



DECENTRALISED WATER CONSULTING

Un-sewered Village Wastewater Risk Assessment and Prioritisation for High-level Servicing Options





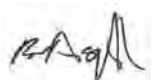

MIDCOAST
council

5/08/2021

DOCUMENT CONTROL SHEET

| | | |
|---|------------------|---|
| Decentralised Water Australia Pty Ltd trading as Decentralised Water Consulting Unit 2, 12 Channel Road MAYFIELD WEST NSW 2304 4960 2627 enquiries@decentralisedwater.com.au | Document | R.0351.001.00_MCC_Unservicedvillages_Final |
| | Title | Un-Sewered Village Risk Assessment And Prioritisation For High-Level Wastewater Servicing Options |
| | Project Manager | Ben Asquith |
| | Author(s) | Ben Asquith, Jack Sharples, Deni Hourihan |
| | Client | MidCoast Council |
| | Client Contact | Adam Turville |
| | Client Reference | |

REVISION / CHECKING HISTORY

| Revision History | Date | Checked By | | Issued By | |
|------------------|---------------|------------|---|-----------|---|
| R.0351.001.00 | 26 April 2021 | BAA |  | JS |  |
| R.0351.001.01 | 5 August 2021 | BAA |  | AW |  |

Acknowledgment

DWC acknowledges the Traditional Custodians throughout Australia and their continuing connection to land, water, culture and community, and pays respect to their Elders past, present and future.

Limitations Statement

This report and the associated services performed by Decentralised Water Consulting (DWC) relate solely to the scope, budget, time and access constraints as set out in the engagement agreement and quotation between DWC and the Client. DWC accept no liability for any use or reliance on this Report for any purpose not documented in this agreement and quotation by the Client. It has been prepared for the exclusive use of the Client and DWC accepts no liability for any use of or reliance upon this report by any third party.

The outcomes and recommendations contained in this report may have relied upon a range of information and data sources including information and discussions with the client, field investigations (limited to those described in this report), publicly available information and other sources. DWC have not verified the accuracy of third party data and any inaccuracies or inadequacies may influence the accuracy of our findings. Similarly, both the inherent variability of environmental and ground conditions and the passage of time can lead to changes in ground conditions and other factors which may affect the accuracy of our findings. The Client should seek advice from DWC on the accuracy of findings after more than six months has passed or where changes in relevant conditions are known to have occurred. Data and information collected during field investigations should not be taken as accurate and complete for all depths and locations across the site.

The report and services have been completed in accordance with relevant industry standards, guidelines and government legislation as of the date of publication unless stated otherwise. Where an engineering design is included, this design has been based on site and construction plans as provided by the Client and/or their representative and documented in the report. DWC accepts no liability for the impact of any changes to site conditions and / or building layout and extents on our design where DWC were not notified of the changes prior to completing our services. Additional costs may be incurred where work has already been completed.

Copyright © Decentralised Water Consulting

This report and accompanying plans were prepared for the exclusive use of the Client. No part of this report may be reproduced, stored or transmitted in any form without the prior consent of Decentralised Water Consulting unless permitted under the Copyright Act or as outlined in the contract or terms of engagement. Plans accompanying this document may not be reproduced, stored or transmitted in any form unless this copyright note is included.

TABLE OF CONTENTS

| | | |
|-------|--|----|
| 1 | Introduction | 1 |
| 1.1 | Project Drivers | 2 |
| 2 | Background | 3 |
| 2.1 | Available Data | 3 |
| 3 | Risk Based Prioritisation | 5 |
| 3.1 | High Risk Villages / Areas | 5 |
| 3.2 | Methodology | 5 |
| 3.2.1 | MCC Workshop | 11 |
| 3.3 | Results of the Multi-Criteria Analysis | 11 |
| 4 | High Level Options Development | 14 |
| 4.1 | Potential Wastewater Servicing Options | 14 |
| 4.1.1 | Broad Servicing Options | 15 |
| 4.2 | Cost Estimates | 17 |
| 5 | Village Case Studies | 20 |
| 6 | Next Steps? | 31 |
| 7 | References | 33 |
| | Appendix A: Workshop Minutes | 34 |
| | Appendix B: Multi Criteria Analysis (MCA) Results | 35 |
| | Appendix C: MCC Village Extents | 36 |
| | Appendix D: High Level Options Assessment Criteria | 37 |
| | Appendix E: Village Wastewater Characteristics Summary | 38 |
| | Appendix F: Servicing Option Posters | 40 |

LIST OF FIGURES

| | | |
|----------|---|----|
| Figure 1 | Multi-Criteria Analysis Categories | 6 |
| Figure 2 | On-site Wastewater Sub-categories | 6 |
| Figure 3 | Reticulated Water Supply Scoring Method | 7 |
| Figure 4 | Proximity sub-categories and Scoring Method | 7 |
| Figure 5 | In-fill Development Scoring Method | 7 |
| Figure 6 | MCA Weighted Results | 12 |
| Figure 7 | High level options selection criteria | 14 |
| Figure 8 | Next steps flowchart | 31 |

LIST OF TABLES

| | |
|---|----|
| Table 1 Key Village Ranking | 3 |
| Table 2 Available Data Summary | 3 |
| Table 3 MCA Methodology Detail and Scoring | 8 |
| Table 4 Key Villages by Ranking | 13 |
| Table 5 Village Servicing Option and Cost Summary | 18 |
| Table 6 Potential Further Studies | 32 |

1 Introduction

Decentralised Water Consulting (DWC) have prepared this report to assist MidCoast Council (MCC) in understanding the risks from On-site Sewage management systems in un-sewered villages across the Local Government Area (LGA). The report outlines the results from a risk prioritisation assessment designed to identify high risk villages and presents potential high-level options to improve wastewater management for these areas. Wastewater is currently managed in these villages by individual on-site and off-site wastewater management systems (systems) with approval and performance regulated by MidCoast Council. Based on available data and feedback from MCC the systems within these areas are of varying type, age, capacity and condition.

A previous risk prioritisation for small unsewered communities (*Small Communities Wastewater Risk Assessment*) was prepared in 2000. As part of this project DWC worked with MCC to update and revise the previous risk assessment process to reflect more recently available data and information. In addition, the assessment process was able to include key areas within the Gloucester Shire since becoming part of the MCC area of operation because of Council amalgamations.

The project consisted of the following elements:

- Review of previous prioritisation report,
- Data review and selection of villages,
- Development of a risk prioritisation methodology,
- Assessment and ranking of the agreed villages,
- Engagement with MCC,
- Development of high-level options (including initial cost estimation) with focus on top ranked villages,
- Development of example case studies for 5 selected villages.

The updated risk prioritisation process has utilised a Multi-Criteria Analysis (MCA) based on key categories and sub-categories developed in conjunction with MCC.

1.1 Project Drivers

The previous risk assessment completed in 2000 captured the LGA's of Great Lakes and Greater Taree, and therefore needs to now include Gloucester Shire as it has become part of the MCC area of operation. This project has leveraged off the previous on-site hazard mapping work completed as part of the MCC *On-site Sewage Development Assessment Framework* (DAF) project. This involved an assessment across the entire MCC LGA of land capability and receiving environment hazards related to On-site Sewage Management with a single hazard class label assigned to each property based on the identified constraints. The basis for the MCC DAF hazard class includes the relevant regulatory instruments, guidelines and standards applicable to on-site sewage management and therefore provides a robust basis for evaluating the sustainability and risks associated with continuation of owner managed on-site systems through the wastewater management strategy.

The intention of this project was to utilise existing assessments and data to apply a transparent, scientifically robust risk prioritisation process for un-serviced towns, villages and localities across the new MCC area of operation. Specifically, the technical outputs from the DAF project offered a sound basis for a Multi-Criteria Assessment (MCA) process formulated in conjunction with MCC stakeholders. The outcomes of this project will enable MCC to prioritise resourcing towards high-risk villages where the benefits of investment in improved wastewater services are likely to be maximised.

In addition, this project has included consideration of high-level servicing options that encapsulate a broader range of options at a wider variety of scales including decentralised servicing approaches. Since the 2000 study, there has been considerable progress in the technological, regulatory, governance and operational aspects of small and decentralised wastewater servicing approaches. Examples include the advent of remote monitoring and control, machine learning and IoT (Internet-of-Things) to enable centralised, real-time, automated operation and monitoring of decentralised systems. Additionally, there has been an increase in legislative structures to enable the delivery of decentralised water services (e.g. the *Water Industry Competition Act*) and increased consideration of water sensitive and liveability connections between water management and development.

2 Background

The basis of this project is an update and revision of a previous risk prioritisation for small unsewered communities (*Small Communities Wastewater Risk Assessment*) undertaken in 2000. Since the formation of the new MidCoast Council, it is timely for the assessment to include any high-risk villages identified within the Gloucester Shire. Importantly, given the time that has elapsed since the previous prioritisation was undertaken several of the areas have either been provided with reticulated sewer or require re-assessment due to changes that have occurred within the villages over the last 20 years. Table 1 below presents a list of villages located within the Great Lakes and Greater Taree regions identified in the previous risk assessment report as the highest priority for improved wastewater servicing.

Table 1 Key Village Ranking

| Priority Group | Villages Great Lakes LGA | Villages Greater Taree LGA |
|----------------|-----------------------------|-------------------------------|
| 1 | Coomba Park | Bungay |
| | North Arm Cove | |
| | Stroud Road | |
| 2 | Allworth | Cedar Party |
| | Shearwater | Crowdy Head |
| 3 | Pindimar (North and South) | Forrest Downs |
| | Bundabah | |
| | Nerong | |

2.1 Available Data

A summary of the available data and information collated by DWC and utilised as part of the risk prioritisation (MCA) process is provided in Table 2 below.

Table 2 Available Data Summary

| Data | Description | Data Source |
|--|---|-------------|
| Properties / Lots | Cadastral layer – MCC | MCC |
| Suburbs / Localities | Defined suburbs and localities across MCC area. | MCC |
| Land Capability for Onsite Wastewater Management | Captured within Risk Mapping developed for MCC DAF. | DWC / MCC |
| Risk to Receiving Environments | | |

| Data | Description | Data Source |
|--|--|--------------------|
| Potable Water | Reticulated potable water layer | MCC Water Services |
| Watercourses / waterbodies | State-wide data layers | MCC |
| Sensitive Ecological Catchments | Catchments draining to sensitive Great Lakes waterbodies. | MCC |
| Drinking Water Catchments / Potable Groundwater Bores | Surface potable water catchments defined by MCC Water Services, including groundwater bores used for potable water extraction. | MCC |
| SEPP Coastal Zones (2018) | Latest SEPP Coastal / Aquaculture Zones included as part of DAF risk mapping discussed above. | MCC |
| SEPP Primary Production and Rural Development (2019) - Aquaculture Zones | | |
| Stormwater Infrastructure | Available stormwater data for MCC. | MCC |

3 Risk Based Prioritisation

3.1 High Risk Villages / Areas

An initial review of a list of high-risk villages provided by MidCoast Council (MCC) was undertaken by DWC based on available collated data sets and information (discussed in Section 2.1). This included determining the approximate number of high-risk properties within each of the MidCoast LGA villages based on the spatial layer provided by MCC. For the purposes of this report high-risk properties are defined as those with a property size <2,000m² and/or classed as high hazard under the DAF.

The study area selected for each village was determined based on detailed notes provided by MCC in conjunction with village LEP zoning information. This included the addition of potential village areas within the former Gloucester Shire regions not previously considered in the report prepared in 2000. Appendix B includes the detailed Village notes provided by MCC to define the study areas for this project.

3.2 Methodology

A Multi-Criteria Analysis (MCA) methodology was developed and applied to the risk assessment process. The broad categories and sub-categories selected for the risk assessment process are presented in Figures 1 – 5 below with a greater level of detail including the scoring methodology documented in Table 3. A summary of the basis and source data used for scoring each nominated area against the sub-categories is also presented. The selected criteria, their definition, proposed source data and scoring method were subject to review by MCC prior to completion of the MCA.

A distinction has been made between the *long-term sustainability* of on-site wastewater management versus the *current impacts and performance* of existing systems. This recognises that properties within the nominated villages may be suitable for long-term on-site wastewater management subject to upgrade of the existing system. In most situations, areas with the potential for safe and sustainable on-site sewage management will be most cost effectively serviced in this manner.

Inclusion of existing on-site system performance data into the risk assessment process was considered but not taken forward due to limitations on the availability of data. MidCoast Council confirmed that spatial on-site system type data is only available for the former Great Lakes LGA and therefore this may skew the results for high-risk villages in this LGA if utilised.

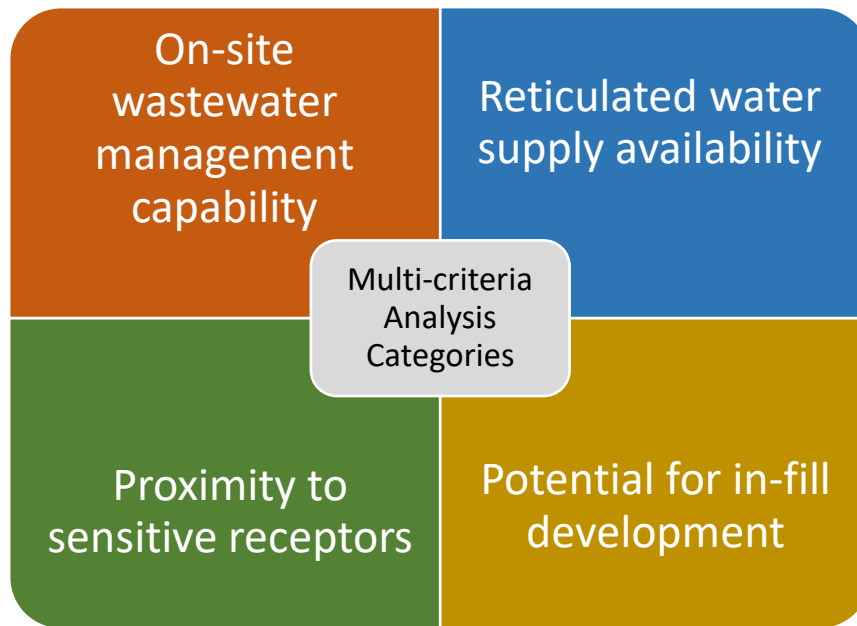


Figure 1 Multi-Criteria Analysis Categories

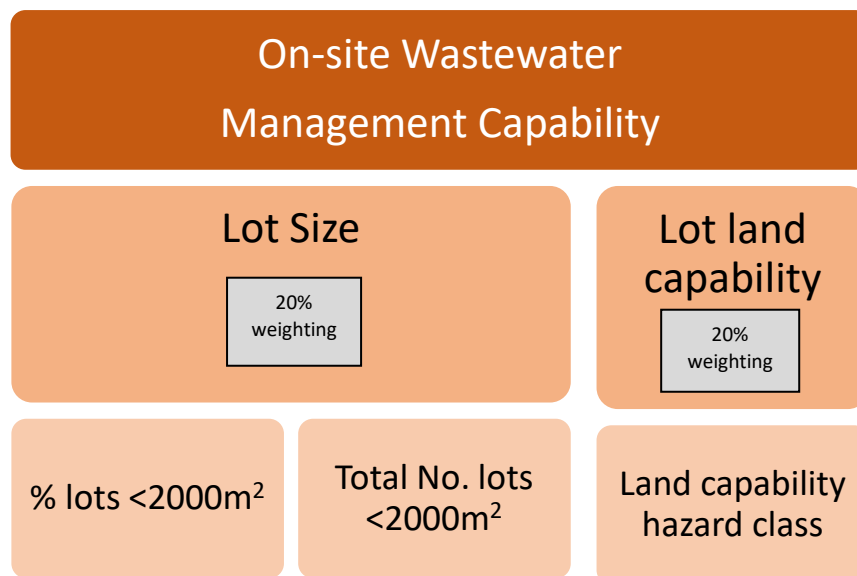


Figure 2 On-site Wastewater Sub-categories

Reticulated Water Supply

Availability of reticulated potable water
Increases priority for wastewater service

10%
weighting

Yes

No

Figure 3 Reticulated Water Supply Scoring Method

Proximity to Sensitive Receiving Environments

Waterways and stormwater

15%
weighting

20%
weighting

Sensitive
environments

No proximity
risk

4 levels of risk based on
proximity to waterways
and stormwater
infrastructure

3 levels of catchment
proximity risk relating to
waterways, potable
supply and aquaculture

Figure 4 Proximity sub-categories and Scoring Method

In-fill Development

Vacant land suitable for future
development

15%
weighting

Low
potential

Medium
potential

High
potential

Figure 5 In-fill Development Scoring Method

Table 3 MCA Methodology Detail and Scoring

| Category | Sub-category | Description | Scoring Method | | Weighting |
|--|---------------------|---|---|--------------------|-----------|
| On-site Wastewater Management Capability | Lot size | % of lots <2,000m ² or defined high hazard under the MCC DAF | Percentage of Properties <2,000m ² and/or DAF High Risk | | 20% |
| | | | 0 – 20% | 0 | |
| | | | 21 – 40% | 1 | |
| | | | 41 – 60% | 3 | |
| | | | 61 – 80% | 4 | |
| | | | 81 – 100% | 5 | |
| | | | Total No. of Properties <2,000m ² and/or High Risk (added to above score with max. of 5) | | |
| | | | <20 | no change to score | |
| | | | 21 – 30 | +1 | |
| | | | 31 – 40 | +2 | |
| | | | 41 – 50 | +3 | |
| | | | >50 | Score = 5 | |
| | Lot land capability | Land capability hazard based on hazard mapping developed for MCC DAF | Average Land Capability Hazard Class | | 20% |
| | | | Average High Hazard | 5 | |
| | | | Average Medium Hazard | 3 | |
| | | | Average Low Hazard | 1 | |
| Reticulated water supply availability | - | Availability of reticulated potable water | | | 10% |

| Category | Sub-category | Description | Scoring Method | | Weighting |
|---|---|---|--|-------------|-----------|
| | | Captures existing village water infrastructure. Increased priority for wastewater service | Yes | 3 | |
| | | | No | 1 | |
| Proximity to sensitive receiving environments | Waterways / waterbodies and stormwater infrastructure | Waterways - Proximity of lots to intermittent versus perennial waterways / waterbodies as an indicator of the risk of pollutant transport Stormwater - Proximity of lots to stormwater pipes and pits\ Accuracy of provided data ~ <u>60-70%</u> according to MCC | All properties within 100m distance to permanent / named waterway and/or waterbody | 5 | 15% |
| | | | Drainage from approx. 50-75% of total properties to permanent / named waterway and/or waterbody | 4 | |
| | | | Drainage from approx. 1-50% of total properties to permanent / named waterway and/or waterbody | 3 | |
| | | | Drainage from approx. 1-50% of total properties to <i>intermittent</i> waterway / dam | 2 | |
| | | | No risk to waterway / waterbody | 0 | |
| | | | Add 1 point to score where stormwater infrastructure present within town / village to reflect elevated risk if failure of on-site systems occurs | | |
| | Potable / ecologically sensitive catchments | Proximity of lots to potable water catchment or other sensitive catchments (defined in DAF) Zone 1 – Direct hydraulic catchment to sensitive lake area | Proximity Zone | | 20% |
| | | | Within zone 1 | Sub-score 5 | |
| Within zones 2 or 3 | | | Sub-score 3 | | |

| Category | Sub-category | Description | Scoring Method | | Weighting |
|---------------------|--|---|-------------------------------------|-------------|------------|
| | | Zone 2 – Broader drinking water catchment (MidCoast Water defined areas) Zone 3 – SEPP aquaculture zone (500m buffer) | Not within any zone | Sub-score 0 | |
| In-Fill development | Vacant lots / Parcels that are potentially developable | Capture potential for development of existing vacant lots within the village extents, and thus potential for future growth capacity. Captures both the potential to exacerbate impact and justify a whole of town solution. | Infill development potential | | 15% |
| | | | Low potential | 0 | |
| | | | Medium potential | 3 | |
| | | | High potential | 5 | |

3.2.1 MCC Workshop

The risk assessment and prioritisation processes were discussed at a workshop held at MCC offices on 25 June 2020.

The primary purpose of the workshop was to discuss and agree on the MCA methodology and the weightings for the six (6) sub-categories. Agreed weightings are presented in Table 3 with the Workshop Minutes provided in Appendix A.

3.3 Results of the Multi-Criteria Analysis

The MCA scoring for each sub-category across all un-serviced villages and the ranking or prioritisation is provided in Figure 6 below.

This figure presents the combined MCA scores for each village with the appropriate weighting applied to the relevant sub-category. A larger weighting means the specific sub-category is considered more important by MCC. The higher the stacked column, the greater the combined score and therefore the higher the risk from existing on-site wastewater management. This indicates a greater priority for consideration for an improved wastewater service.

As an example:

Coomba Park received the highest score of 5 for the land capability risk sub-category however a resulting score of 1 is obtained once the 20% weighting is applied. Thus, each sub-score was multiplied with the relevant weighting, and the sub-scores summed for each of the villages. In the case of Coomba Park a combined score of 4.6 was obtained out of a maximum score of 5.

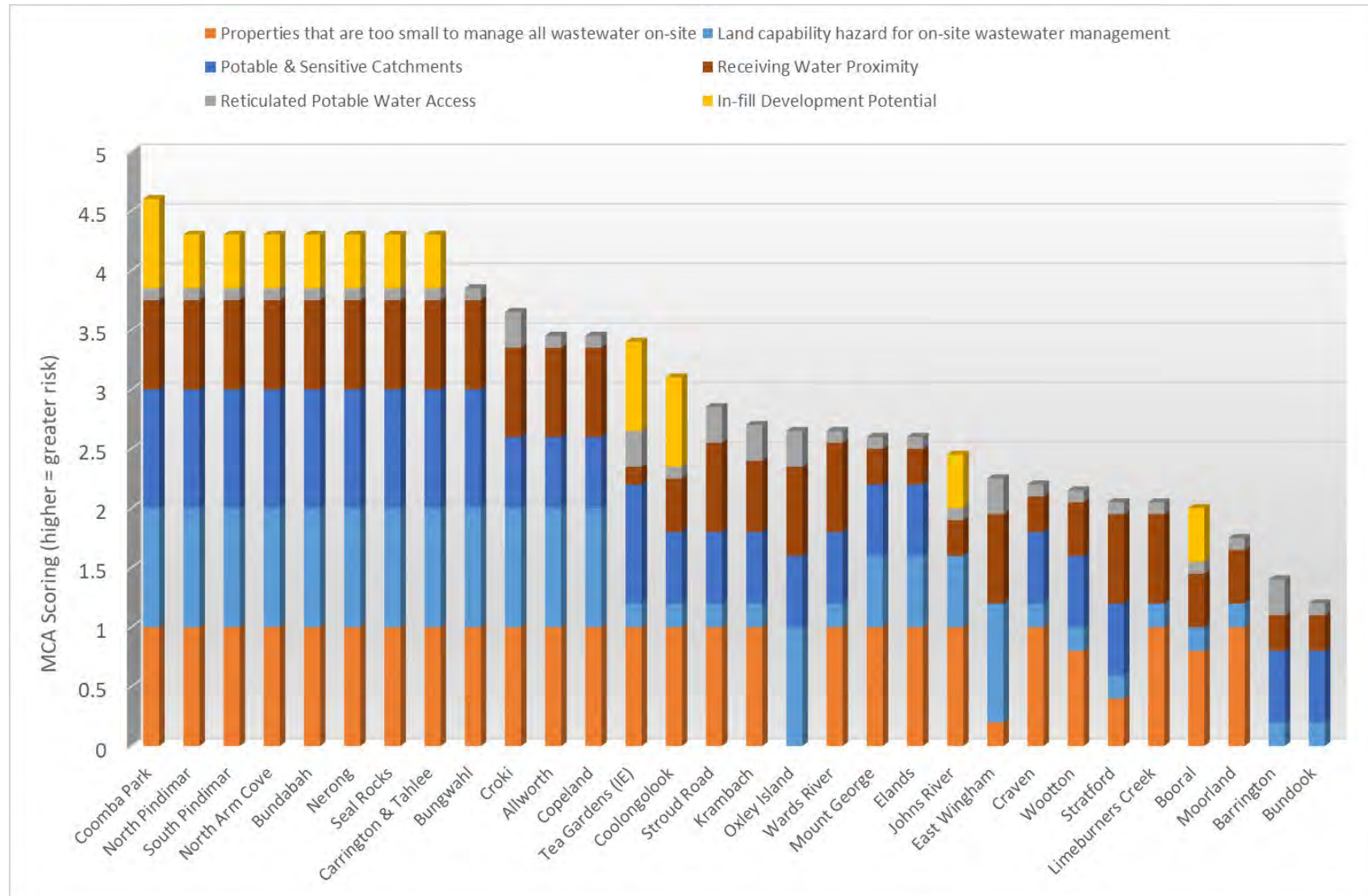


Figure 6 MCA Weighted Results

Based on the MCA prioritisation process the villages with the highest rank are summarised in Table 4.

Table 4 Key Villages by Ranking

| Rank | Score | Village | Key Factors Influencing Rank |
|------|-------|-------------------------------|---|
| 1 | 4.6 | Coomba Park | Received highest score across all criteria other than reticulated water supply availability. Located on Wallis Lake with small sloping lots and low permeability soils. Significant potential for development of existing vacant lots. |
| 2 | 4.3 | North Pindimar | Received highest score for lot size, land capability, receiving environment sensitivity and proximity. Slightly less in-fill development potential than Coomba Park. |
| | | South Pindimar | |
| | | North Arm Cove | |
| | | Bundabah | |
| | | Nerong | |
| | | Seal Rocks | |
| | | Carrington & Tahlee | |
| 9 | 3.9 | Bungwahl | Comparable to the 6 villages ranked equal 2 nd other than the in-fill development potential. |
| 10 | 3.7 | Croki | Constrained by property size, land capability (flooding and groundwater), proximity to Manning River and presence of aquaculture nearby. Limited in-fill growth potential compared to higher ranked areas. Receiving water less sensitive to ecological impact. |
| 11 | 3.5 | Allworth | Like Croki apart from the availability of a reticulated water supply (higher wastewater generation). |
| | | Copeland | |
| 13 | 3.4 | Tea Gardens Industrial Estate | Driven by small lot size, sensitivity of catchment and in-fill potential. |
| 14 | 3.1 | Coolongolook | Small lot size, proximity to Wallis Lake and potential for in-fill development. |

This ranking prioritises villages based on the risk and constraints associated with long-term on-site sewage management and development-based drivers for alternative wastewater servicing. It should be noted that the ranking does not take into consideration of the cost, relative ease of servicing or the willingness of property owners to pay for improved wastewater servicing.

4 High Level Options Development

Following the risk prioritisation process, DWC then proceeded to develop potential high level wastewater servicing solutions for 5 villages given the constraints and limitations present. Consideration was also given to broad servicing options considered most suitable for the remaining lower ranked areas.

4.1 Potential Wastewater Servicing Options

An initial review process was undertaken to identify potential high level wastewater servicing options that may be feasible for each of the villages.

The intention of the high-level options was to capture a range of servicing solutions from a traditional '*flush and forget*' conventional sewer option to decentralised solutions such as cluster or precinct scale systems incorporating Integrated Water Management (IWM) principles.

The initial review process shortlisted five potential servicing options. These options are not exhaustive but have the potential to be adjusted to capture a wide range of variations in servicing approach. Tanker removal of wastewater from properties within the village is an option already being undertaken for several highly constrained areas such as Coomba Park. Based on the likely wastewater generation and current Council experience however, this option is not likely to be economically viable or sustainable over the long-term and was not considered further in the selection process.

The key factors used to assign suitable high-level servicing options to each village is presented in Figure 7 with further information on each criteria detailed in Appendix E.

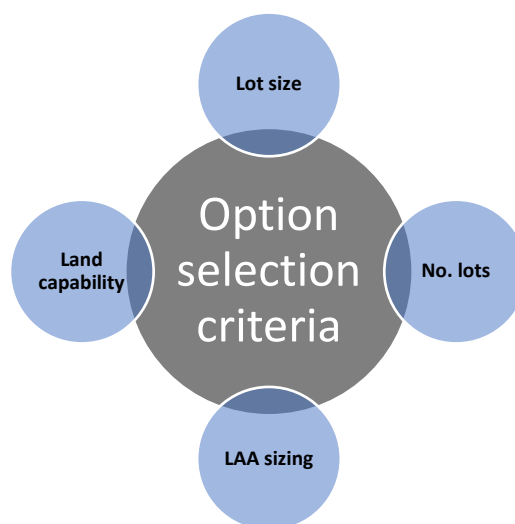


Figure 7 High level options selection criteria

A summary of key characteristics and potential high-level options(s) for the assessed villages are provided in Table 5.

4.1.1 Broad Servicing Options

Option 1 - Reticulated sewerage

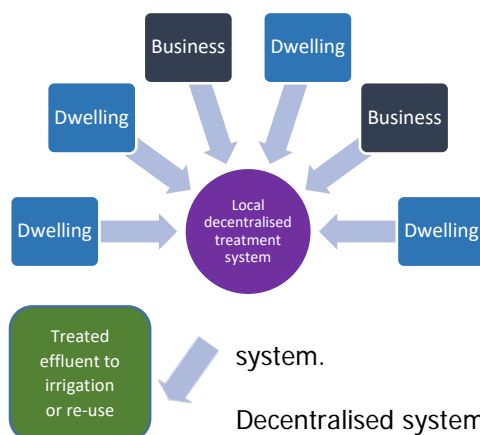
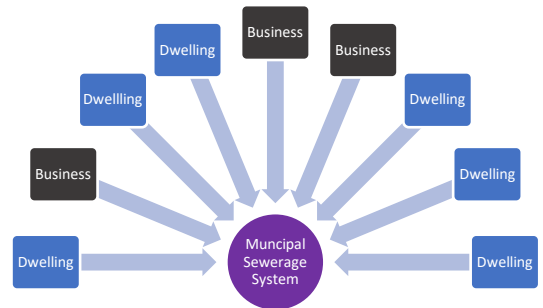
Reticulated sewerage can be defined as *'A network of sewers managed by a sewerage service provider that is designed to convey sewage from any development, lot or subdivision to a centralised facility for treatment and disposal.'*

A reticulated system can be in the form of a traditional gravity sewer, a pressure system or a combination of the two types. Conventional sewerage systems and sewage treatment plants are operated and managed by municipal water and sewer authorities.

This system type involves delivery of gravity or low-pressure sewer including pump stations and rising mains to a connection point in an existing sewerage network or new central Sewage Treatment Plant (STP).

This approach is typically feasible for:

- Villages in proximity to existing sewerage networks such as Tea Gardens, and
- Higher density villages with smaller lot sizes such as Coomba Park.



Option 2 - Local decentralised cluster system

Decentralised wastewater management can be defined as *'The collection, treatment and reuse of wastewater at or near the point of generation.'* (Crites and Tchobanogolous, 1998). The term cluster system can be defined as the collection of wastewater from several adjacent buildings for conveyance to a decentralised wastewater treatment

system. Decentralised systems can provide a feasible and sustainable solution for villages considering construction of a new system or modification, replacement, or expansion of existing treatment systems. A decentralised cluster approach permits *'fit-for-purpose'* treatment system designs to be developed for each situation based on the unique characteristics of the project area. Cluster scale systems are ideally suited to villages with small lot sizes but lower density.

A cluster includes provision of a new localised reticulation system to collect sewage or treated effluent from properties for treatment and reuse. Re-use most commonly involves irrigation (or another land application method) of the treated effluent across community / public open space or agricultural land.

Cluster systems are typically set up at a precinct or small village scale to treat wastewater from a group of properties within the vicinity of a reuse site such as a public open space or private recycled water user. A range of technologies and scales can be considered with the aim of being adaptive to the safest and most feasible opportunities for each specific village (i.e. don't try and make the problem fit a predetermined solution). They typically enable more energy / carbon efficient servicing approaches by avoiding transporting sewage long distances and operating at scales that avoid significant wet weather inflows and enable use of low energy treatment technologies.

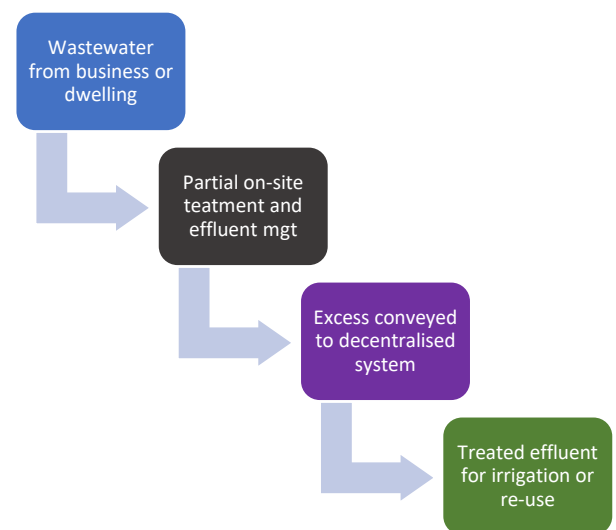
This method enables opportunities for on-property reuse of treated wastewater to reduce downstream treatment and irrigation infrastructure requirements. To operate effectively these systems need to be operated and managed by a Responsible Management Entity (RME) such as MidCoast Council or other licenced private water utility.

Option 3 – Partial on-site containment of wastewater

This method is suitable for medium sized properties where land capability constraints are not limiting but where there is insufficient land available for sustainable on-site management of full wastewater volumes. Excess effluent that cannot be managed on site would be pumped to an effluent (pressure) sewer for conveyance to local reuse facilities.

On-lot irrigation could be set at a reasonable minimum land area with opportunity to increase where available and suitable. Can also be controlled remotely via weather station to maximise irrigation during dry periods and reducing or eliminating during wet.

Advantages include significantly reduced design flows at local reuse sites and reduced treatment requirements due to on-site treatment to (typically) secondary quality effluent. Typically cost effective where lot sizes are 1,000 m² – 3,000 m².

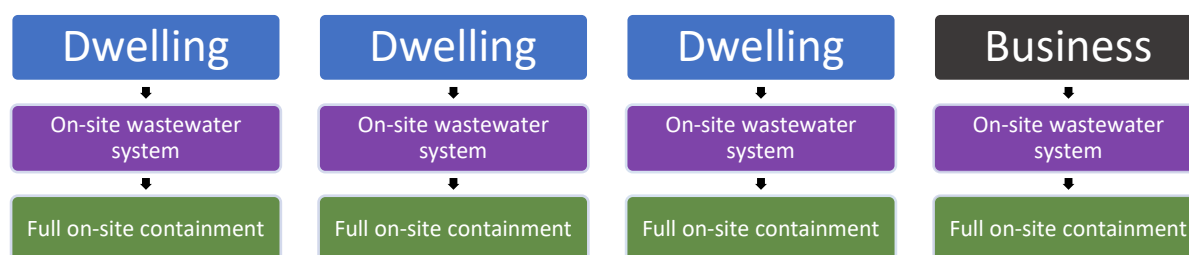


Option 4 – Full On-site containment of wastewater

The continued full management of wastewater on-site can be considered subject to land capability and availability. On-site wastewater management technologies can deliver a very high level of performance at the lowest community cost subject to management and oversight by what the USEPA refer to in their Management Models (USEPA 2003) a Responsible Management Entity who are responsible for the effective operation and regulatory compliance of the systems..

Development of a suitable model for upgrade, ownership and management would be necessary for this option to be successful, given the significant constraints observed in many of the selected villages.

The continuation of the business-as-usual scenario of owner managed on-site systems would need to be evaluated from a risk perspective as part of a feasibility and business case development for suitable villages. There may be some villages with larger lot sizes or limited feasibility for alternative



options for whom business as usual will be the preferred option.

4.2 Cost Estimates

A range of indicative capital cost estimates have been calculated for the potential options. The costs are very high-level in nature and have been based on previous DWC projects involving the feasibility, design and delivery of decentralised servicing approaches under the governance of a public water utility. Further investigations and design work will be required to understand more accurate capital costs. Indicative costs for each village and option have been included in Table 5 below.

Table 5 Village Servicing Option and Cost Summary

| Rank | Village | No. Lots | Servicing Option 1 Sewer | Servicing Option 2 Cluster system | Servicing Option 3 Partial On-site | Servicing Option 4 Full On-site | Cost ¹ \$ Million |
|------|---------------------------------|----------------------------|-----------------------------|--------------------------------------|---------------------------------------|------------------------------------|---------------------------------|
| 1 | Coomba Park | 670 | | | | | 20 – 40 |
| 2 | North Pindimar | 91 | | | | | 9 – 14 |
| | South Pindimar | 137 | | | | | |
| | North Arm Cove ² | 409 | | | | | 16 – 25 |
| | Bundabah | 125 | | | | | 6 – 10 |
| | Nerong ² | 168 | | | | | 8 – 13 |
| | Seal Rocks | 73 | | | | | 4 – 6 |
| | Carrington & Tahlee | 40 | | | | | 2 – 4 |
| 9 | Bungwahl ² | 74 | | | | | 4 – 6 |
| 10 | Croki ² | 25 + 38 caravan park sites | | | | | 2 – 4 |
| 11 | Allworth | 92 | | | | | 4 – 7 |
| | Copeland | 116 | | | | | 6 – 9 |
| 13 | Tea Gardens (Industrial Estate) | 38 | | | | | Sewer |
| 14 | Coolongolook | 77 | | | | | 4 – 6 |
| 15 | Stroud Road | 91 | | | | | Sewer |
| 16 | Krambach | 238 | | | | | 9 – 14 |
| 17 | Oxley Island | 177 | | | | | 3 – 6 |
| | Mitchells Island | 47 | | | | | |
| | Wards River | 64 | | | | | 3 – 5 |
| 19 | Mount George | 97 | | | | | 5 - 8 |
| | Elands | 62 | | | | | 3 – 5 |
| 21 | Johns River | 173 | | | | | 8 – 14 |

| Rank | Village | No. Lots | Servicing Option 1 Sewer | Servicing Option 2 Cluster system | Servicing Option 3 Partial On- site | Servicing Option 4 Full On-site | Cost ¹ \$ Million |
|----------|----------------------|------------------|--------------------------------|--|--|---------------------------------------|---------------------------------|
| 22 | East Wingham | 65 | | | | | Sewer |
| 23 | Craven | 23 | | | | | 1 – 2 |
| 24 | Wootton | 23 | | | | | 1 – 2 |
| 25 | Stratford | 100 | | | | | 5 – 8 |
| 26 | Limeburners Creek | 58 | | | | | 3 – 5 |
| 27 | Booral | 53 | | | | | 3 – 4 |
| 28 | Moorland | 120 | | | | | 6 – 10 |
| 29 | Barrington | 91 | | | | | 2 – 3 |
| 30 | Bundook ² | 79 | | | | | 1 – 3 |
| Selected | | Alternate Option | | | Un-suitable | | |

¹Cost indicative only ²Case study village

5 Village Case Studies

To apply the high-level options in a real context, 5 case studies have been developed for the villages of:

- North Arm Cove,
- Croki,
- Nerong,
- Bungwahl, and
- Bundook.

These case studies have been selected in order to provide a wide cross section of the broad servicing options included in this report. The case studies highlight some of the benefits and constraints associated with their application. Further investigation and design work would be required to confirm feasibility.

Case Study 1 North Arm Cove

Pressure sewer to local treatment & reuse scheme

General Information

| Risk Prioritisation Ranking |
|-----------------------------|
| 2 (equal) |
| Number of Lots |
| 400 |
| Lot Size (Median) |
| 1015m ² |
| ADWF (kL/day) |
| 215 |



Constraints to On-site Sewage Management

- Small lot size with limited to no land available for on-site wastewater management
- Major land capability constraints such as steep slopes, shallow soils and Coast SEPP
- Proximity to sensitive receptors such as Port Stephens and Karuah River (including aquaculture)

Selected High Level Option Summary

| Component | Description |
|---------------------|---|
| On-property | Decommission all existing on-site wastewater systems. |
| Collection | New low pressure sewerage system to collect all wastewater from properties and transfer to local cluster reuse system. Local pump station to transfer to Sewage Treatment Plant (STP) north of serviced properties. |
| Treatment | New STP to allow for restricted access irrigation across the potential reuse site shown in the figure below (~20 hectares). Possible constructed wetland for effluent polishing, naturalisation and carbon sequestration. |
| Effluent Management | Surface or subsurface irrigation at cluster effluent reuse site - large potential reuse site shown in Case Study figure would allow for irrigation area of ~20 hectares (subject to further design and assessment). Potential use as woodlot (carbon forest) and/or recreational area (e.g. mountain bike trails). Given climatic constraints to reuse, utilise wetland / natural based systems to polish effluent, naturalise (quality and hydrology) prior to discharge of excess recycled water to estuary. |
| Cost (approx.) | \$16 - \$25 million |

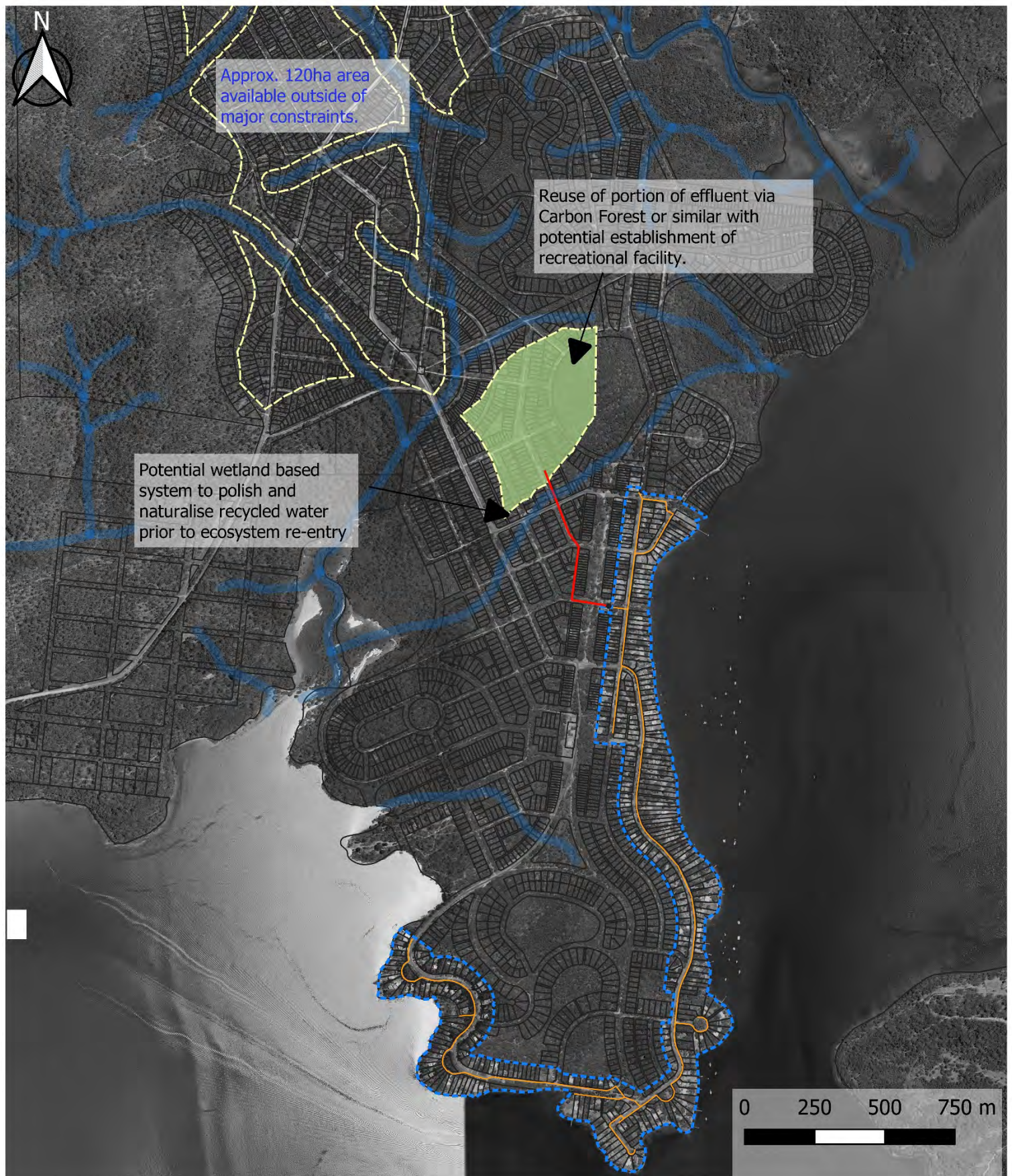


Figure: High Level Option - North Arm Cove Case Study

- ▬ Village Area
- ▬ Watercourse
- ▬ Indicative Pressure Sewer Alignment
- ▬ Indicative Sewage Pump Station
- ▬ Indicative Rising Main
- ▬ Example Reuse & Effluent Management Site (20ha)
- ▬ Potential Effluent Reuse Areas

Case Study 2 Croki

General Information

| Risk Prioritisation Ranking |
|-------------------------------|
| 10 |
| Number of Lots |
| 25 + 38 caravan park sites |
| Lot Size (Median) |
| 810m ² |
| ADWF (kL/day) |
| 18 (variable) |

STEP Sewer to local cluster re-use scheme



Constraints to On-site Sewage Management

- Generally small lot size with limited land available for on-site wastewater management
- Land capability constraints such as flooding potential, seasonal high groundwater and Coast SEPP
- Proximity to sensitive receptors such as Manning River and aquaculture

Selected High Level Option Summary

| Component | Description |
|---------------------|--|
| On-property | Decommission or re-configure existing on-site wastewater systems. Install Septic Tank Effluent Pump (STEP) units on each property. |
| Collection | Construct new effluent (pressure) sewer to collect primary effluent from properties and transfer to local cluster reuse system. Utilise upfront flow balancing at both the caravan park and cluster system to help buffer peak flows prior to the cluster treatment / land application system. This is estimated to be in the order of 120-150kL of flow balancing storage capacity (based on previous designs for similar sized systems). |
| Treatment | Secondary treatment system with treatment capacity of ~20kL/day subject to more detailed estimates of wastewater generation from the Croki caravan park. |
| Effluent Management | Raised effluent land application via two Wisconsin Mounds with an example location / layout shown in the following Case Study Figure . It is estimated that a total Land Application Area (LAA) of approximately 4,000m ² would be required subject to detail design given the size of the town and associated constraints. This would need to be confirmed as part of a design based on specific estimation of wastewater flows from the caravan park. Alternatively, a raised subsurface irrigation could also be considered as a LAA option depending on the site-specific design. |
| Cost (approx.) | \$1.4 – \$2.0 million (total delivery cost) |



Figure: High Level Options - Croki Case Study

- Village Area
- Watercourse
- Wisconsin Mounds (~2,000m² Each)
- Secondary Treatment System (Indicative Location)
- Indicative DN50-63 Effluent (Pressure) Sewer

Case Study 3 Nerong

General Information

| Risk Prioritisation Ranking | |
|-----------------------------|-------------------|
| | 2 (equal) |
| Number of Lots | |
| | 168 |
| Lot Size (Median) | |
| | 660m ² |
| ADWF (kL/day) | |
| | 90 |

STEP / Pressure sewer to local cluster re-use scheme



Constraints to On-site Sewage Management

- Concentration of small lots with limited land available for on-site wastewater management.
- Significant land capability hazards
- Immediate proximity to potable and sensitive receptors including aquaculture.

Selected High Level Option Summary

| Component | Description |
|---------------------|---|
| On-property | Decommission or reconfigure (STEP) all existing on-site wastewater systems. Installation of pressure (grinder) sewer units on each property also an option. |
| Collection | New sewerage system (low pressure) to collect all wastewater from properties and transfer to local cluster reuse system. |
| Treatment | Cluster secondary treatment system to allow for restricted access irrigation across the potential reuse site shown in the figure below. Incorporate flow balancing at the cluster system to help buffer peak flows due to intermittent occupancy of properties. |
| Effluent Management | Surface or subsurface irrigation at cluster effluent reuse site - large potential reuse site shown in Case Study figure which would allow for irrigated area of ~5 hectares (subject to further design and assessment). |
| Cost (approx.) | \$5 - \$10 million |

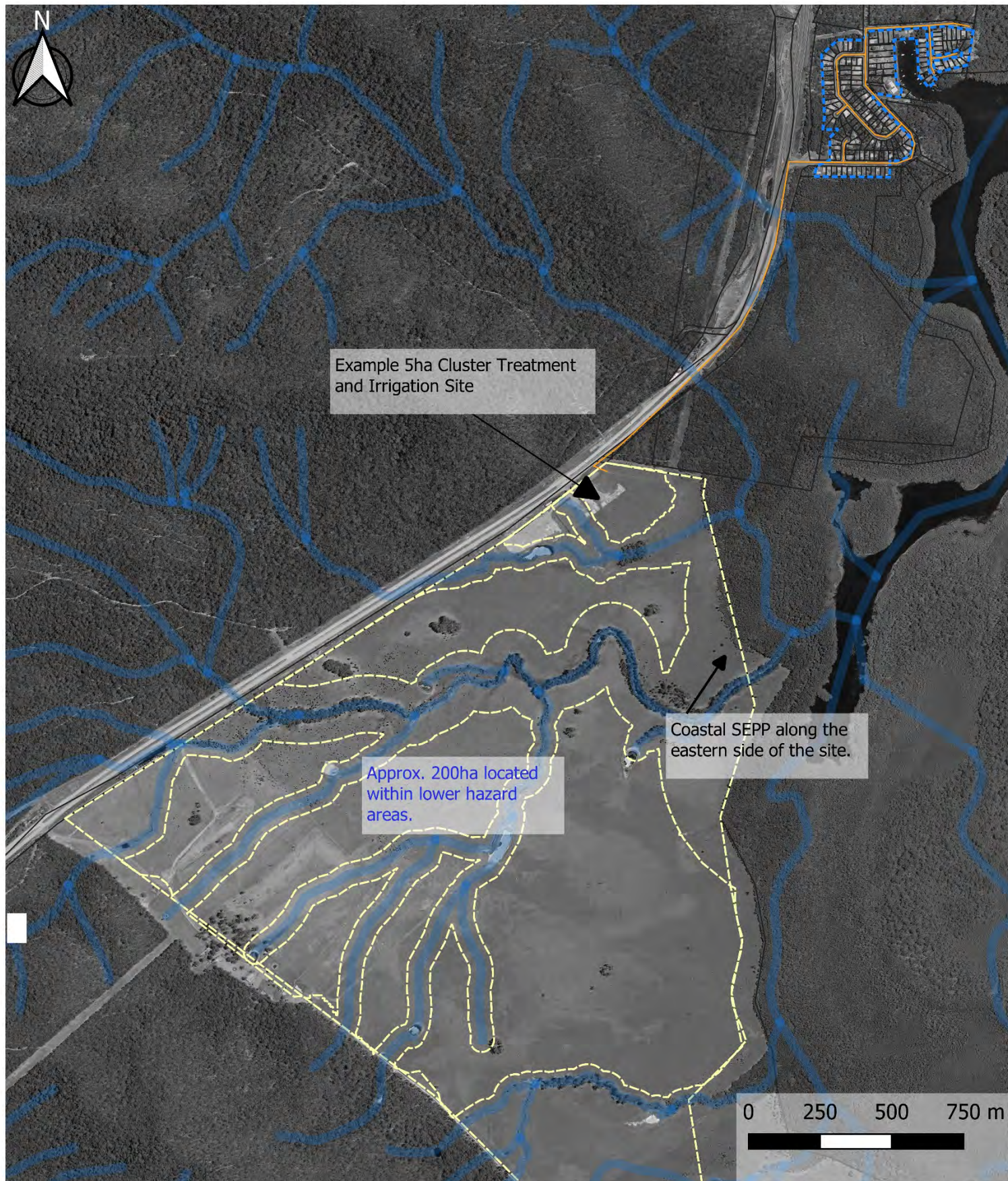


Figure: High Level Option - Nerong Case Study

- ▬▬▬ Village Area
- ▬ Watercourse
- ▬ Indicative Sewer Alignment
- ▬ Example Cluster Irrigation Site (5ha)
- ▬▬▬ Potential Reuse Areas

Case Study 4 Bungwahl

Partial on-site management with local cluster re-use scheme

General Information

| Risk Prioritisation Ranking |
|---|
| 9 |
| Number of Lots |
| 74 |
| Lot Size (Median) |
| 2000m ² (overall) 4000m ² (Dogwood Road) |
| ADWF (kL/day) |
| 40 (20 kL/day at cluster system) |



Constraints to On-site Sewage Management

- Wide variety of lot sizes, including larger lots with greater potential for on-site effluent management along with smaller constrained lots in the central village area.
- Land capability constraints including localized high groundwater, vegetation and climate.
- Proximity to sensitive receptors such as Corrigans Bay to the west, Neranie Bay to the south and Wamwarra Bay to the east of the village area.

Selected High Level Option Summary

| Component | Description |
|---------------------|---|
| On-property | <p>Decommission existing septic systems and install new best practice on-site wastewater systems to achieve partial on-site management whilst meeting regulatory requirements. All excess advanced secondary effluent not managed on-site to be directed to a new effluent pressure sewer.</p> <p>The amount of on-site irrigation can be set at a reasonable minimum land area with opportunity to increase where available and suitable. Can also be controlled remotely via weather station to maximise irrigation during warmer, dry periods and limit during cooler, wet periods.</p> <p>Larger properties suitable for full on-site management subject to best practice upgrade. For this option to be effective, systems would need to be operated and managed by a single competent and accountable authority (both the upgrade works and on-going system operation).</p> |
| Collection | Small diameter effluent (pressure) sewer collecting excess effluent not able to be managed on-site, for conveyance to local cluster reuse (irrigation) system. |
| Treatment | Advanced secondary treatment provided on-lot with polishing at local cluster reuse facility. This allows for reduced cluster treatment infrastructure. Central reuse system could consist of small control shed (filtration and ultraviolet disinfection) and wet weather storage tank. |
| Effluent Management | <p>Surface or subsurface irrigation at cluster reuse site using excess effluent not managed / reused on properties. Large potential reuse site shown in figure below.</p> <p>Alternatively, could use Wisconsin Mounds for a smaller footprint.</p> |
| Cost (Approx.) | \$4 - \$6 million |

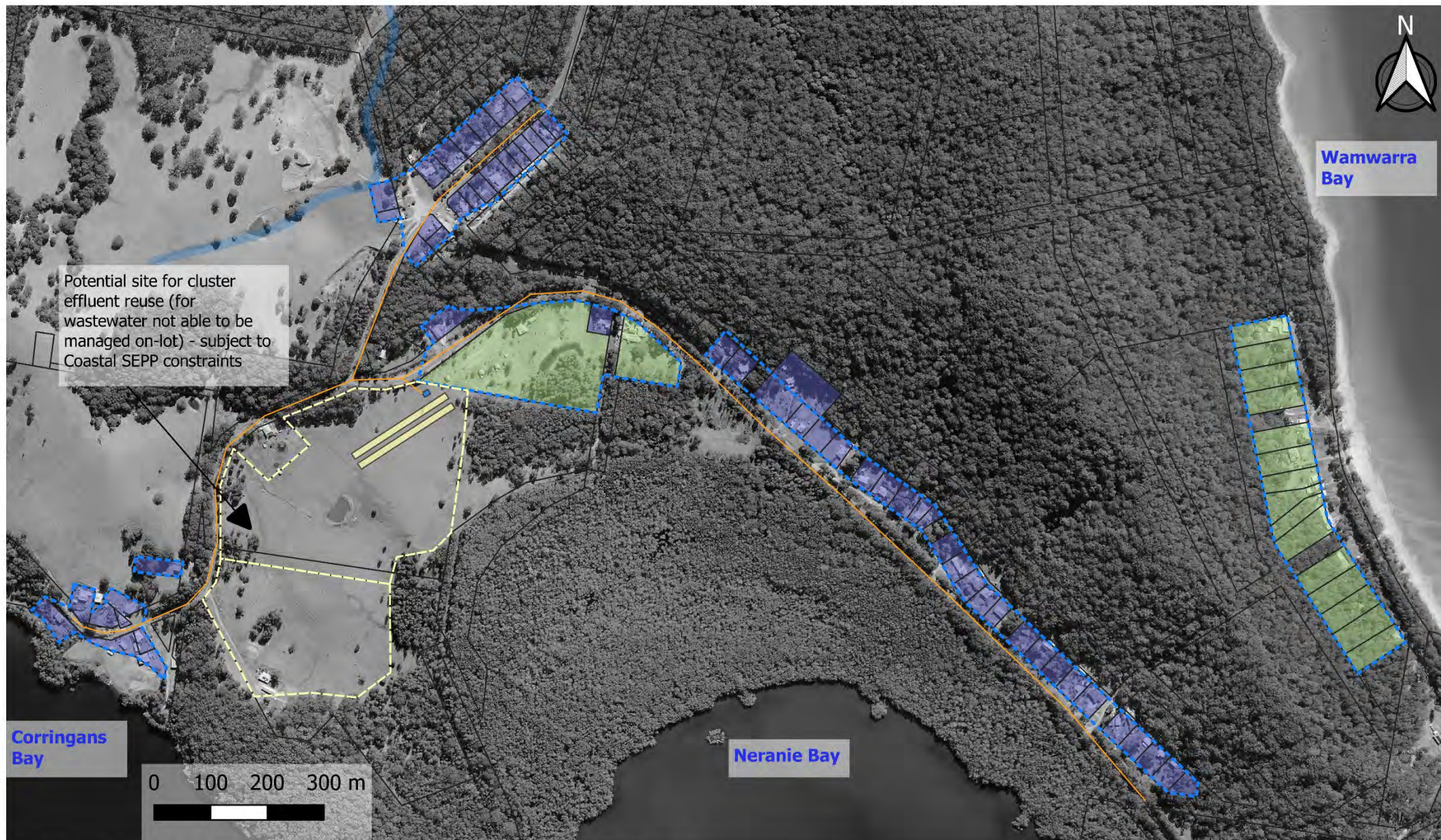
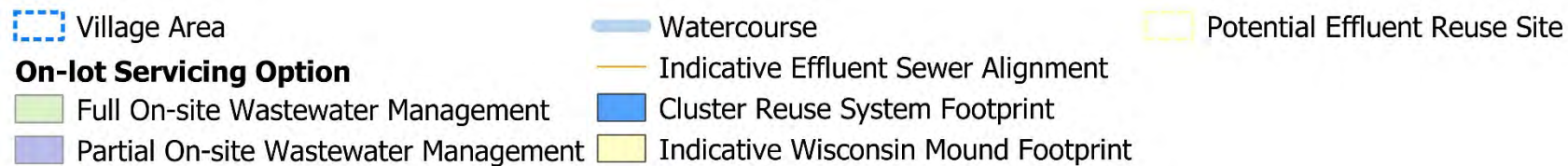


Figure: High Level Option - Bungwahl Case Study



Case Study 5 Bundook

General Information

| Risk Prioritisation Ranking |
|-----------------------------|
| 30 |
| Number of Lots |
| 71 |
| Lot Size (Median) |
| 4055m ² |
| ADWF (kL/day) |
| 41 |

Full on-site management via system
upgrade



Overview

Bundook was selected as a case study village as it is located within the former Gloucester Shire (which was not previously considered in the risk assessment in 2000). The locality consists of typically larger and less constrained lots relative to the other high-risk villages. There is potential for future development given the higher likelihood of installing an on-site wastewater system which can meet MCC requirements. The village is still subject to several land capability constraints including steeper slopes in some areas and intermittent watercourses and farm dams within a number of properties.

Based on high level investigation of the village, there is the potential for full on-site wastewater management via upgraded on-site systems for the properties within the village area. This could involve independent operation and management of systems if justified by the risks.

Selected High Level Option Summary

| Component | Description |
|----------------|--|
| On-property | Decommission existing septic systems and install new best practice on-site wastewater systems (e.g. advanced secondary treatment system with subsurface irrigation or evapotranspiration absorption (ETA) trenches/beds) to achieve full on-site management where feasible to meet regulatory requirements. For this option to be effective the on-site systems would need to be managed by a single competent and accountable authority (both the upgrade works and on-going system operation) with MCC oversight. |
| Off-property | Effluent tanker removal (partial pump-out) for lots that are constrained and are unable to sustainably manage all wastewater on-site in the long-term. |
| Cost (Approx.) | \$1.5 – 2.5 million |

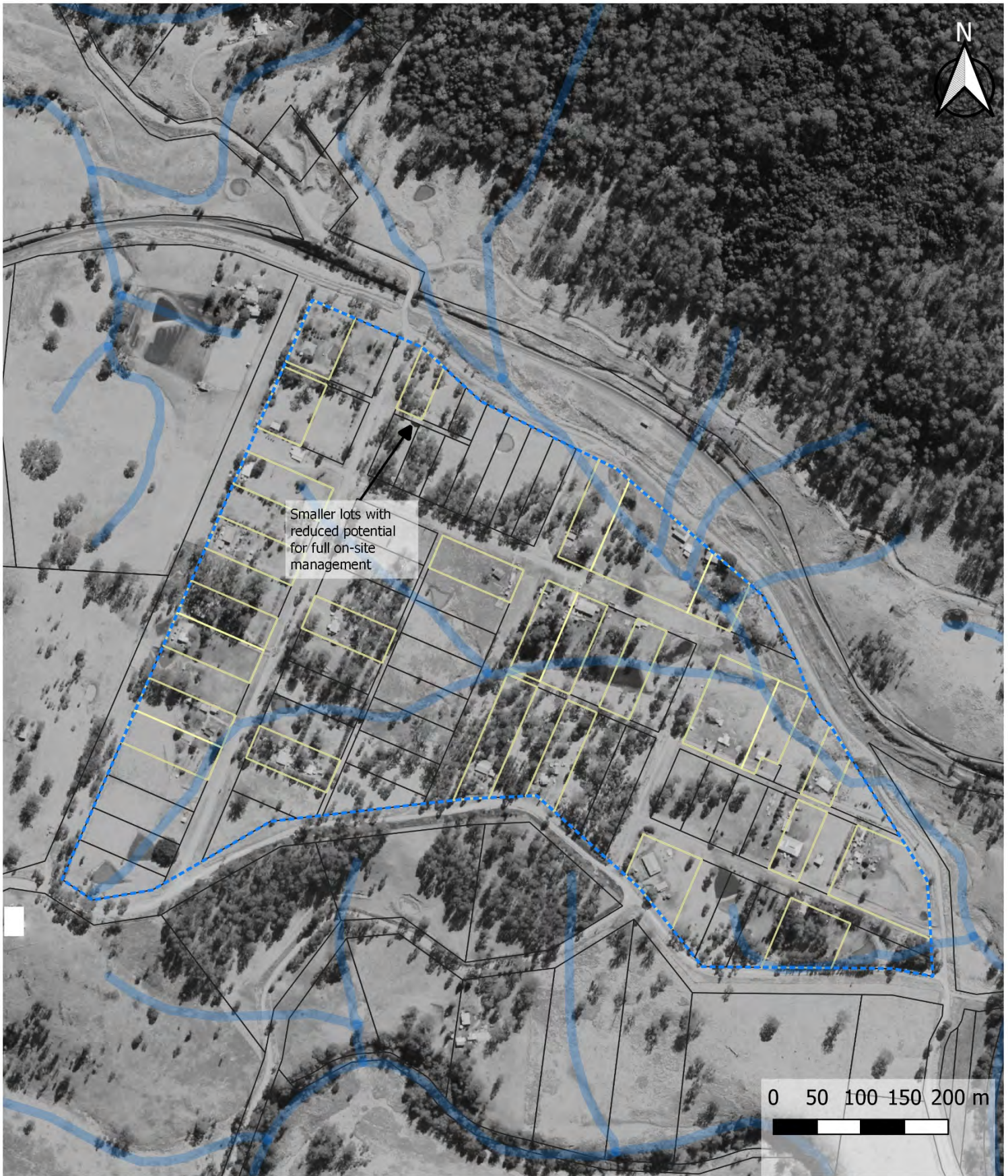


Figure: High Level Options - Bundook Case Study

-  Village Area
-  Watercourse
-  Lots Currently Developed

6 Next Steps?

Based on the high-level options presented and discussed in the previous sections, there are a range of further information and studies required to progress potential design options for each specific village.

Future investigation, design and planning steps are presented in the following flow chart.

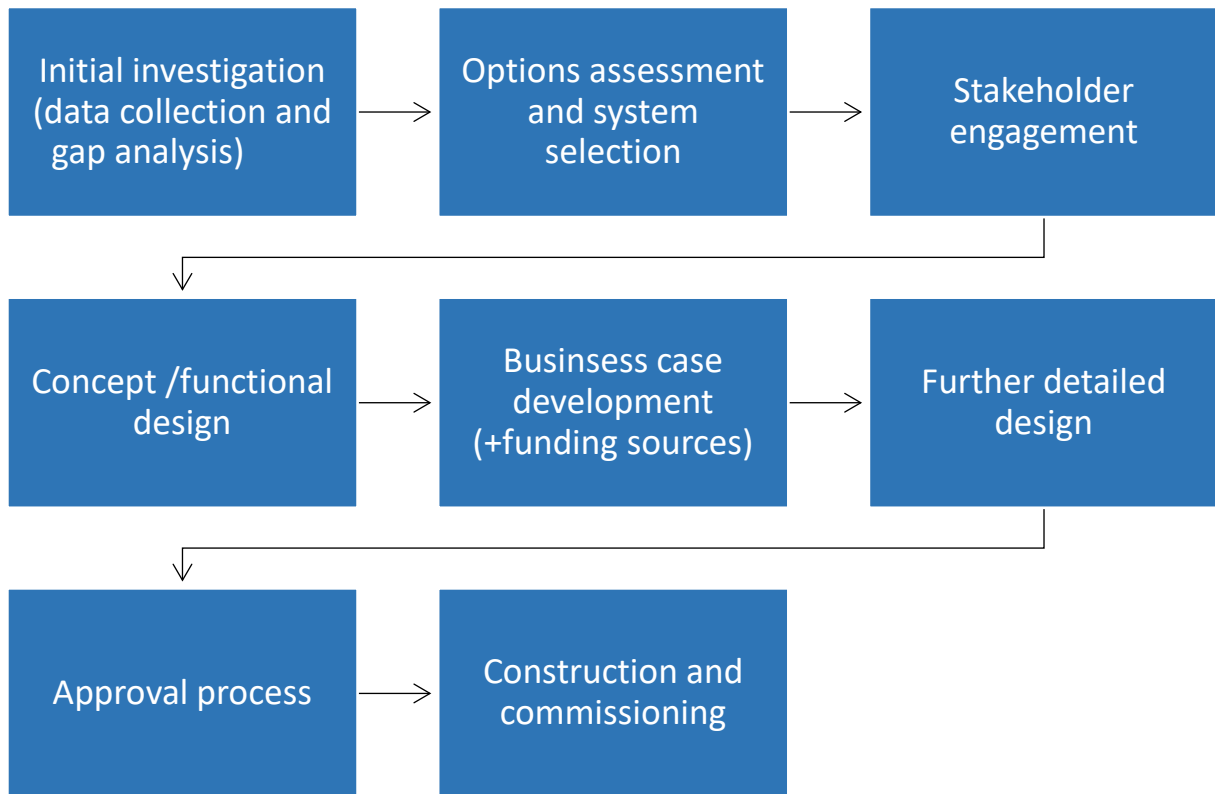


Figure 8 Next steps flowchart

A summary of potential further studies and investigation considered for the high-level options presented is provided in Table 6.

An important consideration for the villages used in the case studies is the completion of comprehensive land capability assessments for the villages identified as potential cluster reuse sites. Given the constrained nature of the high-risk villages, a representative group of on-property assessments should also be considered. It is recommended that a sufficient level of investigation should be performed across the village areas to capture the broad characteristics such as topography and soil landscapes that may be encountered.

Table 6 Potential Further Studies

| No. | Option | Further Studies / Information Required |
|-----|--|--|
| 1 | Connection to reticulated sewer | <ul style="list-style-type: none"> - Reticulation alignments, sizing, grades and depths - Treatment system sizing and constructability |
| 2 | Local decentralised / cluster treatment and reuse system | <ul style="list-style-type: none"> - Identification of potential central / local treatment and reuse sites – consideration of suitability (shortlisting) and land acquisition - Site and soil (land capability) assessments for effluent management / reuse sites - Planning / environmental / health compliance – incl. performance modelling (MEDLI / groundwater) for design justification - Recycled water risk assessment - Community and stakeholder engagement - Costing estimations (CAPEX, OPEX & NPV) and Cost Benefit Analysis - Funding / governance arrangements and Business Case development - Define regulatory requirements for preferred option(s) and identify elements that do not fit current regulatory structures |
| 3 | Full on-site containment of wastewater | <ul style="list-style-type: none"> - Site and soil (land capability) assessments for on-site systems - On-site system option analysis and preferred designs |
| 4 | Partial / Limited on-site containment of wastewater | <ul style="list-style-type: none"> - Environmental / health compliance – incl. performance modelling (MEDLI / groundwater) for design justification - Community and stakeholder engagement - Costing estimations (CAPEX, OPEX & NPV) and Cost Benefit Analysis |
| 5 | Integrated Water Management (IWM) | <ul style="list-style-type: none"> - Funding / governance arrangements and Business Case development - Define regulatory requirements for preferred option(s) and identify elements that do not fit current regulatory structures - Stormwater (e.g. MUSIC) modelling and WSUD measure sizing (if considered as part of IWM strategy) |

7 References

Environment Protection and Heritage Council (2006) Australian Guidelines for Water Recycling: Managing Health and Environmental Risk (Phase 1). Natural Resource Management Ministerial Council and Environment Protection and Heritage Council.

MidCoast Council (2020) On-site Sewage Development Assessment Framework (Draft)

MidCoast Water (2000) Small Communities Wastewater Risk Assessment. Prepared by MCW.

Standards Australia (2012) AS/NZS1547:2012 On-site domestic wastewater management. Standards Australia.

USEPA (2003) Voluntary National Guidelines for Management of On-site and Cluster (Decentralised) Wastewater Treatment Systems. USEPA.

http://water.epa.gov/scitech/wastetech/upload/septic_guidelines.pdf

Appendix A: Workshop Minutes

WORKSHOP: MCC Unserviced Villages MCA

MINUTES

JUNE 25, 2020

9:30 AM – 12:30 PM

MCC (COUNCIL CHAMBERS),
4 BREESE PARADE, FORSTER

| | |
|-------------------|---|
| MEETING CALLED BY | Adam Turville (Mid Coast Council) |
| TYPE OF WORKSHOP | Discussion of Multi Criteria Analysis (MCA) for risk prioritisation of unserviced villages across MCC area. |
| FACILITATOR | Ben Asquith (Decentralised Water Consulting) |
| NOTE TAKER | Jack Sharples (Decentralised Water Consulting) |
| ATTENDEES | Ben Asquith, Jack Sharples, Adam Turville, Tracey Hamer, Malcolm Hunter, Alexandra Macvean, Gary Mead, Prue Tucker, Aaron Kelly (remote), Michael Griffiths (remote). |
| APOLOGIES | Georgina Martin, Rachael Abberton |

1 Background

Attendees were engaged in a workshop to discuss current progress with the high risk unserviced villages project and provide final input into the risk prioritisation (Multi Criteria Analysis) process for the nominated villages.

2 Objectives

1. Provide understanding of current progress with project including the draft criteria / scoring methodology (provided previously to MCC) and selected villages to be assessed (as per MCC planners' feedback).
2. Discussion of any data availability for finalisation of MCA process.
3. Finalisation of how infill development potential is to be factored into MCA process (not currently included).
4. The appropriate weightings for MCA to be determined based on feedback from all attendees.
5. Initial discussion of draft village ranking based on MCC experience.

3 Key Discussion Items

1. Water quality data has not been included given it is incomplete for the whole MCC LGA and therefore will create prioritisation bias for areas in which significant data is available (specifically North Arm Cove).
2. Croki is village with strong interest from Progress Association. Important to ensure assessment is robust and impartial. Sensitive catchment hazard appropriate to be set to Medium (DAF Zone 2)

given village is directly adjacent to Aquaculture Zones. Current Draft MCA ranking reflects this (refer figures below).

3. Key discussion around infill (town) growth and if and how to best to include in the MCA. Infill development potential is to be included in the MCA and has been weighted accordingly (refer Table 1 below). This has been included as a semi-quantitative sub-measure based advice from strategic planners that informed a relative scoring as agreed by all attendees during the Workshop (results presented in figures below).
4. Marine Protected Areas (Marine Parks) not directly included given the large number of villages in proximity or draining to a protected marine area. Although Allworth is not within proximity of Aquaculture Zones (500m buffer) it is directly upslope and therefore set to Medium (DAF Zone 2) sensitive catchment hazard.
5. Influence of proximity to existing sewerage connection point discussed as part of MCA. To be included as part of next stage of option development for high ranked villages, given other factors need to be considered such as existing sewer capacity.

4 Outcomes

The primary outcome of the workshop was the development of weightings for the six (6) sub measures provided previously to MCC. Each broad category and sub measure was discussed amongst the group. Discussion was held to determine an agreed weighting (relating to proportional importance) for each sub measure based on all attendees. In addition the relative scoring for the In-fill Development Potential sub measure were developed for each village based on MCC discussion and feedback.

The MCA methodology and agreed weightings are summarised in Table 1 below. The draft MCA scoring for each sub measure across all unserviced villages and the draft ranking or prioritisation is provided in Figure 1.

Table 1 MCA Methodology Summary - Prioritisation Sub-measure Weightings

| Category | Sub-Measure | Description | Scoring Method | Weighting |
|---|-----------------|--|--|-----------|
| Sustainability of On-site Wastewater Management | Lot Size | Number and % of lots <2,000m ² and therefore considered High Hazard for on-site wastewater management (as per Mid Coast Council Final Draft DAF). | <p>Percentage of <2,000m² (High Risk) Properties</p> <p>0 – 20% = 0</p> <p>21 – 40% = 1</p> <p>41 – 60% = 3</p> <p>61 – 80% = 4</p> <p>80 – 100% = 5</p> <p>Total No. of <2,000m² Properties (added to above score with max. of 5)</p> <p><20 = no change to score</p> <p>20-30 = add 1 to score</p> <p>30-40 = add 2 to score</p> <p>40-50 = add 3 to score</p> <p>>50 = Score equals five in all circumstances</p> | 20% |
| | Land Capability | Land capability hazard for on-site wastewater management based on Hazard Mapping developed for MCC Development Assessment Framework (DAF). | <p>Average Land Capability Hazard class for lots within township.</p> <p>Average High Hazard = 5</p> <p>Average Medium Hazard = 3</p> <p>Average Low Hazard = 1</p> | 20% |
| Potable Water Access | - | <p>Access to potable water for unsewered lots within village / township.</p> <p>Captures existing water infrastructure in towns, and thus increases priority for wastewater service.</p> | <p>Yes = 3</p> <p>No = 1</p> | 10% |
| | | | | |

| Category | Sub-Measure | Description | Scoring Method | Weighting |
|---|--|--|--|-----------|
| Receiving Environment Sensitivity & Proximity | Proximity to waterways / waterbodies | Proximity of township properties to sensitive waterways / waterbodies | All properties directly adjacent to permanent / named waterway and/or waterbody = 5 | 15% |
| | Sensitivity of waterways / waterbodies | Sensitivity of waterways / waterbodies | Partial drainage (~75%) of total properties to permanent / named waterway and/or waterbody = 4 Partial drainage (~50%) of total properties to permanent / named waterway and/or waterbody = 3 | |
| | Stormwater infrastructure | Proximity of properties to stormwater pipes / pits. Accuracy of provided data ~ <u>60-70%</u> according to MCC. | Partial drainage (~50%) of total properties to intermittent waterway / dam = 2 No risk to waterway / waterbody = 0 Add 1 point to score where stormwater infrastructure present within town / village to reflect elevated risk if failure of onsite systems occur. | |
| | Potable / sensitive catchments | Proximity of township properties to potable or sensitive catchments. Defined as part of DAF: Zone 1 – Direct hydraulic catchment to sensitive Lakes areas. Zone 2 – Broader drinking water catchment (Mid Coast Water defined areas) and Aquaculture Zones | Within Zone 1 = sub-score of 5 Within Zone 2 = sub-score of 3 Not within either Zone = sub-score of 0 | |
| In-Fill Development Potential | Vacant Lots / Parcels that are developable | Capture potential for Development / Section 68 Applications for existing vacant lots within the village extents, and thus potential for future growth capacity. | Infill development potential. Low Potential = 0 Moderate Potential = 3 High Potential = 5 | 15% |

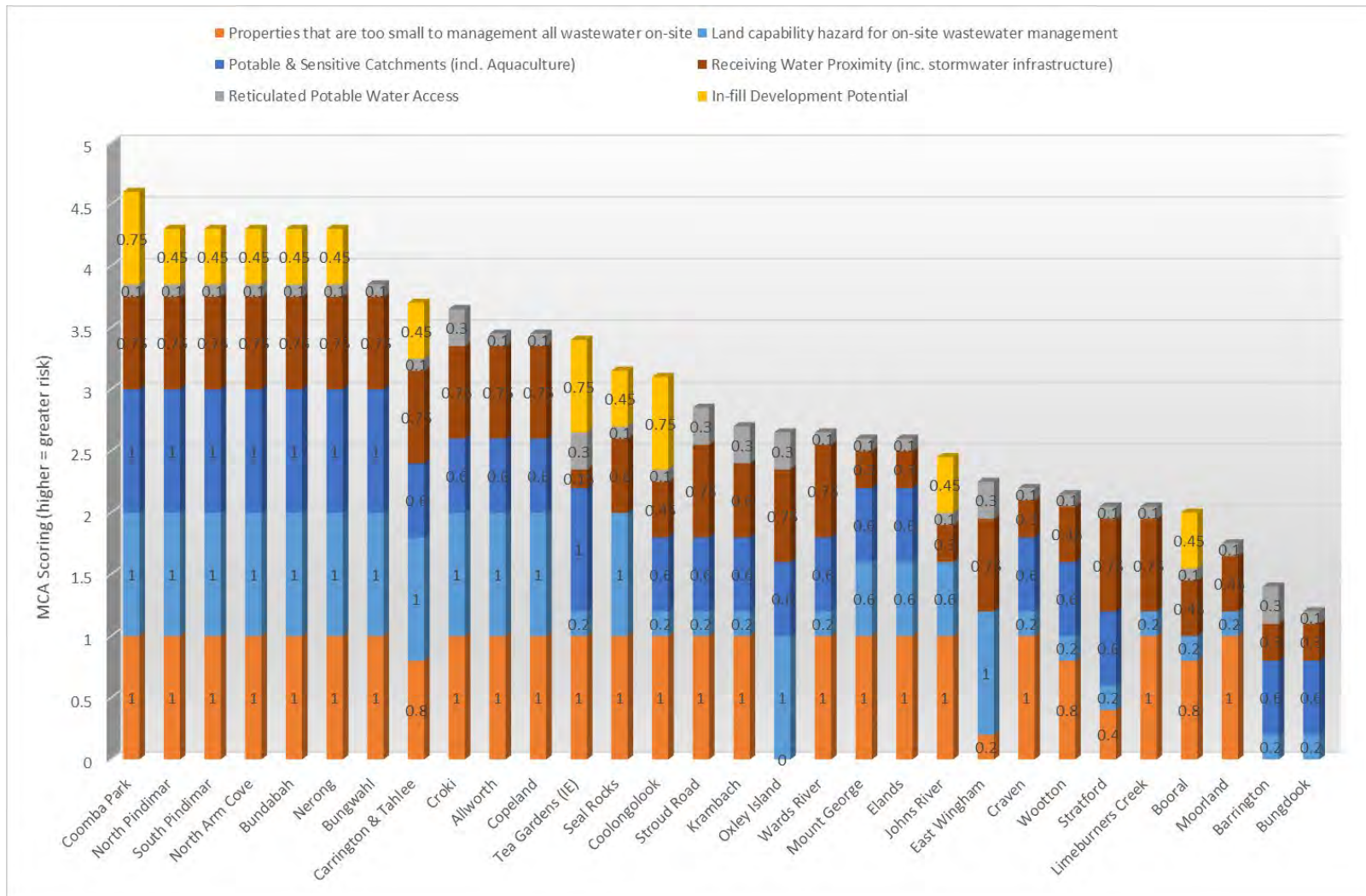


Figure 1 Draft MCA Weighted Scoring

5 Next Steps

DWC are seeking feedback from MCC on these workshop minutes and outcomes, in particular regarding the draft ranking of villages. The highest ranked villages are summarised in Table 2 below.

The intention is for DWC to move onto developing potential wastewater servicing solutions with a focus on the top 5 to 10 key villages. However, consideration will be given to the development of servicing solutions with potential to be applied in other lower ranked areas.

Table 2 Draft Village Ranking

| Rank | Village |
|---------|---------------------------------|
| 1 | Coomba Park |
| 2 (all) | North Pindimar |
| | South Pindimar |
| | North Arm Cove |
| | Bundabah |
| | Nerong |
| 7 | Bungwahl |
| 8 | Carrington & Tahlee |
| 9 | Croki |
| 10 | Allworth |
| 11 | Copeland |
| 12 | Tea Gardens (Industrial Estate) |
| 13 | Seal Rocks |
| 14 | Coolongolook |

Appendix B: Multi Criteria Analysis (MCA) Results

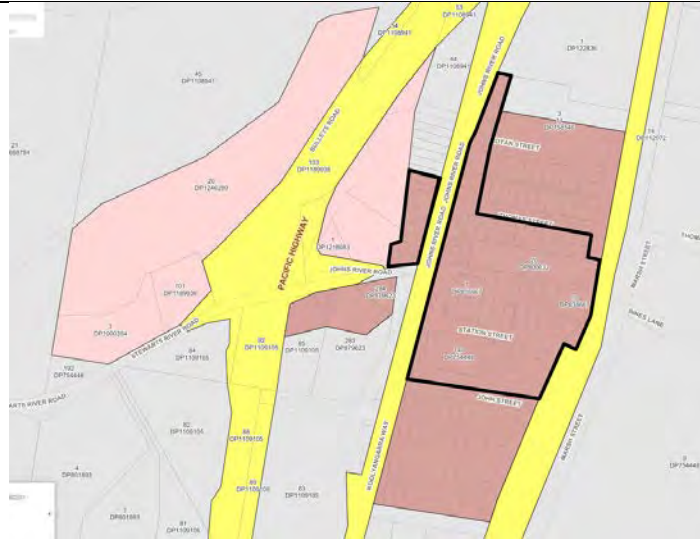
| <div><div>DWC</div><div>DECENTRALISED WATER CONSULTING</div></div> | | Sustainability of On-site Wastewater Management | | | | | | Reticulated Potable Water Access | | Receiving Environment Sensitivity / Proximity | | | | | | | In-fill Development Potential | | | | | | | | |
|--|---------------------|---|--|-----------------------|-----------|-----|--|----------------------------------|-----|---|-----------|--------------------------------|--|-----------|---------------------------|---|-------------------------------|--------------------------|-----------|--|-----------|---|----------------|------|----|
| | | Total Lots | Properties that are too small to management all wastewater on-site | | | | Land capability hazard for on-site wastewater management | | | | | Potable & Sensitive Catchments | | | Receiving Water Proximity | | | | | Properties and parcels that are undeveloped - and have the capacity to be developed. | | | | | |
| | | | % <2,000m2 Lot Size | No. <2,000m2 Lot Size | Sub-score | | Ave. Land Capability Hazard Class | Sub-score | | Comment (Y/N) | Sub-score | | Comment | Sub-score | | Comment | Score | SW infrastructure? (Y/N) | Sub-score | | Sub-score | | | | |
| | | | | | 1-5 | | | 1,3 or 5 | | | 1 or 3 | | | 0,3 or 5 | | | 1-5 | (Y/N) | 1-5 | | 0 / 3 / 5 | | Combined Score | RANK | |
| | | | | 20% | | | 10% | | | | | | 20% | | | | | | 15% | | 15% | | | | |
| LGA | Village / Township | | | Calcs | | | Calcs | | | Calcs | | | | | | | | | Calcs | | | | | | |
| GLC | Coomba Park | 672 | 99% | 668 | 5 | 1 | High | 5 | 1 | N | 1 | 0.1 | Zone 1 (Sensitive Catchment) | 5 | | Haz could probably be 5 but because there is SW in | 4 | Y | 5 | 0.75 | | 5 | 0.75 | 4.6 | 1 |
| GLC | North Pindimar | 125 | 78% | 98 | 5 | | High | 5 | | N | 1 | 0.1 | Zone 1 (Sensitive Catchment) | 5 | | | 5 | Y | 5 | 0.75 | | 3 | 0.45 | 4.3 | 2 |
| GLC | South Pindimar | 120 | 90% | 108 | 5 | | High | 5 | | N | 1 | 0.1 | Zone 1 (Sensitive Catchment) | 5 | | | 5 | Y | 5 | 0.75 | | 3 | 0.45 | 4.3 | 2 |
| GLC | North Arm Cove | 460 | 93% | 430 | 5 | | High | 5 | | N | 1 | 0.1 | Zone 1 (Sensitive Catchment) | 5 | | | 5 | Y | 5 | 0.75 | | 3 | 0.45 | 4.3 | 2 |
| GLC | Bundabah | 199 | 98% | 196 | 5 | | High | 5 | | N | 1 | 0.1 | Zone 1 (Sensitive Catchment) | 5 | | | 5 | Y | 5 | 0.75 | | 3 | 0.45 | 4.3 | 2 |
| GLC | Nerong | 173 | 97% | 168 | 5 | | High | 5 | | N | 1 | 0.1 | Zone 1 (Sensitive Catchment) | 5 | | | 5 | Y | 5 | 0.75 | | 3 | 0.45 | 4.3 | 2 |
| GLC | Seal Rocks | 76 | 100% | 76 | 5 | | High | 5 | | N | 1 | 0.1 | Zone 1 (Sensitive Catchment) | 5 | | Beachfront lots and caravan park drain directly to E | 5 | N | 5 | 0.75 | | 3 | 0.45 | 4.3 | 2 |
| GLC | Carrington & Tahlee | 88 | 80% | 70 | 5 | | High | 5 | | N | 1 | 0.1 | Zone 1 (Sensitive Catchment) | 5 | | | 5 | Y | 5 | 0.75 | | 3 | 0.45 | 4.3 | 2 |
| GLC | Bungwahl | 74 | 50% | 37 | 5 | | High | 5 | | N | 1 | 0.1 | Zone 1 (Sensitive Catchment) | 5 | | Appears as though most of the poperties drain to C | 5 | N | 5 | 0.75 | | 0 | | 3.9 | 9 |
| GTCC | Croki | 35 | 100% | 35 | 5 | | High | 5 | | Y | 3 | 0.3 | Zone 2 (Aquaculture Buffer Zone) | 3 | | Whole study area drains to Manning River | 5 | N | 5 | 0.75 | | 0 | | 3.7 | 10 |
| GLC | Allworth | 94 | 90% | 85 | 5 | | High | 5 | | N | 1 | 0.1 | Drains to Aquaculture (but not within 500mm buffer Zone 1 area) - adjacent to Marine Park so set to 3. | 3 | | Site drains to Karuah River | 5 | Y | 5 | 0.75 | | 0 | | 3.5 | 11 |
| GSC | Copeland | 118 | 87% | 103 | 5 | | High | 5 | | N | 1 | 0.1 | Zone 2 (Drinking Water Catchment) | 3 | | | 5 | N | 5 | 0.75 | | 0 | | 3.5 | 11 |
| GLC | Tea Gardens (IE) | 35 | 74% | 26 | 5 | | Low | 1 | | Y | 3 | 0.3 | Zone 1 (Sensitive Catchment) | 5 | | Doesn't appear to drain to any significant receiving | 0 | Y | 1 | 0.15 | | 5 | 0.75 | 3.4 | 13 |
| GLC | Coolongolook | 70 | 76% | 53 | 5 | | Low | 1 | | N | 1 | 0.1 | Zone 2 (Drinking Water Catchment) | 3 | | Flows from intermittent WCs go to the Coolongoloo | 2 | Y | 3 | 0.45 | | 5 | 0.75 | 3.1 | 14 |
| GLC | Stroud Road | 78 | 83% | 65 | 5 | | Low | 1 | | Y | 3 | 0.3 | Zone 2 (Drinking Water Catchment) | 3 | | Eastern and Western Sites drain to permanent Wa | 5 | Y | 5 | 0.75 | | 0 | | 2.9 | 15 |
| GTCC | Krambach | 211 | 65% | 137 | 5 | | Low | 1 | | Y | 3 | 0.3 | Zone 2 (Drinking Water Catchment) | 3 | | Drains to permanent watercourses to the north an | 4 | N | 4 | 0.6 | | 0 | | 2.7 | 16 |
| GTCC | Oxley Island | 182 | 2% | 3 | 0 | | High | 5 | | Y | 3 | 0.3 | Zone 2 (Aquaculture Buffer Zone) | 3 | | Whole area is surrounded by permanent Watercours | 5 | N | 5 | 0.75 | | 0 | | 2.7 | 17 |
| GLC | Wards River | 56 | 91% | 51 | 5 | | Low | 1 | | N | 1 | 0.1 | Zone 2 (Drinking Water Catchment) | 3 | | | 4 | Y | 5 | 0.75 | | 0 | | 2.7 | 17 |
| GTCC | Mount George | 76 | 49% | 37 | 5 | | Medium | 3 | | N | 1 | 0.1 | Zone 2 (Drinking Water Catchment) | 3 | 0.6 | | 2 | N | 2 | 0.3 | | 0 | | 2.6 | 19 |
| GTCC | Elands | 71 | 76% | 54 | 5 | | Medium | 3 | | N | 1 | 0.1 | A portion of the southern study area is located within the catchment (hazard may be reduced) | 3 | 0.6 | | 2 | N | 2 | 0.3 | | 0 | | 2.6 | 19 |
| GTCC | Johns River | 80 | 58% | 46 | 5 | 1 | Medium | 3 | 0.6 | N | 1 | 0.1 | | 0 | | Drains to intermittent Watercourses | 2 | N | 2 | 0.3 | | 3 | 0.45 | 2.5 | 21 |
| GTCC | East Wingham | 27 | 37% | 10 | 1 | 0.2 | High | 5 | 1 | Y | 3 | 0.3 | | 0 | | Directly on Manning River | 5 | Y | 5 | 0.75 | | 0 | | 2.3 | 22 |
| GSC | Craven | 20 | 95% | 19 | 5 | 1 | Low | 1 | 0.2 | N | 1 | 0.1 | Zone 2 (Drinking Water Catchment) | 3 | 0.6 | This may drain to the permanent WC, however the | 2 | N | 2 | 0.3 | | 0 | | 2.2 | 23 |
| GLC | Wootton | 15 | 73% | 11 | 4 | 0.8 | Low | 1 | 0.2 | N | 1 | 0.1 | Zone 2 (Drinking Water Catchment) | 3 | 0.6 | SW pits may be within study area. Considering the | 2 | Y | 3 | 0.45 | | 0 | | 2.2 | 24 |
| GSC | Stratford | 81 | 31% | 25 | 2 | 0.4 | Low | 1 | 0.2 | N | 1 | 0.1 | Zone 2 (Drinking Water Catchment) | 3 | 0.6 | | 5 | N | 5 | 0.75 | | 0 | | 2.1 | 25 |
| GLC | Limeburners Creek | 49 | 88% | 43 | 5 | 1 | Low | 1 | 0.2 | N | 1 | 0.1 | | 0 | | DEM appears to be skewed - Site appears flat | 5 | Y | 5 | 0.75 | | 0 | | 2.1 | 26 |
| GLC | Booral | 39 | 59% | 23 | 4 | 0.8 | Low | 1 | 0.2 | N | 1 | 0.1 | | 0 | | While the Karuah River is located ~400m away, me | 2 | Y | 3 | 0.45 | | 3 | 0.45 | 2.0 | 27 |
| GTCC | Moorland | 91 | 80% | 73 | 5 | 1 | Low | 1 | 0.2 | N | 1 | 0.1 | | 0 | | Just over 50% drain to a permanent WC (in northern study area). | 3 | N | 3 | 0.45 | | 0 | | 1.8 | 28 |
| GSC | Barrington | 61 | 2% | 1 | 0 | | Low | 1 | 0.2 | Y | 3 | 0.3 | Zone 2 (Drinking Water Catchment) | 3 | 0.6 | | 2 | N | 2 | 0.3 | | 0 | | 1.4 | 29 |
| GSC | Bungdook | 77 | 3% | 2 | 0 | | Medium | 1 | 0.2 | N | 1 | 0.1 | Zone 2 (Drinking Water Catchment) | 3 | 0.6 | Intermittent WCs through village - however setback | 2 | | 2 | 0.3 | | 0 | | 1.2 | 30 |

Appendix C: MCC Village Extents

**Johns River –
only lots with
existing
dwellings within
Black outline -**
urban sized
allotments within
Village zone with
existing dwellings

Note: Housing
Strategy – only
properties within
black outline to be
retained in Village
zone. Land in SW
village zone to go
to R5, other land in
Dept Industry
ownership and
heavily vegetated –
to be rezoned to
environmental zone
(consistent with
Bungwahl)

Est. approx.
capacity – 30 -40
lots if sewered.



**Mount George –
RU 1 Zoned
allotments with
existing
dwellings within
Black Outline -**

Allotments to be considered for rezoning as part of Rural Strategy to recognise urban allotments within a 'small village' context. No additional subdivision potential to be created with rezoning

Possible enforcement of minimum lot size for consolidation as part of new LEP if not sewerred

If sewerred- Est approx. capacity 50-60 lots



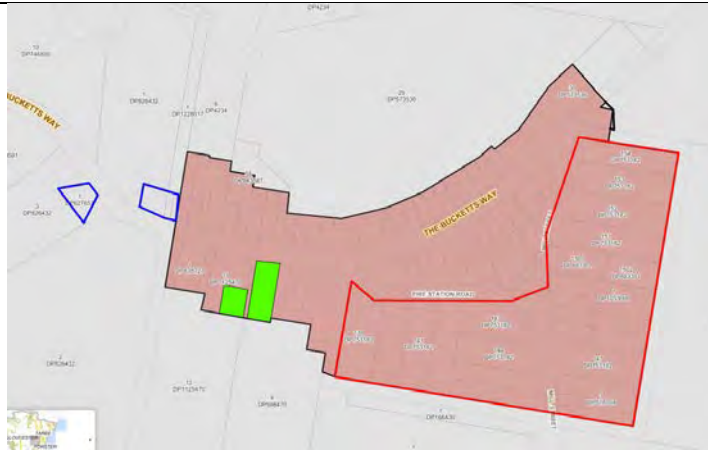
**Krambach –
existing lots with
dwellings in
Black outline and
4 additional
allotments
outlined in blue
(NW)**

Rural strategy to
consider rezoning
large lots E, SE &
NE to R5 (red
outline) –
topography
constrains
additional
subdivision

Area in red outline
to be considered
for rezoning to R5
as part of Rural
Strategy (possible
un-sewered)

Includes public
facilities and
commercial
premises

If sewerred – Est
approx. capacity
50-60 lots



Croki - existing lots with dwellings in village zone in Black outline

Rural strategy to consider rectification of RU5 zone boundary with property boundaries and/or possible back zoning due to severe flooding.

Caravan park in green outline.

Further expansion of development, subdivision or further dwellings in Croki not supported due to flood impacts also associated with evacuation route limitations (one road in and out).

LEP consolidation clause may be appropriate.

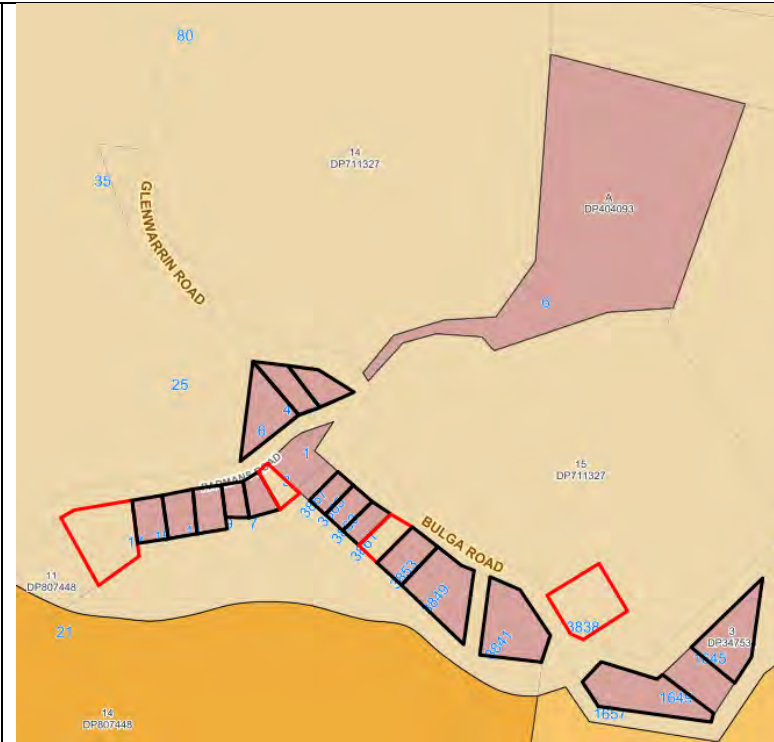
If sewerage – Est. approx. capacity for 20 dwellings + existing caravan park.



**Elands – existing
lots with
dwellings in
Black outline and
4 additional
allotments
outlined in red**

Rural strategy to
consider rezoning
of additional lots in
red outline to
village zone.

Est. approx.
capacity 20-25 lots.

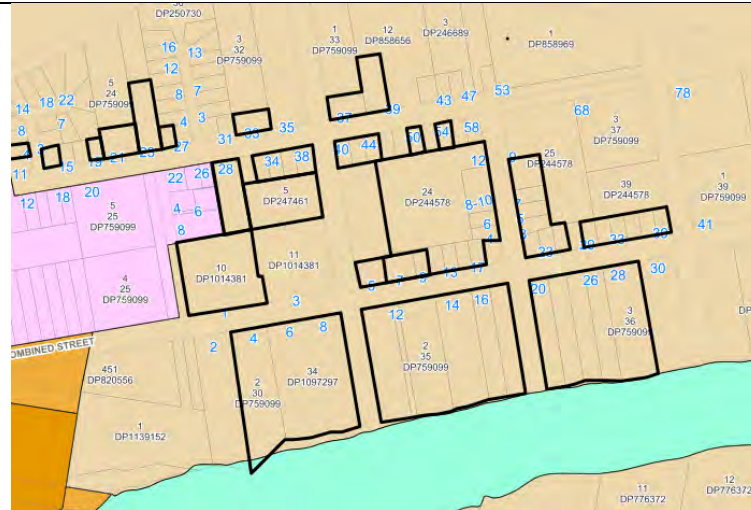


East Wingham – existing lots with dwellings in black outline only

Lots significantly constrained due to Manning River 1% AEP Flooding due to convergence point with Cedar Party Creek – high velocity hazard restrictions with risk to life and property.

Rezoning as part of Rural Strategy will not be considered – further subdivision or dwellings discouraged

If sewer extended – Est. additional capacity for 45 -50 existing dwellings only.

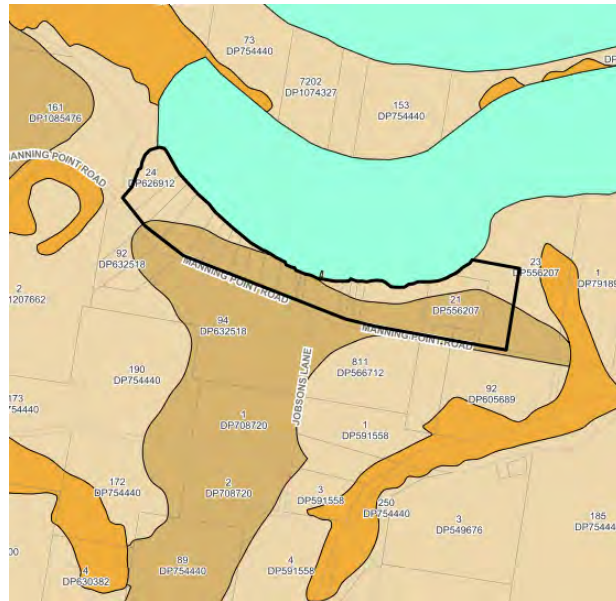


**Oxley Island –
existing dwellings in
rural zones in black
outline**

Rural Strategy to
consider possible
rezoning to R5 Large
Lot Residential –
however further
subdivision or
dwellings discouraged

Consider oyster
processing facility.

Capacity for 22 existing
dwellings and oyster
processing facility.



Allworth – existing lots with dwellings in village zone and additional dwellings to west (in red outline but outside village zone) and toilet facilities within foreshore reserves.

Rural Strategy - Village zoned land to south west to be considered for R5 instead of village given vegetated state.

Approximately 9ha in single ownership.

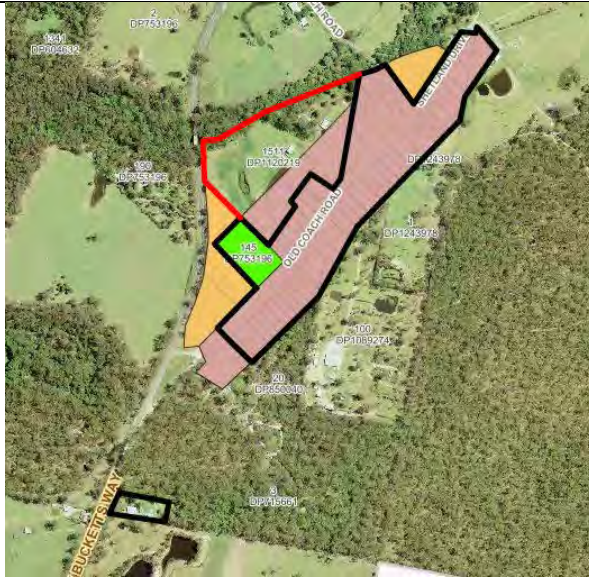
If sewerred – Est. approx. capacity 50-60 lots



**Limeburner's Creek
– existing lots
within dwellings in
village zone and one
potential additional
to south as shown.**

Rural Strategy -
Allotments to NW and
various other parcels
only suitable for R5,
RU4 and/or E4 based
on lot size, vegetation,
flooding and existing
land uses

If sewerage - Est.
approx. capacity 30 -
40 lots

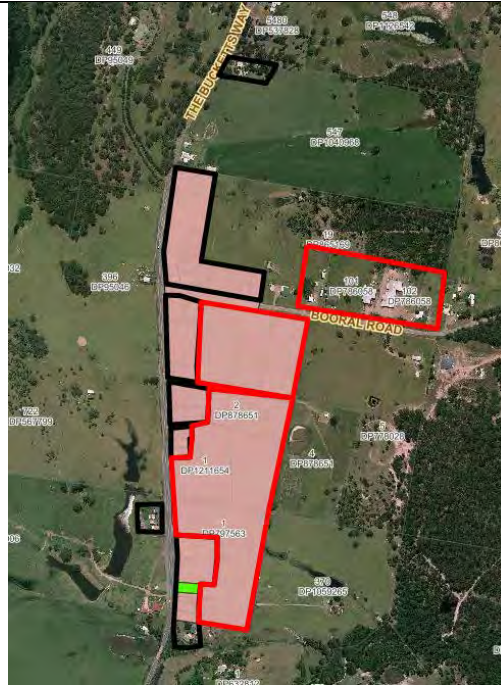


Booral – existing lots with dwellings in village zone including school. Three small allotments outside village zone identified

Rural Strategy - Areas in red outline are potentially suitable for R5, RU4 and IN activities based on existing activities and lot sizes.

Booral – industrial activities have located here as a result of road access to larger centres west and south.

If sewerred – Est. approx. capacity 20-30 lots



Allow for additional half a dozen – some larger sites would be suitable for subdivision if sewer available – (blue outline NW and village area SE).

If sewerred – Est.
approx. capacity 20-30
lots



Wards River – lots with existing dwellings in village zone (black outline).

Two additional lots outside of village zone (black outline). Also allow for a few additional lots within village area and black outline – some larger lots could subdivide if sewer.

Also – consider relocation of “Wards River Toilets” (red outline) to recreation area – out of potential flood.

Rural Strategy – rezone village area outside of black outline to rural – flood affected and not suitable for development

If sewerage - Est. approx. capacity 30-40 lots.



Coomba Park (west) and Coomba Park (east) - lots with existing dwellings in village zone (black outline).

All lots in village zone are priorities. No further expansion possible. High current lot occupation.No further expansion to village zone to be considered as part of Rural Strategy.

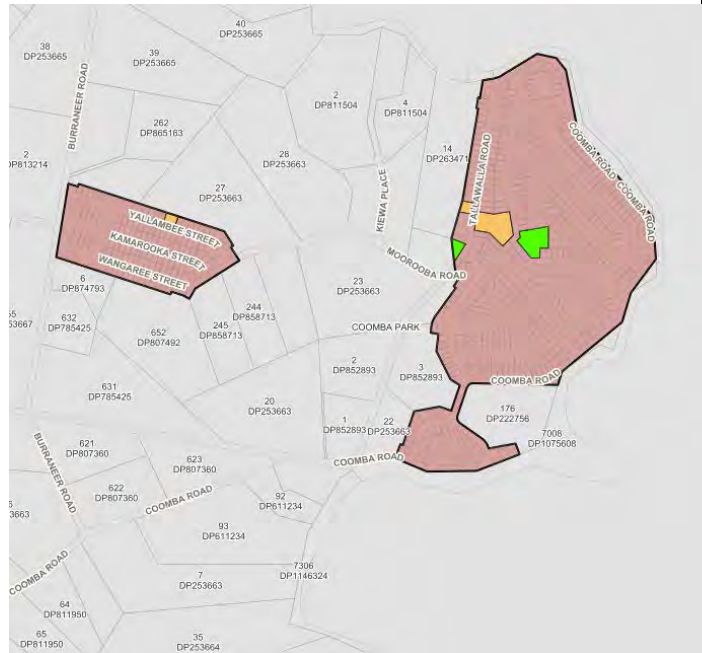
High current lot occupation with further potential for facilities and shops to allow self-sustaining community.

All individual lot ownership. Rural Strategy unlikely to warrant changes.

If not sewerred possible consolidation clause in LEP.

Allow for numerous public toilet facilities and general store

If sewerred - Est. approx. capacity for 250 – 300+ lots.

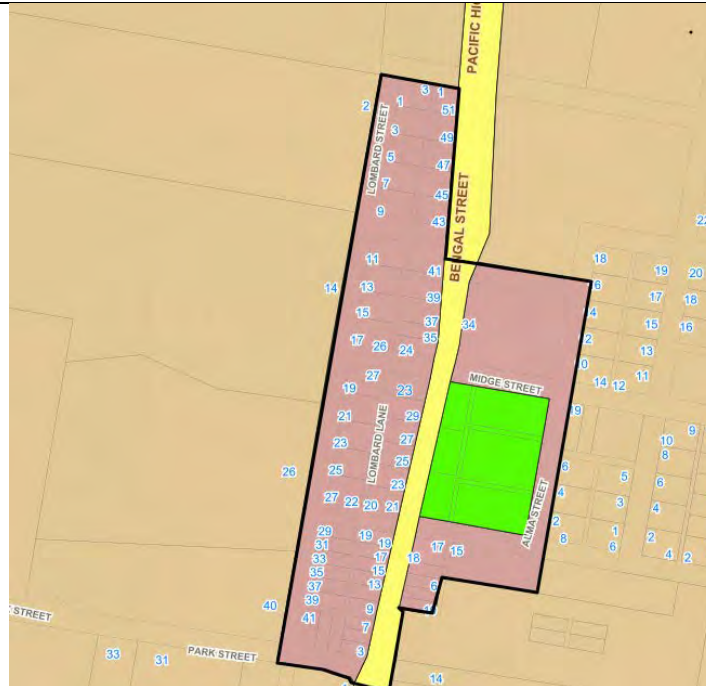


Coolongolook -lots with existing dwellings in village zone (black outline)

Five additional lots outside of village zone (red outline outline).

Highway service town which includes service stations, restaurants and cafes and public toilets in green recreation area.

If sewerred – Est. approx. capacity 50-60 lots, with additional consideration of commercial scale developments.



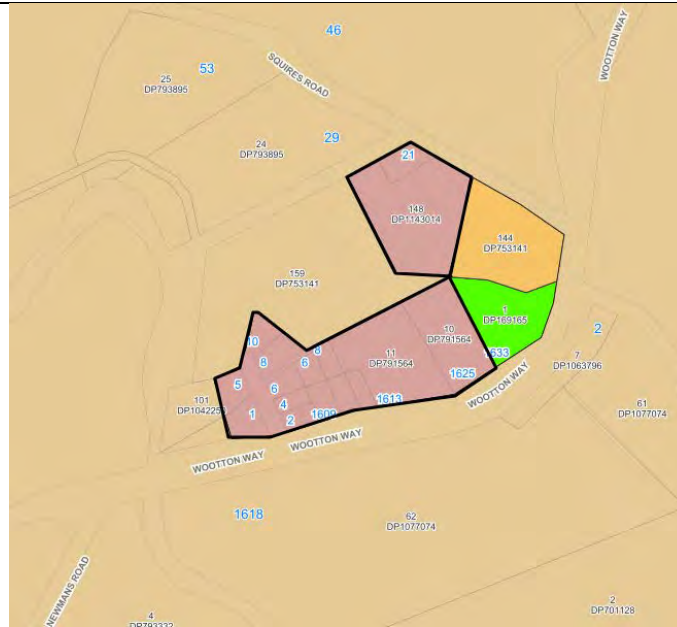
Wootton - lots with existing dwellings in village zone (black outline)

Rural strategy to consider rezoning of additional lots in red outline to village zone.

Subdivision potential if sewerred.

Consider Wootton community hall and facilities in Public Recreation Zone.

If sewerred – Est. approx. capacity 30+ lots.



**North Pindimar
Village area - village
zone only (black
outline)**

Known OSS issues
(pump out prevalent)
preventing
development of
undeveloped lot in
village area.

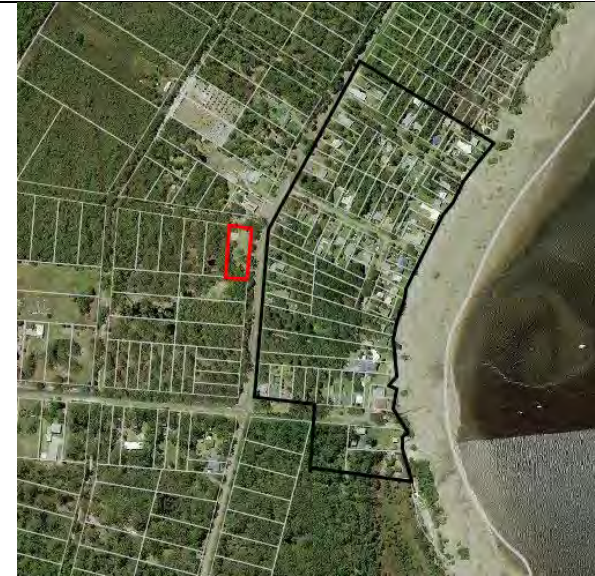
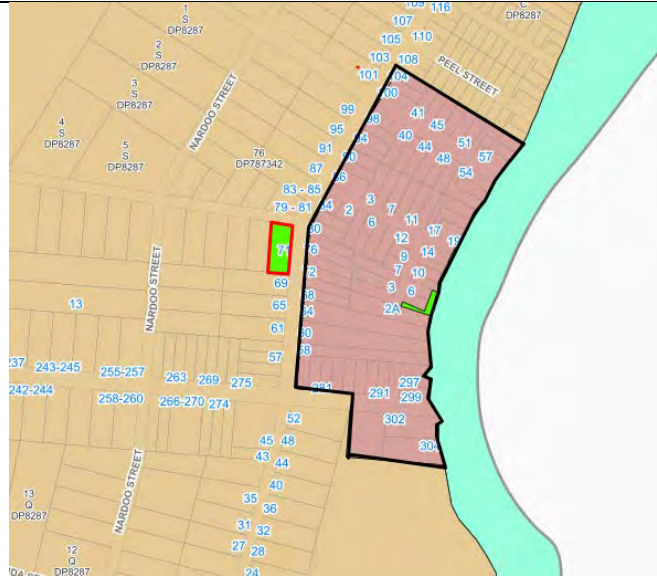
All individual lot
ownership. Some
flooding and
development
constraints such as
sensitive vegetation
communities with
threatened species and
bushfire.

If not sewerred possible
lot consolidation or
minimum lot size
clause for OSS in LEP.

No preliminary
considerations in Rural
strategy for village
zone extension.

Secondary
consideration for toilet
in memorial park (red
outline)

If sewerred – Est.
approx. capacity 40-
50+ lots.



**South Pindimar
village area - village
zone only (black
outline)**

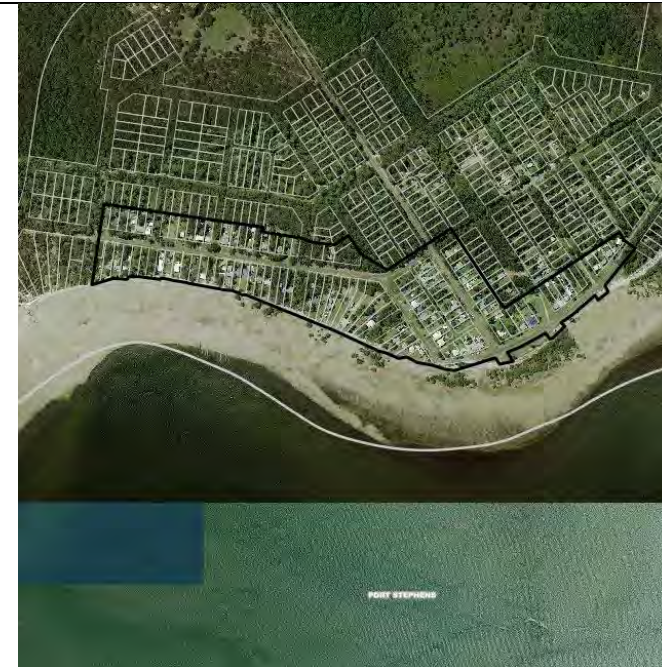
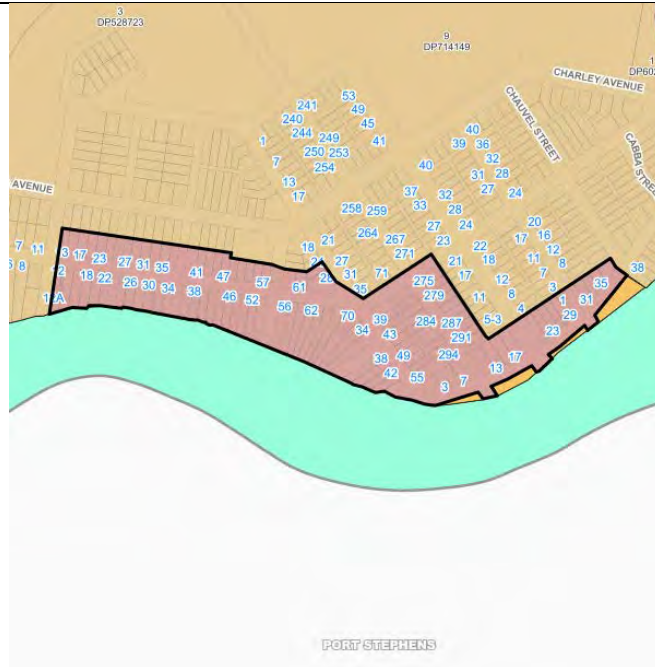
Known OSS issues
(pump out prevalent)
preventing
development of
undeveloped lot in
village area.

All individual lot
ownership. Some
flooding and
development
constraints such as
sensitive vegetation
communities with
threatened species and
bushfire.

If not sewerred possible
lot consolidation or
minimum lot size
clause for OSS in LEP.

No preliminary
considerations in Rural
strategy for village
zone extension.

If sewerred – Est.
approx. capacity 60+
lots

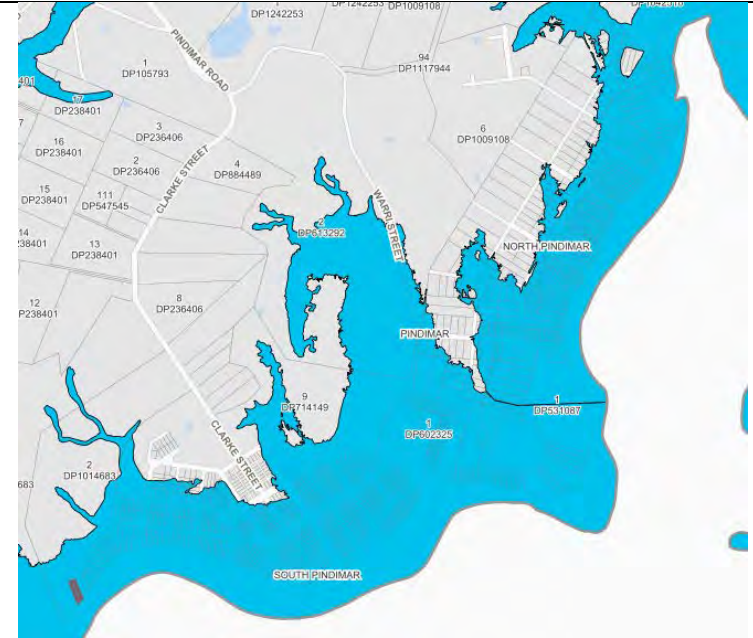
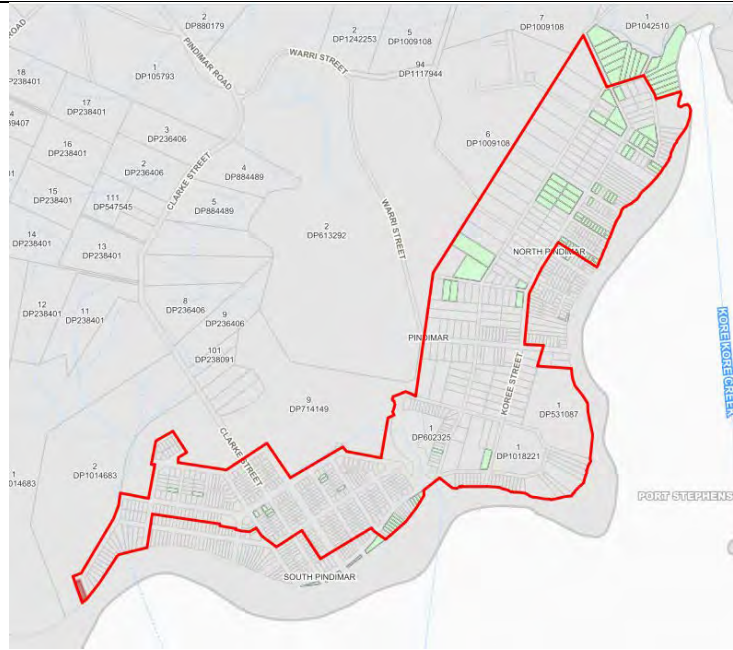


Pindimar rural extent

Majority of paper subdivision lots do not have dwelling entitlement; are environmentally sensitive, several lots have been transferred back to Council (see green shading) either voluntarily or through unpaid rates.

Sporadic dwelling entitlements – resulting in a fractured development pattern.

Rural strategy to consider priorities and principles for paper subdivisions.



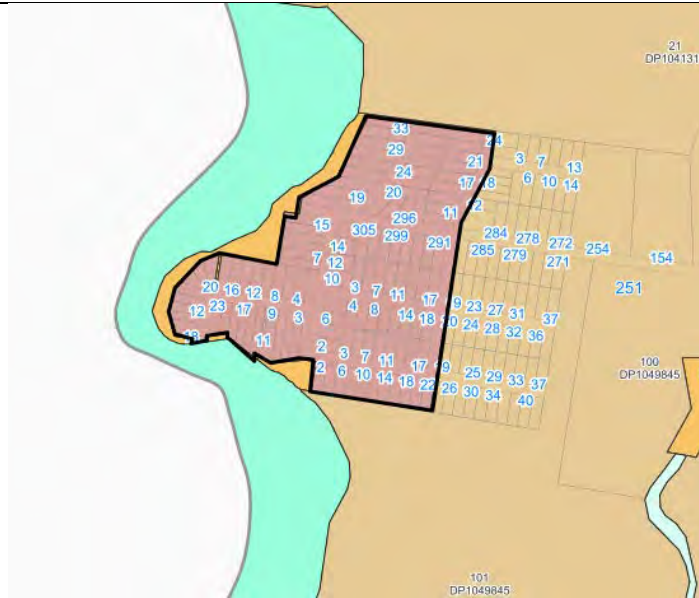
Bundabah - village zone only (black outline) – small number of additional existing dwellings should also be considered

Known OSS issues (pump out prevalent) preventing development of undeveloped lot in village area.

All individual lot ownership. development constraints such as sensitive vegetation communities with threatened species and bushfire. No preliminary considerations in Rural strategy for village zone extension.

If not sewered possible lot consolidation or minimum lot size clause for OSS in LEP.

If sewered – Est. approx. capacity 80 + lots.



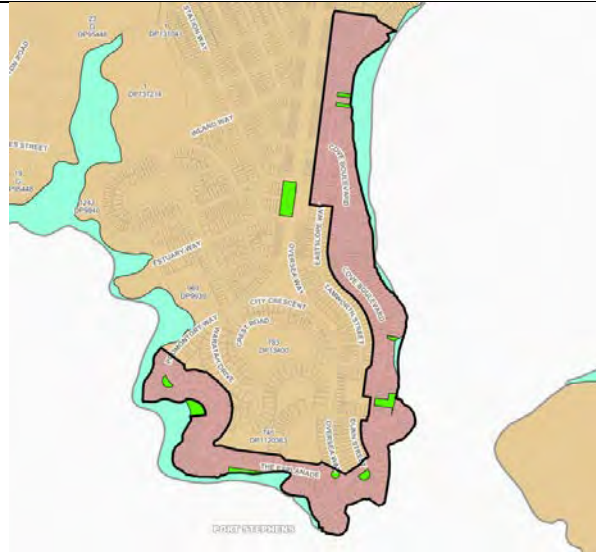
**North Arm Cove -
village zone only
(black outline)**

Known OSS issues
(pump out prevalent)
preventing
development of
undeveloped lot in
village area.

All individual lot
ownership.
development
constraints such as
sensitive vegetation
communities with
threatened species and
bushfire. No
preliminary
considerations in Rural
strategy for village
zone extension.

If not sewerred possible
lot consolidation or
minimum lot size
clause for OSS in LEP.

If sewerred – Est.
approx. capacity 100+
lots.

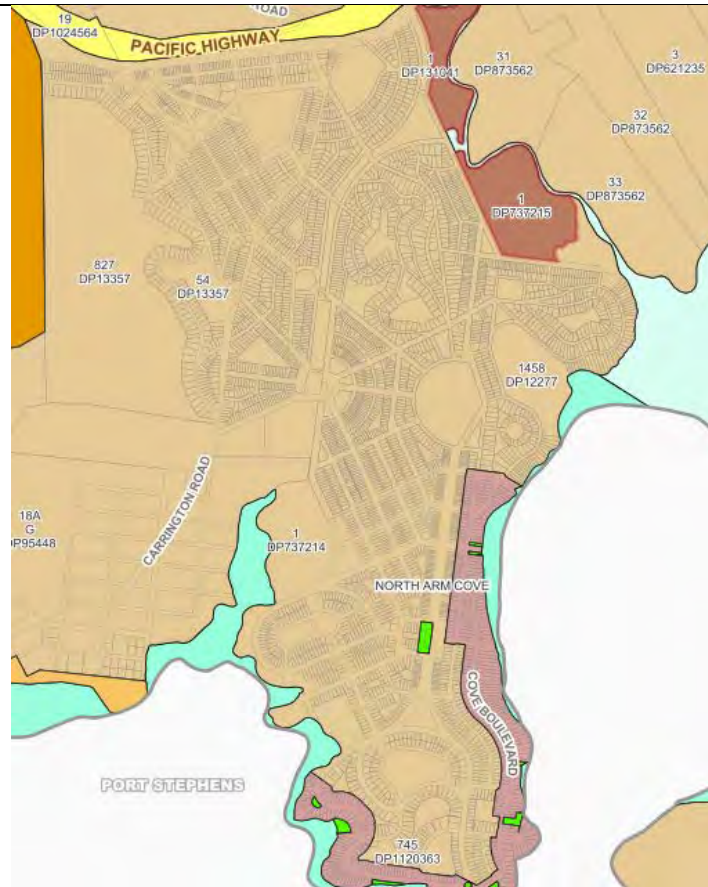


North Arm Cove rural extent – outside of village zone area

Majority of paper subdivision lots do not have dwelling entitlement; are environmentally sensitive - several lots have been transferred back to Council (see green shading) either voluntarily or through unpaid rates.

Sporadic dwelling entitlements – fractured development pattern
Sporadic dwelling entitlements throughout resulting in a fractured development pattern.

Rural strategy to consider priorities and principles for paper subdivisions.



**Carrington & Tahlee
- village zone only
(black outline)**

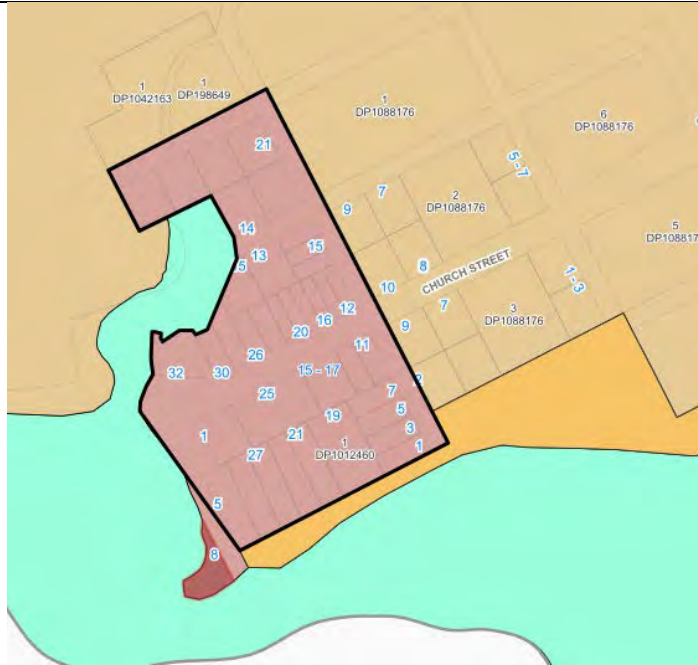
No preliminary considerations in Rural strategy for village zone extension.

Undeveloped Lots outside village zone do not have dwelling entitlement or are environmentally sensitive.

If not sewered possible lot consolidation or minimum lot size clause for OSS in LEP.

If sewered – Est. approx. capacity 30+ lots.

Conference centre at Tahlee – needs to accommodate significant numbers (up to 2000 per event – Gary Mead has more information on this event)



Nerong – lots with existing dwellings in village zone in black outline

All lots with existing dwellings are priorities. No further expansion possible – Coastal area, flooding impacts and wetlands.

Known OSS issues. Many vacant village zone lots are problematic.

Secondary considerations – public toilet facilities

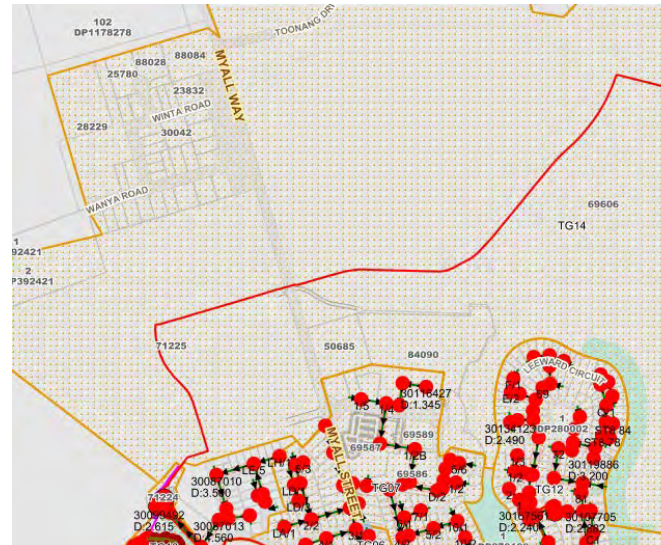
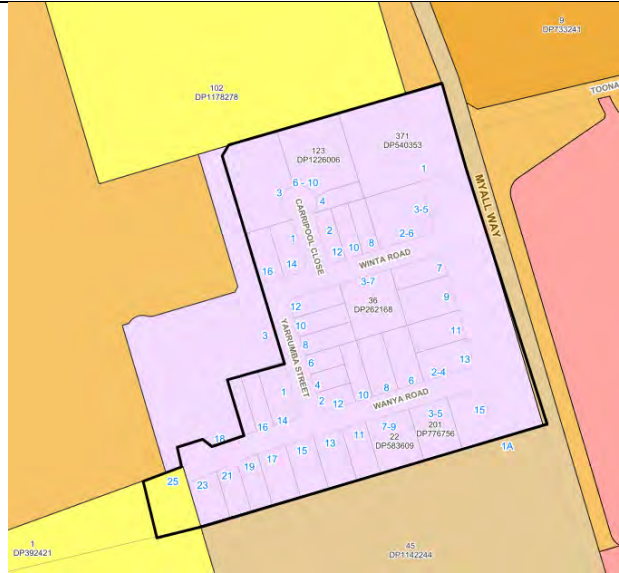
If not sewered possible consolidation clause in LEP.

if sewered – Est. approx. capacity 60-70+ dwellings



**Tea Gardens
Industrial – industrial
lots in black outline**

Secondary considerations
– Council's Tea Gardens
landfill offices and
amenities



Bungwahl - lots with existing dwellings only in village zone and existing dwellings in rural zones on Seal Rocks Road and Dogwood Road (black outline).

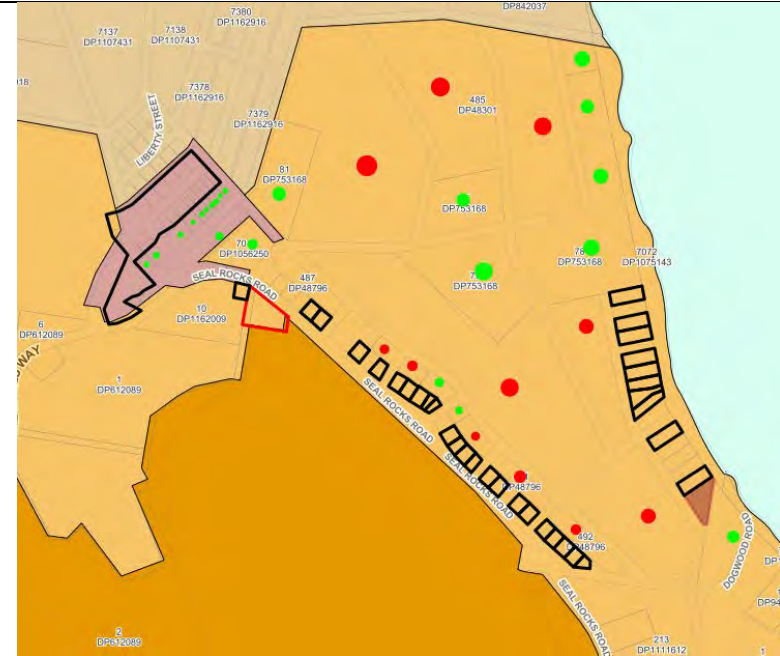
Majority of land by NSW Department of Industry (green circle) and Forster Aboriginal land Council (red circle).

Rural Strategy to unlikely expand Village Zone. Possible backzoning of village zone to Environmental Zones.

No more dwelling entitlements will be released in rural zones. Bushfire constraints.

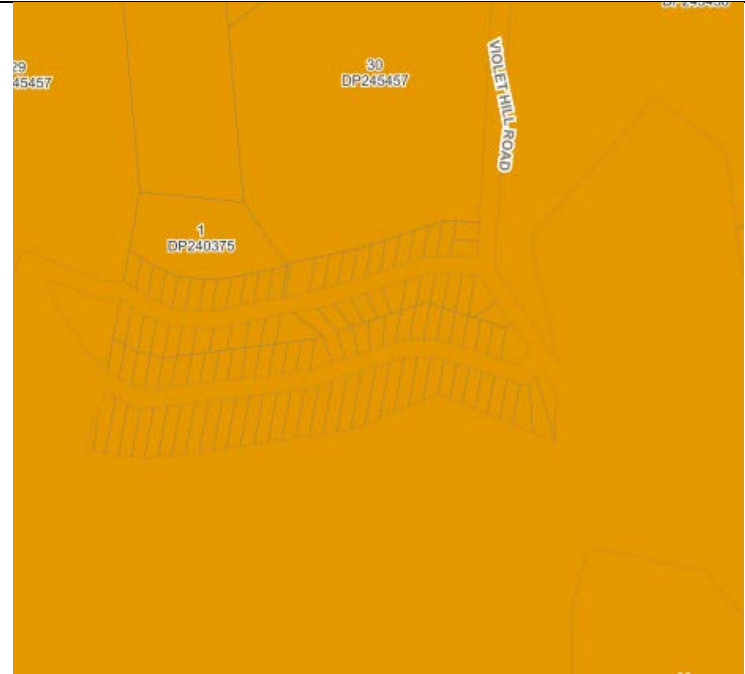
Secondary considerations – Bungwahl Public School (red outline) and development opportunities for Aboriginal Land Council.

Est. approx. capacity if sewerred- 30-40 dwellings + public school + land council development.



Violet Hill

All lots are zoned E1 and owned by NSW National Parks and Wildlife Service.



The Branch

Majority of lots do not have dwelling entitlement; are environmentally sensitive and/or in water; and are significantly flood affected (blue shading) - have been transferred back to Council (see green shading).



Copeland Common (East Copeland) – currently RU1

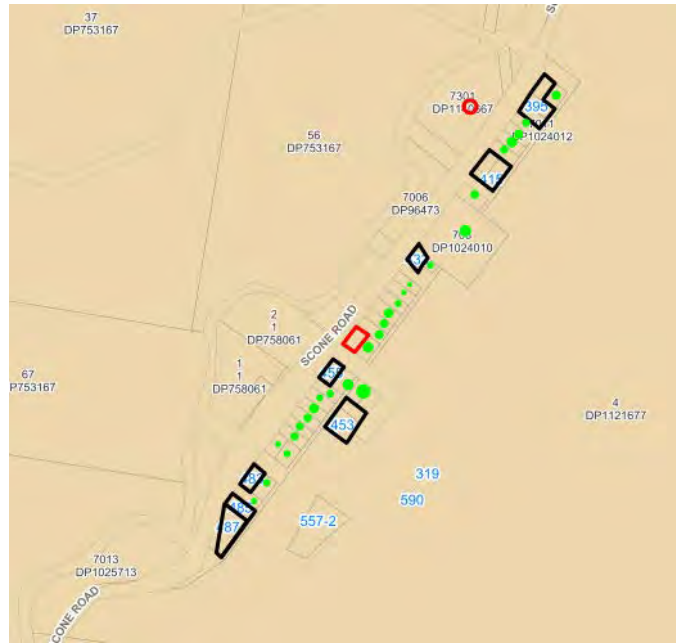
Lots with existing dwellings in (black outline) - 8 dwellings in total

Majority is Council or Crown owned (green).

Historical context is important – Copeland is a historical gold mining village of over 1,000 people, essentially all previous lots contained buildings.

Rezoning as part of Rural Strategy unlikely given all entitlements taken up and Council and Crown ownership./ Fractured development pattern.

Free camping facility on Copeland Common (red circle) consideration for sewerage amenities.



Copeland (west
Copeland currently
RU1)

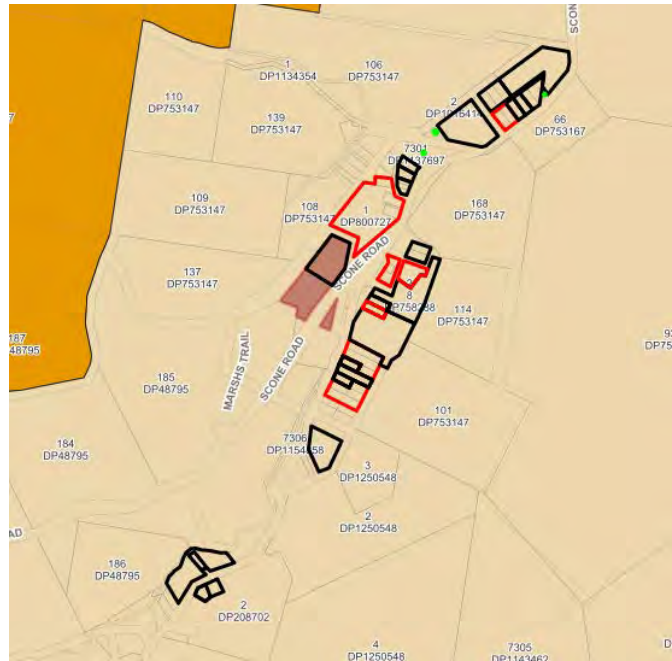
Lots with existing
dwellings (black
outline)

Rural Strategy –
investigation of
possible village
zone – some lots
unsuitable for
development due to
vegetation and
bushfire

Forster Aboriginal
Land Council own
several allotments.

Existing on-site
sewerage issues
relates to boundary
uncertainties,
reflected in
historical mining as
mentioned above.

If sewerred - Est.
approx. capacity
30+ lots.



**Stratford
Lots with
existing
dwellings in
village zone
(black outline)**

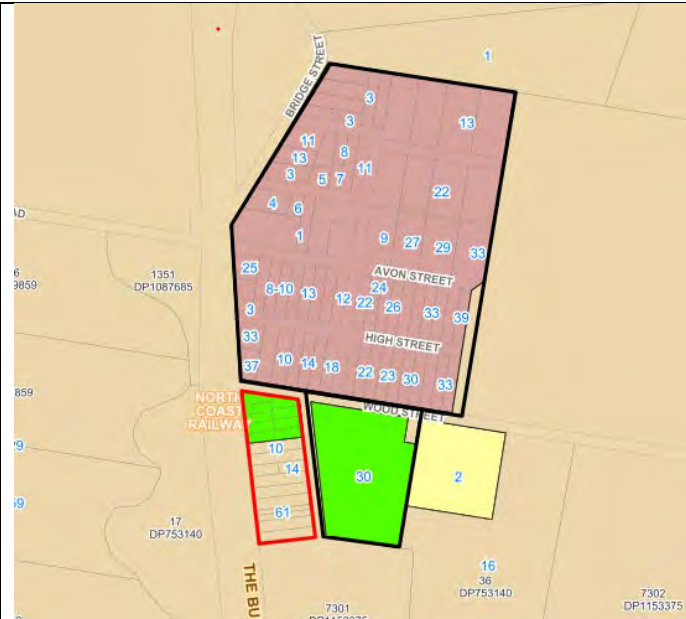
Additional lots
outside of village
zone (red outline).

Also allow for a few
additional lots
within village area
and black outline –
some larger lots
could subdivide if
sewer.

Rural Strategy –
considered rezoning
of rural area in red
outline to village.
Also consider public
toilets in RE1 Zone.

Aboriginal Land
claims on crown
red in red outlined
area does not
preclude servicing
by sewerage

If sewerred – Est.
approx. capacity
40-50 lots.



Barrington
All RU5 sewered
in addition to
some adjoining
R5

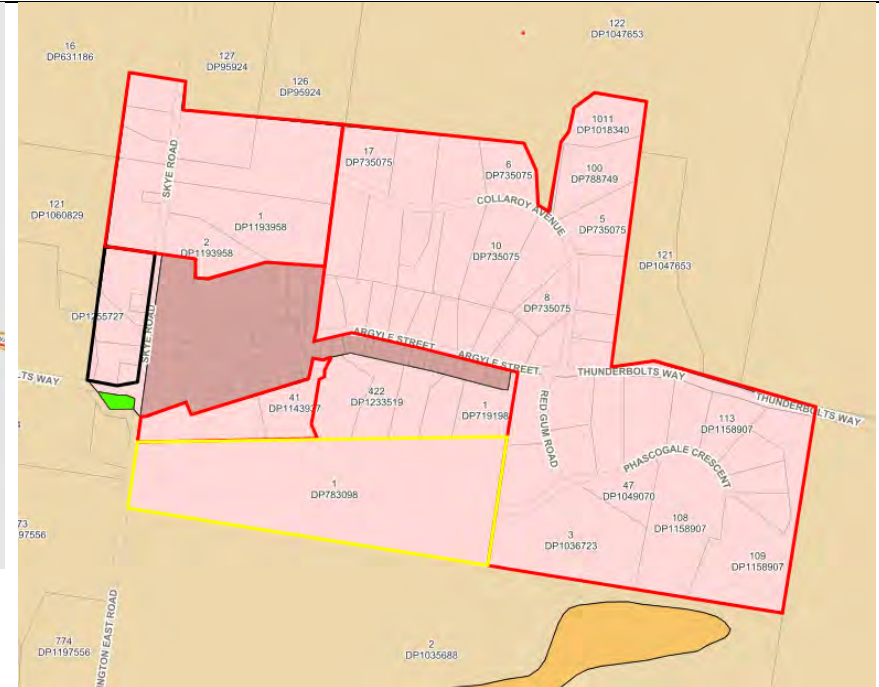
Lot highlighted in yellow subject to approval part of which requires sewerage infrastructure

R5 lots have land parcels area predominantly over 8,000sq.m – topography issues

Sewerage infrastructure may observe more subdivision of R5 lots creating undesirable fragmentation in area highlighted red

Rural Strategy – considered extension of village areas to black outline

If sewered – additional capacity approx. 10 lots.



Craven - lots with existing dwellings in RU1 Primary Production zone (black outline).

2 section, 8 dwellings and 7 dwellings.

Known OSS issues – flat and subject to local flooding – predominantly aerated systems due to clay soils.

Constrained land subject to flooding/drainage issues.

No further development encouraged.



**Bundook – R5
zoned area
outlined in black**

Former paper
subdivision rezoned
to R5 in 2010.

Rural Strategy to
investigate possible
RU5 zone to
encourage self-
sustaining
community i.e.
cafes

Existing dwellings
highlighted in red

Individual Lot size
ranging from 2,000
to 4,000 square
metres

Traversed by a
watercourse
offering a
development
constraint.

If not sewered
possible
consolidation clause
in LEP.



Appendix D: High Level Options Assessment Criteria

This table provides further information explaining the criteria used for selection of a preferred high-level option for each village.

| Element | Details | Description |
|---|---|--|
| Lot size | Key factor determining area available for effluent management | This has been estimated for each lot based on previous analysis undertaken by DWC for DAF (for minimum lot sizing analysis). This included previous analysis for lots across Greater Taree, Kempsey Shire and Monbulk (Victoria). |
| Land area required for effluent management | Land Application Area or Reuse Area (LAA) | <p>Initial estimated size of LAA required for sustainable long-term effluent management (either on-property or local cluster reuse facility).</p> <p>Land Application</p> <p>Design Loading Rate (DLR) of ~1-2mm/day assumed for conservatism given typical climatic and soil conditions across LGA.</p> <p>Beneficial Reuse</p> <p>Initial modelling undertaken to assess potential land application (at a daily timestep) using MEDLI, which is considered a best practice model for simulating effluent irrigation.</p> |
| Total number of lots | Incorporated into ADWF calculation for each village | <p>Factors into the viability of a local cluster treatment or <i>'Whole of Town'</i> solution based on economies of scale and potential value in decentralised management of effluent at dedicated areas</p> <p>Currently assumed ADWF = 525L/day/dwelling</p> |
| On-site hazard rating (land capability and receiving environment) | Detailed on-site hazard classifications inform the potential for sustainable long-term wastewater management either on-lot or at a designated cluster site. | Given the constrained nature of these identified villages, a large proportion of lots are deemed High Hazard under the DAF. However, can help inform the viability of potential cluster reuse sites. |

Appendix E: Village Wastewater Characteristics Summary

This table provides a summary of wastewater servicing characteristics for each village.

| Rank | Village | No. of Lots | Approx. Total ADWF (kL/day) | Lot Size (Median) |
|------|---------------------------------|-----------------------------------|---|---|
| 1 | Coomba Park | 670 | 350 | 560 m ² |
| 2 | North Pindimar | 91 | 48 | 1,310 m ² |
| | South Pindimar | 137 | 72 | 1,150 m ² |
| | North Arm Cove | 409 | 215 | 1,015 m ² |
| | Bundabah | 125 | 66 | 1,215 m ² |
| | Nerong | 168 | 90 | 660 m ² |
| | Seal Rocks | 73 | 38 | 650 m ² |
| | Carrington & Tahlee | 40 (including church / camp site) | 21 (camp site flows will vary) | 1,520 m ² |
| 9 | Bungwahl | 74 | 40 | 2,000 m ² (overall) 4,000m ² (eastern lots along Dogwood Road) |
| 10 | Croki | 25 plus 38 caravan park sites | 18 Plus caravan flows which will vary seasonally | 810 m ² |
| 11 | Allworth | 92 | 48 | 1,010 m ² |
| | Copeland | 116 | 61 | 1,055 m ² |
| 13 | Tea Gardens (Industrial Estate) | 38 | TBC (commercial properties) | 1,890 m ² |
| 14 | Coolongolook | 77 | 40 | 1,800 m ² |
| 15 | Stroud Road | 91 | 48 | 1,089 m ² |
| 16 | Krambach | 238 | 58 | 1,473 m ² |
| 17 | Oxley / Mitchells Island | 177 / 47 | TBC | >1.4 hectares |
| | Wards River | 64 | 34 | 1,013 m ² |

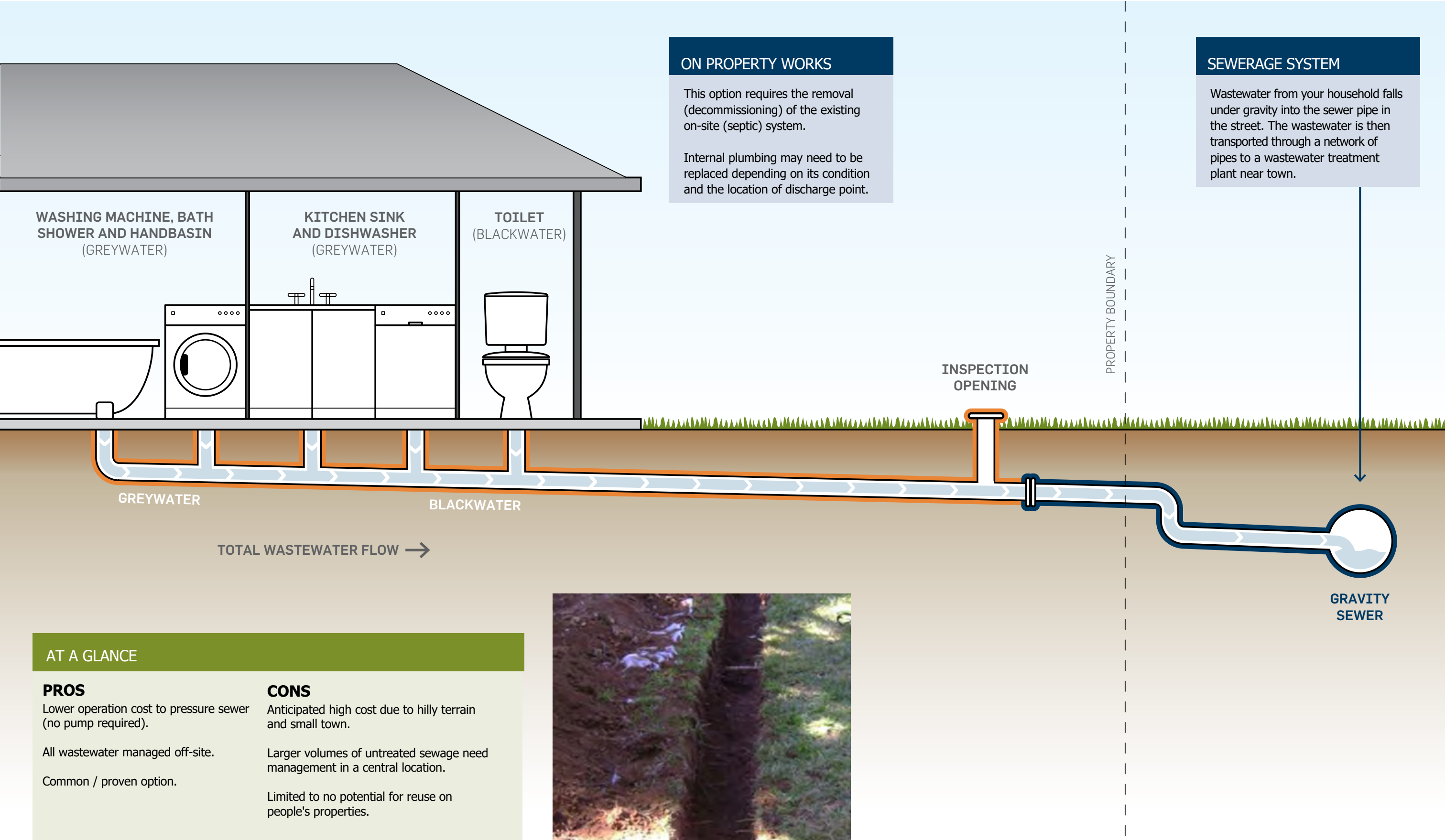
| Rank | Village | No. of Lots | Approx. Total ADWF (kL/day) | Lot Size (Median) |
|------|-------------------|-------------|-----------------------------|----------------------|
| 19 | Mount George | 97 | 51 | 1,800 m ² |
| | Elands | 62 | 33 | 1,492 m ² |
| 21 | Johns River | 173 | 91 | 1,060 m ² |
| 22 | East Wingham | 65 | 34 | 858 m ² |
| 23 | Craven | 23 | 12 | 1,065 m ² |
| 24 | Wootton | 23 | 12 | 3,011 m ² |
| 25 | Stratford | 100 | 53 | 2,022 m ² |
| 26 | Limeburners Creek | 58 | 30 | 1,080 m ² |
| 27 | Booral | 53 | 28 | 2,715 m ² |
| 28 | Moorland | 120 | 63 | 1,295 m ² |
| 29 | Barrington | 91 | 48 | 2 hectares |
| 30 | Bundook | 79 | 41 | 4,055 m ² |

Appendix F: Servicing Option Posters

Courtesy Yarra Valley Water

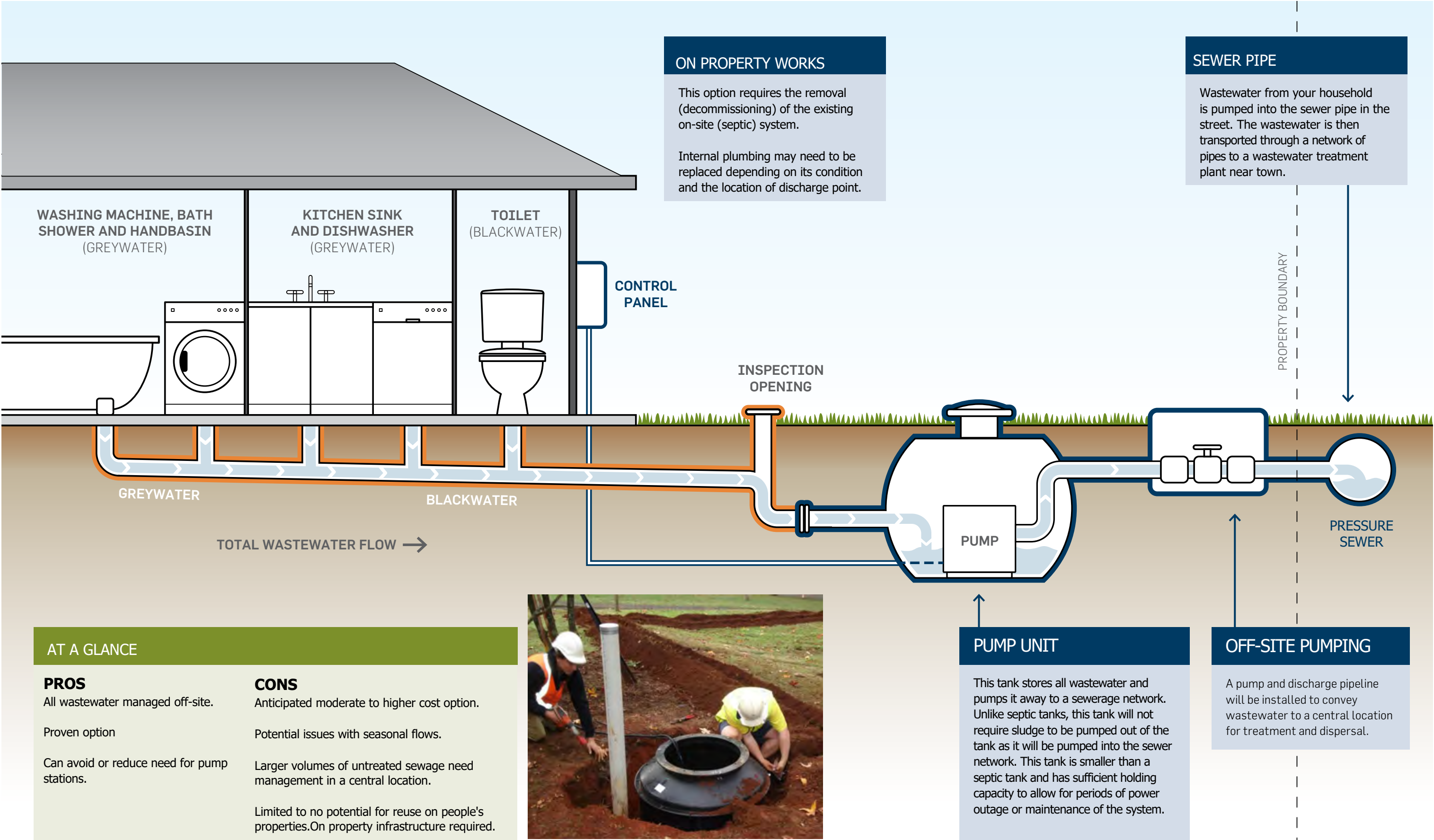
GRAVITY SEWERAGE

A gravity sewer is the traditional way Barwon Water would service a town. Gravity sewerage systems are a known and relatively simple system. However, they can be expensive for small towns that lack the economy of scale of an urban area. They can also require a lot of pump stations in undulating areas.



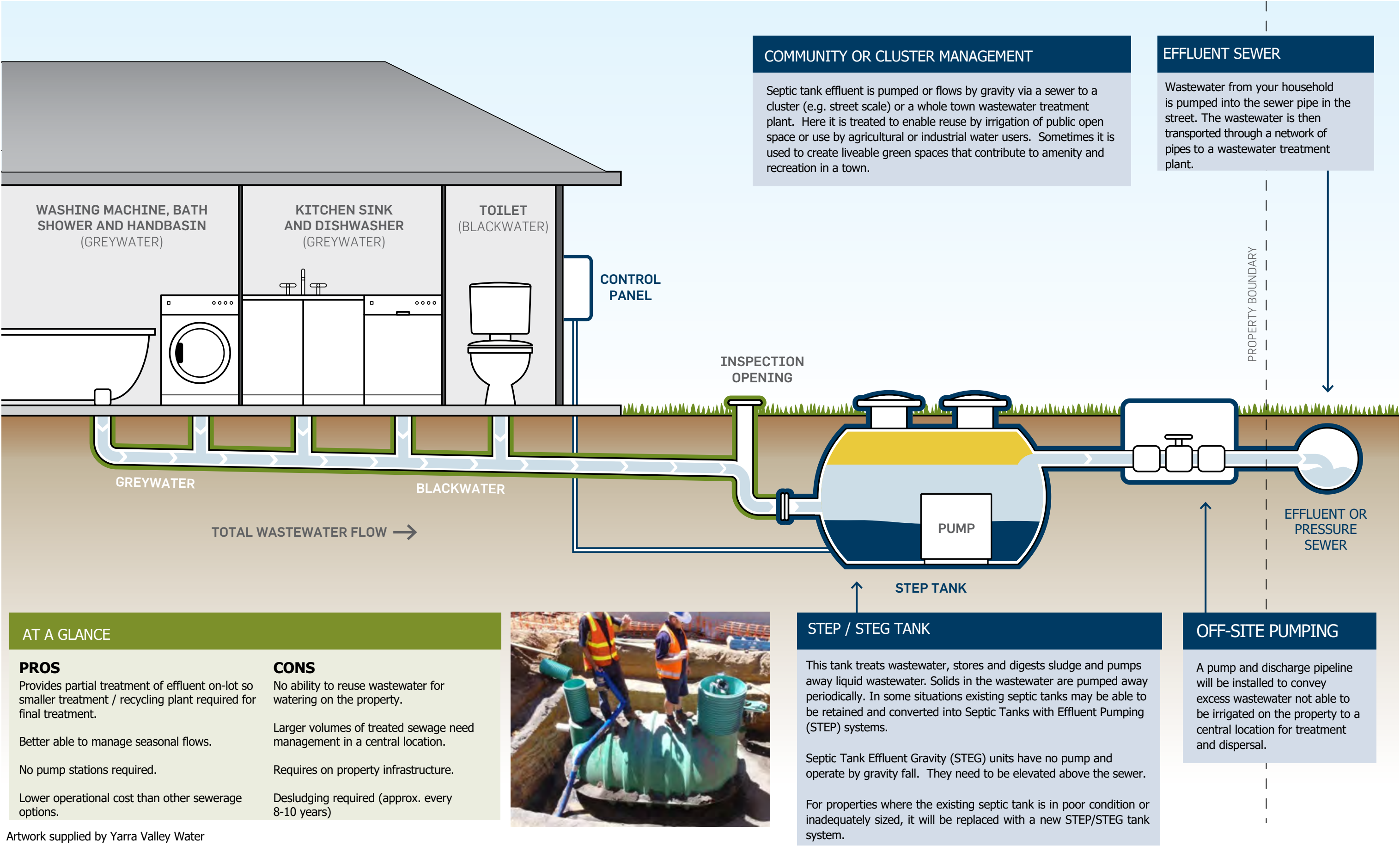
PRESSURE SEWERAGE NETWORK

Pressure sewerage systems can be a cost effective way to provide a full off-site sewerage solution in undulating terrain where gravity sewerage is challenging or expensive. A small pump unit is installed on each property to pump raw macerated sewage into a pressurised sewer network.



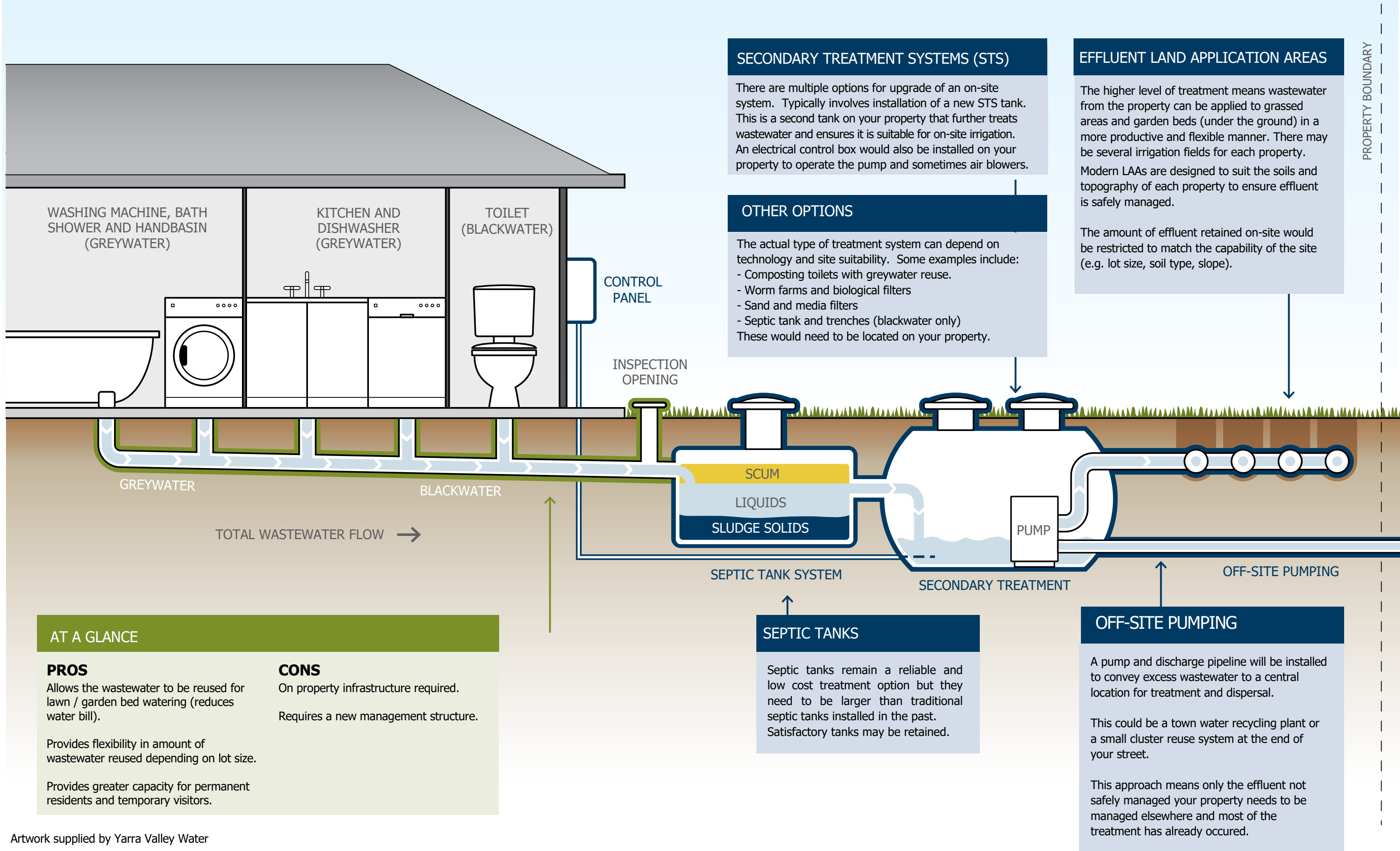
SEPTIC TANK EFFLUENT PUMP / GRAVITY (STEP/STEG) SYSTEMS

STEP/STEG systems can reduce the size and cost of reticulation and treatment plants by providing primary treatment, biosolids breakdown and flow balancing on each property. This can be important in small towns with lower permanent population and economies of scale for central infrastructure.



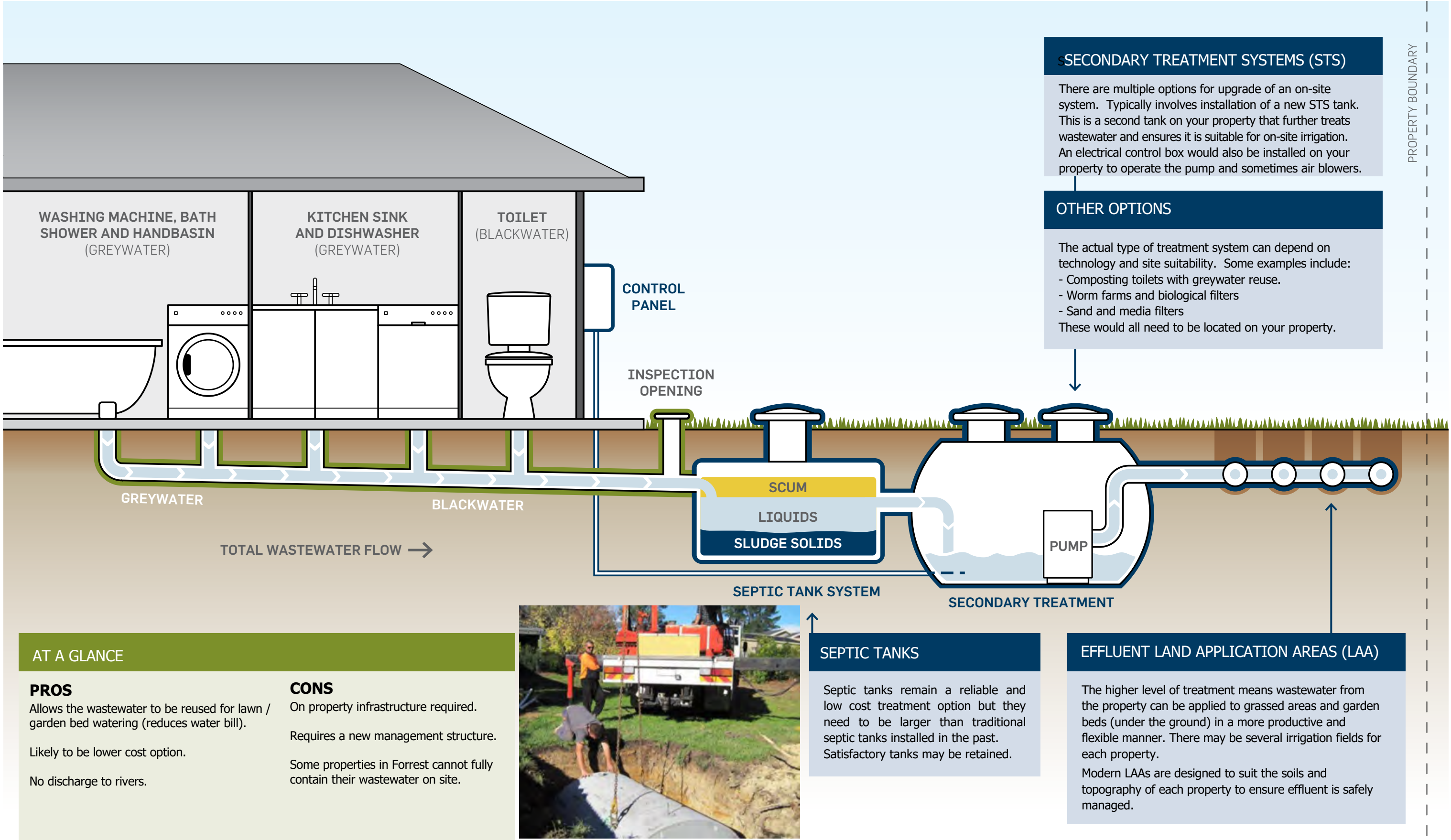
PARTIAL ON-SITE WASTEWATER MANAGEMENT SYSTEMS

Small towns can potentially achieve a cost effective and high quality outcome by managing a safe amount of wastewater on individual properties and sending excess volumes to a managed off-site solution.



UPGRADES TO EXISTING ON-SITE WASTEWATER MANAGEMENT SYSTEMS

There are some properties in Forrest capable of containing their wastewater on-site subject to an upgraded or new on-site wastewater treatment and land application area.



Innovative options

There are range of innovative systems available for wastewater, greywater and stormwater treatment both on the property and along public areas like streets and parks, these include:



Recirculating sand filter with subsurface irrigation



Reed bed – passively treats the wastewater using natural processes as it moves through vegetation.



Power generation



Greywater onsite treatment



Worm farms



Textile filter system



Precinct plants



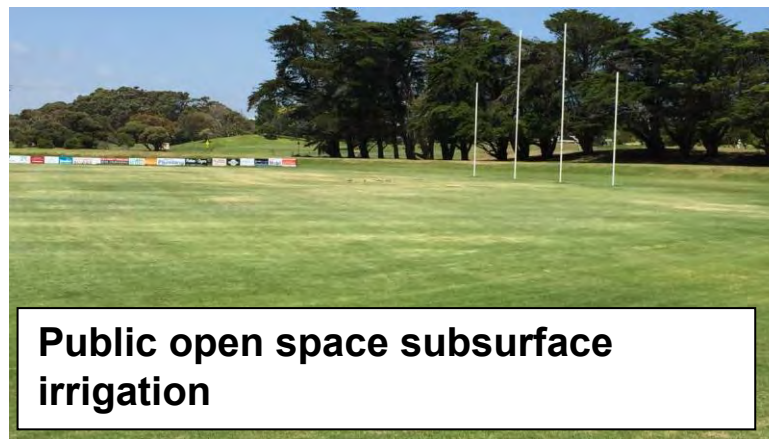
Raingardens



Composting toilets



Potable reuse







DECENTRALISED WATER CONSULTING

enquiries@decentralisedwater.com.au

4960 2627

www.decentralisedwater.com.au