systems rely substantially on effluent absorption to the soil and impose relatively high loading rates on the soil when compared to irrigation, increasing the risk of systems being overloaded and failing hydraulically in the long term.

Furthermore, prolonged effluent application through absorption systems increases the risk of soil degradation by increasing salinity and sodicity, as well as the build-up of impermeable or slowly-permeable ‘bio-mats’ (clogging layer) which can prevent movement of effluent into the soil, leading to ‘creeping failure’. These systems offer very limited opportunity for effective reuse of effluent and do not represent current best practice.

Over the years there have been various modifications to conventional absorption trenches and beds, some of which have been developed into proprietary ‘off-the-shelf’ products including various brands of self-supporting arch drains and the Advanced Enviro-Septic™ modular trench.

Absorption trenches / beds are considered inappropriate for sites with shallow soils, high groundwater, or heavy-textured (clay) soils due to limited infiltration capacity. They are also generally not suitable for gravels and sands, as the very high permeability of these materials can inhibit treatment within the soil profile and allow effluent to rapidly percolate to the groundwater table. Areas with high rainfall are also at high risk of surface and groundwater contamination from absorption trenches / beds.

Absorption trenches / beds may be used with secondary-treated effluent, which can be dosed at a higher rate than primary-treated effluent, in accordance with the Table 4-8 of the GOWM (2024) and Table 5.2 of *AS/NZS 1547:2012*.

Absorption trenches / beds must be inspected by Council;

- Prior to backfilling; and
- After completion of all work (and landscaping / turfing).

10.4.2 Evapotranspiration-Absorption (ETA) Trenches / Beds

Evapotranspiration-absorption (ETA) trenches / beds are essentially shallower absorption systems that allow some plant uptake of the effluent from the soil profile, reducing the amount of effluent that is leached to deeper soils and groundwater.

They can improve public health and environmental outcomes for areas with heavy-textured soils, shallow soils, or high watertables when compared to conventional absorption systems. However, they are prone to similar problems to conventional absorption trenches / beds, including build-up of bio-mats and rapid percolation in highly-permeable soils.

ETA systems are suitable for both primary and secondary treated effluent; however, the design loading rates (DLRs) nominated by both Table 4-8 of the GOWM (2024) and *AS/NZS 1547:2012* do not vary with the level of treatment (as is the case for absorption systems).

ETA beds must be inspected by Council:

- Prior to backfilling; and
- After completion of all work (and landscaping / turfing).

10.4.3 Enhanced ETA Trenches / Beds

In recent years, there have been several proprietary and custom-built modifications to standard ETA trenches / beds, which further optimise evapotranspiration of effluent and minimise deep drainage.

The most common example is the custom-made geotextile-wrapped and / or lined arch or pipe trenches, which use capillary action in the geotextile to 'wick' effluent into the topsoil and root zone above, and are referred to in Section 2.4.2.3 of the GOWM (2024) as a 'wick trenches'. Wick trenches are generally considered suitable for low-permeability soils. Like standard ETA systems, the modified versions are suitable for both primary and secondary treated effluent.

Table 4-8 of the GOWM (2024) nominates DLRs for wick trenches using secondary-treated effluent. For primary-treated effluent, however, the nominated DLRs for standard ETA systems should be adopted as per Table 5.2 of *AS/NZS 1547:2012*. The long term performance of modified ETA systems has not been tested as they are a relative recent innovation. Use of primary-treated effluent could result in clogging of geotextile materials over time.

10.4.4 Mounds

Wisconsin mounds are often an appropriate onsite solution for lots with limited space, shallow soil profiles, poor drainage, or high water tables. Mounds are effectively raised soil absorption systems comprising layered fill, into which effluent is dosed. Effluent receives further treatment as it percolates down through the mound and is then absorbed by the natural soils below the mound. A properly designed mound can have a higher evapotranspiration potential than an ETA bed of equivalent size, further enhancing effluent dispersal on constrained lots.

Mounds have a considerable up-front cost in the materials and construction, and are suitable for primary or secondary treated effluent, providing further treatment of effluent as it moves through the sand profile.

In addition, there are proprietary mound systems which use a modified fill media primarily from industrial waste products of aluminium or iron smelting, which have a very high phosphorus adsorption capacity. When designed, installed, and maintained correctly, these systems can present a good solution for constrained sites. However, the success of these systems has been variable in the past, largely due to inappropriate design and installation.

Mounds must be inspected by Council;

- Once the basal area of the mound has been prepared;
- Prior to covering the distribution manifold and before the agricultural pipe has been placed over the pressure manifold. At this inspection the squirt height from all orifices will be measured. There should be no more than 15% variation in squirt height across the whole manifold; and
- After completion of all work and landscaping / turfing.

10.4.5 Low Pressure Effluent Distribution Irrigation

LPED irrigation systems were originally developed for use in sandy soils where conventional absorption system can result in overloading of soils. However, Table 4-8 of the GOWM (2024) and Table 5.2 of *AS/NZS 1547:2021* now prohibits the use of LPED systems in Category 1 and weakly structured Category 2a soils, as well as all Category 6 soils. LPED systems can be beneficial for Category 5 soils; however, the large area they must occupy for such soils would be better served by subsurface irrigation using secondary treated effluent (refer Section 10.4.7).

In LPED systems, effluent is discharged into 25-30mm perforated pipes contained within 50-100mm slotted pipes, to distribute effluent more evenly into the surrounding aggregate and to prevent soil intrusion into the perforations. The pipes are laid in narrow, shallow trenches filled with aggregate and capped with topsoil in order to optimise contact with aerobic bacteria in topsoil and to facilitate plant uptake of effluent. The system can be pressurised using a pump or a passive dosing device, with a detailed hydraulic design to ensure even distribution throughout the system.

LPED irrigation can be used with either primary or secondary effluent, but is more commonly used as an alternative to trench and bed systems for primary effluent. It is recommended that an outlet filter is installed on primary treatment systems to reduce the amount of suspended solids and organics being conveyed into the LPED system. Table 4-8 of the GOWM and Table 5.2 of *AS/NZS 1547:2012* provide DLRs for LPED systems, with a single DLR for both primary and secondary effluent).

10.4.6 Surface Spray Irrigation

Surface spray irrigation (using mist or droplet sprinklers) while increasing in popularity over the past 20 years, is now considered an outdated technology that can pose unacceptable public health and the environment risks due to potential exposure and also surface runoff during rainfall.

Often, an inadequate number of sprinklers are installed to ensure even coverage over an adequately large area; and commonly the sprinklers are not fixed and must be frequently moved by the resident to reduce over-loading which is often neglected over time. In addition, surface irrigation is not considered appropriate for slopes greater than 10% as the risk of runoff increases. Surface spray irrigation is more suitable for relatively large and flat areas, with limited access to the irrigation field and large buffer distances to surface watercourses and drains.

For typical domestic and small commercial sites, subsurface or covered-surface (i.e. under mulch) drip irrigation is considered best practice. As per Section 2.4.3.3 of the EDRS (2024), surface irrigation system should only be installed on large residential properties or large industrial / commercial developments with sufficient area to able restricted access to the EDS, ensuring no human or animal exposure. Council does not permit any new surface irrigation systems to be installed on small residential lots, but permits the existing surface irrigation systems to be managed as per their current permit.

10.4.7 Subsurface or Covered-surface Drip Irrigation

Subsurface irrigation (SSI) or covered-surface drip irrigation (CSDI) systems are becoming more popular in recent years. Properly designed systems apply effluent at much lower volumetric rates and over larger areas than absorption / ETA systems and mounds.

Effluent is applied in the root zone of plants, 100-150mm below the surface in 250mm of topsoil material, at a rate that more closely matches plant and soil requirements (evapotranspiration), leading to effective effluent reuse. The reliance on soil absorption is relatively low and hence the risk of contaminants accumulating in the soil or leaching to groundwater is also low.

SSI typically comprises a network of proprietary, pressure-compensating drip-irrigation line that is specially designed for use with effluent and contains specially designed emitters that reduce the risk of blockage, biofilm development and root intrusion. SSI virtually eliminates the risk of people inadvertently coming into contact with effluent and also minimises the risk of effluent being transported off-site, even during rain. SSI may be installed on sloping lots, provided the DIR is reduced accordingly to ensure that effluent migration down slope is taken up adequately within the root system (as per Table M2 of *AS/NZS 1547:2012*).

When properly designed, installed and operated, the system will ensure good distribution of effluent at uniform, controlled application rates. By properly sizing the EDS to ensure sustainable hydraulic and nutrient loading rates, water, and nutrients can be effectively utilised and are unlikely to seep to groundwater or run-off to surface waters. Care must be taken in designing and installing systems in areas that experience temperatures below freezing.

SSI / CSDI systems must be inspected by Council prior to:

- Occupation of a new dwelling; and
- Commissioning of the treatment system.

10.4.8 Key Issues for Wastewater Treatment System Selection and Design

The key issues that influence the selection and design of EDS are:

- The level of treatment of the effluent (primary, secondary, or advanced secondary);
- Soil characteristics (particularly texture, structure, depth, dispersibility, and phosphorus adsorption capacity);
- Site characteristics (particularly slope, aspect, and shading); and
- Proximity to sensitive receiving environments (such as surface waters and groundwater).

For constrained sites, the preferred effluent management strategy can dictate the level of wastewater treatment required. For example, a small lot with insufficient area to apply the entire effluent load may require a composting toilet with advanced greywater treatment for beneficial reuse to reduce volume of treated effluent being applied to the limited available space. In some cases, there may be no suitable solution, or a pump-out tank may be required to tanker wastewater off-site for dispersal at an approved facility.

11 Glossary of Terms

Term	Definition
Aerobic treatment	Biological treatment processes that occur in the presence of oxygen (i.e. aerobic bacteria digest wastewater contaminants). Aerobic bacteria are organisms that require oxygen to survive and grow.
Anaerobic treatment	Biological treatment processes that occur in the absence of oxygen.
Blackwater	Wastewater from toilets.
Desludging	Removal of the semi solid waste from a tank.
Effluent	Liquid that flows out of a wastewater treatment plant following Treatment.
Evapotranspiration	Transfer of water from the soil to the atmosphere through evaporation and plant transpiration.
Organic Matter	Material that comes from the tissues of organisms (plants, animals, or microorganisms) that are currently or were once living.
Greywater	Wastewater from showers, baths, hand basins, washing machines, laundry troughs and kitchens.
Hardpan	A hardened, compacted and/or cemented horizon.
Locality	The broader locality surrounding a town (place name within mapped boundaries).
Non-Potable	Water not suitable for human consumption.
Parcel	The smallest unit of land able to be transferred within Victoria's cadastral system, usually having one proprietor or owner (land.vic.gov.au). For the purposes of this OWMP, parcel and lot are given to have the same meaning.
Peds	An aggregate of soil particles.
Permeability	The ability of the soil to allow water to pass through.
P-sorb	Phosphorus adsorption capacity of soil.
Property	Land under common occupation (land.vic.gov.au). May include multiple lots.
Risk	The 'likely' consequence of off-site (OWM) impacts based on the cumulative effect of individual lot constraints (soil suitability, slope, useable lot area, climate and location) and variables affecting the specific land capability and associated limitations of the lot to sustainably manage wastewater in compliance with *EP Act 2017* objectives.
Settlement	An area of residential development within the Rural Living Zone or Rural Conservation Zone.
Sewage	Wastewater containing any of human excreta, urine and toilet flush water and includes greywater (which is also called sullage and may include water from the shower, bath, basins, washing machine, laundry trough and kitchen) (*EP Regulation 2021*).
Sewerage	A system of sewers.
Town	The town servicing a locality, which is predominantly zoned Township Zone. It contains both residential and commercial development.

12 References

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Appendix A

Informative Maps

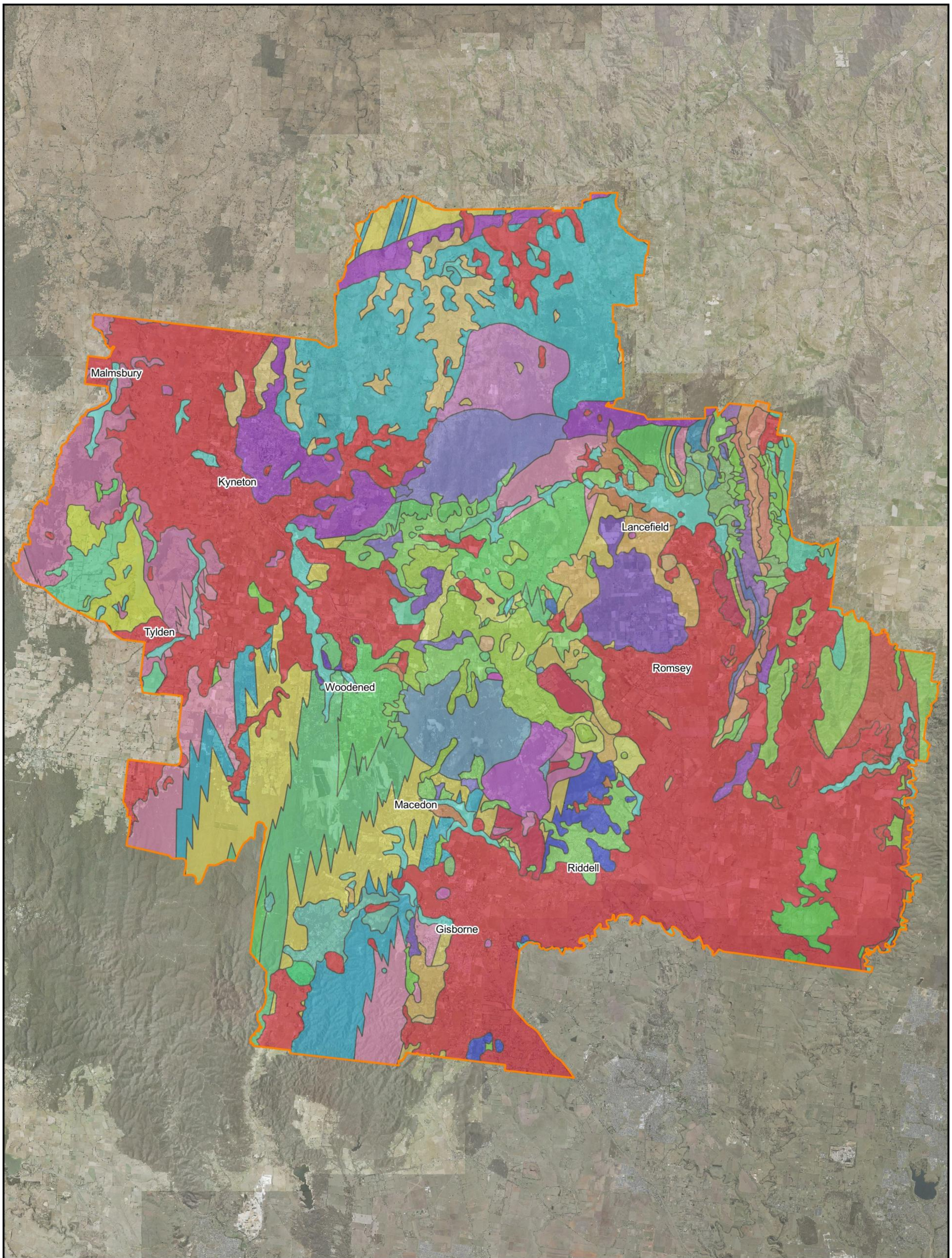

Figure A1: Geology

MRSC OWMP 2025 - 2030

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0 5 10 15 20 km

(Approx Scale)

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Revision	001
Drawn	CM
Approved	MS

MRSC LGA Boundary

Geology Unit

- alluvial terrace deposits(Qa2): generic
- alluvium(Qa1): generic
- Angry Hill Sandstone (Ocra): generic
- Bacchus Marsh Formation (Pxb): generic
- Barringo Granodiorite(G282): generic
- Baynton Granodiorite-porphyritic phase(G284a): generic
- Baynton Granodiorite(G284): generic
- Beauvallet Granodiorite (G285): generic
- Bolinda Shale (Osb): generic
- Bryo Gully Shale (Ocrb): generic
- Bullengarook Gravel (Nxu): generic
- Castlemaine Group - Bendigonian(Ocb): generic
- Castlemaine Group - Castlemainian(Occ): generic
- Castlemaine Group - Chewtonian(Och): generic
- Castlemaine Group - Darriwilian(Ocd): hornfels
- Castlemaine Group - Lancefieldian(Ocl): generic
- Castlemaine Group - Yapeenian(Ocy): hornfels
- colluvium(Qc1): generic
- conglomerate and sandstone (Czg): generic
- Deep Creek Siltstone(Sxd): generic
- dissected colluvium (Qc5): generic
- duricrust (Czf): generic
- Goat Rocks Conglomerate(Srg): hornfels
- Goldie Chert(-Cxg): generic
- granite-derived colluvium (Qc4): generic
- granodiorite porphyry (Dmg): generic
- Hesket Ignimbrite(Dmh): generic
- Humevale Siltstone (Dxh): generic
- incised alluvium (Na): generic
- incised colluvium (Nc1): generic
- Kirribilly Siltstone(Srk): hornfels
- Knowsley East Shale(-Cxk): generic
- Lano Gully Sandstone(Ocrl): generic
- Mount William Metabasalt(-Chm): generic
- Newer Volcanic Group - basalt flows (Neo): generic
- Newer Volcanic Group - icelandite (Net1): generic
- Newer Volcanic Group - scoria deposits(Nes): generic
- Pyalong Granite(G283): generic
- Riddell Sandstone Eastonian(Osre): generic
- Riddell Sandstone Gisbornian(Osrg): generic
- Riddell Sandstone(Osr): generic
- Romsey Subgroup(Ocr): generic
- slump deposits(Qc3): generic
- Smokers Creek Volcanic Subgroup - benmoreite lava (Neab): generic
- Smokers Creek Volcanic Subgroup - basanite lava (Neaa): generic
- Smokers Creek Volcanic Subgroup - hawaiite lava (Neah): generic
- Smokers Creek Volcanic Subgroup - mugearite lava (Neam): generic
- Smokers Creek Volcanic Subgroup - trachyte lava (Neat): generic
- Springfield Sandstone (Sxs): generic
- Stauro Gully Shale plus Split Hill Sandstone plus Bryo Gully Shale (Ocr2): generic
- Sunbury Group (Os): generic
- swamp and lake deposits (Qm1): generic
- White Hills Gravel(-Pxh): generic
- Willimigongong Ignimbrite(Dmw): generic
- Yungabulla Formation (Neay): generic

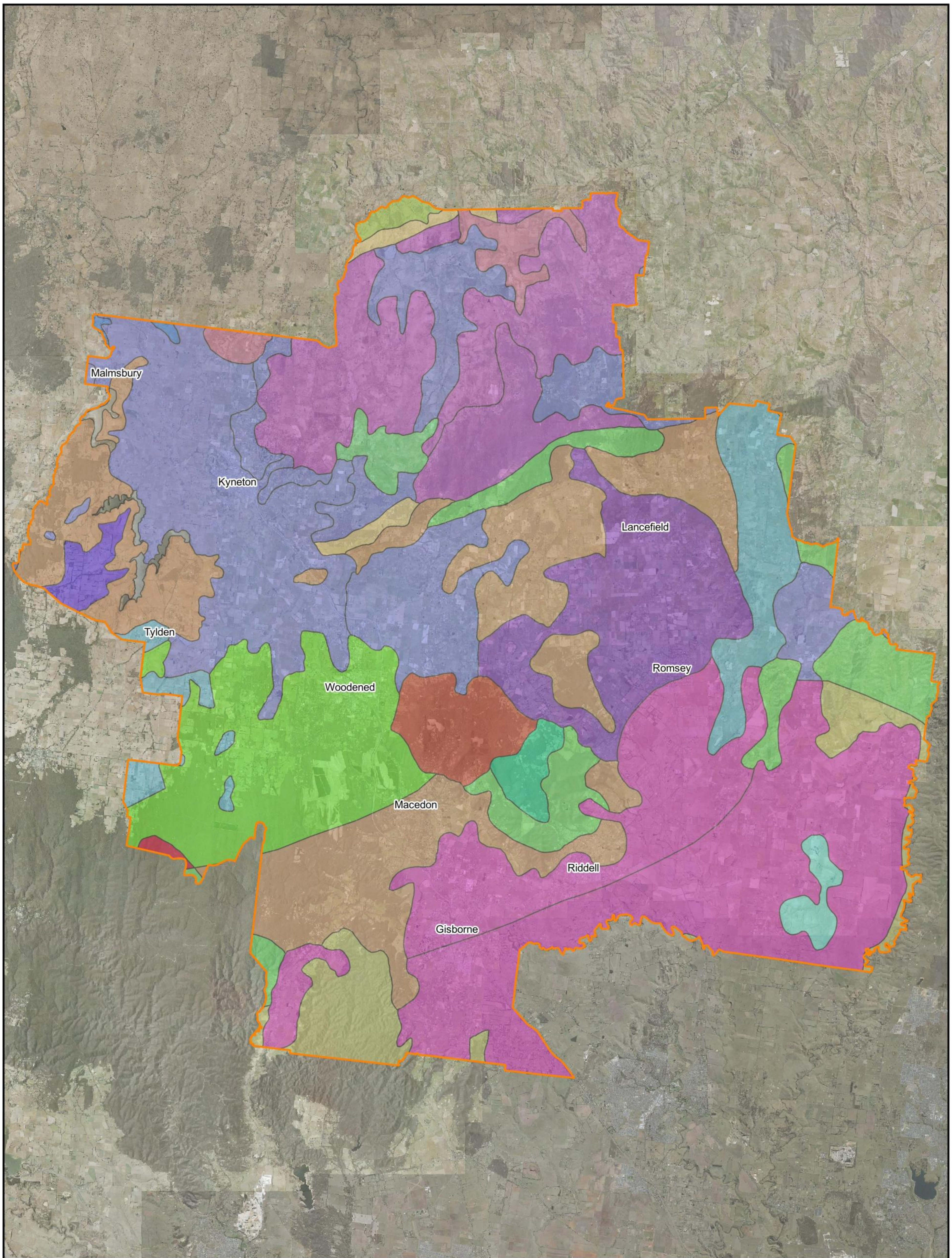

Figure A2: Soil Units

MRSC OWMP 2025 - 2030

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0 5 10 15 20 km

(Approx Scale)

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MRSC LGA Boundary

Soil Unit

- 'Duplex soils, Sands'
- 'Friable earths, Mottled duplex soils'
- 'Red duplex soils, Brown earths'
- 'Red duplex soils, Yellow duplex soils'
- 'Red earths, Brown duplex soils'
- 'Red earths, Red duplex soils'
- 'Red loams, Grey loams'
- 'Shallow stony earths, Friable earths'
- 'Shallow stony loams, Stony red duplex soils'
- 'Stony red earths, Yellow duplex soils'
- 'Yellow earths, Mottled duplex soils'
- Mottled duplex soils
- Red friable earths
- Reddish brown earths
- Reddish yellow earths
- Stony earths
- Yellow duplex soils
- Yellowish brown earths
- Yellowish duplex soils

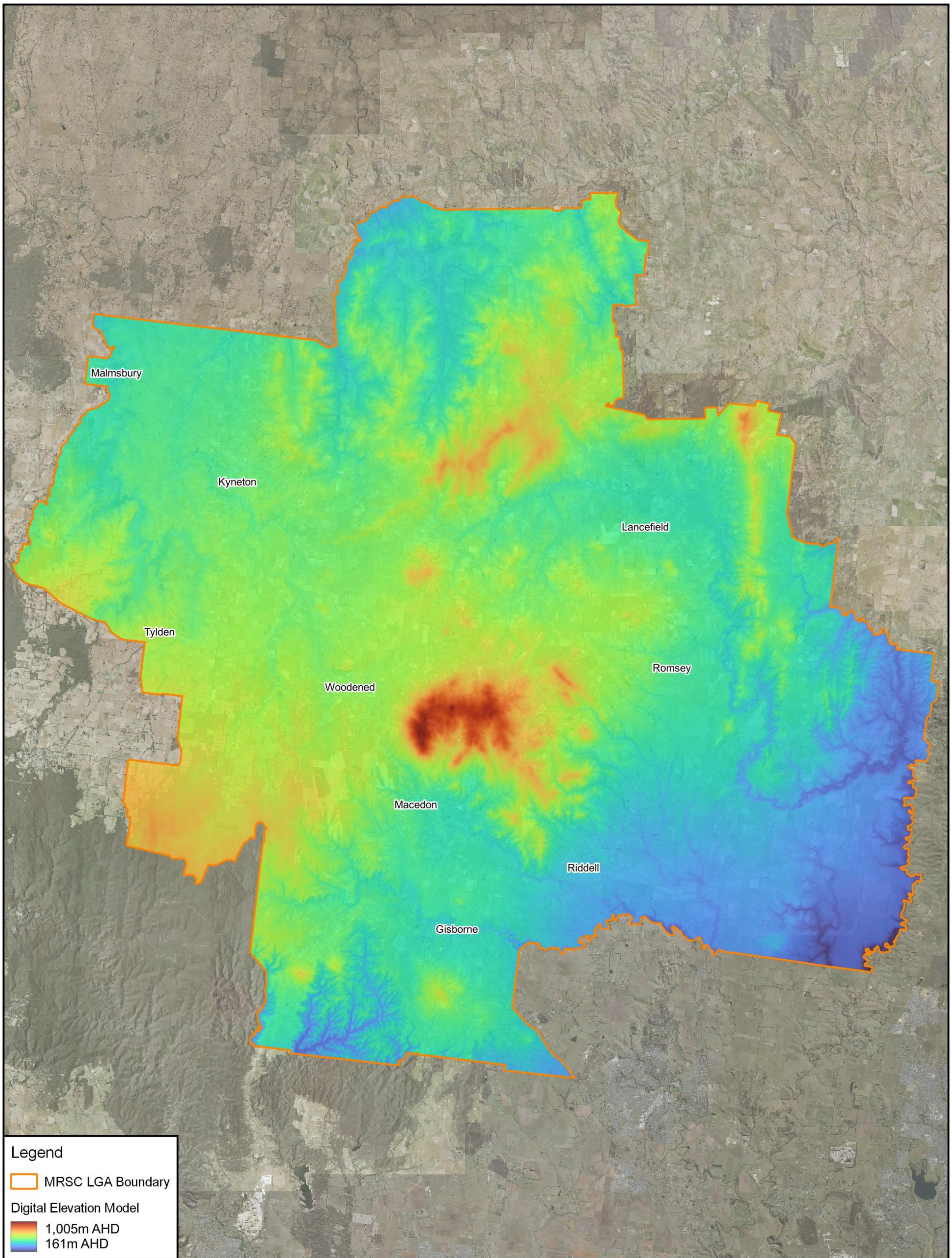

Figure A3: Elevation

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0 5 10 15 20 km (Approx Scale)

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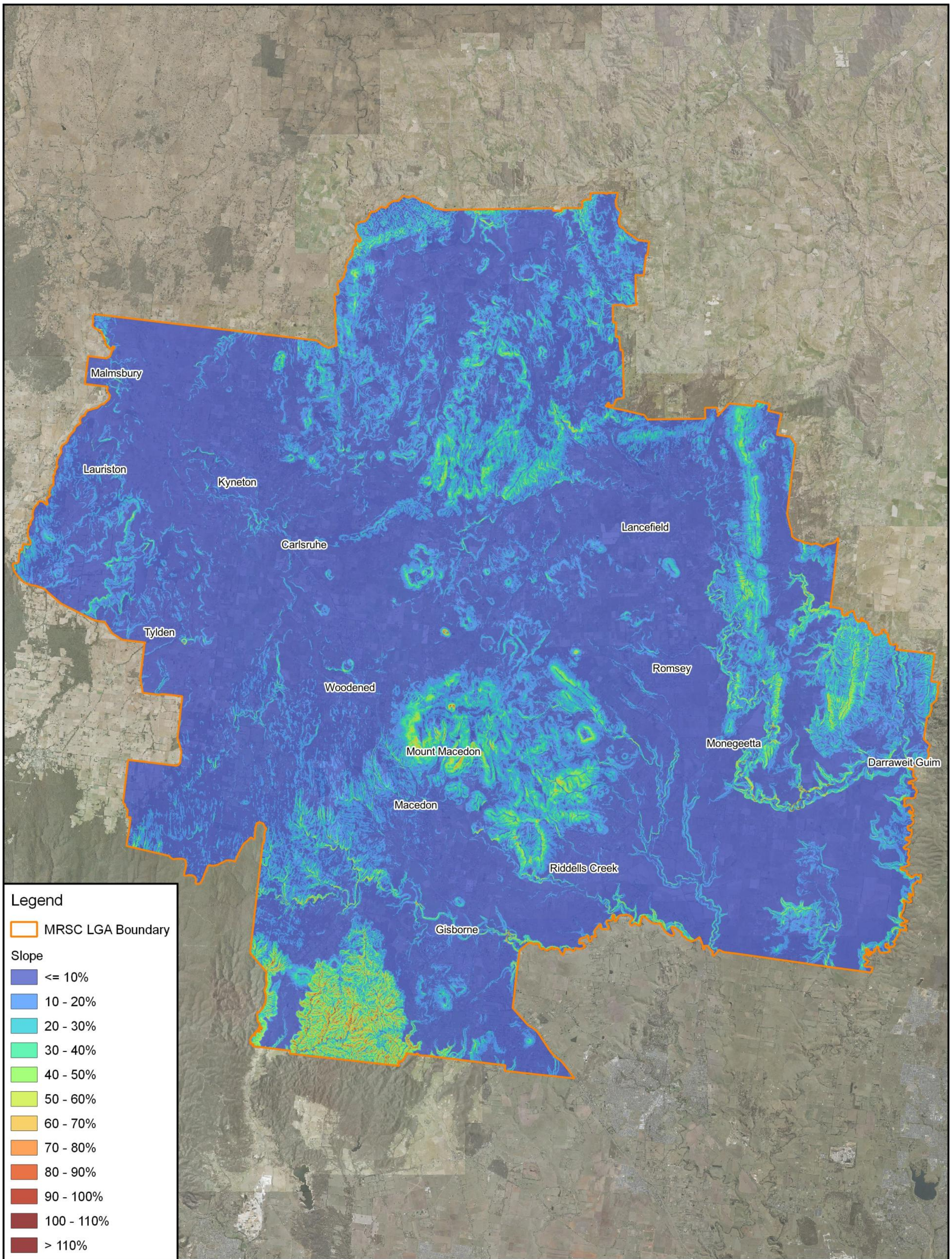

Figure A4: Slope

MRSC OWMP 2025 - 2030

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(Approx Scale)

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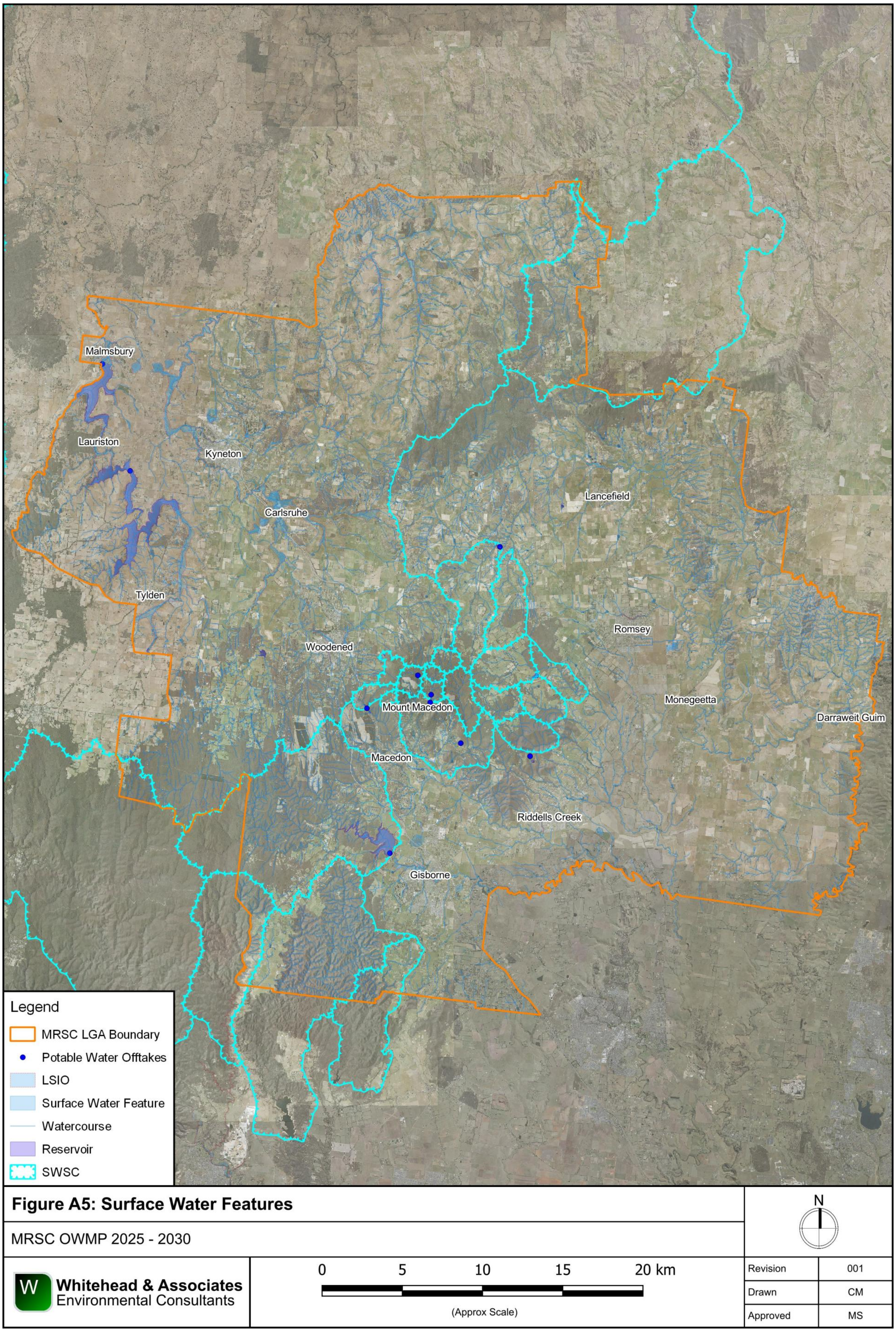

Figure A5: Surface Water Features

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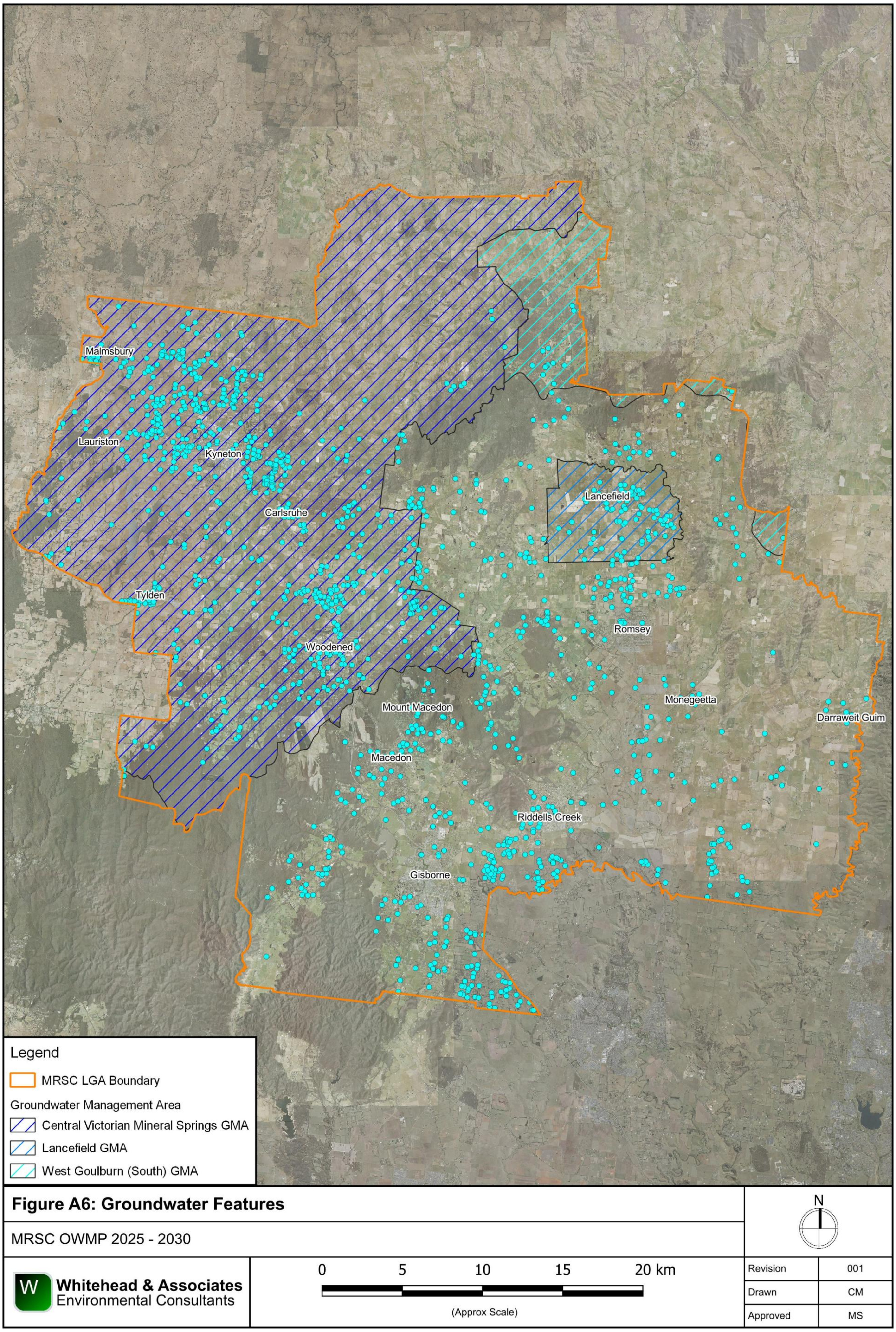

Figure A6: Groundwater Features

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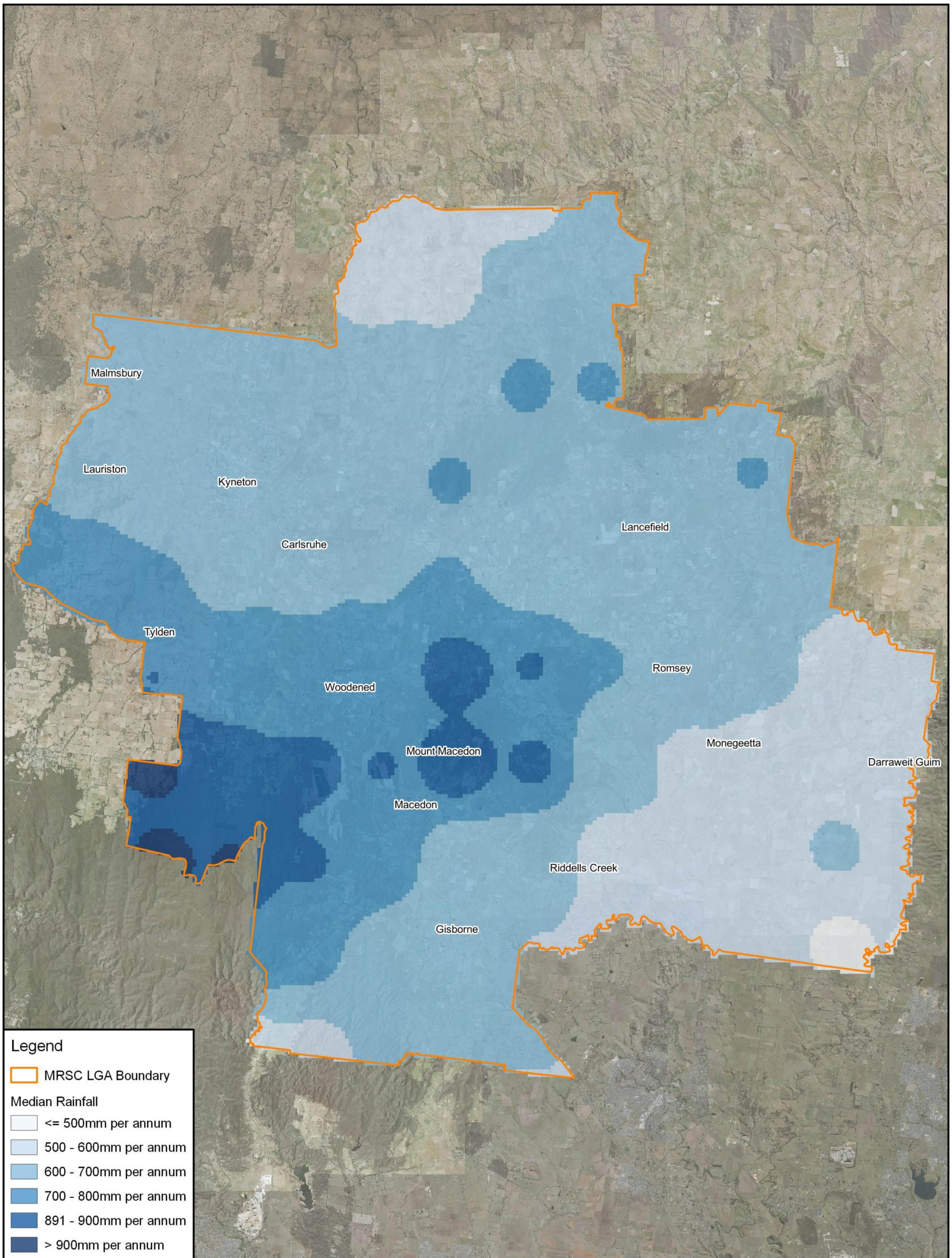

Figure A7: Annual Rainfall

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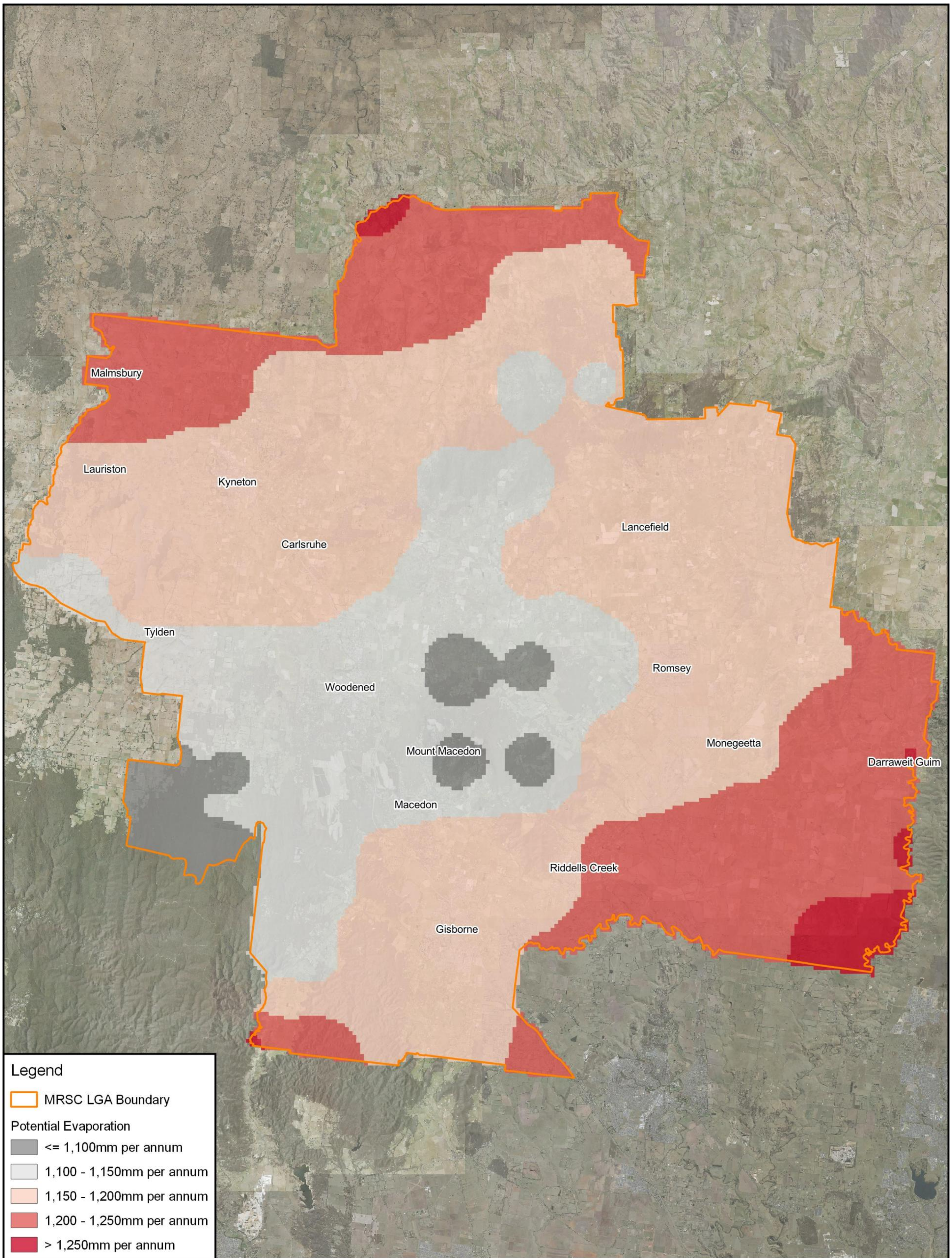

Figure A8: Annual Potential Evaporation

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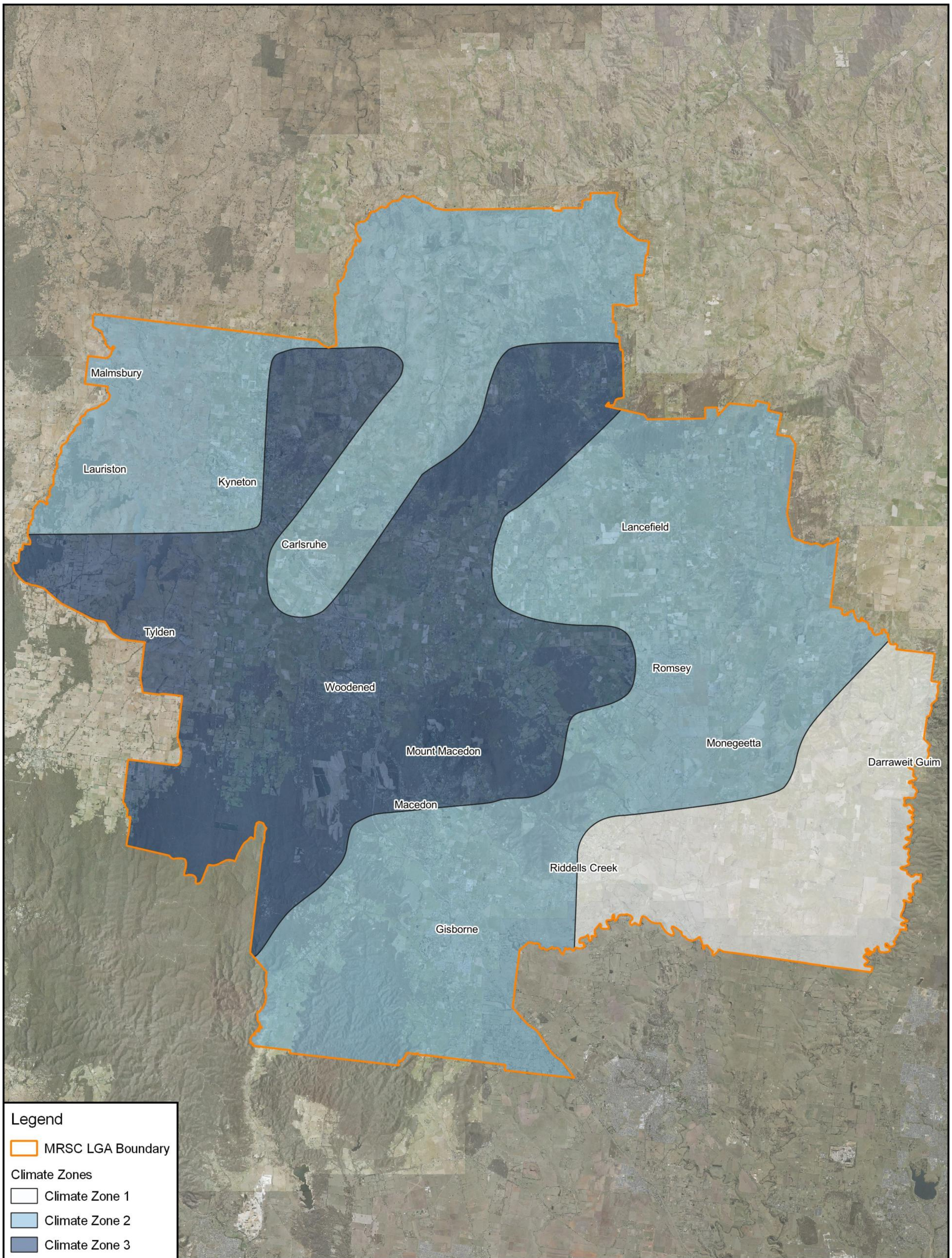

Figure A9: Climate Zones

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0 5 10 15 20 km

(Approx Scale)

N

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Appendix B

Locality Reports

Sizing Tables for each EDS type were created using conservative monthly water balances, following methods described in the MAV & DSE Model LCA (2014). Monthly median rainfall and mean evapotranspiration data for each locality was sourced from the SILO climate databases. The SILO databases use accurate meteorological data collected throughout Australia over long time periods.

The DLRs and DIRs were taken from the current EPA Guidelines and Table 5.2 of AS/NZS 1547:2012. Where the current EPA Guidelines and AS/NZS 1547:2012 has precluded use of a particular type of system on a certain soil type, it is shown as 'N/A' for that soil type in the Sizing Tables.

Where the evapotranspiration deficit requires unrealistically large EDS for a particular system on a certain soil type, it is also shown as 'N/A' for that soil type in the Sizing Tables. Detailed, site-specific LCAs and system designs would be required to further investigate the feasibility of systems deemed 'N/A' in the sizing tables. Mitigation measures, such as importation of topsoil to appropriate depths in the EDS, may be required to sustainably achieve effluent dispersal on constrained lots.

A. Woodend Locality Report

1f. Introduction

Woodend is located within the centre of the Shire, positioned between Macedon / Mount Macedon and Carlsruhe. The locality has a population of 6,732 residents, with 2,777 private dwellings (ABS, 2021). The township and adjacent area is serviced by reticulated sewer. There are a total of 1,078 unsewered developable lots in the locality.

Based on the Pathway database, there are a total of 540 OWM permits within the locality. A summary of the OWMS configurations are presented in the following.

- 134 septic tank and absorption systems;
- 6 pump-out systems;
- 1 vermiculture and subsurface irrigation system;
- 16 septic tanks with unknown EDS;
- 12 vermiculture systems with unknown EDS;
- 67 AWTP and subsurface irrigation systems;
- 61 AWTP and surface irrigation systems;
- 34 AWTP and absorption systems;
- 2 sand filter and subsurface irrigation systems;
- 2 sand filter and absorption systems;
- 27 AWTP systems with unknown EDS;
- 1 sand filter system with unknown EDS;
- 2 unknown treatment systems with subsurface irrigation;
- 1 unknown treatment system with surface irrigation; and
- 174 permits with no OWMS details.

The locality is situated within the Eppalock, Macedon (Kitty English Res), Rosslynne Reservoir (Jackson Creek) and Lancefield (Deep Creek) SWSC areas, with the entire locality within the Central Victorian Mineral Springs GMA.

2f. Summary of Constraints to OWM

Characteristic	Description
Climate	Median rainfall of 725.6mm/year, with mean evaporation of 1,128.5mm/year. Rainfall exceeds evaporation for four (4) months of the year. The entire locality is located in Climate Zone 3.
Surface Waterways	The Campaspe River and Five Mile Creek intersect the locality, with many smaller tributaries throughout. The Campaspe Reservoir is located in the west, with many farm dams scattered throughout.
Groundwater	There are 109 domestic GW bores located throughout the Shire, mostly concentrated within the centre of the locality. A dense cluster of bores is also identified in the east in proximity to South Rick Road.

Characteristic	Description
Land Subject to Inundation	Land adjacent Five Mile Creek in proximity to the township is identified as being flood impacted.
Climate Zone	Zone 3: 1,078 Zone 2: 0 Zone 1: 0
Useable Lot Area Risk	Very High: 410 High: 447 Moderate: 172 Low: 49
Slope Risk	High: 125 Moderate: 396 Low: 562
Soil Suitability Risk	High: 913 Moderate: 165 Low: 0 *Soil landform units: Wombat / Palaeozoic, Kyneton, Diogenes and Macedon; subsoil consists of MC / HC.*
Risk Analysis Rating	Very High: 35 High: 606 Moderate: 437 Low: 0

3f. Risk Analysis (Map)

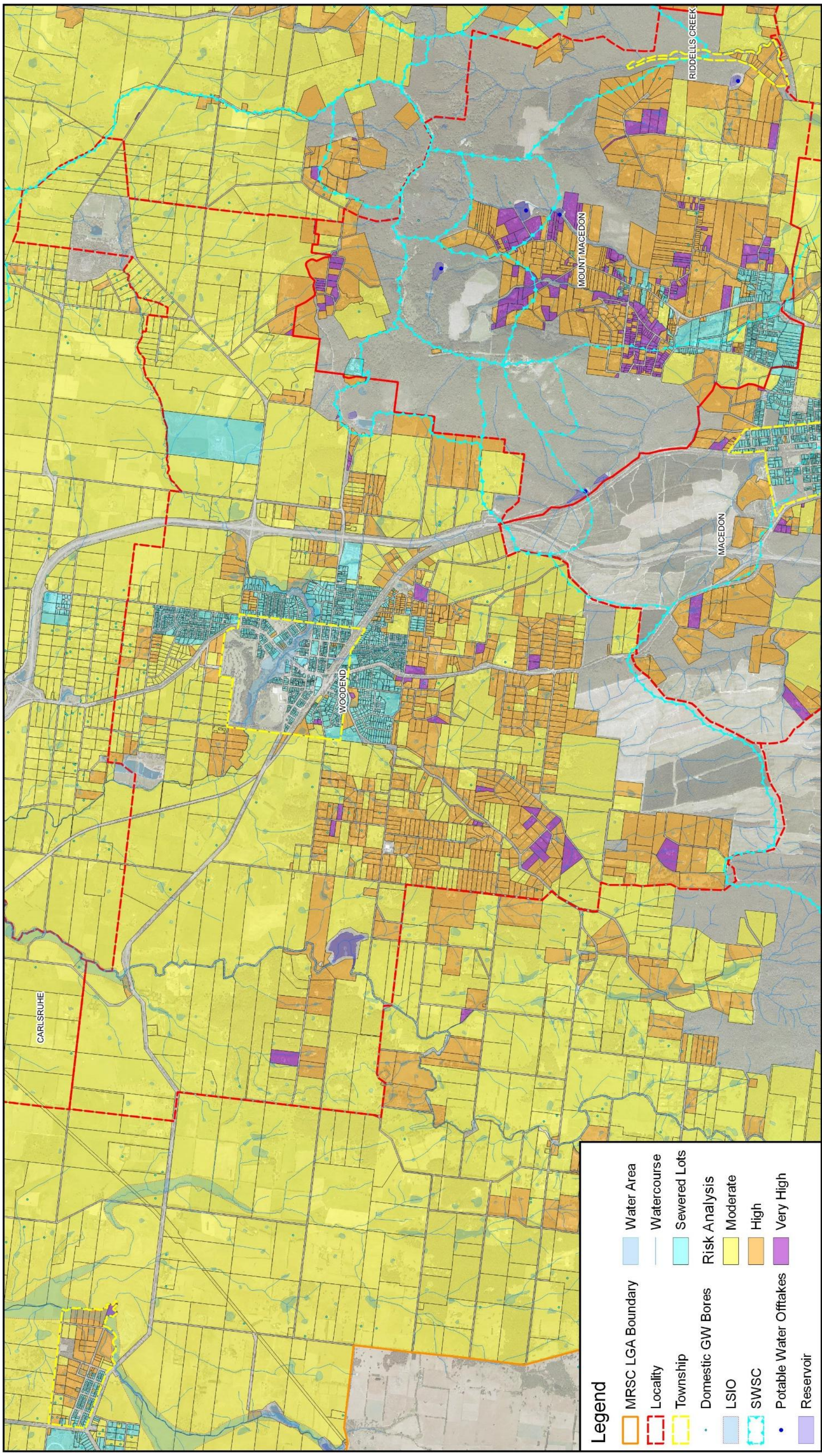

Figure B1: Woodend Locality

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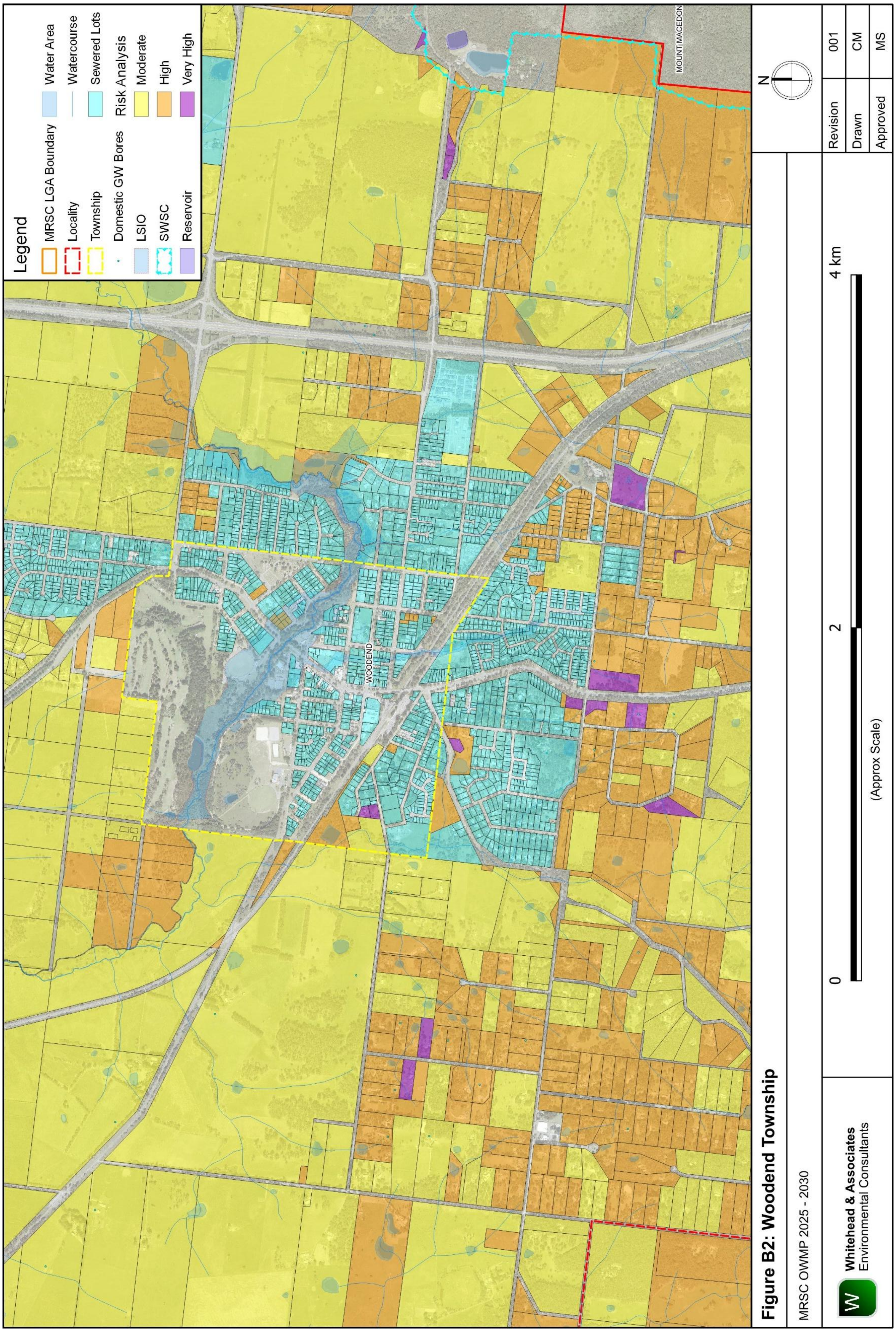

Figure B2: Woodend Township

4f. System Sizing Tables

The EDS sizing tables for Woodend are provided below.

Woodend - Sizing Tables

1 - 3 Bedroom Dwelling

EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	235		345	455	665	N/A[7]
Conventional Absorption System	N/A[3]		95	400	N/A[4]	
Evapotranspiration-Absorption System			95	260		
LPED Irrigation	N/A[6]		455	665	1,220	N/A[6]

4 Bedroom Dwelling

EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	295		435	570	830	N/A[7]
Conventional Absorption System	N/A[3]		120	500	N/A[4]	
Evapotranspiration-Absorption System			120	325		
LPED Irrigation	N/A[6]		570	830	1,525	N/A[5]

>5 Bedroom Dwelling

EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	350		520	680	995	N/A[7]
Conventional Absorption System	N/A[3]		140	600	N/A[4]	
Evapotranspiration-Absorption System			140	385		
LPED Irrigation	N/A[6]		680	995	1,830	N/A[5]

Note:

[1] Irrigation systems assumed to be installed on slopes of <10%. Reduction in DIR required for slopes exceeding 10%, as per Table M2 of *AS/NZS 1547:2012*.
[2] Secondary treatment and disinfection required.
[3] LCA required indicating lack of high perched watertable / high seasonal watertable.
[4] Special design requirements and distribution techniques or soil modification required, refer Notes 2 & 3 in Table L1 of *AS/NZS 1547:2012.*
[5] Secondary treatment required for all systems in Cat 6 soils.
[6] Drip irrigation preferred irrigation method.
[7] Not applicable due to climatic constraints.

5f. System Selection and Management Strategies

Conventional absorption trenches and beds may not be suitable to some areas of the locality due to heavy-textured soils throughout. Table 4-8 of the GOWM (2013) prohibits LPED systems on Category 5 and 6 soils (medium to heavy clays). Irrigation (drip and spray) EDS may not be applicable within the locality due to climatic conditions.

B. Riddells Creek Locality Report

1h. Introduction

Riddells Creek is in the south of the Shire, located to the east of Macedon. The locality has a population 4,390 residents with 1,655 private dwellings (ABS, 2021). The township and adjacent area is serviced by reticulated sewer. There are a total of 923 unsewered developable lots in the locality.

Based on the Pathway database, there are a total of 445 OWM permits in the locality. A summary of the OWMS configurations are presented in the following.

- 97 septic tank and absorption systems;
- 2 pump-out systems;
- 2 vermiculture and subsurface irrigation systems;
- 2 vermiculture and absorption systems;
- 2 septic tanks with unknown EDS;
- 12 vermiculture systems with unknown EDS;
- 1 composting toilet system with unknown EDS;
- 116 AWTP and subsurface irrigation systems;
- 65 AWTP and surface irrigation systems;
- 16 AWTP and absorption systems;
- 1 sand filter and subsurface irrigation system;
- 13 AWTP systems with unknown EDS;
- 1 sand filter system with unknown EDS; and
- 115 permits with no OWMS details.

The locality is situated within the Sunbury (Main and Bollinda Creek), Rosslynne Reservoir (Riddell Creek) and Riddells Creek (Main Creek) SWSC areas.

2h. Summary of Constraints to OWM

Characteristic	Description
Climate	Median rainfall of 543.5mm/year, with mean evaporation of 1,214.4mm/year. Rainfall exceeds evaporation for three (3) months of the year. A majority of the locality is located in Climate Zone 2, with areas of Climate 1 in the southeast and a minor portion of Climate Zone 3 in the northwest.
Surface Waterways	There are many large waterways draining throughout the locality, most significantly Riddells Creek in the south and Main Creek in the North. There are many smaller tributaries contributing flows to these creeks, later discharging to Jackson Creek in the south and Bolinda Creek in the north. The Forster and Wright Reservoirs are located in the north of the locality, directly south of the Sunbury SWSC areas.
Groundwater	There are a total of 76 domestic GW bores within the locality. These bores are scattered throughout the south, with minimal bores identified in the north.
Land Subject to Inundation	Minor flooding adjacent Murnong Creek within the township.

Characteristic	Description
Climate Zone	Climate Zone 3: 22 Climate Zone 2: 607 Climate Zone 1: 294
Useable Lot Area Risk	Very High: 176 High: 421 Moderate: 238 Low: 88
Slope Risk	High: 296 Moderate: 177 Low: 450
Soil Suitability Risk	High: 820 Moderate: 103 Low: 0 *Soil landform units: Palaeozoic Sediments, Wombat / Springfield and Basalt Plains; subsoil consisting of MC / HC.*
Risk Analysis Rating	Very High: 83 High: 252 Moderate: 488 Low: 100

3h. Risk Analysis (Map)

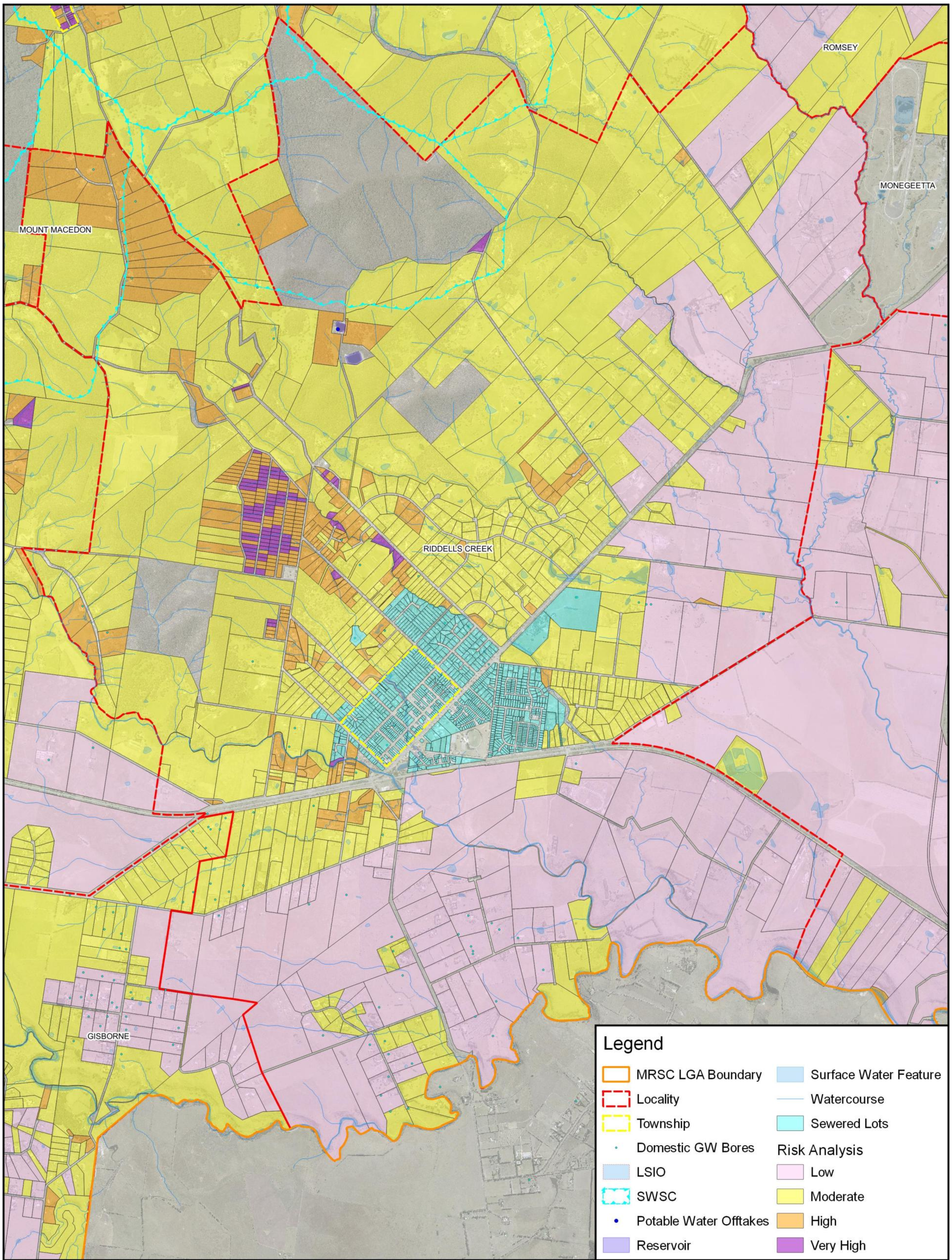

Figure B3: Riddles Creek Locality

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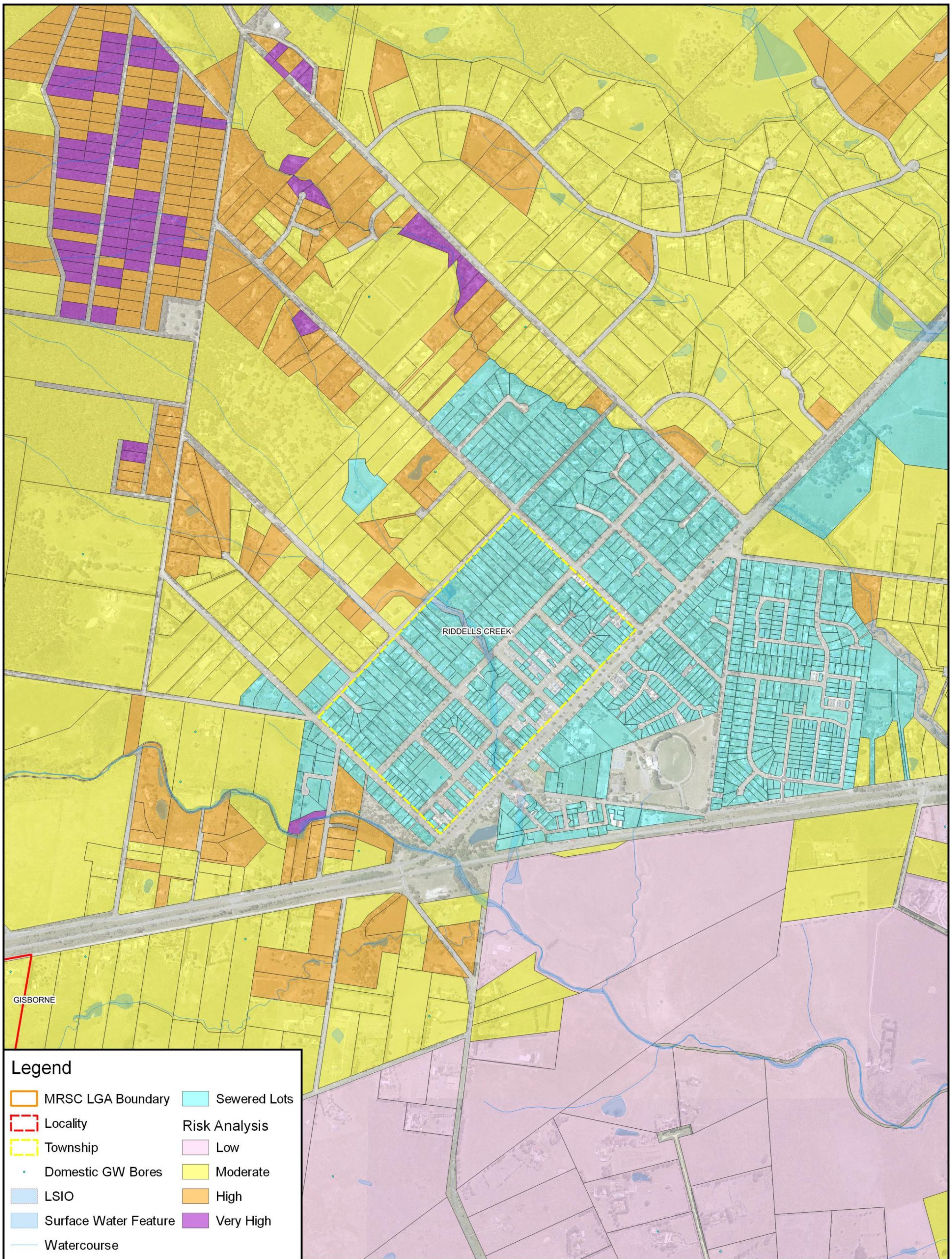

Figure B4: Riddles Creek Township

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0 500 1,000 1,500 m

(Approx Scale)

N

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4h. System Sizing Tables

The EDS sizing tables for Riddells Creek are provided below.

Riddells Creek - Sizing Tables						
1 - 3 Bedroom Dwelling						
EDS Method	**Gravels & Sands (1)**	**Sandy Loams (2)**	**Loams (3)**	**Clay Loams (4)**	**Light Clays (5)**	**Medium to Heavy Clays (6)[5]**
	Minimum EDA basal area (m²) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	185		245	290	365	725
Conventional Absorption System	N/A[3]		85	260	N/A[4]	
Evapotranspiration-Absorption System			85	190		
LPED Irrigation	N/A[6]		290	365	485	N/A[6]
4 Bedroom Dwelling						
EDS Method	**Gravels & Sands (1)**	**Sandy Loams (2)**	**Loams (3)**	**Clay Loams (4)**	**Light Clays (5)**	**Medium to Heavy Clays (6)[5]**
	Minimum EDA basal area (m²) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	230		305	365	455	910
Conventional Absorption System	N/A[3]		105	325	N/A[4]	
Evapotranspiration-Absorption System			105	240		
LPED Irrigation	N/A[6]		365	455	605	N/A[5]
>5 Bedroom Dwelling						
EDS Method	**Gravels & Sands (1)**	**Sandy Loams (2)**	**Loams (3)**	**Clay Loams (4)**	**Light Clays (5)**	**Medium to Heavy Clays (6)[5]**
	Minimum EDA basal area (m²) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	275		365	435	545	1,090
Conventional Absorption System	N/A[3]		125	385	N/A[4]	
Evapotranspiration-Absorption System			125	285		
LPED Irrigation	N/A[6]		435	545	725	N/A[5]

Note:
[1] Irrigation systems assumed to be installed on slopes of <10%. Reduction in DIR required for slopes exceeding 10%, as per Table M2 of *AS/NZS 1547:2012*.
[2] Secondary treatment and disinfection required.
[3] LCA required indicating lack of high perched watertable / high seasonal watertable.
[4] Special design requirements and distribution techniques or soil modification required, refer Notes 2 & 3 in Table L1 of *AS/NZS 1547:2012.*
[5] Secondary treatment required for all systems in Cat 6 soils.
[6] Drip irrigation preferred irrigation method.

5h. System Selection and Management Strategies

Conventional absorption trenches and beds may not be suitable to some areas of the locality due to heavy-textured soils throughout. Table 4-8 of the GOWM (2013) prohibits LPED systems on Category 5 and 6 soils (medium to heavy clays).

C. Gisborne Locality Report

1g. Introduction

Gisborne is located in the south of the Shire, positioned to the south of Macedon and east of Bullengarook. The locality has a population of 10,142 residents with 3,726 private dwellings (ABS, 2021). The township and adjacent area is serviced by reticulated sewer. There are a total of 715 unsewered developable lots in the locality.

Based on the Pathway database, there are a total of 337 OWM permits in the locality. A summary of the OWMS configurations are presented in the following.

- 85 septic tank and absorption systems;
- 4 pump-out systems;
- 3 vermiculture and subsurface irrigation systems;
- 1 vermiculture and absorption system;
- 5 vermiculture systems with unknown EDS;
- 144 AWTP and subsurface irrigation systems;
- 45 AWTP and surface irrigation systems;
- 16 AWTP and absorption systems;
- 1 sand filter and subsurface irrigation system;
- 2 sand filter and absorption systems;
- 11 AWTP systems with unknown EDS;
- 2 sand filter systems with unknown EDS;
- 2 unknown treatment systems with subsurface irrigation; and
- 56 permits with no OWMS details.

The locality is situated within the Lake Merrimu, Djerriwarrh and Rosslynne Reservoir (Jackson Creek) SWSC areas.

2g. Summary of Constraints to OWM

Characteristic	Description
Climate	Median rainfall of 666.2mm/year, with mean evaporation of 1,168.2mm/year. Rainfall exceeds evaporation for four (4) months of the year. The entire locality is located within Climate Zone 2.
Surface Waterways	Jackson Creek intersects the locality in the north, overflowing from the Rosslynne Reservoir in the northwest. Many smaller tributaries contribute flows to the creek. The southwest of the locality contains a network of surface water features discharging to the Merrimu and Djerriwarrh Reservoirs to the south of the Shire.
Groundwater	There are a total of 81 domestic GW bores throughout the locality, mostly identified in the centre and far east of the locality.
Land Subject to Inundation	Land adjacent Jackson Creek in proximity to the township is identified as being flood impacted.
Climate Zone	Climate Zone 3: 0

Characteristic	Description
	Climate Zone 2: 715 Climate Zone 1: 0
Useable Lot Area Risk	Very High: 55 High: 267 Moderate: 336 Low: 57
Slope Risk	High: 107 Moderate: 188 Low: 420
Soil Suitability Risk	High: 187 Moderate: 528 Low: 0 *Soil landform units: Mickleham / Clarkefield, Palaeozoic Sediments / Darraweit Guim, Basalt Plains; subsoil consists of MC / HC.*
Risk Analysis Rating	Very High: 3 High: 83 Moderate: 436 Low: 193

3g. Risk Analysis (Map)

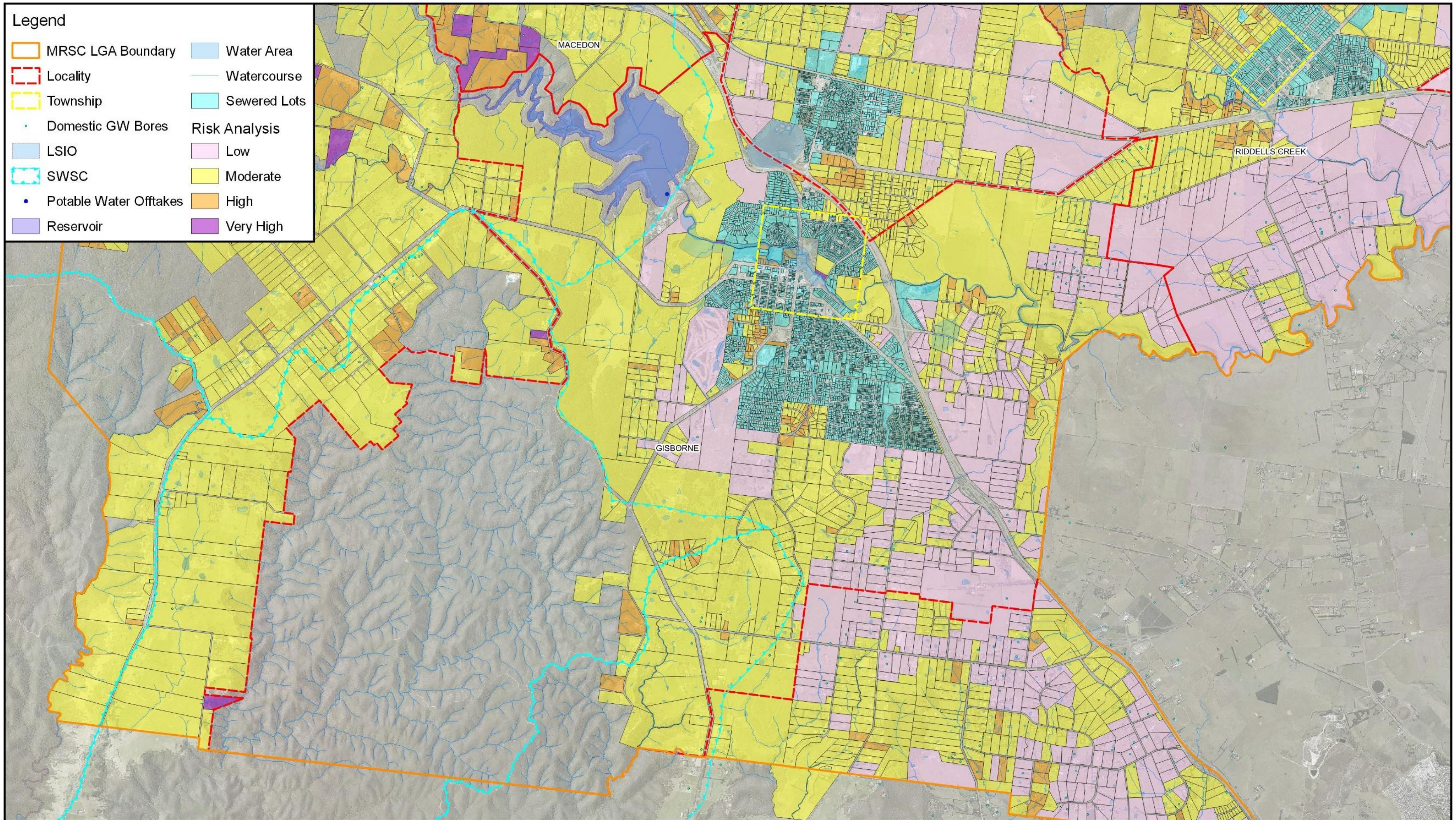

Figure B5: Gisborne Locality

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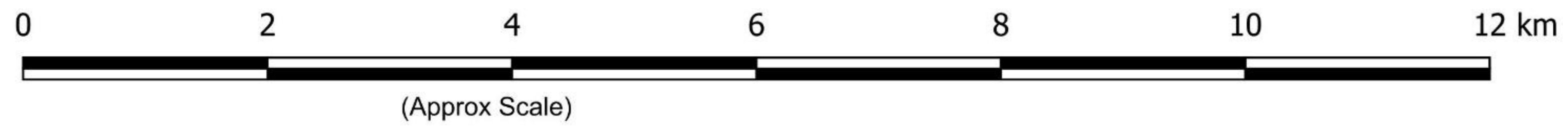

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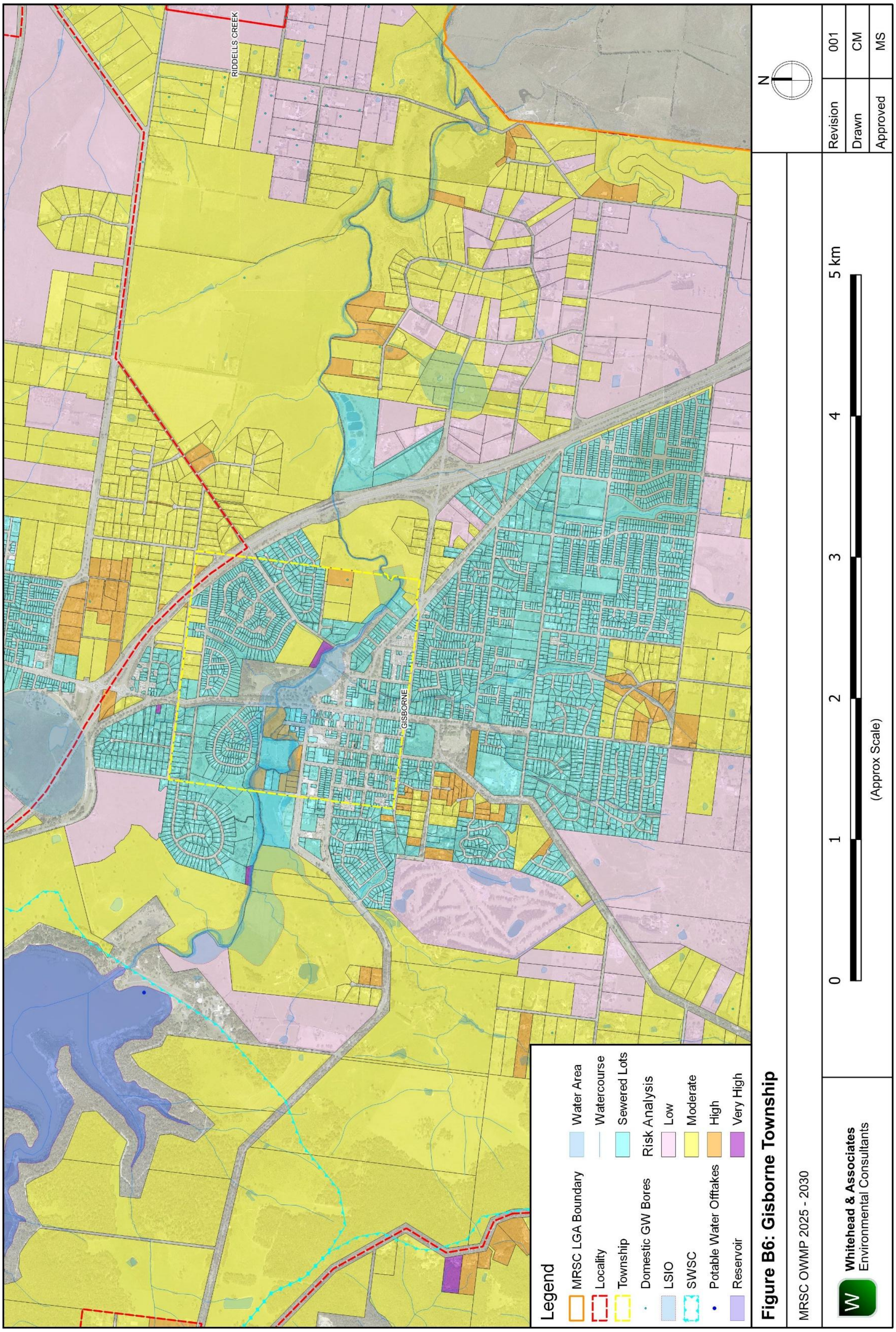

Figure B6: Gisborne Township

4g. System Sizing Tables

The EDS sizing tables for Gisborne are provided below.

Gisborne - Sizing Tables

1 - 3 Bedroom Dwelling

EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	205		280	350	460	1,260
Conventional Absorption System	N/A[3]		90	315	N/A[4]	
Evapotranspiration-Absorption System			90	220		
LPED Irrigation	N/A[6]		350	460	675	N/A[6]

4 Bedroom Dwelling

EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	255		350	435	575	1,575
Conventional Absorption System	N/A[3]		110	395	N/A[4]	
Evapotranspiration-Absorption System			110	275		
LPED Irrigation	N/A[6]		435	575	840	N/A[5]

>5 Bedroom Dwelling

EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	305		420	525	690	1,890
Conventional Absorption System	N/A[3]		135	470	N/A[4]	
Evapotranspiration-Absorption System			135	330		
LPED Irrigation	N/A[6]		525	690	1,010	N/A[5]

Note:

[1] Irrigation systems assumed to be installed on slopes of <10%. Reduction in DIR required for slopes exceeding 10%, as per Table M2 of *AS/NZS 1547:2012*.

[2] Secondary treatment and disinfection required.

[3] LCA required indicating lack of high perched watertable / high seasonal watertable.

[4] Special design requirements and distribution techniques or soil modification required, refer Notes 2 & 3 in Table L1 of *AS/NZS 1547:2012.*

[5] Secondary treatment required for all systems in Cat 6 soils.

[6] Drip irrigation preferred irrigation method.

5g. System Selection and Management Strategies

Conventional absorption trenches and beds may not be suitable to some areas of the town due to heavy-textured soils. Table 4-8 of the GOWM (2024) prohibits LPED systems on Category 5 and 6 soils (medium to heavy clays). Irrigation EDS may not be applicable within the locality due to climatic conditions.

D. Mount Macedon Locality Report

1c. Introduction

Mount Macedon is located within the centre of the Shire, to the north of Macedon and southeast of Woodend. The locality has a population of 1,450 residents with 651 private dwellings (ABS, 2021). The lower areas of the locality, along with select lots within high elevations, are serviced by reticulated sewer. There are a total of 645 unsewered developable lots in the locality.

Based on the Pathway database, there are a total of 616 OWM permits in the locality. A summary of the OWMS configurations are presented in the following.

- 316 septic tank and absorption systems;
- 38 pump-out systems;
- 2 vermiculture and subsurface irrigation systems;
- 4 septic tanks with unknown EDS;
- 11 vermiculture systems with unknown EDS;
- 106 AWTP and subsurface irrigation systems;
- 35 AWTP and surface irrigation systems;
- 27 AWTP and absorption systems;
- 1 sand filter and subsurface irrigation system;
- 12 sand filter and absorption systems;
- 19 AWTP systems with unknown EDS;
- 5 sand filter systems with unknown EDS;
- 1 unknown treatment systems with subsurface irrigation; and
- 39 permits with no OWMS details.

The locality is situated within the Rosslynne Reservoir (Riddell Creek), Gisborne-Sunbury (Barringo), Eppalock, Mount Macedon (Turitable Creek / Stony Creek), Macedon (Stony Creek / Kitty English Res / Bawden Creek) and Riddells Creek (Main Creek) SWSC areas. The far north of the locality is positioned within the Central Victorian Mineral Springs GMA.

2c. Summary of Constraints to OWM

Characteristic	Description
Climate	Median rainfall of 865.6mm/year, with mean evaporation of 1,084.2mm/year. Rainfall exceeds evaporation for five (5) months of the year. The entire locality is located in Climate Zone 3.
Surface Waterways	Turritable Creek, Willimigongon Creek and Railway Creek dissect the locality, draining to Riddells Creek to the south. There are a number of tributaries and farm dams identified throughout the locality. There are multiple reservoirs located throughout the locality, with the Mcdonalds, Orde Hill and Willimigongon Reservoirs in the north, Kitty English and Frank Mann Reservoirs in the west, and Pierce Reservoir in the east.

Characteristic	Description
Groundwater	There are 40 domestic GW bores throughout the locality, mostly identified in proximity to development along Mount Macedon Road and in the east of the locality.
Land Subject to Inundation	No flooding identified within the locality.
Climate Zone	Climate Zone 3: 645 Climate Zone 2: 0 Climate Zone 1: 0
Useable Lot Area Risk	Very High: 359 High: 187 Moderate: 91 Low: 8
Slope Risk	High: 494 Moderate: 117 Low: 34
Soil Suitability Risk	High: 645 Moderate: 0 Low: 0 *Soil landform units: Macedon, Palaeozoic Sediments, Wombat, Darraweit Guim / Springfield, Granite Hills and Diogenes; subsoil consists of LC and MC / HC.*
Risk Analysis Rating	Very High: 243 High: 378 Moderate: 24 Low: 0

3c. Risk Analysis (Map)

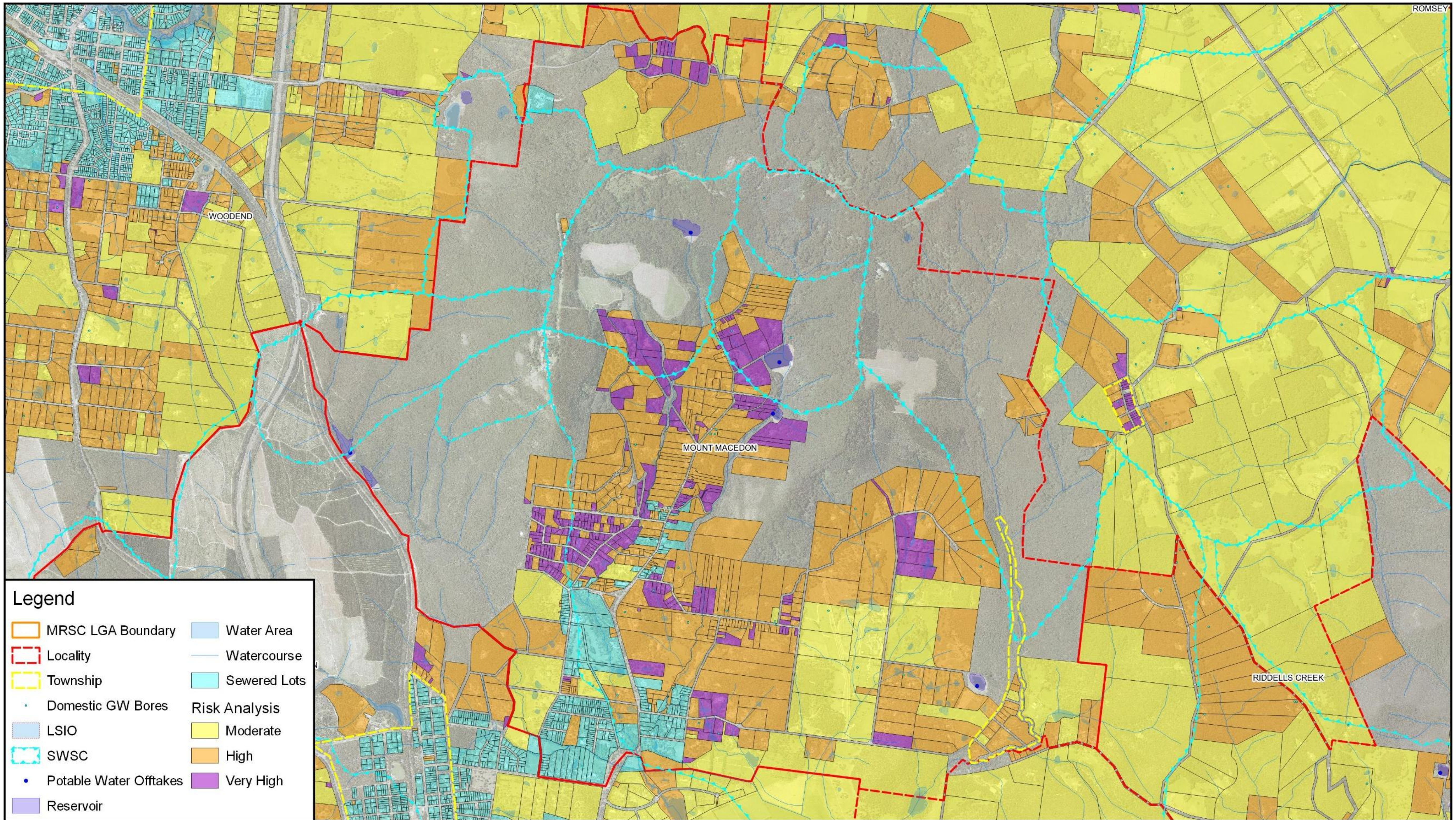

Figure B7: Mount Macedon Locality

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4c. System Sizing Tables

The EDS sizing tables for Mount Macedon are provided below.

Mount Macedon - Sizing Tables						
1 - 3 Bedroom Dwelling						
EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	260		405	560	910	N/A[7]
Conventional Absorption System	N/A[3]		100	490	N/A[4]	
Evapotranspiration-Absorption System			100	295		
LPED Irrigation	N/A[6]		560	910	2,475	N/A[6]
4 Bedroom Dwelling						
EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	325		505	700	1,140	N/A[7]
Conventional Absorption System	N/A[3]		125	615	N/A[4]	
Evapotranspiration-Absorption System			125	365		
LPED Irrigation	N/A[6]		700	1,140	3,090	N/A[5]
>5 Bedroom Dwelling						
EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	390		605	840	1,365	N/A[7]
Conventional Absorption System	N/A[3]		145	735	N/A[4]	
Evapotranspiration-Absorption System			145	440		
LPED Irrigation	N/A[6]		840	1,365	3,710	N/A[5]

Note:

[1] Irrigation systems assumed to be installed on slopes of <10%. Reduction in DIR required for slopes exceeding 10%, as per Table M2 of *AS/NZS 1547:2012*.
[2] Secondary treatment and disinfection required.
[3] LCA required indicating lack of high perched watertable / high seasonal watertable.
[4] Special design requirements and distribution techniques or soil modification required, refer Notes 2 & 3 in Table L1 of *AS/NZS 1547:2012.*
[5] Secondary treatment required for all systems in Cat 6 soils.
[6] Drip irrigation preferred irrigation method.
[7] Not applicable due to climatic constraints.

5c. System Selection and Management Strategies

Conventional absorption trenches and beds may not be suitable to some areas of the town due to heavy-textured soils. Table 4-8 of the GOWM (2024) prohibits LPED systems on Category 5 and 6 soils (medium to heavy clays). Irrigation (drip and spray) EDS may not be applicable within the locality due to climatic conditions.

E. Romsey Locality Report

6h. Introduction

Romsey is located in the east of the Shire, to the south of Lancefield. The locality has a population 5,797 residents with 2,202 private dwellings (ABS, 2021). The township and adjacent area is serviced by reticulated sewer, with a small number of lots in the east also serviced by the reticulated network. There are a total of 535 unsewered developable lots in the locality.

Based on the Pathway database, there are a total of 261 OWM permits in the locality. A summary of the OWMS configurations are presented in the following.

- 91 septic tank and absorption systems;
- 7 pump-out systems;
- 1 vermiculture and subsurface irrigation system;
- 9 vermiculture systems with unknown EDS;
- 28 AWTP and subsurface irrigation systems;
- 40 AWTP and surface irrigation systems;
- 4 AWTP and absorption systems;
- 1 sand filter and absorption system;
- 4 AWTP systems with unknown EDS; and
- 76 permits with no OWMS details.

The locality is situated within the Sunbury (Main Creek / Cherlies Creek), Rosslynne Reservoir (Riddell Creek) and Riddells Creek (Main Creek) SWSC areas. A minor portion of the locality in the north is positioned within the Central Victorian Mineral Springs GMA.

7h. Summary of Constraints to OWM

Characteristic	Description
Climate	Median rainfall of 628.1mm/year, with mean evaporation of 1,165.9mm/year. Rainfall exceeds evaporation for four (4) months of the year. A majority of the locality is located in Climate Zone 2, with a portion of Climate Zone 3 in the west.
Surface waterways	Bolinda Creek is located in the west of the locality, with Five Mile Creek within the north. There are many small tributaries throughout the locality, contributing flows to these creeks. A portion of the Sunbury (Bolinda Creek) and Monument Creek SWSC areas are located in the far west.
Groundwater	There are a total of 86 domestic GW bores within the locality. A majority of bores are located throughout the north, with some bores scattered throughout the south.
Land Subject to Inundation	Minor flooding adjacent Five Mile Creek within the township.
Climate Zone	Climate Zone 3: 129 Climate Zone 2: 406 Climate Zone 1: 0
Useable Lot Area Risk	Very High: 45 High: 179 Moderate: 145

Characteristic	Description
	Low: 166
Slope Risk	High: 64 Moderate: 92 Low: 379
Soil Suitability Risk	High: 535 Moderate: 0 Low: 0 *Soil landform units: U, Basalt Plains, Palaeozoic Sediments, and Mt William; subsoil consisting of S, LC and MC / HC.*
Risk Analysis Rating	Very High: 8 High: 90 Moderate: 349 Low: 88

8h. Risk Analysis (Map)

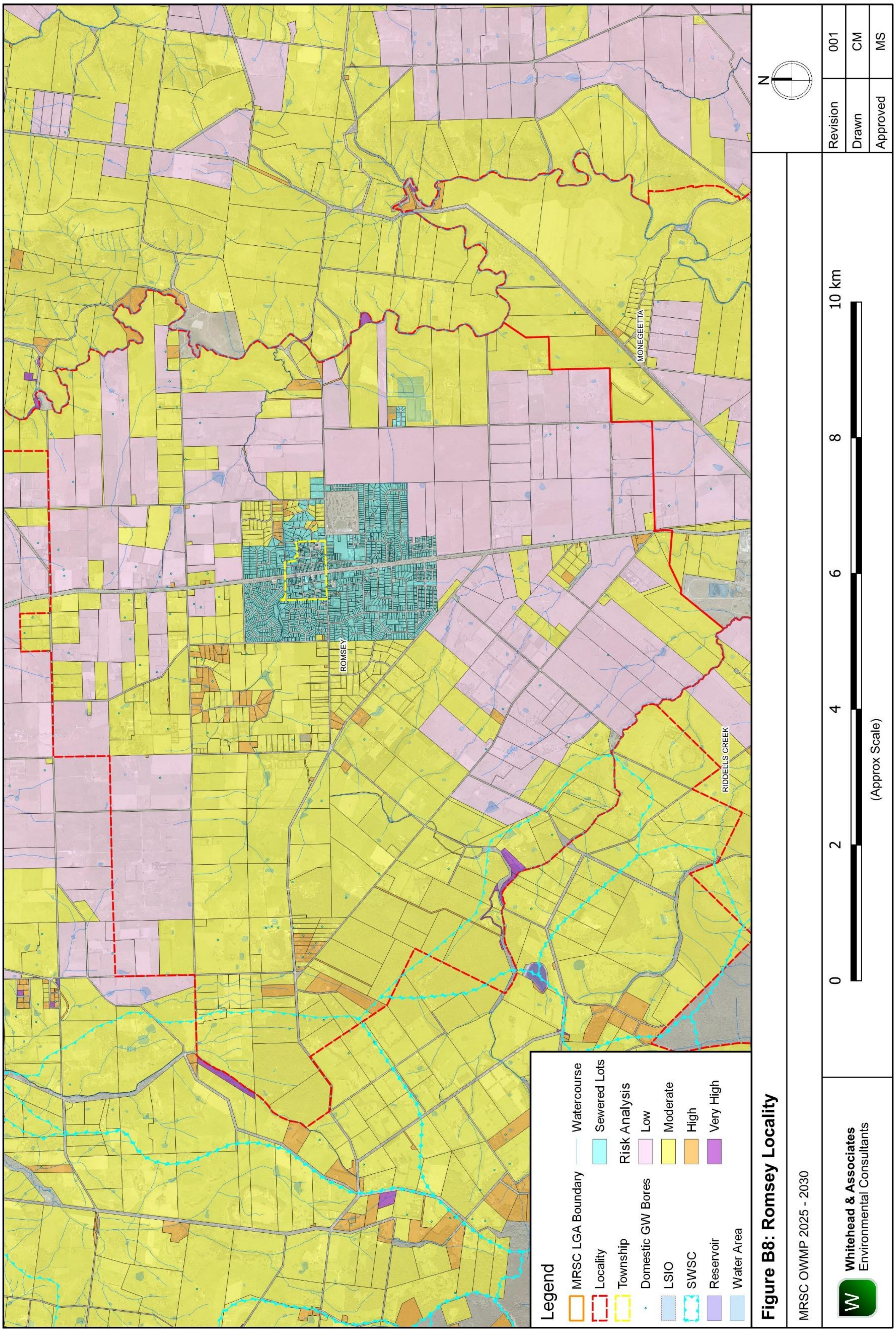

Figure B8: Romsey Locality

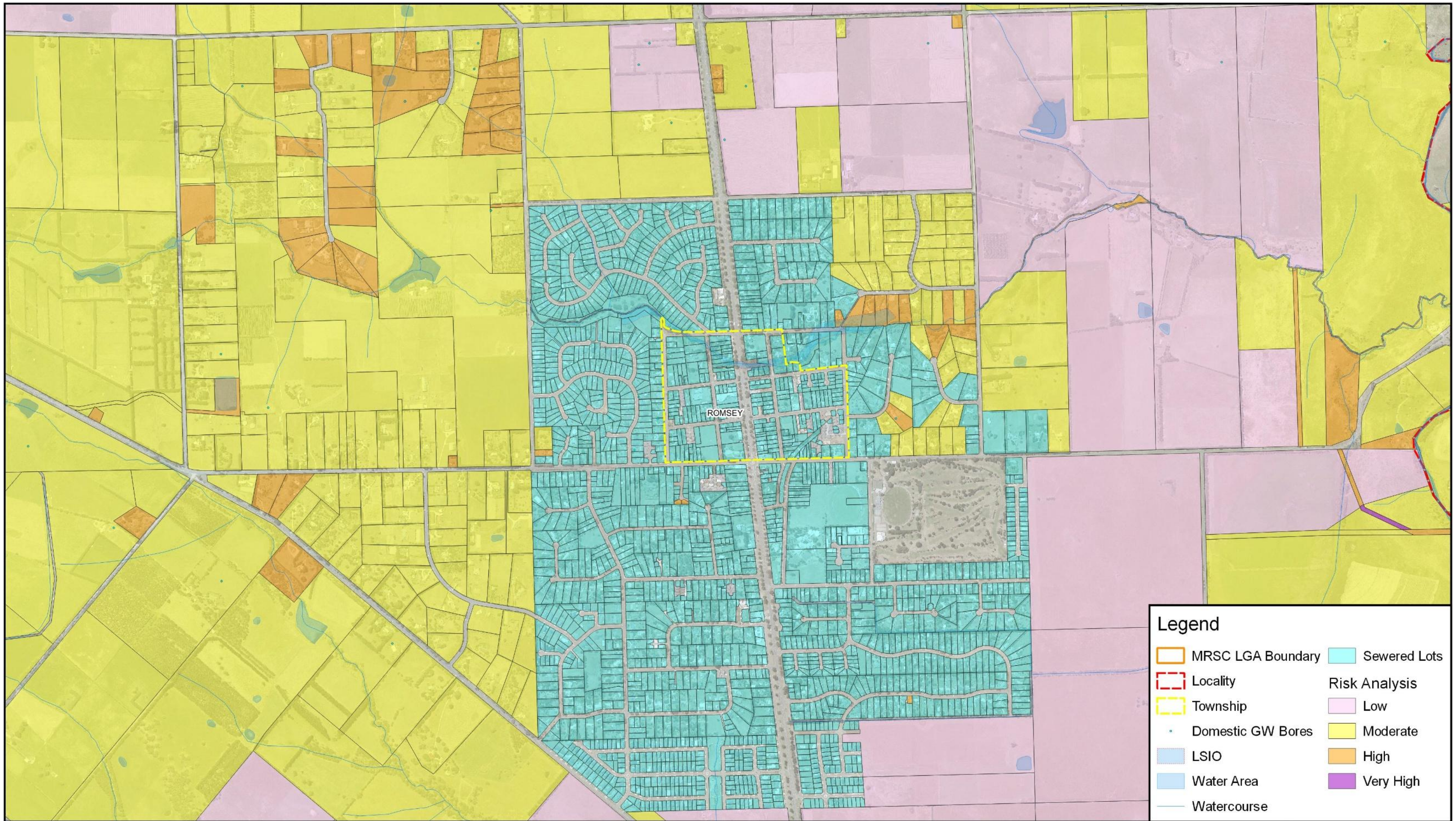

Figure B9: Romsey Township

MRSC OWMP 2025 - 2030

9h. System Sizing Tables

The EDS sizing tables for Romsey are provided below.

Romsey - Sizing Tables						
1 - 3 Bedroom Dwelling						
EDS Method	**Gravels & Sands (1)**	**Sandy Loams (2)**	**Loams (3)**	**Clay Loams (4)**	**Light Clays (5)**	**Medium to Heavy Clays (6)[5]**
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	200		270	335	435	1,070
Conventional Absorption System	N/A[3]		90	300	N/A[4]	
Evapotranspiration-Absorption System			90	215		
LPED Irrigation	N/A[6]		335	435	615	N/A[6]
4 Bedroom Dwelling						
EDS Method	**Gravels & Sands (1)**	**Sandy Loams (2)**	**Loams (3)**	**Clay Loams (4)**	**Light Clays (5)**	**Medium to Heavy Clays (6)[5]**
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	245		340	415	540	1,340
Conventional Absorption System	N/A[3]		110	375	N/A[4]	
Evapotranspiration-Absorption System			110	265		
LPED Irrigation	N/A[6]		415	540	770	N/A[5]
>5 Bedroom Dwelling						
EDS Method	**Gravels & Sands (1)**	**Sandy Loams (2)**	**Loams (3)**	**Clay Loams (4)**	**Light Clays (5)**	**Medium to Heavy Clays (6)[5]**
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	295		405	500	650	1,605
Conventional Absorption System	N/A[3]		130	450	N/A[4]	
Evapotranspiration-Absorption System			130	320		
LPED Irrigation	N/A[6]		500	650	925	N/A[5]

Note:

[1] Irrigation systems assumed to be installed on slopes of <10%. Reduction in DIR required for slopes exceeding 10%, as per Table M2 of *AS/NZS 1547:2012*.

[2] Secondary treatment and disinfection required.

[3] LCA required indicating lack of high perched watertable / high seasonal watertable.

[4] Special design requirements and distribution techniques or soil modification required, refer Notes 2 & 3 in Table L1 of *AS/NZS 1547:2012.*

[5] Secondary treatment required for all systems in Cat 6 soils.

[6] Drip irrigation preferred irrigation method.

10h. System Selection and Management Strategies

Conventional absorption trenches and beds may not be suitable to some areas of the town due to heavy-textured soils. Table 4-8 of the GOWM (2024) prohibits LPED systems on Category 5 and 6 soils (medium to heavy clays). Irrigation (drip and spray) EDS may not be applicable within the locality due to climatic conditions.

F. Macedon Locality Report

11h. Introduction

Macedon is located in the south of the Shire, positioned between Gisborne and Woodend. The locality has a population 2,073 residents with 784 private dwellings (ABS, 2021). The township and adjacent area is serviced by reticulated sewer. There are a total of 335 unsewered developable lots in the locality.

Based on the Pathway database, are a total of 217 OWM permits in the locality. A summary of the OWMS configurations are presented in the following.

- 66 septic tank and absorption systems;
- 1 pump-out system;
- 1 vermiculture and absorption system;
- 7 vermiculture systems with unknown EDS;
- 44 AWTP and subsurface irrigation systems;
- 38 AWTP and surface irrigation systems;
- 13 AWTP and absorption systems;
- 1 sand filter and absorption system;
- 8 AWTP systems with unknown EDS;
- 1 sand filter system with unknown EDS;
- 1 unknown treatment system with subsurface irrigation; and
- 36 permits with no OWMS details.

The locality is situated within the Rosslynne Reservoir (Jackson / Riddell Creek), Macedon (Kitty English Res) and Eppalock SWSC areas, with a minor portion of the locality within the Central Victorian Mineral Springs GMA.

12h. Summary of Constraints to OWM

Characteristic	Description
Climate	Median rainfall of 736.6mm/year, with mean evaporation of 1,118.3mm/year. Rainfall exceeds evaporation for five (5) months of the year. The locality is split across Climate Zone 2 in the south and Climate Zone 3 in the north.
Surface Waterways	The town is surrounded by the branches of Stringers Creek to the west, north and east. The town is proximate to the Thomson River SWSC.
Groundwater	There are a total of 28 domestic GW bores within the locality. These bores are scattered throughout the south, with minimal bores identified in the north.
Land Subject to Inundation	No flooding identified within the locality.
Climate Risk	Climate Zone 3: 97 Climate Zone 2: 238 Climate Zone 1: 0

Characteristic	Description
Useable Lot Area Risk	Very High: 114 High: 130 Moderate: 77 Low: 14
Slope Risk	High: 125 Moderate: 117 Low: 93
Soil Suitability Risk	High: 335 Moderate: 0 Low: 0 *Soil landform units: Palaeozoic Sediments, Wombat / Springfield and Basalt Plains; subsoil consisting of MC / HC.*
Risk Analysis Rating	Very High: 38 High: 184 Moderate: 112 Low: 1

13h. Risk Analysis (Map)

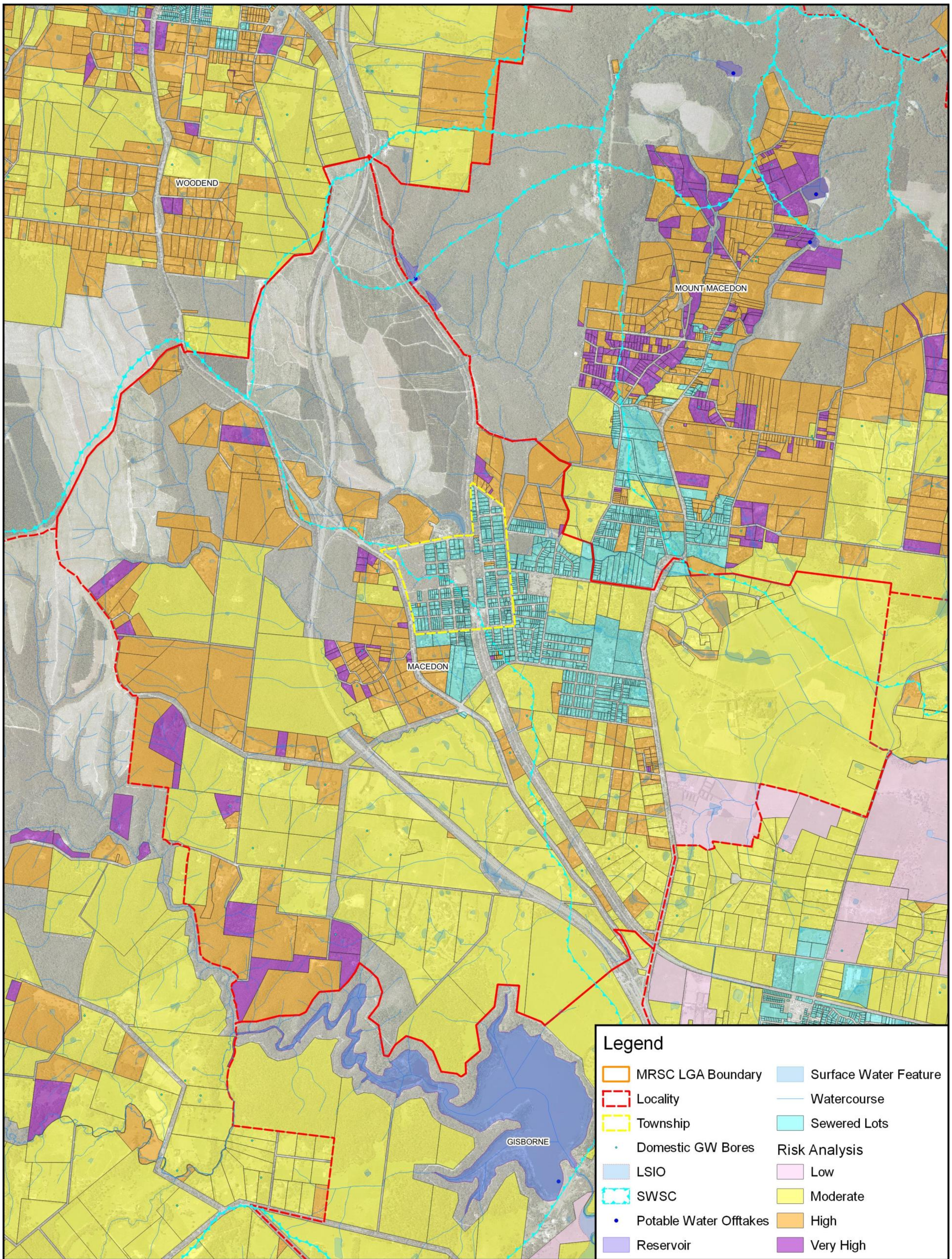

Figure B10: Macedon Locality

MRSC OWMP 2025 - 2030

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Revision	001
Drawn	CM
Approved	MS

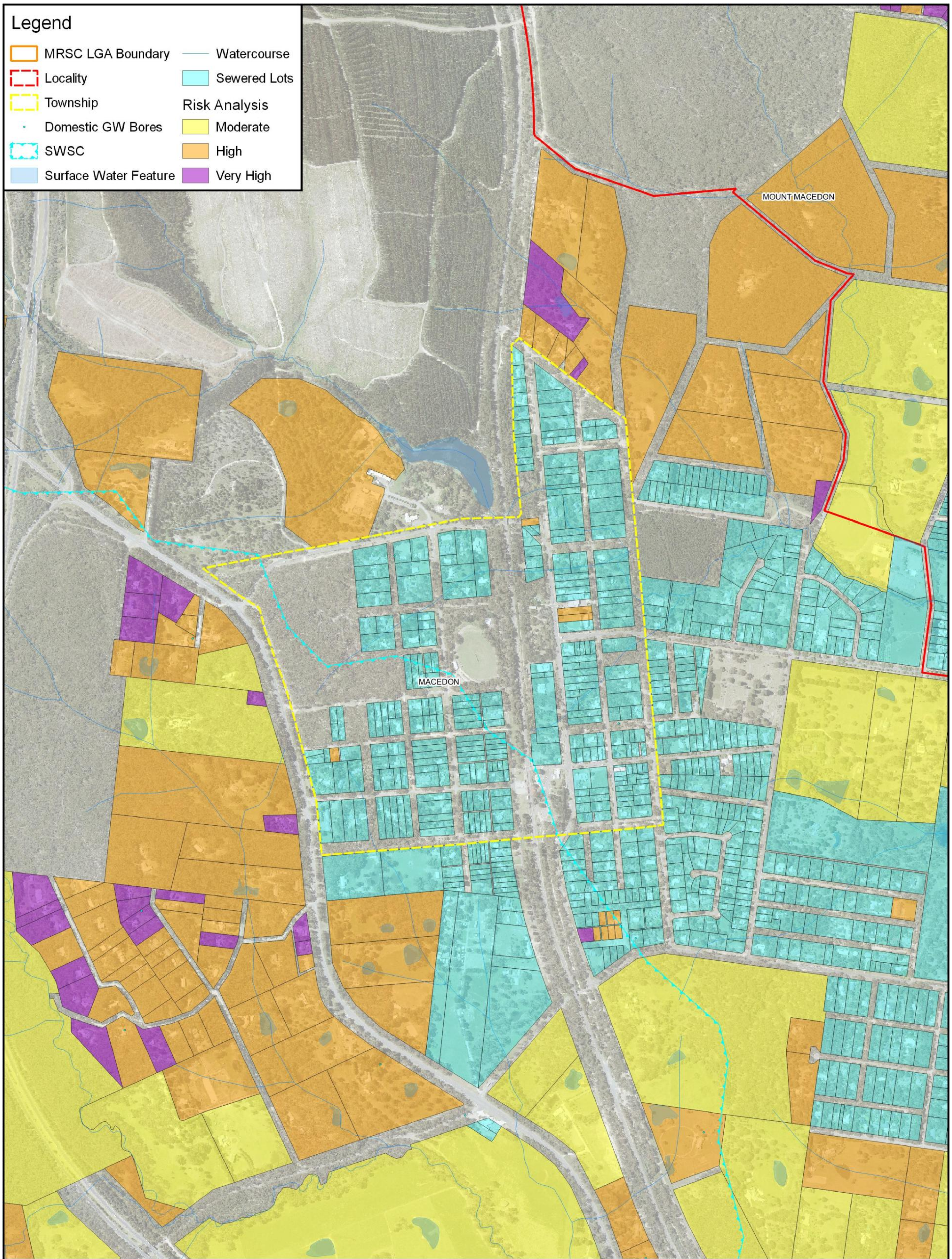

Figure B11: Macedon Township

MRSC OWMP 2025 - 2030

Whitehead & Associates
Environmental Consultants

0 500 1,000 m
(Approx Scale)

N

Revision	001
Drawn	CM
Approved	MS

14h. System Sizing Tables

The EDS sizing tables for Macedon are provided below.

Macedon - Sizing Tables

1 - 3 Bedroom Dwelling

EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	215		305	385	520	N/A[7]
Conventional Absorption System	N/A[3]		90	340	N/A[4]	
Evapotranspiration-Absorption System			90	230		
LPED Irrigation	N/A[6]		385	520	810	N/A[6]

4 Bedroom Dwelling

EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	270		380	480	650	N/A[7]
Conventional Absorption System	N/A[3]		115	420	N/A[4]	
Evapotranspiration-Absorption System			115	290		
LPED Irrigation	N/A[6]		480	650	1,010	N/A[5]

>5 Bedroom Dwelling

EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	320		455	575	780	N/A[7]
Conventional Absorption System	N/A[3]		135	505	N/A[4]	
Evapotranspiration-Absorption System			135	345		
LPED Irrigation	N/A[6]		575	780	1,215	N/A[5]

Note:

[1] Irrigation systems assumed to be installed on slopes of <10%. Reduction in DIR required for slopes exceeding 10%, as per Table M2 of *AS/NZS 1547:2012*.

[2] Secondary treatment and disinfection required.

[3] LCA required indicating lack of high perched watertable / high seasonal watertable.

[4] Special design requirements and distribution techniques or soil modification required, refer Notes 2 & 3 in Table L1 of *AS/NZS 1547:2012.*

[5] Secondary treatment required for all systems in Cat 6 soils.

[6] Drip irrigation preferred irrigation method.

[7] Not applicable due to climatic constraints.

15h. System Selection and Management Strategies

Conventional absorption trenches and beds may not be suitable to some areas of the town due to heavy-textured soils. Table 4-8 of the GOWM (2024) prohibits LPED systems on Category 5 and 6 soils (medium to heavy clays). Irrigation (drip and spray) EDS may not be applicable within the locality due to climatic conditions.

G. Carlsruhe Locality Report

1b. Introduction

Carlsruhe is located between Kyneton and Woodend, within the centre of the Shire. The locality has a population of 382 residents with 167 private dwellings (ABS, 2021). There are a total of 307 unsewered developable lots in the locality.

Based on the Pathway database, there are a total of 99 OWM permits in the locality. A summary of the OWMS configurations are presented in the following.

- 41 septic tank and absorption systems;
- 1 pump-out system;
- 2 septic tanks with unknown EDS;
- 1 vermiculture system with unknown EDS;
- 18 AWTP and subsurface irrigation systems;
- 4 AWTP and surface irrigation systems;
- 11 AWTP and absorption systems;
- 6 AWTP systems with unknown EDS;
- 1 sand filter system with unknown EDS; and
- 14 permits with no OWMS details.

The locality is situated within the Eppalock SWSC area, with the entire locality within the Central Victorian Mineral Springs GMA.

2b. Summary of Constraints to OWM

Characteristic	Description
Climate	Median rainfall of 684.3mm/year, with mean evaporation of 1,162.4mm/year. Rainfall exceeds evaporation for four (4) months of the year. The centre of the locality is within Climate Zone 2, with the east and west within Climate Zone 3.
Surface Waterways	Many surface water features identified throughout the locality draining to the Campaspe in the west.
Groundwater	The entire locality is within the Central Victorian Springs GMA. A total of 56 domestic GW bores located throughout the locality, with a majority within the east. There are 15 GW bores located within the township area.
Land Subject to Inundation	Large areas of land subject to flooding located in proximity to surface water features, most significantly in proximity to the Campaspe River.
Climate Zone	Climate Zone 3: 62 Climate Zone 2: 245 Climate Zone 1: 0
Useable Lot Area Risk	Very High: 104 High: 49 Moderate: 86 Low: 68
Slope Risk	High: 14

Characteristic	Description
	Moderate: 21 Low: 272
Soil Suitability Risk	High: 39 Moderate: 268 Low: 0 *Soil landform units: Kyneton, Diogenes, Koala, Sidonia, Wombat and Pastoria East; subsoil consists of LC to MC / HC.*
Risk Analysis Rating	Very High: 0 High: 16 Moderate: 291 Low: 0

3b. Risk Analysis (Map)

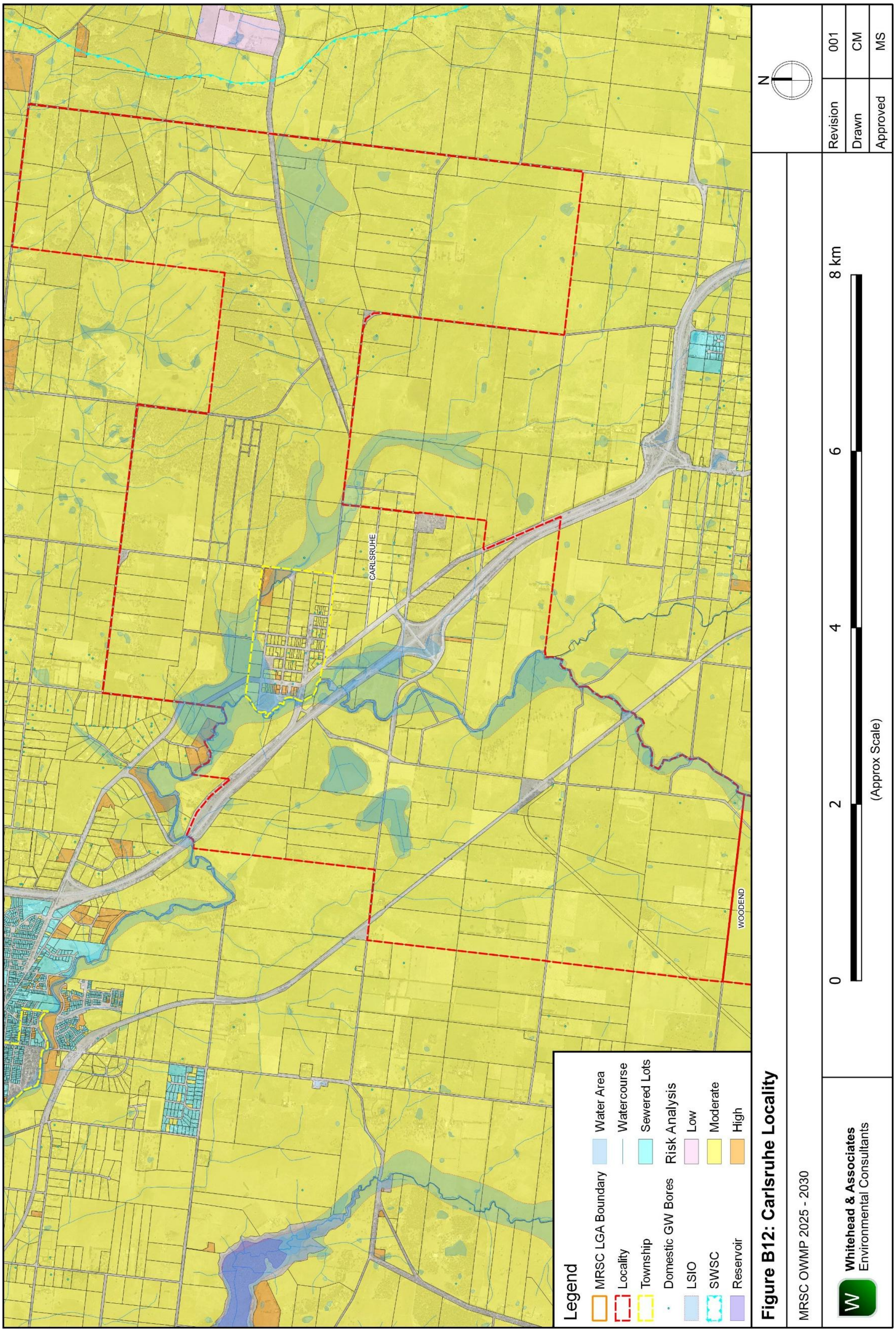

Figure B12: Carlsruhe Locality

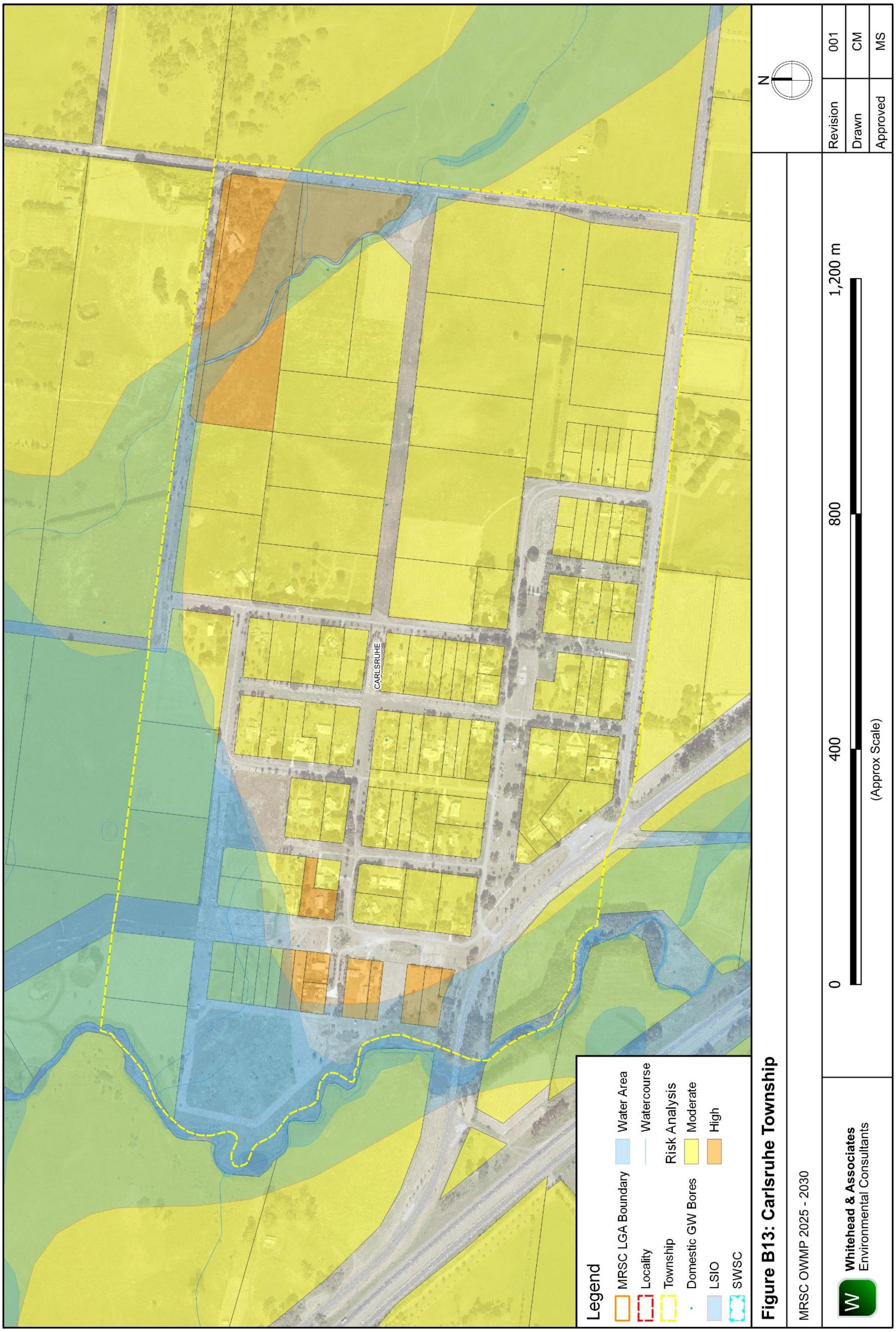

Figure B13: Carlsruhe Township

4b. System Sizing Tables

The EDS sizing tables for Carlsruhe are provided below.

Carlsruhe - Sizing Tables

1 - 3 Bedroom Dwelling

EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	235		340	445	640	N/A[7]
Conventional Absorption System	N/A[3]		95	395	N/A[4]	
Evapotranspiration-Absorption System			95	255		
LPED Irrigation	N/A[6]		445	640	1,150	N/A[6]

4 Bedroom Dwelling

EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	290		425	555	800	N/A[7]
Conventional Absorption System	N/A[3]		115	490	N/A[4]	
Evapotranspiration-Absorption System			115	320		
LPED Irrigation	N/A[6]		555	800	1,440	N/A[5]

>5 Bedroom Dwelling

EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	350		510	665	960	N/A[7]
Conventional Absorption System	N/A[3]		140	590	N/A[4]	
Evapotranspiration-Absorption System			140	380		
LPED Irrigation	N/A[6]		665	960	1,725	N/A[5]

Note:

[1] Irrigation systems assumed to be installed on slopes of <10%. Reduction in DIR required for slopes exceeding 10%, as per Table M2 of *AS/NZS 1547:2012*.

[2] Secondary treatment and disinfection required.

[3] LCA required indicating lack of high perched watertable / high seasonal watertable.

[4] Special design requirements and distribution techniques or soil modification required, refer Notes 2 & 3 in Table L1 of *AS/NZS 1547:2012.*

[5] Secondary treatment required for all systems in Cat 6 soils.

[6] Drip irrigation preferred irrigation method.

[7] Not applicable due to climatic constraints.

5b. System Selection and Management Strategies

Conventional absorption trenches and beds may not be suitable to some areas of the town due to heavy-textured soils. Table 4-8 of the GOWM (2024) prohibits LPED systems on Category 5 and 6 soils (medium to heavy clays). Irrigation (drip and spray) EDS may not be applicable within the locality due to climatic conditions.

H. Lauriston Locality Report

1a. Introduction

Lauriston is located in the west of the Shire, and is approximately 4.5km west of Kyneton. The locality has a population of approximately 247 residents with 115 private dwellings (ABS, 2021). The locality is entirely unsewered, containing a total of 251 unsewered developable lots.

Based on the Pathway database, there are a total of 67 OWM permits in the locality. A summary of the OWMS configurations are presented in the following.

- 15 septic tank and absorption systems;
- 2 septic tanks with unknown EDS;
- 2 vermiculture systems with unknown EDS;
- 13 AWTP and subsurface irrigation systems;
- 10 AWTP and surface irrigation systems;
- 8 AWTP and absorption systems;
- 4 AWTP systems with unknown EDS; and
- 13 permits with no OWMS details.

The locality is located within the Eppalock SWSC area, with the entire locality within the Central Victorian Mineral Springs GMA.

2a. Summary of Constraints to OWM

Characteristic	Description
Climate	Median rainfall of 654.4mm/year, with mean evaporation of 1,193.7mm/year. Rainfall exceeds evaporation for four (4) months of the year. A majority of locality is located within Climate Zone 2, with a portion of Climate Zone 3 in the south.
Surface Waterways	Lauriston contains a number of farm dams and intermittent waterways throughout, with a majority of these features draining to the Lauriston Reservoir in the east and the Malmsbury Reservoir in the north.
Groundwater	The entire locality is within the Central Victorian Mineral Springs GMA. There are 10 domestic GW bores throughout the locality, with one (1) located in the north of the township.
Land Subject to Inundation	Land parcels located between the Lauriston Reservoir and Malmsbury Reservoir are located within areas subject to flooding, with minor flooding in the northwest.
Climate Zones	Climate Zone 3: 14 Climate Zone 2: 237 Climate Zone 1: 0
Useable Lot Area Risk	Very High: 100 High: 40 Moderate: 78 Low: 33
Slope Risk	High: 54 Moderate: 100 Low: 97

Characteristic	Description
Soil Suitability Risk	High: 180 Moderate: 71 Low: 0 *Soil landform units: Wombat, Kyneton, Drummond and Glenvue; subsoil consists of MC / HC.*
Risk Analysis Rating	Very High: 16 High: 99 Moderate: 136 Low: 0

3a. Risk Analysis (Map)

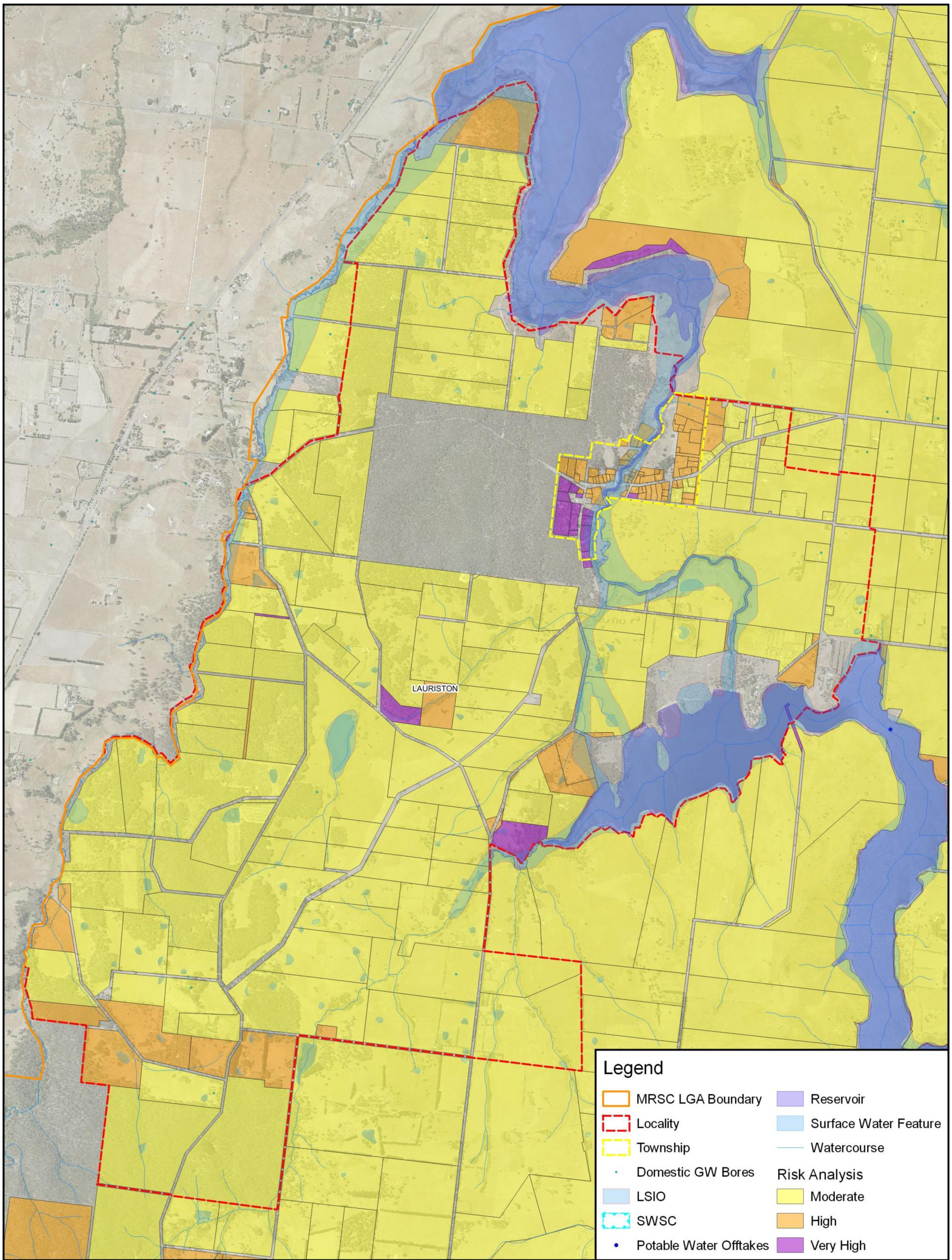

Figure B14: Lauriston Locality

MRSC OWMP 2025 - 2030

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Revision	001
Drawn	CM
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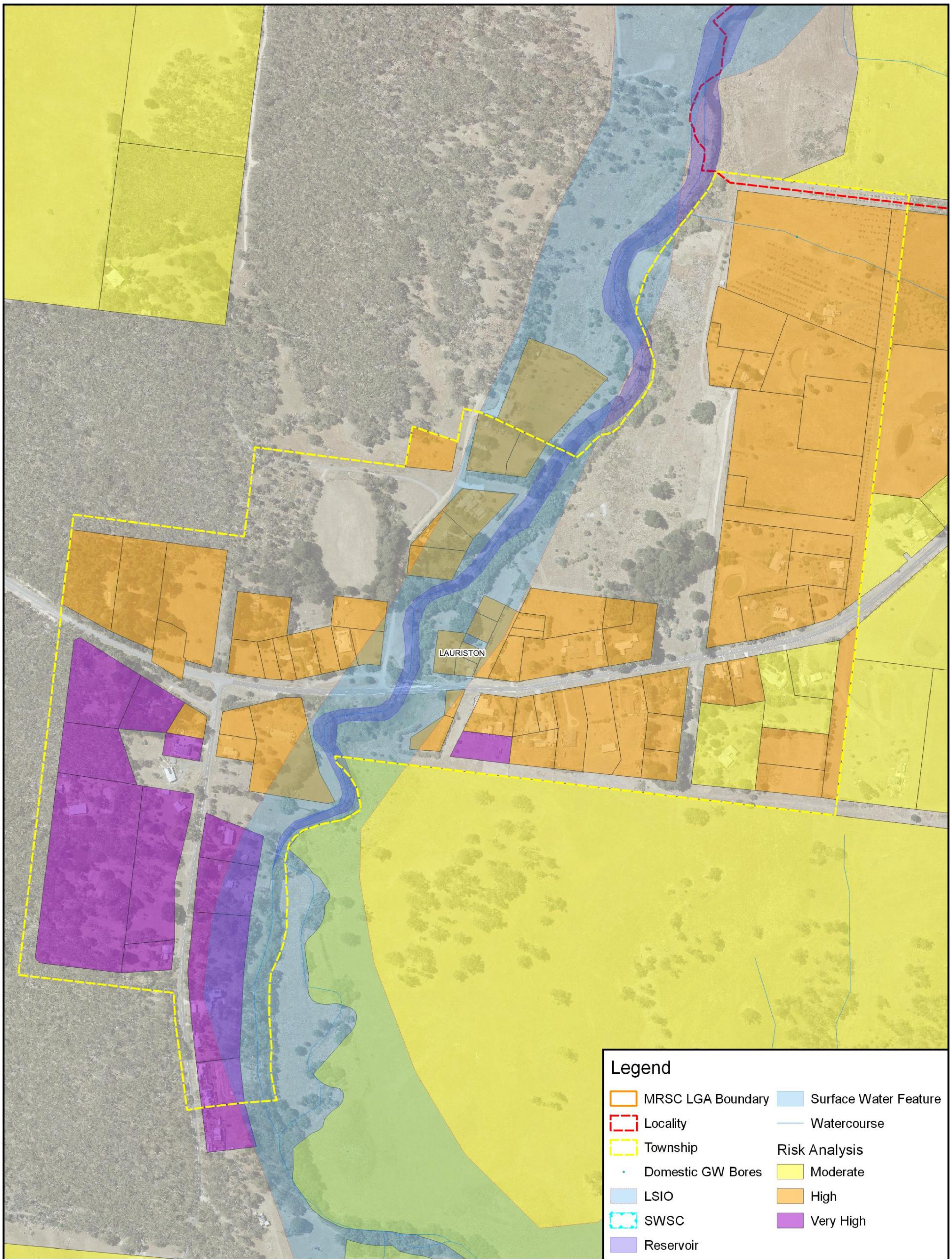

Figure B15: Lauriston Township

MRSC OWMP 2025 - 2030

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Environmental Consultants

0 200 400 600 m
(Approx Scale)

N

Revision	001
Drawn	CM
Approved	MS

4a. System Sizing Tables

The EDS sizing tables for Lauriston are provided below.

Lauriston - Sizing Tables

1 - 3 Bedroom Dwelling						
EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	230		335	435	620	N/A[7]
Conventional Absorption System	N/A[3]		95	385	N/A[4]	
Evapotranspiration-Absorption System			95	250		
LPED Irrigation	N/A[6]		435	620	1,080	N/A[6]

4 Bedroom Dwelling						
EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	285		415	540	770	N/A[7]
Conventional Absorption System	N/A[3]		115	480	N/A[4]	
Evapotranspiration-Absorption System			115	315		
LPED Irrigation	N/A[6]		540	770	1,345	N/A[5]

>5 Bedroom Dwelling						
EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	345		500	650	925	N/A[7]
Conventional Absorption System	N/A[3]		140	575	N/A[4]	
Evapotranspiration-Absorption System			140	375		
LPED Irrigation	N/A[6]		650	925	1,615	N/A[5]

Note:

[1] Irrigation systems assumed to be installed on slopes of <10%. Reduction in DIR required for slopes exceeding 10%, as per Table M2 of *AS/NZS 1547:2012*.

[2] Secondary treatment and disinfection required.

[3] LCA required indicating lack of high perched watertable / high seasonal watertable.

[4] Special design requirements and distribution techniques or soil modification required, refer Notes 2 & 3 in Table L1 of *AS/NZS 1547:2012.*

[5] Secondary treatment required for all systems in Cat 6 soils.

[6] Drip irrigation preferred irrigation method.

[7] Not applicable due to climatic constraints.

5a. System Selection and Management Strategies

Conventional absorption trenches and beds may not be suitable to some areas of the town due to heavy-textured soils. Table 4-8 of the GOWM (2024) prohibits LPED systems on Category 5 and 6 soils (medium to heavy clays). Irrigation (drip and spray) EDS may not be applicable within the locality due to climatic conditions.

I. Darraweit Guim Locality Report

1e. Introduction

Darraweit Guim is located in the far east of the Shire. The locality has a population of 402 residents with 159 private dwellings (ABS, 2021). The entire locality is unsewered, containing a total of 229 unsewered developable lots.

Based on the Pathway database, there are a total of 103 OWM permits in the locality. A summary of the OWMS configurations are presented in the following.

- 55 septic tank and absorption systems;
- 1 pump-out system;
- 2 vermiculture and subsurface irrigation systems;
- 3 vermiculture systems with unknown EDS;
- 9 AWTP and subsurface irrigation systems;
- 9 AWTP and surface irrigation systems;
- 1 AWTP and absorption system;
- 1 AWTP system with unknown EDS;
- 1 unknown treatment system with an absorption system; and
- 21 permits with no OWMS details.

2e. Summary of Constraints to OWM

Characteristic	Description
Climate	Median rainfall of 508.3mm/year, with mean evaporation of 1,249.2mm/year. Rainfall exceeds evaporation for three (3) months of the year. The entire locality is located within Climate Zone 1.
Surface Waterways	Deep Creek transects the locality, with multiple tributaries identified within the north. There are multiple farm dams identified throughout the locality, mostly along waterways.
Groundwater	There are 19 domestic GW bores located within the locality, mostly identified in proximity to the main development area, as well as the south of the locality.
Land Subject to Inundation	Area adjacent Deep Creek to the north of the main development area is identified as being flood prone.
Climate Zones	Climate Zone 3: 0 Climate Zone 2: 0 Climate Zone 1: 229
Useable Lot Area Risk	Very High: 47 High: 39 Moderate: 40 Low: 103
Slope Risk	High: 115 Moderate: 45 Low: 69

Characteristic	Description
Soil Suitability Risk	High: 29 Moderate: 200 Low: 0 *Soil landform units: Mickleham / Clarkefield, Palaeozoic Sediments / Darraweit Guim, Darraweit Guim / Springfield; subsoil consists of LC and MC.*
Risk Analysis Rating	Very High: 0 High: 27 Moderate: 93 Low: 109

3e. Risk Analysis (Map)

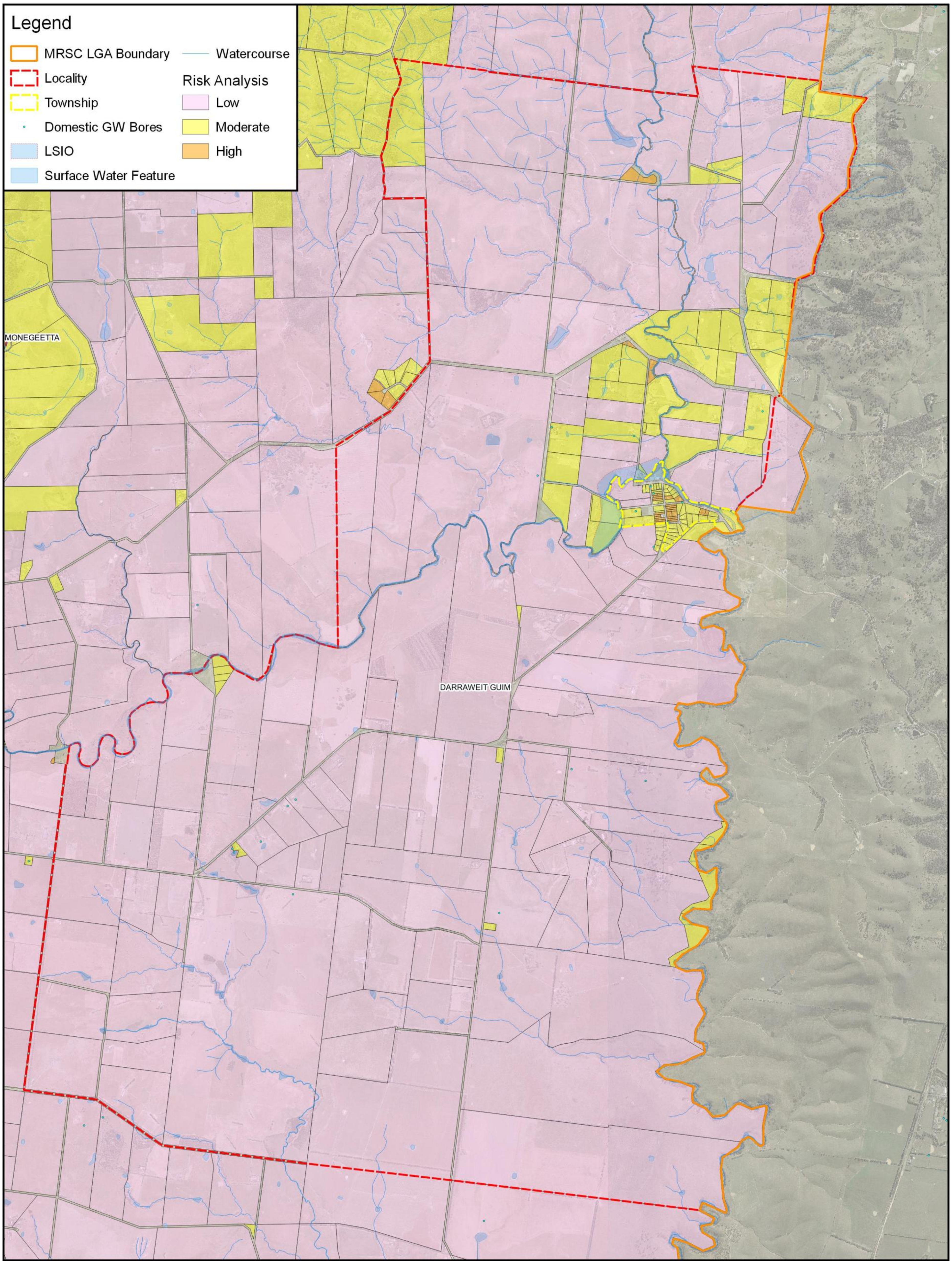

Figure B16: Darraweit Guim Locality

MRSC OWMP 2025 - 2030

Whitehead & Associates Environmental Consultants

Revision	001
Drawn	CM
Approved	MS

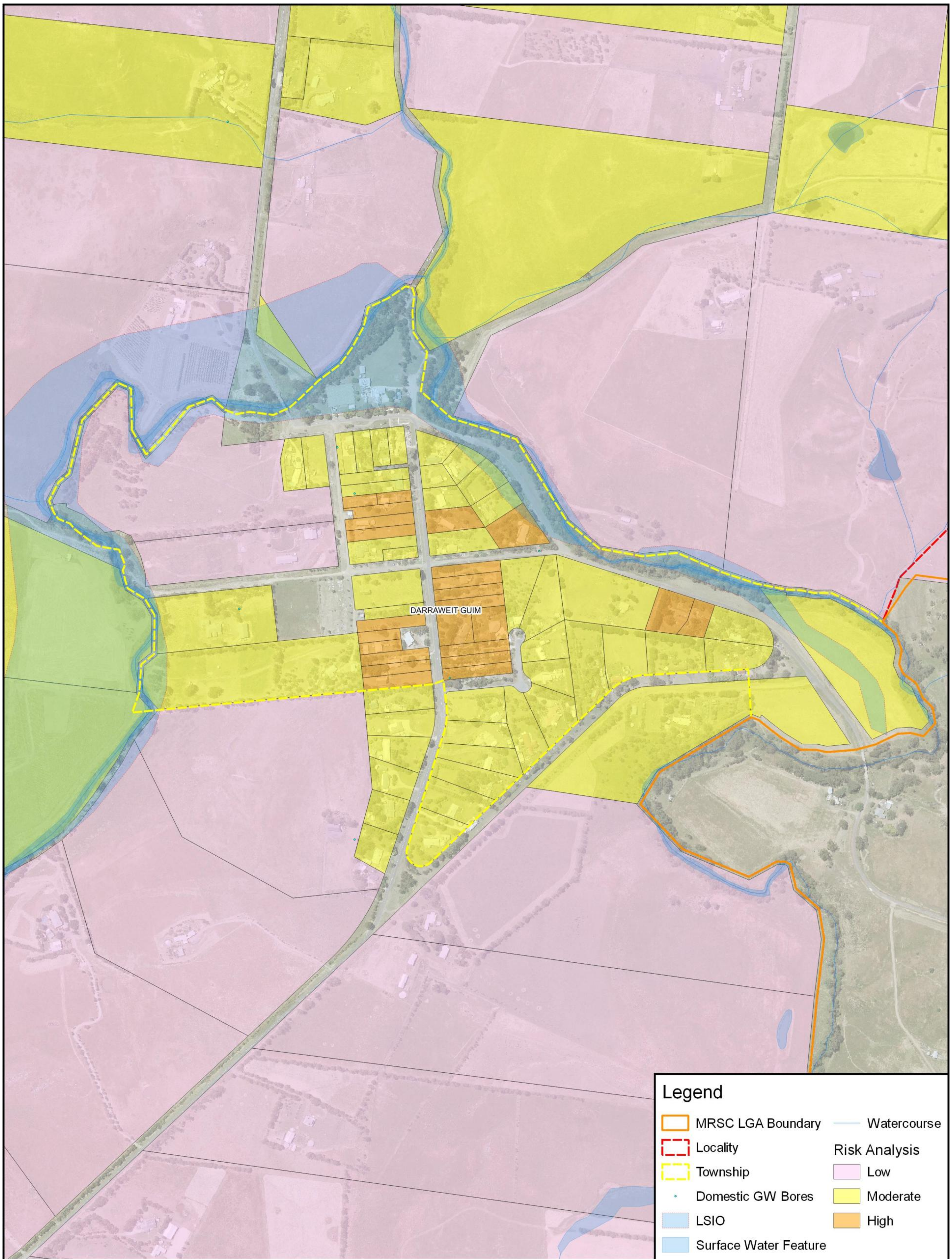

Figure B17: Darraweit Guim Township

MRSC OWMP 2025 - 2030

N

Whitehead & Associates
Environmental Consultants

0 200 400 600 m
(Approx Scale)

Revision	001
Drawn	CM
Approved	MS

4e. System Sizing Tables

The EDS sizing tables for Darraweit Guim are provided below.

Darraweit Guim - Sizing Tables

1 - 3 Bedroom Dwelling						
EDS Method	**Gravels & Sands (1)**	**Sandy Loams (2)**	**Loams (3)**	**Clay Loams (4)**	**Light Clays (5)**	**Medium to Heavy Clays (6)[5]**
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	175		235	275	340	645
Conventional Absorption System	N/A[3]		85	245	N/A[4]	
Evapotranspiration-Absorption System			85	185		
LPED Irrigation	N/A[6]		275	340	445	N/A[6]

4 Bedroom Dwelling						
EDS Method	**Gravels & Sands (1)**	**Sandy Loams (2)**	**Loams (3)**	**Clay Loams (4)**	**Light Clays (5)**	**Medium to Heavy Clays (6)[5]**
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	220		290	345	425	805
Conventional Absorption System	N/A[3]		105	305	N/A[4]	
Evapotranspiration-Absorption System			105	230		
LPED Irrigation	N/A[6]		345	425	555	N/A[5]

>5 Bedroom Dwelling						
EDS Method	**Gravels & Sands (1)**	**Sandy Loams (2)**	**Loams (3)**	**Clay Loams (4)**	**Light Clays (5)**	**Medium to Heavy Clays (6)[5]**
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	265		350	415	510	965
Conventional Absorption System	N/A[3]		125	370	N/A[4]	
Evapotranspiration-Absorption System			125	275		
LPED Irrigation	N/A[6]		415	510	670	N/A[5]

Note:
[1] Irrigation systems assumed to be installed on slopes of <10%. Reduction in DIR required for slopes exceeding 10%, as per Table M2 of *AS/NZS 1547:2012*.
[2] Secondary treatment and disinfection required.
[3] LCA required indicating lack of high perched watertable / high seasonal watertable.
[4] Special design requirements and distribution techniques or soil modification required, refer Notes 2 & 3 in Table L1 of *AS/NZS 1547:2012.*
[5] Secondary treatment required for all systems in Cat 6 soils.
[6] Drip irrigation preferred irrigation method.

5e. System Selection and Management Strategies

Conventional absorption trenches and beds may not be suitable to some areas of the town due to heavy-textured soils. Table 4-8 of the GOWM (2024) prohibits LPED systems on Category 5 and 6 soils (medium to heavy clays).

J. Monegeetta Locality Report

1d. Introduction

Monegeetta is located in the east of the Shire, positioned between Romsey and Darraweit Guim. The locality has a population of 207 residents with 77 private dwellings (ABS, 2021). The entire locality is unsewered, containing a total of 127 unsewered developable lots.

Based on the Pathway database, there is currently a total of 53 OWM permits in the locality. A summary of the OWMS configurations are presented in the following.

- 16 septic tank and absorption systems;
- 1 pump-out system;
- 1 vermiculture system with unknown EDS;
- 6 AWTP and subsurface irrigation systems;
- 14 AWTP and surface irrigation systems;
- 1 AWTP and absorption system; and
- 14 permits with no OWMS details.

2d. Summary of Constraints to OWM

Characteristic	Description
Climate	Median rainfall of 589.1mm/year, with mean evaporation of 1,196.5mm/year. Rainfall exceeds evaporation for four (4) months of the year. The entire located is within Climate Zone 2.
Surface Waterways	There are multiple waterways identified throughout the locality, with Bolinda Creek and Deep Creek forming the western and eastern boundaries (respectively). There are multiple farm dams located throughout the locality.
Groundwater	There are 17 domestic GW bores located throughout the locality, with a majority of these located in the west of the locality and in proximity to the main development area.
Land Subject to Inundation	No flooding identified within the locality.
Climate Zones	Climate Zone 3: 0 Climate Zone 2: 127 Climate Zone 1: 0
Useable Lot Area Risk	Very High: 19 High: 44 Moderate: 18 Low: 46
Slope Risk	High: 26 Moderate: 18 Low: 83
Soil Suitability Risk	High: 120 Moderate: 7 Low:0 *Soil landform units: Basalt Plains, Mt William, Darraweit Guim / Springfield, Mickleham / Clarkefield; subsoil consists of MC / HC with areas of LC and S.*

Characteristic	Description
Risk Analysis Rating	Very High: 1 High: 24 Moderate: 83 Low: 19

3d. Risk Analysis (Map)

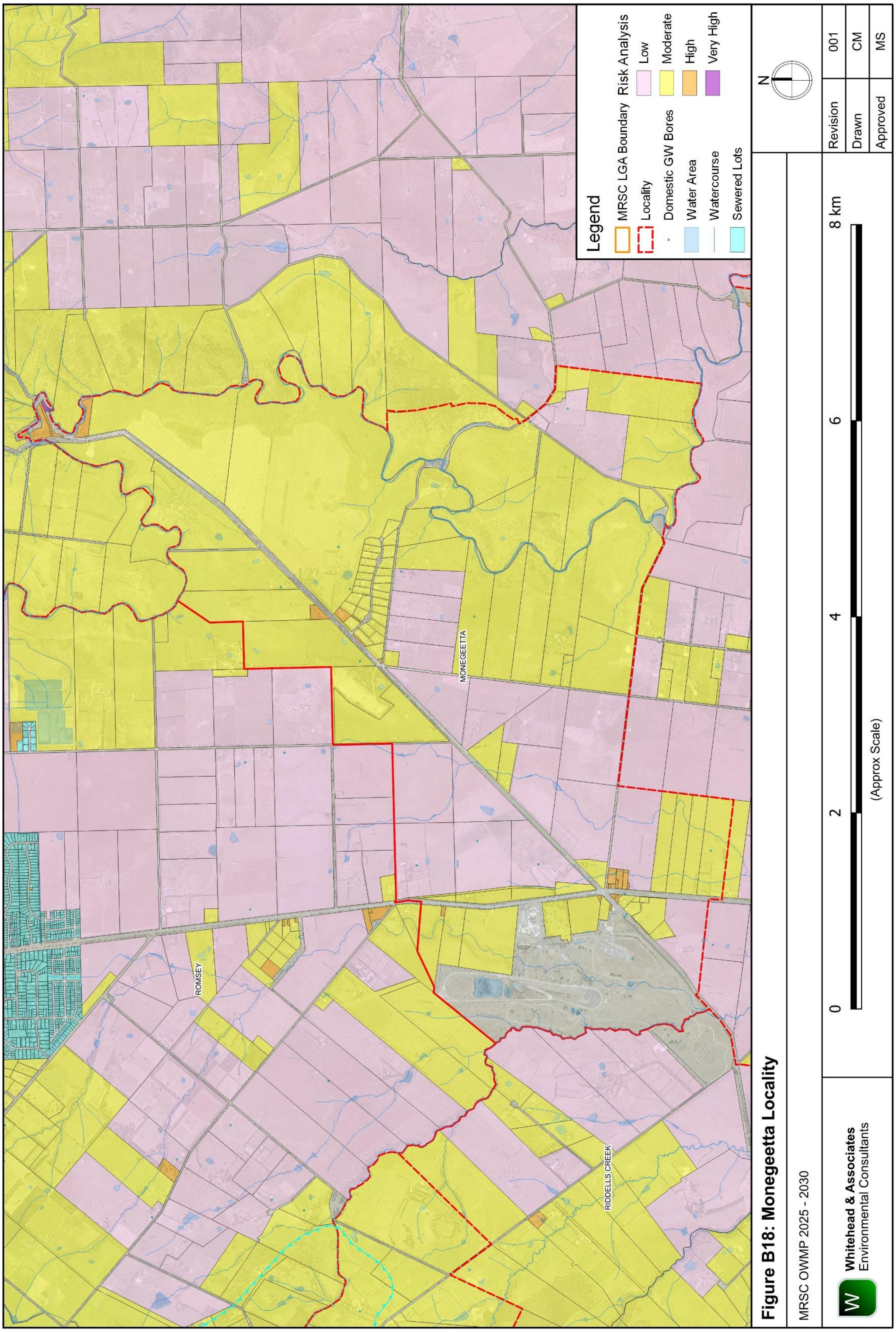

Figure B18: Monegeetta Locality

4d. System Sizing Tables

The EDS sizing tables for Darraweit Guim are provided below.

Monegeetta - Sizing Tables						
1 - 3 Bedroom Dwelling						
EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	190		255	310	390	840
Conventional Absorption System	N/A[3]		85	275	N/A[4]	
Evapotranspiration-Absorption System			85	200		
LPED Irrigation	N/A[6]		310	390	530	N/A[6]
4 Bedroom Dwelling						
EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	235		315	385	485	1,050
Conventional Absorption System	N/A[3]		105	340	N/A[4]	
Evapotranspiration-Absorption System			105	250		
LPED Irrigation	N/A[6]		385	485	665	N/A[5]
>5 Bedroom Dwelling						
EDS Method	Gravels & Sands (1)	Sandy Loams (2)	Loams (3)	Clay Loams (4)	Light Clays (5)	Medium to Heavy Clays (6)[5]
	Minimum EDA basal area (m^2) for zero wet weather storage, doesn't include spacing or setbacks					
Drip and Spray Irrigation[1,2]	280		380	460	585	1,260
Conventional Absorption System	N/A[3]		125	410	N/A[4]	
Evapotranspiration-Absorption System			125	295		
LPED Irrigation	N/A[6]		460	585	795	N/A[5]

Note:

[1] Irrigation systems assumed to be installed on slopes of <10%. Reduction in DIR required for slopes exceeding 10%, as per Table M2 of *AS/NZS 1547:2012*.

[2] Secondary treatment and disinfection required.

[3] LCA required indicating lack of high perched watertable / high seasonal watertable.

[4] Special design requirements and distribution techniques or soil modification required, refer Notes 2 & 3 in Table L1 of *AS/NZS 1547:2012.*

[5] Secondary treatment required for all systems in Cat 6 soils.

[6] Drip irrigation preferred irrigation method.

5d. System Selection and Management Strategies

Conventional absorption trenches and beds may not be suitable to some areas of the town due to heavy-textured soils. Table 4-8 of the GOWM (2024) prohibits LPED systems on Category 5 and 6 soils (medium to heavy clays).

Appendix C

Crop Factors,

Retained Rainfall Values, and

Monthly Climate Data

Acceptable Crop Factors												
Vegetation Type	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Pasture	0.70	0.70	0.70	0.60	0.50	0.45	0.40	0.45	0.55	0.65	0.70	0.70
Lucerne	0.95	0.90	0.85	0.80	0.70	0.55	0.55	0.65	0.75	0.85	0.95	1.00

Slope	**Retained Rainfall Values**	
	Sandy Soils (Category 1 – 2)	**Clay Soils (Category 3 – 6)**
<5%	1.0	0.9
5-10%	0.9	0.8
>10%	0.8	0.75

Note: Sandy soils (Category 1 – 2) have been assigned a higher retained rainfall values due to their higher permeability allowing water to infiltrate, with clay soils (Category 3 – 6) allowing less infiltration due to their lower permeability, therefore generating more runoff. Retained rainfall has a negative relationship with slope, as run-off increases with slope. The provided values are based on the assumption that the EDS surface is vegetated (i.e. turf, pasture).

Median Rainfall													
Locality	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Lauriston	32.4	19.0	29.4	43.6	66.0	73.6	86.0	88.2	68.6	60.4	47.2	40.0	654.4
Carlsruhe	35.7	21.7	31.5	48.9	65.9	78.0	87.3	88.3	67.7	65.8	50.4	43.1	684.3
Mount Macedon	42.2	33.0	44.7	66.8	95.4	95.8	90.9	102.9	81.4	84.7	71.9	55.9	865.6
Monegeetta	39.7	22.1	36.1	48.3	47.7	56.3	61.0	66.6	61.9	54.0	52.6	42.8	589.1
Darraweit Guim	38.4	21.3	31.3	46.6	45.7	51.0	46.3	54.4	55.1	38.7	45.4	34.1	508.3
Woodend	39.7	27.4	35.6	50.9	69.5	84.8	88.1	91.6	67.5	71.1	57	42.4	725.6
Gisborne	38.5	29.8	37.0	54.1	54.6	60.2	63.7	82.8	58.4	66.0	67.0	54.1	666.2
Macedon	44.3	33.6	39.9	56.0	67.7	74.3	73.7	84.0	73.6	72.5	65.2	51.8	736.6
Riddells Creek	35.6	24.5	31.8	42.3	40.4	55.0	50.0	59.0	54.6	52.5	54.3	43.5	543.5
Romsey	36.8	25.3	36.7	50.8	54.7	63.4	64.1	77.7	62.9	58.9	54.1	42.7	628.1

Mean Evaporation													
Locality	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
Lauriston	194.2	163.6	129.0	74.6	41.6	26.9	30.1	45.5	68.9	106.3	136.1	176.9	1,193.7
Carlsruhe	188.6	158.7	125.8	72.6	40.7	26.1	29.4	44.6	67.9	104.0	132.1	171.7	1,162.4
Mount Macedon	177.2	149.3	118.0	67.1	37.2	23.1	26.4	41.2	63.7	97.6	123.1	160.5	1,084.2
Monegeetta	188.2	158.3	127.5	75.3	44.4	29.4	33.6	49.8	73.0	108.6	135.0	173.5	1,196.5
Darraweit Guim	193.6	162.8	131.9	79.0	47.5	32.2	36.8	53.6	77.3	113.8	140.9	179.8	1,249.2
Woodend	183.2	154.4	122.2	70.1	39.4	24.9	28.2	43.4	66.3	101.4	128.1	166.7	1,128.5
Gisborne	183.8	154.6	124.2	73.4	43.5	28.7	33.0	48.8	71.7	106.3	131.3	168.7	1,168.2
Macedon	180.9	152.5	120.8	69.6	39.3	24.9	28.4	43.6	66.3	100.8	126.7	164.6	1,118.3
Riddells Creek	189.5	159.2	128.7	76.7	45.9	30.7	35.2	51.5	74.9	110.6	136.7	174.9	1,214.4
Romsey	186.1	156.6	125.5	73.0	42.1	27.4	31.0	46.8	69.9	105.2	131.9	170.7	1,165.9