Appendix 1: Reports produced in related projects

Reports produced from North East Victoria –Adapting to a Low Water Future

1. Overview of project and final report

Final report and Overview: North East Victoria. Adapting to a Low Water Future. Written by Narelle Martin

2. Context. What is happening and what is predicted?

The following context material is available as a combined document

Historical Climate, climate change and water availability. North East Victoria Adapting to a Low Water Future: Deliverable 1. Written by Craig Beverly, and Mark Hocking.

User Groups, Access to Water and Current Water Usage Statistics. North East Victoria Adapting to a Low Water Future: Deliverable 2, Written by Jayanath Ananda.

Water Demand, Drivers, Trends and Related Behaviours. North East Victoria Adapting to a Low Water Future: Deliverable 3 Written by Alistair Watson.

Preliminary Vulnerability Assessment. North East Victoria Adapting to a Low Water Future: Deliverable 4 Written by Lin Crase, and Harry Clarke.

Summary and Synthesis North East Victoria Adapting to a Low Water Future Deliverable 5 Written by Lin Crase.

3. Climate change risk assessment and adaptation, and governance

Adapting to a Low Water Future: Climate Change Risk Assessment and Adaptation Plan. A Report prepared for the North East Greenhouse Alliance. Written by Marsden Jacob Associates and The Regional Development Company.

Development of Practical Solutions for the North East of Victoria – Adapting to a Low Water Future. Water Security for the North East. Written by Bonacci Water.

North East Victoria – Adapting to a Low Water Future: Review of Municipal documents. Written by Two Hemispheres Environmental Consulting.

4: Practical solutions

Development of Practical Solutions for the North East of Victoria – Adapting to a Low Water Future. Alternative Options to Manage Sullage and Sewage in Small

Rural Towns. Written by Bonacci Water.

Report for Water Efficiency Site Assessments and Action Plans, Phase 3 Part 5 of North East Victoria Adapting to a Low Water Future Written by the Water Group.

North East Victoria Adapting to a Low Water Future Phase 3 Stakeholder Behavioural Study and Analysis. Written by Regional Development Company.

North East Victoria Adapting to a Low Water Future Phase 3: Social Response Skills gap and Training needs analysis Final report. Written by Wodonga Institute of TAFE.

Alpine Shire Council Climate Change Action Plan 2012-2016 Produced for the North East Greenhouse Alliance. Written by Tribal Frog.

Developing a Climate Action Plan. Written by Tribal Frog.

Note: there are a number of extensive spreadsheets supporting this material available to the NEGHA partners.

Reports produced from Socioeconomic Adaptation Planning

Climate Change in North East Victoria: Socioeconomic Resilience Plan. Written by Marsden Jacob Associates.

Regional Community Development Climate Adaptation Plan Report Written by Institute for Sustainable Futures (ISF).

Skills Knowledge and Behaviour Change programs for Resilient Economies Written by URS Australia.

Adapting to Climate Change – Economic Planning and Development Written by URS Australia.

Regional Climate Change Adaptation Strategy. Written by Two Hemispheres Environmental Consulting.

Water in North East Victoria: Context Setting for the areas of Benalla Rural City, Mansfield Shire Council and the Alpine Resorts of Mt Buller / Mt Stirling, Mt Hotham and Falls Creek. Written by Hocking & Beverly

Appendix 2: Linkages to recommendations from *Hume Regional Plan for Sustainable Communities*

Introduction

The *Hume Strategy* is in five volumes. These are designed to be read in conjunction with each other. The regional plan provides recommendations across the whole region, while the sub regional strategy is more location based.

The following analysis takes the recommendations from each relevant section of the *Hume Strategy* and identifies which of the *Regional Climate Change Adaption Strategy* recommendations and associated documents adds value, completes or complements the Hume recommendations.

The *Hume Strategy* material is in purple. Additional sub regional recommendations are included. Those for the *Upper Hume Sub Regional Plan*: Indigo Shire, Towong Shire and City of Wodonga, include the reference 'UH'. Those for the *Central Hume Sub Regional Plan*: Alpine Shire, Benalla Rural City, Rural City of Wangaratta and Mansfield Shire, include the reference 'CH'. With the exception of Mansfield Shire, these two sub regions sit wholly within the area covered by the *Regional Climate Change Adaptation Strategy*.

Hume R P Actions reference	Hume Strategy	Regional Climate Change Adaptation Strategy: relationship with recommendation and further information
	Reducing the Hume Region's carbon footprint	
1.1.1	Development of a comprehensive and integrated Regional Climate Change Strategy, consistent with Victoria's Climate Change White Paper, detailing reduction of greenhouse gas emissions, climate change adaptations, and opportunities for green industry development.	The Regional Climate Change Adaptation Strategy provides a comprehensive regional approach to climate change adaptation.
1.1.2	Undertake social, environmental and economic impact assessment of the consequences of a changed Hume Region climate	Social, environmental and economic impacts of changes undertaken. See related reports including ALWF
1.1.7	Investigate transferability of Climate Change adaptation research projects (for example the Alpine and Towong Shires Climate Change Adaptation Project) occurring within the region.	Research identified pilots that can be transferred across region. Pilots include increasing business resilience, increasing community resilience, undertaking water audits. Outcomes transferrable across region with detailed outline of process included in reports.
1.2	**Being informed about climate change**	
1.2.1	Investigate and develop programs to tackle climate change applied through an integrated, multi-disciplinary approach, based on knowledge and science	Basis of the two projects: ALWF and SEAP has been integrated, multidiscsiplinary science based work. Can be extrapolated and applied across region.
1.2.3	Strongly support analysis of available information and science for the development of climate change adaptation programs and strategies	Information has been analysed and complemented. CC Adaptation programs and strategies developed.
1.2.4	Investigate opportunities for adaptive integration between sectors, for example carbon sequestration/forestry/biolinks/riparian management/water quality	Focus on water impacts but cross reference to other sectors and disciplines.

1.2.6	Develop an online Clearing House which provides a range of tools such as a library of natural resource management information relevant to the Hume Region, for example state and local plans, policies and strategies	Information and reports also proposed for NEGHA (revised) website which will allow access to material. Note that many of the existing council strategies for two sub regions have been analysed: see *Review of Municipal Strategies*.
1.3	**Local leadership supporting local initiatives**	
1.3.1	Create better links between government and community, promote and support local leadership on climate change to inform future thinking about local initiatives	Associated reports (eg ISF and URS) provide practical, piloted examples of developing linkages. See *Regional Climate Change Adaptation Strategy* and supporting SEAP reports
1.3.3	Explore the development of a web based tool for community to access up-to-date information on regional climate change mitigation and adaptation and to promote regional events and opportunities	Potential on line clearing house for community based activity identified with EcoPortal
1.3.4	Promote and build the capacity of community sustainability and climate change networks by offering practical support for participants, such as training opportunities and funding grants.	Recommendation supported by documents and pilots. Training opportunities (workshops for example) offered through IFS work See *Regional Climate Change Adaptation Strategy* and supporting SEAP reports, particularly ISF report.
1.4	**Harnessing opportunities**	
1.4.2	Support local government to form partnerships with government, community groups, and greenhouse alliances to deliver climate change mitigation and adaptation initiatives that are practical and community based	Both ALWF and SEAP are examples of multiple partnerships driven by local government through the NEGHA.
1.4.3	Promote innovative and collaborative approaches to environmental sustainability and climate change through support for local government programs and initiatives	SEAP and ALWF have provided in depth support for local government programs and initiatives, including positioning them for additional funding.
1.4.4	Investigate development of energy emission data tracking systems to accurately report greenhouse emissions in state and local government facilities, with corresponding targets	Tracking recommendations are supported in the *Regional Climate Change Adaptation Strategy*. Practical examples are already in place in some municipalities.

	to reduce greenhouse emissions, consistent with international, national, state and local targets	
1.4.5	Climate change reporting and energy emissions data to be integrated into state and local business planning and reporting	Recommendation consistent with recommendations of *Regional Climate Change Adaptation Strategy*.
1.5	**Integrated Planning Approaches**	
1.5.4	Investigate the information required to improve integration of climate change considerations in regional and local planning	*Review of Municipal Documents* analyses current plans and strategies for five municipalities, identifies in detail gaps, and includes recommendations to assist in integration. See also *Regional Climate Change Adaptation Strategy*
Key Direction 2	**Managing our water resources sustainably**	
2.1	**A water view for the region**	
2.1.1	Promote best practice in efficient water usage across the region, including recycling and grey water treatment, high value water use industries, environmental allocations and consideration of water use close to the source	Detailed analysis of water security for region undertaken including using multiple sources of water, fit for purpose water, including costed case studies. See Bonacci Water report *Water security*
2.1.4	Prioritise development of recycled water projects within the region such as industrial reuse, irrigation and watering systems for parks and sports grounds	Provides analysis of opportunities as well as identifying that municipal owned recreational areas have significant risks associated with them. See *Regional Climate Change Adaptation Strategy* and contributing reports, including risk analysis by Marsden Jacob Associates
2.1.5	Apply an integrated planning approach which utilises Hume Region water reliability information to identify gaps and opportunities and enhance planning, settlement	Significant work undertaken in this area, particularly with Bonacci Water work on water security. Land use planning also addressed in multiple reports including Regional Climate Change Adaptation

	sustainability and future growth.	Strategy.
2.1.7	Develop a scientifically robust and integrated understanding of the impacts of climate change, drought and water management systems to identify and pursue improved water security measures.	Significant and detailed work done in this area, particularly in ALWF projects.
2.1.8	Improve the understanding of surface and groundwater use in unregulated systems to better inform planning and policy change options being considered	Significant and detailed work done in this area, particularly in ALWF projects. Anomalies in groundwater data and modelling identified
2.1.11	Undertake an integrated approach to dry inflow contingency planning across the region	Proposed policy amendments identified for municipalities and other organisations. See *Regional Climate Change Adaptation Strategy*
2.1.12	Improve drinking water quality in childcare centres, schools and school camps not connected to a reticulated water supply system	While not a specific focus, the *Water Security* report by Bonacci Water and the *Sewage and Sullage* report by Bonacci Water provide insights to addressing small unsewered communities, including caravan parks and other areas not connected to reticulated water.
2.1 UH1	Implement the outcomes of the 'North East Victoria – Adapting to a low water future'	Agreed.
2.2	**Water management through innovation**	
2.2.1	Encourage and support the development of a series of demonstration projects located in new residential/commercial/industrial/agricultural developments which focus on applying and promoting new technology in water management, water sensitive urban design and best practice efficient water usage	Background work including modelling, schematics, plans and costs have been done for a number of communities. See *Regional Climate Change Adaptation Strategy* and two reports by Bonacci Water, as well as Addendum to Septic and Sewage report by Bonacci Water.(appendix to this Strategy)

2.2.4	Develop and deliver sustainable water use programs to support landowners adapting to decreasing water availability and climate change impacts	Detailed audits undertaken of a number of small and medium businesses to identify potential savings. See work by Water Group.
2.2. UH1	Promote the development of innovative solutions to improve water supply, sewerage and wastewater management in settlements in the Upper Hume sub region.	Work by Bonacci Water on unsewered communities addresses issue.
2.2. CH1	Promote the development of innovative solutions to improve water supply, sewerage and wastewater management in settlements in the Central Hume sub region.	Work by Bonacci Water on unsewered communities addresses this issue.
2.2. UH2	Investigate opportunities for wastewater reuse from industry or reticulated settlement systems.	Work by Bonacci Water on unsewered communities addresses this issue
2.2. CH2	Develop key opportunities for sustainable use of water at the source through alpine agribusiness projects, while improving understanding of Lower Ovens groundwater resources and interactions and ensuring appropriate management of unregulated schemes	Groundwater systems in upper catchments reviewed and anomalies identified. Gaps in groundwater information also identified. See *Regional Climate Change Adaptation Strategy* for overview of issues.
2.3	**Water guiding planning outcomes**	
2.3.1	Consider water availability and the potential impacts of climate change, as a key driver for all future planning and development within the Hume Region	Background information, research, practical tools and examples of how water can be used as a key driver included in Strategy and accompanying reports.
2.3. CH1	Ensure rural and urban developments in the Ovens River catchment are planned in a way that is consistent with water resource information and future climate change predictions.	Note report on *Review of Municipal Documents* identifies gaps and recommendations to assist in this area.
2.3.2	Ensure future settlement assessments consider water availability and sustainable use as an important	Work by Bonacci Water on *Water Security* provides model to improve the water security for communities.

	determinant of settlement sustainability	
2.3.3	Foster a collaborative approach between government, industry and business, to explore opportunities for water recycling and grey-water systems in existing and new developments; floodplain management; emergency response and planning for management of environmental flows	Process of developing Regional Climate Change Adaptation Plan and the associated documents increased collaboration. Reports produced identify tools to assist in identify and use multiple source of water. Emergency management also considered. See *Regional Climate Change Adaptation Strategy* and associated reports
2.3.6	Investigate viability of requiring new development in residential zones to have dual water supplies and integrated infrastructure rolled out for newly subdivided areas.	Case studies undertaken. Note work undertaken by Towong on Tallangatta as case study.
2.3.7	Investigate access and availability of domestic water supplies in areas not connected to a reticulated water supply system	See Bonacci Water *Septic and Sewage* report for investigation, planning, schematics and costing for alternative approaches.
2.4.1	Improve the management of septic tanks through coordinated programs that include monitoring, education and training to overcome detrimental health and environmental impacts	Bonacci Water work identifies alternative model to address unsewered communities and septic tanks.
2.4.2	Pursue funding opportunities and increase community support for the design, planning and construction of reticulated sewer systems or alternative technology sewerage solutions in small settlements across the region	Bonacci Water work identifies alternative model to address unsewered communities and septic tanks. Includes plans, costings and practical examples for communities.
2.4.9	Maximise the benefits of environmental water flows for the region through integrated planning processes	*Regional Climate Change Adaptation Strategy* and supporting documents provides assistance, detailed analysis and recommendations in this area.
3.4	**Education, incentives and community**	
3.4.4	Build community capacity to engage with and manage the	Skills analysis and capability work done in both SEAP and ALWF.

	regional environment by assisting the development of 'green skills/jobs' education and training	
4	**Harnessing renewable energy sources, reducing greenhouse gas emissions and pursuing innovative waste management approaches**	
4.2	**Energy and innovation**	
4.2.1	Encourage and facilitate the development of a series of energy-efficient, greenhouse friendly demonstration projects, potentially located in new residential developments, which encourage the minimisation of energy and water consumption through energy and water efficient subdivision and building design	This is developed in more detail by Towong. The Bonacci Water Report adds value by using Tallangatta as a case study for demonstrating benefits of multiple sources of water, and renewable energy for water infrastructure.
6.3	**Develop and renew services and infrastructure**	
6.3.1	Ensure settlement plans investigate services and infrastructure requirements to keep pace with population growth, changing demography and emerging needs. These plans must consider water and waste water requirements as well as energy efficiency innovations	*Regional Climate Change Adaptation Strategy* identifies more clearly ways to assist this. Supporting reports also add value.
8	**Strengthening communities, increasing resilience and enhancing liveability**	
8.1	**Engagement and capacity building of people and places**	
8.1.1	Ensure community strengthening activities are tailored and appropriate to local needs	Work by IFS provides case studies and pilots developed for local conditions
8.1.5	Reduce socio-economic disadvantage and build resilience in the most vulnerable locations by engaging affected	Addressed by Vulnerabilty report by Marsden Jacob Associates,

	communities in action to improve service access and responsiveness and participation in education, training and employment.	and work by IFS on pilots for improving capability and resilience.
8.1. UH1	Strengthen community leadership skills development and utilize the existing and emerging community leadership base in the Upper Hume sub region through participatory community development projects.	Leadership development using pilots and case studies addressed by ISF.
8.1. UH2	Target community strengthening activities to the relatively highly disadvantaged urban communities in Wodonga and small rural communities in other parts of the Upper Hume sub region that are facing adjustment challenges.	Wodonga was one of the communities involved in pilot for community resilience by ISF.
8.1. CH1	Engage communities and address socio-economic issues in areas of high relative disadvantage such as Benalla.	Businesses in Benalla included in case study and pilot by URS
8.1. CH2	Strengthen community leadership skills development and utilize the community base of the Alpine Valleys Community Leadership Program (AVCLP) through participatory community development projects. Provide resources and/or assistance to support local community leadership skills development.	Examples of community development projects undertaken by IFS as pilots that can be used across communities.

Appendix 3: Committees overseeing the projects.

North East Victoria: Socioeconomic Adaptation Planning

Project auspicing

This project has been delivered by the North East Greenhouse Alliance on behalf of Alpine Shire Council, Benalla Rural City, Shire of Indigo and Shire of Towong, Rural City of Wangaratta, City of Wodonga, the Alpine Resorts and in partnership with the North East Catchment Management Authority. Department of Sustainability and Environment also provided support and was a partner for the project.

The City of Wodonga provided auspicing for the North East Greenhouse Alliance (NEGHA). This included providing an office and administrative support for the Executive Officer of NEGHA. Nikki Scott as Executive Officer of NEGHA provided project management until September 2011. That role was provided by Jan Ryan who acted on a contract basis to provide project management until the completion of the project (including final reports) in August 2012.

The City of Wodonga also signed agreements with the Federal Government on behalf of the NEGHA. The City of Wodonga provided contractual and financial oversight for the project, including auditing of funds.

Steering group

A steering group was established and met regularly. Members of the steering group included:

Councillor Ed Foulston (Chair) (City of Wodonga)

Councillor Barbara Alexander (Benalla Rural City)

Councillor Ron Webb (Rural City of Wangaratta)

Councillor Ali Pockley (Shire of Indigo)

Councillor Peter Roper (Alpine Shire)

Councillor Peter Joyce (Shire of Towong)

Mark Verbaken (City of Wodonga)

Bronwyn Chapman (Rural City of Wangaratta)

Mark Florence, (Indigo Shire)

Juliana Phelps (Shire of Towong)

Heather Green (Alpine Shire)

Veronica Schilling, (Benalla Rural City Council)

Jeff Taylor (North East Catchment Management Authority)

Alison Mitchell (Wodonga TAFE)

Michael O'Loughlin (Wodonga TAFE)

Executive support: Nikki Scott (to September 2011)/ Jan Ryan

North East Victoria: *Adapting to a Low Water Future*

Project auspicing

This project has been delivered by the North East Greenhouse Alliance on behalf of Alpine, Indigo and Towong Shires, Rural City of Wangaratta, City of Wodonga, and in partnership with the North East Catchment Management Authority, North East Water, and Goulburn-Murray Water. Department of Sustainability and Environment also provided support and was a partner for the project.

The City of Wodonga provided auspicing for the North East Greenhouse Alliance (NEGHA). This included providing an office and administrative support for the Executive Officer of NEGHA. Nikki Scott as Executive Officer of NEGHA provided project management until September 2011. That role was provided by Narelle Martin who acted on a contract basis to provide project management until the completion of the project (including final reports) in February 2012.

The City of Wodonga also signed agreements with the Federal Government on behalf of the NEGHA. The City of Wodonga provided contractual and financial oversight for the project, including auditing of funds.

Steering group

A steering group was established and met regularly. Members of the steering group included:

Cameron Alexander (Alpine Shire);

Mark Verbaken; Anne Visser (City of Wodonga);

Bronwyn Chapman (Rural City of Wangaratta);

Charles Knight, (Towong Shire);

Mark Florence, Helen Jones (Indigo Shire);

Tim Clune (North East Water);

Matthew O'Connell (North East Catchment Management Authority);

Matthew Pethybridge (Goulburn-Murray Water);

Tony Long (DSE)

Executive support: Nikki Scott (to September 2011)/ Narelle Martin

Appendix 4: Overview report for *Adapting to a Low Water Future*

Final Report and Overview

North East Victoria: Adapting to a Low Water Future

Note: the appendices for this document are not included. They have been incorporated within Appendix 3.

Acknowledgements

This document has been prepared with the assistance of people from a range of organisations. Thanks go to the Executive Officer of the North East Greenhouse Alliance, the Technical Team and Steering Group for the project, staff of the Alpine Shire Council, Indigo Shire Council, Towong Shire Council, Rural City of Wangaratta, the City of Wodonga, North East Water, North East Catchment Management Authority, Goulburn-Murray Water and the Department of Sustainability and Environment.

The input of staff, councillors, community members and businesses through workshops, discussions and audits through the course of this project is gratefully acknowledged.

All errors, of course, remain the responsibility of the author.

Funding

The North East Greenhouse Alliance project "North East Victoria Adapting to a Low Water Future" is funded by the Australia Government through *Water for the Future.*

Disclaimer

While every attempt has been made to make this information as accurate as possible, the North East Greenhouse Alliance and its members and contributing organisations and the author assume no legal responsibility for decisions based on the contents of this document.

Narelle Martin
On behalf of the Steering Group

Table of Contents

Introduction

This final report is to:

- Provide a wrap up report for the stakeholders and participants of the project "North East Victoria - Adapting to a low Water Future."

- Provide a starting point for briefings for participating Councils and other interested bodies as the implications, recommendations and suggestions, as well as some of the lessons learnt, are considered.

Scope of the project

The title of the project was "North East Victoria – Adapting to a Low Water Future". When the project was proposed, the region was in the grip of an on-going drought. During the project the drought broke and there was series of serious floods. The project focus then more clearly shifted to a *low water future* and *variability*. This change more clearly reflected the project proposal.

The project was limited to urban community impacts and local government interests and did not consider the reliability of supply to irrigators.

This project was focused on the institution and the partners. It was *not* a community-based project.

The geographical area of the project included the areas covered by the Alpine Shire, Indigo Shire, Towong Shire, Rural City of Wangaratta and the City of Wodonga. These areas largely cover the Victorian side of the upper Murray River catchment, the Kiewa catchment and the Ovens and King catchments.

Governance and funding arrangements

The project "North East Victoria adapting to a low water future" arose from discussions within the North East Greenhouse Alliance (NEGHA). Each of the participating organisations, councils and partners, signed letters of support for the project submission. The project was funded by the Federal Government, through the Australian Government's *Strengthening Basin Communities Program.*

The funding of $800,000 from the federal government was supported by in-kind contributions by the participating organisations.

Management of the project was undertaken initially by the Executive officer of the NEGHA, and latterly by a project manager, supported by a Steering Group. Appendix One provides an outline of the governance structure, and membership of the NEGHA and this project.

A clear basis of the funding agreement was that no money from the project could be spent on infrastructure.

Timing for the project was also tight. The project funding agreement was signed on 15 December 2009 for completion by 31 December 2011.

The Richness of the North East.

It could be argued that the biggest export from North East Victoria is water. Although the North East Victorian region it comprises only 2% of the geographic area of the Murray Darling Basin, the region's rivers contribute 38% to the total water in the Murray Darling Basin systems. Industry, agriculture and communities have been built on the availability of water.

Changes in the amount of rainfall in North East Victoria has impacts both within the North East community and downstream.

Outcomes of the project.

A full listing of the reports produced is included in Appendix Two.

The project comprised three related elements:

- Phase 1 – Project Context setting
- Phase 2 – Climate Change Risk Assessment and Adaptation Planning
- Phase 3 – Development and Delivery of Practical Solutions

The project has:

- Provided the context of the impacts of climate change on the stakeholder communities in the North East of Victoria;
- Undertaken a comprehensive risk analysis identifying the highest risks to the participating organisations;
- Developed an adaptation plan with recommendations for participating organisations, and at the regional level;
- Reviewed existing plans and strategies of Councils to identify whether climate change has been incorporated into existing documents and approaches, identified gaps, and recommended methods of incorporating changes into operations;
- Consulted with stakeholders to identify behavior and communication barriers to change;
- Completed a review of training and development needs for the participating organisations and identified sources of training;
- Undertaken audits of seven small to medium sized businesses in the region to identify water use, potential water savings and recommendations for further action, as well as providing a basis for further savings for businesses across the North East;
- Developed a blueprint for future planning and design, that incorporates sustainable water management principles into land use planning and projects from inception;
- Identified innovative approaches for dealing with septic and sullage in small communities not served by water authorities; and
- Developed a Climate Action Plan for Alpine Shire Council and a template that other municipalities can use.

Appendix 3 shows the reports and linkages to partners.

Contents of Reports

The following information provides a snapshot of the work undertaken in the reports, but does not reflect the conclusions of the work. All of the reports are included on the disc: Adapting to a Low Water Future – Final reports.

It should be noted that the titles of reports listed here are slightly different to the titles of the final reports, for ease of reading. Appendix 3 reflects the full titles.

Phase 1 Context. What is happening and what is predicted?

This suite of reports was overseen by Dr Lin Crase of La Trobe University and is produced as a single document.

Historical Climate, Climate change and Water Availability. Written by Craig Beverly (Department of Primary Industry) and Mark Hocking (Hocking et al Pty Ltd).

This report provides a review of water resources. The study reviewed and analysed historical climate, climate change and water availability within the North- East Catchment Management Authority Region. The report used an approach developed by Department of Primary Industry (DPI). The computer modeling included climate scenarios developed by CSIRO, and used existing surface water and groundwater models to assess the major impacts of climate change on water availability projections to 2030 and 2070.

The estimates that arose from the modeling are shown in a large number of maps, graphs and tables. Outcomes of the modeling, for example predicted changes in rainfall, are also provided by municipality.

The report notes that previous studies typically addressed key river basins such as the Ovens and Kiewa river systems. This was the first time that the climate change study addressed the whole of the North East CMA region at a smaller spatial scale.

The key findings from the study broadly aligned to previous modeling, but identified large uncertainties. It was also noted that there were significant variations in this report and other reports. For example, it points out that there are differences in views in the long term ability to extract groundwater. Conclusions are included on pages 59-60, with recommendations particularly on groundwater dynamics and sustainable extraction limits.

User Groups, Access to Water and Current Water Usage Statistics. Written by Jayanath Ananda (La Trobe University)

This report provides a snapshot of the region including the population and economy, water rights and entitlements, water user groups and consumption trends, water sources and water supply reliability.

Again information is broken down by municipalities. This report looks at both urban and rural water use. It notes that rural water use is the dominant water use in the region. The report also includes a description of water rights and entitlements including security in water entitlements.

Water Demand, Drives, Trends and Related Behaviours. Written by Alistair Watson (Freelance economist and Adjunct Professor, La Trobe University)

This paper provides a discussion on the relative powers on irrigation versus urban water provision. It provides considerable background on the development of water policy, particularly the role of irrigation. The paper also includes some discussion on different approaches to water pricing and the implications for different urban water strategies.

Preliminary Vulnerability Assessment. Written by Lin Crase and Harry Clarke (La Trobe University)

This report focuses on vulnerability assessment on a council by council basis. The approach focuses on reduced water availability while recognizing that increased variability is also an issue.

Potential vulnerable economic activities and assets in each municipality are identified: “hot spots”. For each shire economic drivers, the level of water dependency of the economy and substitution opportunities are addressed.

Policy responses that may lower vulnerability are also discussed: investments in long-term infrastructure; providing information to those affected by changed water supply availability; providing an expanded range of technology; and putting into place a water supply policy regime that encourages rather than discourages adaptation.

The assessment of vulnerability is provided in table form for each municipality. The report also considers the social and economic consequences of vulnerability.

Summary and Synthesis North East Victoria Adapting to a Low Water Future. Written by Lin Crase (La Trobe University)

This report provides a brief summary of the major findings of the above reports.

Phase 2: Climate Change risk assessment and adaptation, and governance

Adapting to a Low Water Future: Climate Change Risk Assessment and Adaptation Plan. Written by Marsden Jacob Associates and The Regional Development Company.

There were two elements of this work. This included a risk assessment, and then developing an adaptation plan based on the outcome of that assessment

The risk assessment was to identify the full range of potential risks of both low water vulnerability and increased rainfall variability. The work involved staff from municipalities and agencies working together to identify how well they could perform their roles and responsibilities. This was assessed for current conditions, for the medium term (2030) and the long term (2070). These last periods took into account the likely changed conditions due to climate change.

The workshop discussions were followed by interviews and further discussions to refine the risk assessment. Following this process, a series of potential adaptation actions were identified.

The final report incorporates both processes. The formal report includes tables summarizing risks and actions. In addition, there are a series of excel reports included as part of the material on the disc that shows the spreadsheets and outcomes by both municipality and agency. There are also some recommendations for the region. These extensive spreadsheets identify risks, quantify risks and identify recommended actions.

Workshop: Changing Behaviours. Provided by Dr Douglas McKenzie-Mohr February 2010.

A workshop with participants across the region was held in February 2010. Dr McKenzie Mohr is a psychologist specializing in working with community change. He has been at the forefront of developing “Community-Based Social Marketing” (CBSM).The work of Dr McKenzie Mohr, including his free downloadable book, is available at http://www.cbsm.com/public/world.lasso

The workshop, over two days, provided participants with practical skills to assist in changing behaviours both in the workplace and in the community.

Water Security for the North East. Written by Bonacci Water.

This report includes the outcomes of re-analysis of significant amount of data from sources across the region, based on individual sites. It has a focus on urban water supply, and examines ways that new developments in particular may benefit from different approaches.

This report challenges municipalities and partners to consider alternative approaches to water supply and management. It includes outcomes of modeling of different scenarios, including the current "business as usual". Scenarios include aspects of integrated water cycle management, including reducing water use, increasing efficiencies, and stormwater management. It identifies that alternative water management strategies have the potential to supplement demands for potable water supplies.

The report divides the North East region intro 45 zones. Analysis show rainfall levels, as well as rainfall intensity and distribution.

The report includes case studies for a range of communities across the North East.

Review of Municipal documents. Written by Two Hemispheres Environmental Consulting.

This work built on the risk assessment and adaptation planning phase of the project. The report uses the priority groupings identified through the risk assessment process: surface water supply and quality; groundwater supply and quality; stormwater and flood management; policy and planning; economic development; recreation and amenity; and emergency services and environment. For each area, this report looks at the work already been undertaken by the five municipalities.

Council documents were reviewed to identify whether climate change had been identified and examined as part of the assumptions, and make recommendations.

Existing plans and strategies examined for each council (where available) have included: Planning scheme; Council Plan; Community Vision; Healthy Communities Plan; Heatwave Plan; Stormwater plan, Recreation Plan; Economic Development Plan and Tourism Plan. In addition plans unique to individual councils were also examined.

The report reviews constraints that municipalities operate under. There is an extensive review of existing plans and strategies (Section B) as well as detailed examination of reports, by Council. (Section C). The report also includes a substantial number of recommendations.

Phase 3: Practical Solutions

Alternative methods to manage sullage and septic in small rural towns. Written by Bonacci Water.

This report has been able to leverage from the work undertaken in Phase 2 by Bonacci, "Water Security". Significant analysis and modeling already developed for the water security project has been able to be used and expanded to address the septic and sullage issues across 17 communities. The report has identified a range of barriers to addressing issues. These included institutional arrangements.

Case studies for options for sullage and sewage management at a number of locations are included in the report. Additional case studies are also being prepared for the municipalities outside of the formal report timetable. These case studies will be made available through councils.

Report for Water Efficiency Site Assessments and Action Plans. Written by the Water Group.

The Water Conservation Group[1] undertook audits of seven businesses in the North East to identify water savings in their operations. The businesses were: Bright Chalet; Burder Industries; Wangaratta Livestock Exchange; Myrtleford Butter Factory; Victoria Alps Winery; Wodonga Caravan and Cabin Park; and La Trobe University Campus.

The report identifies the process used, identifies and costs to the water savings initiatives and includes the detailed reports of the audits of a number of the businesses.

Water savings and financial costs have been identified and extrapolated for across the North East region. These will be used as case studies for other businesses and industry across the North East.

A number of the company audit reports are also included.

Stakeholder Behavioural Study and Analysis. Written by The Regional Development Company.

This report analysed drivers and barriers for key stakeholders (municipalities and partners) to implementing actions for adapting to climate change. It outlines the consultation as part of the review. This included briefings and communications strategies to senior executives of Councils and partner organisations. The report also outlines the outcomes of facilitated workshops held with a number of councils.

An appendix outlines the result of a literature review undertaken to provide an understanding of potential drivers and barriers to embedding sustainability into organizations. It identifies that the drivers, challenges and barriers to sustainability are comparatively well understood. Both the report and the literature review incorporates recommendations.

Social Response Skills Gap and Training Needs Analysis Final report. Written by Wodonga Institute of TAFE.

This report consulted with councils and partners to identify challenges and trends for skills, recruitment and training. The focus is to identify what is needed for the partners to address the changing capability requirements of climate change on water resources.

The report includes a discussion of the environmental factors that will have an impact on knowledge and skills requirements as well as industry factors.

An overview of training and barriers to training are identified. Workforce training needs are also identified, along with current and emerging labour shortages and skills gaps.
The report also includes an extensive listing of existing courses and training available. These include training packages, related degrees across Australia (including distance education);and courses and workshops offered by agencies, including Municipal Association of Victoria, and the Victorian Employers Chamber of Commerce and Industry.

Alpine Shire Council Climate Change Action Plan 2012-2016. Written by Tribal Frog.

This report was developed with an intense effort from the Councillors and staff of the Alpine Shire Council. The approach was to take the outcomes of the work developed as part of “North East

[1] The Water Conservation Group changed their business name during the contractual period to WaterGroup Pty Ltd.

Victoria Adapting to a Low Water Future" and previous work instigated by the Alpine Shire related to Climate Change and develop a consolidated, user friendly and short action plan.

The Plan is recognized as a work in progress and a "first cut" and is designed to be the basis of ongoing action by Alpine Shire Council, for example it may be included or referred to in future Council Plans. It includes an Action Table clustered into three common themes that emerged from previous documents. These are: education and awareness; council business; and advocacy. Priority actions, responsible units and priorities have been identified.

An associated data base included in this disc lists all of the reports developed by the Alpine Shire Council that have addressed some aspects of climate change and sustainability, and the relationship with the Alpine Shire Council Climate Change Action Plan.

Developing a Climate Action Plan. Written by Tribal Frog.

This report provides a template for other municipalities in the project to assist them in developing a Climate Change Action Plan. It documents the process used by Alpine Shire Council and identifies the key steps that contributed to the success of developing the Climate Change Action Plan.

Surprising outcomes

Much more important than the reports is what we have learnt from them, and what can be done in the future.

There are a number of surprises that emerged from the work.

Current risks are not being not met

The risk assessment showed that there are four significant risks that are not being met[2]. Nearly 60 water related risks were identified and rated through workshops and follow up consultations.

Of these risks identified, 7% of the risks are **extreme,** and with current water variability are not being met. This means that we are not currently able to manage some significant risks, never mind risks likely to increase by 2030 or 2070. These are:

- Reduced reliability of unregulated surface water supplies
- Uncertainty of data relating to sustainable yield of groundwater under climate change scenarios
- Degradation of parks, gardens and streetscapes
- Decreased water reliability in unregulated systems for aquatic ecosystems.

The risk assessment showed that the number of high and extreme risks increases significantly over time.

Councils are already managing water variability

It was clear as the project progressed that Councils in particular are already dealing with climate change and variability, but often don't recognize it[3].

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[2] Marsden Jacob Associates, The Regional Development Company, Adapting to a Low Water Future: Climate Change Risk Assessment and Adaptation Plan. A Report prepared for North East Greenhouse Alliance

All Council Plans and strategies were reviewed to see if climate change had been considered. The report by Two Hemispheres Environmental Consulting provides a detailed assessment of Council plans and strategies, and identifies gaps and recommendations. It makes clear that Council and their staff are already grappling with climate change related issues.

For example, there are currently big issues in flooding and implications for management for Councils in the areas of stormwater, planning, emergency management and upgrading of Infrastructure that Councils are struggling to deal with.

Different assumptions provide different outcomes.

While this is not really a surprise, it was interesting to see how different approaches by consultants, reviewing base information, could provide different outcomes. The groundwater modeling by Beverly and Hocking point to less water security than has been identified by other consultants. This is in part a reflection that there is not enough data. This was picked up by the risk assessment, where there are a number of recommendations to try and get a better handle on the risks associated with lack of information, particularly for groundwater.

The work by Bonacci Water, both in relation to water security (phase 2) and in addressing septic and sullage issues (phase 3), has provided challenges for models of business as usual. Their work combines both modeling and discussions with locals. The outcomes of that work has stimulated considerable discussion and may lead to quite different approaches. That is particularly valuable when dealing with intractable issues such as providing water for small communities, and managing septic and sullage (or sewage) in small communities.

Infrastructure costs may vary

Different approaches in thinking about water security[4] and sullage and sewage[5] may lead to reduced infrastructure costs.

The two reports by Bonacci Water addressing both water security and septic and sullage are meant to challenge long held beliefs and approaches to both issues.

One of the premises for the water security brief was to try to incorporate water security into the development process. This work allows councils and partners to consider how they have traditionally approached water provision through large infrastructure, with opportunities to reduce mains water demands, sewerage discharges and impacts on waterways from urban development.
This can also be particularly important in small communities where there is no reticulated water supply.

Alternative approaches to provision of water services may reduce infrastructure and energy costs in some instances.

As part of the development of the report on septic and sullage, a workshop was held. The workshop discussion on managing sullage included participation from Environmental Health Officers across the region. This is an example of an ongoing issue where municipalities and water authorities across

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[3] Two Hemispheres Environmental Consulting, North East Victoria – Adapting to a Low Water Future: Review of Municipal Documents

[4] Bonacci Water Water, Development of Practical Solutions for the North East of Victoria – Adapting to a low water future. Water Security for the North East Greenhouse Alliance.

[5] Bonacci Water, Development of Practical Solutions for the North East of Victoria – Adapting to a low water future. Alternative Options to Manage Sullage and Sewage in small community towns

Victoria have tended to place management of this issue in the too hard, too costly basket. Having an opportunity through this project to more clearly identify both the scale of the challenge, challenge assumptions and look to practical ways of managing hot spots has been welcomed.

There is considerable opportunity to reduce water costs in businesses

One of the projects was to undertake free water audits for seven businesses[6]. This led to a couple of surprises. One was how difficult it was to get businesses to undertake a free service. The second was that the audits clearly showed how much could be saved –water and money - through fairly simple changes. Of the sites audited, water savings of approximately 20% with a pay back period of 5.3 years was identified. These figures have been extrapolated across the North East.

Less surprising was the recognition that communications were critical, and there was more work needed to be done in this area[7].

Discussion

Lessons learnt

There have been some lessons from this project that can be applied elsewhere. With hindsight, some changes would have been helpful. These include trying to expand the timeline, having a dedicated project manager; and having more time in the front stage of the project development to consult and discuss with participating organisations.

A different title (such as dealing with water variability) would have allowed a clearer focus earlier in the life of the project.

There would also have been benefits in having discussions with other local government applicants and organisations that had funding from the same sources about their experiences and to learn from each other.

All of these are issues that arise in part because this was the first round of funding. Some recommendations along these lines will be included in the final report to the Federal Government.

Benefits of the project

There are not many opportunities where staff and organisations can take time to think about the future. More often, the focus is reacting to pressures, events (including drought, fire and flood), and working within funding constraints. A clear benefit of this funding and the project has been the opportunity it has provided to step out of the daily routine and be proactive.

This has pragmatic implications. Councils are already delivering on managing risks and emergencies that are consistent with climate change but there is a challenge to change thinking about reduced water and water variability from a reaction to events e.g. drought or as an emergency, to preparing proactively for change. For example, there is an opportunity to work with the community *in advance* to identify which recreation reserves ones should not get watered during dry periods, or which activities get supported with water and which ones don't.

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[6] Water Group, Report for Water Efficiency Site Assessments and Action Plans, Phase 3 Part 5 of North East Victoria Adapting to a Low Water Future

[7] Regional Development Company, North East Victoria Adapting to a Low Water Future Phase 3 Stakeholders Behavioural Study and Analysis

The project has identified approaches that can reduce duplication and allow communities to leverage from each other. For example, Alpine Shire has been developing a proactive recreational strategy as discussed above. The project has provided an opportunity for different groups and organisations to work together.

Research carried out through this project helps to position the partners for additional funding, for example for infrastructure. The project has identified where Councils and partners can work together to change policy settings, or address gaps. Many of these activities do not need additional funding.

The reports and project outcomes have helped to identify gaps, risks and opportunities. They provide a solid foundation for future work in the region.

Finally, this project adds value to other work within the region. A second project of NEGHA, also funded through the federal government, looking at Socio-economic adaptation will be drawing and leveraging off the work completed as part of the North East Victoria – Adapting to a Low Water Future.

Next stages

This report and accompanying material will be provided to the participating organisations for their consideration.

With some additions to meet their requirements, these reports will also be provided to the federal government. That will complete the formal development stage of the project: ”North East Victoria – Adapting to a Low Water Future”.

Discussions have been held with staff of Regional Development Victoria and various State Government departments about the work.

Additional copies of the reports will be available through NEGHA, and the participating organisations.

Conclusion

NEGHA and its partners with the assistance of the federal government have undertaken a significant piece of work to proactively address issues of climate change and the impacts of water variability. The challenges and opportunities identified through this work position the partners, and the communities they represent, to better meet the current and emerging challenges.

Councils are managing risk as part of their core business. This project has helped identify and quantify current and future risks. A major challenge is to shift from reacting to “one off” events, to considering variability more clearly in long term planning and strategies.

This project provides a solid foundation for future action.

Appendix 5: Overview of reports from Socioeconomic Adaptation Planning

The North East Greenhouse Alliance project "North East Victoria Socioeconomic Adaptation Planning" is funded under the Australian Government's *Water for the Future* initiative through the *Strengthening Basin Communities* program.

Jan Ryan

SEAP Project Manager

“Water in North East Victoria – Socioeconomic Adaptation Planning”

The “Water in North East Victoria – Socioeconomic Adaptation Planning” project was funded by the Australian Government under the “Strengthening the Basin communities” component of the “Water for the future” program. The project methodology is centered on a Climate Change vulnerability assessment and resilience planning framework that focuses on issues related to climate change impacts and water related issues in North East Victoria. It was delivered by the North East Greenhouse Alliance on behalf of City of Wodonga, Rural City of Wangaratta, Rural City of Benalla, Alpine, Indigo and Towong Shires, in partnership with the Alpine Resorts and North East Catchment Management Authority.

The project was comprised of three integrated elements (see Figure 1 – Project outline & methodology), namely:

Phase 1: Vulnerability assessment and resilience planning

Phase 2: Socio economic planning, development and change program studies

Phase 3: Regional Climate change adaptation strategy.

Phase 1 reviewed the issues identified in ‘Adapting to a low water future’ project’, identified new impacts from a socio-economic perspective and conducted a vulnerability assessment based on those impacts. The findings of the vulnerability assessment were prioritised for action and the social and economic impacts addressed through a regional resilience action plan. This plan defined the detailed social and economic adjustment studies undertaken as part of Phase 2 of this project. Phase 3 incorporated the findings of Phase 1 and 2 as well as the findings of ‘Adapting to a low water future’ to develop a regional climate change strategy and action plan. The plan addresses climate change impacts and resulting water related issues in a comprehensive manner, at an institutional, infrastructure and socioeconomic level.

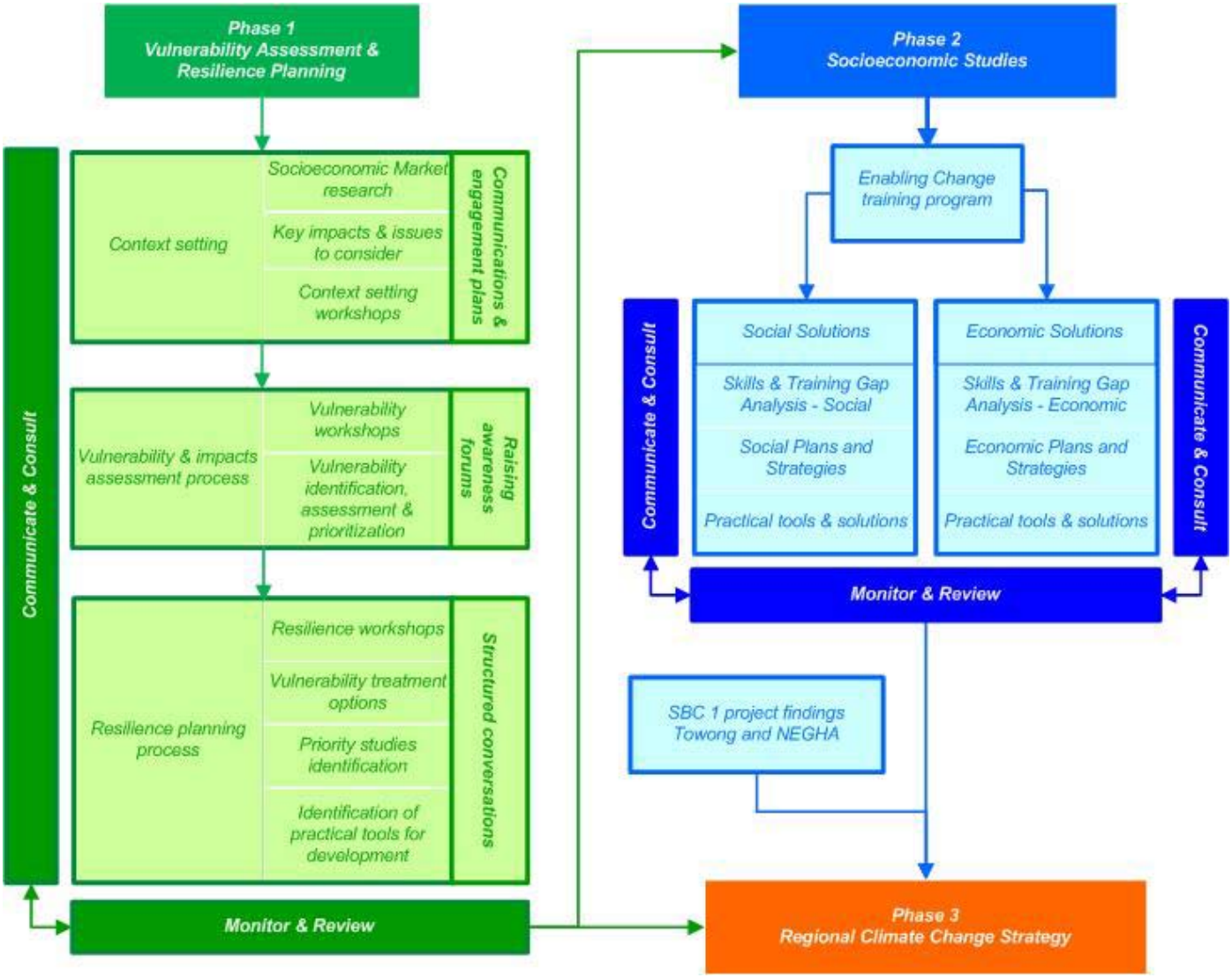

Figure 1 - Project outline & methodology

Reports produced from Socioeconomic Adaptation Planning

Water in North East Victoria: Context Setting - Benalla Rural City, Mansfield Shire Council and the Alpine Resorts of Mt Buller / Mt Stirling, Mt Hotham and Falls Creek. Written by Hocking & Beverly

This report provides contextual information in relation to climate change projections and related water availability for the areas of Benalla Rural City, Mansfield Shire Council and the Alpine Resorts of Mt Buller / Mt Stirling, Mt Hotham and Falls Creek that were not covered in the preceding 'Adapting to a low water future project'.

Specifically this study reviewed and analysed historical climate, climate change and water availability within parts of the Goulburn Broken and North East CMA regions. A methodology developed by DPI was used to interpolate climate scenarios generated by CSIRO to daily climate sequences for each of the climate stations within the study area. These daily climate sequences were incorporated into existing surface water and groundwater models to assess the major impacts of climate change on water availability projections to 2030 and 2070. The modelling approach adopted in this study used a suite of physically based farming system models and a fully distributed multi-layered groundwater model and is shown to offer fine scale, CMA wide regional estimates across a range of designated future climate scenarios.

Specific conclusions from this study are:

1. Data analysis suggests that LGAs located in the snowfields would expect minor reductions in rainfall and notable increases in average daily temperature, these increases in temperature are likely to reduce to duration and depth of snow in these locations. Mt Buller, Mt Stirling, Mt Hotham and Falls Creek are most likely to observe the greatest to least increase in temperature respectively under climate change.
2. The greatest falls in groundwater level and storage were identified to occur in the Mansfield Shire, which is likely to be attributed to the majority of the LGA being located upon basement geology and native vegetation cover.
3. Large uncertainties are associated with climate change predictions, both at the point scale and catchment scale. These uncertainties are introduced due to variability in the underpinning data, simulation model constructs and assumptions adopted with model applications.
4. Significant variations in climate change impacts on water availability have been previously reported, and in some cases contrast the predictions derived in this study. This reinforces the degree of uncertainties associated with the derivation of the hydrological impact of future climate scenarios.
5. Under the low 2030 climate condition runoff would be reduced by between 2% and 16% depending upon landscape position and dynamics. In order of increasing impact, Mount Hotham Alpine Resort would be least impacted (-2%) followed by Falls Creek Alpine Resort (-2%), then Mount Stirling Alpine Resort (-4%), Rural City of Benalla (-4%), Shire of Mansfield (-8%) and Mount Buller Alpine Resort (-16%).
6. Under the dry extreme 2030 climate condition runoff would be reduced by between 10% and 35% across the LGAs. In order of increasing impact, Mount Hotham Alpine Resort would be least impacted (-10%) followed by Falls Creek Alpine Resort (-11%), Rural City of Benalla (-20%), Mount Stirling Alpine Resort (-23%), Shire of Mansfield (-25%) and Mount Buller Alpine Resort (-35%).

7. Under the low 2070 climate condition flows would be reduced to approximately those predicted under the dry extreme 2030 climate conditions with reductions ranging between 10% and 35%.

8. Under the dry extreme 2070 climate condition flows would be reduced across the LGAs by between 34% and 72%. In order of increasing impact, Mount Hotham Alpine Resort would be least impacted (-34%) followed by Falls Creek Alpine Resort (-37%), Mount Stirling Alpine Resort (-39%), Rural City of Benalla (-67%), Shire of Mansfield (-71%) and Mount Buller Alpine Resort (-72%)

9. An understanding of landscape dynamics is critical in estimating the impact of climate change on water availability, productivity and groundwater sustainability.

On the basis that the IPCC original climate change projections have been revised, this study recommends undertaking more detailed modelling using the recently updated CCAM Mark 3.6 pattern of change data from CSIRO. Enhancement of the existing groundwater model to better capture temporal groundwater dynamics and sustainable extraction limits has also been identified as a key recommendation.

Climate Change in North East Victoria: Socioeconomic Resilience Plan. Written by Marsden Jacob Associates.

This report sets out a plan for building the resilience of industries and communities to climate change and variability. The resilience plan draws on an assessment of the vulnerability of industries and communities in North East Victoria to climate change and variability that is also presented in the report.

The socioeconomic resilience action plan identifies initiatives that can be further developed in the next stages of the project and incorporated into the Regional Climate Change Adaptation Strategy.

A vulnerability assessment provided an analysis of the social and economic vulnerabilities of communities and industries in North East Victoria to climate variability and change including reduced water availability and increased rainfall variability. A series of indicators, which combined measure the sensitivity and adaptive capacity of industries and communities in the region to climate change, provide the main basis for the assessment. Surveys designed to measure climate change understanding amongst the community and industries of North East Victoria provide additional information relevant to investigating the vulnerability of the region to climate change

The resilience plan sets out a range of actions designed to build the resilience of the regional economy and communities to climate change and variability. The plan takes into account vulnerable industries and communities identified in the first part of the report, as well as established local and regional measures that are aimed at building the resilience of communities and industries to 'shocks'.

The Plan was based on information and data compiled through a series of resilience planning workshops, follow-up community and stakeholder consultation sessions held throughout the region, social and industry market surveys and focus groups and broad community engagement through project promotion.

Actions were based on an analysis of existing and current industry and economic resilience building initiatives and existing community resilience building initiatives as well as further analysis including desktop review of established programs.

Regional Community Development Climate Adaptation Plan Report Written by Institute for Sustainable Futures (ISF).

This report contains the Regional Community Development Climate Adaptation Plan based on the review and analysis of change behaviour programs and containing a suite of practical solutions and tools trialled through pilot activities for local vulnerable groups and areas.

It documents the process of developing the Plan including reviewing reports from previous consultancies undertaken on climate change adaptation for NEGHA to gain an understanding of the current situation in the region; reviewed best-practice in community engagement on climate change adaptation to provide inspiration for the community engagement program.

In consultation with the steering committee community groups that are vulnerable to climate change were identified and selected potential pilot community engagement activities. These activities were further developed and refined by weaving together desktop research with a series of interviews with key stakeholders and knowledge holders at councils, other agencies or community groups.

The report details the three pilot community engagement programs:

- The North East Brains Trust – workshops on climate change resilience with older people in Wodonga and Tallangatta
- A grassroots community leadership pilot program, involving members of the Harrietville Community Building Initiative and community leaders in Yackandandah
- A trial of several mobile outreach activities on climate change resilience in Wangaratta, alongside a trial of Wangaratta Council's new eco-living trailer.

The pilot activities were evaluated using participant feedback surveys, facilitator observations and reflections and analysis of the outputs from the activities. Finally, drawing on the evaluation and desktop research, a toolbox of ten recommended community engagement activities was developed. These are intended for future use by NEGHA, member Councils and other organisations to engage the community in climate change adaptation activities.

Skills Knowledge and Behaviour Change programs for Resilient Economies Written by URS Australia.

This report delivers an analysis of the current skills, knowledge and capacity in relation to responding to climate change impacts for targeted vulnerable industries and businesses in North East Victoria, and identifies training required to broaden skills and knowledge. It also identifies gaps in training at the local level and details recommendations for practical tools and solutions to enable vulnerable industries and businesses to adapt to climate variability.

It contains a process evaluation of two local pilot projects - 'Speed Date a Sustainable Designer' and 'Sustainable Ideas Campaign' trialling capacity building adaptation strategies for vulnerable industries.

Adapting to Climate Change – Economic Planning and Development Written by URS Australia.

This report provides summary of the compilation of recommendations and actions for local economies and industries in adapting to climate change. It provides a description of the process used to develop the actions, the final actions recommended, a full listing of recommendations and reference to the document they were sourced from, and a toolkit to enable individual councils to assess each action and plan for their implementation.

This report provides a source document for the Regional Climate Change Adaptation Strategy.

Regional Climate Change Adaptation Strategy. Written by Two Hemispheres Environmental Consulting.

Appendix 6: Bonacci Water: Alternative options to manage sullage and sewage in small rural towns - addendum

5 July 2012

Version 1

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1 Additional town scale case studies

The town scale Options STEDS, OPS and RSS were evaluated for towns in the region that currently do not have traditional reticulated sewage services. These towns have been subject to various concerns about overflows from septic tanks and discharge of sullage to drainage networks and ultimately to waterways.

This analysis has included site inspections, discussions with a wide range of stakeholders and informal requests for quotations from many of the local suppliers and service providers. Site inspections of the towns without traditional sewage services reveal that each town commonly included clusters of smaller lots that were perceived to be generating concerns.

In situations where the clusters of smaller lots contained older housing it was noted that some onsite systems to manage septic and sullage were inconsistent with the more robust modern standards of management. The design of the town scale Options responded to need to manage clusters of higher density housing and to allow future clusters of higher density housing.

Each of the STEDS (Septic Tank Effluent Disposal Scheme) schemes were designed as low cost systems using small diameter gravity conduits installed at minimum depth using efficient “Ditch Witch” technology and local plumbers. Importantly, these schemes are based on simple and easy to understand technologies and strategies that are also flexible. These networks are designed to work with the natural terrain at each site and to eliminate requirement for onsite disposal of effluent. The gravity networks utilised 100 mm diameter sewer grade PVC conduits and the rising mains utilised small diameter (63 mm) high pressure poly pipe.

Prefabricated pump wells with storage of 3,000 litres each were also utilised. Effluent is ultimately collected at a package wastewater treatment plant that is designed to produce Class A treated wastewater. Our investigations have revealed that both electroflocculation and small scale membrane bioreactors (MBR) will produce similar results for the same capital costs. These solutions produce higher quality water and occupy a smaller land area.

The OPS (Onsite Pressure Systems) schemes were designed to replace septic tanks with packages of sewage grinder pumps in storage wells at each site. These onsite grinder pumps discharges sewage in a small diameter collection system to a package wastewater treatment plant.

The RSS (Reticulated Sewage Schemes) were designed in accordance with the strategies published by NEW and DSE. Plumbing in houses is disconnected from septic schemes, septic tanks are removed and all wastewater discharges via gravity to a reticulated network of pipes, pump stations and rising mains. The reticulated network ultimately discharges sewage to lagoon based wastewater treatment plants.

This analysis assumes that all works on public and private land are completed by the entity building the schemes and all costs accrue to that entity. This implies that the entity building the schemes must be able to work closely with householders in each town to refine the strategies to best suit local conditions. It was assumed for each Option that a survey would locate all septic tanks and create easements as required. The surveyor would collaborate with a plumber to locate all outlets (and inlets) to existing septic systems. In addition, all septic tanks were pumped out during the early stages of each project. Conceptual designs were created to minimise disruption of local amenity and infrastructure in each town.

Remote sensing techniques using images derived from satellites were combined with field inspections, aerial photographs, cadastre and contour information to generate a digital terrain model of each site. This information was used to select routes for conduits that collect sewage or effluent from each house that are reliant on gravity, for rising mains and for the location of wastewater treatment plants. The same information was then used to assess all three Options.

Note that the alternative strategies for wastewater management in each town generate reductions in water use ranging from 25% to 48% which makes a significant contribution to adapting the towns to the potential for climate change.

1. Bethanga

Bethanga is a small town located on the Bethanga Creek, a tributary to the potable water catchment of Lake Hume which supplies drinking water to the regional centres of Albury and Wodonga. The current population is approximately 189 people in 74 dwellings located on variable lot sizes. At present, many lots remain vacant due to a planning restriction which prevents development of allotments less than 4000m^2. This restriction is associated with an assumption that lots with an area of less than 4,000 m^2 can not retain all wastewater onsite. Although the town has not seen significant population growth in the last few years, its proximity to the regional centres of Albury and Wodonga could see the town develop as a lifestyle village if this issue can be addressed. The need for additional sewage infrastructure is perceived to limit potential development of the town and impact on the general environmental health of Bethanga Creek. The conceptual design solution that was used to assess each Option is presented in Figure 1.1.

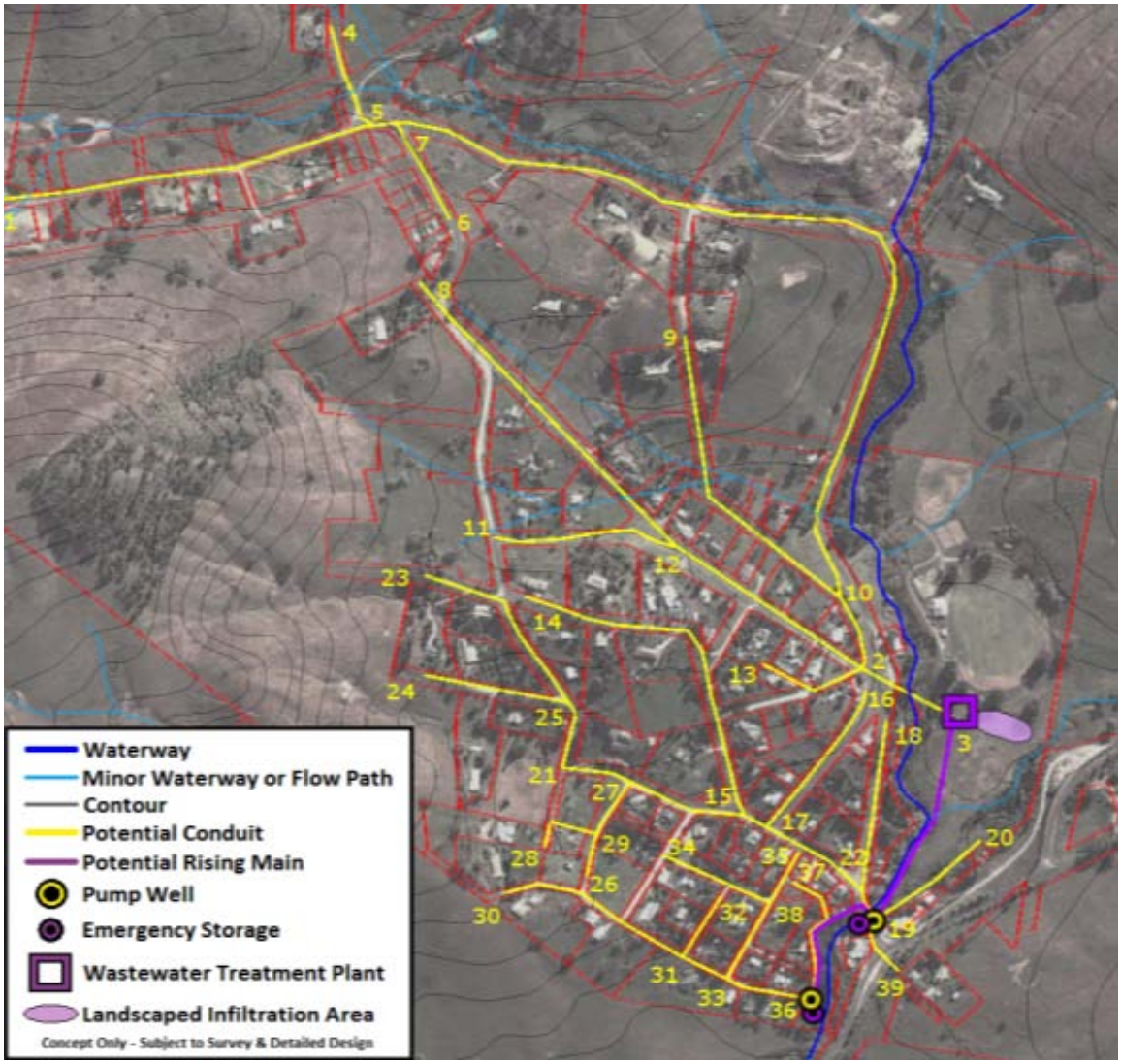

Figure 1.1: Schematic of wastewater system for Bethanga

Figure 1.1 highlights that the land area surrounding the sporting oval will also include a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 430 kL was included in the preliminary design. The strategy includes reuse of treated wastewater to irrigation the grounds in the oval precinct and for toilet flushing in the amenities and at the primary school. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of effluent.

The capital and operating costs of each Option are presented in Table 1.1.

Table 1.1: Summary of capital and operation costs of the Options for Bethanga

Option	Costs ($)	
	CAPEX	OPEX
STEDS	857,600	22,200
OPS	1,710,300	32,920
RSS	2,606,800	27,600

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.1 reveals that the STEDS Option generates the lowest capital and operating costs. This outcome is a result of using readily available simple technologies and installation of conduits at minimum depth using “Ditch Witch” machines that allow rapid trenching. Treatment lower volumes of effluent (33 kL/day) also provide reduced costs in comparison to treating higher volumes of sewage (41 kL/day).

The OPS Option provided the highest costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates higher costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

2. Bogong Village

Bogong Village on the banks of Lake Guy is a former town for hydro electric workers and now a village with 26 self contained cottages (2 to 4 bedrooms) and a school camp. The village includes large school camp building. A preliminary design for Bogong Village includes a package wastewater treatment plant near the school camp building and reuse of class A treated wastewater for toilet flushing and irrigation. The preliminary design is presented in Figure 1.2.

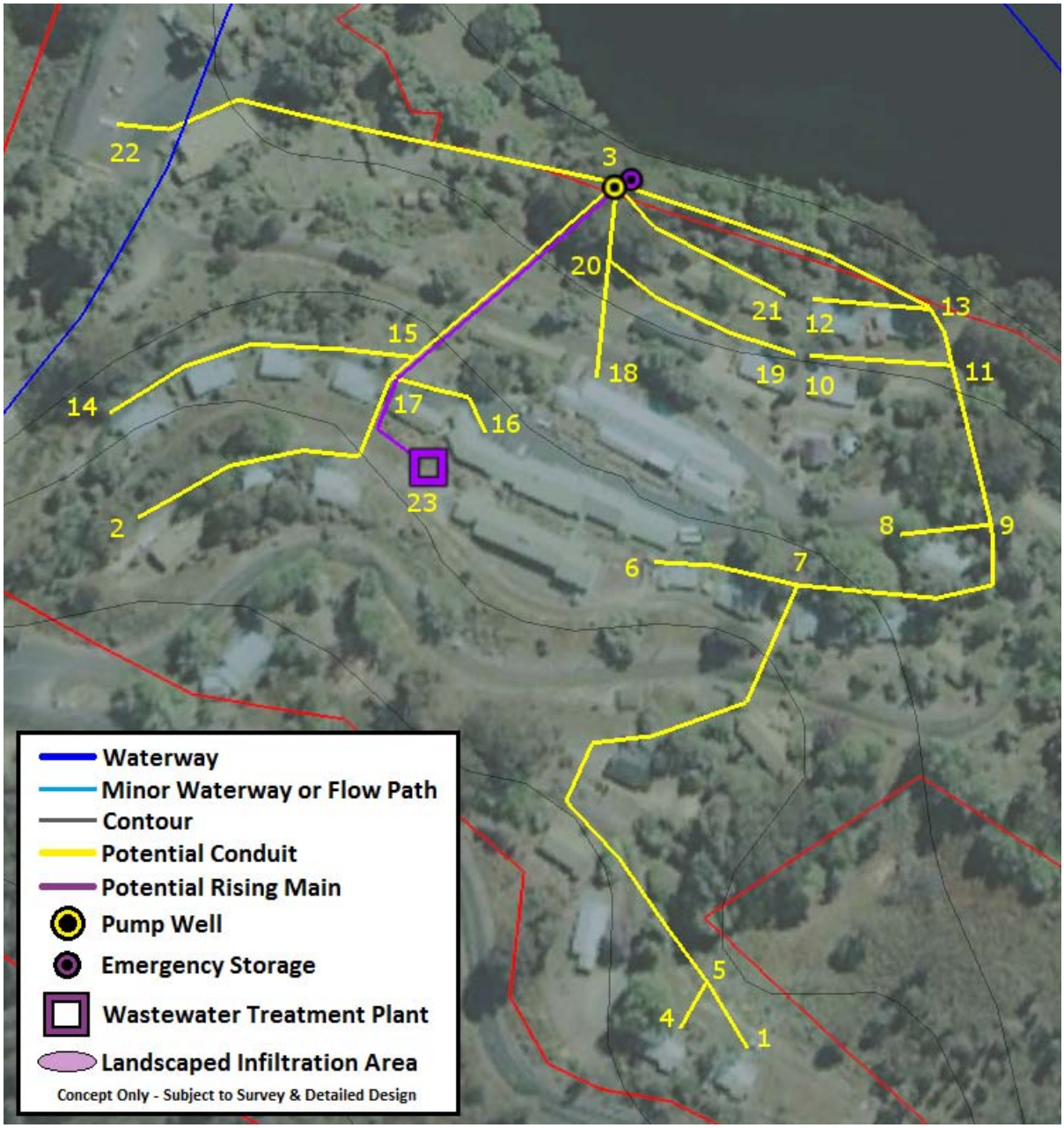

Figure 1.2: schematic of sewage system for Bogong Village

Figure 1.2 shows that the land area surrounding the village will also include a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 170 kL (STEDS) to 250 kL (RSS) was included in the preliminary design. The strategy includes reuse of treated wastewater to irrigation the grounds and for toilet flushing in the dwellings and at the school camp. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of treated effluent.

The capital and operating costs of each Option are presented in Table 1.2.

Table 1.2: Summary of capital and operation costs of the Options for Bogong Village

Option	Costs ($)	
	CAPEX	OPEX
STEDS	373,500	6,700
OPS	667,900	12,000
RSS	938,400	10,100

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.2 reveals that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (10 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (13 kL/day).

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates the highest costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

3. Bonegilla

Bonegilla is located on the banks of Hume Reservoir within the jurisdiction of the Rural City of Wodonga. The village includes about 50 lots and the Boat haven Holiday Camp. Preliminary designs for Bonegilla includes a package wastewater treatment plant near the camping group and reuse of class A treated wastewater for toilet flushing and irrigation. Excess treated wastewater is discharged to a landscaped facility that provides evapotranspiration and infiltration. The preliminary design is presented in Figure 1.3.

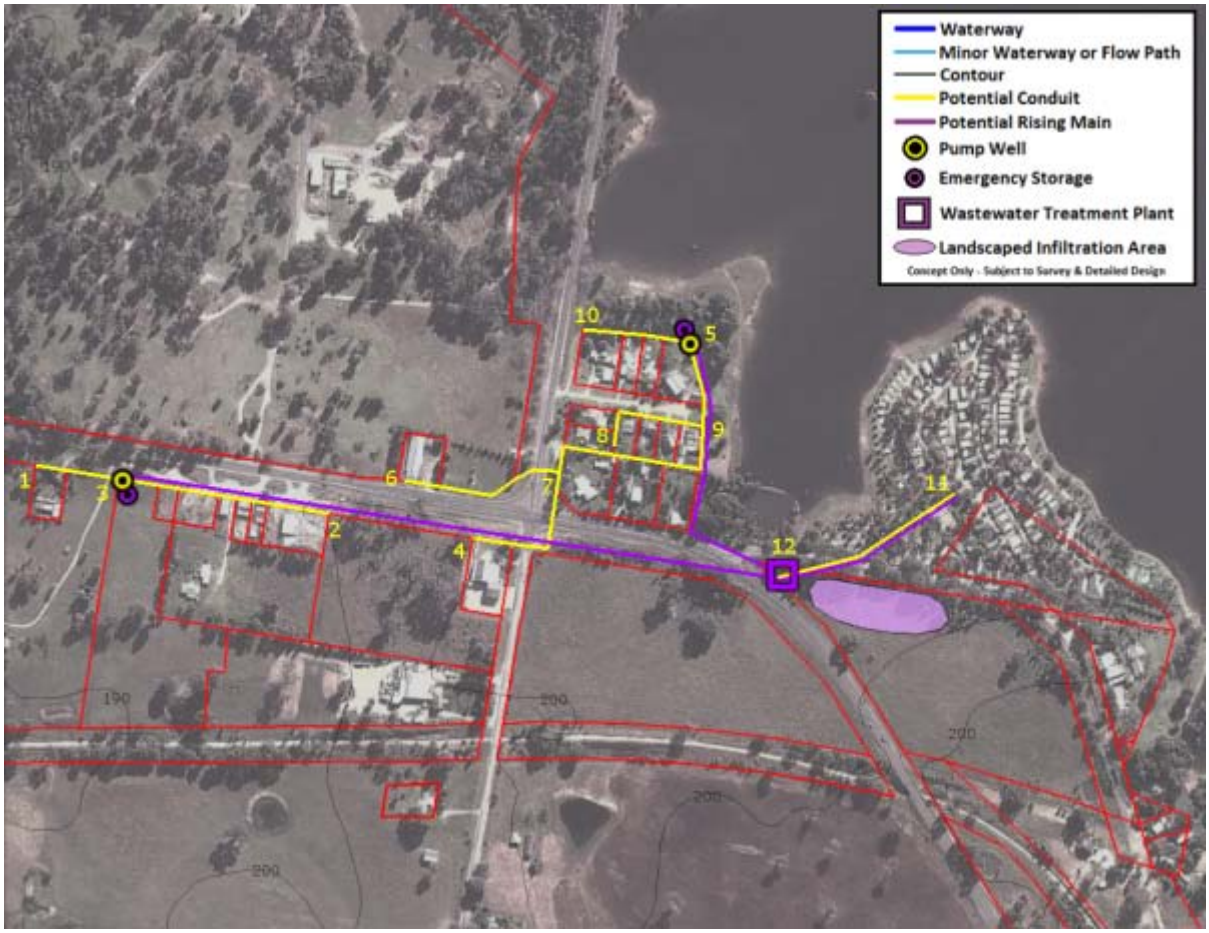

Figure 1.3: Schematic of sewage system for Bonegilla

Figure 1.3 shows that the land area surrounding the town will also include a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 215 kL (STEDS) to 400 kL (RSS) was included in the preliminary design. The strategy includes reuse of treated wastewater to irrigation the grounds and for toilet flushing at the camping park. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of treated effluent.

The capital and operating costs of each Option are presented in Table 1.3.

Table 1.3: Summary of capital and operation costs of the Options for Bonegilla

Option	Costs ($)	
	CAPEX	OPEX
STEDS	698,700	13,500
OPS	1,231,800	23,800
RSS	1,351,400	19,600

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.3 reveals

that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (24 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (30 kL/day).

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates the highest costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

4. Cudgewa

Cudgewa is located within the jurisdiction of the Towong Council. The town includes about 73 lots and a population of 237 people. Preliminary designs for Cudgewa includes a package wastewater treatment plant near the football ground and reuse of class A treated wastewater for toilet flushing and irrigation at the ground. Excess treated wastewater is discharged to a landscaped facility that provides evapotranspiration and infiltration. The preliminary design is presented in Figure 1.4.

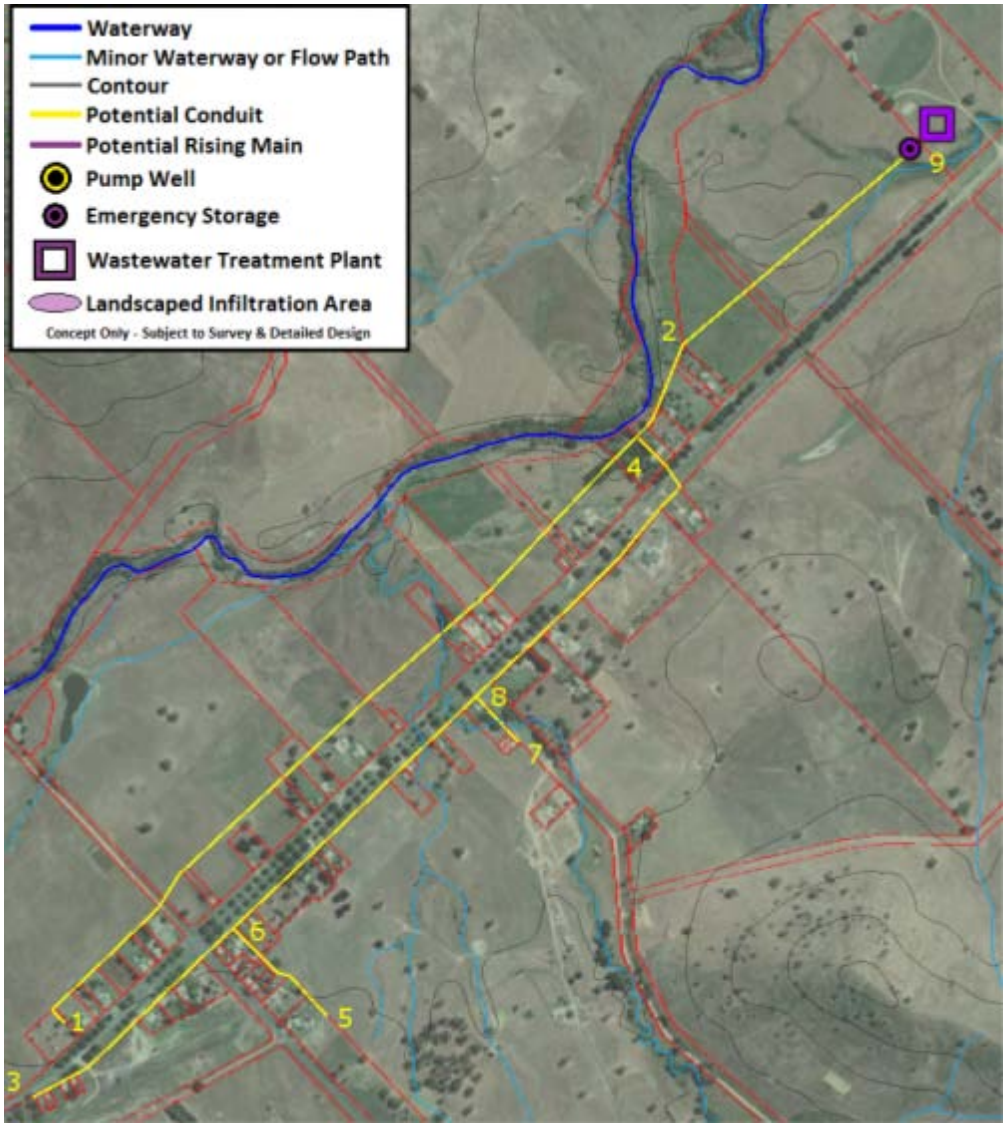

Figure 1.4: Schematic of sewage system for Cudgewa

Figure 1.4 shows that the land area surrounding the town will also include a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 536 kL (STEDS) to 1,000 kL (RSS) was included in the preliminary design. The strategy includes reuse of treated wastewater to irrigation the grounds and for toilet flushing at the football. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of treated effluent. The STEDS Option also includes installation of water efficient toilets in all dwellings.

The capital and operating costs of each Option are presented in Table 1.4.

Table 1.4: Summary of capital and operation costs of the Options for Cudgewa

Option	Costs ($)	
	CAPEX	OPEX
STEDS	895,200	15,000
OPS	1,743,100	34,300
RSS	2,101,000	24,900

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.4 shows that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (27 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (43 kL/day).

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates the highest costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

5. Eldorado

Eldorado is located within the jurisdiction of the Rural City of Wangaratta. The town includes about 85 lots, a caravan park and a football oval. Preliminary designs for Eldorado includes a package wastewater treatment plant near the football ground and reuse of class A treated wastewater for toilet flushing and irrigation at the ground and the caravan park. Excess treated wastewater is discharged to a landscaped facility that provides evapotranspiration and infiltration. The preliminary design is presented in Figure 1.5.

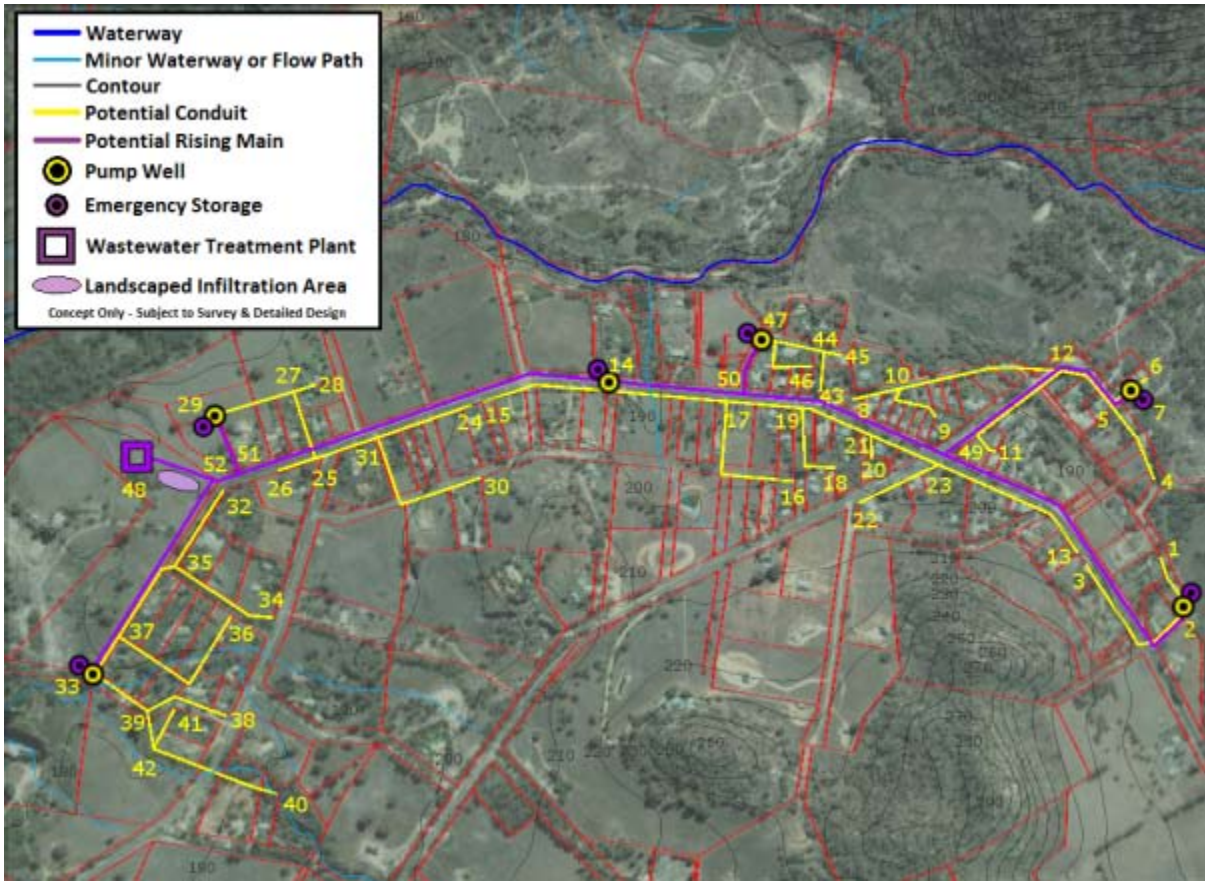

Figure 1.5: Schematic of sewage system for Eldorado

Figure 1.5 shows that the land area surrounding the town will also include a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 590 kL (STEDS) to 1,150 kL (RSS) was included in the preliminary design. The strategy includes reuse of treated wastewater to irrigation the grounds and for toilet flushing at the football ground and camping park. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of treated effluent. The STEDS Option also includes installation of water efficient toilets in all dwellings.

The capital and operating costs of each Option are presented in Table 1.5.

Table 1.5: Summary of capital and operation costs of the Options for Eldorado

Option	Costs ($)	
	CAPEX	OPEX
STEDS	1,188,300	21,600
OPS	2,077,400	40,600
RSS	3,349,300	42,300

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.5 shows that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (33 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (51 kL/day).

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates the highest costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

6. Everton

Everton is located within the jurisdiction of the Rural City of Wangaratta. The town includes about 30 lots, a caravan park, a football oval and a primary school. Preliminary designs for Everton includes a package wastewater treatment plant near the football ground and reuse of class A treated wastewater for toilet flushing and irrigation at the ground, the caravan park and the primary school. Excess treated wastewater is discharged to a landscaped facility that provides evapotranspiration and infiltration. The preliminary design is presented in Figure 1.6.

Figure 1.6: Schematic of sewage system for Everton

Figure 1.6 shows that the land area surrounding the town will also include a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 145 kL was included in the preliminary design for the pressure sewer (OPS) and traditional reticulated sewage (RSS) options. The strategy includes reuse of treated wastewater to irrigation the grounds and for toilet flushing at the football ground, camping park and primary school. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of treated effluent. The STEDS Option also includes installation of water efficient toilets in all dwellings.

The capital and operating costs of each Option are presented in Table 1.6.

Table 1.6: Summary of capital and operation costs of the Options for Everton

Option	Costs ($)	
	CAPEX	OPEX
STEDS	572,300	8,000
OPS	894,700	14,700
RSS	1,470,900	15,700

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.6 shows that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (11 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (17 kL/day).

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates significantly higher costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

7. Freeburg

Freeburgh is located within the jurisdiction of Alpine Council. The town includes about 59 lots, a caravan park (see Figure 1.8) and a sporting oval. Preliminary designs for Freeburgh includes a package wastewater treatment plant near the caravan park and reuse of class A treated wastewater for toilet flushing and irrigation at the sporting ground and the caravan park. Excess treated wastewater is discharged to a landscaped facility that provides evapotranspiration and infiltration. The preliminary design is presented in Figure 1.7.

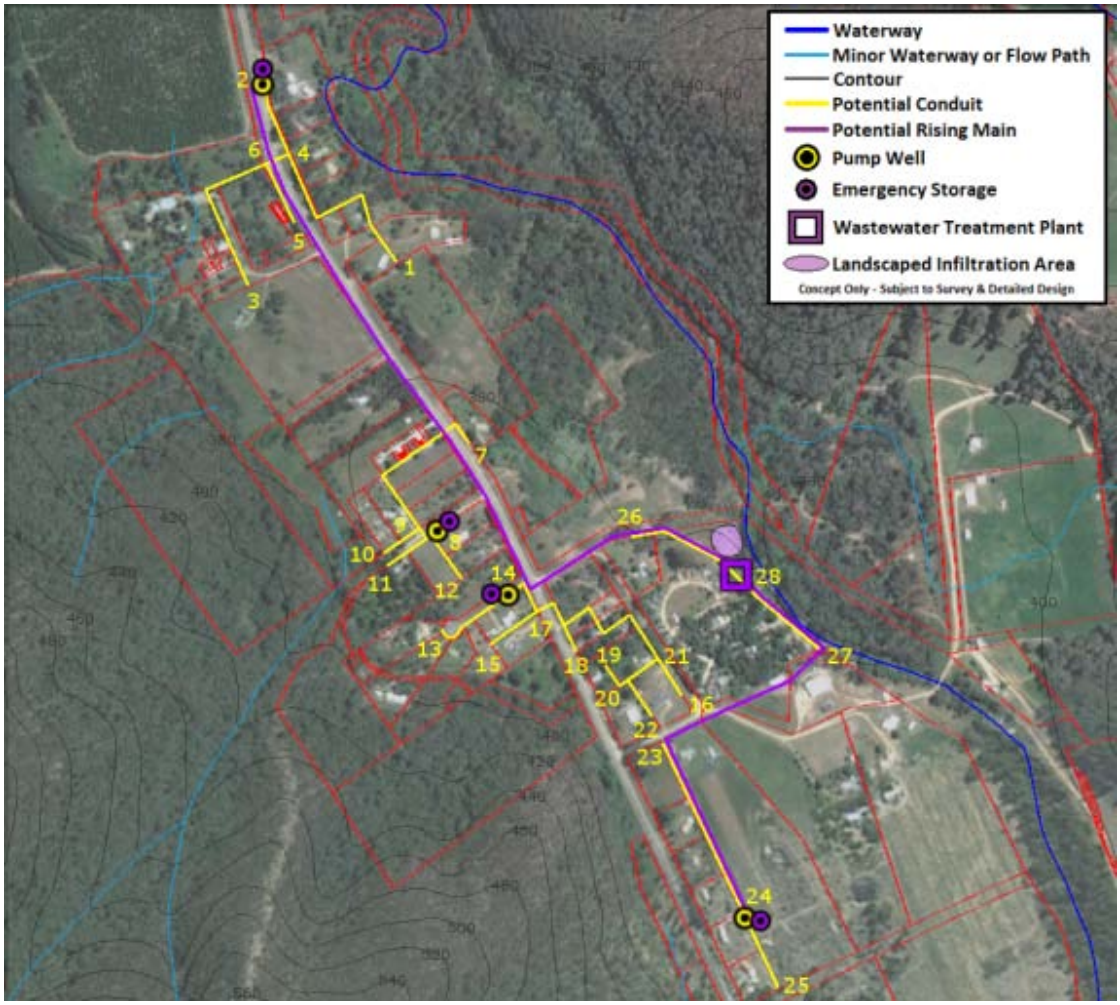

Figure 1.7: Schematic of sewage systems for Freeburg

Figure 1.8: Schematic of caravan park at Freeburg

Figure 1.7 shows that the land area near the caravan park will also include a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 200 kL (STEDS) to 580 kL (RSS) was included in the preliminary design. The strategy includes reuse of treated wastewater to irrigation the grounds and for toilet flushing at the football ground, camping park and primary school. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of treated effluent. The STEDS Option also includes installation of water efficient toilets in all dwellings.

The capital and operating costs of each Option are presented in Table 1.7.

Table 1.7: Summary of capital and operation costs of the Options for Freeburgh

Option	Costs ($)	
	CAPEX	OPEX
STEDS	855,700	14,800
OPS	1,474,900	28,000
RSS	1,731,000	23,500

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.7 shows that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (22 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (35 kL/day).

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates the highest costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

8. Hamilton Park

Hamilton Park is located within the jurisdiction of Rural City of Wangaratta. The town includes about 116 lots and a sporting oval. Preliminary designs for Hamilton Park includes a package wastewater treatment plant near the caravan park and reuse of class A treated wastewater for irrigation of the orchard and at the Arboretum. Excess treated wastewater is discharged to a landscaped facility that provides evapotranspiration and infiltration. The preliminary design is presented in Figure 1.9.

It is noteworthy that Glenrowan is receiving a wastewater strategy from North East Water and is approximately 3 km from Hamilton Park.

Figure 1.9: schematic of sewage systems for Hamilton Park

Figure 1.9 shows that the land area near the orchard will also include a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 890 kL (STEDS) to 1,650 kL (RSS) was included in the preliminary design.

The strategy includes reuse of treated wastewater for irrigation of the orchard and the Arboretum. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of treated effluent. The STEDS Option also includes installation of water efficient toilets in all dwellings.

The capital and operating costs of each Option are presented in Table 1.8.

Table 1.8: Summary of capital and operation costs of the Options for Hamilton Park

Option	Costs ($)	
	CAPEX	OPEX
STEDS	1,321,700	26,900
OPS	2,631,300	54,800
RSS	3,442,200	42,400

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.8 shows that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (45 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (71 kL/day).

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates the highest costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

9. Harrietville

The town of Harriettville includes 223 lots with 363 residents and is located in the jurisdiction of Alpine council. A schematic of the preliminary options for Harriettville is presented in Figure 1.10.

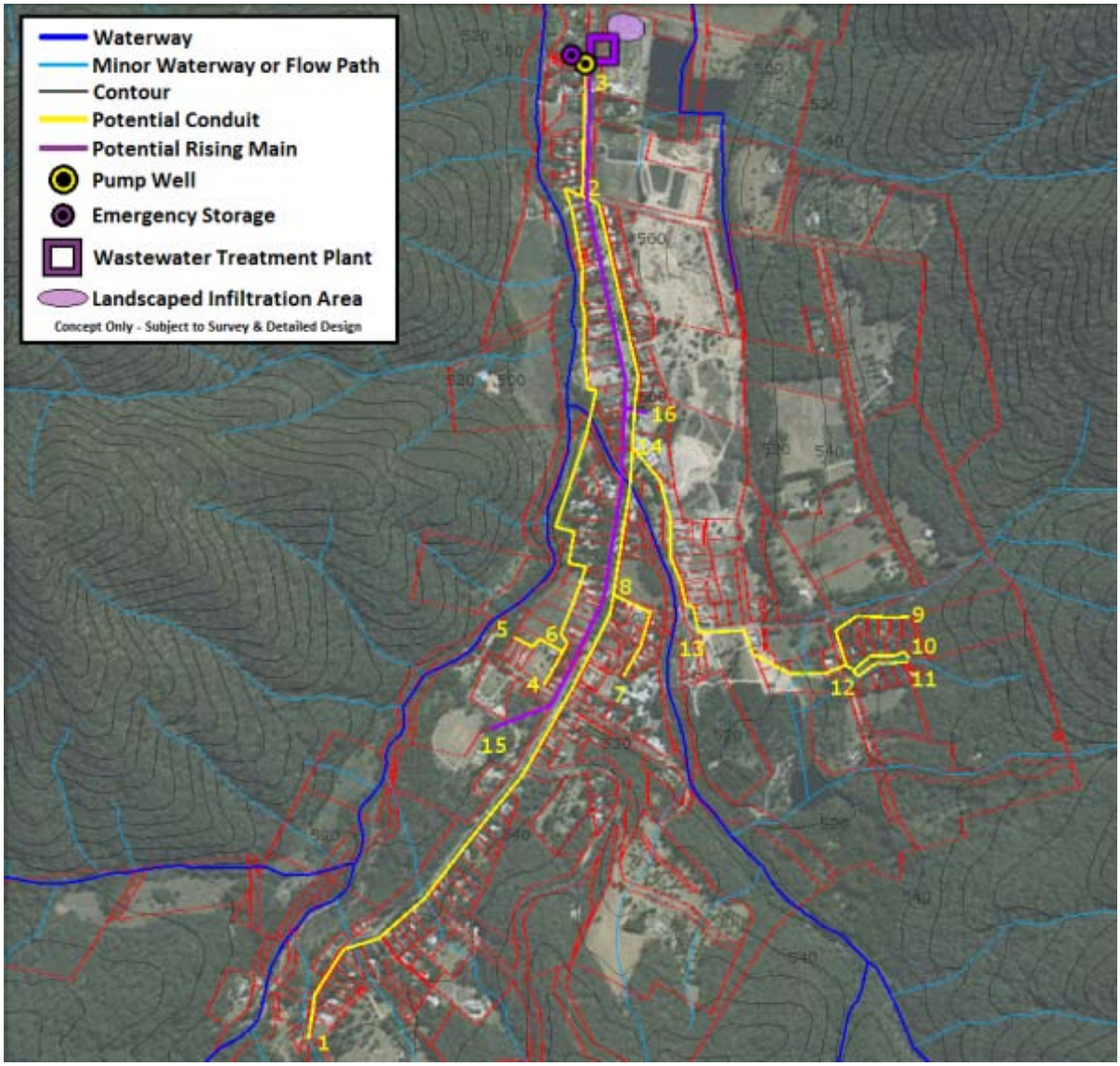

Figure 1.10: Schematic of preliminary designs of wastewater management system for Harrietville

Note that Figure 1 presents a preliminary design of wastewater management options for Harriettville. The design includes reuse of class A treated wastewater for outdoor and toilet uses at the following locations:

Oval to south of town – Harrietville Cricket Club

Harrietville Cabins and Caravan Park (20 Camping Park Road) – next to the oval

Harrietville Primary School

The preliminary design also aims to use high quality treated wastewater for irrigation of nearby agriculture. The STEDS scheme also installs water efficient toilets and washing machines in all dwellings; and supplies treated wastewater to each dwelling. The costs to deliver each scheme are provided in Table 1.9.

Table 1.9: Summary of capital and operation costs of the Options for Harriettville

Option	Costs ($)	
	CAPEX	OPEX
STEDS	1,995,600	45,300
OPS	4,700,300	107,100
RSS	4,645,200	76,700

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage.

10. Mitta Mitta

The town of Mitta Mitta is located near the confluence of Mitta Mitta River and Snowy Creek within the jurisdiction of Towong Council. The town includes about 80 lots, a primary school, a sporting oval, a golf course and a caravan park. Preliminary designs for Mitta Mitta includes a package wastewater treatment plant near the sporting oval and reuse of class A treated wastewater for irrigation and toilet flushing at the golf course, sporting oval, primary school and caravan park. Excess treated wastewater is discharged to a landscaped facility that provides evapotranspiration and infiltration. The preliminary design is presented in Figure 1.11.

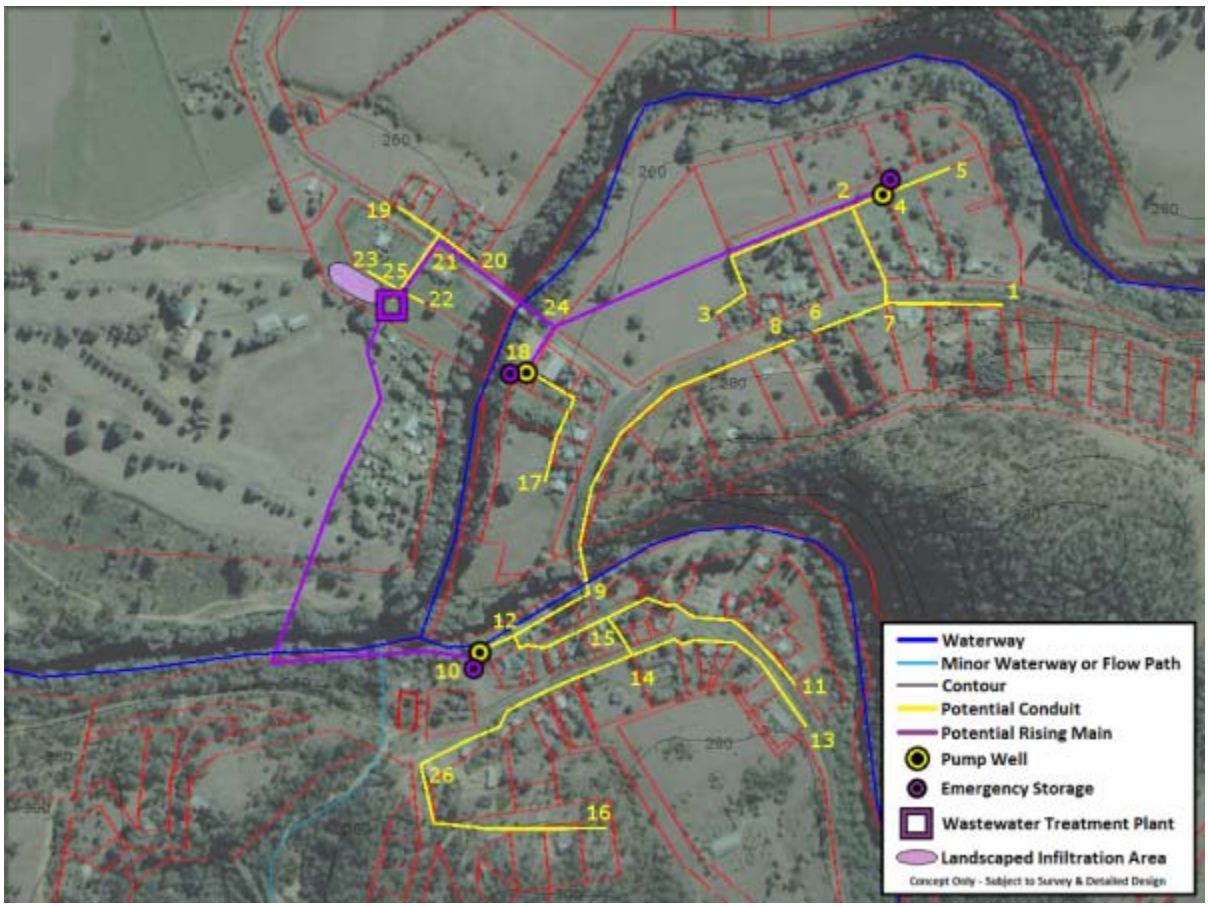

Figure 1.11: Schematic of sewage systems for Mitta Mitta

Figure 1.11 shows that the land area near the oval and the golf course will also include a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated

wastewater. An additional wet weather storage of 300 kL (STEDS) to 1,120 kL (RSS) was included in the preliminary design.

The strategy includes reuse of treated wastewater for irrigation and toilet flushing at the school, golf course, caravan park and the oval. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of treated effluent. The STEDS Option also includes installation of water efficient toilets in all dwellings. The capital and operating costs of each Option are presented in Table 1.10.

Table 1.10: Summary of capital and operation costs of the Options for Mitta Mitta

Option	Costs ($)	
	CAPEX	OPEX
STEDS	858,700	43,200
OPS	1,425,300	46,700
RSS	2,053, 700	71,100

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.10 shows that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (30 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (57 kL/day).

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates the highest costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

11. Ovens

The town of Ovens is located near Myrtleford within the jurisdiction of Alpine Council. The town includes about 31 lots and the Happy Valley Hotel. Preliminary designs for Ovens includes a package wastewater treatment plant near the vineyard and reuse of class A treated wastewater for irrigation and toilet flushing at the vineyard and the hotel. Excess treated wastewater is discharged to a landscaped facility that provides evapotranspiration and infiltration. The preliminary design is presented in Figure 1.12.

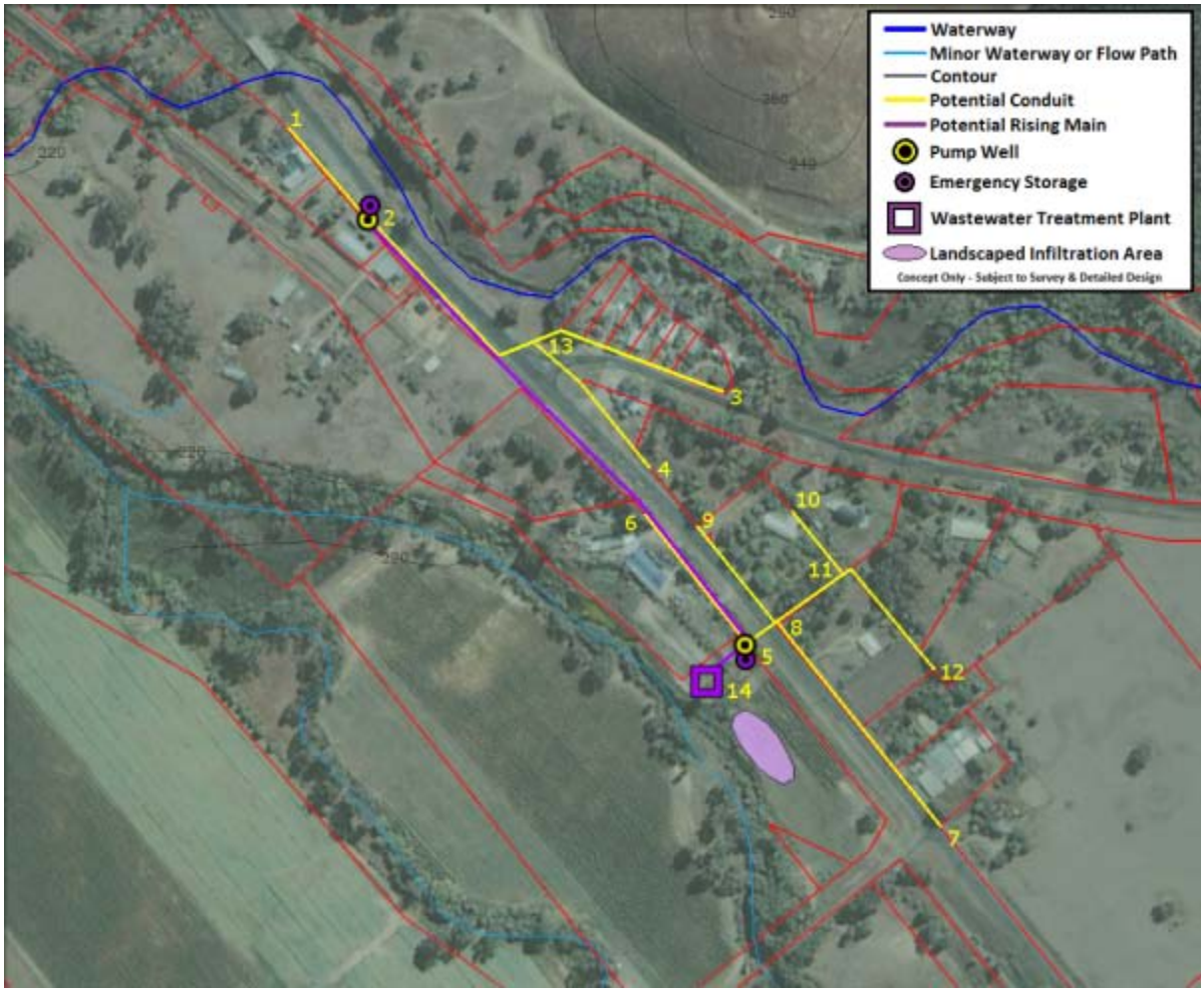

Figure 1.12: Schematic of sewage systems for Ovens

Figure 1.12 shows that the land area near the vineyard will also include a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 90 kL (STEDS) to 460 kL (RSS) was included in the preliminary design.

The strategy includes reuse of treated wastewater for irrigation and toilet flushing at the hotel and the vineyard. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of treated effluent. The STEDS Option also includes installation of water efficient toilets in all dwellings. The capital and operating costs of each Option are presented in Table 1.11.

Table 1.11: Summary of capital and operation costs of the Options for Ovens

Option	Costs ($)	
	CAPEX	OPEX
STEDS	405,100	13,600
OPS	558,300	19,800
RSS	916,400	14,700

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.11 shows that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (9 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (21 kL/day).

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates the highest costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

12. Springhurst

The town of Springhurst is located within the jurisdiction of the Rural City of Wangaratta. The town includes about 85 lots, a primary school and a sporting oval. Preliminary designs for Springhurst includes a package wastewater treatment plant near the oval and reuse of class A treated wastewater for irrigation and toilet flushing at the oval and the primary school. Excess treated wastewater is discharged to a landscaped facility that provides evapotranspiration and infiltration. The preliminary design is presented in Figure 1.13.

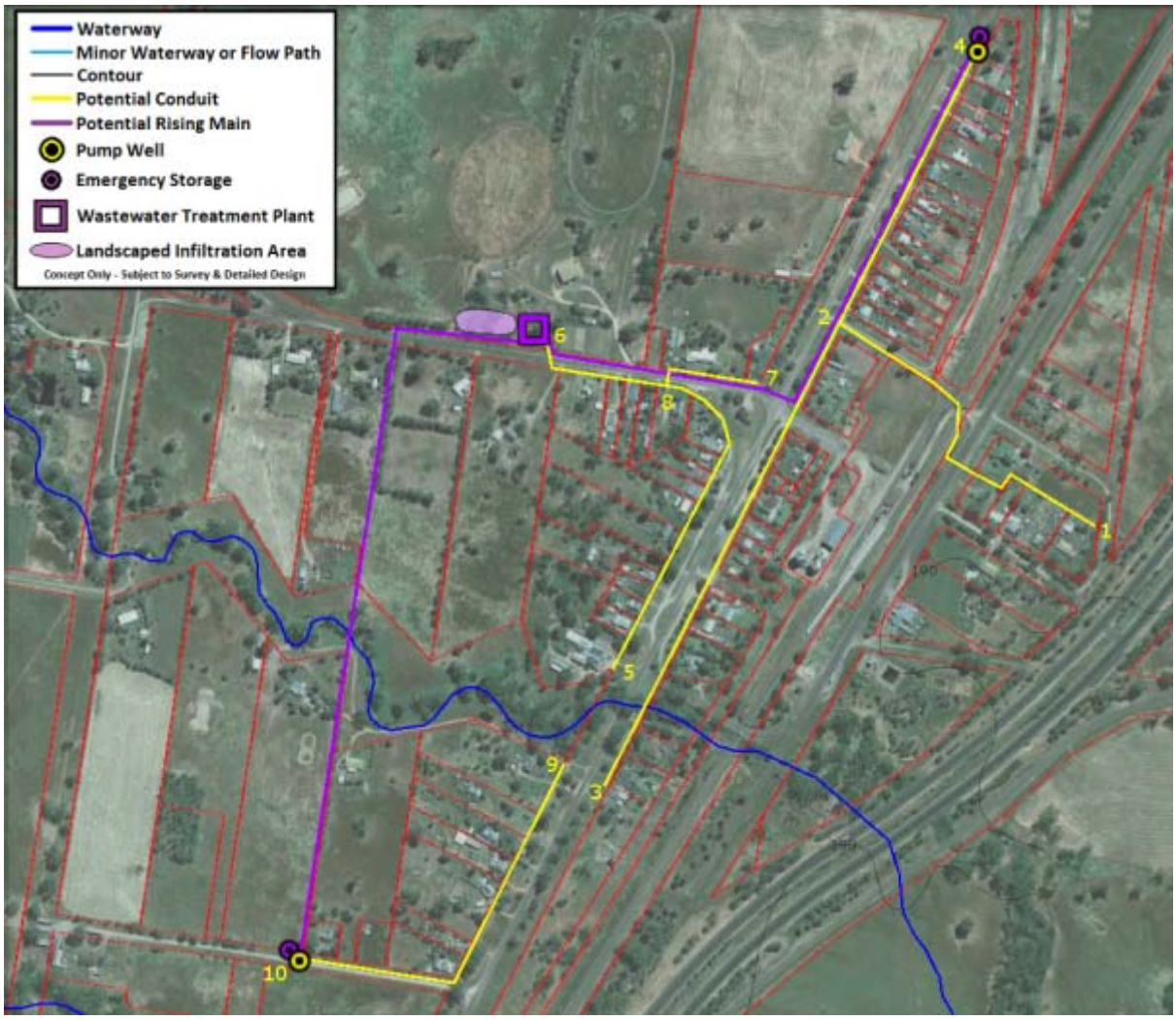

Figure 1.13: Schematic of sewage systems for Springhurst

Figure 1.13 shows that the land area near the oval will also include a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 90 kL (STEDS) to 460 kL (RSS) was included in the preliminary design.

The strategy includes reuse of treated wastewater for irrigation and toilet flushing at the oval and the school. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of treated effluent. The STEDS Option also includes installation of water efficient toilets in all dwellings. The capital and operating costs of each Option are presented in Table 1.12.

Table 1.12: Summary of capital and operation costs of the Options for Springfield

Option	Costs ($)	
	CAPEX	OPEX
STEDS	735,300	20,300
OPS	1,445,500	37,700
RSS	1,929,700	32,100

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.12 shows that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (23 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (56 kL/day).

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates the highest costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

13. Tarrawingee

The town of Tarrawingee is located within the jurisdiction of the Rural City of Wangaratta. The town includes about 47 lots, a golf club and a sporting oval. Preliminary designs for Tarrawingee includes a package wastewater treatment plant near the oval and reuse of class A treated wastewater for irrigation and toilet flushing at the oval and the golf course. Excess treated wastewater is discharged to a landscaped facility that provides evapotranspiration and infiltration. The preliminary design is presented in Figure 1.14.

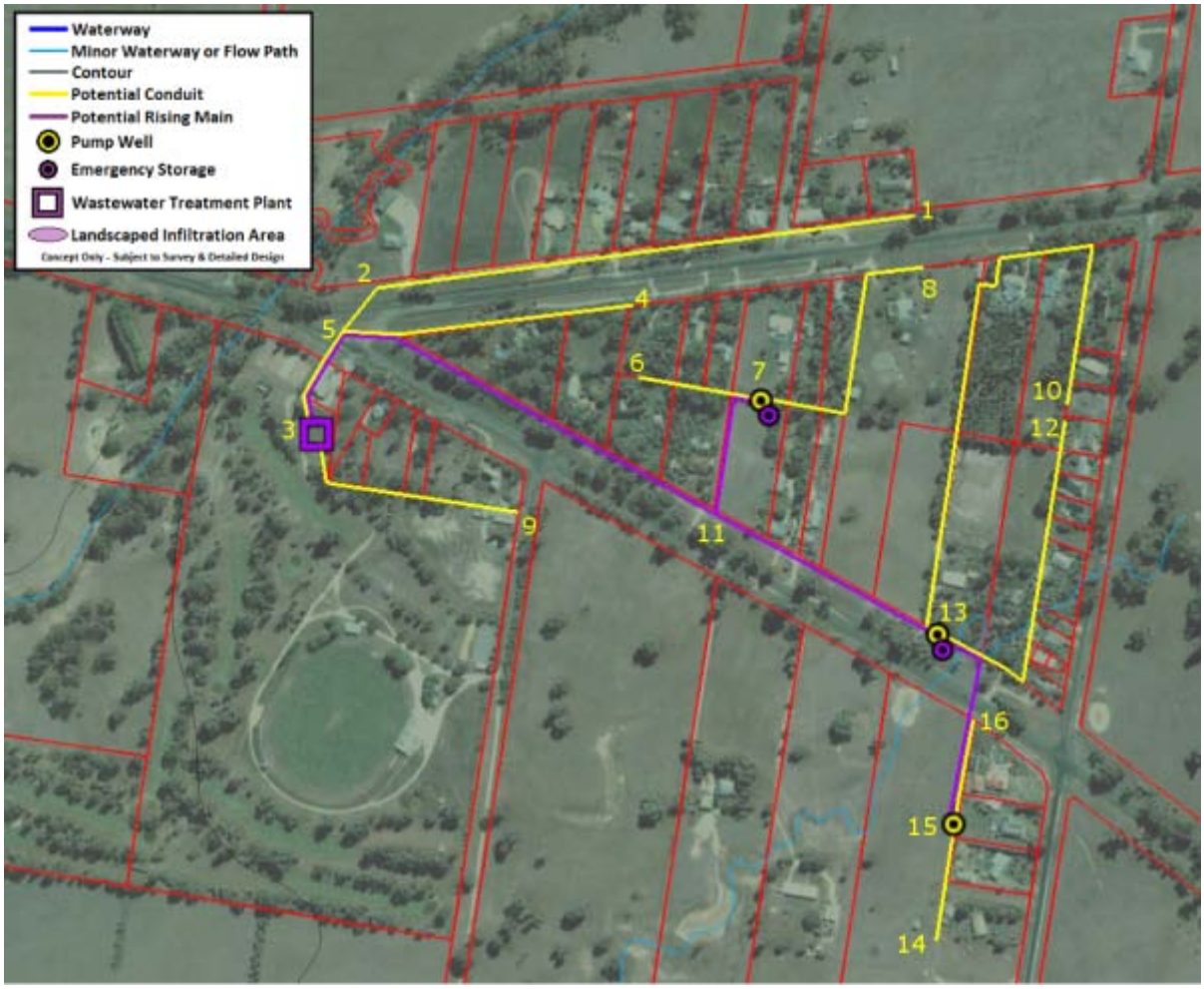

Figure 1.14: Schematic of sewage systems for Tarrawingee

Figure 1.14 shows that the land area near the oval will also include a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 300 kL (STEDS) to 980 kL (RSS) was included in the preliminary design.

The strategy includes reuse of treated wastewater for irrigation and toilet flushing at the oval and the golf course. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of treated effluent. The STEDS Option also includes installation of water efficient toilets in all dwellings. The capital and operating costs of each Option are presented in Table 1.13.

Table 1.13: Summary of capital and operation costs of the Options for Tarrawingee

Option	Costs ($)	
	CAPEX	OPEX
STEDS	572,500	16,900
OPS	887,900	28,000
RSS	1,652,300	25,300

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.12 shows that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (23 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (56 kL/day).

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates the highest costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

14. Tawonga

The town of Tawonga is located within the jurisdiction of Alpine Council. The town includes about 188 lots, a primary school, caravan park and a hotel. Preliminary designs for Tawonga includes a package wastewater treatment plant and reuse of class A treated wastewater for irrigation and toilet flushing at the school, caravan park and the hotel. Excess treated wastewater is discharged to a landscaped facility that provides evapotranspiration and infiltration. The preliminary design is presented in Figure 1.15.

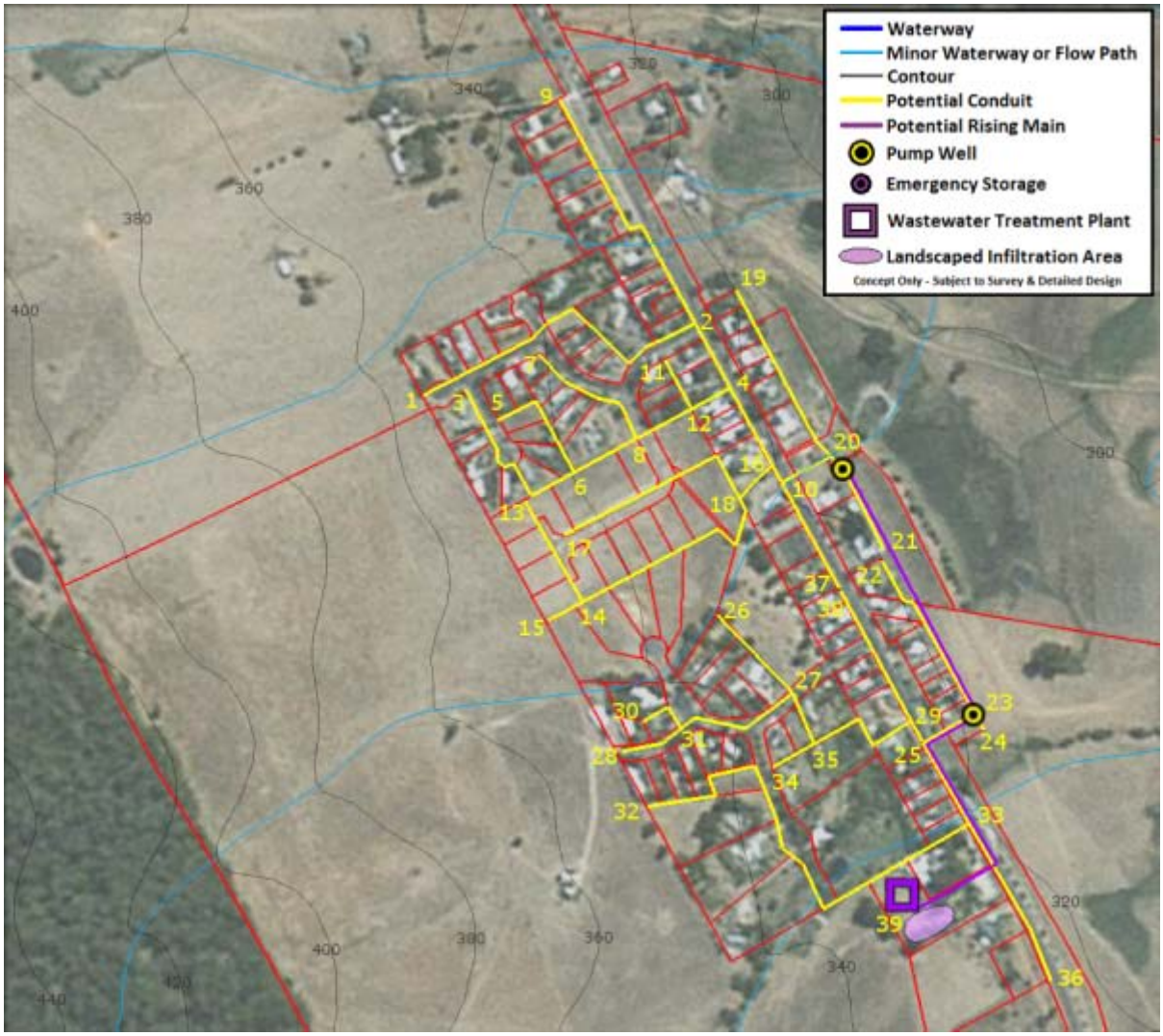

Figure 1.15: schematic of sewage systems for Tawonga

Figure 1.15 shows that the preliminary strategy includes a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 1,000 kL (STEDS) to 3,000 kL (RSS) was included in the preliminary design. The strategy includes reuse of treated wastewater for irrigation and toilet. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of treated effluent. The STEDS Option also includes installation of water efficient toilets in all dwellings. The capital and operating costs of each Option are presented in Table 1.14.

Table 1.14: Summary of capital and operation costs of the Options for Tawonga

Option	Costs ($)	
	CAPEX	OPEX
STEDS	1,355,700	31,200
OPS	3,030,600	66,600
RSS	3,461,000	59,300

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.14 shows that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (46 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (112 kL/day). The STEDS option also reduces water demands by 27%.

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates the highest costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

15. Tintaldra

The town of Tintaldra is located within the jurisdiction of Towong Council. The town includes about 20 lots and a caravan park. Preliminary designs for Tintaldra includes a package wastewater treatment plant and reuse of class A treated wastewater for irrigation and toilet flushing at the caravan park. Excess treated wastewater is discharged to a landscaped facility that provides evapotranspiration and infiltration. The preliminary design is presented in Figure 1.16.

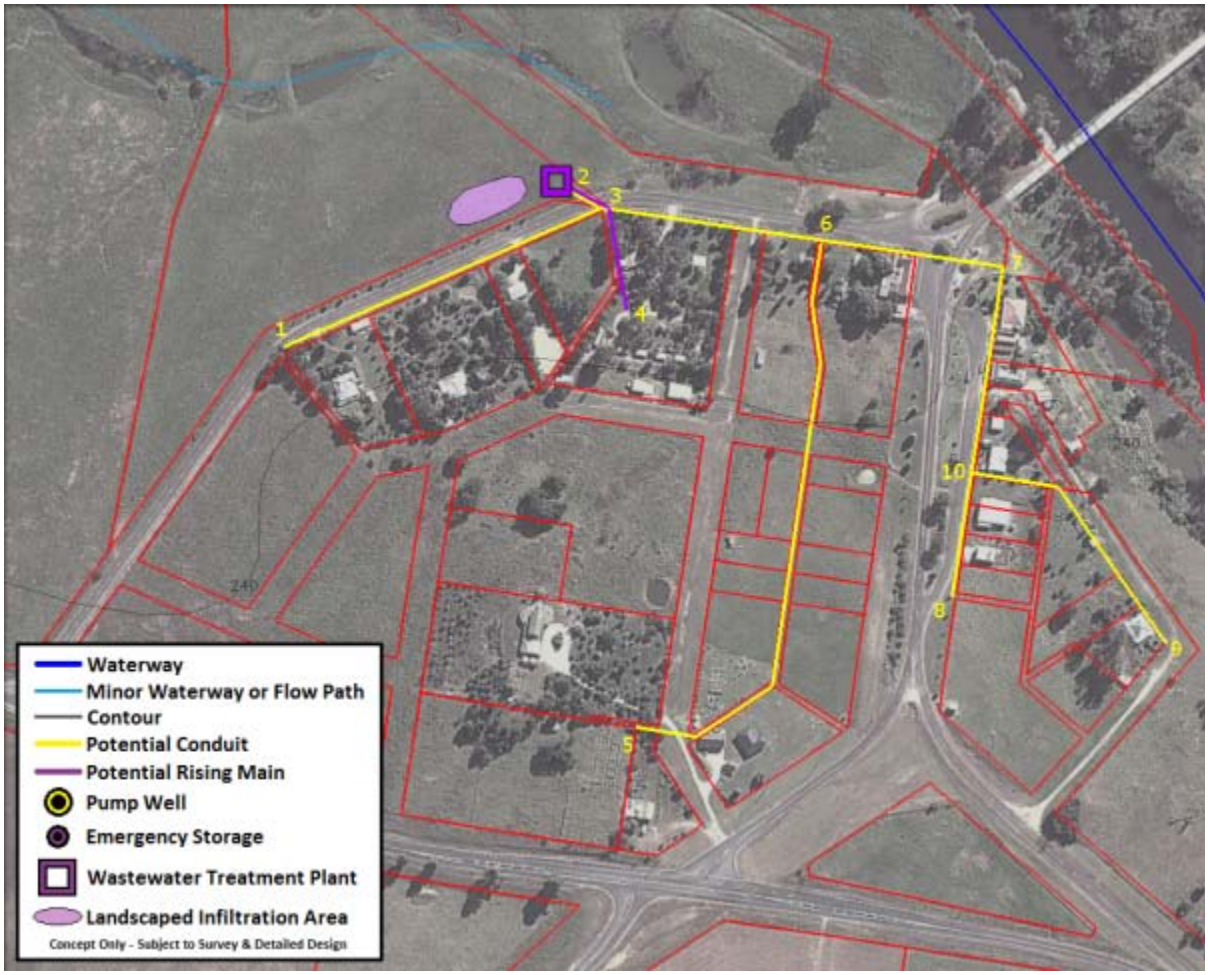

Figure 1.16: Schematic of sewage systems for Tintaldra

Figure 1.16 shows that the preliminary strategy includes a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 63 kL (STEDS) to 369 kL (RSS) was included in the preliminary design. The strategy includes reuse of treated wastewater for irrigation and toilet. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of treated effluent. The STEDS Option also includes installation of water efficient toilets in all dwellings. The capital and operating costs of each Option are presented in Table 1.15.

Table 1.15: Summary of capital and operation costs of the Options for Tintaldra

Option	Costs ($)	
	CAPEX	OPEX
STEDS	231,800	11,400
OPS	346,700	16,300
RSS	606,900	7,900

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.15 shows that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (6 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (14 kL/day). The STEDS option also reduces water demands by 30%.

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates the highest costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

16. Towong

The town of Towong is located within the jurisdiction of Towong Council. The town includes about 30 lots and a caravan park. Preliminary designs for Towong includes a package wastewater treatment plant and reuse of class A treated wastewater for irrigation of nearby agricultural areas. Excess treated wastewater is discharged to a landscaped facility that provides evapotranspiration and infiltration. The preliminary design is presented in Figure 1.17.

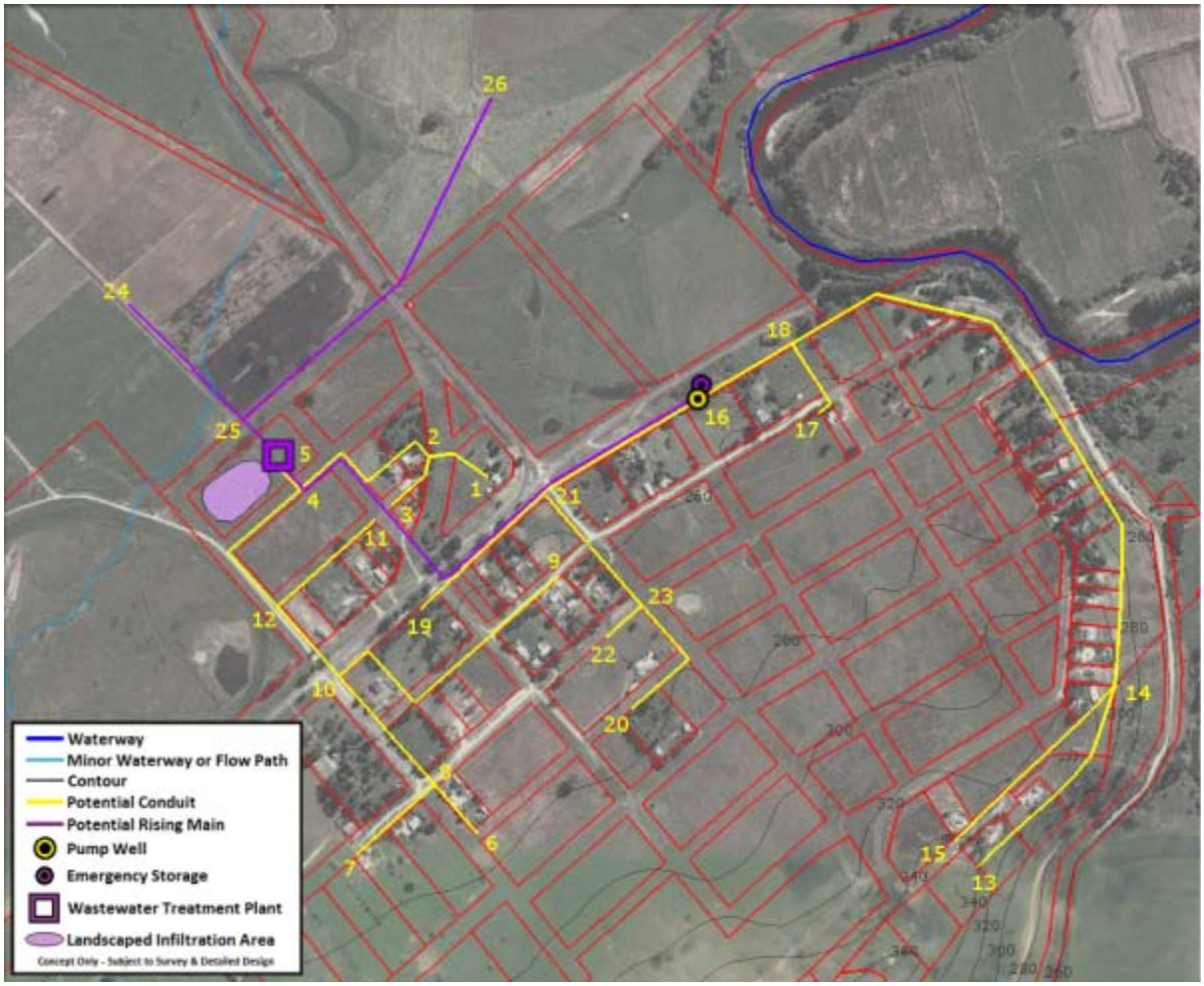

Figure 1.17: Schematic of sewage system for Towong

Figure 1.17 shows that the preliminary strategy includes a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 200 kL (STEDS) to 580 kL (RSS) was included in the preliminary design. The strategy includes reuse of treated wastewater for irrigation and toilet. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of treated effluent. The STEDS Option also includes installation of water efficient toilets in all dwellings. The capital and operating costs of each Option are presented in Table 1.16.

Table 1.16: Summary of capital and operation costs of the Options for Towong

Option	Costs ($)	
	CAPEX	OPEX
STEDS	386,900	13,200
OPS	514,600	21,200
RSS	1,676,800	16,600

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.16 shows

that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (9 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (21 kL/day). The STEDS option also reduces water demands by 26%.

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates the highest costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

17. Walwa

The town of Walwa is located within the jurisdiction of Towong Council. The town includes about 74 lots, a caravan park, school, oval and golf club. Preliminary designs for Walwa includes a package wastewater treatment plant and reuse of class A treated wastewater for irrigation and toilet flushing at the caravan park, oval, school and golf club. Excess treated wastewater is discharged to a landscaped facility that provides evapotranspiration and infiltration. The preliminary design is presented in Figure 1.18.

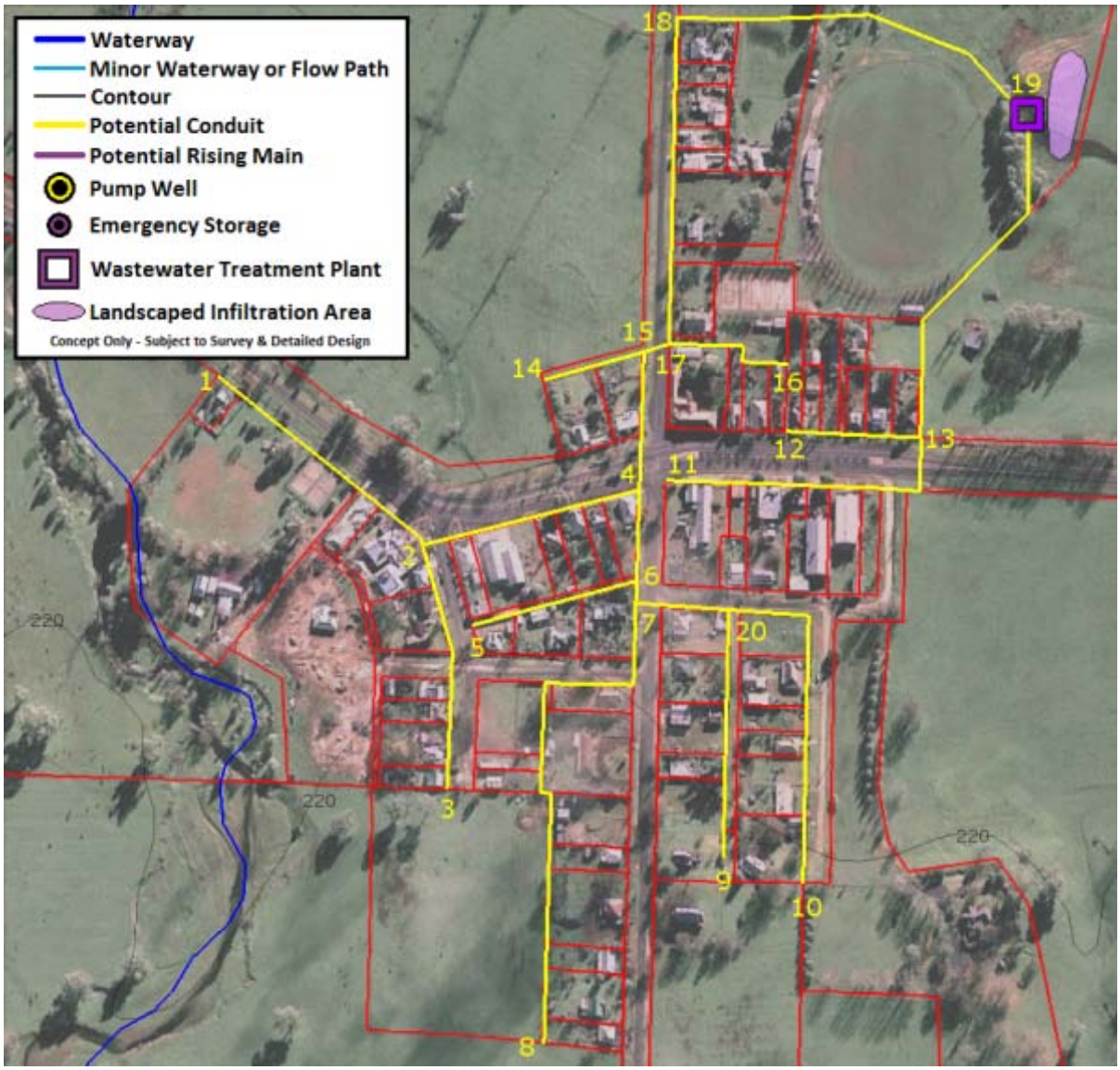

Figure 1.18: Schematic of sewage system for Walwa

Figure 1.18 shows that the preliminary strategy includes a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 680 kL (STEDS) to 1,290 kL (RSS) was included in the preliminary design. The strategy includes reuse of treated wastewater for irrigation and toilet flushing. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of treated effluent. The STEDS Option also includes installation of water efficient toilets in all dwellings. The capital and operating costs of each Option are presented in Table 1.18.

Table 1.18: Summary of capital and operation costs of the Options for Walwa

Option	Costs ($)	
	CAPEX	OPEX
STEDS	814,200	24,100
OPS	1,339,700	36,100
RSS	1,750,600	27,900

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.16 shows that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (33 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (53 kL/day). The STEDS option also reduces water demands by 43%.

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates the highest costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

18. Wandiligong

The town of Wandiligong is located within the jurisdiction of Alpine Council. The town includes about 195 lots, a caravan park, school, oval and golf club. Preliminary designs for Wandiligong includes a package wastewater treatment plant and reuse of class A treated wastewater for irrigation and toilet flushing at the holiday village, oval, school and maze. Excess treated wastewater is discharged to a landscaped facility that provides evapotranspiration and infiltration. The preliminary design is presented in Figure 1.19.

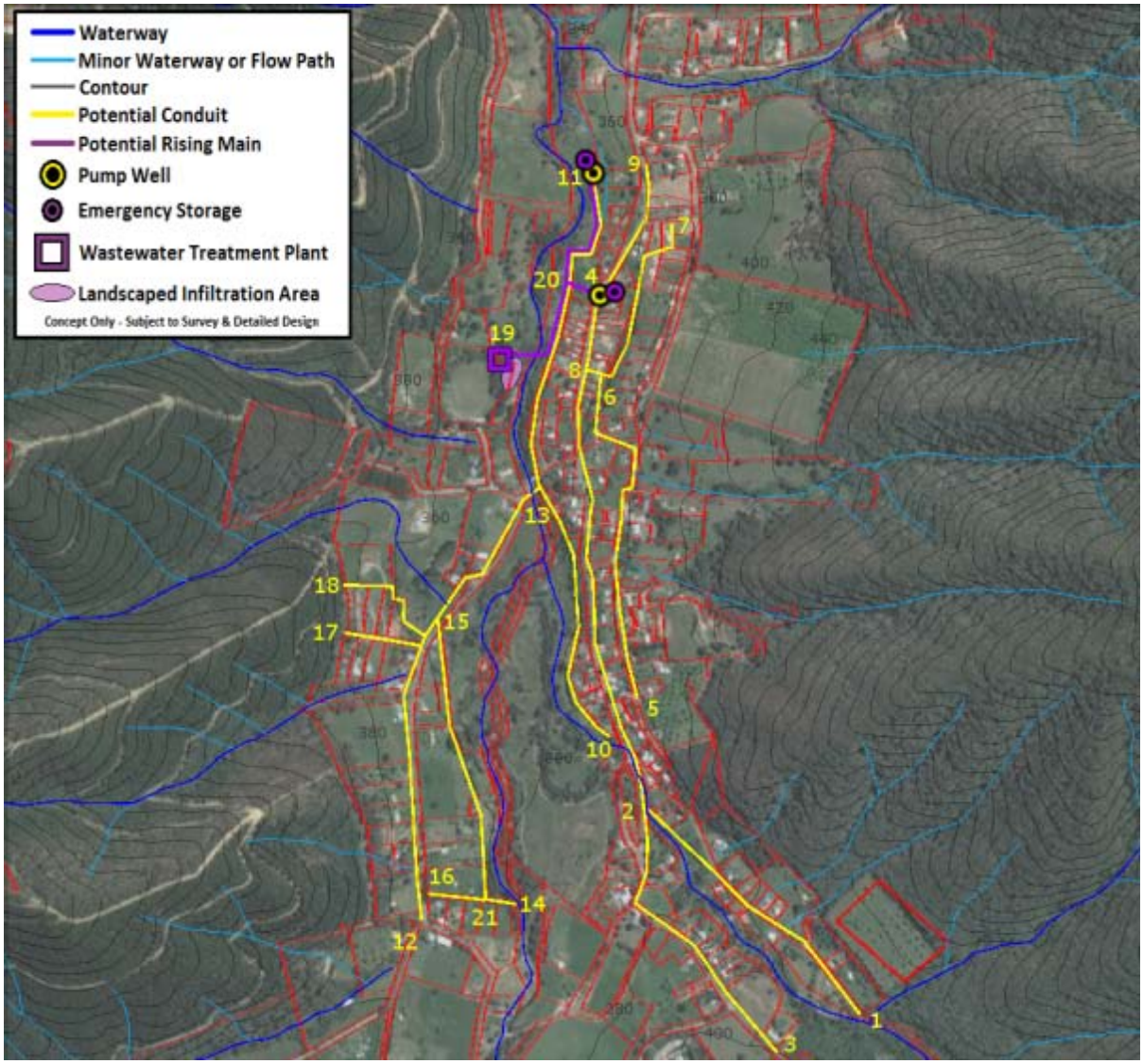

Figure 1.19: Schematic of sewage systems for Wandiligong

Figure 1.19 shows that the preliminary strategy includes a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 1,130 kL (STEDS) to 3,120 kL (RSS) was included in the preliminary design.

The strategy includes reuse of treated wastewater for irrigation and toilet flushing. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of treated effluent. The STEDS Option also includes installation of water efficient toilets in all dwellings. The capital and operating costs of each Option are presented in Table 1.19.

Table 1.19: Summary of capital and operation costs of the Options for Wandiligong

Option	Costs ($)	
	CAPEX	OPEX
STEDS	814,200	24,100
OPS	1,339,700	36,100
RSS	1,750,600	27,900

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.19 shows that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (48 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (116 kL/day). The STEDS option also reduces water demands by 27%.

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to sevice the pumps. The RSS Option generates the highest costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

19. Whitfield

The town of Whitfield is located within the jurisdiction of the Rural City of Wangaratta. The town includes about 50 lots, a caravan park, school, oval, golf course, camping ground and winery. Preliminary designs for Whitfield includes a package wastewater treatment plant and reuse of class A treated wastewater for irrigation and toilet flushing at the caravan park, oval, school, camping ground, golf course and winery. Excess treated wastewater is discharged to a landscaped facility that provides evapotranspiration and infiltration. The preliminary design is presented in Figure 1.20.

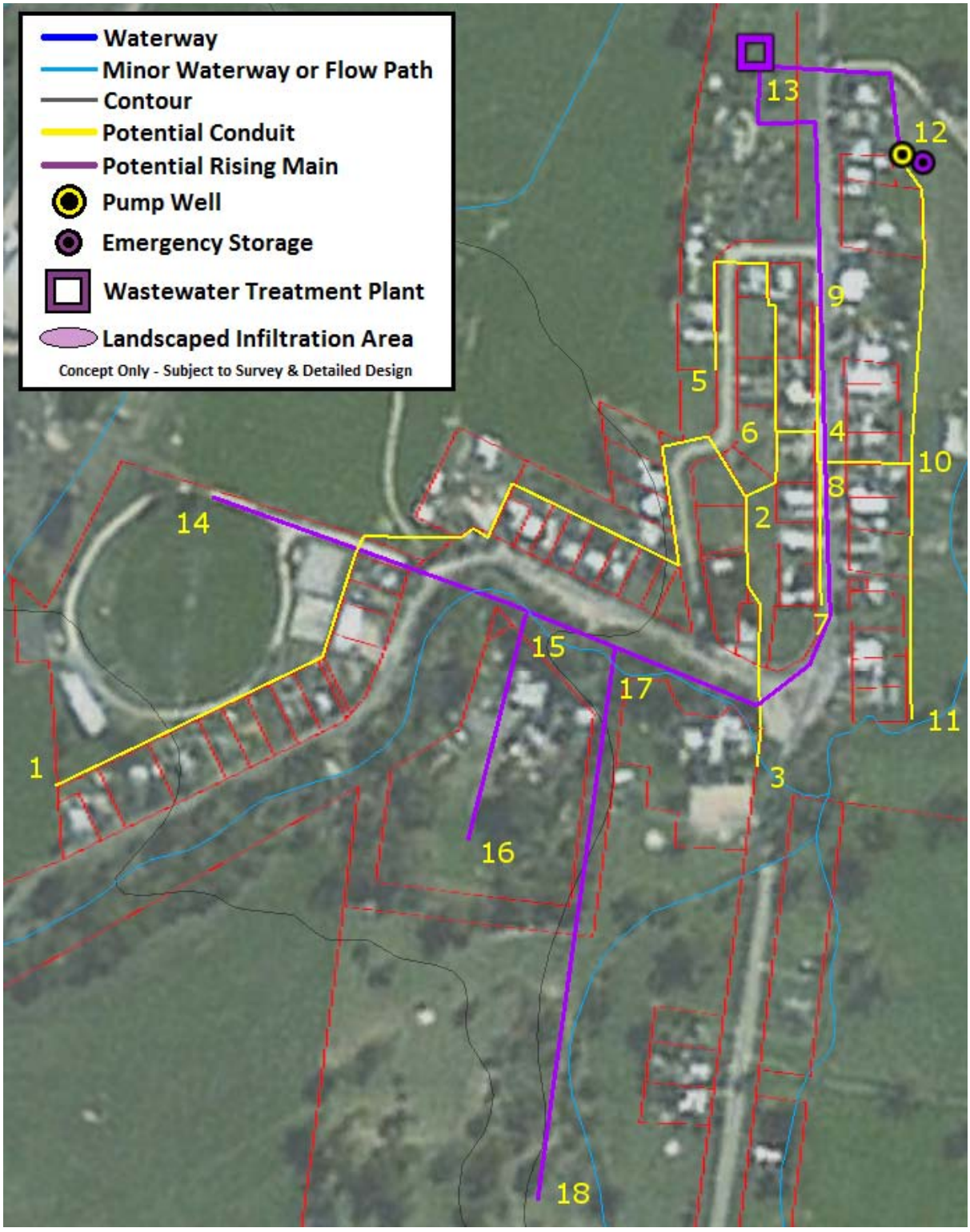

Figure 1.20: Schematic of sewage systems for Whitfield

Figure 1.20 shows that the preliminary strategy includes a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 370 kL (STEDS) to 1,090 kL (RSS) was included in the preliminary design.

The strategy includes reuse of treated wastewater for irrigation and toilet flushing. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow

billabongs to facilitate maximum losses of treated effluent. The STEDS Option also includes installation of water efficient toilets in all dwellings. The capital and operating costs of each Option are presented in Table 1.20.

Table 1.20: Summary of capital and operation costs of the Options for Whitfield

Option	Costs ($)	
	CAPEX	OPEX
STEDS	578,400	18,400
OPS	1,078,300	33,100
RSS	1,553,200	25,700

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.20 shows that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (20 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (49 kL/day). The STEDS option also reduces water demands by 48%.

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates the highest costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.

20. Whorouly

The town of Whorouly is located within the jurisdiction of the Rural City of Wangaratta. The town includes about 47 lots, a school and oval. Preliminary designs for Whorouly includes a package wastewater treatment plant and reuse of class A treated wastewater for irrigation and toilet flushing at the school and the oval. Excess treated wastewater is discharged to a landscaped facility that provides evapotranspiration and infiltration. The preliminary design is presented in Figure 1.21.

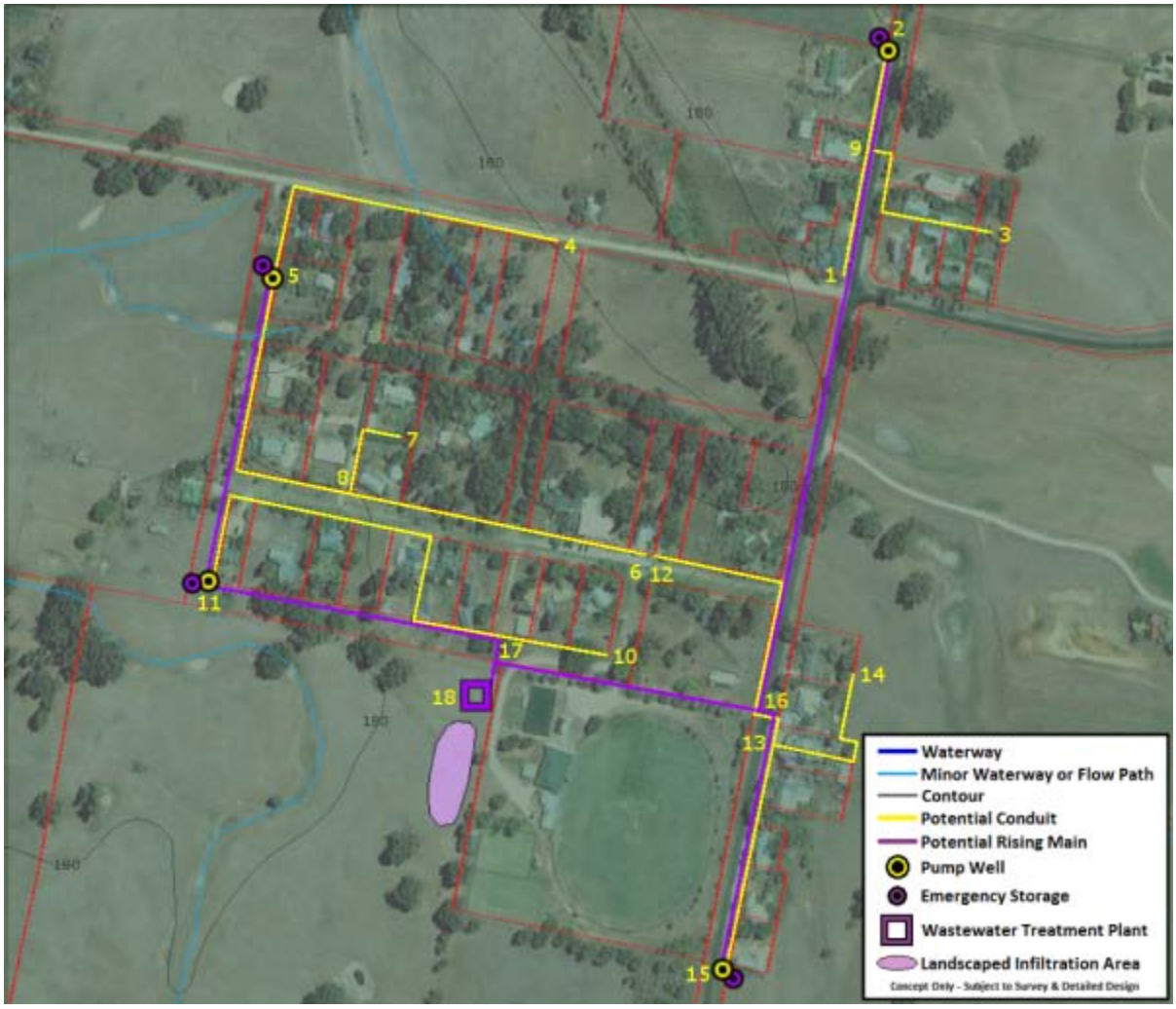

Figure 1.21: Schematic of sewage system for Whorouly

Figure 1.21 shows that the preliminary strategy includes a landscaped infiltration area that will allow infiltration and evapotranspiration of any excess treated wastewater. An additional wet weather storage of 250 kL (STEDS) to 520 kL (RSS) was included in the preliminary design.

The strategy includes reuse of treated wastewater for irrigation and toilet flushing. Note that the landscaped area was designed to provide sub-surface storage and surface storage in shallow billabongs to facilitate maximum losses of treated effluent. The STEDS Option also includes installation of water efficient toilets in all dwellings. The capital and operating costs of each Option are presented in Table 1.21.

Table 1.21: Summary of capital and operation costs of the Options for Whorouly

Option	Costs ($)	
	CAPEX	OPEX
STEDS	475,100	15,600
OPS	773,000	24,300
RSS	1,270,000	17,400

Note that OPS refers to pressure sewer and RSS is traditional reticulated sewage. Table 1.21 shows that the STEDS Option generates the lowest capital and operating costs. A requirement to treat lower volumes of effluent (12 kL/day) in the STEDS option provides reduced costs in comparison to treating higher volumes of sewage (30 kL/day). The STEDS option also reduces water demands by 29%.

The OPS Option provided higher costs that result from replacing septic tanks with grinder pumps in wells on each property. The use of multiple pumps generates a higher likelihood of the need to service the pumps. The RSS Option generates the highest costs due to the deeper installation, decommissioning septic tanks and more expensive nature of traditional sewage infrastructure.