DECENTRALISED WATER CONSULTING

Forrest Wastewater Investigation: Project Report

Final Report

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Document Control Sheet

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EXECUTIVE SUMMARY

Decentralised Water Consulting (DWC) is currently assisting Barwon Water (BW), Colac Otway Shire Council (Council) and the Forrest Community (the Community) to investigate options to improve wastewater management for the town. Wastewater is currently managed by individual on-site wastewater management systems (on-site systems) with approval and performance regulated by Colac Otway Shire Council. On-site systems within Forrest are of varying age, capacity and condition and previous feedback from the Community suggested the performance of these systems varies and is at times impaired by the significant influx of visitors during peak tourist periods. This has been supported by the outcomes of an audit of the existing on-site system conducted on behalf of Council in late 2017.

The Forrest Community do not want inadequate wastewater management practices to impede the growth and liveability of Forrest. Barwon Water and Colac Otway Shire Council are well placed to assist the Community in developing a long-term solution that not only removes this impediment, but captures an opportunity to achieve multiple benefits from the improved management of wastewater.

The project is being undertaken in four stages, namely;

- Project Review, Definition and Justification (Why are we here and where do we want to go?)
- Option Development (Capture ideas and shortlist Solution Packages)
- Solutions Package Assessment (Stakeholder driven triple bottom line assessment)
- Business Case Development and Reporting

Project Definition and Justification

The first phase of the project was focused on evaluating the current wastewater management situation in Forrest and engaging with the community to develop a shared vision of what Barwon Water, Council and the community would like to achieve from the project. As part of this work we have;

- collated and reviewed existing data relevant to wastewater management, water quality and human health impacts in Forrest;
- completed a strategic review of local, state and national policies, legislation and planning instruments to ensure the project aligns with the current and future vision for the community, Council, Barwon Water and region;
- participated in a comprehensive community engagement process to obtain genuine input on the nature of the problem and help the community define a shared vision of success for the project;
- undertaken a range of preliminary technical assessments to characterise the existing wastewater situation for Forrest (including use of the outcomes of the Council Septic Tank Audits);

- developed a Business as Usual scenario as a baseline for development and assessment of potential options; and
- used the outcomes of this information to prepare a project justification that is documented in this report.

These investigations have confirmed that there is a strong need and community desire for improved wastewater management in Forrest. It is clear that a continuation of the Business as Usual wastewater management approach cannot meet regulatory or community expectations. Consequently, this investigation is critical to identify alternative, safe and sustainable long-term wastewater management strategies. The outcomes of the first stage of the project provide a strong basis and direction for the project based on best available information and the community vision for Forrest. The agreed Vision and measures of success for developing and assessing options for Forrest are presented below.

Table: Agreed Vision Aspects and Success Measures

Visioning Aspect	How will this be measured?
Proposed Community Vision Statement	***"The Forrest wastewater management solution will be innovative and cost effective, whilst providing protection of public health, environment and the Forrest way of life."***
Ensure protection of human and environmental health	- Reduction in pollution to waterways - Reduction of offsite discharges - Estimated reduction in disease burden
Enhance community and way of life	- Economic impact to Forrest - Increase to Tourism - Change to population / resident make up - Community support for solution
Give full consideration of costs to residents and community	- Up-front costs and life cycle costs - Fair and equitable distribution of costs
Create flexible wastewater options for the future	- Ability to stage/adapt - Ability to cater for residents and visitors (tourism)
Showcase innovation and best practice	- Opportunities for water recycling and energy recovery. - Level of flexibility of options - Showcase / case study potential - Level of water cycle integration

Option Development and Assessment

The second phase of the project was focused on the development and assessment of a range of options for improved wastewater management in Forrest in consultation with the community. These

various options have been refined through a screening process (based on the previously defined vision and measures of success for the project and community feedback on options) and used to create four (4) Solutions Packages. These Solutions Packages (SP 1 to 4) are summarised below have then been 'fleshed out' in sufficient detail to;

- describe and illustrate the main components of each Package to assist in assessment and comparison;
- confirm their preliminary feasibility (proof of concept);
- develop high level sizing and performance requirements for Package components;
- make a detailed and informed estimate of environmental and health protection performance;
- estimate capital, operating and life cycle costs of each Package; and
- identify additional investigations or risks that need to be addressed.

Please refer to the tables below and Figure 15 to Figure 19 for summary of these four SP's.

Table: Solution Package 1 (SP1) – Integrated Water Management Approach

Summary	Component	Description
Wastewater Maximise on-property management / reuse and utilise existing on-site systems where possible. Residual discharge of (treated) greywater to stormwater. **Stormwater** Improve stormwater management and provide treatment of combined stormwater/greywater discharges.	On-property	Upgrade existing septic systems to achieve full on-site containment on larger lots where feasible – secondary treatment system (e.g. aerated treatment unit or recirculating media filters) with subsurface irrigation to meet regulatory (EPA CoP) requirements. Best Practicable Option (BPO) upgrade for remaining lots that cannot fully contain – maximise land application of wastewater on-site with excess greywater (treated with bio-filter) directed to stormwater. Retain existing septic system where possible. All systems managed by single competent and accountable authority (upgrade works and operation).
	Collection / Treatment	Treat off-site excess discharges using combined stormwater/greywater roadside bioretention swales prior to discharge into treatment measures at nominated locations. Bioretention swales are grassed on the surface but feature a sand filtration media underneath that ensures low flows (such as greywater) infiltrate quickly for treatment. This infiltrated water is collected by an underdrain that discharges to a pit that overflows to the next swale or drainage pipe. Treatment measures to include constructed wetland for low flows (greywater/stormwater) with final filtration and possible UV disinfection. Discharge to waterway only during adequate flow conditions. Large storm events to be directed to a separate, dedicated bioretention basin for stormwater quality treatment and potentially harvesting for reuse.
	Water Management	Establish local stormwater irrigation facilities at feasible locations (potentially school playing fields and open space as shown on Figure 15).
	Water Cycle	Minor residual (treated) greywater discharge. Reduced water extraction/demand for public open space irrigation. Significantly improved stormwater management (flow and pollutant loads).
	Long-term growth	Continued managed discharge of treated greywater to upgrade stormwater for new development unable to contain all wastewater on-site.

Table: Solution Package 2 (SP2) – Partial On-site Containment with Cluster Irrigation / Reuse

Summary	Component	Description
Wastewater Maximise on-property management / reuse with upgraded best practice system. Excess wastewater managed at local cluster irrigation systems. **Stormwater** n/a	On-property	Decommission all existing septic systems and install new best practice secondary treatment system (e.g. aerated treatment unit or recirculating media filters) to achieve full on-site containment on larger lots where feasible with subsurface irrigation to meet regulatory (EPA CoP) requirements. Install secondary treatment and subsurface irrigation on remaining partial containment lots with excess discharging to an effluent sewer. The amount of on property irrigation can be set at a reasonable minimum land area (e.g. 150m^2) 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. Additional flow balancing tankage to be installed for commercial / tourist accommodation sites to manage peak flows. Higher strength wastewater producers would require pre-treatment (trade waste) systems. All systems managed by a single competent and accountable authority (both upgrade works and operation).
	Collection	Small diameter effluent sewer collecting excess secondary treated effluent only from lots where full containment is not achievable. Conveyance to local cluster irrigation systems. This sewer would operate as a pressure sewer.
	Treatment	Upfront treatment provided on-property (Class C) with additional treatment at cluster irrigation site (potentially Class B). This allows for reduced cluster treatment infrastructure. Cluster system to typically consist of small control shed (filtration and ultraviolet disinfection) and wet weather storage tank.
	Water Management	Overnight subsurface irrigation (restricted access) of community / public open space using excess effluent not managed or reused on properties (refer Figure 16).[1]
	Water Cycle	Reduced water demand (residential garden and public open space irrigation).
	Long-term growth	Capacity for town growth to match Forrest Structure Plan (2011). On-site systems based on existing dwellings increasing to four bedroom dwellings on existing lots in the long-term. New developments would require secondary treatment system and minimum ~150m^2 subsurface irrigation for each equivalent dwelling.

Note 1: As the investigations has progressed, availability of local community land has since been identified as limited and therefore the feasibility of SP2 implementation is currently unclear.

Table: Solution Package 3 (SP3) – Partial On-site Containment with Central Irrigation / Reuse

Summary	Component	Description
Wastewater Maximise on-property management / reuse with upgraded best practice system. Excess wastewater managed at central irrigation system. **Stormwater** n/a	On-property	Decommission all existing septic systems and install new best practice secondary treatment system (e.g. aerated treatment unit or recirculating media filters) to achieve full on-site containment on larger lots where feasible with subsurface irrigation to meet regulatory (EPA CoP) requirements. Install secondary treatment and subsurface irrigation on remaining partial containment lots with excess discharging to an effluent sewer. The amount of on property irrigation can be set at a reasonable minimum land area (e.g. 80-100m^2) 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. Additional flow balancing tankage to be installed for commercial / tourist accommodation sites to manage peak flows. Higher strength wastewater producers would require pre-treatment (trade waste) systems. All systems managed by a single competent and accountable authority (both upgrade works and operation).
	Collection	Small diameter effluent sewer collecting excess secondary treated effluent from lots where full containment is not achievable. Conveyance to local cluster irrigation systems. This sewer would operate as a pressure sewer.
	Treatment	Upfront treatment provide on-property (Class C) with additional treatment at central irrigation site. This allows for reduced central treatment infrastructure. Central reuse system likely to consist of small control shed (filtration and ultraviolet disinfection) and wet weather storage tank. Small recirculating media filter may be required to keep stored effluent 'fresh'.
	Water Management	Surface or subsurface irrigation of central reuse site using excess effluent not managed or reused on properties (refer Figure 17). Allowance for a range of irrigation rates and strategies. Any excess effluent would be river discharged at limited flow rates during periods of higher river flows (precautionary discharge).
	Water Cycle	Reduced water demand (residential garden irrigation).
	Long-term growth	Capacity for town growth to match Forrest Structure Plan (2011). On-site systems based on existing dwellings increasing to four bedroom dwellings on existing lots in the long-term. New developments would require secondary treatment system and minimum ~100m^2 subsurface irrigation for each equivalent dwelling.

Table: Solution Package 4 (SP4) – Pressure Sewerage to Water Recycling Plant

Summary	Component	Description
Wastewater All raw wastewater conveyed via reticulated sewerage and treated at WRP. **Stormwater** n/a	On-property	Decommission all septic systems and install pressure sewer units on each property. All systems managed by a single competent and accountable authority.
	Collection	Pressure sewer conveying all raw sewage to Water Recycling Plant (WRP).
	Treatment	Water Recycling Plant for treatment of all raw sewage with storage via dams – greater infrastructure required as all wastewater treated at one central location. Likely to be a wetland system or package treatment plant.
	Water Management	Surface irrigation of recycled water across central reuse site (refer Figure 19). Allowance for a range of irrigation rates and strategies. Any excess effluent would be river discharged at limited flow rates during periods of higher river flows (precautionary discharge).
	Water Cycle	Recycled water available for commercial reuse.
	Long-term growth	Capacity for town growth to match Forrest Structure Plan (2011). Provision of tertiary treatment at the WRP may be required for licensed discharge to waters (depending on actual future development).

Cost Estimates

Cost estimates have been developed for each of the Solution Packages as part of this project to allow relative comparison as part of option assessment. The intention is for the costings of the identified preferred solution to be further refined and developed during business case development. This includes capital (upfront) cost estimates along with operational costs and whole of life Net Present Value (NPV) community costs over 50 years. These capital cost estimates include total project delivery costs (including overheads, design, approvals) and a 20% contingency / risk margin. NPV life cycle costs have utilised a 4% discount rate.

Table: Solution Package Cost Estimates

Scenario	Estimated Capital Cost	Estimated Lifecycle Cost (NPV)
BaU	$2.1M / $14,300 per lot[1]	$3.4M / $23,440 per lot
SP1	$8.9M / $61,500 per lot	$12.4M / $86,000 per lot
SP2	$8M / $55,500 per lot	$11.3M / $78,200 per lot[1]
SP3	$10.1M / $70,200 per lot	$12.3M / $85,500 per lot
SP4	$16.7M / $116,000 per lot	$19.1M / $133,000 per lot

Note 1: BaU CAPEX is the NPV of total CAPEX over 50 years of gradual upgrade and replacement (assumed to take place over 25 years or 4% renewal rate).

Multi-Criteria Analysis

The four Solutions Packages which have been assessed utilising a Multi-Criteria Analysis (MCA) based on each of the Measures of Success previously developed from community feedback. These Measures of Success capture a range of environmental, social and economic factors that were considered most important to the community in relation to a wastewater solution for Forrest.

A community session was held 7th October 2018 to provide information on, and listen to feedback on, the advantages and disadvantages of each of the four Solution Packages in line with the Measures of Success defined by the community. Community members were asked to rank each of the four SP's from most preferred to least preferred (1st to 4th). Feedback was also obtained via online and postage survey. This feedback was subsequently included in the MCA process via the 'Community Support for Solution' scoring.

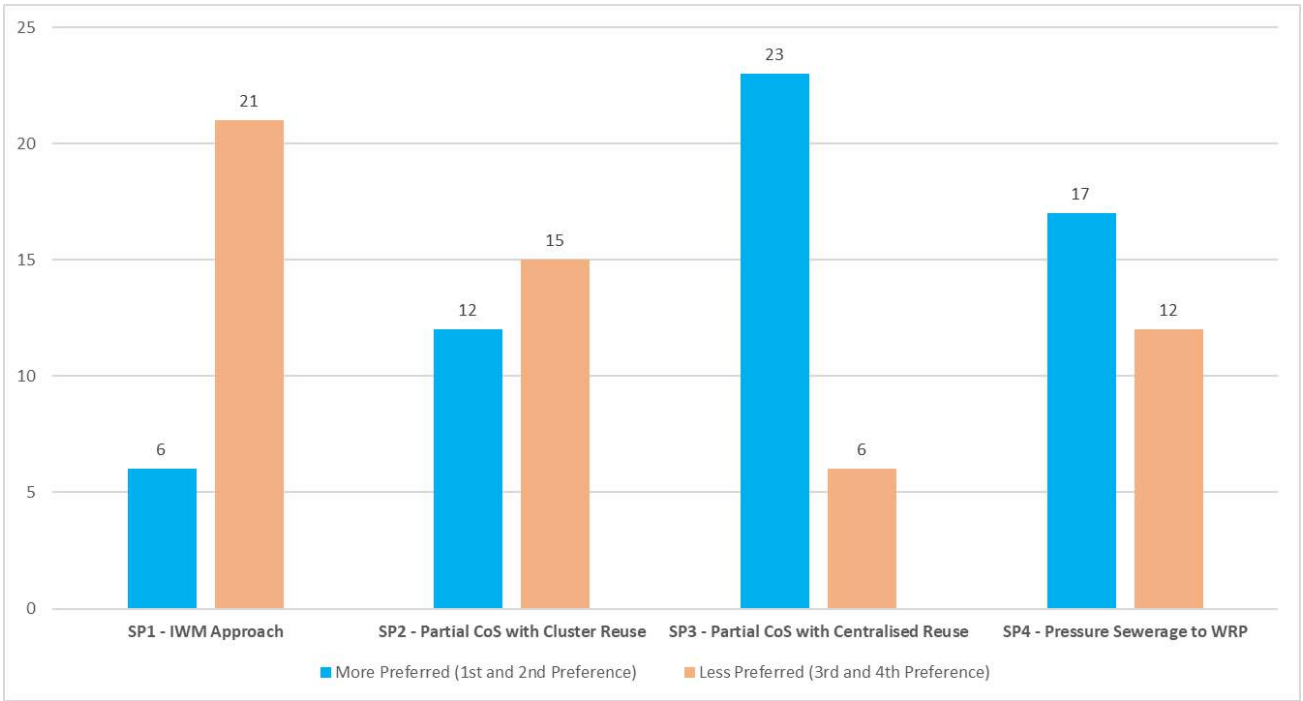

Figure: Solution Package Assessment - Community Feedback Results

The results of the MCA including community feedback are summarised in the table below.

Table: Results of MCA for Forrest Solution Package Assessment

Solution Package	MCA Rank	Rank Score	Strengths	Weaknesses
SP3 - Partial CoS with Centralised Reuse	**1**	320	Very good community support Env. And Human Health Flexibility / adaptability Growth / tourism Showcase / case study potential	Costs (relative to other options) Requires central reuse site Change to Way of Life[1]
SP2 - Partial CoS with Cluster Reuse	**2**	292	Env. And Human Health Flexibility / adaptability Costs (relative to other options) Showcase / case study potential	Growth - limited potential local community reuse sites identified (feasibility and/or cost impacts). Limited community support Change to Way of Life[1]
SP1 - IWM Approach	**3**	260	Env. Health (stormwater and wastewater treatment) provided Flexibility / adaptability Integrated water management Showcase / case study potential Costs (provides both improved stormwater and wastewater)	Growth (some limits to business expansion) Very limited community support Continued off-site discharge (albeit only treated greywater)
SP4 - Pressure Sewerage to WRP	**4**	256	Env. And Human Health Growth / tourism Community support (however non-preference numbers close to preference numbers)	Requires large central reuse site in proximity to town – potential need for river discharge Costs Flexibility / adaptability – full infrastructure required from very beginning (regardless of actual growth) Change to Way of Life[1]

Solution Package	MCA Rank	Rank Score	Strengths	Weaknesses
BaU - Business as Usual	**5**	47	Limited change to Forrest 'Way of Life'	Very poor outcomes for almost all MoS Fails to meet regulatory and government objectives.

Note 1: two opposing views were identified from the Measures of Success - those who wanted to preserve the Forrest 'Way of Life' (country, leafy feel) and those who wished to see economic / population growth and change as part of a wastewater solution for Forrest.

Outcomes and Next Steps / Way Forward

The outcomes of this MCA have determined that Solution Package 3 (Partial On-site Containment with Central Irrigation / Reuse) is the preferred solution for Forrest. This aligns with the overall feedback obtained from the community session held 7th October 2018 along with online / postage feedback received by Barwon Water. Given the Vision and Measures of Success used to score each of the SP's where developed in consultation with the community, it would make sense that the SP most preferred by the community would also achieve the overall highest score.

Solution Package 3 has been taken forward to the next stage of the project (Business Case development and reporting) as per Figure 1. This will be a concise business 'pitch' which can be used to discuss potential funding sources and implementation strategies for appropriate agencies. This will include refinement of costing estimates and potential funding and management structures for SP3 as the preferred solution.

Glossary

A summary of key terms and concepts relating to this investigation is presented in the table below.

Table: Glossary

Term / Element	Definition / Description
EPA Code of Practice (CoP)	EPA Victoria guideline document for the assessment and design of on-site wastewater management systems in areas not serviced by reticulated sewerage. CoP is a risk based document (for suitability qualified consultants / installers) and provides minimum standards along with guidance for situations in which standards are not able to be strictly complied with.
Containment On-site (CoS)	The ability of a property to contain the design wastewater flow within the property boundaries (i.e. no effluent surcharging / run-off) and ensure no adverse impacts on groundwater or nearby receiving environments. Can be considered a high level of health and environmental protection when accompanied by management of on-site infrastructure by a central, competent authority.
Land Capability Assessment (LCA)	On-site assessment of the ability of a property to contain its wastewater on-site and any potential risks to the environment or human health from on-site wastewater management.
Best Practicable Option (BPO)	A feasible option that aims to provide the most benefits and / or the least harm to the environment (as a whole) at acceptable cost over the life of the system in context of the site. Upgrade of existing on-site wastewater systems within Forrest to the best practicable option that maximises (but not necessarily achieves) full on-site containment. Residual discharge of excess greywater (treated via a bio-filter) is to be directed to stormwater drainage (bioretention swale). This option aims to retain existing septic system where possible.
Integrated Water Management (IWM)	Water management approach that aims to provide an holistic and forward thinking approach to all elements of the water cycle (movement of water through its various phases) including wastewater in addition to stormwater, potable / non-potable water supply and local watercourses. The intention is for this approach to be adaptive to temporal changes over the long-term and designed in conjunction with end users (community) with a place based element to design.
Bioretention Measure	Measures including swales, basins and raingardens (depending on scale) which aim to capture stormwater to be filtered through densely vegetated sand / loam filter media. Treated water either discharges via an underdrain, or potentially directly into groundwater in sandy environments. The water is treated via filtration, absorption and biological processes within the media / vegetation. Measures also provide retention of water to release it back into the environment in a manner more consistent with the natural flow regime.

Term / Element	Definition / Description
Biofilter	Biological filter utilised to treat excess greywater from BPO upgrade sites within Forrest. Can consist of slotted / drilled distribution pipe(s) for dosing of greywater across filter media (e.g. coconut fibre above sand / gravel layer) with discharge of treated water via an underdrain connected to stormwater drainage (bioretention swale for further treatment).
Reuse	Use of reclaimed / recycled water for a beneficial purpose e.g. irrigation of community playing fields.
Cluster Reuse (Irrigation) System	System to collect treated effluent from on-property systems for polishing (potentially Class B) and irrigation across community / public open space. Cluster systems are typically set up at a precinct scale to treat wastewater from a group of properties within the vicinity of the nominated community / public open space. Initial upfront on-property treatment allows for reduced cluster treatment infrastructure. Cluster system can typically consist of small control shed (filtration and ultraviolet disinfection) and wet weather storage tank.
Central or Cluster Reuse (Irrigation)	Surface irrigation of Class C or B effluent in an agricultural (non-edible) scenario such as fodder or grazing (e.g. Lucerne). Can be operated as hybrid recycled water / land application system or full beneficial reuse with discharge to waterway.
Commercial Reuse / Agricultural Irrigation	Supplemental supply to local Forrest growers for irrigation of hops / non-edible crops or local forestry. Feasibility dependent on market demand for alternative water supply and suitability of available sites.
Water Recycling Plant (WRP)	Facility that utilises a mix of biological, chemical and mechanical processes to treat raw sewage to a standard appropriate for either reuse (e.g. irrigation) or discharge to the environment.
Reticulated Sewerage	Low pressure sewer, pump stations and rising main to existing sewerage network or central Water Recycling Plant.

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1 Introduction

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The Forrest Community do not want inadequate wastewater management practices to impede the growth and liveability of Forrest. Barwon Water are well placed to assist the Community in developing a long-term solution that not only removes this impediment, but captures an opportunity to achieve multiple benefits from the improved management of wastewater.

The project is being undertaken in four stages, namely;

- Project Review, Definition and Justification (Why are we here and where do we want to go?)
- Option Development (Capture ideas and shortlist Solution Packages)
- Solutions Package Assessment (Stakeholder driven triple bottom line assessment)
- Business Case Development and Reporting

Phase 1 of the investigation was completed early 2018 by DWC and details are summarised in Sections 3 to 6. The first phase of the project was focused on evaluating the current wastewater management situation in Forrest and engaging with the community to develop a shared vision of what Barwon Water, Council and the community would like to achieve from the project. Refer to Figure 1 for context. As part of this work we have;

- collated and reviewed existing available data relevant to wastewater management, water quality and human health impacts in Forrest;
- completed a strategic review of local, state and national policies, legislation and planning instruments to ensure the project aligns with the current and future vision for the community, Council, Barwon Water and region;
- participated in a comprehensive community engagement process to obtain genuine input on the nature of the problem and help the community define a shared vision of success for the project;
- undertaken a range of preliminary technical assessments to characterise the existing wastewater situation for Forrest (including use of the outcomes of the Council Septic Tank Audits);

- developed a Business as Usual scenario as a baseline for development and assessment of potential options; and
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These investigations have confirmed that there is a strong need and community desire for improved wastewater management in Forrest. It is clear that a continuation of the Business as Usual wastewater management approach cannot meet regulatory or community expectations. Consequently, this investigation is critical to identify alternative, safe and sustainable long-term wastewater management strategies. The outcomes of the first stage of the project provide a strong basis and direction for the project based on best available information and the community vision for Forrest.

Sections 7 to 11 summarises the outcomes of the second phase of the project which was focused on the development and assessment of a range of options for improved wastewater management in Forrest in consultation with the community. These various options have been refined through a screening process (based on the previously defined vision and measures of success for the project and community feedback on options) and used to create four (4) Solutions Packages. Please refer to Figure 1 for context and project progress. These Solutions Packages have then been 'fleshed out' in sufficient detail to;

- describe and illustrate the main components of each Package to assist in assessment and comparison;
- confirm their preliminary feasibility (proof of concept);
- develop high level sizing and performance requirements for Package components;
- make a detailed and informed estimate of environmental and health protection performance;
- estimate capital, operating and life cycle costs of each Package; and
- identify additional investigations or risks that need to be addressed.

The four Solutions Packages have been assessed utilising a Multi-Criteria Analysis (MCA) based on each of the Measures of Success previously developed from community feedback. These Measures of Success capture a range of environmental, social and economic factors that were considered most important to the community in relation to a wastewater solution for Forrest.

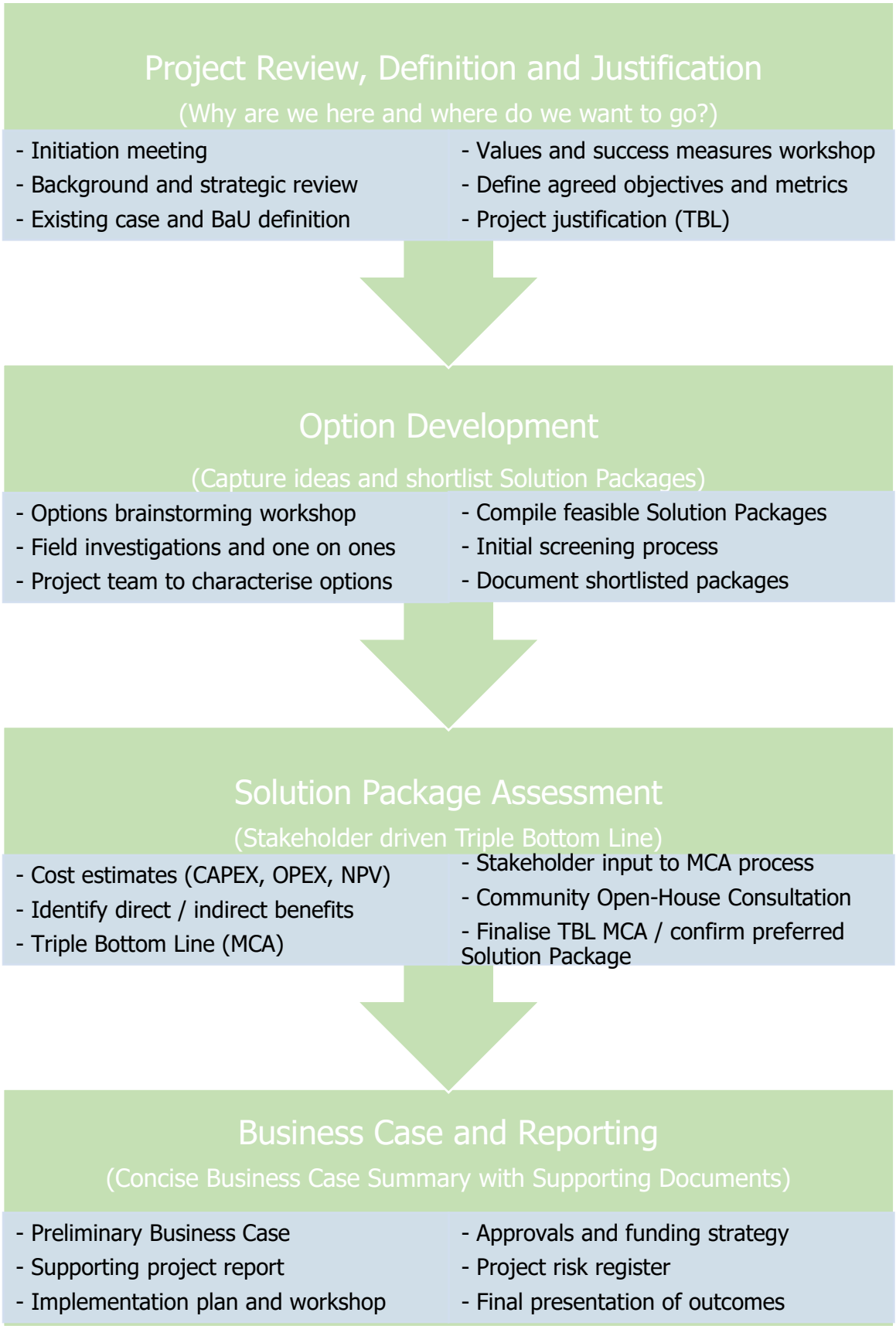

Figure 1 Structure of the Forrest Wastewater Investigation

2 Study Area

Key information about the Forrest Township is provided in Table 1 below with the locality shown in Figure 2.

Table 1 Summary of Study Area

	Details
Township	Forrest
Total No. of Properties	146 - existing lots based on property cadastre (not parcels) within Forrest Township boundary. Excludes a small number of vacant / reserve lots (which currently cannot be developed).
Township Area	80 ha (approx.)
Land Use	Township, Public Park and Recreation, Public Conservation and Re-use, Rural Living, Public Use Zone – Education and Farming
Planning Overlay	Sections of town within Erosion Management Overlay (EMO) and Land Subject to Inundation.
10th% lot size	803 m^2
Median lot size	1,617 m^2
90th% lot size	8,499 m^2
Council Area	Colac Otway Shire
Climate	Average annual rainfall (1,038mm) and evapotranspiration (972mm) with cold winter weather.
Key Issues	Significant tourist influxes, limited public toilet facilities, poorly operating and maintained on-site wastewater systems, limited existing stormwater management infrastructure, poor to moderate soils, poor climate for wastewater management. Complaints from community about odour, high level of off-site discharge of blackwater and greywater to the drainage network and challenge of businesses establishing/expanding due to on-site constraints of containing treated wastewater i.e. inhibits tourism growth.
Structure Plan (Growth Strategy)	Current 2011 Structure Plan identifies strategies for growth in the area and potential rezoning due to tourist influxes (e.g. bike riding) and proximity to Great Ocean Road and national parks. There are also a number of Local and State Government strategies aimed at encouraging tourism growth in the Otways and Great Ocean Road hinterland.

Figure 2: Forrest Township Locality

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3 Vision and Measures of Success

In late 2017, DWC assisted Barwon Water in a number of community engagement activities including a Your Say survey and Community Workshop to help capture their Vision for wastewater management in Forrest. In addition, Barwon Water and the Forrest Wastewater Working Group held other community engagement sessions to help capture information on how important the issue of wastewater management is for the people of Forrest and how they would define a successful project and eventual solution.

The outcomes of the Your Say survey are provided in Appendix A for reference along with the minutes of the Community Vision workshop. Eighty seven (87) responses to the Your Say survey were received which is significant given the population of the town (approximately 200). Respondents placed a high value on the leafy green characteristics of Forrest, the natural landscape and quiet way of life. Over half (53%) of respondents believed there was a significant wastewater problem in Forrest that needed immediate action. The greater majority (79%) of respondents felt wastewater management was an issue for the town that required action. The remaining 21% felt wastewater was not a priority for the town or was not a problem at all.

A Community Visioning workshop was held in Forrest on 12th December 2017. Participants provided significant and valuable input into development of a Vision for the project. They then added ideas on how this vision can be defined and measured during this project and into the future. The following table summarises the Project Vision and measures of success developed following both the Your Say and Visioning Workshop outcomes.

Table 2 Proposed Vision Aspects and Success Measures

Visioning Aspect	How will this be measured?
Proposed Community Vision Statement	***"The Forrest wastewater management solution will be innovative and cost effective, whilst providing protection of public health, environment and the Forrest way of life."***
Ensure protection of human and environmental health	- Reduction in pollution to waterways - Reduction of offsite discharges - Estimated reduction in disease burden
Enhance community and way of life	- Economic impact to Forrest - Increase to Tourism - Change to population / resident make up - Community support for solution
Give full consideration of costs to residents and community	- Up-front costs and life cycle costs - Fair and equitable distribution of costs
Create flexible wastewater options for the future	- Ability to stage/adapt - Ability to cater for residents and visitors (tourism)
Showcase innovation and best practice	- Opportunities for water recycling and energy recovery. - Level of flexibility of options - Showcase / case study potential - Level of water cycle integration

This Vision and the measures of success have been used by the project team to evaluate individual elements of potential wastewater solutions in addition to guide the formation of Solution Packages for Forrest. This ensured DWC maintained options for a wastewater solution that are consistent with the vision of the Forrest community.

4 Define Existing Case

DWC have undertaken a review and analysis of the following information and data so as to characterise the current wastewater management situation within the Forrest township;

- Existing on-site wastewater system audit information obtained from Kernow Environmental in October / November 2017.
- Water quality monitoring data available for the Forrest township (very limited).
- Potable water use based on both the nearby water treatment plant and typical water usage of households to characterise the seasonal effects of tourist influxes.
- Characterised the broader catchment to estimate long-term background loads from stormwater using the MUSIC model.
- Estimate current wastewater derived flows and loads (nutrients and viruses) from existing on-site systems.
- Undertaken a preliminary health risk assessment for the existing case.

4.1 On-site System Audits

Council engaged Kernow Environmental (Kernow) to undertake an audit of on-site wastewater management systems within the Forrest township. The audit was conducted during October and November 2017 and involved assessment of the current treatment system and disposal / land application method, in addition to an overall rating of system performance and hazard to the environment.

DWC undertook a review of the data collected during the audit and classified the wastewater treatment systems into the following categories:

- Primary treatment: Separation of suspended material from wastewater via septic systems or primary settling chambers;
- Secondary treatment: Biological processing (via aeration or sand filtration) of primary treated effluent and further settling of solids;
- Holding Tank: A tank used to hold wastewater prior to pump-out with no on-site wastewater treatment; and
- No formal on-site system: The property did not have a treatment system and was discharging untreated effluent to their property or to the stormwater system.

Additionally, DWC classified the disposal (or land application) method of the audited systems into the following categories:

- Full land application: All wastewater (treated or non-treated) is managed on-site;
- Full off-site discharge: All wastewater (treated or non-treated) is discharged of off-site (usually to the stormwater system); and
- Unknown disposal area: The disposal area could not be located during the inspection.

During the audit inspections undertaken by Kernow, some systems could not be inspected or identified due to a number of reasons such as access restrictions and occupational health and safety issues.

A wide range of wastewater treatment systems are present within the study area. The most common system type was all primary waste systems to full land application followed by primary full off-site discharge systems. There were also a number of properties where it was not possible to confirm the location, type or condition of the on-site system due to access restrictions, safety or due to the lack of any visible sign of a formal system and need for a more detailed (intrusive) inspection.

Table 3 identifies the types of systems identified during the audit and the relative percentage.

Table 3 On-site Wastewater Treatment Systems Identified in the Colac Otway Shire Audit

Wastewater treatment system classification	No. of systems	% of Total
Secondary treatment system to full land application	13	11.4
Secondary treatment system to full off-site discharge	8	7.0
Secondary treatment system to unknown disposal area	2	1.8
Primary treatment system to full land application	30	26.3
Primary treatment system to full off-site discharge	14	12.3
Primary treatment system to partial off-site discharge (split system)	11	9.7
Primary treatment system to unknown disposal area	7	6.1
Holding tank to be pumped out and externally treated	1	0.9
No formal on-site system	9	7.9
Unknown	19	16.7
Total	**114**	**100**

Further to Table 3, a statistical analysis was undertaken on the audit data. The number of occupants within the premises, the risk rating and the setback achievability were assessed and are displayed in Table 4 to Table 6 respectively.

Table 4 Occupant Analysis of Premises Assessed During the Colac Otway Wastewater Treatment System Audit

No. of Occupants	Frequency	% of Total
1	12	10.5
2	11	9.6
3	3	2.6
4	2	1.8
5	3	2.6
6	1	0.9
8	2	1.8
Greater than 8	1	0.9
Unknown	79	69.3
Total	**114**	**100**

Figure 3 provides a breakdown of the observed treatment / discharge methods and any system failures identified during the Colac Otway wastewater treatment system audits. The systems were categorised into primary, secondary and outhouse treatment systems and disposal types were classed as on-site discharge, off-site discharge or partial off-site discharge (pertaining to greywater off-site discharge in split systems).

Where a system or land application area could not be inspected due to safety risks, restricted property access or unknown locality, wastewater treatment systems were categorised as 'unknown'. This category also includes systems which had an unknown treatment type and were identified to be discharging off-site either completely or partially (totalling two systems). Furthermore, sites which were identified to have no on-site treatment system were classified as 'No formal on-site system', while systems with no treatment system and identified off-site discharge were categorised as 'No treatment to off-site discharge'.

Properties identified to have a failing land application area were identified and counted in addition to the wastewater treatment system type, noted in Figure 3 as 'Failing land application area'. This classification also included any properties with an on-site surface discharge pipe or noted land application area subsidence.

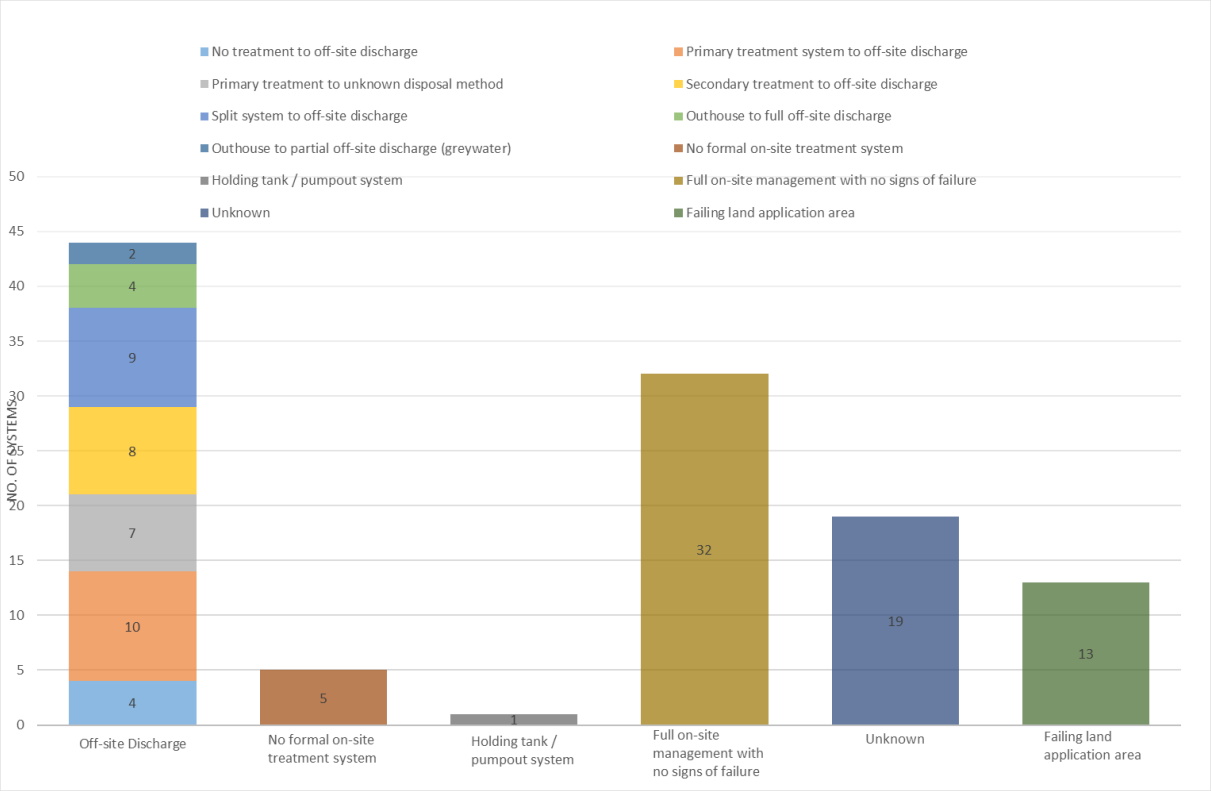

Figure 3 Forrest Wastewater Treatment Systems Identified During the Colac Otway Shire Council Audit

Table 5 Risk Rating of Premises Assessed During the Colac Otway Audit

Risk Rating (Kernow)	Frequency	% of Total
High	41	36.0
Medium	21	18.4
Low	32	28.1
Unknown	20	17.5
Total	**114**	**100**

Table 6 Setback Distance Analysis of Premises Assessed During the Colac Otway Audit

Setback Requirements Met	Frequency	% of Total
Yes	33	28.9
No	48	42.1
Unknown	33	28.9
Total	**114**	**100**

The Kernow system audit identified 41 treatment systems (43%) as being high risk. Approximately 45% - 55% of on-site systems audited (excluding "Unknowns") were identified as discharging either greywater or full sewage loads off site or as having no formal on-site wastewater management system. It is reasonable and most likely conservative to assume the same percentage breakdown of off-site discharge would apply to the Unknown systems. Given a lack of visible system the proportion of off-site discharge within these Unknown systems may actually be higher. In addition, 14% of audited systems displayed signs of Land Application Area (LAA) failure at the time of inspection in the form of boggy, saturated ground, ponded sewage and/or runoff off site. This places the total number of systems that can be considered to be failing and/or impacting on health and the environment at approximately 60% - 70%. Once allowing for the "Unknown" systems, this means only 28% of systems were confirmed to be adequately managing wastewater on-site.

Over 40% of systems also failed to meet recommended setback distances to intermittent or permanent waterways.

Many of the systems audited were over 40-50 years old and can be considered beyond their design life. There were a small number of properties where no formal on-site wastewater management system existed and either blackwater and/or greywater were discharged informally to the ground surface.

There was no significant difference in the condition or performance of commercial on-site systems in comparison with the residential systems. However, seasonal fluctuations in water use have been significant in recent years (see Section 4.2). Data collected during the on-site wastewater management system audit confirms that the majority of systems in Forrest do not have adequate capacity to manage average wastewater flow. Therefore, it is reasonable to assume they would fail significantly under peak season flows (typically 2-5 times the average). The community has raised concerns about the extreme overloading of public facilities at the Caravan Park and other venues during peak tourist season and would likely receive peak loads up to ten times the average.

Based on DWC's analysis of the audit results, and in reference to the EPA *Code of Practice: onsite wastewater management*, it is unclear how the majority of systems audited were identified as Low or Medium Risk. Any system discharging directly into stormwater drains and waterways should be considered High risk. Beyond off-site discharge, the audit results identify a number of the remaining systems to be either very old, undersized, operating poorly or in some cases unapproved.

4.2 Water Use and Wastewater Generation

A statistical analysis of property water consumption data was undertaken to determine the water usage and approximate wastewater generation of individual properties. The wastewater generation was calculated assuming that approximately 75% of domestic property water usage is hydraulically connected to the wastewater system and the remaining volume is used externally (e.g. watering gardens) based on previous monitoring by Yarra Valley Water. For conservatism wastewater was

assumed to be 100% of water usage for commercial and accommodation properties (33 within township based on data available). These values were used for initial information purposes to compare against design wastewater flow values which were adopted as part of system design (discussed in Section 7 and 8).

The statistical analysis was undertaken for annual and daily water usage, displayed in Table 7 and Table 8 respectively.

Table 7 Annual Property Water Use and Wastewater Generation Statistics

Statistics	Water Usage (KL)	Assumed Wastewater Generation (KL)
Average	99.74	75
Median	65.00	49
10th Percentile	4.80	4
25th Percentile	22.75	17
75th Percentile	108.00	81
90th Percentile	177.40	133

Table 8 Daily Property Water Use and Wastewater Generation Statistics

Statistics	Water Usage (L)	Assumed Wastewater Generation (L)
Average	273.26	205
Median	178.08	134
10th Percentile	13.15	10
25th Percentile	62.33	47
75th Percentile	295.88	222
90th Percentile	486.03	365

Water meter data in the above tables suggests a low long-term wastewater generation rate across most properties. However, it is highly likely this is masking a high seasonal variability in occupancy associated with tourism and the use of some properties as temporary accommodation rather than permanent occupancy. Notwithstanding 90th percentile wastewater flows are still significantly below typical values (450 – 600 L/dwelling/day).

Daily data from July 2014 - July 2016 relating to the volume of water delivered to the Water Treatment Plant from the Forrest Reservoir was reviewed to identify seasonal fluctuations. These

data, including the seven day rolling average, average and 75th and 95th percentile statistics are presented below.

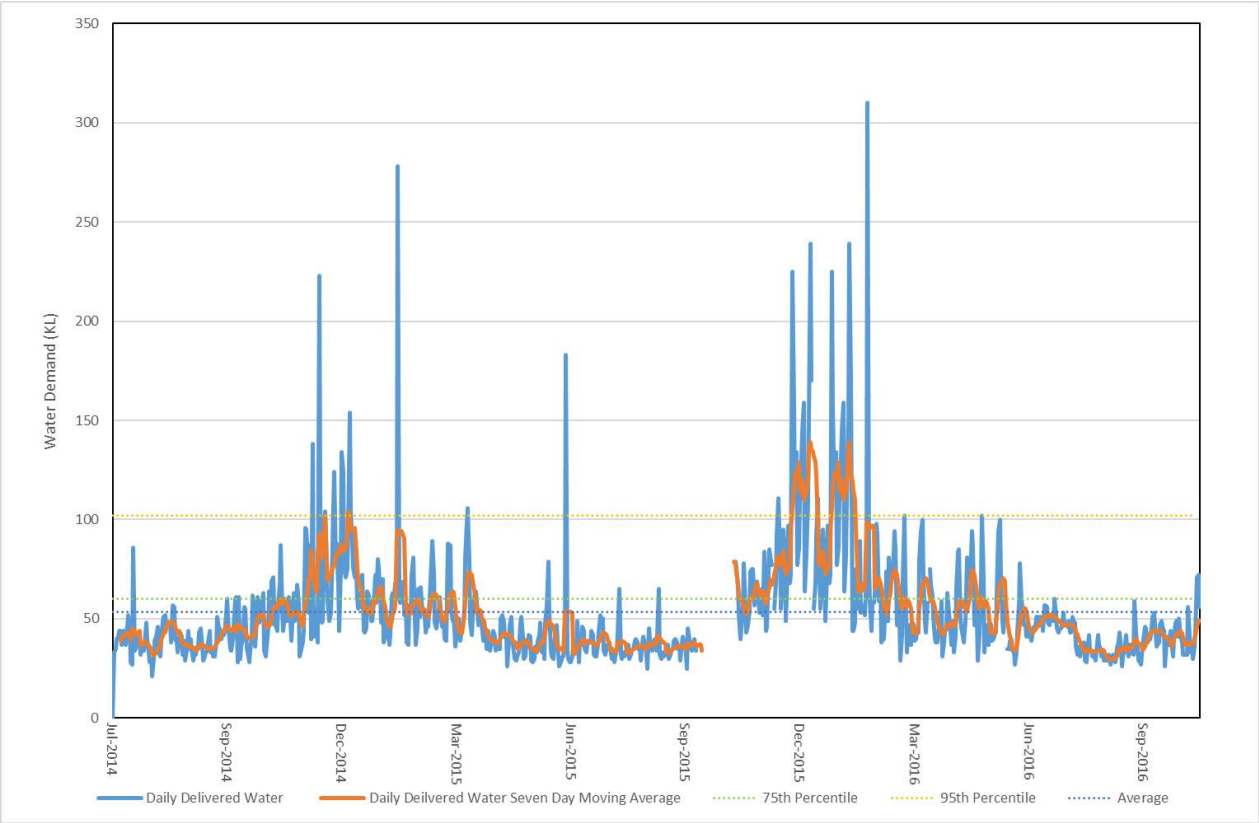

Figure 4 Daily WTP Delivered Water (KL)

Seasonal fluctuations are present within the dataset, whereby spikes in delivered water generally occurred between November and February, indicating that these months are the peak tourism period. A significant spike was also identified in June 2015, with only a minor fluctuations occurring in this month during 2014 and 2016. The seven day rolling average appeared more smooth than the daily dataset, indicating that these peak periods were localised within a short period likely a weekend event.

The statistical data, particularly the 75th and 95th percentiles, indicate that the localised spike events are representative of a significant increase in delivered water due to a large increase in population / water usage. The total delivered water volumes stabilise during winter and likely offer an estimate of typical water use volumes from permanently occupied dwellings in Forrest (approximately 40 kL/day or ~400 L per permanent dwelling per day).

ABS Census data for 2016 identifies 134 dwellings in Forrest (note the statistical area is larger than the study area for this investigation) of which 88-91 were considered permanently occupied at the time of the census. The remaining 43-46 were unoccupied private dwellings which is likely to mean they are used for tourist accommodation (e.g. holiday rentals). ABS Census data also indicates that

occupancy of the permanently occupied dwellings is low with 30% of households containing a single occupant and 75% are occupied by two or less people. When combined with the ~46 unoccupied dwellings (total 114 out of 134) that means 85% of dwellings in Forrest are either low or intermittent occupancy.

4.3 Water Quality / Soil Monitoring

A review was undertaken of water quality monitoring data available for the Forrest township. Data was available from WaterWatch for two sites (refer to Figure 8). However, the West Barwon Reservoir site is located upstream of the township and the site at 7 Bridges Road is a significant distance downstream (and therefore receives flows from various other catchments). In addition, limited data for relevant pollutants was available for the monitoring sites. The Reactive Phosphorus sampling results are presented in the following figures.

The monitoring data indicates that no significant water quality issues are occurring downstream of the study area, however DWC recommended a number of additional sampling sites be established to better understand water quality directly downstream of Forrest. These additional sampling locations are presented in Figure 9 and consist of locations both upstream and downstream of Forrest township. Samples were obtained (where sufficient flow made it possible) fortnightly over a period of six months (April to September 2018). This data is summarised in Table 9 with all sampling data is provided in Appendix H.

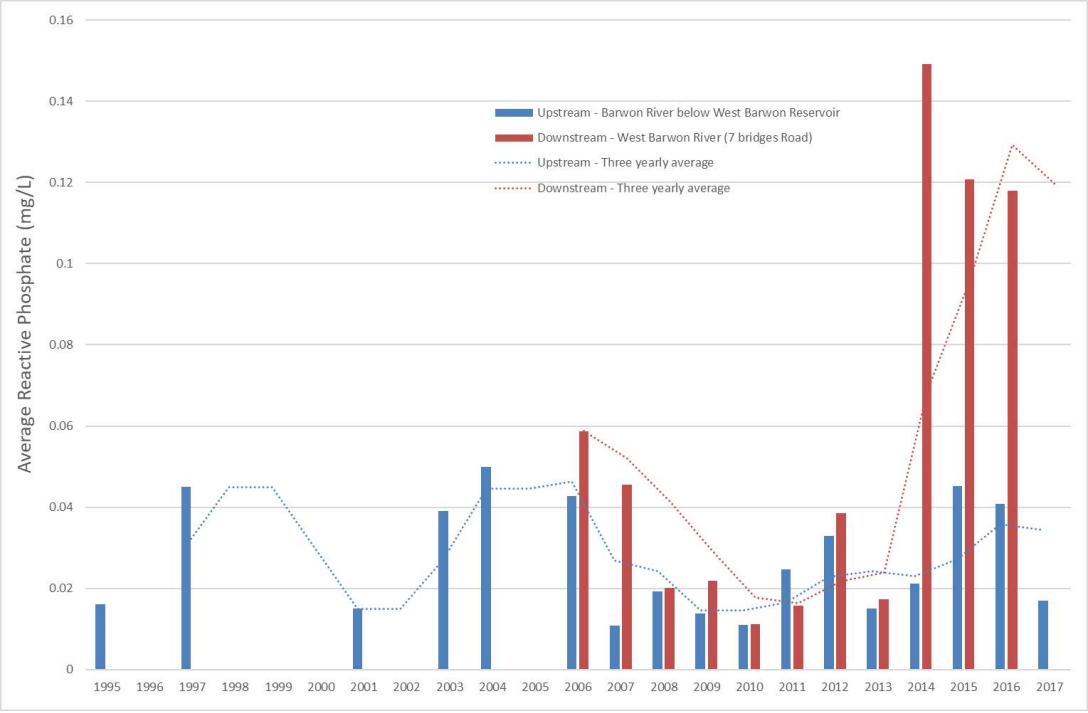

Figure 5 Average Annual Reactive P Sampling Results

There has been a distinct increase in reactive phosphorus concentrations at the downstream monitoring site in the last four years.

Overall, the additional sampling data did not indicate a clear or significant increase in measured parameters that could be attributable to wastewater impacts from Forrest or other sources. In some cases the measured values were actually less from the sample locations downstream of Forrest.

This additional data obtained is sufficient for this stage of the project given that the primary role is to determine if current water quality is clearly compromised (which is currently inconclusive).

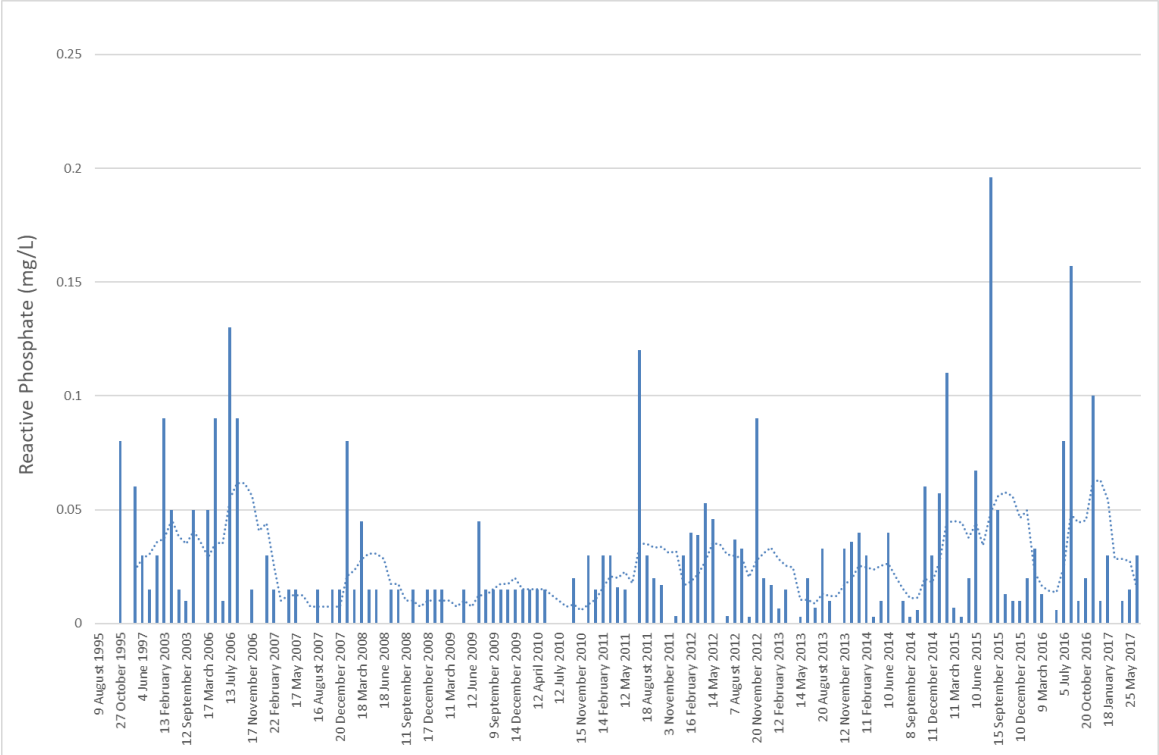

Figure 6 Reactive P Sampling Results - West Barwon Reservoir

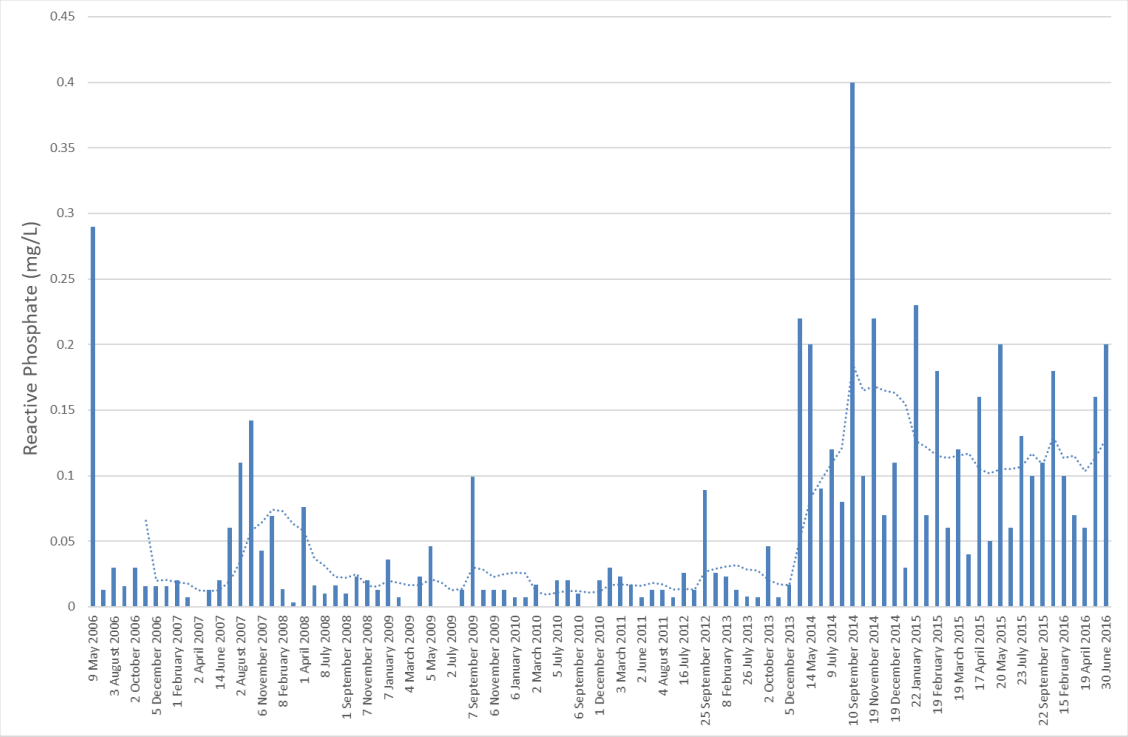

Figure 7 Reactive P Sampling Results – 7 Bridges Road

Table 9 Additional Water Quality Monitoring Data

Parameter	West Barwon River (Upstream) Sample ID. 5688365				West Barwon River (Downstream) Sample ID. 5688366				West Barwon Tributary (Upstream) Sample ID. 5688367				West Barwon Tributary (Downstream) Sample ID. 5688368			
	10%ile	Median	Mean	95%ile	10%ile	Median	Mean	95%ile	10%ile	Median	Mean	95%ile	10%ile	Median	Mean	95%ile
Dissolved Oxygen	6.3	7.6	7.2	8.8	1.0	1.3	2.8	9.0	5.8	9.0	8.2	10.0	6.9	8.0	7.8	8.6
Reactive Phosphorus	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
TP	0.02	0.03	0.04	0.08	0.01	0.03	0.03	0.05	0.02	0.03	0.04	0.09	0.02	0.04	0.04	0.05
TCN	0.90	1.00	1.04	1.48	0.32	0.75	0.69	1.08	0.37	0.75	1.11	2.80	0.70	0.90	0.88	1.15
TKN	0.51	0.90	0.86	1.38	0.32	0.65	0.63	0.95	0.30	0.65	1.05	2.73	0.60	0.70	0.77	1.00
Org N	0.40	0.75	0.76	1.28	0.32	0.65	0.63	0.90	0.27	0.65	1.04	2.73	0.40	0.60	0.67	1.00
Nitrate as N	0.05	0.15	0.19	0.40	0.01	0.02	0.06	0.21	0.01	0.05	0.04	0.06	0.01	0.05	0.08	0.26
Nitrite as N	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.03	0.01	0.01	0.02	0.03
TON	0.06	0.15	0.20	0.41	0.01	0.02	0.06	0.23	0.03	0.05	0.05	0.07	0.04	0.06	0.09	0.26
Enterococci	2	8	61	314	1	6	17	74	0	2	18	81	1	10	19	52

TP = Total Phosphorus; TCN = Total Nitrogen (Calculated); TKN = Total Kjeldahl Nitrogen; Org N = Organic Nitrogen; TON = Total Oxidised Nitrogen

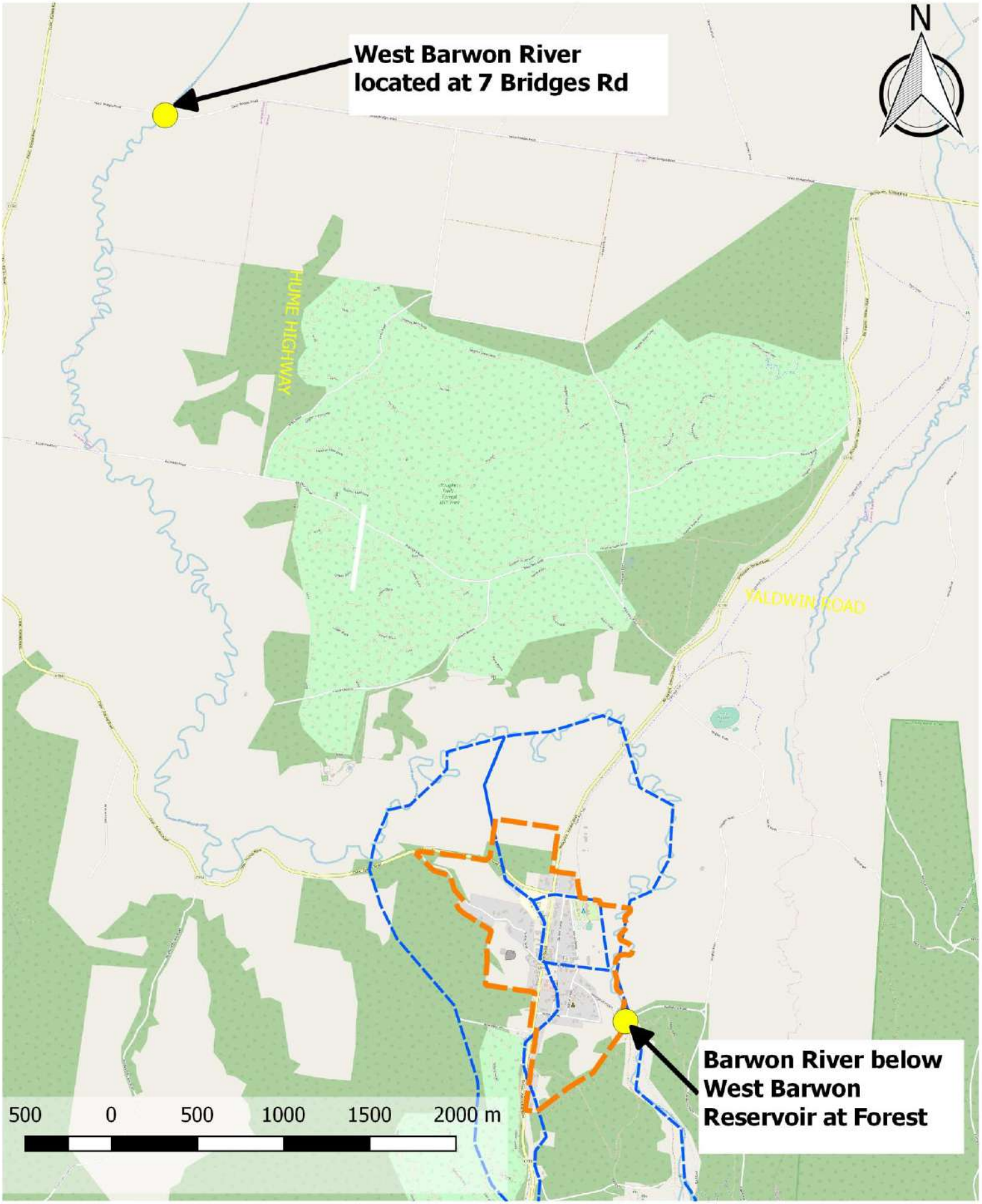

Figure 8: Existing Water Quality Sampling Locations

Legend

- Sampling Location
- Forest Township Location
- Subcatchment

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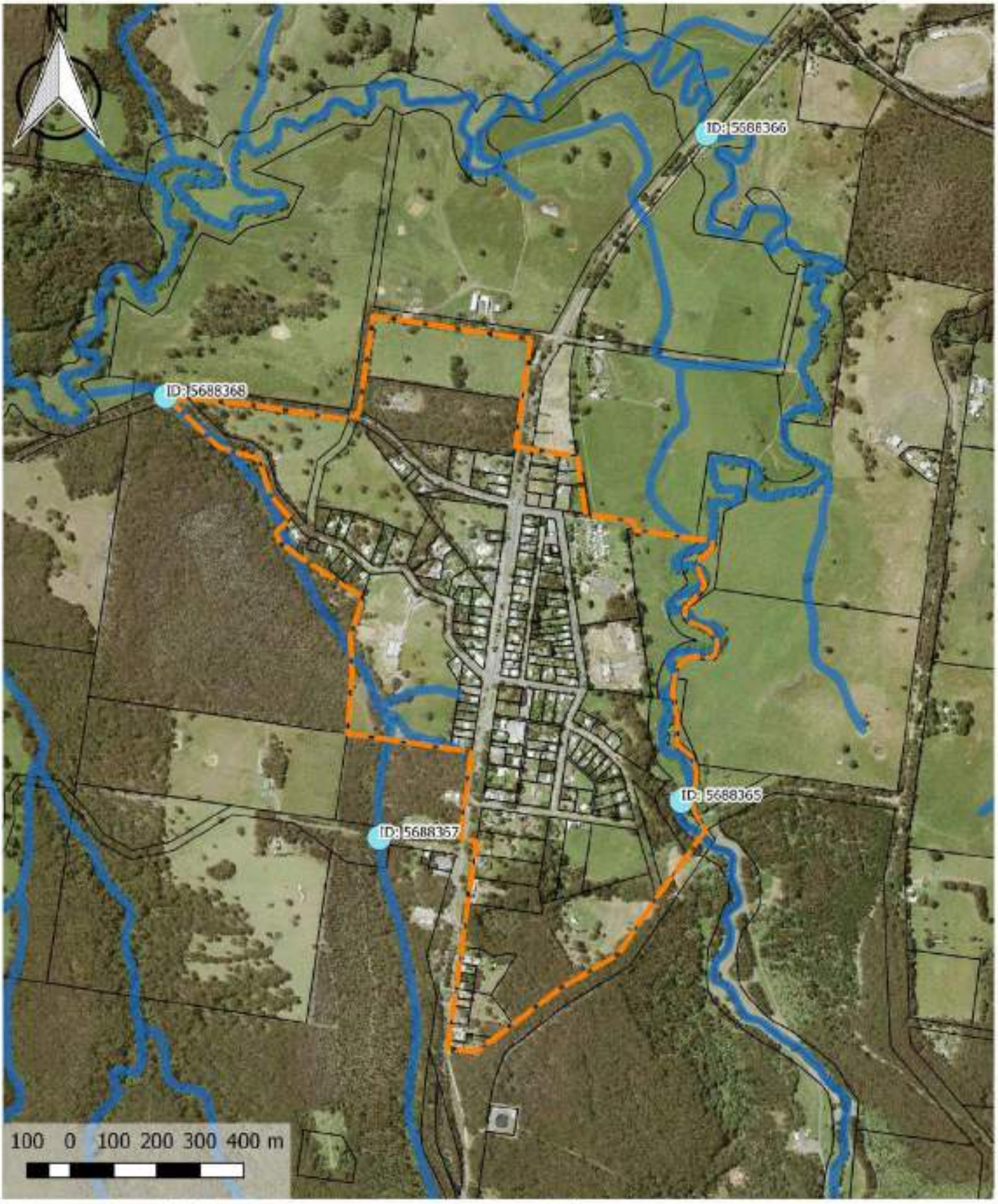

Figure 9: Additional Water Quality Sampling Locations

Legend

- Forrest Township Boundary
- Watercourse
- Additional Barwon Water Quality Sampling Locations

DWC

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4.3.1 Soil sampling

DWC evaluated soil constraints and assigned design parameters based on Victorian EPA guidelines and national best practice. This was supported by field and laboratory soil analysis of reference sites during fieldwork. A total of seven soil profiles were logged with laboratory analysis undertaken for two sampling sites. These sites included the Forrest Primary School and a road reserve along Grant Street. The analysis determined that the capacity to sorb and bind Phosphorus (from effluent) was high to very high. Therefore the ability for the soils across Forrest are highly likely to be able to capture and hold Phosphorus from water reuse (both on-property and off-property) for the design life of the on-site system (50 years). Overall, soils in the study area are moderately to well suited for effluent land application subject to adoption of conservative hydraulic loading rates.

Soil logs and laboratory results are included in Appendix H.

4.4 Background Loads & Flows from Stormwater

Continuous long-term hydrology and water quality analysis was completed for the broader Forrest subcatchments. This was undertaken to estimate the background (i.e. non-wastewater) nutrient loads and stormwater volumes for comparison with wastewater loads from on-site systems. This involved completion of stormwater quantity and quality modelling using Model for Urban Stormwater Improvement Conceptualisation (MUSIC).

Climate input data was sourced from a nearby long-term Bureau of Meteorology (BoM) rainfall station located at Forrest State Forest (Station 090040). Data was available for over 100 years and a daily timeseries was developed for 1950-2017 for the MUSIC modelling. The annual average was similar to the overall annual average (1,084mm compared to long-term 1,034mm). Monthly Average Areal Potential Evapotranspiration (PET) data was obtained from BoM gridded data for the area (1,017mm annual average).

Land use across the Forrest township was categorised into the following;

- Rural / rural-residential
- Road (sealed)
- Forest / Undisturbed

The assumed Effective Impervious Area % (i.e. impervious area directly connected to the stormwater drainage system / measure) was relatively low for the Rural / rural-residential (5%) and road (50%) areas as minimal kerb and guttering and connection of roof area to the road is present.

The previous rainfall-runoff parameters adopted within the MUSIC modelling were calibrated based on the soil landscape data available for the site and soil / groundwater characteristics which define the overall water balance of the site. The parameters adopted are summarised below.

Table 10 Modelling Rainfall-Runoff Parameters

Parameter	Value
Rainfall Threshold (mm/day)	1.0
Soil Storage Capacity (mm)	100
Initial Storage (% of Capacity)	30
Field Capacity (mm)	80
Infiltration Capacity Coefficient – a	210
Infiltration Capacity Exponent – b	2
Initial Depth (mm)	10
Daily Recharge Rate (%)	25
Daily Baseflow Rate (%)	5
Daily Deep Seepage Rate (%)	0

The background stormwater flows and loads derived from the MUSIC modelling for the broader Forrest area are summarised in the table below.

Table 11 Background MUSIC Loads / Flow

Parameter	Annual Average	Average Concentration
Total Catchment Area (ha)	343 (approx.)	-
Flow (ML/yr)	605	-
TSS (kg/yr)	34,900	58 mg/L
TP (kg/yr)	73	0.12 mg/L
TN (kg/yr)	586	0.97 mg/L

4.5 Estimated Wastewater Loads

The Council on-site system audit data and previous modelling investigations by DWC were used to estimate the pollutant loads (nitrogen, phosphorus and pathogens) expected to be discharging to surface or groundwater environments from the existing on-site systems. The existing system audit data was reviewed and systems were categorised based on the existing treatment system and land application / disposal method. DWC has previously undertaken extensive daily wastewater modelling for Yarra Valley Water for deriving wastewater flows / loads for a number of large areas including Park Orchards, Monbulk and North Warrandyte. The Park Orchards modelling included calibration based on site specific information for ~100 lots within the area and is based in a similar soil type to the Forrest township (BMT WBM, 2014 & 2015a). This data was statistically analysed to generate typical wastewater flows / loads for a range of on-site wastewater system types. This data was utilised to develop collective average annual loads for the Forrest township by calculating proportional loads based on the number of different system types present as per the audit data. Site specific modelling for Forrest was completed as part of the Options Assessment phase (refer Section 10.3).

The results of the wastewater loads / flow mass balance are summarised in Table 12 below. Total Phosphorus loads from existing on-site systems are roughly equivalent to the total catchment (~343ha) stormwater loads. In particular the direct off-site discharge systems (either no or partial land application) account for ~45% of total systems and are the key contributor to the overall estimated impacts of septic systems due to the lack of attenuation of pollutants prior to discharge to the environment.

Table 12 Total Wastewater Derived Loads / Flow

Total Flow (ML/yr)	Average Annual Concentration			Average Annual Load		
	TN (mg/L)	TP (mg/L)	Virus (MPN/100mL)	TN (kg)	TP (kg)	Virus (MPN)
7.4	26.5	8.75	245	197	65	1.82×10^{10}

4.6 Total Mass Balance

The figures presented below provide a summary of the proportion of nutrients derived from both stormwater and wastewater sources. This is a common method for allowing comparison of 'background' (stormwater derived loads which typically dominate) and wastewater derived loads. This provides a relative comparison of average loads entering nearby waterways from sources other than wastewater and therefore a relative benchmark. It can be seen that existing onsite wastewater systems are estimated to be a moderate contributor to total nitrogen loads (25%) and a significant contributor to total phosphorus loads (47%). These contributions are strongly influenced by the

proportion of onsite systems currently discharging partially treated effluent and untreated greywater (split systems) directly into stormwater drains.

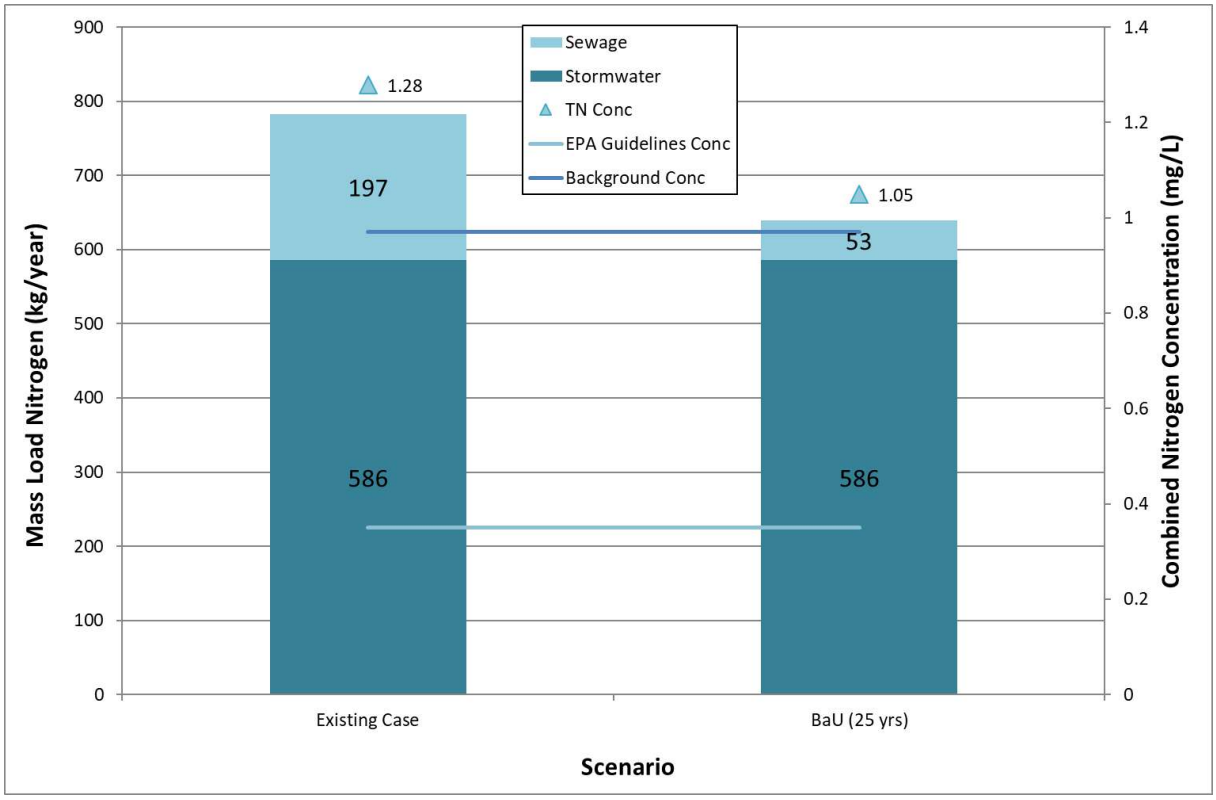

Figure 10 Total Nitrogen Annual Average Export (Stormwater and Wastewater)

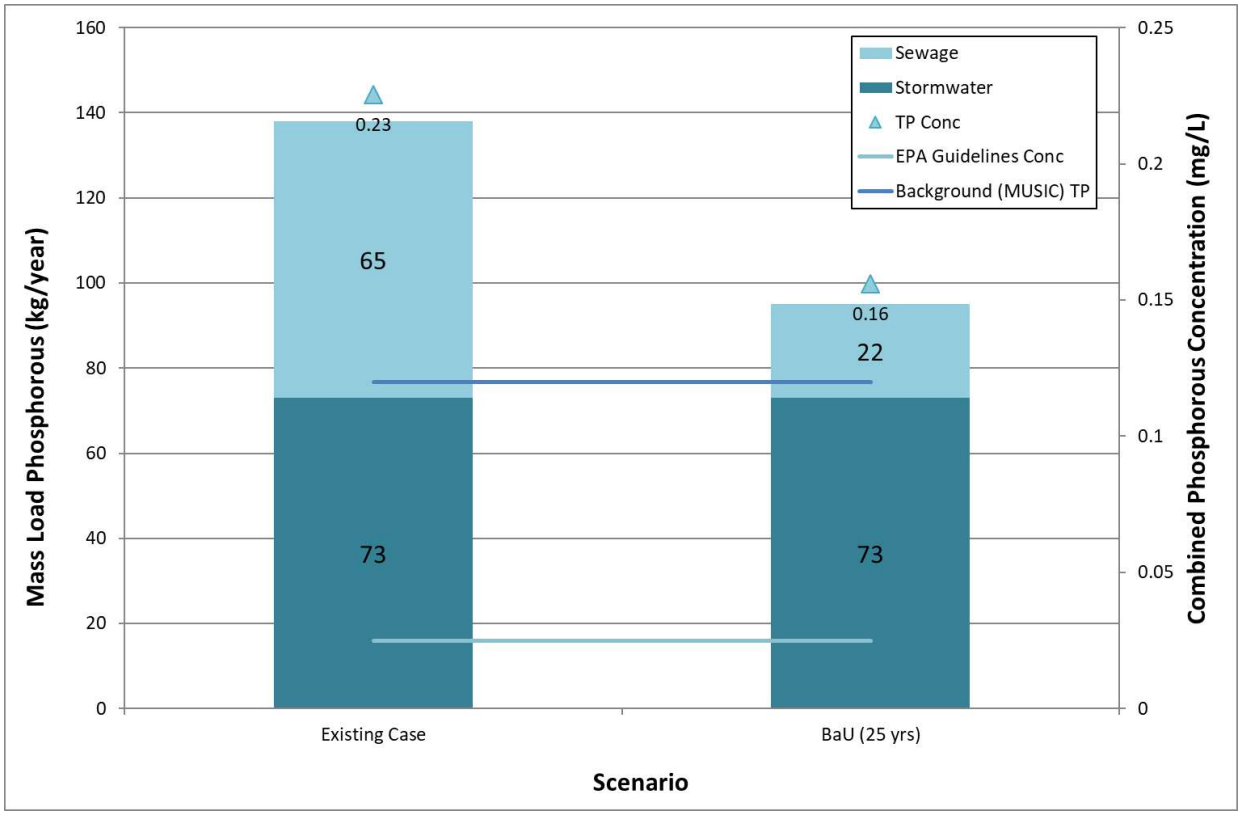

Figure 11 Total Phosphorus Annual Average Export (Stormwater and Wastewater)

4.7 Preliminary Health Risk Assessment

A preliminary microbial risk assessment has been undertaken to enable two outcomes.

- To compare the relative residual health risk associated with the existing and BaU scenarios.
- To evaluate if residual health risks associated with each scenario meet target thresholds for human health protection and disease burden in a population.

The adopted procedure is consistent with the approach recommended in the Australian Drinking Water Guidelines and Australian Guidelines for Water Recycling. Reference can be made to Section 3.2 and 3.3 of this document (EPHC, 2006) for more detail. This approach is also consistent with World Health Organisation (WHO) protocols for assessment of health risks associated with waterborne disease.

It should be noted that this assessment is preliminary in nature and is based on some inputs from published data (in the absence of local data). Where possible, outputs from the dynamic modelling of wastewater systems (for Monbulk based on previous work (BMT WBM, 2015b)) have been used to inform inputs to the risk assessment.

Rotavirus has been adopted for this assessment based on the immediate availability of published values for use as preliminary inputs.

4.7.1 Exposure Pathways

The following potential exposure pathways were examined as part of this assessment.

- Routine exposure to reasonable quantities of ponded sewage from hydraulically surcharging on-site wastewater systems (backyards) under the Do Nothing/BaU scenario.
- Routine exposure to very small quantities via indirect ingestion of secondary effluent under Do Nothing/BaU scenario involving on-lot land application (comparable to backyard garden watering in EPHC, 2006).
- Sporadic exposure to open stormwater drains containing partially or fully treated sewage as a result of existing or continued off-site discharge.

4.7.2 Inputs

The following table summarises the basis for key inputs to the preliminary human health risk assessment.

Table 13 Basis for Inputs to Human Health Risk Assessment

Input	Basis
Virus concentration (MPN/L)	Do Nothing / BaU – virus concentration outputs from previous daily modelling for Monbulk (BMT WBM, 2015b) under a variety of surcharge frequency ranges. EPHC (2006) 95th% typical concentrations in raw sewage with log reductions from EPHC (2006) applied.
Exposure/event (L)	Most conservative of 90th % modelled surcharge volume (Monbulk) or values from Table 3.3 of EPHC (2006).
No. Events/year	Do Nothing backyard exposure: One person/week at each exposure site. Do nothing stormwater: nominal 20 persons/year Backyard irrigation (onsite containment): 90 per household/year
Dose response constants	EPHC (2006) for rotavirus (Cryptosporidium for stormwater)
Ratio of illness/infection	EPHC (2006) for rotavirus (Cryptosporidium for stormwater)
Susceptibility fraction	EPHC (2006) for rotavirus (Cryptosporidium for stormwater)
Disease burden (DALY[1]/case)	EPHC (2006) for rotavirus (Cryptosporidium for stormwater)
Dose equivalent to DALY	EPHC (2006) for rotavirus (Cryptosporidium for stormwater)

DALY – Disability Adjusted Life Year

4.7.3 Outputs

The following figure summarises the total DALYs and DALYs per person per year for each scenario. The total DALYs reflect the total disease burden that can be attributed to wastewater and stormwater management. The WHO and EPHC (2006) require proposed activities to not create a disease burden that is greater than 10^{-6} DALYs/person/year. This threshold has been used as a measure of success for human health protection in addition to achievement of full on-site containment.

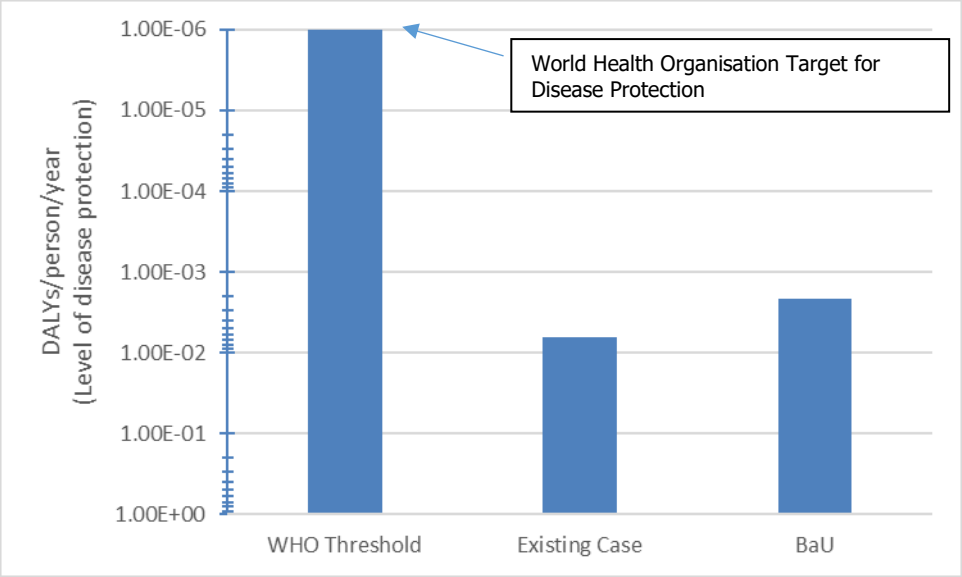

Figure 12 Estimated Level of Disease Protection (Current and Business as Usual)

It can be seen that both the Existing Case and BaU baselines are estimated to only provide half of the minimum recommended level of disease protection according to Australian and global guidelines (WHO/EPHC, 2006). This includes the BaU scenario where it is assumed there is a gradual upgrade of systems by property owners under a BaU scenario (refer to Section 5 for more information).

5 Characterise a Business as Usual (BaU) Scenario

The BaU scenarios was developed in consultation with Council and Barwon Water as the project progressed. The BaU scenario is important as it provides a baseline condition to compare any alternative options against. It is unrealistic to assume that there will be no change in wastewater management practices in Forrest over the next (say) 25 years in the absence of adoption of the preferred wastewater solution that arises from this project. DWC have made the following assumptions.

- Existing, older on-site wastewater management systems are replaced or renewed at an average rate of 4% per annum over the next 25 years through either;
    - voluntary replacement due to old age or failure;
    - a requirement as part of a planning or building permit process; and/or
    - an enforced upgrade due to a compliance issue.
- The total (average) cost of this upgrade is assumed to be $14,000 including approvals with an operational cost of $600 per annum (p.a.) including component replacement, servicing, power use and desludging.

- Existing on-site systems were assumed to cost the average owner approximately $200 p.a. (or $1,000 every 5 years, $2,000 per 10 years etc) to reflect periodic pump out of the septic tank, disposal field repairs, renewal or replacement and in some cases mechanical and electrical maintenance.

It is important to note that this BaU scenario has incorporated the findings of the on-site containment potential mapping documented below in Section 5.1. More than half of the properties in the study area are unlikely to be capable of full on-site containment in accordance with the EPA Code of Practice. As such a BaU scenario would involve continued off-site discharge from approximately 90 properties. The environmental and health protection benefits for a BaU scenario assume on-site containment is maximised with excess effluent treated to a secondary standard with disinfection prior to off-site discharge.

5.1 Onsite Containment Potential

DWC reviewed the previous Domestic Wastewater Management Plan (DWMP) prepared by Whitehead and Associates Environmental Consultants (W&A) in 2015. As part of the DWMP, W&A prepared broad-scale land capability hazard mapping for onsite wastewater management across Forrest. This mapping included the following constraints;

- Climate
- Useable land (for effluent management based on appropriate setbacks recommended in EPA CoP)
- Current Planning Scheme Zoning Minimum Lot Size Compliance
- Slope
- Soil

The W&A mapping identified that the majority (~92%) of the properties within Forrest township were classed with 'Moderate' land capability constraints for onsite effluent management. This mapping was broad scale in nature and did not account for existing development on each site in addition to other factors. Consequently, a more detailed on-site containment assessment has been undertaken as part of this investigation.

DWC have previously developed a risk based Framework for classifying properties based on their ability to contain wastewater on-site. A summary of the containment classification approach based on this Framework is summarised in Table 14

In order to characterise the existing BaU and determine potential upgrade solutions for existing on-site wastewater management systems, DWC undertook an initial analysis of ability for individual properties to contain all wastewater on-site in accordance with the EPA CoP. This analysis was refined as the project progressed and included aerial and fieldwork inspections of properties across Forrest.

Following this a general risk based analysis has been undertaken of key hazards present to sustainable on-site containment (CoS). Due to the small lot size (and consequently limited available area for effluent management) this was one of the key constraints to sustainable on-site effluent management. Under the current Victorian Planning Provisions (based on Low Density Residential zoning) the minimum lot size for long-term sustainable on-site wastewater management is 4,000m^2. This is in comparison to lot sizes ranging from 350m^2 to 2,500 m^2 in the town zone of Forrest.

The BaU scenario does not assume full compliance with the EPA CoP. It is reflective of typical practice in Victoria and nationally, whereby on-site containment is maximised, effluent quality is improved with the overall objective of minimising human health and environmental impact. This is the recommended approach from 2.3.5 and 2.3.6 of the EPA CoP for existing small lots and existing off-site discharges. Furthermore, properties identified as High Risk CoS assume wastewater can be fully contained subject to a high level of design, construction and operational oversight despite the fact that many of these sites do not meet EPA CoP requirements.

Table 14 CoS Mapping Classification

Classification	Contain On-site?	EPA CoP?	Derivation	Description
CoS Low Risk	Yes	Yes	Lot size ≥4,000m^2 and no sensitive receiving environments present.	Few/minor constraints to on-site wastewater management and low risk receiving environment.
CoS Medium Risk			Lot size >2,500m^2 and <4,000m^2 and/or in close proximity to sensitive receiving environments (e.g. watercourse).	Individual and/or cumulative hazards slightly elevate the likelihood and/or consequence of on-site system failure.
CoS High Risk			Lot size <2,500m^2 and/or in close proximity to sensitive receiving environments (e.g. watercourse).	Individual and/or cumulative hazards significantly elevate the likelihood and/or consequence of on-site system failure. Best practice design, construction, maintenance and oversight essential to manage risk and meet regulatory objectives for health and ecosystem protection.
Partial CoS	Exceptional circumstances	No	Available area < required to CoS but > 100m^2.	Insufficient suitable land available for CoS strictly in accordance with EPA CoP. Full CoS may be possible subject to advanced engineering and oversight where the provision of an off-site solution is cost prohibitive. However, either a full or partial off-lot solution will be required on most of these properties to meet the objectives of the SEPP (Waters).
Non CoS	No		Available area < 100m^2.	Effectively no suitable land available for CoS. Full off-site solution is essential to meet the objectives of the SEPP.

The overall results of this on-site containment assessment are summarised in Table 15 and Figure 13 below and are based on **the properties** (and not the existing systems). It can be seen that the majority of properties (64%) are not capable of installing a system that is compliant with current EPA CoP requirements and would be unlikely to be able to fully contain on-site. This is predominately due to the very small lot size across the central area of the township. In addition, approximately 16% of properties could potentially fully contain on-site but would require a higher cost system with additional oversight and management to ensure they are performing as required. This means only 20% of properties are considered readily capable (Low/Medium Risk) of on-site containment using more traditional on-site wastewater management technologies and practices.

Table 15 Onsite Containment Statistics

Long-term On-site Containment	No. of Lots (%)
Non to Partial but not full on-site containment possible	95 (64%)
Full on-site containment possible at higher cost	23 (16%)
Full on-site containment possible	30 (20%)

This map represents the *long-term sustainability* of on-site wastewater management for each property. It assumes each lot is eventually upgraded to meet the current Victorian and Australian Standards. Where this isn't possible (primarily due to property size), the system would need to be provided with some form of off-site service (such as sewerage) or upgraded to the best practicable option that seeks to minimise off-site discharge of effluent and pollutants (EPA CoP, 2016). What this map is illustrating is that for the majority of lots in Forrest, the upgrade of existing on-site systems is highly unlikely to meet current regulatory requirements regardless of the level of investment and oversight.

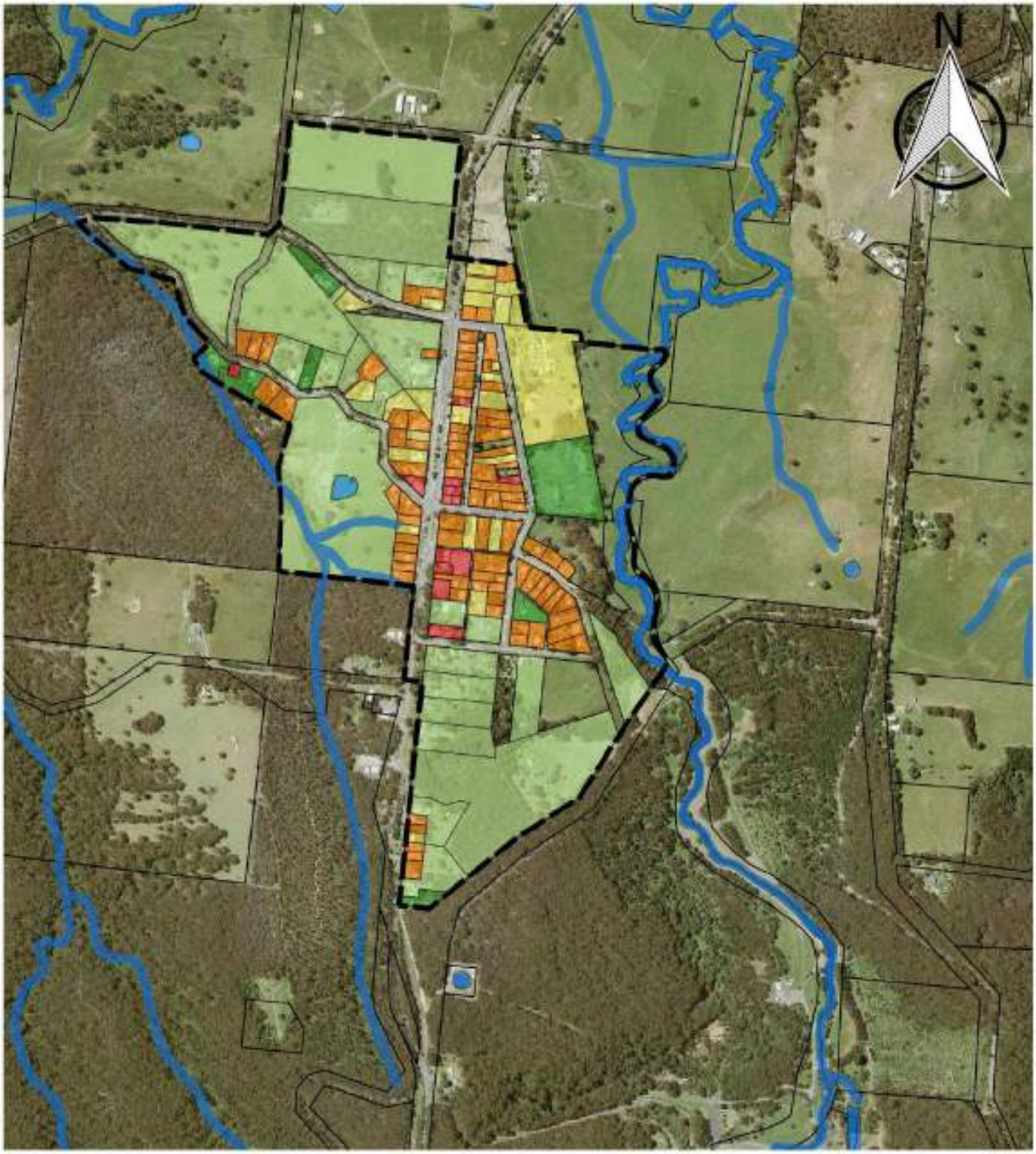

Figure 13: Forrest On-site Containment Map

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5.2 Snapshot Triple Bottom Line (TBL) Assessment

Full characterisation of the BaU scenario was completed as part of the Options Assessment process (Section 10). A 'snapshot' TBL assessment was undertaken to assist with project justification in January 2018 and is provided in Table 16 for completeness. It shows the following.

- A BaU scenario will still require a $10k-$20k investment per property through inevitable, gradual upgrade and replacement of existing on-site systems.
- Estimated (modelled) environmental outcomes are not insignificant. However, they still fail to meet the objectives of the SEPP (Waters of Victoria) or the EPA CoP.
- Without some form of off-site solution (such as sewerage or local cluster wastewater management), a residual off-site discharge will remain. Associated with this is an amenity, odour and health risk.
- A preliminary health risk assessment indicates the residual disease burden would remain elevated above acceptable standards.
- A BaU scenario would effectively cap an increase in permanent and temporary visitors to much of the town due to constraints to wastewater management.

Table 16 Snapshot Triple Bottom Line (TBL) Assessment of the Existing and BaU Wastewater Management Situation: Forrest

Visioning Aspect	How will this be measured?	Evaluation of BaU[1]
Ensure protection of human and environmental health[1]	- Reduction in pollution to waterways - Reduction of offsite discharges - Estimated reduction in disease burden	- 73%/66% reduction in TN/TP respectively. Improved but not compliant with SEPP. - Some off-site discharge must continue: ~65% reduction in off-site discharge volumes and 80% reduction in pollutant loads - Minor reduction but still fails to meet Australian and WHO standards
Enhance community and way of life[1]	- Economic impact to Forrest - Increase to Tourism - Change to population / resident make up - Community support for solution	- Whole life cost ~$20k/lot in 2018 dollars (Net Present Value – 50 year) - Restricts any tourism increase in Forrest due to inadequate facilities - Limits potential for town renewal. Population likely to decline. - Community feedback to date not supportive – recognise problem
Give full consideration of costs to residents and community[1]	- Up-front costs and life cycle costs - Fair and equitable distribution of costs	- Whole life cost ~$20k/lot in 2018 dollars (Net Present Value 50 year) - Likely to be lowest up front and operational cost option (not necessarily best value for money). - Costs borne by each individual owner as upgrade of their existing system takes place.
Create flexible wastewater options for the future	- Ability to stage/adapt - Ability to cater for residents and visitors (tourism)	- Can be staged readily and adapted (property by property). - Options constrained on the smaller properties. - Very little capacity to cater for visitors or residents (growth limits).
Showcase innovation and best practice	- Opportunities for water recycling and energy recovery. - Level of flexibility of options - Showcase / case study potential - Level of water cycle integration	- None (ad hoc may be possible on individual properties). - Most lots are limited in flexibility due to small lot size. - Limited to none (effectively non-compliant). - Limited to none.

Note: This assumes consistent operation and maintenance of on-site systems in accordance with EPA and Council requirements over 25 years.

6 Outcomes of Project Justification

The Forrest Community want the Forrest wastewater management solution to be innovative and cost effective, whilst providing protection of public health, environment and the Forrest way of life. A set of success measures have been developed and accepted by the Community that have then been used to evaluate the existing wastewater management situation and potential future options.

DWC have documented the current understanding of the existing wastewater management situation in Forrest. It can be seen that existing on-site wastewater management systems are typically older systems in a highly variable operational state. The prevalence off systems that discharge off-site to local drains and waterways is high and consequently, preliminary modelling suggest wastewater is a moderate to high contributor of nutrients to local waterways. Preliminary health risk assessment confirm that the observed level of off-site discharge should be considered an unacceptable risk to human health. That said, evidence is not currently available to confirm that those risks have translated into associated illnesses in the township.

DWC have also examined a Business as Usual (BaU) under which improvements to wastewater management would be incremental and largely driven by voluntary upgrades on a property by property basis over an extended period (e.g. 25 years). There are a number of properties in Forrest that are too small to enable full on-site containment to be achieved even where an upgrade to best practice occurs. An evaluation of the BaU scenario against the measures of success for the project indicate that benefits would be limited and there are a number of success measures that could not be met or achieved without some form of off-site wastewater management solution.

In light of the outcomes of this work (including that of Barwon Water, Council and the Community), DWC consider this wastewater options investigation to be critical to the future of Forrest. There are a number of strong drivers for a co-ordinated, sustainable and adaptable wastewater solution for the town and there are an even greater number of risks associated with retaining a BaU approach.

7 Compiling Potential Servicing Options

Following the project definition and justification (Phase 1), DWC worked in consultation with Barwon Water, Colac Otway Shire Council and the Community to develop a range of initial potential servicing options and elements for Forrest.

The various options / elements considered;

- the scale of application (e.g. on-property, street, cluster or whole of town);
- the type of servicing element (e.g. collection, treatment, reuse, management, regulation); and
- water cycle element / source (wastewater, in additional to stormwater, water supply and discharge to waterways).

These initial options / elements were developed with the vision and measures of success in mind. The success measures were previously developed in consultation with the community to ensure any option taken forward aligned with the long-term values and plans for the town. The range of potential options / elements were then taken forward for initial feedback from the community (discussed Section 8.1). The key options presented to the community are detailed in Appendix B.

As discussed previously, the Vision and the measures of success outlined in Section 3 were used to guide the formation of Solution Packages and were subsequently used to evaluate individual elements of potential wastewater solutions. This ensured DWC maintained options for a wastewater solution that were consistent with the vision of the Forrest community.

7.1 Option Design Basis & Assumptions

A summary of the overall design basis for the option development is presented in the table below.

Table 17 Design Basis Summary

Component	Details
On-property wastewater generation / on-site system design flow	Water use data utilised in conjunction with inspection and interview data for characterising site specific commercial / tourist accommodation wastewater generation. Assumption of ultimate development at an average four bedrooms per equivalent dwelling taken forward to capture long-term wastewater generation and land application / effluent irrigation sizing. On-site effluent land application based on EPA CoP (2016) and MAV (2014) Land Capability Assessment (LCA) Framework.
On-site System Audit Data	Council previously engaged Kernow Environmental to undertake an audit of on-site wastewater management systems within Forrest township. This data was utilised to evaluate the condition / operation of existing systems and help in the development of Solution Packages. Further details of the audits are provided in Section 4.1.
On-property Containment Potential	GIS analysis undertaken of useable land for effluent management across the township. Refer to Section 5.1 for further details. Adopts an LCA approach to assessing the capacity of managing (or containing) wastewater on-site.
Cost Estimates	Cost estimates consist of total Capital Delivery Costs and whole of life cycle costs (50 year Net Present Value) developed for option comparison and assessment. Estimates have been derived from the best available data on Barwon Water sewerage infrastructure projects in addition to both on-site wastewater and integrated water management projects from Victoria (as a priority) and Australia. Further detail can be found in Appendix G. This includes costs for asset renewal and on property power consumption.
Soil	Data sourced from Victorian Resources Online and Colac Otway Online Mapping. Soils consist of poorly drained, duplex (Sodosol) soils within the township with moderate to poorly drained, gradational alluvial soils toward the main watercourses. DWC have significant experience in both on-site wastewater and effluent irrigation assessment and design. DWC have evaluated soil constraints and assigned design parameters based on Victorian EPA guidelines and national best practice. Supported by field and laboratory soil analysis of reference sites during field visit.
Climate	Interpolated rainfall, pan evaporation, temperature, humidity and solar radiation sourced from SILO Data Drill. Rainfall / evapotranspiration data also sourced from Bureau of Meteorology (BoM).
Effluent Quality Standards	Developed based on EPA Victoria (2003) *Use of Reclaimed Water Guidelines* along with EPHC (2006) *Australian Guidelines for Water Recycling* (National Guideline).
Sustainable Irrigation / Land Application Design	MEDLI utilised to test sustainable land application within Forrest based on climatic / soil data within the region. A conservative Design Loading Rate (DLR) of 1.8mm/day was taken forward for on-site containment for modelling and design – allows for medium / heavy clay subsoil and ensures that horizontal wastewater movement through the topsoil (and potential breakout) is minimised. Effluent irrigation (reuse) elements were designed based on a deficit irrigation approach with winter storage in addition to a hybrid beneficial reuse / land treatment approach.
Stormwater Management / Design	MUSIC utilised for long-term hydrological / water quality modelling and stormwater design. Pluviograph rainfall data (6 minute timestep) not available near Forrest with similar climatic conditions – pluviograph rainfall data from alternative site (Upwey) utilised which matched long-term monthly / daily data statistics (Forrest State Forest station). Refer to Section 4.3.1 for details of existing case characterisation.

8 Summary of Solution Packages

8.1 Initial Shortlisting Process

A community information session / workshop was undertaken in April 2018 to seek feedback from the community on the range of potential servicing ideas and options for Forrest that were initially developed by DWC and Barwon Water. Additional ideas and opportunities were also put forward by the Community. Feedback from this session was then utilised to shortlist a number of distinct options and Solution Packages for the community which would be carried forward for assessment. The intention of the Solution Packages was to effectively group the wide range of options / elements (servicing scale / type, water cycle component, etc.) into viable servicing approaches which could be meaningfully compared. The Packages aim to capture the distinct range of community opinions, ranging from a 'flush and forget' preference (conventional sewerage) through to interest in smaller footprint, more sustainable and local solutions.

All Solution Packages include provision for additional public toilets with improved facilities that can cope with additional tourist loads as per the Measures of Success.

All Packages also assume a single accountable authority will manage and maintain the upgraded systems. This includes all on-site treatment and irrigation components.

Details of funding sources will be explored and better defined during business case development.

Long-term growth has been considered as part of the Packages (as per the Measures of Success) to provide enhanced potential for tourism and businesses to start up or expand. All packages assume growth is in accordance with that identified in the Forrest Structure Plan (2011).

The most recent strategic land use plan for Forrest by Council has identified the potential for approximately 90 new residential lots to be developed. Approximately 65 of these would be from new subdivisions, which currently are 'locked up' and are dependent on a managed wastewater service. Allowance has been made for connection of these additional properties to the Forrest wastewater solution as development occurs.

Previous data from a nearby sewered town (Birregurra) suggests that an improved wastewater management service resulted in an increase in new dwellings from ~2 per year to ~6 per year on average. Wastewater solutions for Forrest have been developed based on enabling development to rise back to the predicted growth in the Structure Plan (developed ~8 years ago) of 2-4 new dwellings per year. Forrest has only seen ~1 new dwelling per year with the growth rate dropping since 2011.

Colac Otway Shire Council have also recently provided an updated assessment of potential new land supply within the study area which includes existing vacant lots. This revised estimate increased land supply from the 50 potential lots to 89. This revised land supply has been used to incorporate growth allowances into all wastewater Solution Packages. This land supply information provided by COS Council is provided in Appendix I.

The following table summarises the growth assumptions and allowances incorporated into all Solution Packages. Also provided is a comparison against historical Census data, Forrest Structure Plan assumptions and Victorian Government growth predictions.

Table 18 Comparison of Growth Assumptions for Forrest Wastewater Investigation

Source	Assumptions / Basis	20 Year Growth Allowance
ABS Census (2016)	Long-term population growth rate for Forrest (80 people from 1996 – 2016).	80 persons at 4 persons/year (30-40 equivalent dwellings).
	Recent growth rate for Forrest (62 people from 2006 – 2016).	124 persons at 6.2 persons/year (50-60 equivalent dwellings).
Forrest Structure Plan (2011)	Target of 3.5 new dwellings/year at 2 (current) to 2.6 (Victorian Average) persons/dwelling (ABS Census, 2016).	154 persons at 7.7 persons/year (60-77 equivalent dwellings).
Victoria in Future (2016)	Estimated Resident Population for Colac-Otway Shire 2019 – 2031. Estimated to be a 0.086% reduction (effectively no change).	No growth.
Forrest Wastewater Investigation	Total build out of COS best estimate of land supply (89 lots). Design assumes average occupancy of existing households increases from 2 to 2.8-3 persons per lot.	360-380 persons at 18-19 persons/year (89-146 equivalent dwellings).

Table 19 Lot, Dwelling and Growth Summary

	Current	20 Year Growth Allowance	Total based on 2011 Structure Plan	Total (assumed for this Project)
No. of Lots	146	65	211	211
No. of Dwellings	122	89	211	211
Population	230[1]	154	384	590-610

1. Current population based on broader Forrest statistical area from ABS 2016 Census.

It can be seen that a significant capacity for growth has been allowed for in the Solutions. It should be noted that the adopted growth allowance was more accurately based on 30 year growth. In light of recent dwelling approvals (1 per year) and population growth, the allowance made is considered to provide adequate buffer for tourist based growth in addition to new residential growth.

The Solution Packages were provided to Barwon Water in June 2018 and are outlined in the following sections and presented in Figure 15 to Figure 19.

8.1.1 Community Feedback

The key feedback comments / themes from the community session are summarised in table below and full details of community feedback is provided in Appendix C.

Table 20 Summary of Key Community Comments

Comment	Discussion / Incorporation into Options
Preference for reticulated sewerage	This has been taken forward as a potential option (Solution Package 4). The focus has been on pressure sewer as initial assessment of gravity sewer has indicated it would involve greater overall costs due to variable topography and ability to achieve gravity fall on lots. Pressure sewer is also more innovative (e.g. smart controllers) and is typically less disruptive during installation. SP4 assumes potential installation of a local Water Recycling Plant as transfer to the existing Birregurra WRP is 27-28 km away and cost prohibitive (this option would also involve additional upgrades of the existing WRP to cater for the additional flows). Some community members did express a preference for not pushing the treatment / management to somewhere outside Forrest ('don't push the problem out of town').
Provide value for money Improve existing poor stormwater infrastructure.	Due to the potential cost implications for the community, Solution Package 1 was developed as a potential lower cost option in which significant improvement to the current Business as Usual would be achieved, however some offsite discharge (greywater only) to stormwater would still occur (not strictly compliant with current regulations for new or upgraded systems). This option would involve upgrades to both septic systems and stormwater and therefore provides dual benefits of providing an improved wastewater and stormwater service to the community whilst trying to ensure costs are manageable.
Cater for growth / tourist influxes	Growth has been factored into design assumptions for all Solution Packages and details for each are provided in Table 23 to Table 26.
Management of 'septic' on-site systems	A number of concerns were raised about the continued owner management of septic systems. The assumption for all Solution Packages is that all system components are managed by an independent competent and accountable authority. This includes on-site systems and other on property infrastructure.
Use of treated water on-property for garden watering, lawn, etc.	Community members were amenable to the idea of using treated water from watering on their property provided the system was operating correctly. On-property access to treated water for irrigation has been included as part of Solution Packages 1, 2 and 3.
Use of treated water for local Community / Public Open Space – don't move the problem out of town.	In addition, some community members were also supportive of the idea of utilising treated water for irrigation of local community areas / public open spaces. This has been included as part of Solutions Package 1 and 2. The current potential reuse sites have been selected based on available land and proximity to town.
Climate and soils are not suitable for effluent application.	The design and modelling has been based on a conservative application rate of wastewater both on- and off-property to account for these constraints and is consistent or beyond Victorian and National Codes and Standards. Any excess wastewater not able to be sustainably managed on a property will be directed to an off-site irrigation area.
Opportunities for innovation	Solution Package 1 aims to provide a compromise between utilising existing systems whilst providing both an upgraded wastewater and stormwater service for Forrest. Biofilters for greywater treatment along with bioretention basins / wetlands for stormwater treatment have been included within this solution to provide an Integrated Water Management approach. Solution Package 2 and 3 provide opportunities for reuse of treated water both on-property (e.g. garden watering), within community / public open space or commercial reuse. The use of upgraded on-site systems can include additional elements such as remote monitoring (telemetry, sensors, etc.) which is an innovative means of checking and controlling system performance remotely. This also provides flexibility to stage upgrades based on actual town growth and balance flows during tourist seasons. Other innovative options including waste to energy and nutrient recovery are to be considered during the option assessment stage.

Table 21 Community Preference for Options / Elements

Option	Comfortable	Uncomfortable	Undecided
Pressure sewer	16	9	1
Gravity sewer	14	9	1
Upgrade of on-site systems (Partial Containment) - Cluster / Whole of Town Reuse	13	10	-
Upgrade of on-site systems (Full Containment)	10	12	-
Septic Tank Effluent Pump (STEP) / Septic Tank Effluent Gravity (STEG)	9	11	-
Business as Usual (continue with existing situation)	1	18	-

8.1.2 Initial Investigation of Potential Reuse Sites

DWC undertook an initial investigation of sites surrounding Forrest which had the potential to be utilised for water recycling / reuse as part of a community system. The suggestions provided by the community were referred to for site selection and were refined based on a number of initial screening parameters for useable (irrigable) land within the property;

- Sufficient useable area to ensure management of all estimated wastewater loads (for either cluster or whole of town system);
- Slope <15% to ensure run-off / downslope movement of irrigated water is minimised;
- Floodprone area avoided (Subject to Inundation overlay);
- Low to moderate susceptibility to landslide as per Council's online mapping;
- Minimum setbacks (as required for use of reclaimed water and a WRP) able to be achieved for any watercourses present and residential properties; and
- Within approximately 2 kilometres of town to ensure water is being 'locally' managed (as per community feedback). This was extended to 5 kilometres to capture potential commercial reuse sites mentioned in community feedback.

The initial sites identified following this general screening process are presented in Figure 14 below. Please note the sites are **indicative only** and no consultation / discussions with the owners of these sites has been undertaken during the selection process.

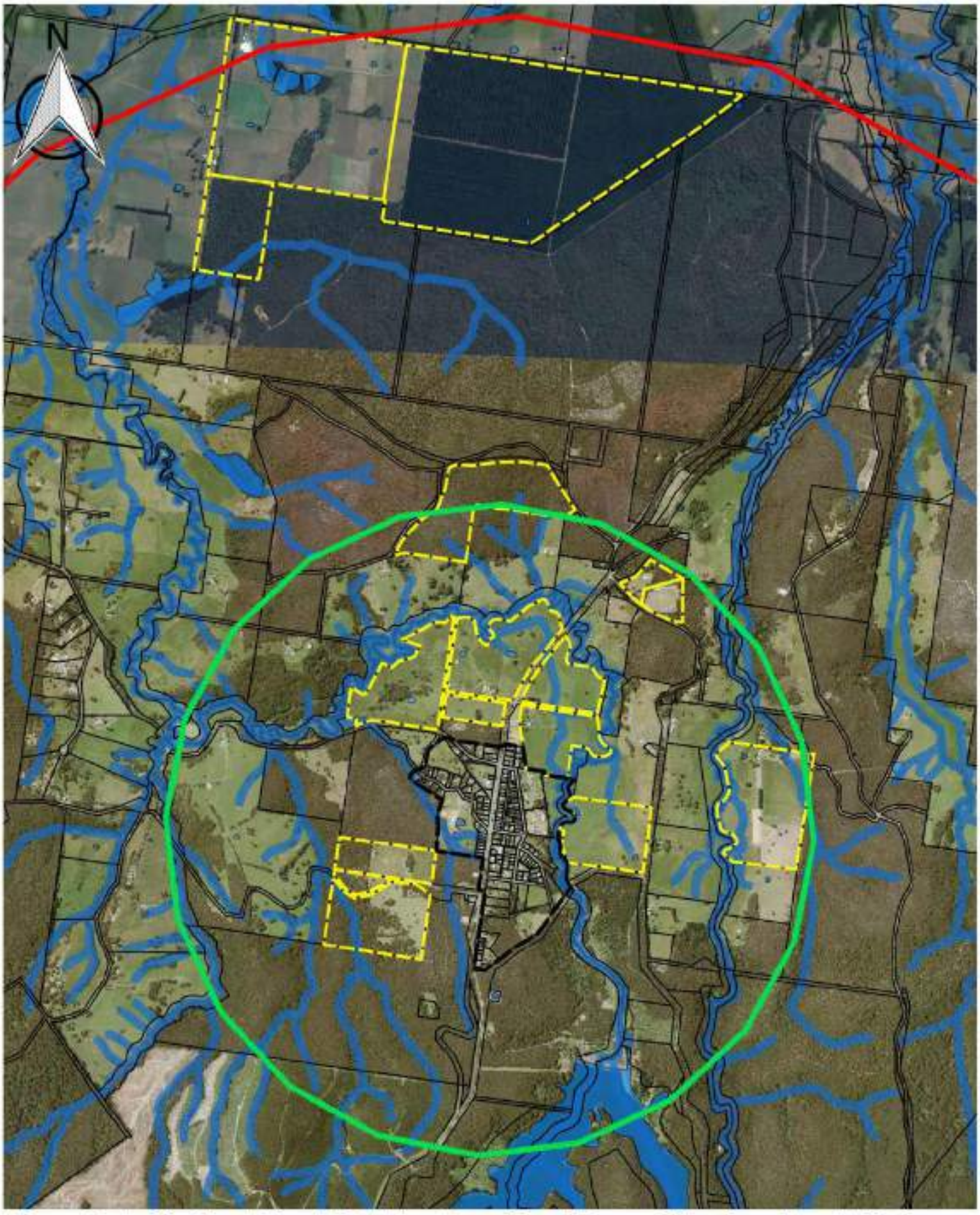

Figure 3: Indicative Potential Water Recycling / Reuse Sites based on Initial Screening Process

8.2 Business as Usual (BaU)

The overwhelming feedback from the community session was that the current wastewater management situation within Forrest is unacceptable and an improvement is essential. A Business as Usual (BaU) scenario has been taken forward as a baseline for comparison with the shortlisted Solution Packages and to assist in ensuring the community Measures of Success are able to be achieved.

Table 22 BaU Summary

Summary	Component	Description
Wastewater Retain full on-site containment where feasible. Partial upgrade of remaining on-site systems to best practicable option. Remains owner managed and council regulated. **Stormwater** n/a	On-property	*PREMISE OF SCENARIO IS TO RETAIN OWNER MANAGEMENT OF SEPTIC SYSTEMS AND REGULATION BY COUNCIL.* Incremental (owner driven) upgrade existing septic systems to achieve full on-site containment where feasible over 25 year period. Install secondary treatment and subsurface irrigation on remaining lots with excess discharging to stormwater over 25 year period. **Higher failure rate assumed based on less oversight and limited regulatory capacity.**
	Collection / Treatment	All treatment provided on-property (highly variable performance).
	Water Management	All irrigation / land application on-property (highly variable performance).
	Long-term growth	Limited to gradual upgrade of systems (by owners) over time. Low rate of current on-site system improvement and continued high rate of non-compliance / issues e.g. odour. New business may be constrained from establishing/expanding, which constrains tourism and employment growth. New properties would be required to install on-property works in accordance with current regulations. This may constrain some development given existing lot sizes.

8.3 Solution Package 1 – Integrated Water Management Approach

An Integrated Water Management Approach seeks to maximise value for money through a combined wastewater and stormwater management solution for Forrest township. Feedback from the community has identified a number of locations where stormwater run-on and runoff are impacting on people's properties and exacerbating wastewater impacts. This option provides many benefits, including improved wastewater and stormwater management, however as described below, offers constrained solutions for commercial and tourism growth and retains some level of off-site discharge.

Solution Package is summarised in the following table.

Table 23 SP1 Summary

Summary	Component	Description
Wastewater Maximise on-property management / reuse and utilise existing on-site systems where possible. Residual discharge of (treated) greywater to stormwater. **Stormwater** Improve stormwater management and provide treatment of combined stormwater/greywater discharges.	On-property	Upgrade existing septic systems to achieve full on-site containment on larger lots where feasible – secondary treatment system (e.g. aerated treatment unit or recirculating media filters) with subsurface irrigation to meet regulatory (EPA CoP) requirements. Best Practicable Option (BPO) upgrade for remaining lots that cannot fully contain – maximise land application of wastewater on-site with excess greywater (treated with bio-filter) directed to stormwater. Retain existing septic system where possible. All systems managed by single competent and accountable authority (upgrade works and operation).
	Collection / Treatment	Treat off-site excess discharges using combined stormwater/greywater roadside bioretention swales prior to discharge into treatment measures at nominated locations. Bioretention swales are grassed on the surface but feature a sand filtration media underneath that ensures low flows (such as greywater) infiltrate quickly for treatment. This infiltrated water is collected by an underdrain that discharges to a pit that overflows to the next swale or drainage pipe. Treatment measures to include constructed wetland for low flows (greywater/stormwater) with final filtration and possible UV disinfection. Discharge to waterway only during adequate flow conditions. Large storm events to be directed to a separate, dedicated bioretention basin for stormwater quality treatment and potentially harvesting for reuse.
	Water Management	Establish local stormwater irrigation facilities at feasible locations (potentially school playing fields and open space as shown on Figure 15).
	Water Cycle	Minor residual (treated) greywater discharge. Reduced water extraction/demand for public open space irrigation. Significantly improved stormwater management (flow and pollutant loads).
	Long-term growth	Continued managed discharge of treated greywater to upgrade stormwater for new development unable to contain all wastewater on-site.

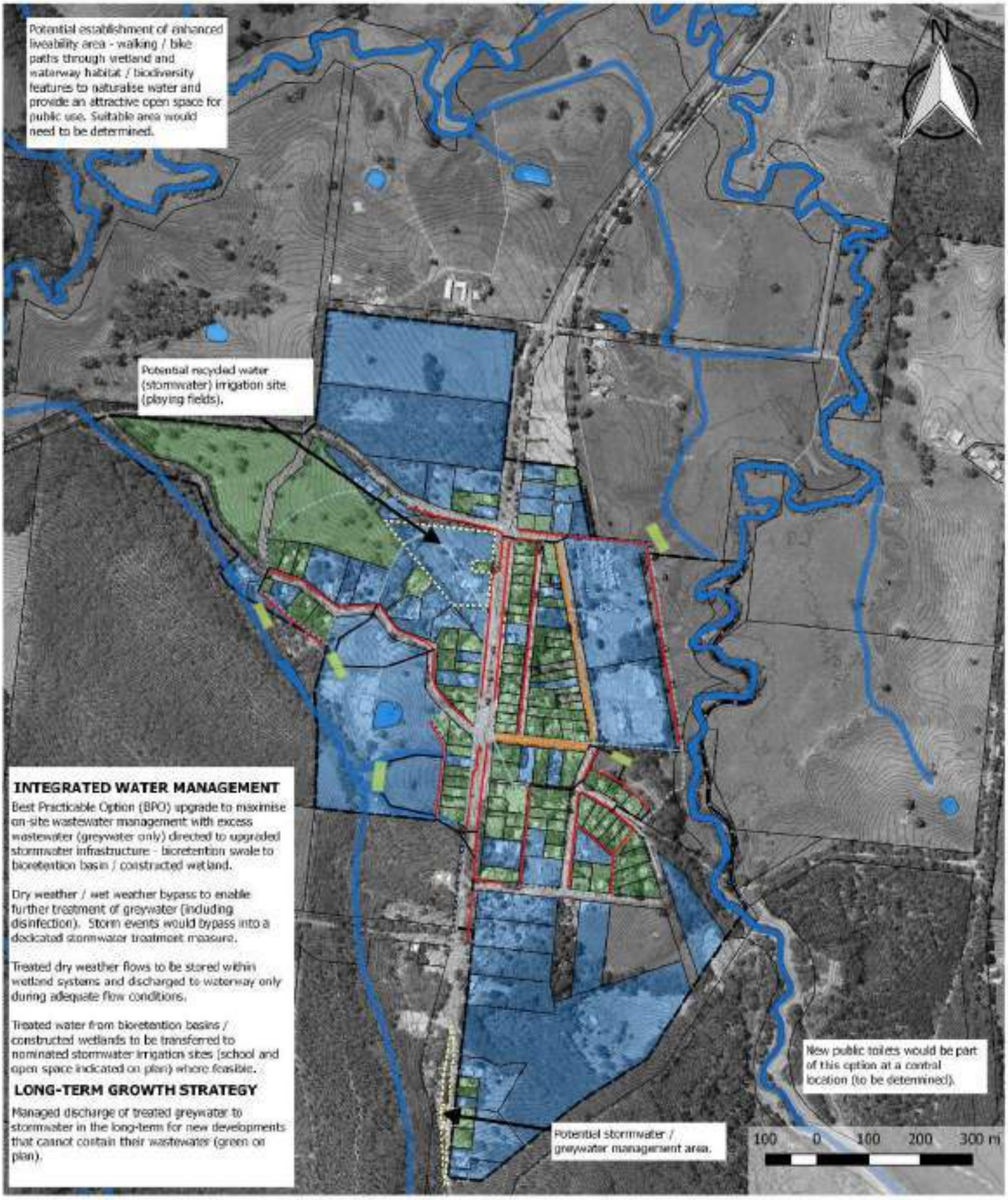

Figure 15 Forrest Wastewater Investigation: Solutions Package 1 Servicing Layout - Integrated Water Management Approach

- Forrest Township
- Watercourse / Waterbody
- Bioretention Basin / Constructed Wetland
- Existing Kerb and Gutter Drainge
- Proposed Stormwater Pipe
- Bioretention Swale

On-property Servicing

- BPO On-site System Upgrade with Excess Treated Greywater to Bioretention Swales
- New On-Site System (Managed by Single Authority)

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8.4 Solution Package 2 – Partial On-site Containment with Cluster Irrigation / Reuse

This Solution Package aims to provide Authority delivered upgraded on-site systems across all properties, which are compliant with EPA requirements and provide a high level of service. Excess wastewater not able to be managed on-site is to be transferred to multiple local cluster reuse systems for subsurface irrigation across community / public open space. This Solution Package provides Integrated Water Management elements via local reuse of water across both properties and public open space across the Township.

Solution Package 2 is summarised in the following table.

Table 24 SP2 Summary

Summary	Component	Description
Wastewater Maximise on-property management / reuse with upgraded best practice system. Excess wastewater managed at local cluster irrigation systems. **Stormwater** n/a	On-property	Decommission all existing septic systems and install new best practice secondary treatment system (e.g. aerated treatment unit or recirculating media filters) to achieve full on-site containment on larger lots where feasible with subsurface irrigation to meet regulatory (EPA CoP) requirements. Install secondary treatment and subsurface irrigation on remaining partial containment lots with excess discharging to an effluent sewer. The amount of on property irrigation can be set at a reasonable minimum land area (e.g. 150m^2) 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. Additional flow balancing tankage to be installed for commercial / tourist accommodation sites to manage peak flows. Higher strength wastewater producers would require pre-treatment (trade waste) systems. All systems managed by a single competent and accountable authority (both upgrade works and operation).
	Collection	Small diameter effluent sewer collecting excess secondary treated effluent only from lots where full containment is not achievable. Conveyance to local cluster irrigation systems. This sewer would operate as a pressure sewer.
	Treatment	Upfront treatment provided on-property (Class C) with additional treatment at cluster irrigation site (potentially Class B). This allows for reduced cluster treatment infrastructure. Cluster system to typically consist of small control shed (filtration and ultraviolet disinfection) and wet weather storage tank.
	Water Management	Overnight subsurface irrigation (restricted access) of community / public open space using excess effluent not managed or reused on properties (refer Figure 16).[1]
	Water Cycle	Reduced water demand (residential garden and public open space irrigation).
	Long-term growth	Capacity for town growth to match Forrest Structure Plan (2011). On-site systems based on existing dwellings increasing to four bedroom dwellings on existing lots in the long-term. New developments would require secondary treatment system and minimum ~150m^2 subsurface irrigation for each equivalent dwelling.

Note 1: As the investigations has progressed, availability of local community land has since been identified as limited and therefore the feasibility of SP2 implementation is currently unclear.

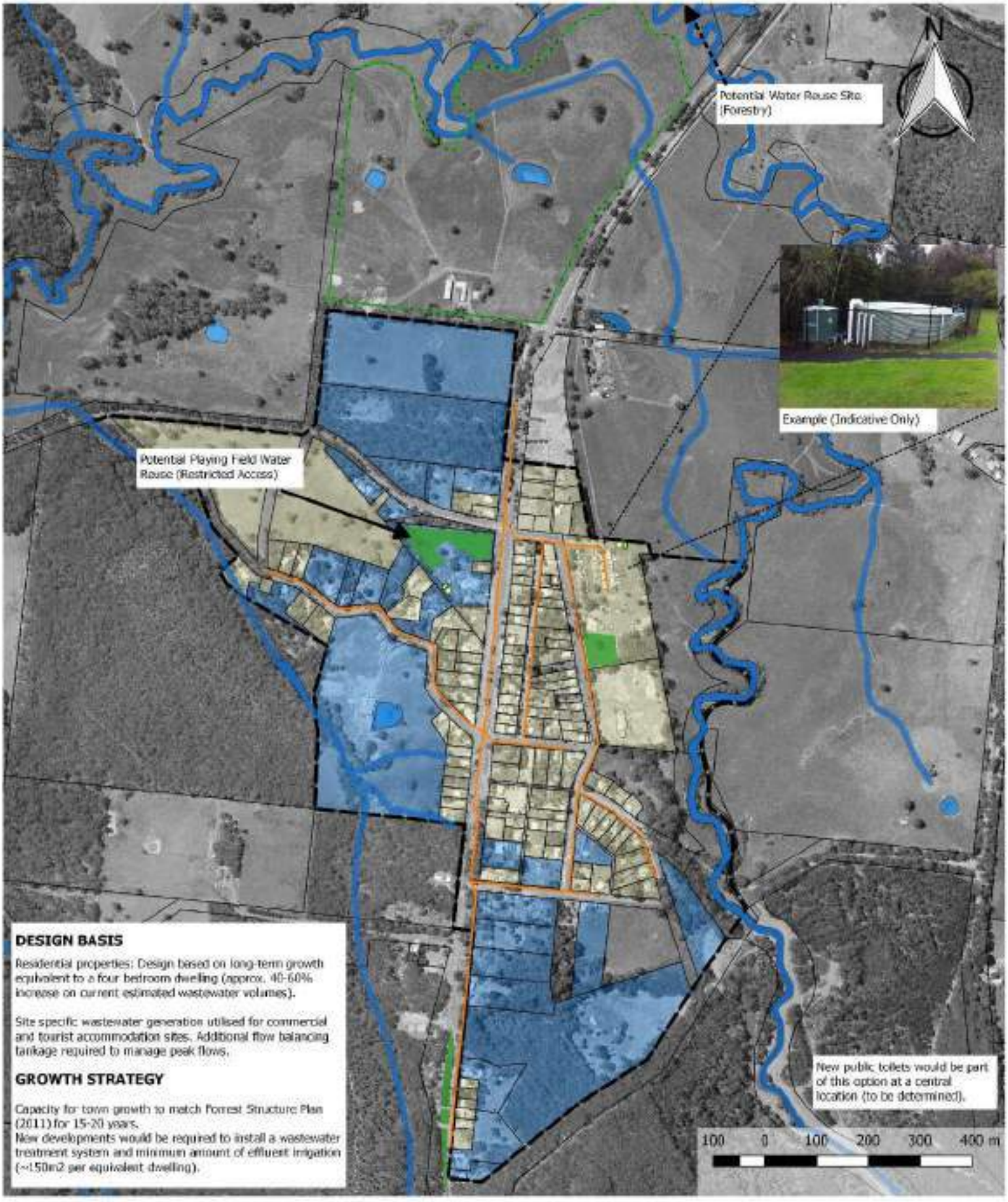

Figure 16 Forrest Wastewater Investigation: Solutions Package 2 Servicing Layout – Partial On-site Containment with Cluster Irrigation / Reuse

- Forrest Township
- Watercourse / waterbody
- Effluent Sewer (indicative)
- Control/Pump Shed (indicative)
- Storage Tank (indicative)
- Indicative Future Water Reuse Site (Cater for Growth)
- Potential Community / Public Open Space Water Reuse Areas

On-Property Servicing

- New Partial On-site Management with Excess to Sewer
- New On-Site System (Managed by Single Authority)

8.5 Solution Package 3 – Partial On-site Containment with Central Irrigation / Reuse

This Solution Package aims to provide Authority delivered upgraded on-site systems across all properties, which are compliant with EPA requirements and provide a high level of service. Excess wastewater not able to be managed on-site is to be transferred to a single central reuse / irrigation system. This Solution Package provides Integrated Water Management elements via local reuse of water across properties across the Township along with a central irrigation area located in close proximity to Forrest.

Solution Package 3 is summarised in the following table.

Table 25 SP3 Summary

Summary	Component	Description
Wastewater Maximise on-property management / reuse with upgraded best practice system. Excess wastewater managed at central irrigation system. **Stormwater** n/a	On-property	Decommission all existing septic systems and install new best practice secondary treatment system (e.g. aerated treatment unit or recirculating media filters) to achieve full on-site containment on larger lots where feasible with subsurface irrigation to meet regulatory (EPA CoP) requirements. Install secondary treatment and subsurface irrigation on remaining partial containment lots with excess discharging to an effluent sewer. The amount of on property irrigation can be set at a reasonable minimum land area (e.g. 80-100m^2) 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. Additional flow balancing tankage to be installed for commercial / tourist accommodation sites to manage peak flows. Higher strength wastewater producers would require pre-treatment (trade waste) systems. All systems managed by a single competent and accountable authority (both upgrade works and operation).
	Collection	Small diameter effluent sewer collecting excess secondary treated effluent from lots where full containment is not achievable. Conveyance to local cluster irrigation systems. This sewer would operate as a pressure sewer.
	Treatment	Upfront treatment provide on-property (Class C) with additional treatment at central irrigation site. This allows for reduced central treatment infrastructure. Central reuse system likely to consist of small control shed (filtration and ultraviolet disinfection) and wet weather storage tank. Small recirculating media filter may be required to keep stored effluent 'fresh'.
	Water Management	Surface or subsurface irrigation of central reuse site using excess effluent not managed or reused on properties (refer Figure 17). Allowance for a range of irrigation rates and strategies. Any excess effluent would be river discharged at limited flow rates during periods of higher river flows (precautionary discharge).
	Water Cycle	Reduced water demand (residential garden irrigation).

Summary	Component	Description
	Long-term growth	Capacity for town growth to match Forrest Structure Plan (2011). On-site systems based on existing dwellings increasing to four bedroom dwellings on existing lots in the long-term. New developments would require secondary treatment system and minimum ~100m^2 subsurface irrigation for each equivalent dwelling.

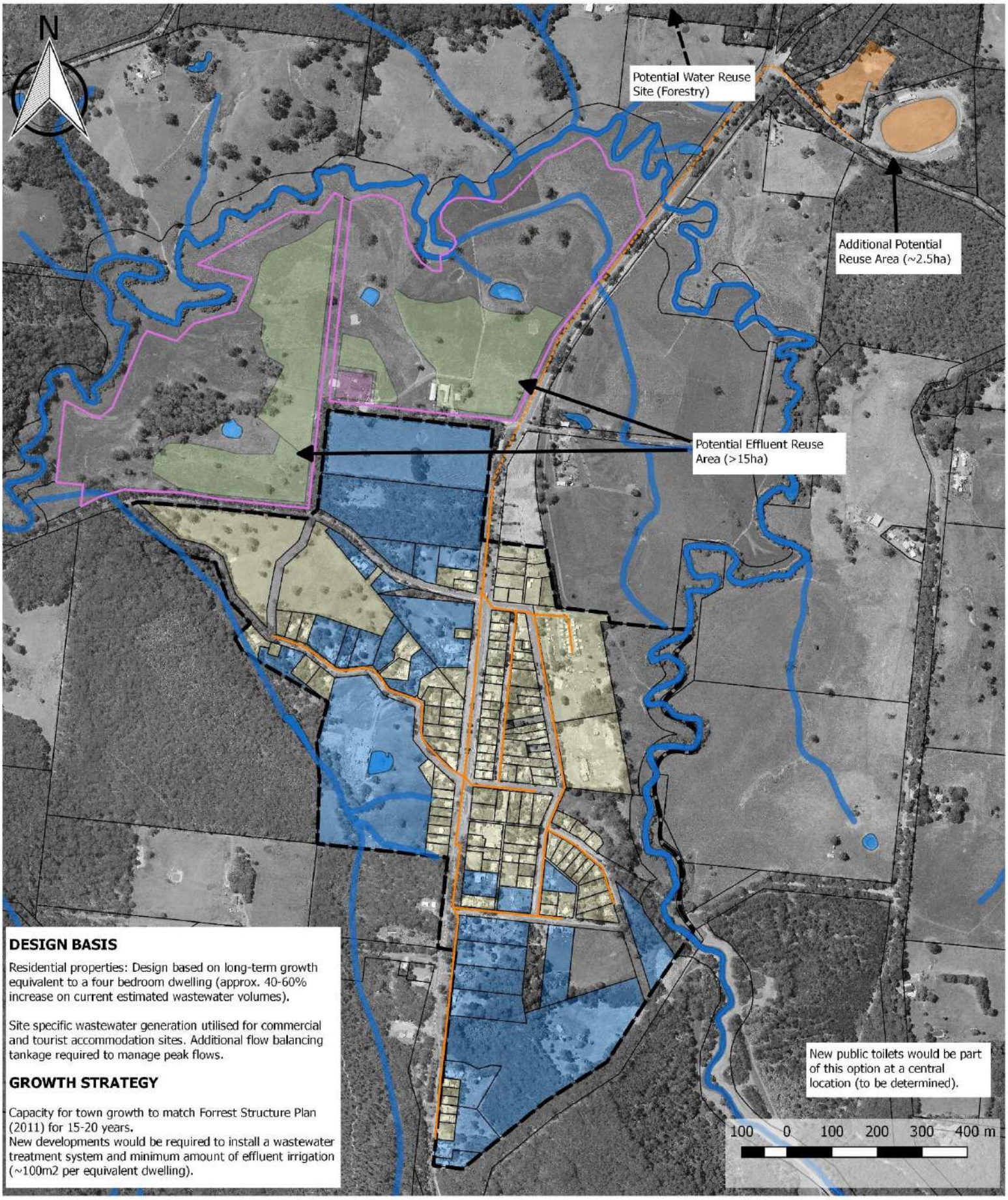

Figure 17 Forrest Wastewater Investigation: Solutions Package 3 Servicing Layout – Partial On-site Containment with Central Irrigation / Reuse

- Forrest Township
- Watercourse / waterbody
- Effluent Sewer (Indicative)
- Recycled Water Main (Indicative)
- Indicative Cluster Reuse Site
- Indicative Water Recycling Plant Footprint
- Indicative Useable Land (Forrest Recreation Reserve)

On-Property Servicing

- New Partial On-site Management with Excess to Sewer
- New On-Site System (Managed by Single Authority)

DWC
DECENTRALISED WATER CONSULTING

Figure: Example On-property Infrastructure (Solutions Package 2 & 3)

- Property Boundary
- Effluent Sewer (Indicative - Example Only)
- New Subsurface Irrigation Area (Indicative - Example Only)
- New Treatment System (Indicative - Example Only)

DWC
DECENTRALISED WATER CONSULTING

8.6 Solution Package 4 – Pressure Sewerage to Water Recycling Plant

Reticulated sewerage is typically the traditional wastewater solution provided by Barwon Water. This wastewater solution is similar to those provided in other nearby towns like Birregurra or Colac i.e. a centralised system with a local water recycling plant. The difference is that a pressure sewer system is the preferred technology for that system in Forrest. A pressure sewer system has recently been installed in Point Lonsdale to service a new development area. All existing on-site wastewater systems would be decommissioned and removed and a new tank and pump would pump raw sewage to a Water Recycling Plant (WRP). The WRP would treat the sewage and produce effluent for reuse by irrigation. Other options to supply recycled water to external water users will also be considered as part of SP4. It is unlikely that all recycled water could be re-used due to the total volume and therefore a river discharge may be necessary.

Solution Package 4 is summarised in the following table.

Table 26 SP4 Summary

Summary	Component	Description
Wastewater All raw wastewater conveyed via reticulated sewerage and treated at WRP. **Stormwater** n/a	On-property	Decommission all septic systems and install pressure sewer units on each property. All systems managed by a single competent and accountable authority.
	Collection	Pressure sewer conveying all raw sewage to Water Recycling Plant (WRP).
	Treatment	Water Recycling Plant for treatment of all raw sewage with storage via dams – greater infrastructure required as all wastewater treated at one central location. Likely to be a wetland system or package treatment plant.
	Water Management	Surface irrigation of recycled water across central reuse site (refer Figure 19). Allowance for a range of irrigation rates and strategies. Any excess effluent would be river discharged at limited flow rates during periods of higher river flows (precautionary discharge).
	Water Cycle	Recycled water available for commercial reuse.
	Long-term growth	Capacity for town growth to match Forrest Structure Plan (2011). Provision of tertiary treatment at the WRP may be required for licensed discharge to waters (depending on actual future development).

A variation to SP4 involving transfer of raw sewage to Birregurra WRP was evaluated at a high level. Initial estimates would suggest capital cost alone is likely to be prohibitive (in the order of $20-$30M). The feasibility and sustainability of augmenting Birregurra WRP to meet the existing and potential future needs of not only Forrest but other townships along the alignment have not been confirmed. Given that minimising costs for residents what expressed as a key concern this option of transfer to Birregurra WRP was not taken forward for further assessment. During option development and evaluation, some community members also voiced concern about 'exporting' their sewage to another town for someone else to deal with.

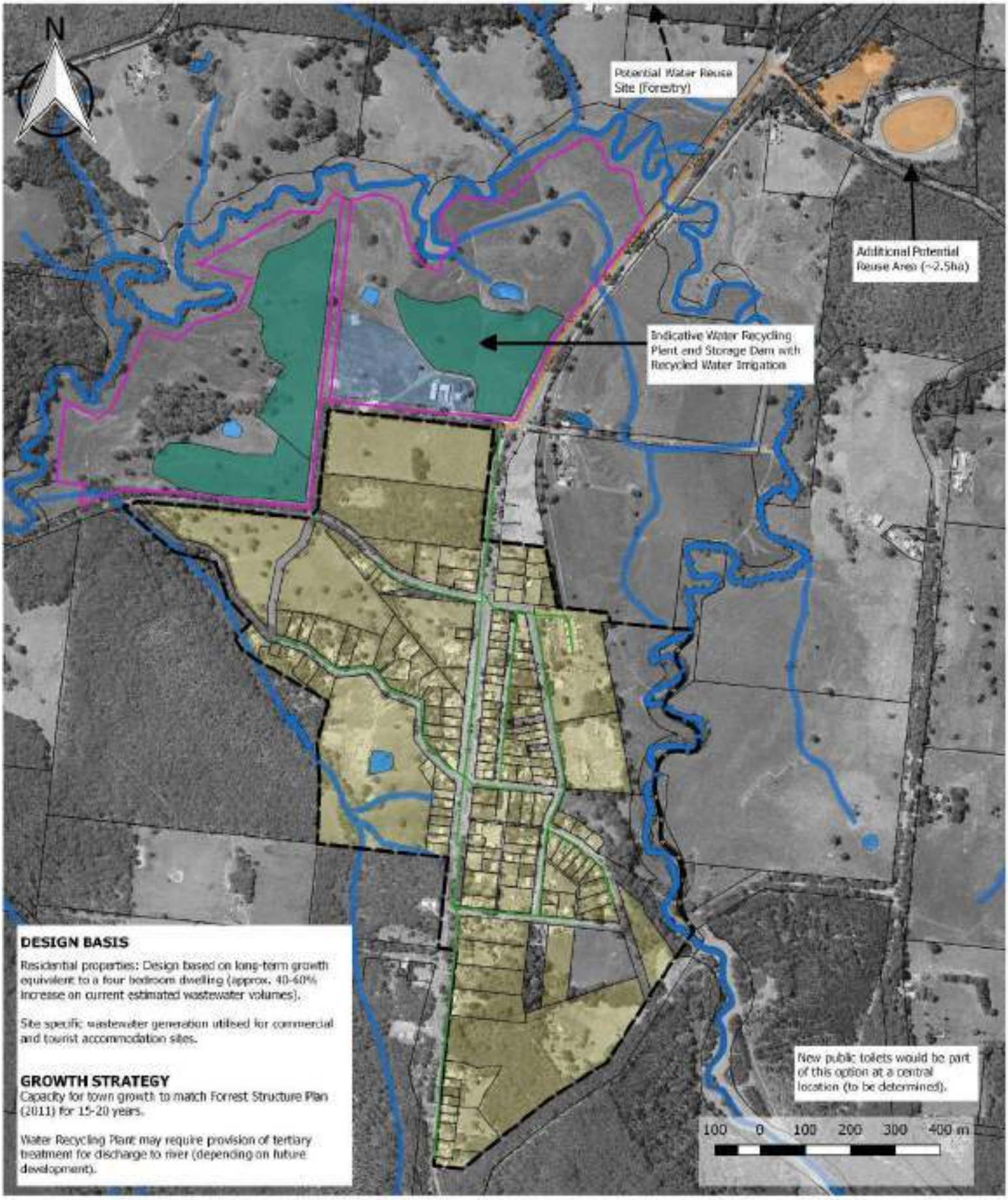

Figure 18 Forrest Wastewater Investigation: Solutions Package 4 Servicing Layout – Reticulated Pressure Sewerage to Water Recycling Plant

- Forrest Township
- Watercourse / waterbody
- Pressure Sewer (Indicative)
- Recycled Water Main (Indicative)
- Indicative Site for Water Recycling Plant
- Indicative Footprint of Water Recycling Plant
- Indicative Water Recycling Plant Farm Irrigation Area
- Indicative Useable Land (Forrest Recreation Reserve)

On-Property Servicing

- Pressure Sewer

DWC
DECENTRALISED WATER CONSULTING

9 Cost Estimates

Cost estimates have been developed for each of the Solution Packages as part of this project to allow relative comparison as part of the MCA. The intention is for the costings of the identified preferred solution to be further refined and developed during business case development. This includes capital (upfront) cost estimates along with operational costs and whole of life Net Present Value (NPV) community costs over 50 years. These capital cost estimates include total project delivery costs (including overheads, design, approvals) and a 20% contingency / risk margin. NPV life cycle costs have utilised a 4% discount rate.

Table 27 Solution Package and BaU Cost Estimates

Scenario	Estimated Capital Cost	Estimated Lifecycle Cost (NPV)
BaU	$2.1M / $14,300 per lot[1]	$3.4M / $23,440 per lot
SP1	$8.9M / $61,500 per lot	$12.4M / $86,000 per lot
SP2	$8M / $55,500 per lot	$11.3M / $78,200 per lot[1]
SP3	$10.1M / $70,200 per lot	$12.3M / $85,500 per lot
SP4	$16.7M / $116,000 per lot	$19.1M / $133,000 per lot

Note 1: BaU CAPEX is the NPV of total CAPEX over 50 years of gradual upgrade and replacement (assumed to take place over 25 years or 4% renewal rate).

It is important to note these are preliminary estimates only and will be dependent on a wide range of factors that are yet to be defined or investigated. Presented estimates can be considered in the order of +/-30% accuracy based on the Solutions Packages outlined in this report. A more refined and comprehensive cost estimate will be prepared as part of business case development for the preferred Solution Package. These current cost estimates are sufficient to enable comparison between Solution Packages and have been developed from the same cost basis. More detail is provided in Appendix G

10 Solution Package Assessment (Multi-Criteria Analysis)

10.1 Multi-Criteria Analysis (MCA) Process

10.1.1 Scoring / Ranking

A MCA scoring system using a value between 1 to 10 was utilised as follows;

- Excellent / Exceeds (10)
- Very Good (8 - 9)
- Good (6 - 7)
- Satisfactory (5) achievement of MoS
- Poor (3 - 4)
- Very Poor (1 - 2)
- Fail (0)

The relevant MCA Weightings for each MoS were developed based on community feedback / survey data to date (i.e. larger weighting means the particular MoS is considered more important). The initial survey at the start of the project of community feedback is presented below with full consultation outcomes provided in Appendix A. As can be seen protection of the environment / human health and costs to the community were ranked of highest importance (as reflected via the adopted Weightings).

These Weightings were agreed upon in an Agency Workshop and are presented in Table 28 below. Each MoS score was multiplied with the relevant Weighting, and the scores combined for each of the SP's and BaU. The largest score (ranking score) was considered the most preferred Solution Package.

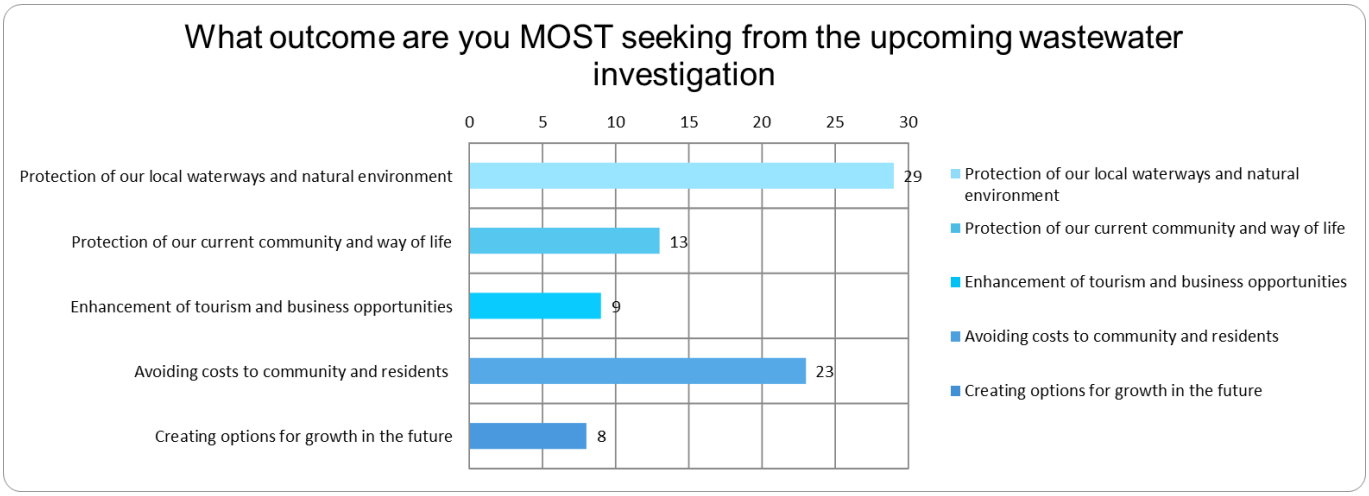

Table 28 Vision Aspects and Success Measures with Adopted Weightings

Visioning Aspect	How will this be measured?	Weighting (Importance: (5 – Most, 1 – Least)
Proposed Community Vision Statement	***"The Forrest wastewater management solution will be innovative and cost effective, whilst providing protection of public health, environment and the Forrest way of life."***	
Ensure protection of human and environmental health	- Reduction in pollution to waterways - Reduction of offsite discharges - Estimated reduction in disease burden	5 (all)
Enhance community and way of life	- Economic impact to Forrest - Increase to Tourism - Change to population / resident make up (way of life) - Community support for solution	2 2 3 3
Give full consideration of costs to residents and community	- Up-front costs and life cycle costs - Fair and equitable distribution of costs	4 (all)
Create flexible wastewater options for the future	- Ability to stage/adapt - Ability to cater for residents and visitors (tourism)	2 3
Showcase innovation and best practice	- Opportunities for water recycling and energy recovery. - Level of flexibility of options - Showcase / case study potential - Level of water cycle integration	1 (all)

10.1.2 Development of Input Information

A summary of the input information for the option assessment MCA process is presented in the table below.

Table 29 Input Information / Data Summary

Component	Details
Community Support for SP's	Based on feedback obtained from community session held 7th October 2018 along with online / postage feedback. Further details are provided in Section 10.2.
Improved Environmental Health	Daily wastewater modelling undertaken using MEDLI to estimate upgraded on-site wastewater management systems under the various SP's. Continuous long-term hydrology and water quality analysis undertaken using Model for Urban Stormwater Improvement Conceptualisation (MUSIC). Stormwater treatment measures were modelled within MUSIC to estimate potential water quality improvements. Fieldwork was undertaken by DWC in June 2018 to assess potential reuse sites (including characterising soil profiles across Forrest), existing stormwater infrastructure / drainage and potential for infrastructure upgrades (as part of SP1).

Component	Details
Improved Human Heath	DALY (Disability Adjusted Life Year) analysis undertaken for each SP – DALYs reflect the total disease burden that can be attributed to wastewater and stormwater management as per World Health Organisation and Environment Protection Heritage Council (EPHC) (2006).
Upfront and lifecycle costs	Cost estimates have been developed by DWC for both total Capital Delivery Costs and whole of life cycle costs (NPV) for each SP. Estimates have been derived from the best available data on Barwon Water sewerage infrastructure projects in addition to both on-site wastewater and integrated water management projects from Victoria (as a priority) and Australia. Further detail can be found in Appendix F.
Economic impact / increase to tourism	Long-term growth has been considered as part of each SP to provide enhanced potential for tourism and businesses to start up or expand. Growth outlined in the Forrest Structure Plan has been considered for this Measure of Success. This assessment has been focused on the ability of each option to facilitate an increase in business growth and tourism, given the viability of new business is not solely driven by wastewater management.
Fair and equitable distribution of costs	All SP's assume a single accountable authority will manage and maintain the upgraded systems. **This includes all on-site treatment and irrigation components**. It is also assumed that for all SP's a funding / management structure would be established before the option was taken forward i.e. not left to home owner to deal with. This was also flagged by community as essential for any solution. Therefore this Success Measure was removed from the MCA given all four SP's would be scored the same (Satisfactory).
Ability to stage / adapt	Based on ability for each SP to be staged and adapt based on expected / actual growth as part of the Forrest Structure Plan, based on DWC and BW experience with feedback from Project Steering Committee.
Cater for residents / visitors (tourism)	All SP's include provision for new public toilets with improved facilities that can cope with additional tourist loads. The ranking is based on the relative ability of each option to cope with tourist influxes.
Opportunities for water recycling and energy recovery.	All options can incorporate recycling but at different (often high) costs and low / uncertain medium to long-term demand. Qualitative assessment by the Project Steering Committee.
Level of water cycle integration	The degree to which each SP aims to provide a holistic and forward thinking approach to all elements of the water cycle (movement of water through its various phases) including wastewater in addition to stormwater, potable / non-potable water supply and local watercourses. SP1 was developed with this in mind. Qualitative assessment by the Project Steering Committee.
Showcase / case study potential	Based on the innovative options that make up each SP. Qualitative assessment by Project Steering Committee.

10.1.3 Agency Workshop

A Solution Package Assessment Workshop was undertaken with the Project Steering Committee on 22nd August 2018. This involved engagement between the various relevant agencies and stakeholders (Barwon Water, Colac Otway Shire Council, Regional Development Victoria) with discussion of, and agreeance on, the various rankings / scoring as part of the MCA process. Discussion was also focused on the most effective way to present Option Assessment information and scoring to the community as part of the community feedback session. The minutes for this Workshop are presented in Appendix D.

10.2 Community Feedback

A community session was held 7th October 2018 to provide information on, and listen to feedback on, the advantages and disadvantages of each of the four Solution Packages in line with the Measures of Success defined by the community. Community members were asked to rank each of the four SP's from most preferred to least preferred (1st to 4th). Feedback was also obtained via online and postage survey. This feedback was subsequently included in the MCA process via the 'Community Support for Solution' scoring.

The results of the community consultation are summarised in Figure 20. Approximately 31 community members contributed, although a small number either didn't rank the options or only ranked their most preferred option. The results have been presented based on the number of 'More Preferred' (i.e. ranked either 1st or 2nd) and 'Less Preferred' (i.e. ranked either 3rd or 4th) scores from the community. This ensures that resolution of the consultation data is maximised by including the numbers for rankings as 2nd and 3rd choice by the community. A 'Net Preference' was also determined from the data which involved the numbers for 'Less Preferred' being subtracted from the 'More Preferred' numbers (see Table 30). As can be seen in Figure 20, Solution Package 3 received both the most preference of support along with the least non-preference.

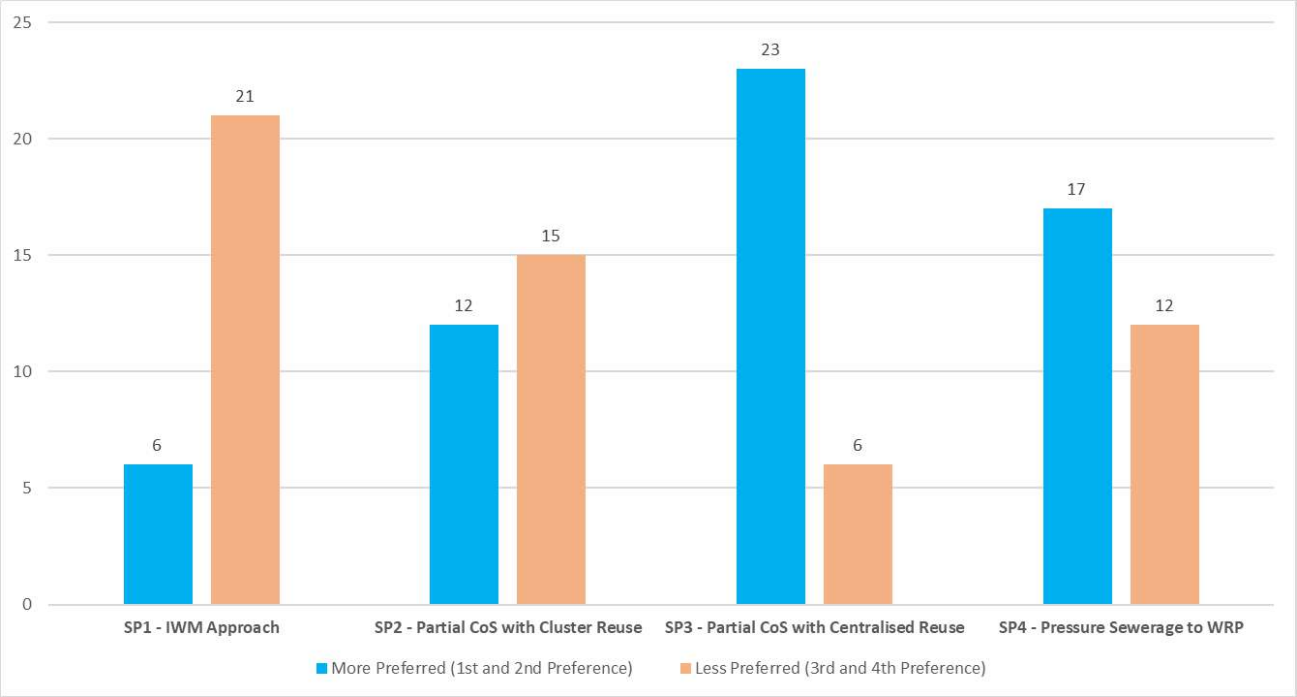

Figure 20 Community Feedback Results

Table 30 Option Net Preference

Solution Package	Net Preference
SP1 - IWM Approach	-15
SP2 - Partial CoS with Cluster Reuse	-3
SP3 - Partial CoS with Centralised Reuse	17
SP4 - Pressure Sewerage to WRP	5

Community feedback shows a split in *first* preference between SP3 and SP4. However SP3 received no least preferred votes whilst SP4 received 10 (the second most least preferred votes behind SP1). Overall, SP4 received twice as many least preferred votes (i.e. total 3rd and 4th votes) as SP3. Overall, SP3 received 35% more Most Preferred votes (1st and 2nd combined) compared to SP4 with a net preference score of 17 versus 5.

SP3 is considered the most preferred Solution Package from community feedback with SP4 second. SP1 was not considered acceptable to most members of the community whilst SP2 received more Less Preferred than More Preferred votes.

10.3 Estimated Wastewater Loads / Reductions

As discussed previously, wastewater and nutrient modelling was undertaken using Model for Effluent Disposal by Land Irrigation (MEDLI). MEDLI is widely accepted throughout Australia as the most technically robust tool for simulating the operation of effluent or recycled water irrigation. MEDLI was used to derive average annual hydraulic and nutrient loads from wastewater treatment systems in Forrest to surface and subsurface export routes.

As discussed previously in Section 4.3.1, 'background' catchment loads derived from stormwater were modelled using MUSIC. The same methodology outlined in Section 4.3.1 was applied with the subcatchment areas refined based on field investigations of stormwater infrastructure and the key drainage points within Forrest township (refer to Figure 15 for these subcatchments). The wastewater and stormwater derived flows and loads were combined for each of the proposed SP's to provide a relative comparison of both the estimated reductions in wastewater loads from system upgrades, in addition to the overall contribution in comparison to the broader catchment. The Solution Package wastewater derived loads include the attenuated cluster reuse system / WRP irrigation loads from MEDLI modelling of the respective irrigation areas for each SP.

10.3.1 Pollutant Attenuation

Simplistic two dimensional groundwater modelling has been undertaken to estimate the potential transport and fate of pathogens discharging below the root zone as deep drainage. A steady state analytical approach using the Domenico Equation was adopted. The Domenico equation calculates pollutant concentration at a given point from a finite, planar, continuous source of pollutant under steady state (i.e. equilibrium) conditions. This modelling was done to estimate the approximate attenuation of nutrients and viruses from wastewater loads from properties across the township. The minimum 6 metre setback to stormwater infrastructure (as per the EPA CoP) was used given this would be the limiting separation distance for many systems within the township centre (small lots with limited available area). All minimum setbacks would be achieved for the proposed cluster / WRP irrigation area(s) and therefore nutrient / virus export to the environment would be minimal.

Even based on the minimum 6m setback distance, a high level of treatment is anticipated given reuse of effluent on-lot would be done so (for SP1, 2 and 3) at a sustainable and managed manner.

10.3.2 Outputs

The figures presented below provide a summary of the proportion of nutrients derived from both stormwater and wastewater sources. It can be seen that all Solution Packages provide a high level of nutrient attenuation prior to movement of water off-property to the environment (e.g. stormwater drain, waterway, etc.) This is due, in part, to the low design loading rate (1.8mm/day) of treated effluent that has been taken forward for both on-lot and off-lot effluent management across the SP's. This is a significant reduction in the current loading rate of on-site systems within Forrest (in the order of 20-30 times less in some cases). It can also be seen that SP1 provides the additional benefit

of reducing background (stormwater) derived nutrient loads via the improvement of stormwater drainage infrastructure using such measures as roadside bioretention swales.

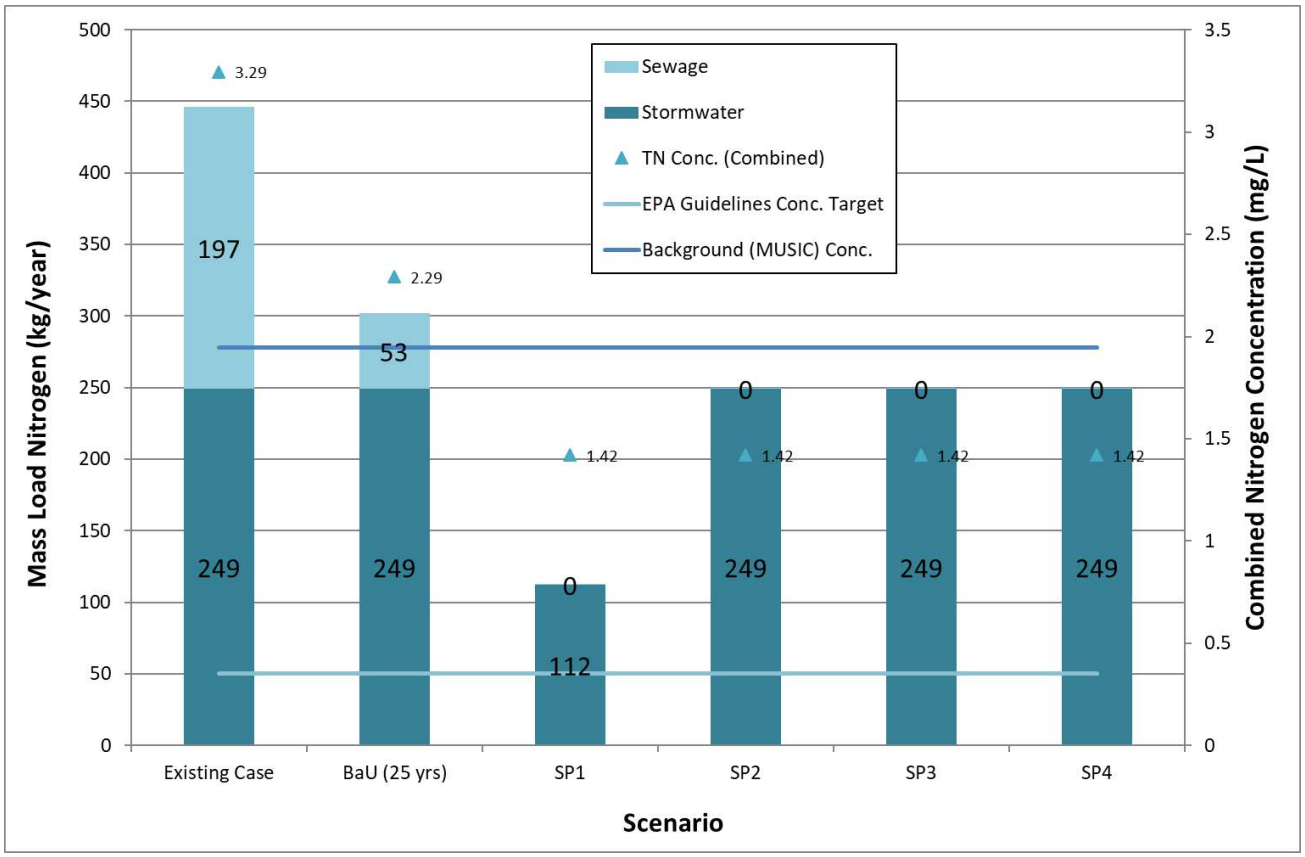

Figure 21 Total Nitrogen Annual Average Export (Stormwater and Wastewater)

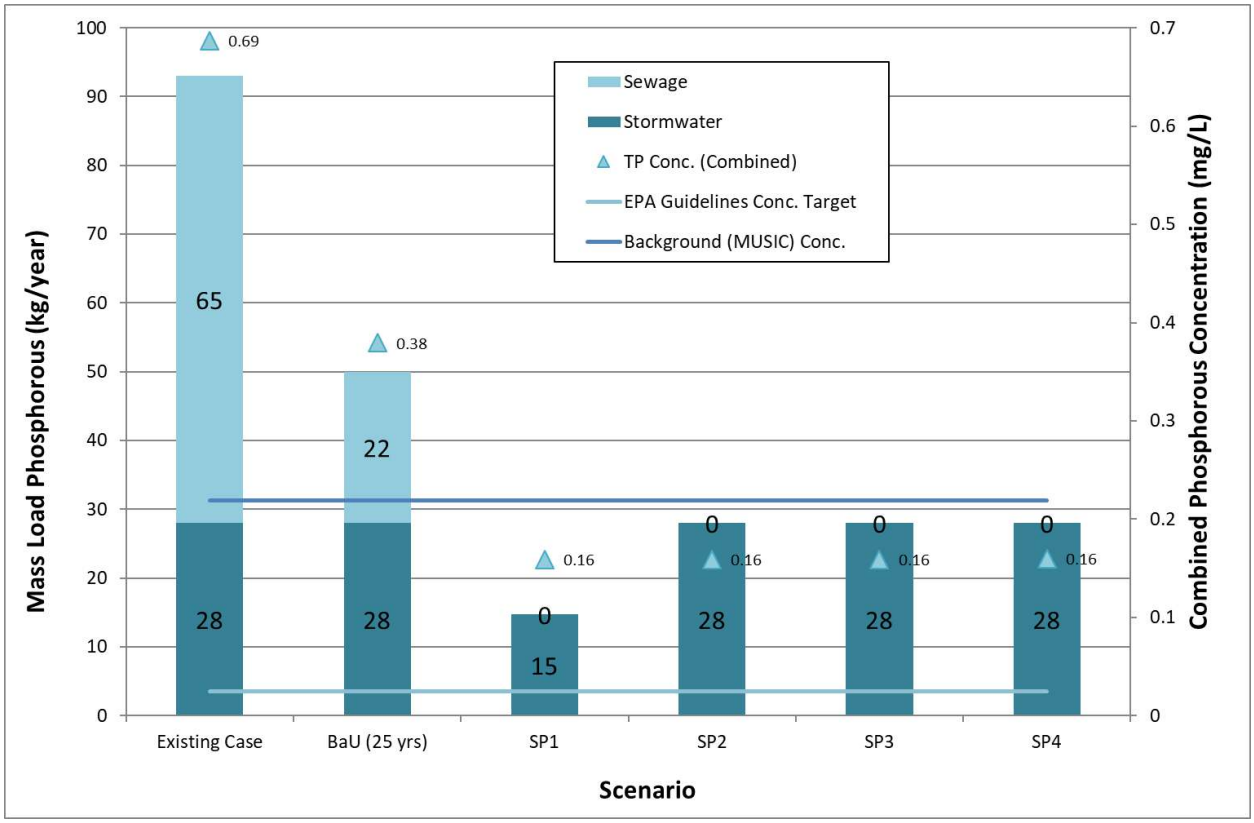

Figure 22 Total Phosphorus Annual Average Export (Stormwater and Wastewater)

10.4 Health Risk Assessment

A microbial risk assessment has been undertaken to enable two outcomes.

- To compare the relative residual health risk associated with the existing, BaU and SP scenarios for the MCA process.
- To evaluate if residual health risks associated with each scenario meet target thresholds for human health protection and disease burden in a population.

As discussed previously in Section 4.7, the adopted procedure is consistent with the approach recommended in the Australian Drinking Water Guidelines and Australian Guidelines for Water Recycling. Reference can be made to Section 3.2 and 3.3 of this document (EPHC, 2006) for more detail. This approach is also consistent with World Health Organisation (WHO) protocols for assessment of health risks associated with waterborne disease. Refer should be made to Section 4.7 for further details of the methodology and data sources used (including previous studies where no data was available).

10.4.1 Outputs

The following figure summarises the total DALYs and DALYs per person per year for each scenario. The total DALYs reflect the total disease burden that can be attributed to wastewater and stormwater management. The WHO and EPHC (2006) require proposed activities to not create a disease burden that is greater than 10^{-6} DALYs/person/year. This threshold has been used as a measure of success for human health protection in addition to achievement of full on-site containment.

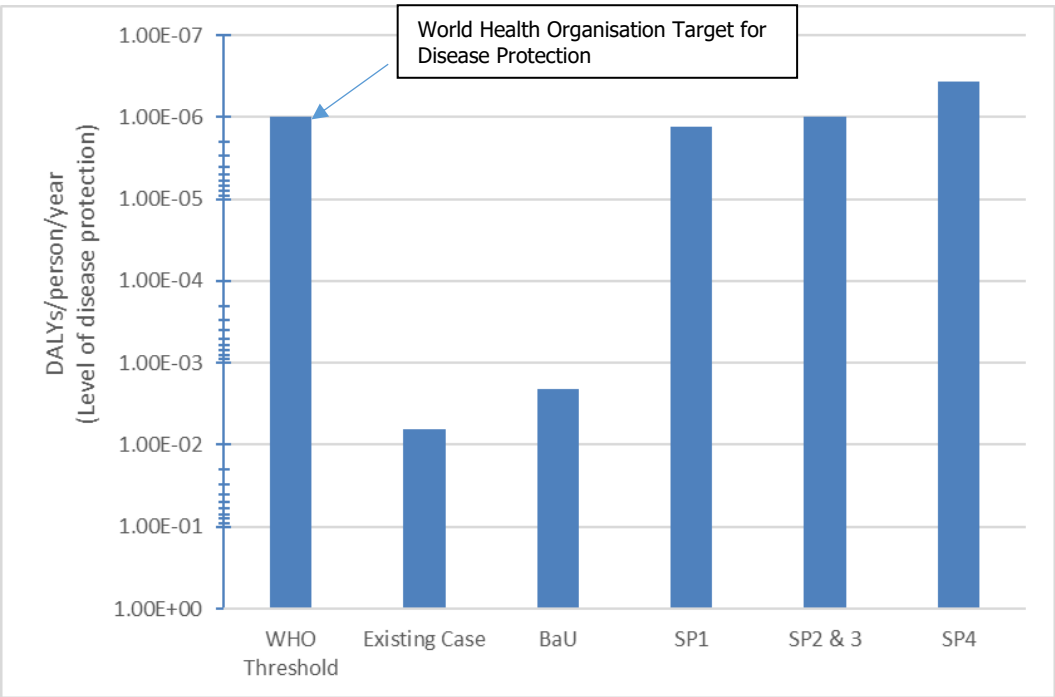

Figure 23 Estimated Level of Disease Protection

It can be seen that SP2, 3, and 4 are estimated to meet the minimum recommended level of disease protection according to Australian and global guidelines (WHO/EPHC, 2006). The SP1 scenario was estimated to be very close to the threshold target, given the additional treatment provided for off-site (greywater) discharges via improved stormwater infrastructure.

10.5 MCA Results

The results are summarised in the table below. Detailed results for the MCA are provided in Appendix F.

Table 31 Results of MCA for Forrest Options Assessment

Solution Package	MCA Rank	Rank Score	Strengths	Weaknesses
SP3 - Partial CoS with Centralised Reuse	**1**	320	Very good community support Env. And Human Health Flexibility / adaptability Growth / tourism Showcase / case study potential	Costs (relative to other options) Requires central reuse site Change to Way of Life[1]
SP2 - Partial CoS with Cluster Reuse	**2**	292	Env. And Human Health Flexibility / adaptability Costs (relative to other options) Showcase / case study potential	Growth - limited potential local community reuse sites identified (feasibility and/or cost impacts). Limited community support Change to Way of Life[1]
SP1 - IWM Approach	**3**	260	Env. Health (stormwater and wastewater treatment) provided Flexibility / adaptability Integrated water management Showcase / case study potential Costs (provides both improved stormwater and wastewater)	Growth (some limits to business expansion) Very limited community support Continued off-site discharge (albeit only treated greywater)

Solution Package	MCA Rank	Rank Score	Strengths	Weaknesses
SP4 - Pressure Sewerage to WRP	**4**	256	Env. And Human Health Growth / tourism Community support (however non-preference numbers close to preference numbers)	Requires large central reuse site in proximity to town – potential need for river discharge Costs Flexibility / adaptability – full infrastructure required from very beginning (regardless of actual growth) Change to Way of Life[1]
BaU - Business as Usual	**5**	47	Limited change to Forrest 'Way of Life'	Very poor outcomes for almost all MoS Fails to meet regulatory and government objectives.

Note 1: two opposing views were identified from the Measures of Success - those who wanted to preserve the Forrest 'Way of Life' (country, leafy feel) and those who wished to see economic / population growth and change as part of a wastewater solution for Forrest.

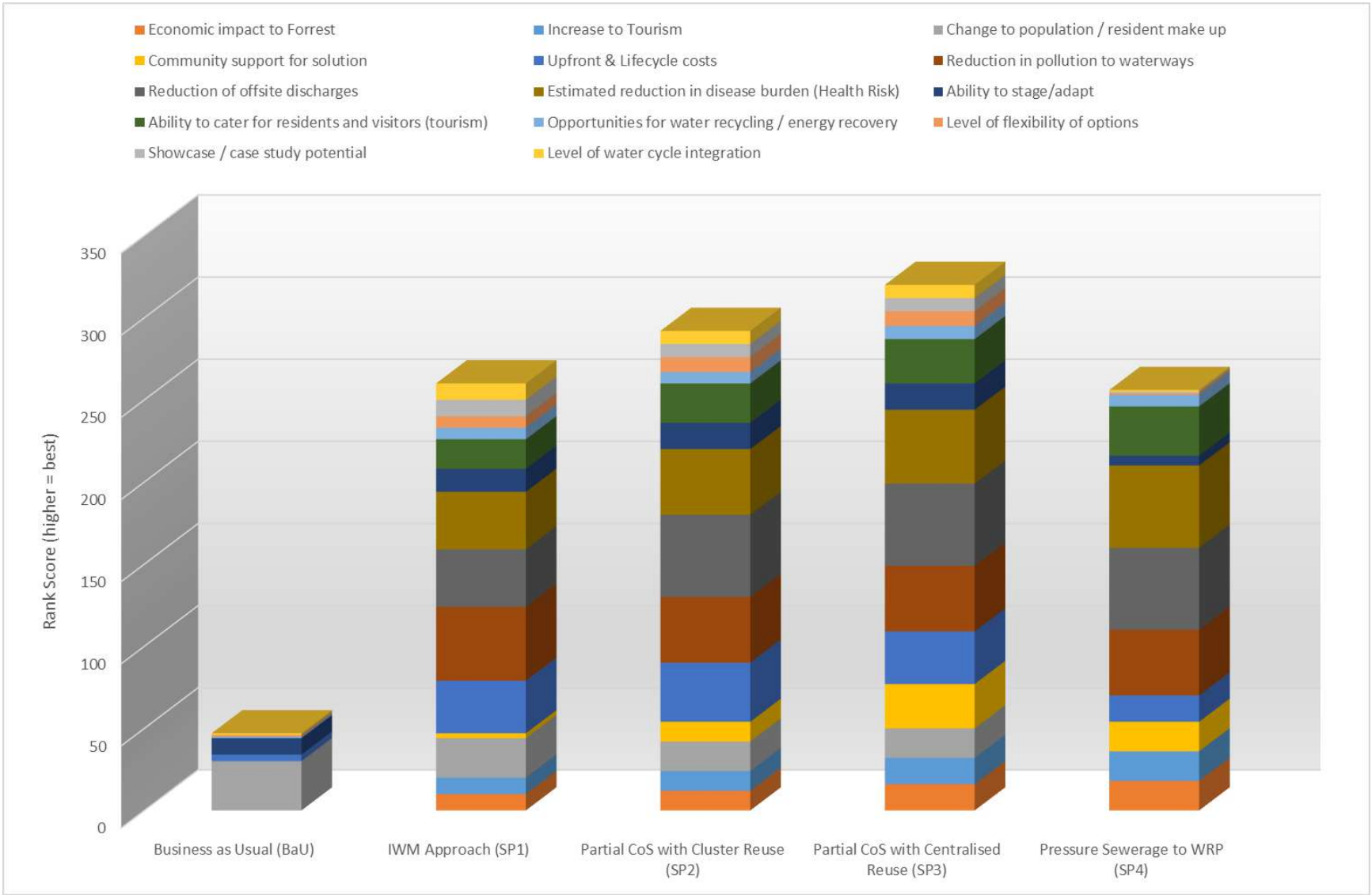

Figure 24 MCA Ranking Summary

11 Outcomes of Solution Package Assessment

The four Solutions Packages taken forward have been assessed utilising a Multi-Criteria Analysis (MCA) based on each of the Measures of Success previously developed from community consultation.

The outcomes of this MCA have determined that Solution Package 3 (Partial On-site Containment with Central Irrigation / Reuse) is the preferred solution for Forrest. This aligns with the overall feedback obtained from the community session held 7th October 2018 along with online / postage feedback received by Barwon Water. Given the Vision and Measures of Success used to score each of the SP's where developed in consultation with the community, it would make sense that the SP most preferred by the community would also achieve the overall highest score.

12 Next Steps / Way Forward

Solution Package 3 has been taken forward to the next stage of the project (Business Case development and reporting) as per Figure 1. This will be a concise business 'pitch' which can be used to discuss potential funding sources and implementation strategies for appropriate agencies. This will include refinement of costing estimates and potential funding and management structures for SP3 as the preferred solution.

13 References

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Appendix A: Community Visioning Workshop Agenda and Feedback

Forrest Wastewater Investigation:
Community Visioning Workshop Feedback Summary

Summary and key themes:

- The Forrest community is keen to see wastewater management in the town improve and want to be directly involved in the process.
- The septic system audit identified a widespread need for improvements
- Protection of the environment, health and the Forrest way of life were considered priorities.
- The Forrest community want a flexible, scalable solution that captures opportunities to recycle resources and is fair to everyone.

Suggested actions:

1. Get permission from presenters for slide deck to be uploaded to YourSay
2. Publish key aspects of feedback summary on YourSay
3. Review the Success Visioning Aspects with project team
4. Publish new visioning aspects survey on YourSay with results to be presented at Feb workshop

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1. Introduction and Project Background

To begin the process, Lindsey Brown from Foundry asked participants why they had come on the night. The purpose of this exercise was to find areas of common interest, flag any issues, in particular any concerns outside the project scope.

Why People Came

Key themes:

- Listen to the audit results
- Hear about other's wastewater challenges
- Explore solutions and possible approaches
- Connect with other community members
- Engage in the consultation process
- Discuss visitors/tourism impacts
- Raise their specific issues or projects (various)

Following further discussion, some key principles for collaboration were established by the group to set the parameters for the workshop series ahead.

Principles for Collaboration

- Transparency: We will all openly share information wherever possible
- Trust: We trust each other to speak and act in good faith
- Respect: We respect each other's opportunity to be heard without taking over the conversation
- Support: We validate people's views and offer compassion
- Solutions-focus: We look positively toward the future with a "can-do" attitude

2. Project Drivers

Kate Vallence from Barwon Water, Doug McNeill from Colac Otway Shire Council and Ben Asquith from DWC presented on the results of the Your Say survey, the audit process and the need for the study in the region.

Questions and feedback from the presentations generally focused on:

- Agreement that bad smells and a desire to stop pollution were the strongest drivers for change.
- The group asked what will be the strategy for including members of the community and property owners who had not completed a Your Say survey or were not in attendance. Specifically, elderly long-term residents and non-resident owners.
- Members of the group were interested in fact that the audit outcomes showed issues with sewage and greywater discharging into drains was widespread.
- Questions were asked of Council regarding compliance and the likelihood some form of enforcement action would be taken.
- Issues around seasonal influx of tourists and wastewater were raised.
- Some people attending saw wastewater solution as critical to unlocking the towns potential, others were concerned it would enable development that they did not wish to see in Forrest.
- People asked if the solution would be scalable and future proofed.

3. Success Visioning

There was significant discussion of the aspects for improvement that the community wanted considered as part of the visioning process. It was agreed to use the aspects from the YourSay survey (in grey below) as a starting point but then the community quickly added several to those. Discussions proceeded on how they would be measured and these are also listed.

Visioning Aspect	Outcomes/Metrics
Environment and waterways	Nutrient loads to waterways Soil nutrient accumulation Reduced offsite discharges

Community and way of life	Land value change (if possible) Economic impact Changes to population/resident make up (eg. Permenant residents)
Tourism and business	Capacity for visitation
Costs to residents	Impact on rates Up-front and life cycle costs Consideration of socio-economic situation Up-front and life cycle costs Fair distribution of costs
Creating options for the future	Scalability Ability to stage/adapt
Human health and wellbeing (pathogens, smells)	Reduction in offsite discharges (odour reduction and health risk) Estimated disease burden (DALYs)
Flexibility of users	Public toilets Residents Business improved service
Good stewardship	Community support for solution Knowledge of maintenance requirements
Innovative, showcase	Offer flexible options to suit individual owners (Danny)
Considers whole water cycle	Incorporate water, nutrient or energy recovery (kL, kgs or kW saved).

Note: Community involvement was also raised as an aspect, however it was agreed that the process would satisfy that in driving towards any option and would not be a point of differentiation between the options to assess.

The group resolved that further work would be done by the project team to improve the wording and streamline the concepts in the visioning aspects before putting this to a broader community survey (again using YourSay) for input on prioritisation.

The group was finally asked what they would be willing to contribute towards the outcome of the vision they had discussed. A mix of organisations and residents participated and offered some heartening suggestions.

What Can I Contribute?

- Tell neighbours: Residents will talk to their neighbours about the project and the progress to date, especially those who may not be aware it is happening

- Face to face conversations: Barwon Water will seek to communicate directly with people in the community who may not have received electronic communication so far

- Talking post: Barwon Water and the Wastewater Working Group will set up “Talking Posts” at community gatherings such as the CFA meeting and near the shops to help communicate about the project with residents

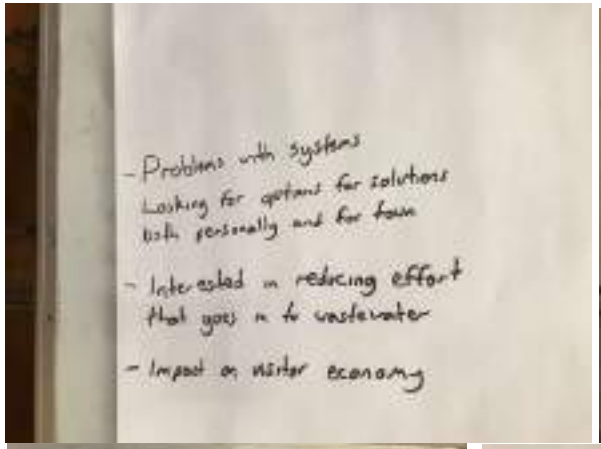
- Bring others to next meeting: Residents will bring other interested community members along to the next meeting to increase engagement

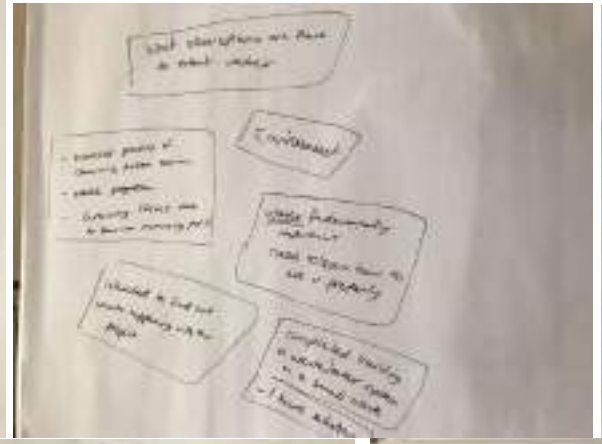
- Send data: Several residents had information on water quality, tourist stop-overs, etc, that they will send through to Barwon Water to include in the investigation

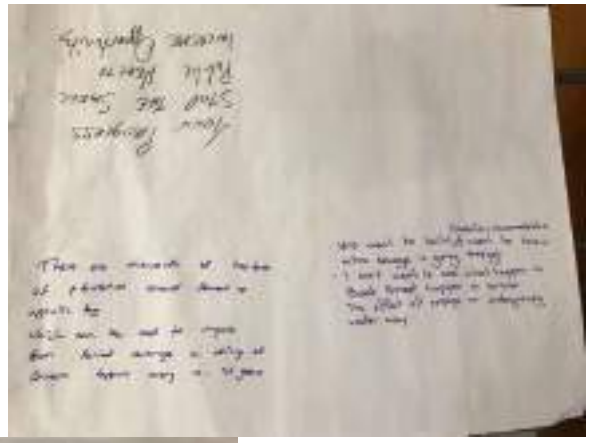
The meeting concluded very positively and with residents generally appearing satisfied with the experience.

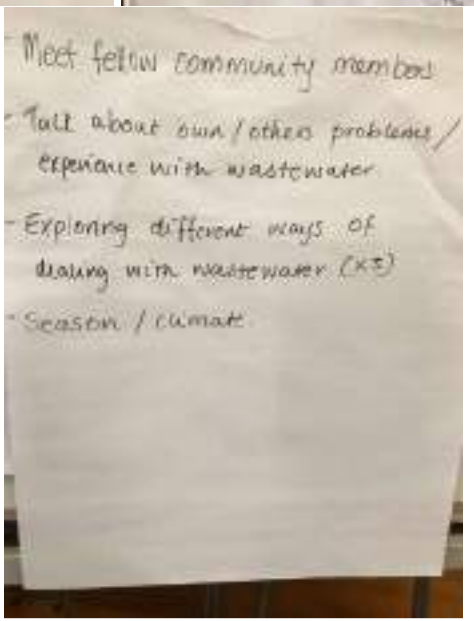
Appendix A – Screenshots of flip charts

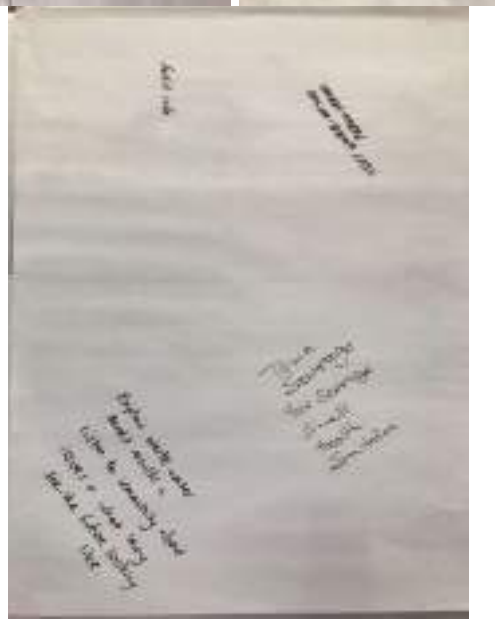
Why Did You Come?





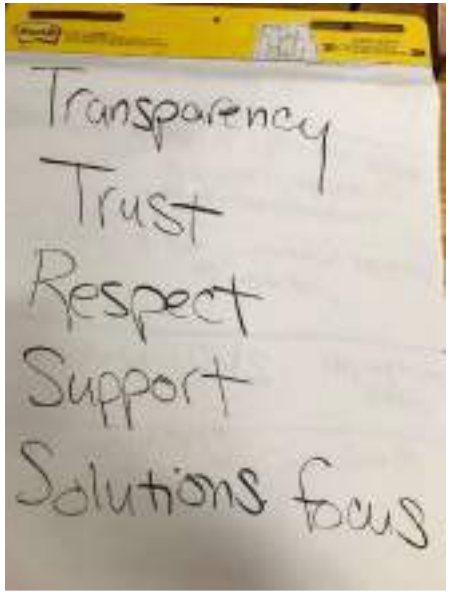




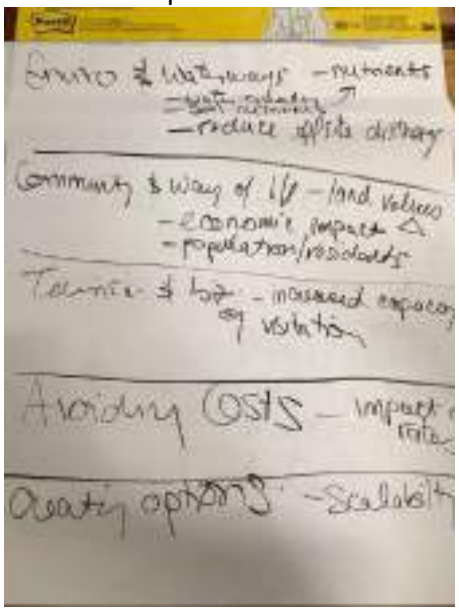


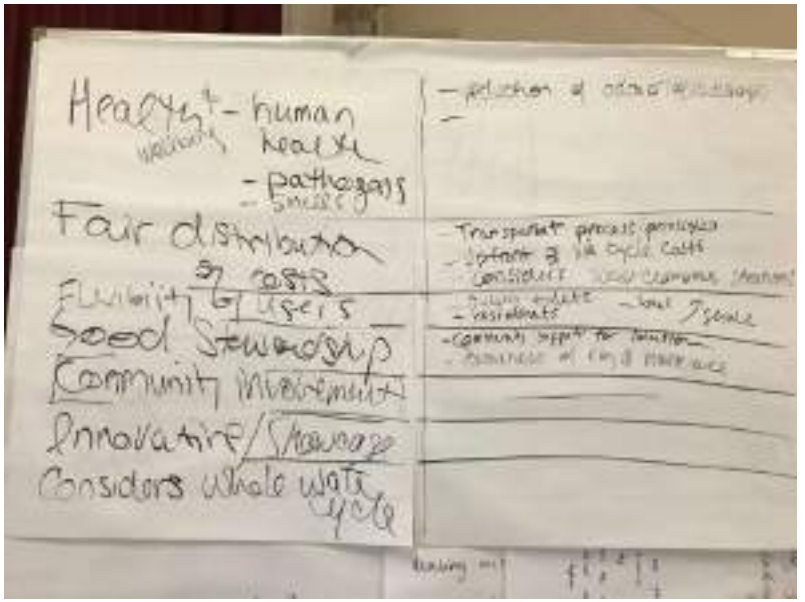
FOUNDRY
FORGE AHEAD

Principles for Collaboration

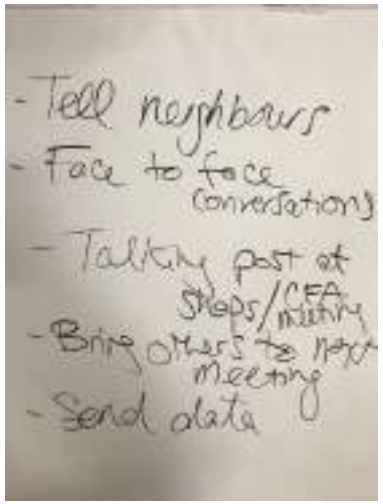


Success Aspects and Metrics





What Can I Contribute?



Appendix B – Workshop Agenda

Agenda Item	Purpose	Who?	Timing
	Welcome, intro and project process	BW (Rhys)	5:30-5:40
Introduction and Project Background	Why are we here today? Group Activity: Why Did You Come Today? Project scope – how we deal with things out of scope How the outcomes from the night will inform the process Principles of collaboration – how we want to work together	Foundry (LB)	5:40-6:10pm
Project drivers	Results of the YourSay	BW (Kate)	6:10-6:20pm
	Outcomes of COS On-site System Audit	COS (DM)	6:20-6:45pm
	Why is this project important? Is there a need to improve wastewater management in Forrest?	DWC (BA)	6:45-6:55pm
Success visioning	Success visioning at table	Foundry (LB)	6:55-7:50pm
	Live polling prioritisation of values		
	How values will be measured		
	What can I contribute?		
Close	Recap next steps and close		7:50-8:00pm

Appendix C – List of Attendees

Forrest wastewater investigation project

Community feedback report

November 2017 to January 2018

Table of contents

Overview

Barwon Water and Colac Otway Shire Council are partnering with the Forrest community to investigate opportunities for wastewater improvements in the township.

This partnership acknowledges the growing role tourism plays in Forrest and the regional economy, and the increasing stress this may place on existing wastewater systems in the town.

The purpose of this report is to share the views of the community sourced through the online and hard copy surveys that were sent to Forrest residents and businesses to complete.

The findings from the survey, along with the views shared at the December 2017 community visioning workshop will be used to develop an overall wastewater vision for the community and help inform possible wastewater solutions.

What we did

A community values survey was created and hosted on the dedicated online platform for the project – www.yoursay.barwonwater.vic.gov.au/forrest and was also distributed to more than 180 homes and businesses in the Forrest community.

The survey was also promoted through the Barwon Water social media channels which resulted in reaching more than 3,000 people, 26 likes and shares and 123 post clicks. The online platform www.yoursay.barwonwater.vic.gov.au/forrest received 246 visits.

The community was invited to share its feedback on:

- What makes Forrest special
- How you felt about wastewater issues (if any)
- What wastewater issues you experience the most (if any)
- What outcome you were seeking from the wastewater investigation

In total, 87 surveys were completed.

A community open house and community visioning workshop were hosted in November and December, 2017, which saw more than 25 people attend the events.

What we heard

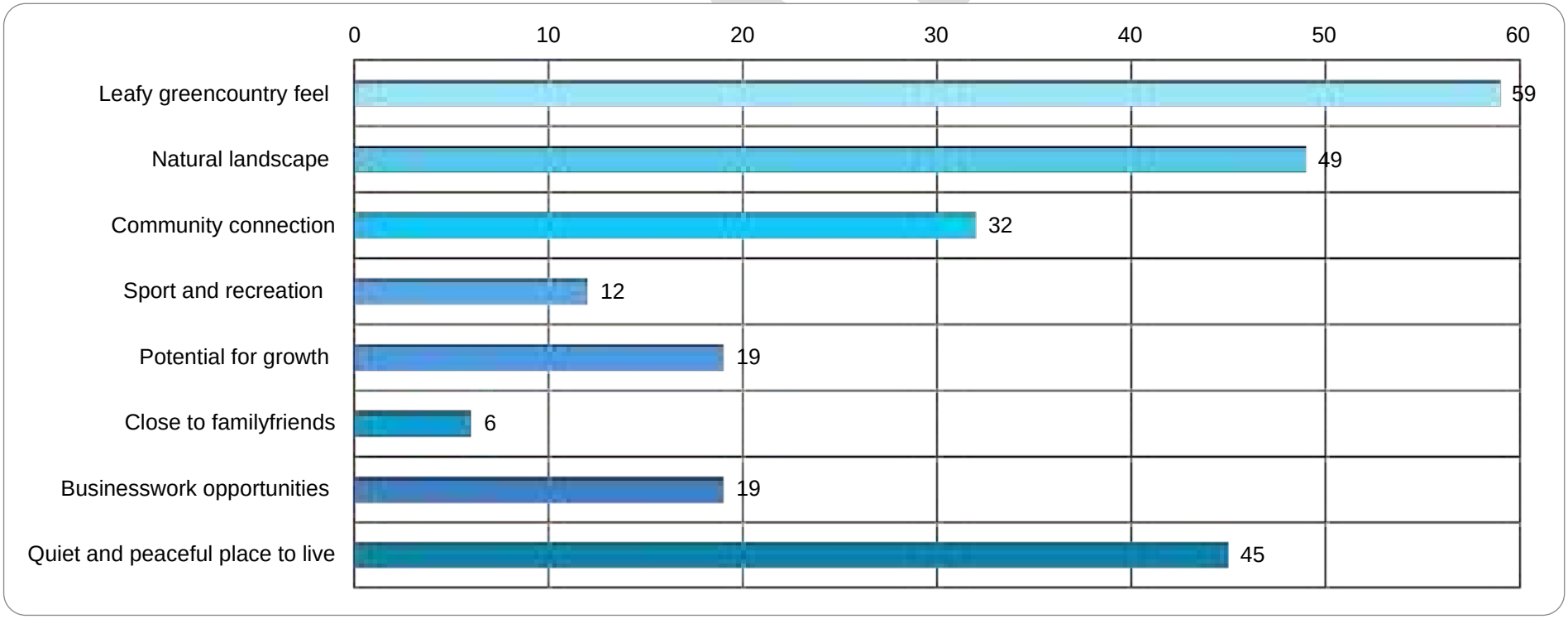
The community were asked to select three aspects that defined what made Forrest special to them.

The top three aspects that were selected were:

1) Leafy green / country feel (59 respondents, 68%)
2) Natural landscape (49 respondents, 56%)
3) Quiet and peaceful place to live (45 respondents, 52%)

The full results are detailed below in Figure 1.

Figure 1: What makes Forrest special to you?

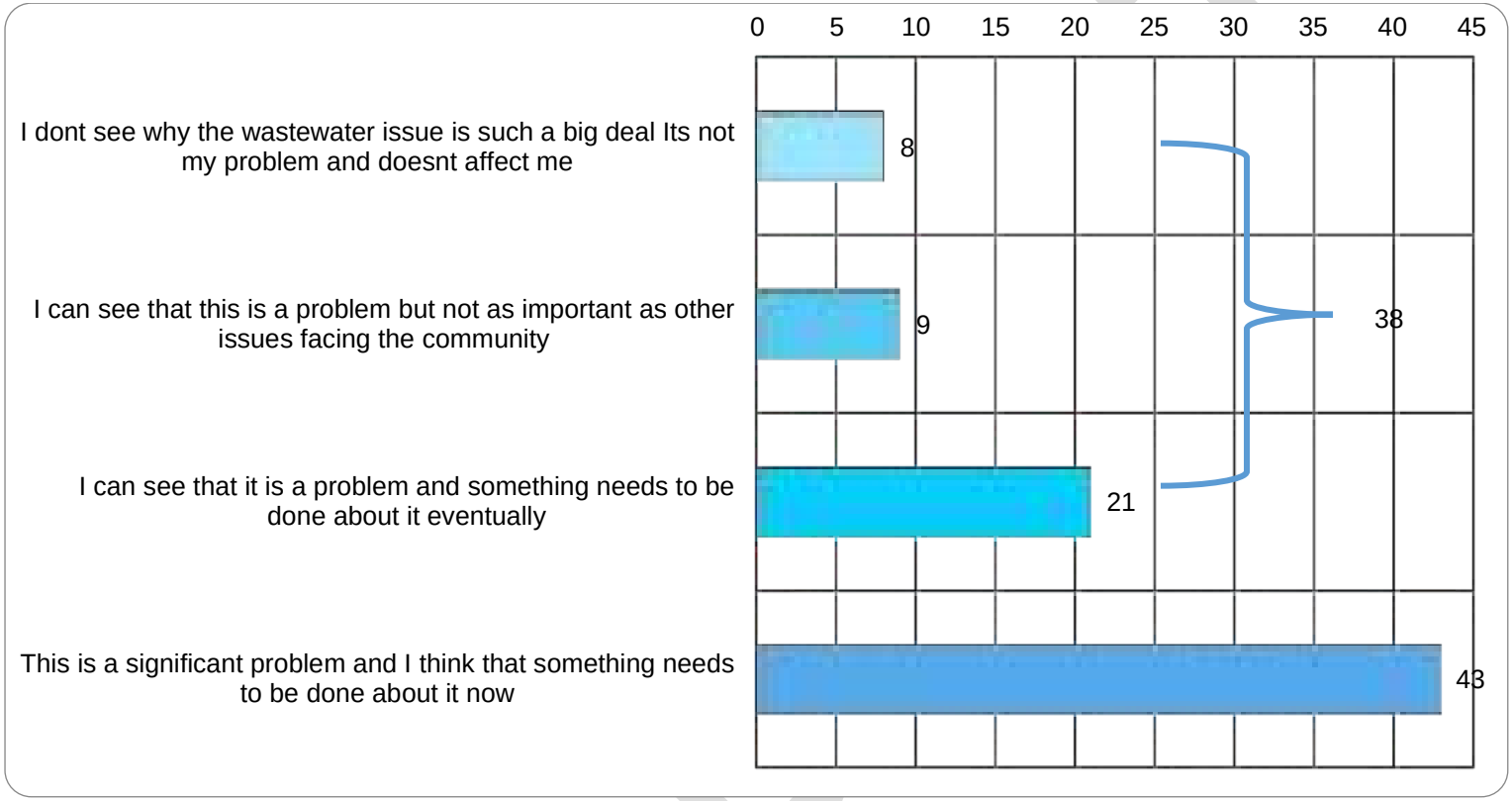


The community were asked to select one statement that characterised their perception or feelings toward the wastewater issued facing Forrest.

The feedback was split, with 43 respondents (49%) stating that ***there is a significant problem and I think something needs to be done about it right now.*** Whereas 38 respondents (44%) views from no problem at all to acknowledging a problem that needed to be addressed in the future.

Figure 2 highlights the full findings.

Figure 2: Which of these statements best characterises how you feel about the wastewater issues facing Forrest?



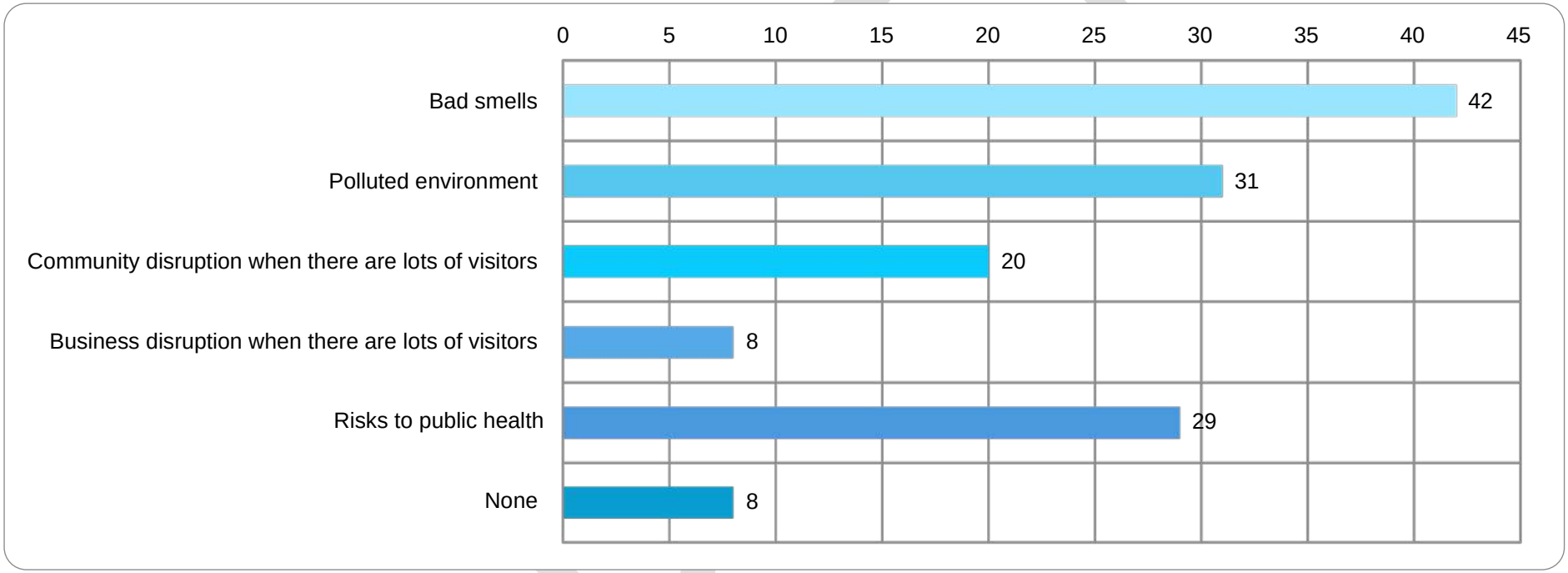
The community were asked to nominate two wastewater issues they experience the most.

The survey found that the top two wastewater issues facing the community were:

1) Bad smells (42 respondents or 48%)
2) Polluted environment (31 respondents or 36%)

The full results are detailed below in Figure 3.

Figure 3: Which two aspects of the wastewater issue do you experience most



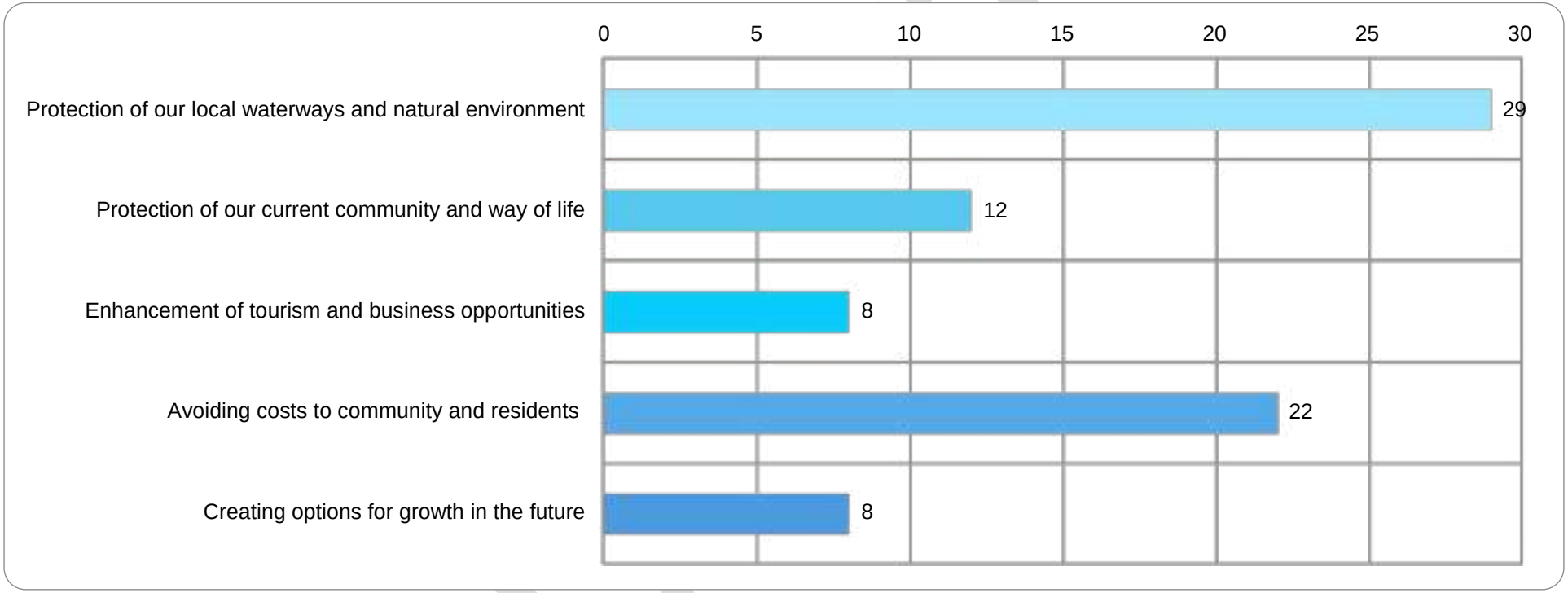
Finally the community were asked what outcome they were seeking from the wastewater investigation.

Respondents were asked to choose from five outcomes, respondents could also provide further comment to this question.

The most selected outcome from the project was: ***Protection of local waterways and natural environment***.

The full results are details below in Figure 4.

Figure 4: What outcome are you most seeking from the upcoming wastewater investigation?



Respondents could also provide additional comments to the survey, if their issue was not presented in the lists to choose from. The theme of this feedback is collated below:

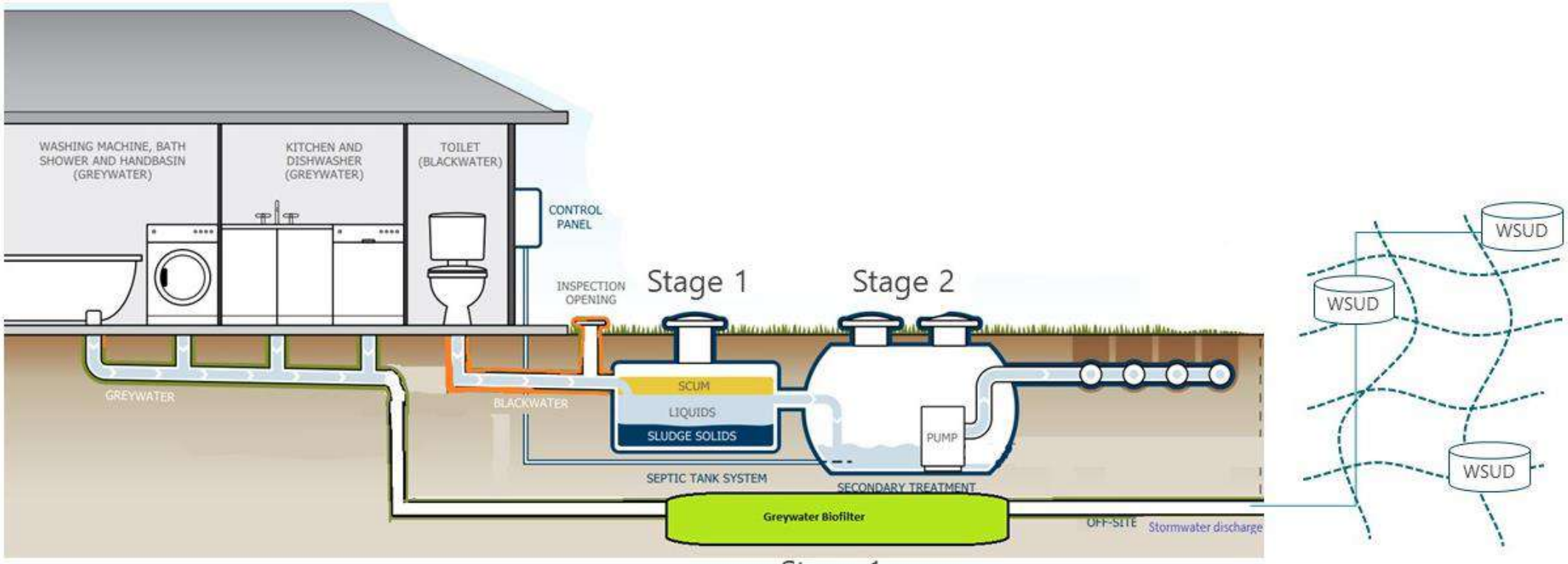
Appendix B: Options Presented to Community

Table 32 Options Presented to Community

Option	Scale	Inclusion in Solution Package?	Inclusion are a Later Stage?	Details / Explanation
New, upgraded secondary treatment system	Lot-scale	SP1, 2 and 3	-	Replace / upgrade existing septic systems to achieve partial to full on-site containment – new secondary treatment system (e.g. aerated treatment unit or recirculating media filters) with subsurface irrigation to meet regulatory (EPA CoP) requirements.
Septic Tank Effluent Pump (STEP) / Septic Tank Effluent Gravity (STEG)	Lot-scale	SP4	-	New watertight, compliant septic tank to be installed on-site with either gravity or pressure discharge of partially treatment (liquid) portion of wastewater to sewer network. To be further treated downstream – provides reduced infrastructure requirements due to reduced flows / loads being sent off-site.
Cluster Reuse (Irrigation) System	Precinct-scale / Whole-of-town	SP1, 2 and 3	-	System to collect treated effluent from on-property systems for polishing (potentially Class B) and irrigation across community / public open space. Cluster systems are typically set up at a precinct scale to treat wastewater from a group of properties within the vicinity of the nominated community / public open space. Initial upfront on-property treatment allows for reduced cluster treatment infrastructure. Cluster system can typically consist of small control shed (filtration and ultraviolet disinfection) and wet weather storage tank.
Central or Cluster Reuse (Irrigation)	Precinct-scale / Whole-of-town	SP2, 3 and 4	-	Surface irrigation of Class C or B effluent in an agricultural (non-edible) scenario such as fodder or grazing (e.g. Lucerne). Can be operated as hybrid recycled water / land application system or full beneficial reuse with discharge to waterway.
Commercial Reuse / Agricultural Irrigation	Precinct-scale / Whole-of-town	SP2, 3 and 4	-	Supplemental supply to local Forrest growers for irrigation of hops / non-edible crops or local forestry. Feasibility dependent on market demand for alternative water supply and suitability of available sites.
Water Recycling Plant (WRP)	Precinct-scale / Whole-of-town	SP3 and 4		Facility that utilises a mix of biological, chemical and mechanical processes to treat raw sewage to a standard appropriate for either reuse (e.g. irrigation) or discharge to the environment.

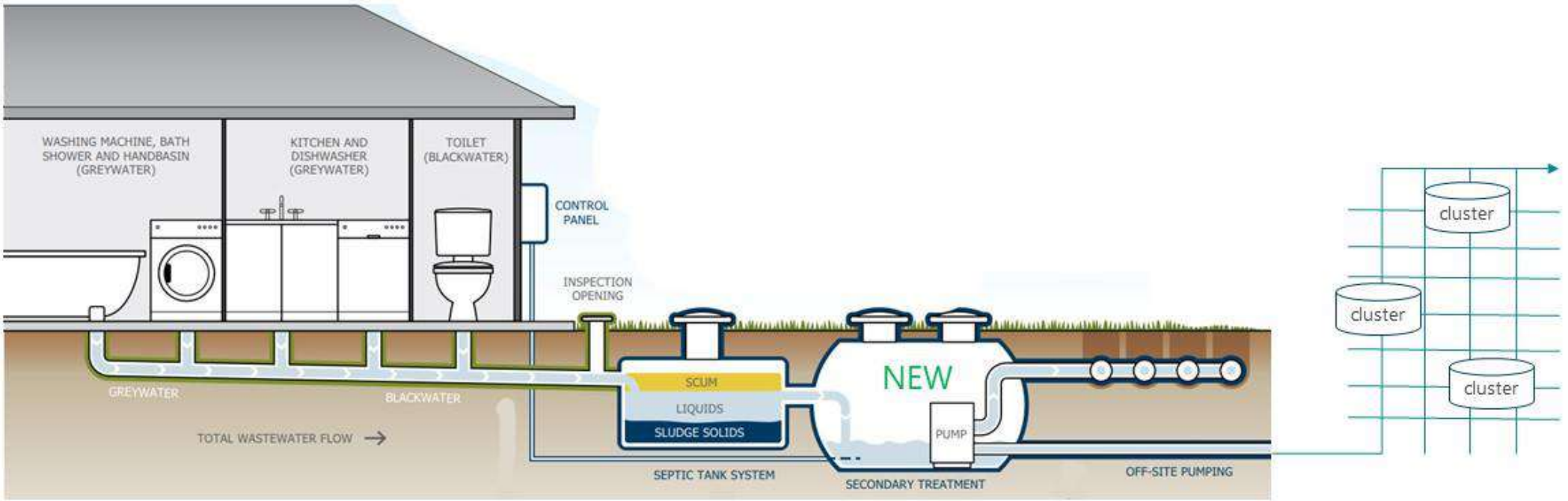
Option	Scale	Inclusion in Solution Package?	Inclusion are a Later Stage?	Details / Explanation
Effluent sewer	Precinct scale / Whole-of-town	SP2 and 3	Yes SP1	Operates in exactly the same manner as a pressure sewer. However, on-lot treatment means it is only required to convey primary or secondary quality effluent.
Reticulated sewerage.	Whole-of-town	SP4	-	This has been taken forward as a potential option (Solution Package 4). The focus has been on pressure sewer as initial assessment of gravity sewer has indicated it would involve greater overall costs due to variable topography and ability to achieve gravity fall on lots. Low pressure sewer, pump stations and rising main to existing sewerage network or central Water Recycling Plant.
Transfer to existing Birregurra WRP	Whole-of-town	-	Not at this stage	Distance to existing Birregurra WRP is 27-28km and therefore was determined to be cost prohibitive. Reticulated sewerage with reuse and / or discharge to Barwon River was taken forward in Solution Package 4.
Biofilter	Lot-scale	SP1	-	Biological filter utilised to treat excess greywater from BPO upgrade sites within Forrest. Can consist of slotted / drilled distribution pipe(s) for dosing of greywater across filter media (e.g. coconut fibre above sand / gravel layer) with discharge of treated water via an underdrain connected to stormwater drainage (bioretention swale for further treatment).
Bioretention Measure	Lot-scale / Precinct-scale	SP1	-	Measures including swales, basins and raingardens (depending on scale) which aim to capture stormwater to be filtered through densely vegetated sand / loam filter media. Treated water either discharges via an underdrain, or potentially directly into groundwater in sandy environments. The water is treated via filtration, absorption and biological processes within the media / vegetation. Measures also provide retention of water to release it back into the environment in a manner more consistent with the natural flow regime.

Solutions Package 1

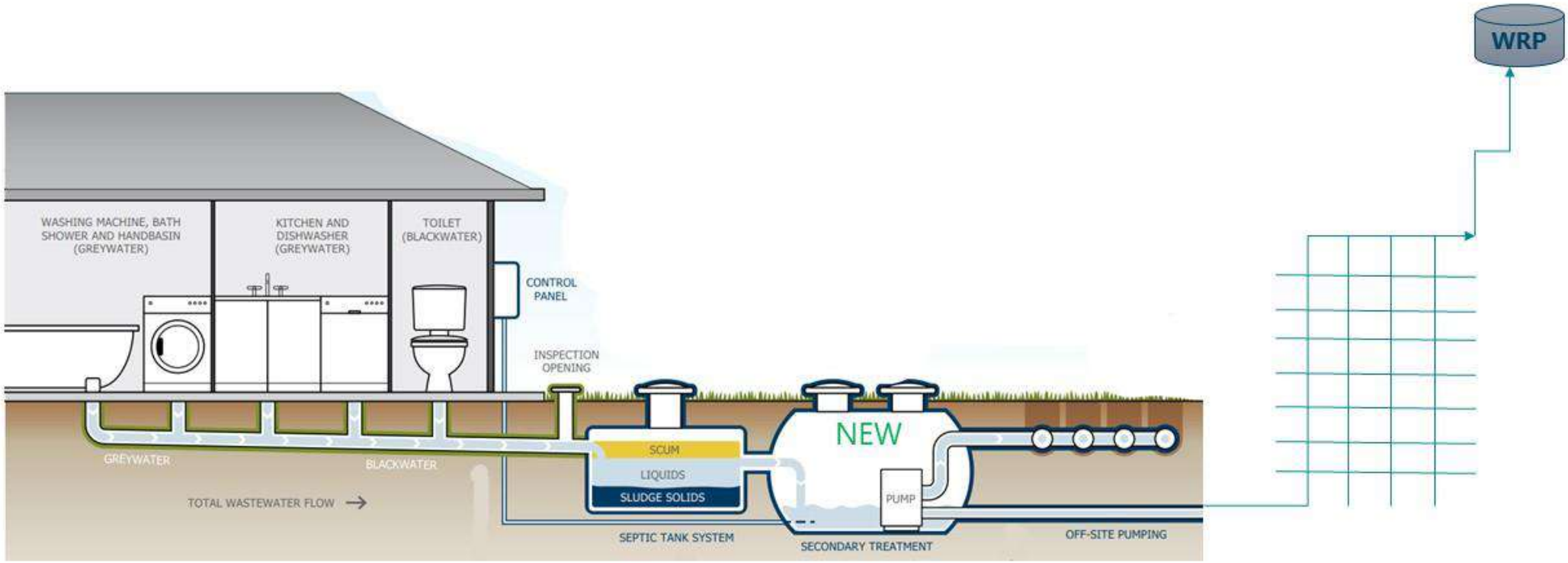


Stage 1

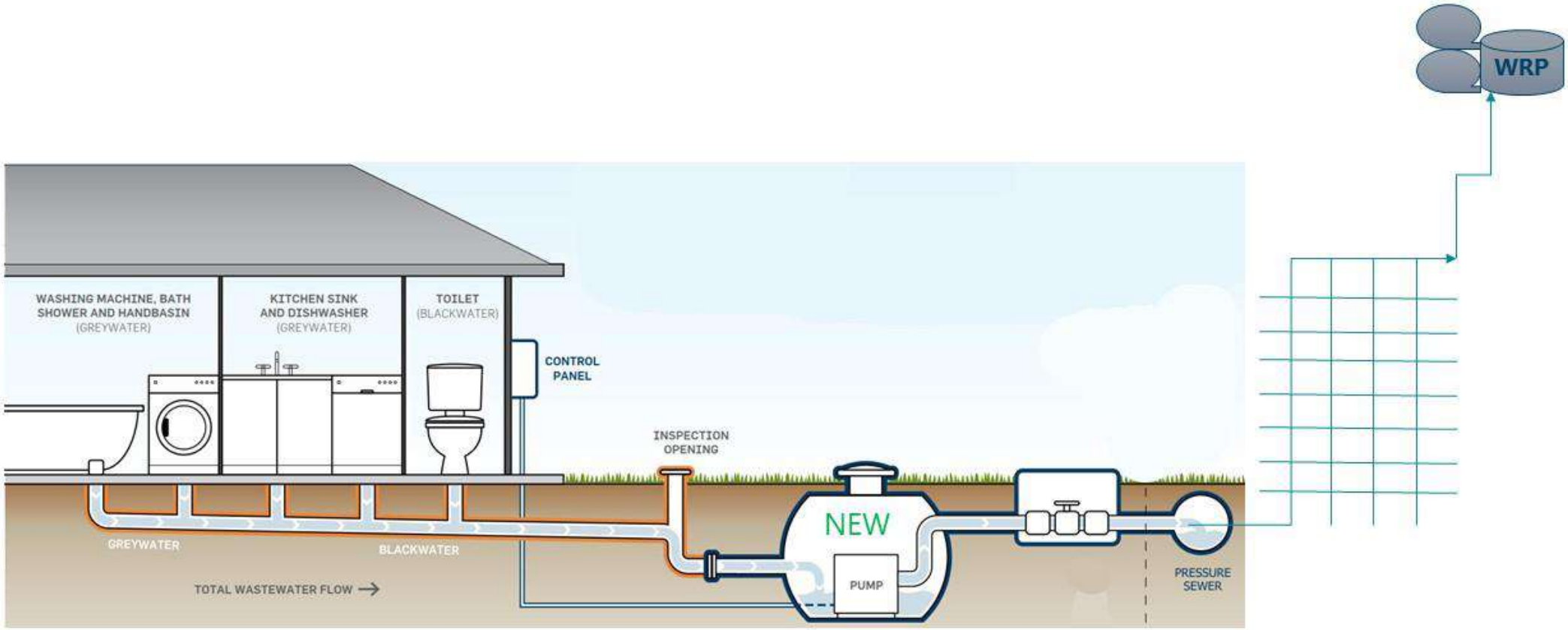
Solution Package 2



Solution Package 3



Solution Package 4



Appendix C: Community Consultation Feedback – Option Development

Table 33 Community Consultation Feedback

Feedback / Comment	Feedback Source	Inclusion in Solution Package?	Inclusion are a Later Stage?	Details / Explanation
Provide reticulated (conventional) sewerage for town.	Session feedback / Yoursay survey	SP4	-	This has been taken forward as a potential option (Solution Package 4). The focus has been on pressure sewer as initial assessment of gravity sewer has indicated it would involve greater overall costs due to variable topography and ability to achieve gravity fall on lots.
Transfer to existing Birregurra WRP	Session feedback	-	Not at this stage	Distance to existing Birregurra WRP is 27-28km and therefore was determined to be cost prohibitive. Reticulated sewerage with reuse and / or discharge to Barwon River was taken forward in Solution Package 4.
Solution must future-proof and allow for growth.	Session feedback / Yoursay survey	All	-	Accounted for in all SP's – refer to Table 23 to Table 26 for details of how growth will be accounted for in each option. Considered a measure of success.
Existing situation is not acceptable.	Session feedback / Yoursay survey	-	-	The overwhelming feedback from the community session was that the current wastewater management situation within Forrest is unacceptable and an improvement is essential. Business as Usual (BaU) scenario will be assessed in conjunction with all SP's.
Need to consider improved stormwater management / treatment (consistent issue).	Session feedback	SP1	-	SP1 includes additional improvements to stormwater treatment / infrastructure as part of the design. Refer to description for further details (Table 23).
Additional and improved public toilets are essential.	Session feedback / Yoursay survey	All	-	All SP's will include provision for additional public toilets with improved facilities that can cope with additional tourist loads. Potential sites include the mountain bike meeting point to the south along Grant Street and the town hall.

Feedback / Comment	Feedback Source	Inclusion in Solution Package?	Inclusion are a Later Stage?	Details / Explanation
Climate and soils are not suitable for effluent application.	Session feedback / Yoursay survey	All	-	The design and modelling (for all SP's) has been based on a highly conservative application rate of wastewater both on- and off-property to account for these constraints. Any excess wastewater not able to be sustainably managed on a property will be directed to an off-site irrigation area. All options include wet weather storage for effluent irrigation.
Cutting edge opportunities for innovation e.g. fungi treatment systems, solar panels, biofuels, alternative power sources, etc.	Session feedback / Yoursay survey	To be confirmed.	Yes (All)	Packages can incorporate additional, more innovative or value added components where specific opportunities are identified. However, there not currently not a fundamental component of any one Package. DWC will assess the relative opportunity for innovation and new approaches to be integrated into each Package as part of the Options Assessment process.
Use of treated water for local Community / Public Open Space – don't move the problem out of town.	Session feedback / Yoursay survey	SP1 and SP2	Yes (All)	Some community members were supportive of the idea of utilising treated water for irrigation of local community areas / public open spaces. The current potential reuse sites have been selected based on available land and proximity to town. These include potential use of water across nature strips, playing fields and enhanced liveability area (as per feedback).
Consideration of alternative treatment systems such as reed beds.	Session feedback / Yoursay survey	SP1	Yes (SP4)	Alternative treatment systems such as reed beds, constructed wetlands, biofilters, etc. are currently being considered as part of SP1 (refer to Table 23).
Provide water for bushfire management	Session feedback	To be confirmed.	Yes (All)	All SP's provide water for reuse purposes, which could include bushfire management (to be confirmed in the later stages).
Include management / service charges for upgraded systems (transparent on-going costs).	Session feedback	All	-	All options assume a single accountable authority will manage and maintain the upgraded systems. Details of costings to be further developed as part of next stage (Options Assessment). Funding sources will be explored and better defined during business case development.
Consider ongoing funding approach for upgraded on-site systems over time.	Session feedback	All	-	See above.

Feedback / Comment	Feedback Source	Inclusion in Solution Package?	Inclusion are a Later Stage?	Details / Explanation
Installations approved / maintained by external contractor.	Session feedback	All	-	See above.
Third pipe reuse of effluent back to properties.	Yoursay survey	To be confirmed.	Yes	Third Pipe reuse is a potential option for the town, however the high treatment requirements and costs mean that the economies of scale are unlikely to be available based on the current number of properties. Reuse via irrigation has currently been taken forward as the more viable option as part of all SP's. It is also recognised that the climate and soils in Forrest do not create a high residential water demand for irrigation.

Appendix D: Option Assessment Workshop Minutes

WORKSHOP: Solution Package Assessment – Forrest Wastewater Investigation

MINUTES AUGUST 22, 2018 9:00 AM – 12:00 PM BARWON WATER, 55-67 RYRIE ST GEELONG

MEETING CALLED BY	Barwon Water
TYPE OF WORKSHOP	Solution Assessment Workshop for the Forrest Wastewater Investigation
FACILITATOR	Rhys Bennett (BW)
NOTE TAKER	Rhys Bennett / Jack Sharples (Decentralised Water Consulting)
ATTENDEES	Ben Asquith (DWC), Jack Sharples (DWC), Kate Vallence (BW), Rhys Bennett (BW), Peter Van Wyk (BW), Peter Morgan (BW), Kate Sullivan (BW), Doug McNeil (COS), James Maw (COS), Ange Nichols (RDV), Jacqui Beck (RDV).

1 Background

Stakeholders were engaged in a workshop to discuss the four Solution Packages (SPs) developed for the Forrest Wastewater Investigation and determine how each of the Packages will be assessed based on the Measures of Success (MoS) previously defined in consultation with the Forrest Community.

2 Objectives

1. Work through each of the Measures of Success and determine an appropriate score (where possible) for each of the Packages in addition to review of relative weightings developed for the Multi Criteria Analysis (MCA).
2. Determine how to best facilitate community inputs to the scoring process for each element appropriately during the upcoming session (particularly for MoS's that are opposed to each other).
3. Discuss the upcoming community session and how it will be run / format.

3 Discussion Items

4. For all SPs, need to be assessed as stand-alone solutions which address the full Structure Plan growth and not options which could morph from one into another at a later date. If at a later date once a preferred option is identified, we want to explore ways to stage it, then so be it.
5. SP1 was developed to incorporate an Integrated Water Management approach (as per the recent Victoria Framework) and provide dual benefits of both potential wastewater and stormwater management within Forrest. However it is recognised that there are constraints / restrictions with SP1 regarding Structure Plan growth and initial servicing of commercial sites. A level of managed

off-site discharge (treated greywater to upgraded stormwater infrastructure) will continue as part of this option.

6. More defensible, robust numbers on visitation to Forrest would be very valuable and help support business case taken forward. DELWP should have new data but hasn't been released yet.
7. Agreement on the current weightings developed by DWC based on community feedback to date (refer to Table 2 – larger weighting means MoS considered more important).
8. Discussion on Structure Plan in relation to population change. Forrest 'Way of Life' MoS is more about the desire of residents for the town to remain as it currently is i.e. density of housing, country feel, leafy, aesthetically pleasing etc. How do each of the packages change that, either better or worse?
9. Costs - how we communicate this to the community? We need to understand what the costs of the baseline 'should' be for customers (Business as Usual), that way they can see what extra they could be paying. At this stage all we can really advise is that the more expensive the option, the more costs that would likely be passed on to the property owners.
10. Agreement that a simple scoring system for the community session is essential e.g. Like it, Can live with It, Don't like it. Alternatively, the SP's can be ranked overall (1-4) based on the outcomes to MoS that are presented and discussed.
11. Currently looking at new date for community session (Sunday 7th October).

4 Outcomes

Table 1 contains a summary of key actions identified during the workshop.

Table 1 Initial Stakeholder Discussion Summary

Action	Person	Status
For all SP's rather than directing a specific spot for the Public toilets, include a comment in the legend that "public toilets would be part of this option at a central location to be determined."	DWC / BW	Done
Forrest caravan park classification / map colour to be updated to highlight that an upgrade will be required given that only part of the land available is public open space and the current system is far from compliant.	DWC / BW	Done
Provide Barwon Water with site details of northern forested area that DWC identified during fieldwork as a potential Water Reuse Site (likely DELWP owned site).	DWC / BW	Provided
Complete system audit data for Forrest is currently be complied. COS to provide to DWC when available.	COS / DWC	To be provided
BW to check what their statement of obligations says about charging customers over and above the standard sewer charge.	BW	Done
Investigate the tip site as potential treatment plant location – mentioned during community session.	DWC / BW	Done

Action	Person	Status
May need to capture relative disruption / disturbance of each SP and how it will affect home owners (Way of Life?).	DWC / BW	Noted
Investigation fungi research discussed during community session (covers innovation MoS).	DWC	Ongoing

4.1 Measures of Success

Economic impact / Increase in Tourism

- SP1 has been scored accordingly (5 – 'Satisfactory') to account for constrained ability to meet Structure Plan / commercial site growth.

Change to Population (Forrest Way of Life)

- Change MoS wording to *'Change to Way of Life'* to capture this Vision Theme more broadly as it is mentioned. To be left to community to discuss and rank SP's with this in mind.
- May need to include relative disruption to Way of Life from each SP e.g. on-lot infrastructure installation, local Water Recycling Plant.

Economic Assessment

- Upper end costs provided by DWC are based on what is required to meet Structure Plan growth (multiple variables which need to be factored in). As this is considered a minimum requirement of any SP, use these costs in assessment and reporting.

Fair and Equitable Costs to Residents

- All SP's to be scored the same as all assume appropriate management / funding structure is established as a minimum.

Ability to Stage / Adapt

- In context of Structure Plan – all SP's meet targets to a varying degree and has been captured in relative scorings. Upfront infrastructure (and inflexibility associated with this) that needs to be built is captured in costings and therefore will be scored accordingly.

Tourism / Public Toilets

- All SP's provide provision of additional public toilets – SP4 provides greater flow buffering capacity overall, however SP3 is not too dissimilar.

Show Case Potential

- SP1 is most innovative overall, however wetland / bioretention measures and biofilters are common in context of stormwater / greywater treatment. SP2 / 3 will also be scored well.

Water Recycling & Energy Recovery

- Group comfortable with DWC's current scoring / assumptions.

Table 2 MoS Weightings

Visioning Aspect	Measure of Success	Weighting
Ensure protection of human and environmental health	Reduction in pollution to waterways Reduction of offsite discharges Estimated reduction in disease burden	5 (all)
Enhance community and way of life	Economic impact to Forrest Increase to Tourism Change to population / resident make up Community support for solution	2 2 3 3
Give full consideration of costs to residents and community	Up-front costs and life cycle costs Fair and equitable distribution of costs	4 (all)
Create flexible wastewater options for the future	Ability to stage/adapt Ability to cater for residents and visitors (tourism)	2 3
Showcase innovation and best practice	Opportunities for water recycling and energy recovery. Level of flexibility of options Showcase / case study potential Level of water cycle integration	1 (all)

Appendix E: Community Consultation Feedback – Option Assessment

Permanent resident?	Package 1	Package 2	Package 3	Package 4	Comments
Y			2	1	
Y	3	4	2	1	Package 4 - No on site management by resident landowner. Treated water (subject to EPA) could be discharged to West Barwon River to enhance flow, compare with alpine snow resorts in north east Victoria (Falls Creek Resort discharges to an alpine stream). "Ugly wastewater treatment plant" could be screened with suitable trees/shrubs. Other packages while chapers require resident maintenance. Difficult om getting plumbers and electricians to come to Forrest to service equipment.
N (plan to build 2019)	4	2	1	3	Most appropriate for long term growth
Y	3	2	1	4	Package 3 - gives best opportunity for growth, good use of recycled water, especa=ially use of excess water to north of town. Package 2 - could be difficult to contain recycled water within town during wet winter months (for 2 and 3, it's great to have on-site systems under one management). Package 1 - as per package 2, difficult to contain the volume of water during winter. Package 4 - very expensive, and sets a limit on growth.
Y	4	3	2	1	
Y	3	2	1	4	I scored 3 as my preferred option because: - allows for town growth - seems to have less visual impact than package 4 - seems to be simpler system which can be added to - recycled water use Package 1 + 2 - rely on individual responsibility so we may encounter some problems in the future - human fallibility Package 4 - Too complicated, too inflexible for our little town
Y	4	3	2	1	SP3 + SP2 - have no provision for stormwater, therefore they do not adequately address rainfall + topography of town. SP2 - disproportion occupancy patterns due to influence of Air BnB etc. Houses are selling for tourism development not occupancy with high occupancy rates. Only SP4 adequately provides for commercial development and supports EO Strategy + Regional Tourism and Growth Strategies.
Y	3	2	1	4	Prefer the flexibility of option 3 and onsite use options for gardens while considering re-use of excess wastewater for community use.
Y	4	3	1	2	Groundwater saturation will be most alleviated by packages 3 and 4. The status at present will not be chnaged greatly by packages 1 + 2 in my opinion. Package 3 allows for some reuse of wastewater on-site if required (green values). Maintenance of systems by water authorities ensures hygiene standards are consistent. Future development of the township and businesses is encouraged by better wastewater management of packages 3 + 4. Thank you for the process!
Y	4	3	2	1	Need to keep the control of the system in house with Barwon Water. Any other solution will end with contractors cutting corners and we will be back here in 10-15 years.
Y	4	3	1	2	Like the disposal to river idea.
Y	3	2	1	4	Solves the problemns and recycles the wastewater
Y	3	1	2	4	Need water for roses and plants
Y	4	3	1	2	Package 3 allows more flexibility
Y	4	3	1	2	It'll be good to use greywater for domestic use
Y	4	3	2	1	I want for gorwth for town

Permanent resident	Package 1	Package 2	Package 3	Package 4	Comments
Y	1	2	3	4	Do not want water reclamation plant or anything on his property. Definitley not, please remove from plans. Not opposed to sewer. Options which take up private property least preferred.
Y	4	3	2	1	Full treatment only solution
Y	4	2	1	3	Use of water on property, relatively less cost. Package 4 problematic regarding distance to treatment areas and possible problem as town grows
Y	1	2	3	4	I have an Ozzi Clean Treatment Plant with all treated wastewater used and retained onsite.
Y	4	3	2	1	SP1 - not good for businesses, no expansion SP2 - not enough recycling SP3 - not too bad SP4 - creates jobs and stops all smells from emanating into town
Y	4	3	2	1	SP1 - not enough recycling SP2 - not enough recycling and wastewater still escapes into the envionment SP3 - nearly good enough SP4 - the best as good for business, no smell, job creation
Y	3	1	2	4	Because I want to water the roses and plants with the treated grey water.
Y	1	4	3	2	Package 1 seems to be at the lowesr cost to residents yet a reliable solution to both stormwater and wastewater issues. Package 4 is obviously the most expensive solution however we feel that residnets would need to wait an extensive amount of time to enact this solution so current issues would not be addressed for some time. If not for the time attached, this package would be our number 1 preferred package
N					We are satisfied with our current system. Costs to ratepayers are a major issue for us (rates could become excessive). How do you get at the pumps if they break down?
N	2	1	3	4	We only reside at the property 3-4 nights per month throughout the year. We do not rent the property out, it is for our own use only. Our current septic is a 90 meter relm system that easily meets our needs. We do not want any changes. We "cannot" afford any upgrade.
N			1		Recycled water reuse high priority with minimal additional cost to each lot i.e. from $55K to $70K.
N	1	2	3	4	The septic set up we have is adequate for our needs and we'll still need an upgrade with package 1. Cost is a factor, how will households pay for it? We don't want to see Forrest grow too much. We moved there 25 years ago for the quiet lifestyle and at peak times the town can get very busy. Would package 1 still be suitable for the needs of businesses in town? Package 4 would be excellent but I can't imagine may people in town being able to afford $116K.
Y					Any of these costed packages would be well outside my ability to pay for them. Even a payment plan is out of my reach - I am 70. Still working, but don't want to work forever. If this became a mandatory solution I would have to sell up and leave.
N				1	For the future growth of Forrest and district and to eliminate the discharge which is being created more and more often.
N	4	3	2	1	Forrest needs to have a full reticulated sewerage system now. The growth in the population of Forrest as a visitor destination has overstretched the existing septic tank systems. I am concerned that in the latest iteration of the packages the language is unfavourable to package 4 (e.g. in the pros for package 3 "no requirement for an ugly wastewater treatment plant"). Yes - full sewerage will be very costly and disruptive, but is the best solution for the long term.
Y	2	4	3	1	Package 1 - lower cost, not so fussed about treatment. My cousin has one and it's good. Tank under ground, no ugly sites Package 2 - Cost is high but clean and efficient. Predictive with minimum waste. Tank underground. No ugly sites. Nice lawn. No smells. Package 3 - Pipes could clog up. Weather wear. Smells stinks. Ugly site. Could burst. Not in my garden. No thanks. Vehicle or 4x4 could hit pipes. Package 4 - Package not good.

Appendix F: Option Assessment MCA Results

RANKINGS

	Enhance community and way of life				Economic		Environmental and Human Health			Flexible options		Showcase innovation and best practice					
	Economic impact to Forrest	Increase to **Tourism**	Change to population / resident make up **(Way of Life)**	Community support for solution	Upfront & Lifecycle costs	Fair and equitable distribution of costs	Reduction in pollution to waterways	Reduction of offsite discharges	Estimated reduction in disease burden **(Health Risk)**	Ability to stage/adapt	Ability to cater for residents and visitors **(tourism)** - **public toilets**	Opportunities for water recycling / energy recovery	Level of flexibility of options	Showcase / case study potential	Level of water cycle integration	*Weighted Score*	**FINAL RANK**
Weighting (5=most important, 1=least)	2	2	3	3	4	4	5	5	5	2	3	1	1	1	1		
Option	**Description**																
BaU	Business as Usual (BaU)	0	0	10	0	1		0	0	0	5	0	1	1	0	1	*47*	**5**
SP1	IWM Approach (SP1)	5	5	8	1	8		9	7	7	7	6	7	7	10	10	*260*	**3**
SP2	Partial CoS with Cluster Reuse (SP2)	6	6	6	4	9		8	10	8	8	8	7	9	8	8	*292*	**2**
SP3	Partial CoS with Centralised Reuse (SP3)	8	8	6	9	8		8	10	9	8	9	8	9	8	8	*320*	**1**
SP4	Pressure Sewerage to WRP (SP4)	9	9	0	6	4		8	10	10	3	10	7	1	1	1	*256*	**4**
						All Satifactory												

Appendix G: Cost Estimate Basis

Component	Scenario	Capital Cost Basis	Notes
Existing on-site wastewater management system upgrades	BaU (gradual owner upgrades)	Typical contractor rates for supply and installation of septic tanks, secondary treatment systems, absorption trenches/beds, pressure subsurface compensating irrigation. Assumes a 4% renewal rate triggered by catastrophic failure, house extension or rebuild. Also allowance for 5% of land application systems requiring renewal or repair p.a.	Current market rates for an installation by an individual property owner (checked against local delivered costs) **that meets EPA CoP**.
	SP1 (Authority managed)	Water Authority contractor rates for supply and installation of septic tanks, secondary treatment systems, absorption trenches/beds, pressure subsurface compensating irrigation. Delivered rates obtained from the Yarra Valley Water Park Orchards On-site Containment Trial.	Slightly (~10-20%) higher costs for Metropolitan Melbourne retained as factor of safety.
	SP2-3 (Authority managed)		
Partial On-site Containment Systems	Residential (SP1-3)		
	Commercial (SP1-3)		Based on site specific analysis and information (including site visits). Typically included a flow balancing tank and pump set as a minimum. Some included additional treatment capacity due to larger flows and loads.
Pressure Sewer Unit	SP4	Typical supply and installation rates as provided by unit suppliers and installation contractors. Includes PS unit, property discharge line, boundary kit and smart controller.	
On Property Plumbing and Electrical Costs	All	Rates taken from Birregurra project and adapted based on a pressure sewerage or on-site upgrade arrangement. Typically involves reduced lengths of plumbing upgrades due to location of pressure sewer / upgraded system near original septic tank where possible.	All properties with a pump assumed to need electrical upgrade. Nominal allowance made for upgrade or replacement of sanitary drainage under building.
Pressure sewerage (reticulation)	All	Barwon Water (APES) cost estimate tool using delivered contract rates and typical design arrangements for a pressure sewer.	Typically 63 – 90mm PE
Irrigation polishing	SP2-3	Cost rates obtained from Monbulk Integrated Water Cycle Business Case (BMT WBM, 2015) and checked against current rates for supply and installation of key components.	Based on above ground steel water tanks, typical control shed on slab and contractor rates for media filtration, UV disinfection, irrigation pump set and controller and ancillary components (e.g fencing, access).

Component	Scenario	Capital Cost Basis	Notes
Water Recycling Plant	SP4	Based on recent Barwon Water projects (including Birregurra) and budget estimates from suppliers.	Lagoon / wetland (similar cost) or MBR treatment used to test the scenario with an MBR being required for a licenced discharge to waterways.
Recycled Water Storage Dam	SP3-4	Based civil rate for Water Authority delivered recycled water projects in non-metropolitan areas of Victoria and NSW. Adjusted for inflation. Includes a per m^3 of storage rate and scaled, fixed cost for ancillary infrastructure.	Subject to site selection and geotechnical investigations.
Wastewater (dry weather) treatment wetlands	SP1	Adopted the most limiting (upper) pro-rata cost rate based on surface area and/or volume using both WSUD (Melbourne Water 2013 and BMT WBM, 2015) and wastewater treatment wetlands. Adopted typical contract rates based on estimated material quantities and construction effort for reed beds (horizontal and vertical flow).	Checked against historical (2012) Melbourne Water WSUD developer services cost rates for WSUD measures.
Bioretention Swales and Basins	SP1	Adopted the most limiting (upper) pro-rata cost rate based on surface area and/or volume using both WSUD (Melbourne Water 2013 and BMT WBM, 2015).	
Stormwater pipes and pits	SP1	Typical contractor rates for Greater Melbourne.	
Subsurface Irrigation of Public Open Space	SP2 (potentially all)	Adopted cost per m^2 of ha installation rate for subsurface irrigation based on delivered water authority and private contracts in Victoria and NSW at similar scales.	
Surface spray irrigation (agricultural)	SP3-4	Based upon zoned grid of impact sprays or wobblers (due to topographical constraints on most potential sites). Allowance made for site preparation and crop / pasture establishment using NSW DPI cost rates as a guide. Also includes for stormwater management.	Assumes fully funded and operated by Barwon Water or equivalent.
Land Purchase	All	Adopted Colac Otway Shire values for applicable land use type in Victorian Valuer General statistics (https://www.propertyandlandtitles.vic.gov.au/property-information/property-prices)	

Capital Delivery Cost Estimate
Forrest Wastewater Investigation

Business As Usual

Version 1.0
Date 20/11/2018

Component	Description	Unit	Quantity	Rate	Subtotal
ON PROPERTY INFRASTRUCTURE (These are per property allowances that have been applied as per logic below)					
Existing Land Application Renewal	Renewal of trench / agline LAA following hydraulic failure (clogging). 5% of systems per annum	Lots	1	$ 4,000	$ 4,000
On-site system upgrade - Full containment	Supply and installation of secondary treatment system and EPA compliant effluent LAA. Long-term renewal rate of 4% of existing systems per annum triggered by catastrophic failure, extension of dwelling or redevelopment.	Lots	1	$ 14,000	$ 14,000
Commercial / Institutional Upgrades	As per the residential partial on-site containment upgrade with additional flow balance pumps, controls and tank(s) in addition to trade waste pre-treatment (e.g. brewery, pub). Effluent irrigation where land is available.	Lots	1	$ 30,500	$ 30,500
OPEX ITEMS					
Desludge septic tank	Typically occurs as a result of LAA blockage or drainage problems in fixtures (approx. 8 yrs average)	Site	1	$ 350	$ 350
Secondary treatment servicing	Quarterly service inspection of existing secondary treatment units + nominal allowance for component replacement and power use	Site	1	$ 600	$ 600

Capital Delivery Cost Estimate
Forrest Wastewater Investigation

Solution Package 1

Version 1.0
Date 29/06/2018

Component	Description	Unit	Quantity	Rate	Subtotal		Total
ON PROPERTY INFRASTRUCTURE						**$**	**2,366,000**
Retain Existing System and Treat Greywater	Desludge septic tank and install access riser as required. Install additional ETA trenches (assume ave. 2x20m trenches). Install single pass biofilter on greywater.	Lots	36	$ 5,000	$ 180,000		
Install Blackwater System and Treat Greywater	Install 4600L septic tank (future proof) and maximise ETA trenches. Install single pass biofilter for greywater.	Lots	21	$ 10,000	$ 210,000		
Retain Treatment Plant and Treat Greywater	Audit and service secondary treatment unit. Install max. SSI with greywater biofilter for excess.	Lots	16	$ 5,000	$ 80,000		
On-site system upgrade - Full containment	Supply and installation of secondary treatment system and EPA compliant effluent LAA (blue properties on Servicing Layout). Includes connection to effluent sewer where available.	Lots	25	$ 18,000	$ 450,000		
Partial on-site containment upgrade	Supply and installation of secondary treatment system and 100-200m2 of subsurface irrigation (yellow properties on Servicing Layout). Gravity off-site discharge of filtered greywater.	Lots	14	$ 16,000	$ 224,000		
Commercial / Institutional Upgrades	As per the residential partial on-site containment upgrade with additional flow balance pumps, controls and tank(s) in addition to trade waste pre-treatment (e.g. brewery, pub). Effluent irrigation where land is available.	Lots	32	$ 30,500	$ 976,000		
Property plumbing	Plumbing for all house connections to new Treatment Unit (Assume 15m @ $100/m Supply and Install)	Lots	144	$ 1,500	$ 216,000		
Electrical connection	Household electrical connection and upgrade (if required)	Lots	60	$ 500	$ 30,000		
RETICULATION / COLLECTION INFRASTRUCTURE						**$**	**1,390,000**
Bioretention Swales in street	Construct bioretention swales in accordance with FAWB. Cost estimate based on Melbourne Water DSP. Assume 3-4m top width	m	4200	$ 150	$ 630,000		
Stormwater pipes and pits	Supply an install reticulated stormwater (assumed average DN600) as shown on Servicing Layout	m	1200	$ 300	$ 360,000		
Culverts	Nominal allowance for culvert supply and install including traffic management	No.	8	$ 50,000	$ 400,000		
TREATMENT AND STORAGE						**$**	**1,794,000**
Dry Weather Flow Wetlands	Sized and costed as either a free water surface wastewater wetland or reed bed	m2	400	$ 150	$ 60,000		
Dry Weather Vertical Reed Beds	Sized and costed based on vertical flow reed bed / sand filter design.	m2	200	$ 320	$ 64,000		
Irrigation / Discharge Polishing	Supply and install of shed, switchboard, control panel, auto-backflushing media filtration, UV disinfection, pump set and associated pipework.	No.	1	$ 20,000	$ 20,000		
Wet Weather Flow Bioretention Basins	SC1=1350m2, SC2=640, SC3&4=455, SC5=380m2, SC6=475m2	m2	3300	$ 500	$ 1,650,000		
EFFLUENT MANAGEMENT AND REUSE						**$**	**350,000**
Subsurface irrigation of Public Open Space	Supply and install a zoned, automated pressure compensating subsurface irrigation system. Restricted access irrigation (overnight).	ha	0.5	$ 60,000	$ 30,000		
Land purchase	For WSUD measures / wetlands	m2	4000	$ 80	$ 320,000		

TOTAL ESTIMATED COSTS		**$**	**5,900,000**
Investigation & Design	20%	$	1,180,000
Risk and Opportunity	10%	$	590,000
Barwon Water Supervision, PM, Overheads & Indirects	10%	$	590,000
Allowance for Scope Growth/Functionality/Operational Requirements	10%	$	590,000
	50%	**$**	**2,950,000**
TOTAL DELIVERY COST		**$**	**8,850,000**

Capital Delivery Cost Estimate
Forrest Wastewater Investigation

Solution Package 2

Version 1.0
Date 29/06/2016

Component	Description	Unit	Quantity	Rate	Subtotal	Total
ON PROPERTY INFRASTRUCTURE						**$ 3,518,000**
On-site system upgrade - Full containment	Supply and installation of secondary treatment system and EPA compliant effluent LAA (blue properties on Servicing Layout). Includes connection to effluent sewer where available.	Lots	25	$ 18,000	$ 450,000	
Partial on-site containment upgrade	Supply and installation of secondary treatment system and 100-200m2 of subsurface irrigation (yellow properties on Servicing Layout). Includes effluent sewer pump, property line and boundary kit.	Lots	119	$ 20,000	$ 2,380,000	
Commercial / Institutional Upgrades	As per the residential properties with additional flow balance pumps, controls and tank(s) in addition to trade waste pre-treatment (e.g. brewery, pub). Effluent irrigation where land is available.	Lots	32	$ 12,500	$ 400,000	
Property plumbing	Plumbing for all house connections to new Treatment Unit (Assume 15m @ $100/m Supply and Install)	Lots	144	$ 1,500	$ 216,000	
Electrical connection	Household electrical connection and upgrade (if required)	Lots	144	$ 500	$ 72,000	
RETICULATION / COLLECTION INFRASTRUCTURE						**$ 1,000,000**
Pressure Mains in Sreet (63mm, 75mm, 90mm)	Supply & Installation of Pressure Sewer Collection pipework in streets. See APES estimate.	m	4000	$ 250	$ 1,000,000	
Pressure Mains to WRP	Based on dairy farm property to north of town	m	0	$ 250	$ -	
TREATMENT AND STORAGE						**$ 579,081**
Irrigation polishing (on-site treatment)	Supply and install of shed, switchboard, control panel, auto-backflushing filtration, UV disinfection, irrigation pump set and associated pipework.	kL	45	Cost Curve	$ 529,081	
Wet weather storage re-treatment	Recirculating packed bed reactor to maintain aerobic / Class B effluent quality in storage	m2		$ 2,500	$ -	
Treated effluent storage	Above ground steel (lined) storage tanks on gravel base (should full compliance be required)	m3	500	100	$ 50,000	
EFFLUENT MANAGEMENT AND REUSE						**$ 225,000**
Subsurface irrigation of Public Open Space	Supply and install a zoned, automated pressure compensating subsurface irrigation system. Restricted access irrigation (overnight).	ha	3	$ 60,000	$ 180,000	
Land purchase		ha	3	$ 15,000	$ 45,000	

TOTAL ESTIMATED COSTS		**$**	**5,322,081**
Investigation & Design	20%	$	1,064,416
Risk and Opportunity	10%	$	532,208
Barwon Water Supervision, PM, Overheads & Indirects	10%	$	532,208
Allowance for Scope Growth/Functionality/Operational Requirements	10%	$	532,208
	50%	**$**	**2,661,040**
TOTAL DELIVERY COST		**$**	**7,983,121**

Capital Delivery Cost Estimate
Forrest Wastewater Investigation

Solution Package 3

Version 1.0
Date 29/06/2016

Component	Description	Unit	Quantity	Rate	Subtotal		Total
ON PROPERTY INFRASTRUCTURE						**$**	**3,518,000**
On-site system upgrade - Full containment	Supply and installation of secondary treatment system and EPA compliant effluent LAA (blue properties on Servicing Layout). Includes connection to effluent sewer where available.	Lots	25	$ 18,000	$ 450,000		
Partial on-site containment upgrade	Supply and installation of secondary treatment system and 100-200m2 of subsurface irrigation (yellow properties on Servicing Layout). Includes effluent sewer pump, property line and boundary kit.	Lots	119	$ 20,000	$ 2,380,000		
Commercial / Institutional Upgrades	As per the residential properties with additional flow balance pumps, controls and tank(s) in addition to trade waste pre-treatment (e.g. brewery, pub). Effluent irrigation where land is available.	Lots	32	$ 12,500	$ 400,000		
Property plumbing	Plumbing for all house connections to new Treatment Unit (Assume 15m @ $100/m Supply and Install)	Lots	144	$ 1,500	$ 216,000		
Electrical connection	Household electrical connection and upgrade (if required)	Lots	144	$ 500	$ 72,000		
RETICULATION / COLLECTION INFRASTRUCTURE						**$**	**1,125,000**
Pressure Mains in Sreet (63mm, 75mm, 90mm)	Supply & Installation of Pressure Sewer Collection pipework in streets. See APES estimate.	m	4000	$ 250	$ 1,000,000		
Pressure Mains to WRP	Based on dairy farm property to north of town	m	500	$ 250	$ 125,000		
TREATMENT AND STORAGE						**$**	**1,205,072**
Irrigation polishing (on-site treatment)	Supply and install of shed, switchboard, control panel, auto-backflushing filtration, UV disinfection, irrigation pump set and associated pipework.	kL	50	Cost Curve	$ 564,255		
Treated effluent storage (Dam)	Construct earthen wet weather storage dam	m3	13000	$ 49	$ 640,817		
Treated effluent storage (Tanks)	Above ground steel (lined) storage tanks on gravel base						
EFFLUENT MANAGEMENT AND REUSE						**$**	**860,000**
Surface spray irrigation (fodder crop)	Supply and install a zoned, automated surface spray (impact or wobblers) irrigation system on risers. Includes irrigation pumps and controller.	ha	11	$ 40,000	$ 440,000		
Land purchase		ha	28	$ 15,000	$ 420,000		

TOTAL ESTIMATED COSTS		**$**	**6,708,072**
Investigation & Design	20%	$	1,341,614
Risk and Opportunity	10%	$	670,807
Barwon Water Supervision, PM, Overheads & Indirects	10%	$	670,807
Allowance for Scope Growth/Functionality/Operational Requirements	10%	$	670,807
	50%	**$**	**3,354,036**
TOTAL DELIVERY COST		**$**	**10,062,108**

Capital Delivery Cost Estimate
Forrest Wastewater Investigation

Solution Package 4

Version 1.0
Date 29/06/2016

Component	Description	Unit	Quantity	Rate	Subtotal	Total
ON PROPERTY INFRASTRUCTURE						**$ 2,185,600**
Supply PSS Units	Supply of new grinder pressure pump and well	Lots	144	$ 4,500	$ 648,000	
Installation PSS Units	Installation of new grinder pressure pump and well within customers backyard	Lots	144	$ 5,000	$ 720,000	
Telemetry One Box (or equivalent)	Telemetry Unit and Pressure transducer from Aquatech		144	$ 1,500	$ 216,000	
Property discharge line (PSS to street)	40mm PE from PSS to rising main -assume 10m distance connection @ $40/m supply and install		144	$ 400	$ 57,600	
Commercial / Institutional Upgrades	As per the residential properties with additional flow balance pumps, controls and tank(s) in addition to trade waste pre-treatment (e.g. brewery, pub).	Lots	32	$ 8,000	$ 256,000	
Property plumbing	Plumbing for all house connections to new Treatment Unit (Assume 15m @ $100/m Supply and Install)	Lots	144	$ 1,500	$ 216,000	
Electrical connection	Household electrical connection and upgrade (if required)	Lots	144	$ 500	$ 72,000	
RETICULATION / COLLECTION INFRASTRUCTURE						**$ 1,262,500**
Pressure Mains in Sreet (63mm, 75mm, 90mm)	Supply & Installation of Pressure Sewer Collection pipework in streets. See APES estimate.	m	4550	$ 250	$ 1,137,500	
Pressure Mains to WRP	Based on dairy farm property to north of town	m	500	$ 250	$ 125,000	
TREATMENT AND STORAGE						**$ 7,107,081**
Lagoon Treatment System	Refer to WRP Capex Tab in Forrest Sewerage Scheme Cost Estimates Sheet	LS	0	$ 3,050,000	$ -	
MBR (for river discharge or recycled water)	Refer to WRP Capex Tab in Forrest Sewerage Scheme Cost Estimates Sheet	LS	1	$ 6,650,000	$ 6,650,000	
Treated effluent storage	Construct earthen wet weather storage dam (Assumes 50% reuse)	m3	6000	$ 76	$ 457,081	
EFFLUENT MANAGEMENT AND REUSE						**$ 590,000**
Surface spray irrigation (fodder crop)	Supply and install a zoned, automated surface spray (impact or wobblers) irrigation system on risers. (Assumes 50% reuse)	ha	5	$ 40,000	$ 200,000	
Land purchase		ha	26	$ 15,000	$ 390,000	

TOTAL ESTIMATED COSTS			**$ 11,145,181**
Investigation & Design	20%	$	2,229,036
Risk and Opportunity	10%	$	1,114,518
Barwon Water Supervision, PM, Overheads & Indirects	10%	$	1,114,518
Allowance for Scope Growth/Functionality/Operational Requirements	10%	$	1,114,518
	50%	**$**	**5,572,590**
TOTAL DELIVERY COST		**$**	**16,717,771**

Financial Analysis Template

FORREST WASTEWATER INVESTIGATION

BUSINESS AS USUAL

Discount Rate 4.00%

		28/06/2018	28/06/2019	29/06/2020	29/06/2021	28/06/2022	28/06/2023	28/06/2024	28/06/2025	28/06/2026	28/06/2027	27/06/2028	27/06/2029	27/06/2030	27/06/2031	26/06/2032	26/06/2033	26/06/2034	26/06/2035	25/06/2036	25/06/2037	25/06/2038	25/06/2039	24/06/2040	24/06/2041	24/06/2042	24/06/2043	23/06/2044	23/06/2045	23/06/2046	23/06/2047	22/06/2048	22/06/2049	22/06/2050	22/06/2051	21/06/2052	21/06/2053	21/06/2054	21/06/2055	20/06/2056	20/06/2057	20/06/2058	20/06/2059	19/06/2060	19/06/2061	19/06/2062	19/06/2063	18/06/2064	18/06/2065	18/06/2066	18/06/2067	17/06/2068
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
COSTS	TOTAL																																																			
Capital Costs																																																				
On Property Infrastructure	$ (3,040)		$ (204)	$ (203)	$ (202)	$ (201)	$ (139)	$ (137)	$ (136)	$ (135)	$ (134)	$ (133)	$ (131)	$ (100)	$ (98)	$ (97)	$ (96)	$ (95)	$ (64)	$ (62)	$ (91)	$ (90)	$ (89)	$ (88)	$ (86)	$ (85)	$ (84)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Relocation / Collection	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Treatment and Storage	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Effluent Management and Reuse	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL Capital Costs	**$ (3,040)**	$ -	$ (204)	$ (203)	$ (202)	$ (201)	$ (139)	$ (137)	$ (136)	$ (135)	$ (134)	$ (133)	$ (131)	$ (100)	$ (98)	$ (97)	$ (96)	$ (95)	$ (64)	$ (62)	$ (91)	$ (90)	$ (89)	$ (88)	$ (86)	$ (85)	$ (84)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Operating Costs																																																			
On Property Infrastructure	$ (3,573)		$ (27)	$ (29)	$ (32)	$ (34)	$ (37)	$ (39)	$ (42)	$ (44)	$ (47)	$ (49)	$ (52)	$ (54)	$ (57)	$ (59)	$ (62)	$ (64)	$ (65)	$ (69)	$ (71)	$ (74)	$ (76)	$ (79)	$ (81)	$ (84)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)
Relocation / Collection	$ -																																																		
Treatment and Storage	$ -																																																		
Effluent Management and Reuse	$ -																																																		
TOTAL Operating Costs	**$ (3,573)**	$ -	$ (27)	$ (29)	$ (32)	$ (34)	$ (37)	$ (39)	$ (42)	$ (44)	$ (47)	$ (49)	$ (52)	$ (54)	$ (57)	$ (59)	$ (62)	$ (64)	$ (65)	$ (69)	$ (71)	$ (74)	$ (76)	$ (79)	$ (81)	$ (84)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)
Loss of Revenue																																																			
Stand		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Units of revenue loss	$ -																																																		
TOTAL Revenue Lost	**$ -**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL COSTS	**$ (6,612)**	$ -	$ (231)	$ (232)	$ (234)	$ (235)	$ (173)	$ (176)	$ (178)	$ (179)	$ (180)	$ (182)	$ (183)	$ (154)	$ (155)	$ (156)	$ (158)	$ (159)	$ (129)	$ (131)	$ (162)	$ (164)	$ (165)	$ (167)	$ (168)	$ (169)	$ (170)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)
YIELD (ML)	TOTAL																																																	
Yield 1	-																																																	
Yield 2	-																																																	
Yield 3	-																																																	
TOTAL Yield	-																																																	
REVENUE ($)	TOTAL	POINT																																																	
Stream 1	$ -	$0.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Stream 2	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Stream 3	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL Revenue	**$ -**		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
NET CASH FLOW	$ -	$ -	$ (231)	$ (232)	$ (234)	$ (235)	$ (173)	$ (176)	$ (178)	$ (179)	$ (180)	$ (182)	$ (183)	$ (154)	$ (155)	$ (156)	$ (158)	$ (159)	$ (129)	$ (131)	$ (162)	$ (164)	$ (165)	$ (167)	$ (168)	$ (169)	$ (170)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)	$ (86)
Discounted Cash Flows	TOTAL		1.0000	0.9615	0.9246	0.8890	0.8548	0.8219	0.7903	0.7599	0.7307	0.7026	0.6756	0.6496	0.6246	0.6006	0.5775	0.5553	0.5339	0.5134	0.4936	0.4746	0.4564	0.4388	0.4220	0.4057	0.3901	0.3751	0.3607	0.3468	0.3335	0.3207	0.3083	0.2965	0.2851	0.2741	0.2636	0.2534	0.2437	0.2343	0.2253	0.2166	0.2083	0.2003	0.1926	0.1852	0.1780	0.1712	0.1646	0.1583	0.1522	0.1463	0.1407
Capital Costs	**-$ 2,063**	$ -	$ 196	$ 188	$ 179	$ 172	$ 114	$ 109	$ 103	$ 99	$ 94	$ 90	$ 85	$ 62	$ 59	$ 56	$ 53	$ 51	$ 48	$ 46	$ 43	$ 41	$ 39	$ 37	$ 35	$ 33	$ 32	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Operating Costs	**-$ 1,311**	$ -	$ 26	$ 27	$ 28	$ 29	$ 30	$ 31	$ 32	$ 32	$ 33	$ 33	$ 33	$ 34	$ 34	$ 34	$ 34	$ 34	$ 34	$ 34	$ 34	$ 34	$ 34	$ 33	$ 33	$ 33	$ 32	$ 31	$ 30	$ 29	$ 28	$ 27	$ 26	$ 25	$ 24	$ 23	$ 22	$ 21	$ 20	$ 19	$ 19	$ 18	$ 17	$ 17	$ 16	$ 15	$ 15	$ 14	$ 13	$ 12
Loss of Revenue	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
REVENUE ($)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DCF	$	**-$**	**222 -$**	**215 -$**	**208 -$**	**201 -$**	**144 -$**	**139 -$**	**135 -$**	**131 -$**	**127 -$**	**123 -$**	**119 -$**	**96 -$**	**93 -$**	**90 -$**	**87 -$**	**85 -$**	**62 -$**	**60 -$**	**77 -$**	**75 -$**	**73 -$**	**70 -$**	**68 -$**	**66 -$**	**64 -$**	**31 -$**	**30 -$**	**29 -$**	**28 -$**	**27 -$**	**26 -$**	**25 -$**	**24 -$**	**23 -$**	**22 -$**	**21 -$**	**20 -$**	**19 -$**	**19 -$**	**18 -$**	**17 -$**	**17 -$**	**16 -$**	**15 -$**	**15 -$**	**14 -$**	**14 -$**	**13 -$**	**13 -$**	**12**

NPV $ (3,375)

Payback period 51 years

0 -232 -437 -644 -845 -989 -1,128 -1,263 -1,394 -1,521 -1,643 -1,762 -1,858 -1,951 -2,041 -2,129 -2,214 -2,296 -2,376 -2,452 -2,528 -2,600 -2,670 -2,738 -2,804 -2,868 -2,899 -2,929 -2,958 -2,986 -3,013 -3,039 -3,063 -3,087 -3,109 -3,133 -3,152 -3,173 -3,192 -3,211 -3,229 -3,246 -3,263 -3,279 -3,294 -3,309 -3,323 -3,337 -3,350 -3,362 -3,375

IRR #NUM!

YIELD (ML) $ -

Levelised cost ($/Lot) $ (23.44)

144

Financial Analysis Template

FORREST WASTEWATER INVESTIGATION

Discount Rate 4.00%

SOLUTION PACKAGE 1a

		30/06/2014	30/06/2015	29/06/2016	29/06/2017	29/06/2018	29/06/2019	29/06/2020	29/06/2021	29/06/2022	29/06/2023	27/06/2024	27/06/2025	27/06/2026	27/06/2027	26/06/2028	26/06/2029	26/06/2030	26/06/2031	25/06/2032	25/06/2033	25/06/2034	25/06/2035	24/06/2036	24/06/2037	24/06/2038	24/06/2039	23/06/2040	23/06/2041	23/06/2042	23/06/2043	22/06/2044	22/06/2045	22/06/2046	22/06/2047	21/06/2048	21/06/2049	21/06/2050	21/06/2051	20/06/2052	20/06/2053	20/06/2054	20/06/2055	19/06/2056	19/06/2057	19/06/2058	19/06/2059	18/06/2060	18/06/2061	18/06/2062	18/06/2063	17/06/2064
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
COSTS	**TOTAL**																																																		
Capital Costs																																																			
On Property Infrastructure	$ (5,248)		$ (2,126)	$ (1,420)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (154)	$ (154)	$ (154)	$ (154)	$ (154)	$ (154)	$ (314)	$ (154)	$ (154)	$ (154)	$ (154)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Relocation / Collection	$ (2,065)		$ (1,668)	$ (417)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Treatment and Storage	$ (2,691)		$ (2,153)	$ (538)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Effluent Management and Reuse	$ (325)		$ (325)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL Capital Costs	**$ (10,549)**	$ -	$ (6,473)	$ (2,375)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (154)	$ (154)	$ (154)	$ (154)	$ (154)	$ (154)	$ (314)	$ (154)	$ (154)	$ (154)	$ (154)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Operating Costs																																																			
On Property Infrastructure	$ (3,581)		$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)	$ (72)
Relocation / Collection	$ (1,250)		$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)	$ (25)
Treatment and Storage	$ (1,625)		$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)	$ (33)
Effluent Management and Reuse	$ (509)		$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)
TOTAL Operating Costs	**$ (6,964)**	$ -	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)
Loss of Revenue																																																			
Grant	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Units of revenue loss	$ -																																																		
TOTAL Revenue Lost	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL COSTS	**$ (17,513)**	$ -	$ (6,614)	$ (2,514)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (293)	$ (293)	$ (293)	$ (293)	$ (293)	$ (453)	$ (293)	$ (293)	$ (293)	$ (293)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)
YIELD (ML)	**TOTAL**																																																	
Yield 1	-																																																	
Yield 2	-																																																	
Yield 3	-																																																	
TOTAL Yield	-																																																	
REVENUE ($)	**TOTAL**	**Yield**																																																	
Stream 1	$ -	30.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Stream 2	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Stream 3	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL Revenue	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
NET CASH FLOW	$ -	$ -	$ (6,614)	$ (2,514)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (293)	$ (293)	$ (293)	$ (293)	$ (293)	$ (453)	$ (293)	$ (293)	$ (293)	$ (293)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)	$ (139)
Discounted Cash Flows	**TOTAL**	1.0000	0.9615	0.9246	0.8890	0.8548	0.8219	0.7903	0.7599	0.7307	0.7026	0.6756	0.6496	0.6246	0.6006	0.5775	0.5553	0.5339	0.5134	0.4936	0.4746	0.4564	0.4388	0.4220	0.4057	0.3901	0.3751	0.3607	0.3468	0.3335	0.3207	0.3083	0.2965	0.2851	0.2741	0.2636	0.2534	0.2437	0.2343	0.2253	0.2166	0.2083	0.2003	0.1926	0.1852	0.1780	0.1712	0.1646	0.1583	0.1522	0.1463	0.1407
Capital Costs	**-$ 9,388**	$ -	-$ 6,226	-$ 2,196	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-$ 104	-$ 100	-$ 96	-$ 92	-$ 89	-$ 174	-$ 82	-$ 79	-$ 76	-$ 73	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Operating Costs	**-$ 2,989**	$ -	-$ 134	-$ 129	-$ 124	-$ 119	-$ 114	-$ 110	-$ 106	-$ 102	-$ 98	-$ 94	-$ 90	-$ 87	-$ 84	-$ 80	-$ 77	-$ 74	-$ 71	-$ 69	-$ 66	-$ 63	-$ 61	-$ 59	-$ 56	-$ 54	-$ 52	-$ 50	-$ 48	-$ 46	-$ 45	-$ 43	-$ 41	-$ 40	-$ 38	-$ 37	-$ 35	-$ 34	-$ 33	-$ 31	-$ 30	-$ 29	-$ 28	-$ 27	-$ 26	-$ 25	-$ 24	-$ 23	-$ 22	-$ 21	-$ 20	-$ 20
Loss of Revenue	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
REVENUE ($)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DCF		$ -	**-$ 6,360**	**-$ 2,324**	**-$ 124**	**-$ 119**	**-$ 114**	**-$ 110**	**-$ 106**	**-$ 102**	**-$ 98**	**-$ 198**	**-$ 190**	**-$ 183**	**-$ 176**	**-$ 169**	**-$ 252**	**-$ 156**	**-$ 150**	**-$ 145**	**-$ 139**	**-$ 63**	**-$ 61**	**-$ 59**	**-$ 56**	**-$ 54**	**-$ 52**	**-$ 50**	**-$ 48**	**-$ 46**	**-$ 45**	**-$ 43**	**-$ 41**	**-$ 40**	**-$ 38**	**-$ 37**	**-$ 35**	**-$ 34**	**-$ 33**	**-$ 31**	**-$ 30**	**-$ 29**	**-$ 28**	**-$ 27**	**-$ 26**	**-$ 25**	**-$ 24**	**-$ 23**	**-$ 22**	**-$ 21**	**-$ 20**	**-$ 20**
NPV	**$ (12,376)**																																																	
Payback period	**51 years**	0	-6,360	-8,684	-8,808	-8,927	-9,041	-9,151	-9,257	-9,358	-9,456	-9,654	-9,844	-10,028	-10,203	-10,373	-10,624	-10,781	-10,931	-11,076	-11,215	-11,278	-11,339	-11,398	-11,455	-11,509	-11,561	-11,611	-11,659	-11,706	-11,750	-11,793	-11,835	-11,874	-11,912	-11,949	-11,984	-12,018	-12,051	-12,082	-12,112	-12,141	-12,169	-12,196	-12,222	-12,246	-12,270	-12,293	-12,315	-12,336	-12,357	-12,376
IRR	**#NUM!**																																																	
YIELD (ML)	**$ -**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Levelised cost ($/Lot)	$ (85.95)																																																
	144																																																	

Financial Analysis Template

FORREST WASTEWATER INVESTIGATION

Discount Rate 4.00%

SOLUTION PACKAGE 2

		30/06/2014	30/06/2015	29/06/2016	29/06/2017	29/06/2018	29/06/2019	28/06/2020	28/06/2021	28/06/2022	28/06/2023	27/06/2024	27/06/2025	27/06/2026	27/06/2027	26/06/2028	26/06/2029	26/06/2030	26/06/2031	25/06/2032	25/06/2033	25/06/2034	25/06/2035	24/06/2036	24/06/2037	24/06/2038	24/06/2039	23/06/2040	23/06/2041	23/06/2042	23/06/2043	22/06/2044	22/06/2045	22/06/2046	22/06/2047	21/06/2048	21/06/2049	21/06/2050	21/06/2051	20/06/2052	20/06/2053	20/06/2054	20/06/2055	19/06/2056	19/06/2057	19/06/2058	19/06/2059	18/06/2060	18/06/2061	18/06/2062	18/06/2063	17/06/2064
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
COSTS	**TOTAL**																																																		
Capital Costs																																																			
On Property Infrastructure	$ (3,609)		$ (2,126)	$ (1,420)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (360)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Reticulation / Collection	$ (2,065)		$ (1,668)	$ (417)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Treatment and Storage	$ (2,741)		$ (2,153)	$ (538)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (10)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (10)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (10)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (10)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (10)
Effluent Management and Reuse	$ (443)		$ (325)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (65)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (60)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL Capital Costs	**$ (9,380)**	$ -	$ (6,473)	$ (2,375)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (10)	$ -	$ -	$ -	$ -	$ (360)	$ -	$ -	$ -	$ -	$ (75)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (10)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (70)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (10)
Operating Costs																																																		
On Property Infrastructure	$ (4,620)		$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)
Reticulation / Collection	$ (360)		$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)
Treatment and Storage	$ (300)		$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)
Effluent Management and Reuse	$ (920)		$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)
TOTAL Operating Costs	**$ (6,410)**	$ -	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)
Loss of Revenue																																																			
Slurid		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Units of revenue loss	$ -																																																		
TOTAL Revenue Lost	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL COSTS	**$ (15,390)**	$ -	$ (6,593)	$ (2,495)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (130)	$ (120)	$ (120)	$ (120)	$ (120)	$ (480)	$ (120)	$ (120)	$ (120)	$ (120)	$ (195)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (130)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (196)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (130)
YIELD (ML)	**TOTAL**																																																	
Yield 1	-																																																	
Yield 2	-																																																	
Yield 3	-																																																	
TOTAL Yield	-																																																	
REVENUE ($)	**TOTAL**	**/Unit**																																																
Stream 1	$ -	$0.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Stream 2	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Stream 3	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL Revenue	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
NET CASH FLOW	$ -	$ -	$ (6,593)	$ (2,495)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (130)	$ (120)	$ (120)	$ (120)	$ (120)	$ (480)	$ (120)	$ (120)	$ (120)	$ (120)	$ (195)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (130)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (196)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (120)	$ (130)
Discounted Cash Flows	**TOTAL**																																																	
		1.0000	0.9615	0.9246	0.8890	0.8548	0.8219	0.7903	0.7599	0.7307	0.7026	0.6756	0.6496	0.6246	0.6006	0.5775	0.5553	0.5339	0.5134	0.4936	0.4746	0.4564	0.4388	0.4220	0.4057	0.3901	0.3751	0.3607	0.3468	0.3335	0.3207	0.3083	0.2965	0.2851	0.2741	0.2636	0.2534	0.2437	0.2343	0.2253	0.2166	0.2083	0.2003	0.1926	0.1852	0.1780	0.1712	0.1646	0.1583	0.1522	0.1463	0.1407
Capital Costs	**-$ 8,679**	$ -	-$ 6,226	-$ 2,196	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-$ 7	$ -	$ -	$ -	$ -	-$ 200	$ -	$ -	$ -	$ -	-$ 32	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-$ 3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-$ 15	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-$ 1
Operating Costs	**-$ 2,882**	$ -	-$ 116	-$ 111	-$ 107	-$ 103	-$ 99	-$ 95	-$ 91	-$ 88	-$ 84	-$ 81	-$ 78	-$ 75	-$ 72	-$ 69	-$ 67	-$ 64	-$ 62	-$ 59	-$ 57	-$ 55	-$ 53	-$ 51	-$ 49	-$ 47	-$ 45	-$ 43	-$ 42	-$ 40	-$ 39	-$ 37	-$ 36	-$ 34	-$ 33	-$ 32	-$ 30	-$ 29	-$ 28	-$ 27	-$ 26	-$ 25	-$ 24	-$ 23	-$ 22	-$ 21	-$ 21	-$ 20	-$ 19	-$ 18	-$ 18	-$ 17
Loss of Revenue	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
REVENUE ($)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DCF	**$ -**	$ -	**-$ 6,342**	**-$ 2,307**	**-$ 107**	**-$ 103**	**-$ 99**	**-$ 95**	**-$ 91**	**-$ 88**	**-$ 84**	**-$ 88**	**-$ 78**	**-$ 75**	**-$ 72**	**-$ 69**	**-$ 267**	**-$ 64**	**-$ 62**	**-$ 59**	**-$ 57**	**-$ 87**	**-$ 53**	**-$ 51**	**-$ 49**	**-$ 47**	**-$ 45**	**-$ 43**	**-$ 42**	**-$ 40**	**-$ 39**	**-$ 40**	**-$ 36**	**-$ 34**	**-$ 33**	**-$ 32**	**-$ 30**	**-$ 29**	**-$ 28**	**-$ 27**	**-$ 26**	**-$ 49**	**-$ 24**	**-$ 23**	**-$ 22**	**-$ 21**	**-$ 21**	**-$ 20**	**-$ 19**	**-$ 18**	**-$ 18**	**-$ 18**
NPV	**$ (11,262)**																																																	
Payback period	**51 years**	0	-6,342	-8,648	-8,755	-8,858	-8,957	-9,052	-9,143	-9,231	-9,316	-9,403	-9,482	-9,557	-9,629	-9,698	-9,965	-10,029	-10,091	-10,150	-10,207	-10,294	-10,347	-10,397	-10,446	-10,493	-10,538	-10,582	-10,623	-10,663	-10,702	-10,742	-10,778	-10,812	-10,845	-10,876	-10,907	-10,936	-10,964	-10,991	-11,018	-11,057	-11,081	-11,104	-11,127	-11,148	-11,169	-11,189	-11,207	-11,226	-11,243	-11,262
IRR	**#NUM!**																																																	
YIELD (ML)	**$ -**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Levelised cost ($/Lot)	$ (78.21)																																																	
	144																																																		

Financial Analysis Template

FORREST WASTEWATER INVESTIGATION

Discount Rate 4.00%

SOLUTION PACKAGE 3

		30/06/2014	30/06/2015	29/06/2016	29/06/2017	29/06/2018	29/06/2019	29/06/2020	29/06/2021	29/06/2022	29/06/2023	27/06/2024	27/06/2025	27/06/2026	27/06/2027	26/06/2028	26/06/2029	26/06/2030	26/06/2031	25/06/2032	25/06/2033	25/06/2034	25/06/2035	24/06/2036	24/06/2037	24/06/2038	24/06/2039	23/06/2040	23/06/2041	23/06/2042	23/06/2043	22/06/2044	22/06/2045	22/06/2046	22/06/2047	21/06/2048	21/06/2049	21/06/2050	21/06/2051	20/06/2052	20/06/2053	20/06/2054	20/06/2055	19/06/2056	19/06/2057	19/06/2058	19/06/2059	18/06/2060	18/06/2061	18/06/2062	18/06/2063	17/06/2064
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
COSTS	**TOTAL**																																																		
Capital Costs																																																			
On Property Infrastructure	$ (5,637)		$ (3,166)	$ (2,111)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (360)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Reticulation / Collection	$ (1,668)		$ (1,350)	$ (318)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Treatment and Storage	$ (1,808)		$ (1,446)	$ (362)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Effluent Management and Reuse	$ (1,480)		$ (1,296)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (185)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (185)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL Capital Costs	**$ (10,622)**	$ -	$ (7,252)	$ (2,810)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (360)	$ -	$ -	$ -	$ (185)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (185)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Operating Costs																																																			
On Property Infrastructure	$ (4,620)		$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)	$ (92)
Reticulation / Collection	$ (439)		$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)	$ (9)
Treatment and Storage	$ (300)		$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)	$ (6)
Effluent Management and Reuse	$ (400)		$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)	$ (8)
TOTAL Operating Costs	**$ (5,759)**	$ -	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)
Loss of Revenue																																																			
Slurd		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Units of revenue loss	$ -																																																		
TOTAL Revenue Lost	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL COSTS	**$ (16,381)**	$ -	$ (7,367)	$ (2,925)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (475)	$ (115)	$ (115)	$ (115)	$ (115)	$ (215)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (215)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)
YIELD (ML)	**TOTAL**																																																	
Yield 1	-																																																	
Yield 2	-																																																	
Yield 3	-																																																	
TOTAL Yield	-																																																	
REVENUE ($)	**TOTAL**	**Yield**																																																
Stream 1	$ -	30.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Stream 2	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Stream 3	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL Revenue	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
NET CASH FLOW	$ -	$ -	$ (7,367)	$ (2,925)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (475)	$ (115)	$ (115)	$ (115)	$ (115)	$ (215)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (215)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)	$ (115)
Discounted Cash Flows	**TOTAL**																																																	
		1.0000	0.9615	0.9246	0.8890	0.8548	0.8219	0.7903	0.7599	0.7307	0.7026	0.6756	0.6496	0.6246	0.6006	0.5775	0.5553	0.5339	0.5134	0.4936	0.4746	0.4564	0.4388	0.4220	0.4057	0.3901	0.3751	0.3607	0.3468	0.3335	0.3207	0.3083	0.2965	0.2851	0.2741	0.2636	0.2534	0.2437	0.2343	0.2253	0.2166	0.2083	0.2003	0.1926	0.1852	0.1780	0.1712	0.1646	0.1583	0.1522	0.1463	0.1407
Capital Costs	**-$ 9,838**	$ -	-$ 6,973	-$ 2,598	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 200	$ -	$ -	$ -	$ 46	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-$ 46	$ 21	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Operating Costs	**-$ 2,474**	$ -	-$ 111	-$ 106	-$ 102	-$ 98	-$ 95	-$ 91	-$ 88	-$ 84	-$ 81	-$ 78	-$ 75	-$ 72	-$ 69	-$ 67	-$ 64	-$ 61	-$ 59	-$ 57	-$ 55	-$ 53	-$ 51	-$ 49	-$ 47	-$ 45	-$ 43	-$ 42	-$ 40	-$ 38	-$ 37	-$ 36	-$ 34	-$ 33	-$ 32	-$ 30	-$ 29	-$ 28	-$ 27	-$ 26	-$ 25	-$ 24	-$ 23	-$ 22	-$ 21	-$ 21	-$ 20	-$ 19	-$ 18	-$ 18	-$ 17	-$ 16
Loss of Revenue	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
REVENUE ($)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DCF	$ -	$ -	-$ 7,084	-$ 2,704	-$ 102	-$ 98	-$ 95	-$ 91	-$ 88	-$ 84	-$ 81	-$ 78	-$ 75	-$ 72	-$ 69	-$ 67	-$ 264	-$ 61	-$ 59	-$ 57	-$ 55	-$ 98	-$ 51	-$ 49	-$ 47	-$ 45	-$ 43	-$ 42	-$ 40	-$ 38	-$ 37	-$ 36	-$ 34	-$ 33	-$ 32	-$ 30	-$ 29	-$ 28	-$ 27	-$ 26	-$ 25	-$ 46	-$ 23	-$ 22	-$ 21	-$ 21	-$ 20	-$ 19	-$ 18	-$ 18	-$ 17	-$ 16

NPV	**$ (12,312)**
Payback period	**51 years**
IRR	**#NUM!**
YIELD (ML)	**$ -**

Levelised cost ($/Lot) $ (85.50)

144

	0	-7,084	-9,788	-9,891	-9,989	-10,084	-10,175	-10,262	-10,347	-10,429	-10,505	-10,580	-10,652	-10,721	-10,789	-11,052	-11,113	-11,172	-11,229	-11,284	-11,382	-11,433	-11,481	-11,528	-11,573	-11,616	-11,658	-11,697	-11,736	-11,773	-11,808	-11,842	-11,875	-11,907	-11,937	-11,966	-11,994	-12,021	-12,047	-12,072	-12,117	-12,140	-12,162	-12,184	-12,204	-12,224	-12,243	-12,261	-12,279	-12,296	-12,312
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Financial Analysis Template

FORREST WASTEWATER INVESTIGATION

Discount Rate 4.00%

SOLUTION PACKAGE 4

		30/06/2014	30/06/2015	29/06/2016	29/06/2017	29/06/2018	29/06/2019	29/06/2020	29/06/2021	29/06/2022	29/06/2023	27/06/2024	27/06/2025	27/06/2026	27/06/2027	26/06/2028	26/06/2029	26/06/2030	26/06/2031	25/06/2032	25/06/2033	25/06/2034	25/06/2035	24/06/2036	24/06/2037	24/06/2038	24/06/2039	23/06/2040	23/06/2041	23/06/2042	23/06/2043	22/06/2044	22/06/2045	22/06/2046	22/06/2047	21/06/2048	21/06/2049	21/06/2050	21/06/2051	20/06/2052	20/06/2053	20/06/2054	20/06/2055	19/06/2056	19/06/2057	19/06/2058	19/06/2059	18/06/2060	18/06/2061	18/06/2062	18/06/2063	17/06/2064
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
COSTS	**TOTAL**																																																		
Capital Costs																																																			
On Property Infrastructure	$ (3,278)		$ (1,967)	$ (1,311)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Reticulation / Collection	$ (1,804)		$ (1,515)	$ (378)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Treatment and Storage	$ (11,611)		$ (8,528)	$ (2,132)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (150)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (150)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (150)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (150)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (150)
Effluent Management and Reuse	$ (1,085)		$ (885)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (150)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (150)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (150)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (150)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL Capital Costs	**$ (17,868)**	$ -	$ (12,896)	$ (3,822)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (150)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (296)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (150)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (296)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (150)
Operating Costs																																																			
On Property Infrastructure	$ (2,024)		$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)	$ (40)
Reticulation / Collection	$ (462)		$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)	$ (10)
Treatment and Storage	$ (2,300)		$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)	$ (50)
Effluent Management and Reuse	$ (1,509)		$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)	$ (30)
TOTAL Operating Costs	**$ (6,314)**	$ -	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)
Loss of Revenue																																																			
Slurdi		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Units of revenue loss	$ -																																																		
TOTAL Revenue Lost	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL COSTS	**$ (24,364)**	$ -	$ (13,026)	$ (3,953)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (320)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (420)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (320)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (426)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (330)
YIELD (ML)	**TOTAL**																																																		
Yield 1	-																																																		
Yield 2	-																																																		
Yield 3	-																																																	
TOTAL Yield	-																																																	
REVENUE ($)	**TOTAL**	**/ YEAR**																																																	
Stream 1	$ -	30.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Stream 2	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Stream 3	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL Revenue	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
NET CASH FLOW	$ -	$ -	$ (13,026)	$ (3,953)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (320)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (420)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (320)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (426)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (130)	$ (330)
Discounted Cash Flows	**TOTAL**																																																		
		1.0000	0.9615	0.9246	0.8890	0.8548	0.8219	0.7903	0.7599	0.7307	0.7026	0.6756	0.6496	0.6246	0.6006	0.5775	0.5553	0.5339	0.5134	0.4936	0.4746	0.4564	0.4388	0.4220	0.4057	0.3901	0.3751	0.3607	0.3468	0.3335	0.3207	0.3083	0.2965	0.2851	0.2741	0.2636	0.2534	0.2437	0.2343	0.2253	0.2166	0.2083	0.2003	0.1926	0.1852	0.1780	0.1712	0.1646	0.1583	0.1522	0.1463	0.1407
Capital Costs	**-$ 16,340**	$ -	-$ 12,400	-$ 3,534	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 128	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 132	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 59	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 60	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 27
Operating Costs	**-$ 2,880**	$ -	-$ 125	-$ 120	-$ 116	-$ 111	-$ 107	-$ 103	-$ 99	-$ 95	-$ 92	-$ 86	-$ 85	-$ 81	-$ 78	-$ 75	-$ 72	-$ 70	-$ 67	-$ 64	-$ 62	-$ 59	-$ 57	-$ 55	-$ 53	-$ 51	-$ 49	-$ 47	-$ 45	-$ 43	-$ 42	-$ 40	-$ 39	-$ 37	-$ 36	-$ 34	-$ 33	-$ 32	-$ 31	-$ 29	-$ 28	-$ 27	-$ 26	-$ 25	-$ 24	-$ 23	-$ 22	-$ 21	-$ 21	-$ 20	-$ 19	-$ 18
Loss of Revenue	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
REVENUE ($)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DCF		$ -	-$ 12,525	-$ 3,654	-$ 116	-$ 111	-$ 107	-$ 103	-$ 99	-$ 95	-$ 92	-$ 216	-$ 85	-$ 81	-$ 78	-$ 75	-$ 72	-$ 70	-$ 67	-$ 64	-$ 62	-$ 192	-$ 57	-$ 55	-$ 53	-$ 51	-$ 49	-$ 47	-$ 45	-$ 43	-$ 42	-$ 99	-$ 39	-$ 37	-$ 36	-$ 34	-$ 33	-$ 32	-$ 31	-$ 29	-$ 88	-$ 26	-$ 25	-$ 24	-$ 23	-$ 22	-$ 21	-$ 21	-$ 20	-$ 19	-$ 45
NPV	**$ (19,140)**																																																		
Payback period	**51 years**	0	-12,525	-16,179	-16,295	-16,407	-16,514	-16,617	-16,716	-16,811	-16,902	-17,119	-17,204	-17,285	-17,363	-17,438	-17,511	-17,580	-17,647	-17,712	-17,773	-17,965	-18,023	-18,078	-18,130	-18,181	-18,230	-18,277	-18,322	-18,366	-18,408	-18,506	-18,545	-18,582	-18,618	-18,652	-18,685	-18,717	-18,748	-18,777	-18,805	-18,893	-18,949	-18,994	-18,968	-18,991	-19,014	-19,035	-19,056	-19,075	-19,094	-19,140
IRR	**#NUM!**																																																		
YIELD (ML)	**$ -**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Levelised cost ($/Lot) $ (132.91)

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Appendix H: Additional Water Quality Data / Soil Sampling Data

CERTIFICATE OF ANALYSIS

Batch No:	**18-18738**	*Page*	**Page 1 of 2**
Final Report	**685357**	*Laboratory*	Geelong Laboratory
		Address	16 Crown Street, Geelong, VIC 3220
Client:	**Barwon Regional Water Corporation**		
Contact:	**Water Quality**	*Phone*	03 5246 9403
Address:	PO Box 659 GREATER GEELONG VIC 3220	*Fax*	
		Contact:	Adele Vance Senior Chemist Adele.Vance@alsglobal.com
PO No:	**Not Available**	Date Sampled:	**16-Apr-2018**
Sampler Name:	**Tom Carroll**	Date Samples Received:	**16-Apr-2018**
ALS Program Ref:	**BW_WSP_01020**	*Date Issued:*	**23-Apr-2018**
Program Description:	**BW_WSP_01020**		
Client Ref:	**Forrest WW Investigation**		

The sample(s) referred to in this report were analysed by the following method(s) under NATA Accreditation No. 992. The hash (#) below indicates methods not covered by NATA accreditation in the performance of this service .

Analysis	*Method*	*Laboratory*	*Analysis*	*Method*	*Laboratory*
Enterolert	MM517	Geelong	Dissolved Oxygen	WP025	Geelong
Nutrients	WK055A, WK057A and WK058A	Geelong	P, Reactive (LL)	EK071SP	Geelong
TP (LL)	EK067SP	Geelong	TCN	EK062	Geelong
Org N as N	EK060	Geelong	TKN ISE	EK061ISE	Geelong

Signatories

These results have been electronically signed by the authorised signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11

Name	*Title*	*Name*	*Title*
Adele Vance	**Senior Chemist**	**Adele Vance**	**Senior Chemist**
Mark Sheedy	**Analyst**		

Accreditation No. 992
Accredited for compliance with ISO/IEC 17025 - Testing

Samples collected by ALS according to procedure EN/67.

Soil results expressed in mg/kg dry weight unless specified otherwise. Soil microbiological testing was commenced within 48 hours from the day received unless otherwise stated. Water microbiological testing was commenced on the day received and within 24 hours of sampling unless otherwise stated.

MM524: Plate count results <10 per mL and >300 per mL are deemed as approximate.

MM526: Plate count results <2,500 per mL and >250,000 per mL are deemed as approximate.

Calculated results are based on raw data.

Legionella species refers to Legionella species other than Legionella pneumophila

Measurement Uncertainties values for your compliance results are available at this link

Batch No: **18-18738**
Report Number: **685357**
Client: **Barwon Regional Water Corporation**
ALS Program Ref: **BW_WSP_01020**
Program Description: **BW_WSP_01020**

Sample No	Site Code	Site Description	Sample Type	Sampled Date/Time
5616353		West Barwon River U/S	WATER	16/04/18 11:15
5616354		West Barwon River D/S	WATER	16/04/18 11:25

Analysis - Analyte	*Sample No. Site Code Units*	5616353	5616354
Dissolved Oxygen - Oxygen, Dissolved	mg/L	6.3	0.8
P, Reactive (LL) - Reactive Phosphorus as P	mg/L	0.016	0.006
TP (LL) - Total Phosphorus as P	mg/L	0.096	0.051
TCN - Total Nitrogen as N (Calc)	mg/L	0.9	0.5
TKN ISE - Total Kjeldahl Nitrogen, as N (ISE)	mg/L	0.9	0.5
Org N as N - Organic Nitrogen, as N	mg N / L	0.7	0.5
Nutrients - Nitrate as N	mg/L	0.06	<0.01
Nutrients - Nitrite as N	mg/L	0.02	<0.01
Nutrients - Total Oxidised Nitrogen as N	mg/L	0.08	<0.01
Enterolert - Enterococci MPN Enterolert	orgs/100mL	260	150

A blank space indicates no test performed.

CERTIFICATE OF ANALYSIS

Batch No:	**18-20778**	*Page*	**Page 1 of 2**
Final Report	**687167**	*Laboratory*	Geelong Laboratory
		Address	16 Crown Street, Geelong, VIC 3220
Client:	**Barwon Regional Water Corporation**		
Contact:	**Water Quality**	*Phone*	03 5246 9403
Address:	PO Box 659 GREATER GEELONG VIC 3220	*Fax*	
		Contact:	Adele Vance Senior Chemist Adele.Vance@alsglobal.com
PO No:	**Not Available**	Date Sampled:	**30-Apr-2018**
Sampler Name:	**Matthew Pope**	Date Samples Received:	**30-Apr-2018**
ALS Program Ref:	**BW_WSP_01020**	*Date Issued:*	**04-May-2018**
Program Description:	**BW_WSP_01020**		
Client Ref:	**Forrest WW Investigation**		

The sample(s) referred to in this report were analysed by the following method(s) under NATA Accreditation No. 992. The hash (#) below indicates methods not covered by NATA accreditation in the performance of this service .

Analysis		*Method*	*Laboratory*	*Analysis*	*Method*	*Laboratory*
Field Information	#	FIELD	Geelong	Enterolert	MM517	Geelong
Dissolved Oxygen		WP025	Geelong	Nutrients	WK055A, WK057A and WK058A	Geelong
P, Reactive (LL)		EK071SP	Geelong	TP (LL)	EK067SP	Geelong
TCN		EK062	Geelong	Org N as N	EK060	Geelong
TKN ISE		EK061ISE	Geelong			

Signatories

These results have been electronically signed by the authorised signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11

Name	*Title*	*Name*	*Title*
Adele Vance	**Senior Chemist**	**Adele Vance**	**Senior Chemist**
Mark Sheedy	**Analyst**		

Accreditation No. 992
Accredited for compliance with ISO/IEC 17025 - Testing

Samples collected by ALS according to procedure EN/67.

Soil results expressed in mg/kg dry weight unless specified otherwise. Soil microbiological testing was commenced within 48 hours from the day received unless otherwise stated. Water microbiological testing was commenced on the day received and within 24 hours of sampling unless otherwise stated.

MM524: Plate count results <10 per mL and >300 per mL are deemed as approximate.

MM526: Plate count results <2,500 per mL and >250,000 per mL are deemed as approximate.

Calculated results are based on raw data.

Legionella species refers to Legionella species other than Legionella pneumophila

Measurement Uncertainties values for your compliance results are available at this link

Batch No: **18-20778**
Report Number: **687167**
Client: **Barwon Regional Water Corporation**
ALS Program Ref: **BW_WSP_01020**
Program Description: **BW_WSP_01020**

Sample No	Site Code	Site Description	Sample Type	Sampled Date/Time
5634529		West Barwon River U/S	WATER	30/04/18 12:25
5634530		West Barwon River D/S	WATER	30/04/18 12:15
5634531		West Barwon Tributary U/S	WATER	30/04/18
5634532		West Barwon Tributary D/S	WATER	30/04/18 13:00

Analysis - Analyte	*Sample No. Site Code Units*	5634529	5634530	5634531	5634532
Dissolved Oxygen - Oxygen, Dissolved	mg/L	6.3	<0.5		6.9
P, Reactive (LL) - Reactive Phosphorus as P	mg/L	0.014	0.006		<0.005
TP (LL) - Total Phosphorus as P	mg/L	0.070	0.058		0.035
TCN - Total Nitrogen as N (Calc)	mg/L	1.0	0.6		0.9
TKN ISE - Total Kjeldahl Nitrogen, as N (ISE)	mg/L	0.9	0.6		0.9
Org N as N - Organic Nitrogen, as N	mg N / L	0.7	0.6		0.9
Nutrients - Nitrate as N	mg/L	0.05	<0.01		0.04
Nutrients - Nitrite as N	mg/L	0.02	<0.01		<0.01
Nutrients - Total Oxidised Nitrogen as N	mg/L	0.06	<0.01		0.04
Enterolert - Enterococci MPN Enterolert	orgs/100mL	16	7		47
Field Information - Field Information				No Flow	

A blank space indicates no test performed.

CERTIFICATE OF ANALYSIS

Batch No:	**18-22970**	*Page*	**Page 1 of 2**
Final Report	**690056**	*Laboratory*	Geelong Laboratory
		Address	16 Crown Street, Geelong, VIC 3220
Client:	**Barwon Regional Water Corporation**		
Contact:	**Water Quality**	*Phone*	03 5246 9403
Address:	PO Box 659 GREATER GEELONG VIC 3220	*Fax*	
		Contact:	Adele Vance Senior Chemist Adele.Vance@alsglobal.com
PO No:	**Not Available**	Date Sampled:	**14-May-2018**
Sampler Name:	**Matthew Pope**	Date Samples Received:	**14-May-2018**
ALS Program Ref:	**BW_WSP_01020**	*Date Issued:*	**22-May-2018**
Program Description:	**BW_WSP_01020**		
Client Ref:	**Forrest WW Investigation**		

The sample(s) referred to in this report were analysed by the following method(s) under NATA Accreditation No. 992. The hash (#) below indicates methods not covered by NATA accreditation in the performance of this service .

Analysis		*Method*	*Laboratory*	*Analysis*	*Method*	*Laboratory*
Field Information	#	FIELD	Geelong	Enterolert	MM517	Geelong
Dissolved Oxygen		WP025	Geelong	Nutrients	WK055A, WK057A and WK058A	Geelong
P, Reactive (LL)		EK071SP	Geelong	TP (LL)	EK067SP	Geelong
TCN		EK062	Geelong	Org N as N	EK060	Geelong
TKN ISE		EK061ISE	Geelong			

Signatories

These results have been electronically signed by the authorised signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11

Name	*Title*	*Name*	*Title*
Adele Vance	**Senior Chemist**	**Adele Vance**	**Senior Chemist**
Lauren Spalding	**Analyst**		

Accreditation No. 992
Accredited for compliance with ISO/IEC 17025 - Testing

Samples collected by ALS according to procedure EN/67.

Soil results expressed in mg/kg dry weight unless specified otherwise. Soil microbiological testing was commenced within 48 hours from the day received unless otherwise stated. Water microbiological testing was commenced on the day received and within 24 hours of sampling unless otherwise stated.

MM524: Plate count results <10 per mL and >300 per mL are deemed as approximate.

MM526: Plate count results <2,500 per mL and >250,000 per mL are deemed as approximate.

Calculated results are based on raw data.

Legionella species refers to Legionella species other than Legionella pneumophila

Measurement Uncertainties values for your compliance results are available at this link

Batch No: **18-22970**
Report Number: **690056**
Client: **Barwon Regional Water Corporation**
ALS Program Ref: **BW_WSP_01020**
Program Description: **BW_WSP_01020**

Sample No	Site Code	Site Description	Sample Type	Sampled Date/Time
5652763		West Barwon River U/S	WATER	14/05/18 11:00
5652764		West Barwon River D/S	WATER	14/05/18 10:50
5652765		West Barwon Tributary U/S	WATER	14/05/18
5652766		West Barwon Tributary D/S	WATER	14/05/18 11:40

Analysis - Analyte	*Sample No. Site Code Units*	5652763	5652764	5652765	5652766
Dissolved Oxygen - Oxygen, Dissolved	mg/L	6.8	1.5		8.1
P, Reactive (LL) - Reactive Phosphorus as P	mg/L	<0.005	0.006		0.006
TP (LL) - Total Phosphorus as P	mg/L	0.041	0.032		0.048
TCN - Total Nitrogen as N (Calc)	mg/L	1.7	0.9		1.0
TKN ISE - Total Kjeldahl Nitrogen, as N (ISE)	mg/L	1.6	0.9		0.9
Org N as N - Organic Nitrogen, as N	mg N / L	1.5	0.9		0.8
Nutrients - Nitrate as N	mg/L	0.13	<0.01		0.06
Nutrients - Nitrite as N	mg/L	<0.01	<0.01		<0.01
Nutrients - Total Oxidised Nitrogen as N	mg/L	0.13	<0.01		0.06
Enterolert - Enterococci MPN Enterolert	orgs/100mL	11	5		54
Field Information - Field Information				No Flow	

A blank space indicates no test performed.

CERTIFICATE OF ANALYSIS

Batch No:	**18-24199**	*Page*	**Page 1 of 2**
Final Report	**692207**	*Laboratory*	Geelong Laboratory
		Address	16 Crown Street, Geelong, VIC 3220
Client:	**Barwon Regional Water Corporation**		
Contact:	**Water Quality**	*Phone*	03 5246 9403
Address:	PO Box 659 GREATER GEELONG VIC 3220	*Fax*	
		Contact:	Adele Vance Senior Chemist Adele.Vance@alsglobal.com
PO No:	**Not Available**	Date Sampled:	**28-May-2018**
Sampler Name:	**matthew pope**	Date Samples Received:	**28-May-2018**
ALS Program Ref:	**BW_WSP_01020**	*Date Issued:*	**04-Jun-2018**
Program Description:	**BW_WSP_01020**		
Client Ref:	**Forrest WW Investigation**		

The sample(s) referred to in this report were analysed by the following method(s) under NATA Accreditation No. 992. The hash (#) below indicates methods not covered by NATA accreditation in the performance of this service .

Analysis		*Method*	*Laboratory*	*Analysis*	*Method*	*Laboratory*
Field Information	#	FIELD	Geelong	Enterolert	MM517	Geelong
Dissolved Oxygen		WP025	Geelong	Nutrients	WK055A, WK057A and WK058A	Geelong
P, Reactive (LL)		EK071SP	Geelong	TP (LL)	EK067SP	Geelong
TCN		EK062	Geelong	Org N as N	EK060	Geelong
TKN ISE		EK061ISE	Geelong			

Signatories

These results have been electronically signed by the authorised signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11

Name	*Title*	*Name*	*Title*
Adele Vance	**Senior Chemist**	**Adele Vance**	**Senior Chemist**
Lauren Spalding	**Analyst**		

Accreditation No. 992
Accredited for compliance with ISO/IEC 17025 - Testing

Samples collected by ALS according to procedure EN/67.

Soil results expressed in mg/kg dry weight unless specified otherwise. Soil microbiological testing was commenced within 48 hours from the day received unless otherwise stated. Water microbiological testing was commenced on the day received and within 24 hours of sampling unless otherwise stated.

MM524: Plate count results <10 per mL and >300 per mL are deemed as approximate.

MM526: Plate count results <2,500 per mL and >250,000 per mL are deemed as approximate.

Calculated results are based on raw data.

Legionella species refers to Legionella species other than Legionella pneumophila

Measurement Uncertainties values for your compliance results are available at this link

Batch No: **18-24199**
Report Number: **692207**
Client: **Barwon Regional Water Corporation**
ALS Program Ref: **BW_WSP_01020**
Program Description: **BW_WSP_01020**

Sample No	Site Code	Site Description	Sample Type	Sampled Date/Time
5663734		West Barwon River U/S	WATER	28/05/18 11:10
5663735		West Barwon River D/S	WATER	28/05/18 10:55
5663736		West Barwon Tributary U/S	WATER	28/05/18 12:00
5663737		West Barwon Tributary D/S	WATER	28/05/18 11:40

Analysis - Analyte	*Sample No. Site Code Units*	5663734	5663735	5663736	5663737
Dissolved Oxygen - Oxygen, Dissolved	mg/L	7.1	1.0		8.0
P, Reactive (LL) - Reactive Phosphorus as P	mg/L	<0.005	0.006		0.008
TP (LL) - Total Phosphorus as P	mg/L	0.035	0.025		0.041
TCN - Total Nitrogen as N (Calc)	mg/L	1.0	0.8		1.0
TKN ISE - Total Kjeldahl Nitrogen, as N (ISE)	mg/L	0.9	0.8		0.9
Org N as N - Organic Nitrogen, as N	mg N / L	0.8	0.8		0.3
Nutrients - Nitrate as N	mg/L	0.17	<0.01		0.10
Nutrients - Nitrite as N	mg/L	<0.01	<0.01		<0.01
Nutrients - Total Oxidised Nitrogen as N	mg/L	0.17	<0.01		0.10
Enterolert - Enterococci MPN Enterolert	orgs/100mL	8	6		12
Field Information - Field Information				No Flow	

A blank space indicates no test performed.

CERTIFICATE OF ANALYSIS

Batch No:	**18-27264**	*Page*	**Page 1 of 2**
Final Report	**694013**	*Laboratory*	Geelong Laboratory
		Address	16 Crown Street, Geelong, VIC 3220
Client:	**Barwon Regional Water Corporation**		
Contact:	**Water Quality**	*Phone*	03 5246 9403
Address:	PO Box 659 GREATER GEELONG VIC 3220	*Fax*	
		Contact:	Adele Vance Senior Chemist Adele.Vance@alsglobal.com
PO No:	**Not Available**	Date Sampled:	**12-Jun-2018**
Sampler Name:	**Matthew Pope**	Date Samples Received:	**12-Jun-2018**
ALS Program Ref:	**BW_WSP_01020**	*Date Issued:*	**15-Jun-2018**
Program Description:	**BW_WSP_01020**		
Client Ref:	**Forrest WW Investigation**		

The sample(s) referred to in this report were analysed by the following method(s) under NATA Accreditation No. 992. The hash (#) below indicates methods not covered by NATA accreditation in the performance of this service .

Analysis	*Method*	*Laboratory*	*Analysis*	*Method*	*Laboratory*
Enterolert	MM517	Geelong	Dissolved Oxygen	WP025	Geelong
Nutrients	WK055A, WK057A and WK058A	Geelong	P, Reactive (LL)	EK071SP	Geelong
TP (LL)	EK067SP	Geelong	TCN	EK062	Geelong
Org N as N	EK060	Geelong	TKN ISE	EK061ISE	Geelong

Signatories

These results have been electronically signed by the authorised signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11

Name	*Title*	*Name*	*Title*
Adele Vance	**Senior Chemist**	**Adele Vance**	**Senior Chemist**
Lauren Spalding	**Analyst**		

Accreditation No. 992
Accredited for compliance with ISO/IEC 17025 - Testing

Samples collected by ALS according to procedure EN/67.

Soil results expressed in mg/kg dry weight unless specified otherwise. Soil microbiological testing was commenced within 48 hours from the day received unless otherwise stated. Water microbiological testing was commenced on the day received and within 24 hours of sampling unless otherwise stated.

MM524: Plate count results <10 per mL and >300 per mL are deemed as approximate.

MM526: Plate count results <2,500 per mL and >250,000 per mL are deemed as approximate.

Calculated results are based on raw data.

Legionella species refers to Legionella species other than Legionella pneumophila

Measurement Uncertainties values for your compliance results are available at this link

Batch No: **18-27264**
Report Number: **694013**
Client: **Barwon Regional Water Corporation**
ALS Program Ref: **BW_WSP_01020**
Program Description: **BW_WSP_01020**

Sample No	Site Code	Site Description	Sample Type	Sampled Date/Time
5688365		West Barwon River U/S	WATER	12/06/18 10:35
5688366		West Barwon River D/S	WATER	12/06/18 11:00
5688367		West Barwon Tributary U/S	WATER	12/06/18 11:40
5688368		West Barwon Tributary D/S	WATER	12/06/18 11:30

Analysis - Analyte	*Sample No. Site Code Units*	5688365	5688366	5688367	5688368
Dissolved Oxygen - Oxygen, Dissolved	mg/L	8.2	1.0	9.0	8.3
P, Reactive (LL) - Reactive Phosphorus as P	mg/L	<0.005	0.006	0.006	0.008
TP (LL) - Total Phosphorus as P	mg/L	0.025	0.006	0.11	0.047
TCN - Total Nitrogen as N (Calc)	mg/L	1.3	0.7	3.6	1.0
TKN ISE - Total Kjeldahl Nitrogen, as N (ISE)	mg/L	1.2	0.7	3.5	0.9
Org N as N - Organic Nitrogen, as N	mg N / L	1.1	0.7	3.5	0.9
Nutrients - Nitrate as N	mg/L	0.10	<0.01	0.06	0.05
Nutrients - Nitrite as N	mg/L	<0.01	<0.01	<0.01	<0.01
Nutrients - Total Oxidised Nitrogen as N	mg/L	0.10	<0.01	0.06	0.05
Enterolert - Enterococci MPN Enterolert	orgs/100mL	380	10	120	20

A blank space indicates no test performed.

CERTIFICATE OF ANALYSIS

Batch No:	**18-29552**	*Page*	**Page 1 of 2**
Final Report	**697270**	*Laboratory*	Geelong Laboratory
		Address	16 Crown Street, Geelong, VIC 3220
Client:	**Barwon Regional Water Corporation**		
Contact:	**Water Quality**	*Phone*	03 5246 9403
Address:	PO Box 659 GREATER GEELONG VIC 3220	*Fax*	
		Contact:	Frank Matthies Geelong Laboratory Manager Frank.Matthies@alsglobal.com
PO No:	**Not Available**	Date Sampled:	**25-Jun-2018**
Sampler Name:	**Leo Bourke**	Date Samples Received:	**25-Jun-2018**
ALS Program Ref:	**BW_WSP_01020**	*Date Issued:*	**04-Jul-2018**
Program Description:	**BW_WSP_01020**		
Client Ref:	**Forrest WW Investigation**		

The sample(s) referred to in this report were analysed by the following method(s) under NATA Accreditation No. 992. The hash (#) below indicates methods not covered by NATA accreditation in the performance of this service .

Analysis	*Method*	*Laboratory*	*Analysis*	*Method*	*Laboratory*
Enterolert	MM517	Geelong	Dissolved Oxygen	WP025	Geelong
Nutrients	WK055A, WK057A and WK058A	Geelong	P, Reactive (LL)	EK071SP	Geelong
TP (LL)	EK067SP	Geelong	TCN	EK062	Geelong
Org N as N	EK060	Geelong	TKN ISE	EK061ISE	Geelong

Signatories

These results have been electronically signed by the authorised signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11

Name	*Title*	*Name*	*Title*
Adele Vance	**Senior Chemist**	**Adele Vance**	**Senior Chemist**
Lauren Spalding	**Analyst**		

Accreditation No. 992
Accredited for compliance with ISO/IEC 17025 - Testing

Samples collected by ALS according to procedure EN/67.

Soil results expressed in mg/kg dry weight unless specified otherwise. Soil microbiological testing was commenced within 48 hours from the day received unless otherwise stated. Water microbiological testing was commenced on the day received and within 24 hours of sampling unless otherwise stated.

MM524: Plate count results <10 per mL and >300 per mL are deemed as approximate.

MM526: Plate count results <2,500 per mL and >250,000 per mL are deemed as approximate.

Calculated results are based on raw data.

Legionella species refers to Legionella species other than Legionella pneumophila

Measurement Uncertainties values for your compliance results are available at this link

Batch No: **18-29552**
Report Number: **697270**
Client: **Barwon Regional Water Corporation**
ALS Program Ref: **BW_WSP_01020**
Program Description: **BW_WSP_01020**

Sample No	Site Code	Site Description	Sample Type	Sampled Date/Time
5706908		West Barwon River U/S	WATER	25/06/18 10:00
5706909		West Barwon River D/S	WATER	25/06/18 10:10
5706910		West Barwon Tributary U/S	WATER	25/06/18 10:20
5706911		West Barwon Tributary D/S	WATER	25/06/18 10:30

Analysis - Analyte	*Sample No. Site Code Units*	5706908	5706909	5706910	5706911
Dissolved Oxygen - Oxygen, Dissolved	mg/L	8.4	1.3	9.9	8.6
P, Reactive (LL) - Reactive Phosphorus as P	mg/L	<0.005	<0.005	<0.005	<0.005
TP (LL) - Total Phosphorus as P	mg/L	0.030	0.013	0.030	0.021
TCN - Total Nitrogen as N (Calc)	mg/L	1.1	0.8	1.3	0.8
TKN ISE - Total Kjeldahl Nitrogen, as N (ISE)	mg/L	0.7	0.7	1.3	0.7
Org N as N - Organic Nitrogen, as N	mg N / L	0.4	0.7	1.3	0.6
Nutrients - Nitrate as N	mg/L	0.31	0.06	0.04	0.05
Nutrients - Nitrite as N	mg/L	0.02	<0.01	<0.01	0.02
Nutrients - Total Oxidised Nitrogen as N	mg/L	0.33	0.06	0.04	0.07
Enterolert - Enterococci MPN Enterolert	orgs/100mL	4	2	1	2

A blank space indicates no test performed.

CERTIFICATE OF ANALYSIS

Batch No:	**18-31517**	*Page*	**Page 1 of 2**
Final Report	**698725**	*Laboratory*	Geelong Laboratory
Client:	**Barwon Regional Water Corporation**	*Address*	16 Crown Street, Geelong, VIC 3220
Contact:	**Water Quality**	*Phone*	03 5246 9403
Address:	PO Box 659 GREATER GEELONG VIC 3220	*Fax*	
		Contact:	Adele Vance Senior Chemist Adele.Vance@alsglobal.com
PO No:	**Not Available**	Date Sampled:	**09-Jul-2018**
Sampler Name:	**Matthew Pope**	Date Samples Received:	**09-Jul-2018**
ALS Program Ref:	**BW_WSP_01020**	*Date Issued:*	**13-Jul-2018**
Program Description:	**BW_WSP_01020**		
Client Ref:	**Forrest WW Investigation**		

The sample(s) referred to in this report were analysed by the following method(s) under NATA Accreditation No. 992. The hash (#) below indicates methods not covered by NATA accreditation in the performance of this service .

Analysis	*Method*	*Laboratory*	*Analysis*	*Method*	*Laboratory*
Enterolert	MM517	Geelong	Dissolved Oxygen	WP025	Geelong
Nutrients	WK055A, WK057A and WK058A	Geelong	P, Reactive (LL)	EK071SP	Geelong
TP (LL)	EK067SP	Geelong	TCN	EK062	Geelong
Org N as N	EK060	Geelong	TKN ISE	EK061ISE	Geelong

Signatories

These results have been electronically signed by the authorised signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11

Name	*Title*	*Name*	*Title*
Adele Vance	**Senior Chemist**	**Adele Vance**	**Senior Chemist**
Lauren Spalding	**Analyst**		

Accreditation No. 992
Accredited for compliance with ISO/IEC 17025 - Testing

Samples collected by ALS according to procedure EN/67.

Soil results expressed in mg/kg dry weight unless specified otherwise. Soil microbiological testing was commenced within 48 hours from the day received unless otherwise stated. Water microbiological testing was commenced on the day received and within 24 hours of sampling unless otherwise stated.

MM524: Plate count results <10 per mL and >300 per mL are deemed as approximate.

MM526: Plate count results <2,500 per mL and >250,000 per mL are deemed as approximate.

Calculated results are based on raw data.

Legionella species refers to Legionella species other than Legionella pneumophila

Measurement Uncertainties values for your compliance results are available at this link

Batch No: **18-31517**
Report Number: **698725**
Client: **Barwon Regional Water Corporation**
ALS Program Ref: **BW_WSP_01020**
Program Description: **BW_WSP_01020**

Sample No	Site Code	Site Description	Sample Type	Sampled Date/Time
5724819		West Barwon River U/S	WATER	09/07/18 11:45
5724820		West Barwon River D/S	WATER	09/07/18 12:15
5724821		West Barwon Tributary U/S	WATER	09/07/18 12:00
5724822		West Barwon Tributary D/S	WATER	09/07/18 11:25

Analysis - Analyte	*Sample No. Site Code Units*	5724819	5724820	5724821	5724822
Dissolved Oxygen - Oxygen, Dissolved	mg/L	6.9	2.0	8.3	7.2
P, Reactive (LL) - Reactive Phosphorus as P	mg/L	<0.005	0.008	0.009	0.009
TP (LL) - Total Phosphorus as P	mg/L	0.058	0.025	0.051	0.045
TCN - Total Nitrogen as N (Calc)	mg/L	1.0	0.8	0.7	0.8
TKN ISE - Total Kjeldahl Nitrogen, as N (ISE)	mg/L	0.6	0.6	0.6	0.7
Org N as N - Organic Nitrogen, as N	mg N / L	0.6	0.6	0.6	0.6
Nutrients - Nitrate as N	mg/L	0.41	0.11	<0.01	0.06
Nutrients - Nitrite as N	mg/L	0.02	0.02	0.03	0.02
Nutrients - Total Oxidised Nitrogen as N	mg/L	0.43	0.13	0.04	0.08
Enterolert - Enterococci MPN Enterolert	orgs/100mL	35	9	0	50

A blank space indicates no test performed.

CERTIFICATE OF ANALYSIS

Batch No:	**18-34383**	*Page*	**Page 1 of 2**
Final Report	**701686**	*Laboratory*	Geelong Laboratory
		Address	16 Crown Street, Geelong, VIC 3220
Client:	**Barwon Regional Water Corporation**		
Contact:	**Water Quality**	*Phone*	03 5246 9403
Address:	PO Box 659 GREATER GEELONG VIC 3220	*Fax*	
		Contact:	Adele Vance Senior Chemist Adele.Vance@alsglobal.com
PO No:	**Not Available**	Date Sampled:	**26-Jul-2018**
Sampler Name:	**Leo Bourke**	Date Samples Received:	**26-Jul-2018**
ALS Program Ref:	**BW_WSP_01020**	*Date Issued:*	**01-Aug-2018**
Program Description:	**BW_WSP_01020**		
Client Ref:	**Forrest WW Investigation**		

The sample(s) referred to in this report were analysed by the following method(s) under NATA Accreditation No. 992. The hash (#) below indicates methods not covered by NATA accreditation in the performance of this service .

Analysis	*Method*	*Laboratory*	*Analysis*	*Method*	*Laboratory*
Enterolert	MM517	Geelong	Dissolved Oxygen	WP025	Geelong
Nutrients	WK055A, WK057A and WK058A	Geelong	P, Reactive (LL)	EK071SP	Geelong
TP (LL)	EK067SP	Geelong	TCN	EK062	Geelong
Org N as N	EK060	Geelong	TKN ISE	EK061ISE	Geelong

Signatories

These results have been electronically signed by the authorised signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11

Name	*Title*	*Name*	*Title*
Adele Vance	**Senior Chemist**	**Adele Vance**	**Senior Chemist**
Lauren Spalding	**Analyst**		

Accreditation No. 992
Accredited for compliance with ISO/IEC 17025 - Testing

Samples collected by ALS according to procedure EN/67.

Soil results expressed in mg/kg dry weight unless specified otherwise. Soil microbiological testing was commenced within 48 hours from the day received unless otherwise stated. Water microbiological testing was commenced on the day received and within 24 hours of sampling unless otherwise stated.

MM524: Plate count results <10 per mL and >300 per mL are deemed as approximate.

MM526: Plate count results <2,500 per mL and >250,000 per mL are deemed as approximate.

Calculated results are based on raw data.

Legionella species refers to Legionella species other than Legionella pneumophila

Measurement Uncertainties values for your compliance results are available at this link

Batch No: **18-34383**
Report Number: **701686**
Client: **Barwon Regional Water Corporation**
ALS Program Ref: **BW_WSP_01020**
Program Description: **BW_WSP_01020**

Sample No	Site Code	Site Description	Sample Type	Sampled Date/Time
5747880		West Barwon River U/S	WATER	26/07/18 11:20
5747881		West Barwon River D/S	WATER	26/07/18 11:10
5747882		West Barwon Tributary U/S	WATER	26/07/18 11:30
5747883		West Barwon Tributary D/S	WATER	26/07/18 11:00

Analysis - Analyte	*Sample No. Site Code Units*	5747880	5747881	5747882	5747883
Dissolved Oxygen - Oxygen, Dissolved	mg/L	8.8	9.6	3.2	8.0
P, Reactive (LL) - Reactive Phosphorus as P	mg/L	<0.005	<0.005	<0.005	<0.005
TP (LL) - Total Phosphorus as P	mg/L	0.045	0.025	0.022	0.058
TCN - Total Nitrogen as N (Calc)	mg/L	1.1	0.8	0.8	1.1
TKN ISE - Total Kjeldahl Nitrogen, as N (ISE)	mg/L	1.0	0.8	0.7	0.7
Org N as N - Organic Nitrogen, as N	mg N / L	1.0	0.8	0.7	0.6
Nutrients - Nitrate as N	mg/L	0.07	0.05	0.06	0.41
Nutrients - Nitrite as N	mg/L	<0.01	<0.01	<0.01	<0.01
Nutrients - Total Oxidised Nitrogen as N	mg/L	0.07	0.05	0.06	0.41
Enterolert - Enterococci MPN Enterolert	orgs/100mL	7	0	0	3

A blank space indicates no test performed.

CERTIFICATE OF ANALYSIS

Batch No:	**18-35329**	*Page*	**Page 1 of 2**
Final Report	**703252**	*Laboratory*	Geelong Laboratory
		Address	16 Crown Street, Geelong, VIC 3220
Client:	**Barwon Regional Water Corporation**		
Contact:	**Water Quality**	*Phone*	03 5246 9403
Address:	PO Box 659 GREATER GEELONG VIC 3220	*Fax*	
		Contact:	Adele Vance Senior Chemist Adele.Vance@alsglobal.com
PO No:	**Not Available**	Date Sampled:	**06-Aug-2018**
Sampler Name:	**Matthew Pope**	Date Samples Received:	**03-Aug-2018**
ALS Program Ref:	**BW_WSP_01020**	*Date Issued:*	**13-Aug-2018**
Program Description:	**BW_WSP_01020**		
Client Ref:	**Forrest WW Investigation**		

The sample(s) referred to in this report were analysed by the following method(s) under NATA Accreditation No. 992. The hash (#) below indicates methods not covered by NATA accreditation in the performance of this service .

Analysis	*Method*	*Laboratory*	*Analysis*	*Method*	*Laboratory*
Enterolert	MM517	Geelong	Dissolved Oxygen	WP025	Geelong
Nutrients	WK055A, WK057A and WK058A	Geelong	P, Reactive (LL)	EK071SP	Geelong
TP (LL)	EK067SP	Geelong	TCN	EK062	Geelong
Org N as N	EK060	Geelong	TKN ISE	EK061ISE	Geelong

Signatories

These results have been electronically signed by the authorised signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11

Name	*Title*	*Name*	*Title*
Adele Vance	**Senior Chemist**	**Adele Vance**	**Senior Chemist**
Frank Matthies	**Geelong Laboratory Manager**	**Lauren Spalding**	**Analyst**

Accreditation No. 992
Accredited for compliance with ISO/IEC 17025 - Testing

Samples collected by ALS according to procedure EN/67.

Soil results expressed in mg/kg dry weight unless specified otherwise. Soil microbiological testing was commenced within 48 hours from the day received unless otherwise stated. Water microbiological testing was commenced on the day received and within 24 hours of sampling unless otherwise stated.

MM524: Plate count results <10 per mL and >300 per mL are deemed as approximate.

MM526: Plate count results <2,500 per mL and >250,000 per mL are deemed as approximate.

Calculated results are based on raw data.

Legionella species refers to Legionella species other than Legionella pneumophila

Measurement Uncertainties values for your compliance results are available at this link

Batch No: **18-35329**
Report Number: **703252**
Client: **Barwon Regional Water Corporation**
ALS Program Ref: **BW_WSP_01020**
Program Description: **BW_WSP_01020**

Sample No	Site Code	Site Description	Sample Type	Sampled Date/Time
5756464		West Barwon River U/S	WATER	06/08/18 10:30
5756465		West Barwon River D/S	WATER	06/08/18 10:45
5756466		West Barwon Tributary U/S	WATER	06/08/18 11:15
5756467		West Barwon Tributary D/S	WATER	06/08/18 11:25

Analysis - Analyte	*Sample No. Site Code Units*	5756464	5756465	5756466	5756467
Dissolved Oxygen - Oxygen, Dissolved	mg/L	1.7	8.4	6.9	6.7
P, Reactive (LL) - Reactive Phosphorus as P	mg/L	<0.005	<0.005	<0.005	<0.005
TP (LL) - Total Phosphorus as P	mg/L	0.022	0.032	0.045	0.025
TCN - Total Nitrogen as N (Calc)	mg/L	1.0	1.3	1.2	1.2
TKN ISE - Total Kjeldahl Nitrogen, as N (ISE)	mg/L	0.9	1.0	1.1	1.1
Org N as N - Organic Nitrogen, as N	mg N / L	0.9	0.9	1.1	1.1
Nutrients - Nitrate as N	mg/L	0.04	0.34	0.05	<0.01
Nutrients - Nitrite as N	mg/L	0.01	0.02	0.03	0.03
Nutrients - Total Oxidised Nitrogen as N	mg/L	0.05	0.36	0.08	0.04
Enterolert - Enterococci MPN Enterolert	orgs/100mL	3	2	6	1

A blank space indicates no test performed.

CERTIFICATE OF ANALYSIS

Batch No:	**18-37650**	*Page*	**Page 1 of 2**
Final Report	**706401**	*Laboratory*	Geelong Laboratory
		Address	16 Crown Street, Geelong, VIC 3220
Client:	**Barwon Regional Water Corporation**		
Contact:	**Water Quality**	*Phone*	03 5246 9403
Address:	PO Box 659 GREATER GEELONG VIC 3220	*Fax*	
		Contact:	Adele Vance Senior Chemist Adele.Vance@alsglobal.com
PO No:	**Not Available**	Date Sampled:	**23-Aug-2018**
		Date Samples Received:	**23-Aug-2018**
Sampler Name:	**Leo Bourke**	*Date Issued:*	**30-Aug-2018**
ALS Program Ref:	**BW_WSP_01020**		
Program Description:	**BW_WSP_01020**		
Client Ref:	**Forrest WW Investigation**		

The hash (#) below indicates methods not covered by NATA accreditation in the performance of this service .

Analysis	*Method*	*Laboratory*	*Analysis*	*Method*	*Laboratory*
Enterolert	MM517	Geelong	Dissolved Oxygen	WP025	Geelong
Nutrients	WK055A, WK057A and WK058A	Geelong	P, Reactive (LL)	EK071SP	Geelong
TP (LL)	EK067SP	Geelong	TCN	EK062	Geelong
Org N as N	EK060	Geelong	TKN ISE	EK061ISE	Geelong

Signatories

Name	*Title*	*Name*	*Title*
Adele Vance	**Senior Chemist**	**Adele Vance**	**Senior Chemist**
Frank Matthies	**Geelong Laboratory Manager**	**Lauren Spalding**	**Analyst**

Accreditation No. 992
Accredited for compliance with ISO/IEC 17025 - Testing

Samples collected by ALS according to procedure EN/67.

Soil results expressed in mg/kg dry weight unless specified otherwise. Soil microbiological testing was commenced within 48 hours from the day received unless otherwise stated. Water microbiological testing was commenced on the day received and within 24 hours of sampling unless otherwise stated.

MM524: Plate count results <10 per mL and >300 per mL are deemed as approximate.

MM526: Plate count results <2,500 per mL and >250,000 per mL are deemed as approximate.

Calculated results are based on raw data.

Legionella species refers to Legionella species other than Legionella pneumophila

Measurement Uncertainties values for your compliance results are available at this link

Batch No: **18-37650**
Report Number: **706401**
Client: **Barwon Regional Water Corporation**
ALS Program Ref: **BW_WSP_01020**
Program Description: **BW_WSP_01020**

Sample No	Site Code	Site Description	Sample Type	Sampled Date/Time
5774260		West Barwon River U/S	WATER	23/08/18 11:00
5774261		West Barwon River D/S	WATER	23/08/18 11:20
5774262		West Barwon Tributary U/S	WATER	23/08/18 10:55
5774263		West Barwon Tributary D/S	WATER	23/08/18 11:10

Analysis - Analyte	*Sample No. Site Code Units*	5774260	5774261	5774262	5774263
Dissolved Oxygen - Oxygen, Dissolved	mg/L	8.7	3.0	10.0	8.5
P, Reactive (LL) - Reactive Phosphorus as P	mg/L	<0.005	0.006	0.009	0.011
TP (LL) - Total Phosphorus as P	mg/L	0.016	0.009	0.016	0.025
TCN - Total Nitrogen as N (Calc)	mg/L	1.0	0.5	0.6	0.7
TKN ISE - Total Kjeldahl Nitrogen, as N (ISE)	mg/L	0.8	0.5	0.6	0.7
Org N as N - Organic Nitrogen, as N	mg N / L	0.8	0.5	0.6	0.7
Nutrients - Nitrate as N	mg/L	0.29	<0.01	<0.01	<0.01
Nutrients - Nitrite as N	mg/L	<0.01	<0.01	0.02	0.02
Nutrients - Total Oxidised Nitrogen as N	mg/L	0.29	<0.01	<0.01	<0.01
Enterolert - Enterococci MPN Enterolert	orgs/100mL	2	4	1	7

A blank space indicates no test performed.

CERTIFICATE OF ANALYSIS

Batch No:	**18-37651**	*Page*	**Page 1 of 2**
Final Report	**708978**	*Laboratory*	Geelong Laboratory
		Address	16 Crown Street, Geelong, VIC 3220
Client:	**Barwon Regional Water Corporation**		
Contact:	**Water Quality**		
Address:	PO Box 659 GREATER GEELONG VIC 3220	*Phone*	03 5246 9403
		Fax	
		Contact:	Adele Vance Senior Chemist Adele.Vance@alsglobal.com
PO No:	**Not Available**	Date Sampled:	**06-Sep-2018**
		Date Samples Received:	**06-Sep-2018**
Sampler Name:	**Leo Bourke**	*Date Issued:*	**11-Sep-2018**
ALS Program Ref:	**BW_WSP_01020**		
Program Description:	**BW_WSP_01020**		
Client Ref:	**Forrest WW Investigation**		

The hash (#) below indicates methods not covered by NATA accreditation in the performance of this service .

Analysis	*Method*	*Laboratory*	*Analysis*	*Method*	*Laboratory*
Enterolert	MM517	Geelong	Dissolved Oxygen	WP025	Geelong
Nutrients	WK055A, WK057A and WK058A	Geelong	P, Reactive (LL)	EK071SP	Geelong
TP (LL)	EK067SP	Geelong	TCN	EK062	Geelong
Org N as N	EK060	Geelong	TKN ISE	EK061ISE	Geelong

Signatories

Name	*Title*	*Name*	*Title*
Adele Vance	**Senior Chemist**	**Adele Vance**	**Senior Chemist**
Lauren Spalding	**Analyst**		

Accreditation No. 992
Accredited for compliance with ISO/IEC 17025 - Testing

Samples collected by ALS according to procedure EN/67.

Soil results expressed in mg/kg dry weight unless specified otherwise. Soil microbiological testing was commenced within 48 hours from the day received unless otherwise stated. Water microbiological testing was commenced on the day received and within 24 hours of sampling unless otherwise stated.

MM524: Plate count results <10 per mL and >300 per mL are deemed as approximate.

MM526: Plate count results <2,500 per mL and >250,000 per mL are deemed as approximate.

Calculated results are based on raw data.

Legionella species refers to Legionella species other than Legionella pneumophila.

Measurement Uncertainties values for your compliance results are available at this link

Batch No: **18-37651**
Report Number: **708978**
Client: **Barwon Regional Water Corporation**
ALS Program Ref: **BW_WSP_01020**
Program Description: **BW_WSP_01020**

Sample No	Site Code	Site Description	Sample Type	Sampled Date/Time
5774307		West Barwon River U/S	WATER	06/09/18 10:25
5774308		West Barwon River D/S	WATER	06/09/18 11:00
5774309		West Barwon Tributary U/S	WATER	06/09/18 10:40
5774310		West Barwon Tributary D/S	WATER	06/09/18 10:50

Analysis - Analyte	*Sample No. Site Code Units*	5774307	5774308	5774309	5774310
Dissolved Oxygen - Oxygen, Dissolved	mg/L	8.8	1.0	8.9	7.8
P, Reactive (LL) - Reactive Phosphorus as P	mg/L	<0.005	<0.005	0.006	0.009
TP (LL) - Total Phosphorus as P	mg/L	0.019	0.009	0.016	0.022
TCN - Total Nitrogen as N (Calc)	mg/L	0.9	0.3	0.4	0.5
TKN ISE - Total Kjeldahl Nitrogen, as N (ISE)	mg/L	0.5	0.2	0.3	0.4
Org N as N - Organic Nitrogen, as N	mg N / L	0.4	0.2	0.3	0.4
Nutrients - Nitrate as N	mg/L	0.40	0.03	0.04	0.05
Nutrients - Nitrite as N	mg/L	<0.01	<0.01	<0.01	<0.01
Nutrients - Total Oxidised Nitrogen as N	mg/L	0.40	0.03	0.04	0.05
Enterolert - Enterococci MPN Enterolert	orgs/100mL	1	1	3	1

A blank space indicates no test performed.

CERTIFICATE OF ANALYSIS

Batch No:	**18-42487**	*Page*	**Page 1 of 2**
Final Report	**711939**	*Laboratory*	Geelong Laboratory
		Address	16 Crown Street, Geelong, VIC 3220
Client:	**Barwon Regional Water Corporation**		
Contact:	**Water Quality**	*Phone*	03 5246 9403
Address:	PO Box 659 GREATER GEELONG VIC 3220	*Fax*	
		Contact:	Adele Vance Senior Chemist Adele.Vance@alsglobal.com
PO No:	**Not Available**	Date Sampled:	**24-Sep-2018**
		Date Samples Received:	**24-Sep-2018**
Sampler Name:	**Matthew Pope**	*Date Issued:*	**01-Oct-2018**
ALS Program Ref:	**BW_WSP_01020**		
Program Description:	**BW_WSP_01020**		
Client Ref:	**Forrest WW Investigation**		

The hash (#) below indicates methods not covered by NATA accreditation in the performance of this service .

Analysis	*Method*	*Laboratory*	*Analysis*	*Method*	*Laboratory*
Enterolert	MM517	Geelong	Dissolved Oxygen	WP025	Geelong
Nutrients	WK055A, WK057A and WK058A	Geelong	P, Reactive (LL)	EK071SP	Geelong
TP (LL)	EK067SP	Geelong	TCN	EK062	Geelong
Org N as N	EK060	Geelong	TKN ISE	EK061ISE	Geelong

Signatories

Name	*Title*	*Name*	*Title*
Adele Vance	**Senior Chemist**	**Adele Vance**	**Senior Chemist**
Lauren Spalding	**Analyst**		

Accreditation No. 992
Accredited for compliance with ISO/IEC 17025 - Testing

Samples collected by ALS according to procedure EN/67.

Soil results expressed in mg/kg dry weight unless specified otherwise. Soil microbiological testing was commenced within 48 hours from the day received unless otherwise stated. Water microbiological testing was commenced on the day received and within 24 hours of sampling unless otherwise stated.

MM524: Plate count results <10 per mL and >300 per mL are deemed as approximate.

MM526: Plate count results <2,500 per mL and >250,000 per mL are deemed as approximate.

Calculated results are based on raw data.

Legionella species refers to Legionella species other than Legionella pneumophila

Measurement Uncertainties values for your compliance results are available at this link

Batch No: **18-42487**
Report Number: **711939**
Client: **Barwon Regional Water Corporation**
ALS Program Ref: **BW_WSP_01020**
Program Description: **BW_WSP_01020**

Sample No	Site Code	Site Description	Sample Type	Sampled Date/Time
5814123		West Barwon River U/S	WATER	24/09/18 10:25
5814124		West Barwon River D/S	WATER	24/09/18 10:20
5814125		West Barwon Tributary U/S	WATER	24/09/18 11:15
5814126		West Barwon Tributary D/S	WATER	24/09/18 11:30

Analysis - Analyte	*Sample No. Site Code Units*	5814123	5814124	5814125	5814126
Dissolved Oxygen - Oxygen, Dissolved	mg/L	8.0	1.2	9.2	8.0
P, Reactive (LL) - Reactive Phosphorus as P	mg/L	<0.005	0.009	0.006	0.009
TP (LL) - Total Phosphorus as P	mg/L	0.029	0.016	0.035	0.038
TCN - Total Nitrogen as N (Calc)	mg/L	0.5	0.3	0.3	0.7
TKN ISE - Total Kjeldahl Nitrogen, as N (ISE)	mg/L	0.3	0.3	0.3	0.6
Org N as N - Organic Nitrogen, as N	mg N / L	0.2	0.3	0.2	0.5
Nutrients - Nitrate as N	mg/L	0.29	0.02	0.05	0.06
Nutrients - Nitrite as N	mg/L	<0.01	<0.01	<0.01	0.02
Nutrients - Total Oxidised Nitrogen as N	mg/L	0.29	0.02	0.05	0.08
Enterolert - Enterococci MPN Enterolert	orgs/100mL	3	11	<10	<10

A blank space indicates no test performed.

Sheet 1 - Soil Sampling Schedule and Results of pH, EC and Emerson Aggregate Test Analysis

Site Name	Sample Name	Sample Depth (mm)	Texture Class	EAT [1]	Rating [2]	pH_f [3]	$pH_{1:5}$ [4]	Rating	$EC_{1:5}$ (µS/cm)	ECe (dS/m) [5]	Rating	Other analysis [6]
Roadside Reserve (Grant Street)	TP4	300	L		n/a	-		n/a		0.00	n/a	
Forrest Public School	TP6/1	350	L	7	Low	-	5.09	Strongly acid	30	0.30	Non-saline	
	TP6/2	1100	LC	3(2)	Low	-	5.18	Strongly acid	27	0.22	Non-saline	
	TP6/3	1500	MC	3(2)	Low	-	5.02	Strongly acid	28	0.20	Non-saline	

Notes:- (also refer Interpretation Sheet 1)

[1] The modified Emerson Aggregate Test (EAT) provides an indication of soil susceptibility to dispersion.

[2] Ratings describe the likely hazard associated with land application of treated wastewater.

[3] pH measured in the field using Raupac Indicator.

[4] pH measured on 1:5 soil:water suspensions using a *Hanna Combo* hand-held pH/EC/temp meter.

[5] Electrical conductivity of the saturated extract (Ece) = $EC_{1:5}$(µS/cm) x MF / 1000. Units are dS/m. MF is a soil texture multiplication factor.

[6] External laboratories used for the following analyses, if indicated:

- CEC (Cation exchange capacity)
- Psorb (Phosphorus sorption capacity)
- Bray Phosphorus
- Organic carbon
- Total nitrogen

Interpretation Sheet 1 - pH, EC & Emerson Aggregate Class

Interpretation of Soil pH (1:5 Soil:Water)
(rating based on Hazelton & Murphy (1992))

pH			Rating
0.00	to	4.50	Extremely acid
4.51	to	5.00	Very strongly acid
5.01	to	5.50	Strongly acid
5.51	to	6.00	Moderately acid
6.01	to	6.50	Slightly acid
6.51	to	7.30	Neutral
7.31	to	7.80	Mildly alkaline
7.81	to	8.40	Moderately alkaline
8.41	to	9.00	Strongly alkaline
9.01	to	14.00	Very strongly alkaline

preferred range

Multiplier Factors for Calculating ECe
(taken from Hazelton & Murphy (1992))

Texture Class	Applicable Soil Textures	MF
S	Sand, loamy sand, clayey sand	17
SL	sandy loam, fine sandy loam	11
L	loam, loam fine sandy, silty loam	10
CL	clay loam, sandy clay loam	9
LC	light clay	8
MC	medium clay	7
HC	heavy clay	6

Interpretation of ECe (1:5 Soil:Water)
(rating based on Hazelton & Murphy (1992))

Ece (dS/m)			Rating
0.00	to	2.00	Non-saline
2.01	to	4.00	Slightly saline
4.01	to	8.00	Moderately saline
8.01	to	16.00	Highly saline
16.00	up		Extremely saline

increasing hazard

Interpretation of Emerson Aggregate Class
(rating describes likelihood of dispersion)

EAT Class	Rating
1	High
2(1)	Mod
2(2)	Mod
2(3)	High
2(4)	High
3(1)	Low
3(2)	Low
3(3)	Mod
3(4)	Mod
4	Low
5	Low
6	Low
7	Low
8	Low

Results of External Laboratory Analysis

Site Name	Sample Name	Depth (mm)	CEC (me/100g)	Rating	Ca (mg/kg)	Rating	Mg (mg/kg)	Rating	Na (mg/kg)	Rating	K (mg/kg)	Rating	ESP (%)	Rating	P-sorp. (mg/kg)	Rating	Bray P (mg/kg)	Rating	Total Nitrogen (%)	Rating	Organic Carbon (%)	Rating
Roadside Reserve (Grant Street)	TP4	300	3.3	VL	68	VL	89	L	36	L	37	VL	4.8	NS	514	H	-	n/a	-	n/a	-	n/a
Forrest Public School	TP6/1	350	4.3	VL	266	VL	72	L	22	VL	67	VL	2.2	NS		n/a	-	n/a	-	n/a	-	n/a
	TP6/2	1100	14.7	M	54	VL	545	H	80	M	50	VL	2.4	NS		n/a	-	n/a	-	n/a	-	n/a
	TP6/3	1500	15.7	M	9	VL	501	H	75	M	54	VL	2.1	NS	>1384	VH	-	n/a	-	n/a	-	n/a

Interpretation Sheet 2 - CEC, P-Sorption, Bray P, Organic carbon, Total nitrogen

Interpretation of CEC
(rating based on Hazelton & Murphy (1992))

Rating	CEC (me/100g)	Ca (mg/kg)	Mg (mg/kg)	Na (mg/kg)	K (mg/kg)
VL	0.00 to 6.00	0.00 to 400.00	0.00 to 36.50	0.00 to 23.00	0.00 to 78.20
L	6.01 to 12.00	400.01 to 1000.00	36.51 to 121.50	23.01 to 69.00	78.21 to 117.00
M	12.01 to 25.00	1000.01 to 2000.00	121.51 to 365.00	69.01 to 161.00	117.01 to 274.00
H	25.01 to 40.00	2000.01 to 4000.00	365.01 to 972.00	161.01 to 460.00	274.01 to 782.00
VH	40.01 up	4000.01 up	972.01 up	460.01 up	782.01 up

VL=very low, L=low, M=medium, H=high, VH=very high

Interpretation of ESP
(rating based on Hazelton & Murphy (1992))

Rating	ESP (%)	Description
NS	0.00 to 6.00	Non-sodic
S	6.01 to 15.00	Sodic
SS	15.01 to 25.00	Strongly sodic
VSS	25.01 up	Very strongly sodic

↓ increasing hazard

Interpretation of Phosphorus Sorption Capacity
(rating based on Hazelton & Murphy (1992))

Rating	P-sorption (mg/kg)	Description
L	0.00 to 125.00	Low
M	125.01 to 250.00	Medium
MH	250.01 to 400.00	Medium-High
H	400.01 to 600.00	High
VH	600.01 up	Very high

↑ increasing hazard

Interpretation of Bray Phosphorus
(rating based on Hazelton & Murphy (1992))

Rating	Bray P (mg/kg)	Description
VL	0.00 to 5.00	Very Low
L	5.01 to 10.00	Low
M	10.01 to 17.00	Moderate
H	17.01 to 25.00	High
VH	25.01 up	Very high

Interpretation of Soil Nitrogen (TN)
(rating based on Hazelton & Murphy (1992))

Rating	TN (%)	Description
VL	0.000 to 0.050	Very Low
L	0.051 to 0.150	Low
M	0.151 to 0.250	Medium
H	0.251 to 0.500	High
VH	0.501 up	Very high

Interpretation of Soil Organic Carbon (OC)
(rating based on Hazelton & Murphy (1992))

Rating	OC (%)	Description
VL	0.00 to 1.50	Very Low
L	1.51 to 2.00	Low
M	2.01 to 3.00	Medium
H	3.01 to 5.00	High
VH	5.01 up	Very high

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Director: Dr Robert Patterson FIEAust, CPSS, CPAg
Soil Scientists and Environmental Engineers

Lanfax Laboratories

ABN 72 212 385 096
Quality Assurance and Quality Control by Approved Methods

Analysis of Soil Sample for Wastewater System Design

Client... Decentralised Water Consulting *Date*..26th June 2018
Soil sample received 21st June 2018 *Analysis completed*. 26th June 2018
Source of soil: Forrest School

RESULTS – DWC - Forrest School

(all units in milligrams per kilogram unless otherwise stated)

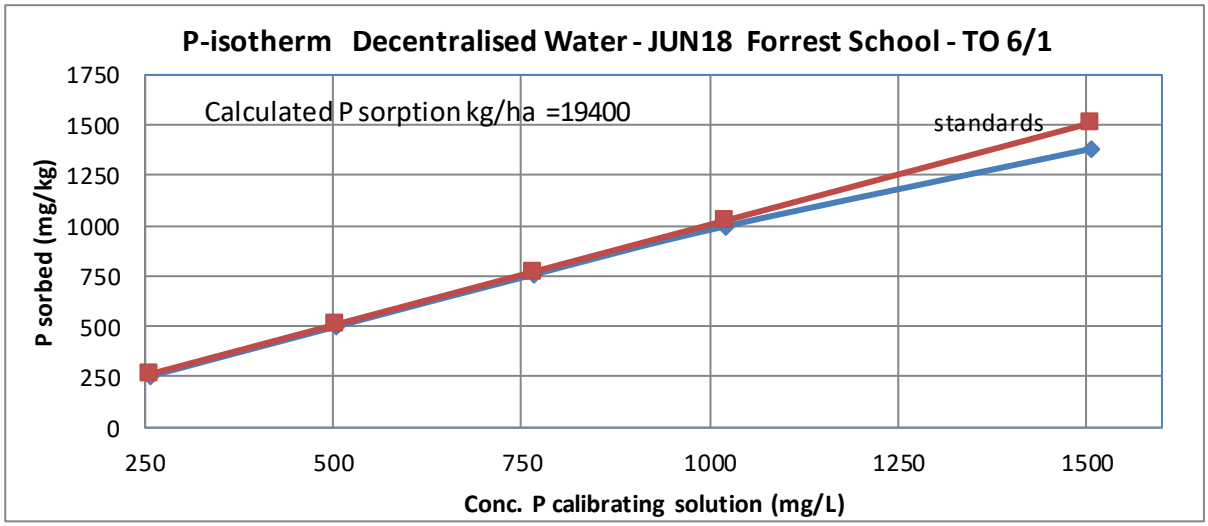
Parameter /Sample No.				Method
Client reference no.	TP6/1	TP6/2	TP6/3	
pH 1:5 in water	5.09	5.18	5.02	4A1
pH 1:5 in $CaCl_2$	4.25	4.13	4.00	4B1
E.C. (uS/cm)	30	27	28	3A1
Salinity hazard	Non-saline	Non-saline	Non-saline	Based on EC/Texture
Exch. calcium (mg kg^{-1})	266	54	9	15D3
Exch. potassium (mg kg^{-1})	67	50	54	15D3
Exch. magnesium (mg kg^{-1})	72	545	501	15D3
Exch. sodium (mg kg^{-1})	22	80	75	15D3
Exch. acidity (cmol(+) kg^{-1})	2.2	9.4	11.0	15 G1.
Cation Exchange Capacity (meq+/100g)	4.3	14.7	15.7	calculation
Exch. Sodium Percentage	2.2	2.4	2.1	
Sodicity	Non-sodic	Non-sodic	Non-sodic	
Base Saturation (%)	50.3	35.6	29.5	
Ca: Mg ratio	2.1	0.1	<0.1	
Field Texture	Loam	Medium clay	Medium clay	Northcote 1979
Soil Colour (moist)	10YR 5/4 dull yellowish brown	10YR 6/8 bright yellowish brown	7.5YR 5/6 bright brown	Munsell Colour
Permeability Class	3	6	6	AS/NZS 1547:2012
LTAR (trenches) mm/day	15-25	2-5	2-5	AS/NZS 1547:2012
DLR (irrigation) mm/day	4.0	2.0	2.0	AS/NZS 1547:2012
Initial dispersion test	Water stable, swell	Slake 2	Slake 2	SAR5, EC 1 dS/m
Emerson's Aggregate Test	Class 7	*3/6, slake 2	*3/6, slake 2	

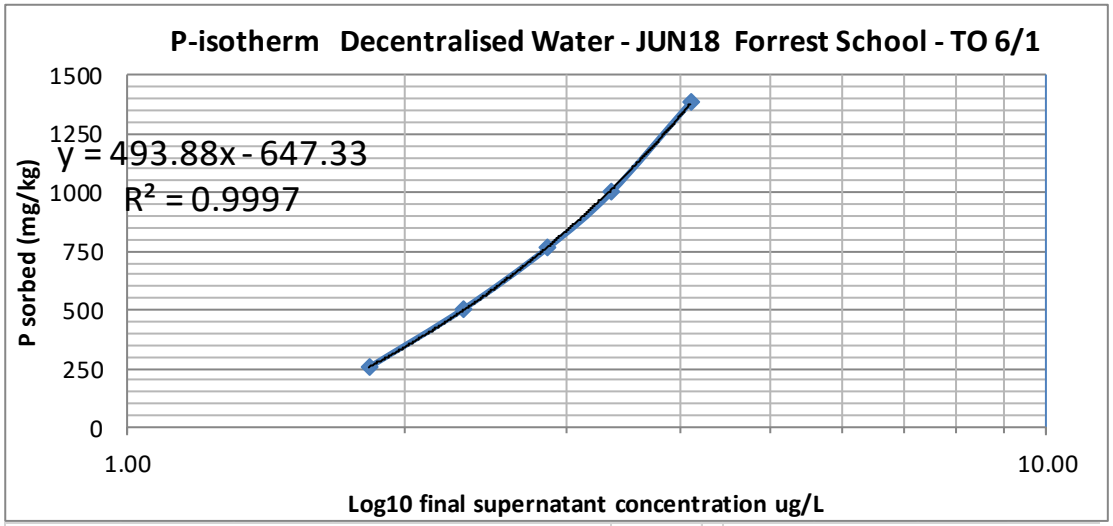
Reference: Rayment, G.E. and Lyons, D. J.(2011) *Soil Chemical Methods - Australasia.* CSIRO Publishing. Canberra. All methods in accordance with accreditation procedures.

NOTE: The dispersion test is done in solution that represents domestic wastewater, with sodium adsorption ratio of 5 and EC of 1 dS/m.

w/s = water stable in SAR5, EC 1 dS/m solution

Slake - severity of slaking 1,2 or 3. Reported slaking means no dispersion.





Percent sorbed is the proportion of the initial P sorbed during equilibration

Initial P	filtrate	sorbed P	Sample	Percent		P-isotherm Decentralised Water - JUN18 F			
						Std line	filtrate	X-axis	Y-axis
mgP/L	P	mg/kg	I.D.	sorbed			C	Log C	
	mg/L			(%)			ugP/L		
25.9	0.07	258.0	Decentralised Water - JUN18	99.7		259	68	1.83	258.0
50.6	0.21	504.2	Forrest School - TO 6/1	99.6		506	208	2.32	504.2
76.9	0.72	761.5		99.1		769	722	2.86	761.5
102.3	2.29	999.9		97.8		1023	2287	3.36	999.9
150.9	12.50	1384.0		91.7		1509	12504	4.10	1384.0
Calculated P sorption kg/ha =		19400							

Methods: Rayment & Lyons 2011
pH Method 4A1 (water) 4B1 ($CaCl_2$)
EC Method 3A1
Exchangeable acidity (H^+, Al^{3+}) Method 15 G1
Cation Exchange Capacity Method 15D3 plus exchangeable acidity
Exchangeable sodium percentage ratio sodium to ECEC
P sorption modified method 9J1 - elevated equilibrating solutions, ICP determination of P

Dr Robert Patterson FIEAust, CPSS(3), CPAg
Soil Scientist and Environmental Engineer

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Director: Dr Robert Patterson FIEAust, CPSS, CPAg
Soil Scientists and Environmental Engineers

Lanfax Laboratories

ABN 72 212 385 096
Quality Assurance and Quality Control by Approved Methods

Analysis of Soil Sample for Wastewater System Design

Client... Decentralised Water Consulting *Date*..26th June 2018
Soil sample received 21st June 2018 *Analysis completed*. 26th June 2018
Source of soil: Roadside Reserve

RESULTS – DWC - Roadside Reserve

(all units in milligrams per kilogram unless otherwise stated)

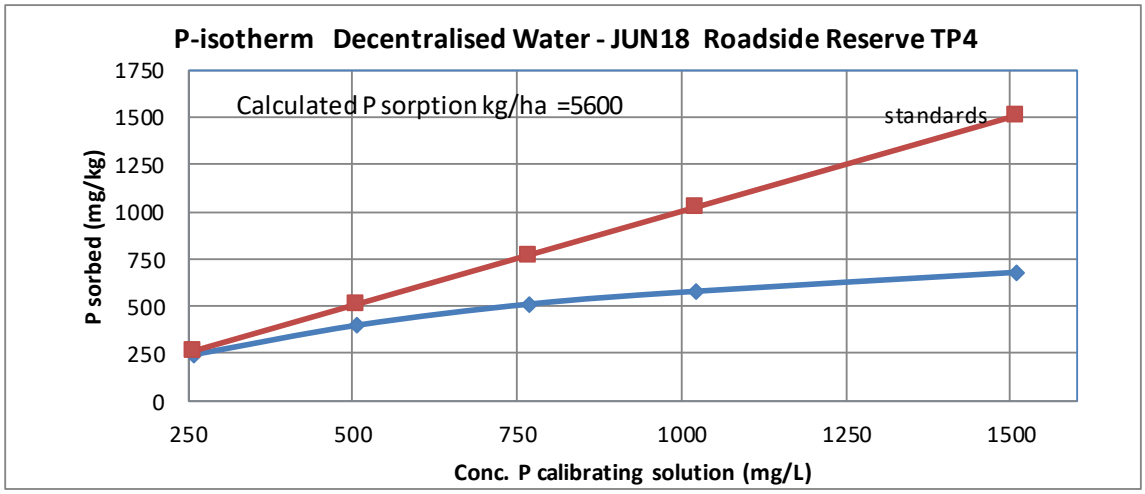
Parameter /Sample No.				Method
Client reference no.	TP4			
pH 1:5 in water				4A1
pH 1:5 in $CaCl_2$				4B1
E.C. (uS/cm)				3A1
Salinity hazard				Based on EC/Texture
Exch. calcium (mg kg^{-1})	68			15D3
Exch. potassium (mg kg^{-1})	37			15D3
Exch. magnesium (mg kg^{-1})	89			15D3
Exch. sodium (mg kg^{-1})	36			15D3
Exch. acidity (cmol(+) kg^{-1})	2.0			15 G1.
Cation Exchange Capacity (meq+/100g)	3.3			calculation
Exch. Sodium Percentage	4.8			
Sodicity	Non-sodic			
Base Saturation (%)	39.8			
Ca: Mg ratio	0.5			
Field Texture				Northcote 1979
Soil Colour (moist)				Munsell Colour
Permeability Class				AS/NZS 1547:2012
LTAR (trenches) mm/day				AS/NZS 1547:2012
DLR (irrigation) mm/day				AS/NZS 1547:2012
Initial dispersion test				SAR5, EC 1 dS/m
Emerson's Aggregate Test				

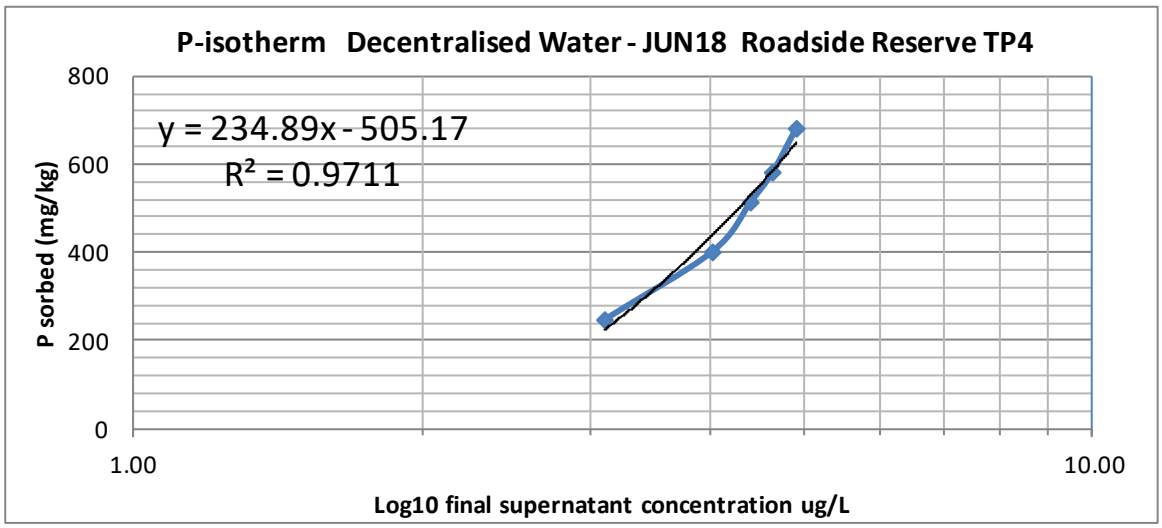
Reference: Rayment, G.E. and Lyons, D. J.(2011) *Soil Chemical Methods - Australasia.* CSIRO Publishing. Canberra. All methods in accordance with accreditation procedures.

NOTE: The dispersion test is done in solution that represents domestic wastewater, with sodium adsorption ratio of 5 and EC of 1 dS/m.

w/s = water stable in SAR5, EC 1 dS/m solution

Slake - severity of slaking 1,2 or 3. Reported slaking means no dispersion.





Percent sorbed is the proportion of the initial P sorbed during equilibration						P-isotherm Decentralised Water - JUN18 F			
Initial P	filtrate	sorbed P	Sample	Percent		Std line	filtrate	X-axis	Y-axis
mgP/L	P	mg/kg	I.D.	sorbed			C	Log C	
	mg/L			(%)			ugP/L		
25.9	1.26	246.1	Decentralised Water - JUN18	95.1		259	1256	3.10	246.1
50.6	10.46	401.7	Roadside Reserve TP4	79.3		506	10460	4.02	401.7
76.9	25.45	514.2		66.9		769	25454	4.41	514.2
102.3	44.06	582.2		56.9		1023	44057	4.64	582.2
150.9	82.62	682.8		45.2		1509	82624	4.92	682.8
Calculated P sorption kg/ha =		5600							

Methods: Rayment & Lyons 2011
pH Method 4A1 (water) 4B1 ($CaCl_2$)
EC Method 3A1
Exchangeable acidity (H^+, Al^{3+}) Method 15 G1
Cation Exchange Capacity Method 15D3 plus exchangeable acidity
Exchangeable sodium percentage ratio sodium to ECEC
P sorption modified method 9J1 - elevated equilibrating solutions, ICP determination of P

Dr Robert Patterson FIEAust, CPSS(3), CPAg
Soil Scientist and Environmental Engineer

Appendix I: Council Land Supply Data

Forrest Waste Water Investigation

Residential development land supply

Previous data

- According to the Forrest Structure Plan 2011, there were 26 vacant lots within the TZ zoned settlement boundary in Forrest, with an additional four vacant lots in the Rural Living Zone to the south of the township
- Lots to the north of Forrest and within the Settlement Boundary were noted as being significantly constrained
- There were 9 larger lots in Forrest identified as having subdivision potential, with a supply of 65 lots
- There was found to be a supply of 91 potential vacant dwelling lots in the Forrest township in 2011

Latest data

- A current search of the latest Colac Otway building records indicated one dwelling approval and completion permit issued since 2010.
- An examination of the 2016 aerial photography and Council information systems indicates a total three new lots created, all of which all were vacant in 2016. No other land (including land identified in the Structure Plan as being potentially suitable for subdivision) has been subdivided since 2011.
- A further two vacant lots, zone Rural Living, have been included within the town boundary, with one previously identified vacant lot rezoned to a public conservation zone, thus removing it from development potential
- An examination of aerial photography indicated the construction of seven new dwellings up until 2016, all within the Township Zone
- In summary, in examining the previous accepted subdivision potential of Forrest Township and current vacant lots, it is considered that there are 24 vacant residential lots and a further 65 potential residential lots with the Township Zone, Rural Living Zone and Farm Zone within the Settlement Boundary area of Forrest).

Current Forrest Land Supply*

Type of Lot	**Vacant**
Township Zone lots	20
Rural Living Zone lots	4
Estimated subdivision yield potential in all zones (including lots already partially developed), as identified in the Forrest Structure Plan 2011	65
Total potential residential lots available	**89**

*Note that this review is desktop only, using 2016 aerial photography

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