South Gippsland Water Urban Water Strategy

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Document history and status

Revision	Date	Description	By	Review	Approved
Draft	31 March 2017	Draft Urban Water Strategy for SGW review	REB	BPN, KAA	KAA
Final	21 April	Final UWS for DELWP	REB	KAA	KAA

Contents

Executive Summary

South Gippsland Water (SGW) has responsibility for the operation and future system planning for 10 separate town water supply systems in its district, shown in Figure ES-1. This Urban Water Strategy (UWS) outlines South Gippsland Water's (SGW) strategy for managing the water supply and demand balance to its customers over the next 50 years. This long-term view is a component of SGW's overall planning processes, which includes planning for drought response, financial expenditure, asset management, water quality and wastewater. Short-term actions presented in this strategy will feed directly into the Corporation's expenditure program. This UWS is also important in the context of the Gippsland Region Sustainable Water Strategy, which considers the needs of other water users such as irrigators and the environment. The UWS takes into account regional river health strategies and works within sustainable diversion limits for water resource development set by the State Government.

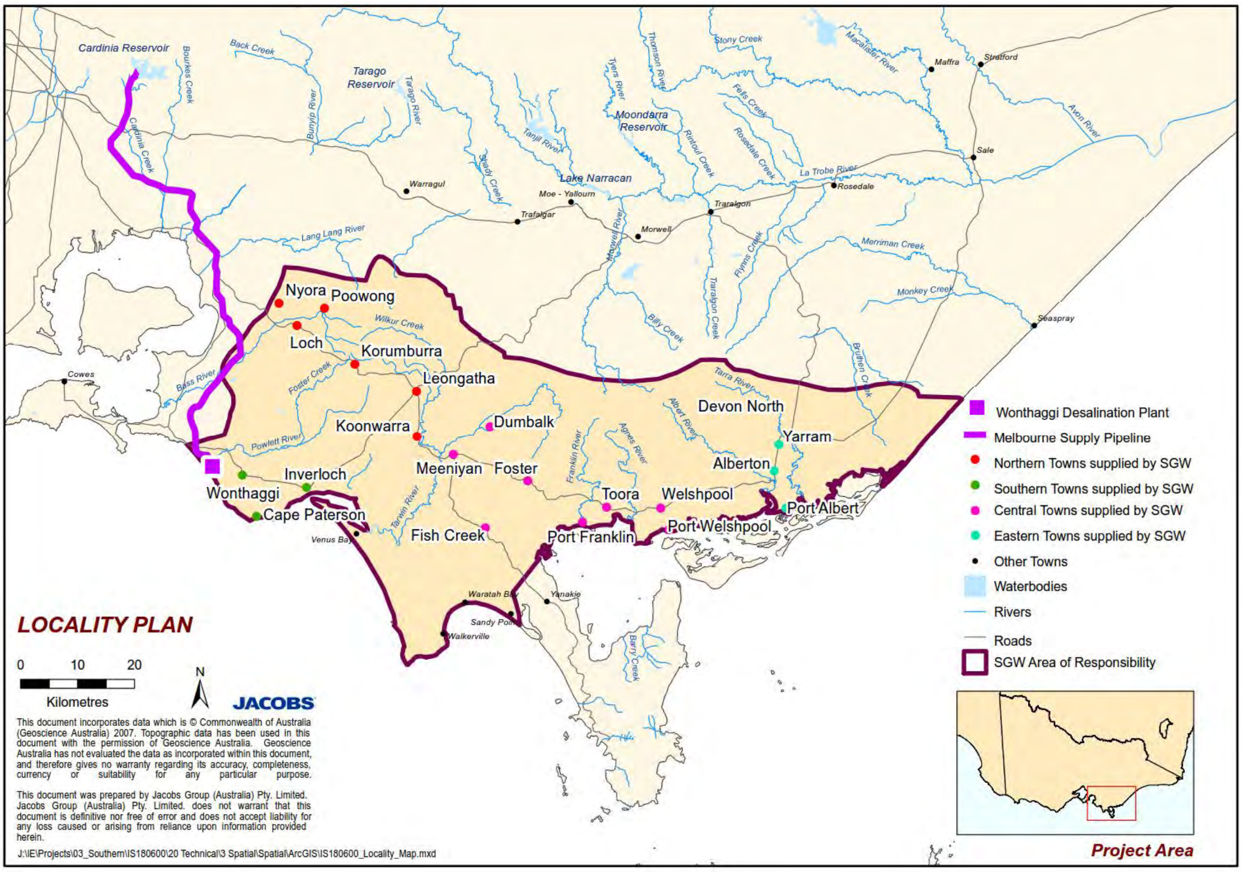

Figure ES-1 Locality Map

This strategy is to be reviewed every five years to take into account changes in consumer demand and water availability. Actions which are due to take place more than five years into the future can therefore be reviewed in light of better knowledge when that update takes place. Revision of the UWS will be particularly important for current areas of uncertainty, such as demand growth and the impact of climate change on available water supplies.

This UWS is an update to the Water Supply Demand Strategy (WSDS) prepared by SGW in 2011. It incorporates the effects of the Millennium Drought, changes in SGW's operation since the WSDS, the 2016 Victoria In Future population projections, the 2011 population census results, updated climate change projections for Victoria and modelling to incorporate the operation of the connection from the Melbourne Water Supply System. This strategy is supported by a Water Atlas for each system.

This strategy was prepared in accordance with the Department of Environment, Land, Water and Planning (DELWP) *Guidelines for the Development of Urban Water Strategies and the Melbourne Water System Strategy* (DELWP, 2017).

Various changes have occurred since the preparation of the 2011 WSDS, the most significant for this strategy being the recent or imminent connection of several of SGW's supply systems to the Melbourne supply system. Connection to the Melbourne supply system provides SGW with an opportunity to access a significant volume of water from outside of our water supply catchments. This reduces SGW's supply risk from future population growth and climate change. This strategy therefore considers future supply options that leverage off the connection to the Melbourne supply system alongside alternatives that involve augmentation of the existing SGW supply systems.

South Gippsland continues to grow – with a high rate of growth particularly evident along the coastal strip near Inverloch. Total demands for water from SGW's systems are expected to increase because several towns supplied by SGW are close to the ever expanding Melbourne fringe. There is also potential for major industry to relocate to the area. Some industrial water customers who produce saline wastewater could potentially move from Melbourne to take advantage of SGW's saline outfall transfer system, which the Victorian Environment Protection Authority (EPA) has noted as being an asset of State-wide significance. Some of SGW's existing industrial water customers also have the potential to expand, particularly in the food processing industry. The dairy industry – producing milk, cheese, butter, yoghurt and now more sophisticated protein and pharmaceutical products – is one of the main industries in the region. SGW supplies a limited amount of water to dairy farms and a considerable amount of water to dairy processing factories in Leongatha and Korumburra. These factories require a very reliable supply of water.

Urban water strategies for each supply system have been developed for a demand scenario which incorporates population projections from the Victoria in Future (ViF) forecasts available from the State Government. Figure 1-2 indicates that total water demand from SGW's supply systems is expected to increase by almost 50% over the next 50 years based on forecast population growth and the impact of climate change.

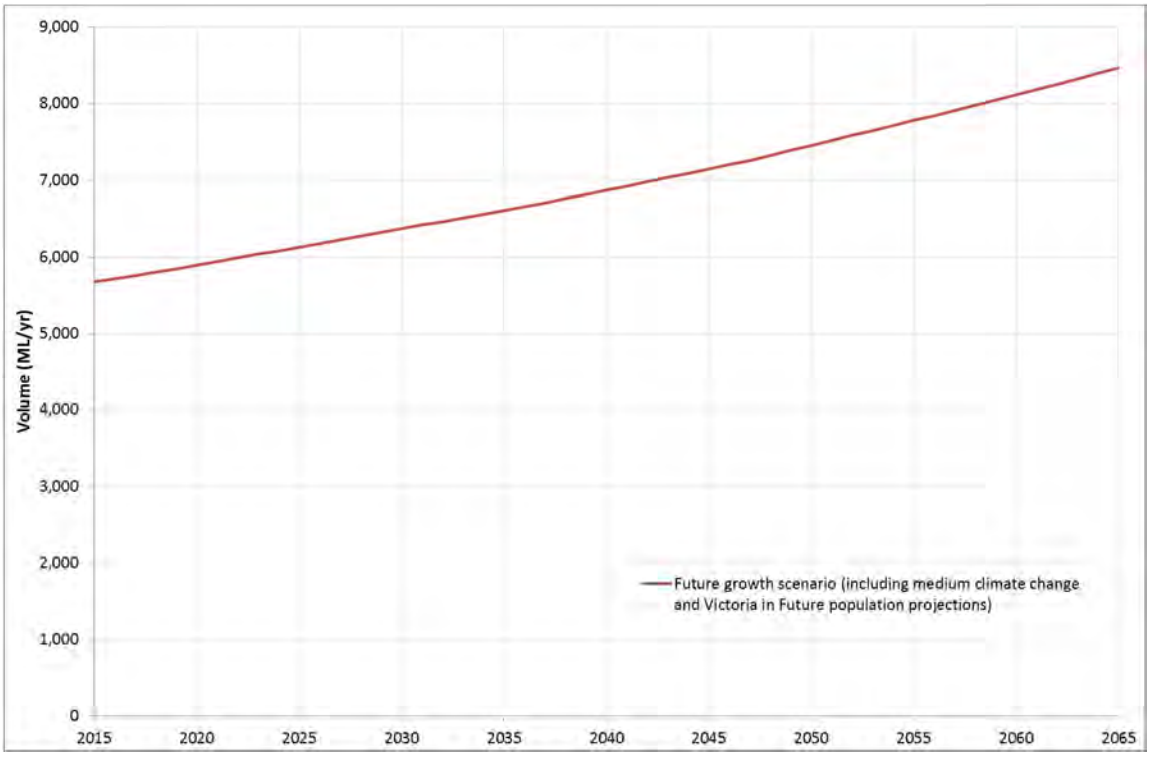

Figure 1-2 Anticipated Growth in Demand for Urban Water in South Gippsland

SGW foresaw the risk of shortfalls in some of its water supply systems many years ago and commissioned strategic assessments of demand and future supply alternatives. In 2010, the State Government funded a pipeline to provide a water supply from the Lance Creek water supply system (supplying Wonthaggi, Cape Paterson and Inverloch) to the Victorian Desalination Plant construction site. SGW can now operate this pipeline in reverse to provide a direct connection from the Melbourne supply system (from Cardinia Reservoir) to the Lance Creek supply system. Taking advantage of this infrastructure, SGW has started to implement its strategy to secure additional water supplies for Korumburra, Poowong, Loch and Nyora with a connection to the Melbourne Water Supply System, due to be completed in early 2019.

The 2017 strategy also takes into account the additional data collated over the past five years, changes in SGW's infrastructure and operation, the 2011 population census results and projections, and the potential to extend the supply from the Melbourne Water Supply System.

The approach to this planning study has been to consider future supply options for the northern, southern and central towns, including options to leverage off the connection to the Melbourne supply system where relevant. SGW will carefully consider any cost implications associated with being connected to the Melbourne supply system, and continues to work through these arrangements with Melbourne Water. The connection to the Melbourne supply system also has implications for SGW's water treatment operations. SGW has developed this Urban Water Strategy by considering a range of options which include both developing local water sources or utilising water from the Melbourne supply system.

For the UWS, SGW has considered a range of climate change conditions to undertake planning for the next 50 years, based on the Victorian Government Climate Change guidelines (DELWP, 2016a) as required by the Guidelines for the preparation of Urban Water Strategies (DELWP, 2017). For supply systems that are relatively secure, the high (drier) climate change and post-1997 step climate change scenarios have been presented to illustrate that level of service objectives are not expected to be threatened under the driest climate change scenarios considered by DELWP. For supply systems that are less secure, the medium climate change scenario has been presented, with a description of the projected earliest and latest timing for action under the high (drier) and low (wetter) climate change scenarios. All of the climate change scenarios presented in this UWS are considered equally likely, including the possibility of future climate change conditions lying outside of the envelope of climate projections provided by DELWP for this strategy. This uncertainty therefore lends itself to robust, adaptable supply strategies. The presentation of the medium climate change scenario in this UWS is consistent with feedback obtained by SGW through the customer consultation.

Strategy Outcomes

The key outcomes from the UWS assessment process were:

- SGW's customers have responded well to calls to reduce water consumption. Consumption has reduced significantly since the Millennium Drought (1997-2009) and these reductions have been sustained. In many cases this has been achieved despite increases in population and the number of dwellings. SGW's demand reduction measures targeting specific user groups have also been successful, such as the incentives available to customers in Poowong, Loch and Nyora for the installation of water efficient appliances, the Small Community Grant Scheme available to help businesses and community organisations invest in water saving measures, and the WaterMAP program for industrial customers. Water conservation remains a top priority to help balance supply and demand.
- Additional water savings have been made within SGW's treatment facilities, with the capture, treatment and reuse of washwater supernatant from Fish Creek, Foster, Devon North, Lance Creek and Korumburra Treatment Plants.
- SGW has invested in and supported a number of Integrated Water Management programs that provide alternative water sources to customers. These include the supply of raw water or the reuse of treated wastewater for rural customers and watering of public facilities (such as golf courses and football ovals), alternative water storages for emergency irrigation supplies during drought, and incentives for on-farm water capture to reduce potable demands.
- In some cases, demand reduction measures alone are expected to be insufficient to maintain supply at SGW's level of service objective for reliability of supply in some supply systems over the 50 year planning horizon. Supply augmentation is likely to be required in these systems.
- In some systems, SGW is aware of issues such as poor raw water quality events, asset age and asset condition that may influence reliability of supply in their systems, or provide opportunities for cost savings in works to concurrently improve water availability. Asset replacement/renewal works are known to be required for a number of systems, irrespective of the consideration of the long-term supply and demand balance.
- A number of towns within SGW's region are currently unserviced, including Sandy Point, Walkerville, Waratah Bay, Yanakie, Venus Bay and Tarwin Lower. The connection of these towns has not been explicitly tested, however all augmentation options for existing towns have considered their compatibility with possible future connection to these unserviced towns.
- **For SGW's northern and southern towns**, which includes Poowong, Loch, Nyora, Korumburra, Leongatha, Wonthaggi, Cape Paterson and Inverloch:
  - Supply enhancement is required for Poowong, Loch, Nyora and Korumburra, as previously planned. These towns will be connected to Melbourne via the Lance Creek system in 2019 to increase supply security. The Lance Creek system already has a connection to the Melbourne supply system. In the interim, SGW's Drought Preparedness Plan provides options for the management of the system under dry conditions, if they occur in individual years prior to 2019.
  - The Lance Creek system, including the current 1 GL Bulk Entitlement from the Melbourne system, meets the current demands of Wonthaggi, Cape Paterson and Inverloch. It is also estimated to meet the combined demands following the Lance Creek Connection Project (incorporating Poowong, Loch, Nyora and Korumburra) in the short term. SGW expects to take up the opportunity to purchase

additional Bulk Entitlement from the Melbourne System to help support the growing demands of these towns into the future. The purchase of an additional 4 GL of entitlement from the Melbourne system (bringing the total entitlement to 5 GL) will help meet the future demands for approximately 35 years under a medium climate change scenario. If drier conditions occur, this 5 GL entitlement would meet SGWs service objectives for approximately 20 years, whereas this entitlement volume would be sufficient for 50 years under wetter conditions.

  - Supply enhancement options for Leongatha are required in the near future to maintain security of supply. This brings forward the need for augmentation compared to the 2011 WSDS because anticipated demand reductions were not fully realised. A number of alternative options have been considered for Leongatha. These include the refurbishment of obsolete infrastructure, connection to the Bellview Creek Reservoir, decommissioning of the Ruby Creek infrastructure or an interlinked system connected to Lance Creek Reservoir and the Melbourne supply, as well as various combinations of these alternatives.
  - Preliminary outcomes from this UWS indicate supply to the Leongatha system would be best served by retaining the existing Ruby Creek infrastructure, with future augmentation by connection to Melbourne via the Lance Creek system. A detailed assessment is required to determine the viability of connecting Bellview Creek Reservoir to the Ruby Creek system. This is planned to be completed in the short term. The outcomes of this assessment will confirm the timing of the future interconnection of Leongatha to the Lance Creek system, either directly or in combination with the Bellview Creek Reservoir connection. In combination with these infrastructure upgrades, SGW would need to purchase additional Bulk Entitlements from the Melbourne System. The volume and timing of the purchase of additional entitlement will consider issues such as prevailing conditions, market price for water, availability of entitlement, trade, and other aspects.

- **For SGW's central towns**, which includes Dumbalk, Meeniyan, Foster, Fish Creek, Toora, Port Welshpool, Welshpool and Port Franklin:
  - Dumbalk, Meeniyan and Foster are projected to have sufficient supply to meet demands at SGW's level of service objective for reliability of supply over the 50 year planning horizon. Future enhancements for Dumbalk and Meeniyan may be assessed based on water quality, cost and development considerations.
  - Supply enhancement is required for Fish Creek and towns currently supplied by the Agnes River (Toora, Port Welshpool, Welshpool and Port Franklin) under all climate assumptions considered.
  - Two alternative supply strategies were considered for the central towns, namely enhancing existing SGW headworks or supply from an interlinked system connecting Foster to Fish Creek and/or Toora.
  - Preliminary results from this UWS suggest that the enhancement of the existing systems with increased storage capacity at Toora and Fish Creek would provide adequate supply and help to maintain SGW's diversity in water supply. These alternatives also maintain the possibility of future connection of the unserviced towns to the Foster system.
- **For SGW's eastern towns**, which include Yarram, Port Albert, Alberton and Devon North:
  - SGW has progressed the strategy recommended in the 2011 WSDS, namely to purchase groundwater licences to enhance supply to the eastern towns. The current bore licence of 214 ML/yr is projected to be sufficient to meet SGW's level of service objective for reliability of supply over the 50 year planning horizon.

A plan of system wide actions is shown in Table ES-1, along with specific actions for each group of towns in Table ES-2 to Table ES-4. The UWS will be reviewed and updated every 5 years to incorporate additional hydrologic data, changes in demand for water, changes to supply system configuration, changes in community expectations and improvements in scientific knowledge. There are several areas of uncertainty for SGW in developing the UWS, which will need to be monitored on an ongoing basis, such as the future demand growth, and climate change impacts.

Table ES-1 : Action plan – system wide actions

Priority	System wide actions
A. Demand Management	
1	Reduce uncertainty in current and future estimates of consumer demand through ongoing monitoring and metering, particularly for major commercial and industrial water users
2	Continue current successful water conservation initiatives, including initiatives similar to the WaterMap program for major industrial and rural customers
3	Where economically viable, actively pursue opportunities for the use of treated wastewater and other IWM options to offset potable supply
B. System Management	
4	Reduce water leaks and wastage in reticulation systems and water treatment processes
5	Secure dams against leakage and future failures
C. Management for Forward Planning	
6	Monitor stream flows and impacts of climate change
7	Monitor catchments to ensure reliable supply and quality of water
8	Encourage the use of alternative water sources where appropriate and economically viable
9	Monitor public appetite for the connection of water supplies to unserviced towns
10	Monitor demographic trends, and hence potential demand for water, in cooperation with DELWP, Local Government and other planning authorities

Table ES-2 : Action plan for Northern and Southern Towns

Approximate Timing	Actions	
	Lance Creek	Leongatha
2019	Connect Korumburra, Poowong, Loch and Nyora to the Lance Creek system. Start planning and consultation for re-commissioning / decommissioning of existing Coalition Creek and Little Bass water treatment plants and raw water storages.	Initiate detailed investigation of Leongatha augmentation options and confirm preferred approach to supplement the Ruby Creek system. Alternative 1: Connection to Bellview Creek Reservoir and Lance Creek Alternative 2: Direct connection to Lance Creek
Next 5 years	Plan strategy for purchase additional BE from the Melbourne system for the connected Lance Creek system	Implement preferred Leongatha augmentation option Phase 1 (connection to Bellview Creek Reservoir or direct to Lance Creek)
Next 10 years	Purchase additional BE from the Melbourne system for the connected Lance Creek system	If relevant, implement Leongatha augmentation option Phase 2 (connection to Lance Creek)
From 2040	Planning to secure additional yield, (purchase additional BE from the Melbourne system, trade, local system augmentation)	

- Table ES-3 : Action plan for Central Towns

Approximate Timing	Actions	
	Fish Creek	Agnes River (Toora)
Next 5 years	Implement program of works to reduce distribution losses in Fish Creek system	
Next 10 years	Review success of loss reduction works. Reassess requirement for augmentation works. If required, raise Battery Creek Reservoir by 1 metre in combination with dam safety upgrade works.	
From 2030		Construct 70 ML off-stream storage at Toora

- Table ES-4 : Action plan for Eastern Towns

Approximate Timing	Action
Ongoing	Monitor ongoing demands to identify the need for further groundwater licence purchase

Glossary

Aquifer A layer of underground sediments which holds water and allows water to flow through it.

Augmentation Increase in size and/or number.

Baseflows The component of streamflow supplied by groundwater discharge.

Bulk Entitlement (BE) The right to water held by water corporations and other authorities defined in the Water Act 1989. The BE defines the amount of water that an authority is entitled to from a river or storage, and may include the rate at which it may be taken and the reliability of the entitlement. The seasonal or annual allocation available to the authority is expressed as a proportion of the bulk entitlement and will depend on stored water available, the local conditions and climate forecasts, and may be up to the BE volume.

Cap An upper limit for the diversion of water away from a waterway, catchment or basin.

Catchment An area of land where run-off from rainfall goes into one river system.

Catchment Management Authorities (CMAs) Government authorities established to manage river health, regional and catchment planning, and waterway, floodplain, salinity and water quality management.

Dead storage Water in a storage that is below the lowest constructed outlet.

Desalination Removing salt from water sources – normally for drinking purposes.

Diversions The removal of water from a waterway.

Domestic and stock Water used in households and for livestock.

Drought Preparedness Plan Used by urban water corporations to manage water shortages, including implementation of water restrictions.

Ecosystem A dynamic complex of plant, animal, fungal and micro-organism communities and the associated non-living environment interacting as an ecological unit.

Effluent Treated sewage that flows out of a sewage treatment plant.

Environmental flow regime The timing, frequency, duration and magnitude of flows recommended for the environment.

Environmental water reserve (EWR) The share of water resources set aside to maintain the environmental values of a water system.

EPA Victoria Environmental Protection Authority Victoria.

Estuaries Zones where a river meets the sea, influenced by river flows and tides and characterised by a gradient from fresh to salt water.

Farm dams Individually owned storages that capture catchment run-off that are not on a waterway. Also referred to as small catchment dams.

Floodplain Lands which are subject to overflow during floods. Often valuable for their ecological assets.

Gigalitre (GL) 1,000,000,000 litres.

Greywater Household water which has not been contaminated by toilet discharge, and can be reused for non drinking purposes. Typically includes water from bathtubs, dishwashing machines and clothes washing machines.

Groundwater All subsurface water, generally occupying the pores and crevices of rock and soil.

Groundwater Management Area (GMA) Discrete area where groundwater resources of a suitable quality for irrigation, commercial or domestic and stock use are available or are expected to be available.

Groundwater management plans Created for water supply protection areas that have been or are proposed to be proclaimed under the Water Act 1989 to ensure equitable and sustainable use of groundwater.

Groundwater Management Unit (GMU) Either a groundwater management area (GMA) or water supply protection area (WSPA).

Headworks Dams, weirs and associated works used for the harvest and supply of water.

Inflows Water flowing into a storage or a river.

Instream The component of a river within the river channel, including pools, riffles, woody debris, the river bank and benches along the bank.

Level of service objectives SGW's target maximum frequency of restrictions and the objective to maintain continuous supply to customers without running out of water.

Licensing authority Administers the diversion of water from waterways and the extraction of groundwater on behalf of the Minister for Water.

Mean Annual Flow (MAF) is the average flow for the individual year or multi-year period of interest. Mean annual flow is calculated by dividing the sum of all the individual flows records by the number of years of data.

Megalitre (ML) One million (1,000,000) litres.

Non-residential Water use in industry, commercial/institutional buildings, open spaces (parks and gardens) and the water distribution system.

Outfall The site of discharge of a liquid from a pipe. Applied particularly to the point at which a drain or sewer discharges to a treatment works or receiving water (such as river, creek or bay).

Passing flow Flows that a water corporation must pass at its reservoirs before it can take any water for consumptive use, specified in the relevant Bulk Entitlement.

Perennial stream A stream that flows all year.

Permissible consumptive volume (PCV) The volume of water permitted to be allocated in discrete groundwater management areas. Previously called permissible annual volumes (PAVs).

Potable Suitable for drinking.

Qualification of rights The Minister for Water declares a water shortage and qualifies existing water entitlements to reallocate water to priority uses.

Raw water Water that has not been treated for the intended purpose.

Recharge (to groundwater) The process where water moves downward from surface water to groundwater due to rainfall infiltration or seepage/leakage.

Recycled water Water derived from sewerage systems or industry processes that is treated to a standard appropriate for its intended use.

Regional River Health Strategy The key strategy for the protection of river values in each catchment management region in Victoria.

Reliability of supply Represents the frequency with which water can be supplied without the need for water restrictions. This is usually expressed annually for urban supply.

Reservoir Natural or artificial dam or lake used for the storage and regulation of water.

Residential use Water use in private housing.

Reticulation Network of pipelines used to deliver water to end users.

River basin The land into which a river and its tributaries drain.

Run-off Precipitation or rainfall which flows from a catchment into streams, lakes, rivers or reservoirs.

Salinity The total amount of water-soluble salts present in the soil or in a stream.

Sewage Wastewater produced from household and industry.

Sewerage The pipes and plant that collect, remove, treat and dispose of liquid urban waste.

Stormwater Run-off from urban areas. The net increase in run–off and decrease in groundwater recharge resulting from the introduction of impervious surfaces such as roofs and roads within urban development.

Streamflow management plan Prepared for a water supply protection area to manage the surface water resources of the area.

Sustainable Diversion Limit (SDL) The upper limit on winter-fill diversions within an unregulated river sub-catchment, beyond which there is an unacceptable risk to the environment. The SDLs referenced in this document refer to those developed by the Victorian Government, rather than the MDBA definition used in reference to the Murray Darling Basin Plan.

Unincorporated areas (UA) Areas with limited groundwater resources which are not defined as groundwater management areas and do not have a defined permissible consumptive volume.

Unregulated systems River systems with no large dams or weirs to regulate flow and all groundwater sources or where some user types do not have rights to stored water.

Water corporations Government organisations charged with supplying water to urban and rural water users. They administer the diversion of water from waterways and the extraction of groundwater. Formerly known as water authorities.

Water Supply Protection Area (WSPA) An area declared under the Water Act 1989 to protect groundwater and/or surface water resources in the area. Once an area has been declared, a water management plan is prepared.

Water-use licence Authorises the use of water on land for irrigation.

Wetlands Inland, standing, shallow bodies of water, which may be permanent or temporary, fresh or saline.

Winter-fill licence A licence issued which permits taking water from a waterway to fill a storage only during the winter months (July-November). The storage may be on stream or off stream.

Yield The quantity of water that a storage or aquifer produces. For supply systems in this UWS it is defined as the average annual demand that can be supplied at which the level of service objectives for supply are just met.

1. Introduction

1.1 About the Urban Water Strategy (UWS)

This Urban Water Strategy (UWS) outlines South Gippsland Water's (SGW) strategy for managing the water supply and demand balance to its customers over the next 50 years. This long-term view is a component of SGW's overall planning processes, which includes planning for drought response, financial expenditure, asset management, water quality and wastewater. Short-term actions presented in this strategy will feed directly into the Corporation's expenditure program. This UWS is also important in the context of the Gippsland Region Sustainable Water Strategy, which considers the needs of other water users such as irrigators and the environment. The UWS takes into account regional river health strategies and works within sustainable diversion limits for water resource development set by the State Government.

This strategy is to be reviewed every five years to take into account changes in consumer demand and water availability. Actions which are due to take place more than five years into the future can therefore be reviewed in light of better knowledge when that update takes place. Revision of the UWS will be particularly important for current areas of uncertainty, such as demand growth and the impact of climate change on available water supplies.

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This strategy was prepared in accordance with the Department of Environment, Land, Water and Planning (DELWP) *Guidelines for the Development of Urban Water Strategies and the Melbourne Water System Strategy* (DELWP, 2017).

1.2 SGW's supply systems

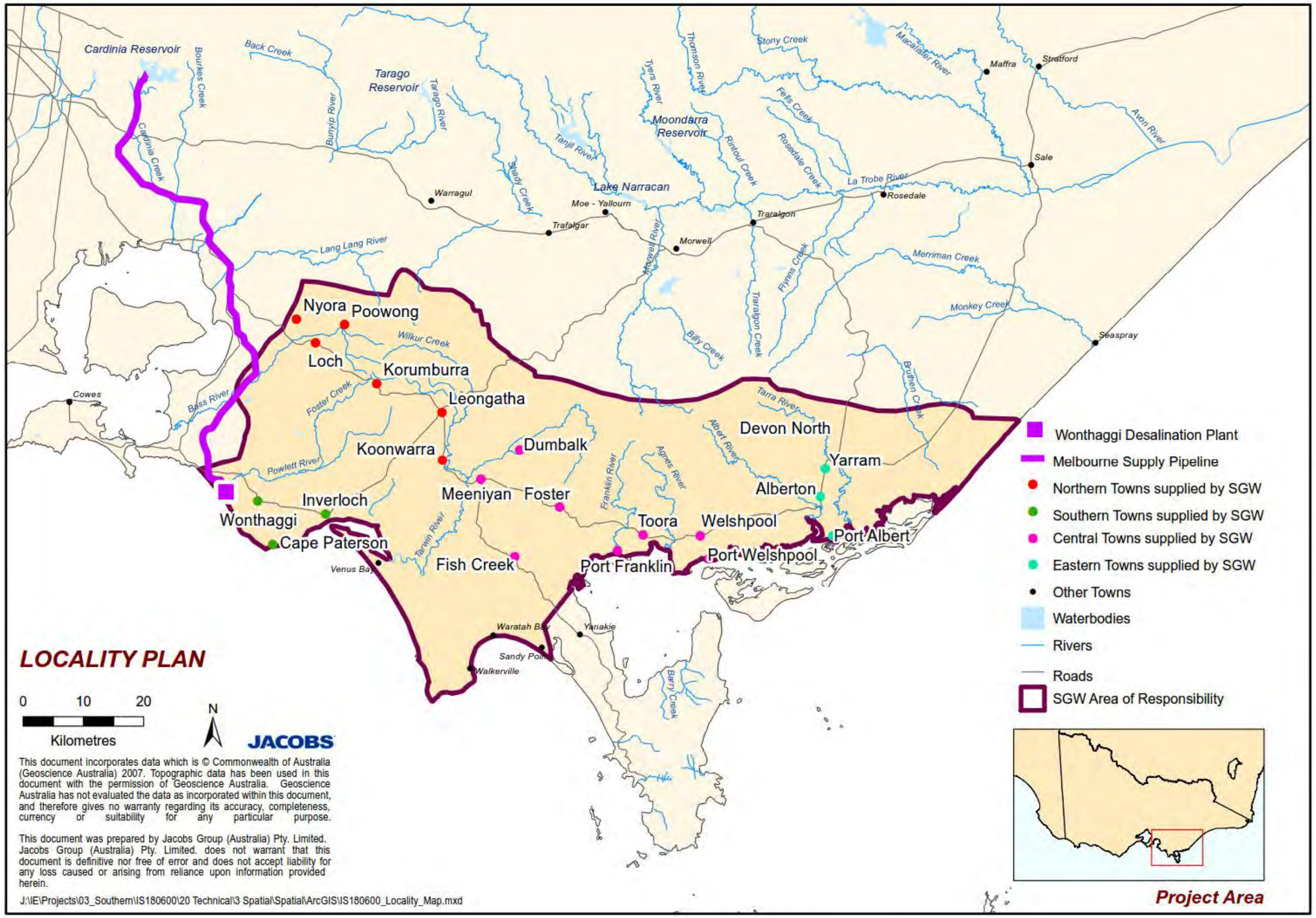
SGW currently manages ten water supply systems to 21 individual towns, listed in Table 1-1. A locality map of the towns supplied by SGW is shown in Figure 1-1.

Current raw water demand is presented to indicate the relative size of each supply system. The towns of Poowong, Loch, Nyora, Korumburra, Leongatha and Koonwarra are referred to collectively as SGW's "northern towns" and Wonthaggi, Cape Paterson and Inverloch are referred to as SGW's "southern towns". Dumbalk, Meeniyan, Foster, Fish Creek, Toora, Welshpool, Port Welshpool, Port Franklin and Barry Beach are referred to as SGW's "central towns", whilst "Yarram, Alberton, Port Albert and Devon North are referred to as SGW's "eastern towns".

n Table 1-1 Water Supply Systems Managed by SGW

Supply System	Towns Supplied	Period of assessment	Current average raw water demand (ML/year) (1)
Northern Towns			
Little Bass River	Poowong, Loch, Nyora	1950-2016	265
Coalition Creek	Korumburra	1950-2016	675
Ruby Creek	Leongatha, Koonwarra	1950-2016	1,639
Southern Towns			
Lance Creek	Wonthaggi, Cape Paterson, Inverloch	1892-2016	1,709
Central Towns			
Tarwin River East Branch	Dumbalk	1950-2016	14
Tarwin River	Meeniyan	1950-2016	66
Deep Creek/Foster Dam	Foster	1963-2016	177
Battery Creek	Fish Creek	1950-2016	124
Agnes River	Toora, Welshpool, Port Welshpool, Port Franklin, Barry Beach Port	1957-2016	518
Eastern Towns			
Tarra River	Yarram, Alberton, Port Albert, Devon North	1960-2016	448
TOTAL			5,635

(1) Estimated at current level of population and industrial development over a long-term climate sequence (typically 40+ years) to account for differences in water demand in wet, average and dry years.



n Figure 1-1 Locality Map

1.3 Previous long-term water supply planning undertaken by SGW

SGW's area of operation includes a number of townships which are rapidly growing. SGW has been actively investigating the future water demand and supply balance in its region over a number of years in order to anticipate and adequately plan for any potential future water supply shortfalls.

SGW examined specific supply augmentation options for those supply systems that did not meet level of service objectives in 2003 (SKM, 2003b). It then prepared a long-term water supply planning strategy for all of its supply systems in 2004, including options to supply unserviced towns (SKM, 2004b). This strategy pre-empted the State Government's call for a WSDS from Victoria's water authorities, which was prepared and released by SGW in 2007 and updated in 2011.

SGW also completed various investigations in parallel with the 2011 WSDS, which in particular include supply enhancement investigations for connecting to the Melbourne supply, financial business case modelling of options, and Bulk Entitlement amendments for some surface water systems.

Since then, the interconnection between the Melbourne system and the Lance Creek system has been constructed. This current UWS takes into account the current interconnection, in additional to potential future expansion of this connected system to support further growth across the SGW system.

1.4 The Melbourne supply connection and SGW's water planning

In 2010, the State Government funded a 7.6 ML/d pipeline to provide a water supply from the Lance Creek water supply system (adjacent to the Powlett River near Wonthaggi) to the desalination construction site. The arrangement also made this pipeline available to SGW following the completion of the construction of the desalination plant.

This pipeline connects the Lance Creek system to the Melbourne supply system. The Lance Creek system has historically provided a very reliable source of water for the towns of Wonthaggi, Cape Paterson and Inverloch. The availability of a connection to the Melbourne supply system provides increased drought security to these towns, as well as the potential to connect other less reliable supply systems and currently unserviced towns. Since the previous WSDS was completed, SGW has approved the extension of the Lance Creek connection to establish a link to Korumburra, Poowong, Loch and Nyora. This connection will commence operation in 2019, with the existing water supply headworks in these systems due to be decommissioned shortly thereafter.

Key to this update of the long-term UWS for South Gippsland is consideration of the opportunity for additional water that the connection of SGW to the Melbourne supply system provides. SGW's Bulk Entitlement conditions have been confirmed since the previous WSDS was prepared, with water entitlements sourced from the Melbourne system (Greater Yarra – Thomson River Pool) rather than the Victorian Desalination Plant. SGW currently holds a Bulk Entitlement for 1 GL from the Melbourne supply system, with the option to purchase an additional 4 GL under an agreement that is valid until 30 June 2024. Modelling undertaken by Melbourne Water as a part of the development of their System Water Strategy (SWS) has projected future water likely to be available to entitlement holders within the Melbourne system. This information has been incorporated into SGW's UWS to better represent our future water availability.

The previous WSDS noted that the connection to the Melbourne system had the potential to provide a significant volume of water that is not dependent upon rainfall. The nature of the connection is now better understood and it is expected that the annual volume available to SGW will still be climate dependent, but due to the extensive storage in the Melbourne system, this climate dependence is significantly buffered. While this connection will help to improve SGW's water supplies in the future, the risks due to climate variability and climate change are not eliminated.

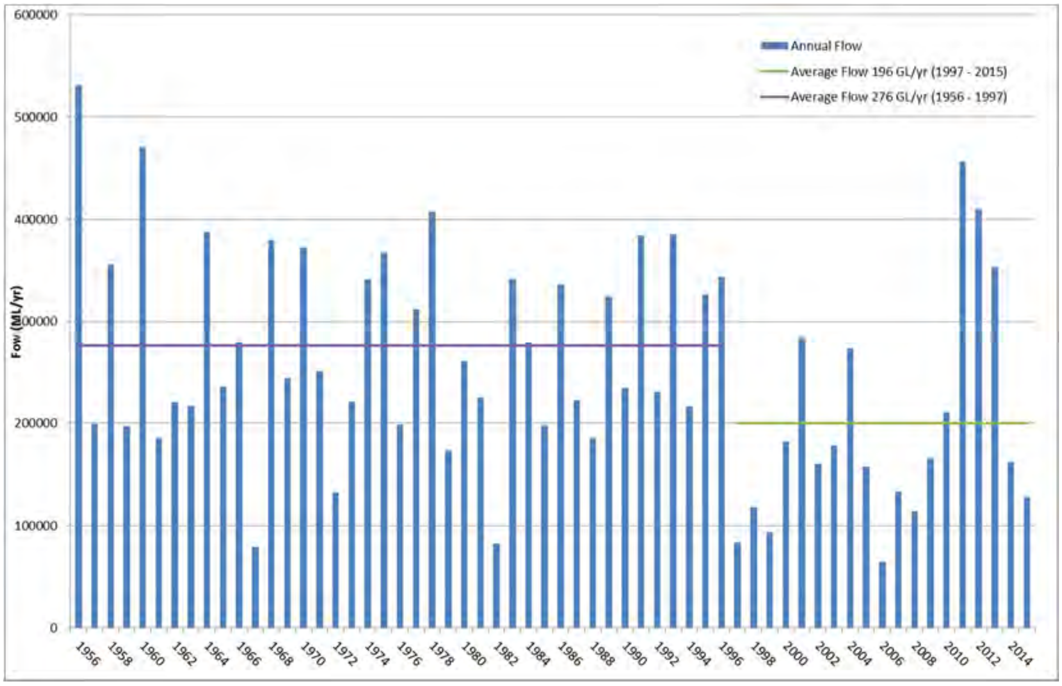
The approach to this planning study has been to consider the most suitable future supply options for SGW's systems. This includes consideration of extending the connection from the Melbourne system to Leongatha. However, SGW must carefully consider any cost implications associated with being connected to the Melbourne supply system and further detailed assessments are required. This UWS presents alternative options for the future augmentation of the Leongatha system to support the decision making process.

1.5 Climate conditions assumed for the UWS

Climate change projections as outlined in DELWP's Guidelines Assessing the Impact of Climate Change on Water Supplies in Victoria (2016a) have been applied for this UWS. The climate change scenarios used are updated compared to those used in the 2011 WSDS, based on the latest global climate modelling. Therefore current and previous results are not directly comparable.

All climate data was adjusted to represent the "current climate" scenario, as required by DELWP (2016a), which recognises that greenhouse gas concentrations, southern hemisphere climate circulation behaviour and associated seasonal rainfall behaviour across Victoria have changed over the last few decades, relative to earlier decades. This scenario is created by adjusting the climate data that is used in SGW's water resource assessments, such that the climate prior to 1975 has the same characteristics as the last few decades from 1975 to date. This creates a long-term climate series that is representative of climate behaviour at current levels of greenhouse gas emissions. This scenario is referred to as the "baseline" scenario. All adjustments for future high, medium and low climate change scenarios, which represent the uncertainty in global climate model behaviour, are then applied to this baseline scenario.

Given the uncertainty in climate change projections from global climate models, a further climate scenario was considered. This scenario, known as the step climate change scenario, conservatively assumes that a step shift in climate may have occurred at the start of the Millennium Drought in 1997. The persistence of seasonal shifts in rainfall across Victoria during and since the end of the Millennium Drought suggests that this climate scenario is possible, however due to the short reference climate period used, it is difficult to assess the extent to which the full range of climate variability is captured by this scenario. As a result, this scenario is primarily used to sensitivity test outcomes under the possibility of a drier climate future in the short- to medium-term. In practical terms, the step climate change scenario assumes that the below average rainfall and streamflow observed since 1997 would persist into the future. This allows a scenario to be modelled that assumes that very recent conditions are the new current climate situation. An example of this observed historical reduction in flow can be seen in Figure 1-2, where the flow at Meeniyan has been observed to reduce by an average of nearly 100 GL/yr after 1997. Note that this figure excludes the relatively wet 2016 winter/spring period after June 2016. It is recognised that the post-1997 period is a relatively short period and is sensitive to fluctuations in climate, for example the high rainfall in winter/spring 2016 which is not included in the modelling period used for this project.



n Figure 1-2 : Tarwin River at Meeniyan Streamflow

As recommended by the DELWP guidelines (2016a), current (or baseline) yield modelling is undertaken for each system, followed by the drier "high" and "step climate change" scenarios. This assesses the vulnerability of the system under drier conditions and therefore represents a more conservative yield estimate for the current infrastructure arrangements. If supply exceeds demand within the planning horizon (until 2065) under these drier climate change scenarios, no further modelling is undertaken.

For those systems where level of service objectives are no longer met at some point within the 50 year planning horizon, then medium and low climate scenarios are also considered. This aims to identify the potential range of timing of actions to address any supply-demand imbalance. For those systems where level of service objectives were projected to no longer be met in the future, supply augmentation options were investigated. The supply system modelling for the augmentation options was completed in a similar manner, using the various climate scenarios specified above.

The UWS has been prepared by considering a range of different climate change scenarios. Feedback from the customer consultation activities has highlighted that local consumers feel that the medium climate change scenario is pragmatic and rational. For systems where actions are required to enhance supplies, the medium climate change scenario is presented as the basis of the UWS. Drier and wetter climate scenarios provide a measure of robustness of these supply enhancement options and indicate a potential range of timing for future implementation of actions.

The medium climate change assumes that there is a 12% reduction in streamflow by 2040 and 17% reduction by 2065 across South Gippsland. In addition, rainfall reduces by between 4% and 5% and evaporation increases by between 4% and 7% for the medium climate change scenario.

1.6 Consultation process for preparing the UWS

SGW established an extensive consultation and engagement programme to support the development of this UWS. The consultation process commenced in July 2016 and has continued to engage with major industrial customers, local customers, landholders and other relevant stakeholders over the duration of the development of this UWS.

The consultation program has included consideration of the requirements of the UWS as specified in the DELWP guidelines (DELWP, 2017) in combination with the Victorian Auditor-General's Office (VAGO) Better Practice Guide for Public Participation in Government Decision-making (VAGO, 2015) and the Essential Services Commission's Performance, Risk, Engagement, Management and Outcomes (PREMO) requirements (ESC, 2016). SGW established a weekly engagement calendar to track planning activities and interactive opportunities. A licenced trainer from the International Association for Public Participation (IAP2) was also engaged to monitor the progress of the engagement activities against the audit checklists associated with the UWS, VAGO and PREMO processes. The outcomes of the review by IAP2 provide an independent check to verify SGW's approach to the engagement process.

Throughout the engagement process, SGW aimed to be open to all feedback. Appropriate levels of rigour were established with the process overseen by the Infrastructure, Service Delivery and Customer Committee and the SGW Board. Outcomes from the consultation process were regularly reported up to the SGW Infrastructure, Service Delivery and Customer Committee. An external Advisory Panel was established and consulted at key times through the process.

1.6.1 Engagement with Customers

A range of formal and informal engagement activities were undertaken to provide consumers with an opportunity to have input into the UWS as well as the Pricing Review being completed by SGW in parallel. A variety of media were used to inform the customer base of the engagement activities, including media releases, regular updates to SGW's website, community updates, and other social media. All information was prepared in plain English form, to ensure information was readily digestible.

This process included:

- Distribution of discussion sheets and surveys to the general public;
- Representative customer surveys undertaken on levels of service by phone;
- Targeted distribution of discussion sheets and consultation with specific community groups and special interest groups;
- Discussion sessions with community groups.

In addition, in-depth phone interviews with community and customer representatives will continue to take place after the completion of the UWS.

Table 1-2 provides a summary of the target audience of the various discussion sheets that were prepared and distributed by SGW, and the level of engagement that was undertaken with each group. The level of engagement was targeted to the audience and the topic matter. Outcomes from this process are summarised in a number of customer insights, as presented in Figure 1-3.

n Table 1-2 : Discussion sheet distribution and consultation

Key Topic Area	IAP2 Level	Advisory Panel		Community Group	Special Interest Group	General Distribution
Water & Wastewater Delivery Reliability	Consult/Involve					
Securing regions water supply	Consult/Involve					
Pricing: Volumetric & Service Charges	Consult/Involve					
Pricing Standpipes/Access Fees/Concessions	Inform/Consult					
Making quality water better	Inform/Consult					
Protecting our natural environment	Inform/Consult					
Customers: Programs to support	Inform/Consult					
Customer Service & Communications	Inform					

Customers support SGW planning for future pressures & threats to the regions water & wastewater services

Customers recognise that climate is changing & want SGW to plan for increased variability in wet & dry – Medium level of climate change models at a minimum

Customers favour supply augmentation where it is economical & complimentary to existing systems

Customers believe water restrictions are inevitable in drought years and the Corporation should not be planning to avoid these.

Customers do not want water restrictions to impact or limit industry or regional growth

Customers favour using price & restrictions to communicate the value of water as a resource

Customers see frequency of faults, not the time taken to fix as most important & support investment into reducing fault #'s

Customers see wastewater as most important in reliability and health amenity stakes. They desire no unplanned interruptions and no impact inside the home

Customers believe education is key to water efficiency & tolerance of system limitations/faults

Customers desire for quality communication relating to faults & interruptions

Customers favour delivering to social obligations and contributing towards customer hardship programs

Customer value investment into protecting the environment

n Figure 1-3 : Customer insights

These insights highlight the issues of greatest importance to SGW's customers and clarify their views on aspects such as:

- Placing a value on water as a resource through the implementation of restrictions and SGW's pricing policy;
- The relevance of restrictions, particularly during drought years;
- Confirmation that the need for restrictions should not prevent growth in the region; and
- Recognition of climate change, with a preference for the medium climate scenario to be used as the basis for planning and decision making.

Forums were held in areas where SGW's level of service objectives are not met. The engagement process provided an opportunity for local customers to:

- Understand the issues most relevant to their region;
- Understand and identify the priorities and trade-offs associated with their water supply;
- Identify options for the future augmentation of the water supply system; and
- Gain awareness of the timing, cost and other advantages and disadvantages of the augmentation options.

These targeted discussion sessions included a range of community representatives drawn from those systems considered to be most at risk. This specifically included the Toora, Fish Creek and Leongatha areas. Table 1-3 provides a summary of the responses from these discussions.

Table 1-3 : Summary of targeted discussions

Discussion topic	Fish Creek	Toora	Leongatha
Appropriate levels of service	SGW's current levels of service objectives remain appropriate in the future.	SGW's current levels of service objectives remain appropriate in the future.	SGW's current levels of service objectives remain appropriate in the future.
Potential need to take action to keep supply and demand in balance	Yes works required in the Fish Creek area. Frequent restrictions should not prevent growth in the area.	Disagree with the "at risk" assumption and general consensus no action needed in the short term	Works could be undertaken once needed
Possible initiatives that might help to address any imbalance between supply and demand	Localised solution preferred, networking systems not supported for this area	Localised solution preferred, networking systems not supported in this areas	Option that provided water security for the long term preferred.
Costs and benefits of taking action	Cost impact to the customer included, low cost localised solution preferred and provision of secure services remains a priority.	Cost impact to the customer included, low cost localised solution preferred and provision of secure services remains a priority.	Provision of a long term solution preferred to short term, lower cost options.

As an ongoing part of the communication process, further information sessions are planned. These will present the SGW Board endorsed Strategy, to the regions key stakeholders and community throughout 2017.

1.6.2 Local Stakeholders

SGW established an Advisory Panel that includes members from across a broad range of business and wider community groups from the area of their operation. To date, the Advisory Panel has met on five occasions to discuss the issues identified through other customer engagement programs that relate to both the preparation of the UWS and SGW's Pricing Review. Specific elements of discussion by the Advisory Panel include:

- Securing the region's water supplies. This discussion included confirmation that SGW's current levels of service objectives remain appropriate in the future.
- Water and wastewater delivery reliability. This discussion clarified to SGW that the frequency, not duration, of service interruptions is most important to customers and that adequate information must be provided to keep users informed of the status. Figure 1-4 quantifies this view, with Advisory Panel members asked to allocate hypothetical investment funding based on their priorities around water and wastewater services.

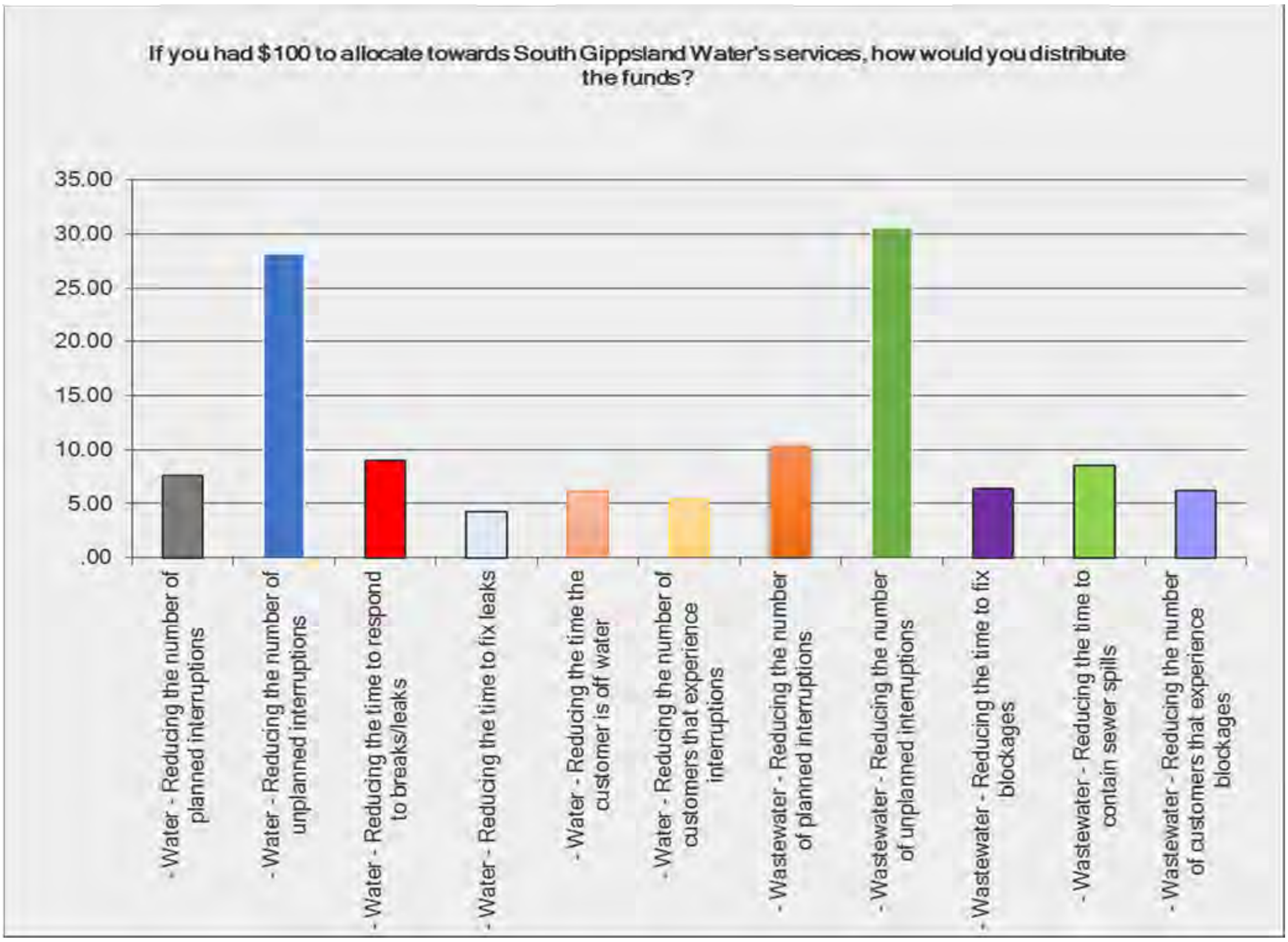


Figure 1-4 : Advisory Panel Investment Priorities

SGW is working with the Advisory Panel to develop statements that reflect customers' service expectations. These statements will incorporate customer preference and priorities, and will be used to:

- Align service priorities to reflect customer views; and
- Measure and report on the performance of customer experiences.

'Word clouds' were used to prompt this discussion, drawing from the content of previous Advisory Panel workshops and customer surveys, as presented in Figure 1-5. The agreed set of statements are yet to be finalised but development activities continue with input from SGW, the Advisory Panel and other forums.

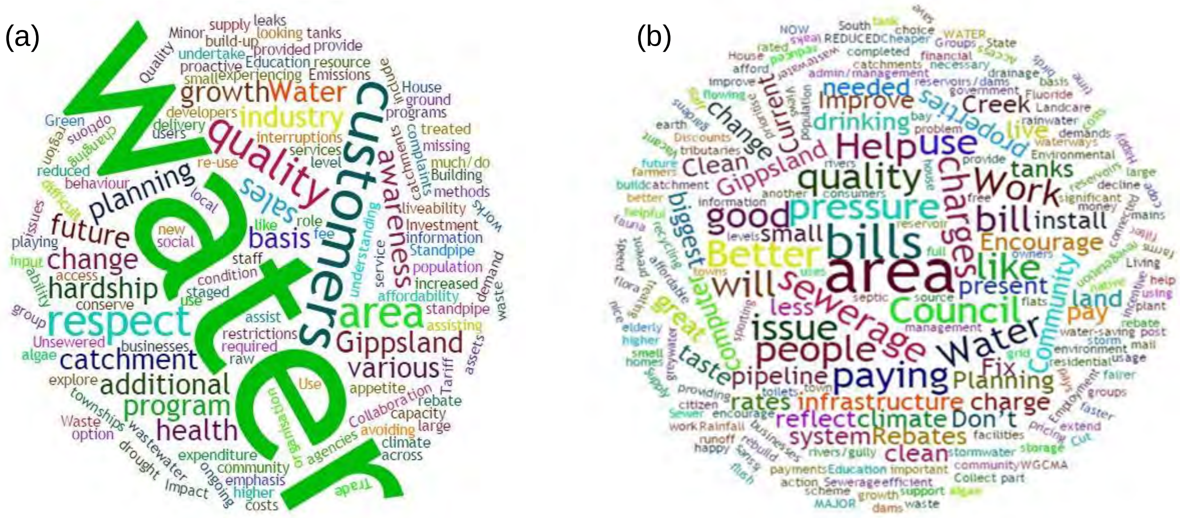


Figure 1-5 : Word Clouds developed from (a) Advisory Panel workshop discussions; and (b) 'Have Your Say' customer survey

Outside of this Advisory Panel, SGW has also engaged with other regional water corporations, Regional Councils, major industry and DELWP to progressively develop the UWS.

SGW established contacts with key stakeholders including Wellington Shire Council, South Gippsland Shire Council and Bass Coast Council. Engagement workshops were held in conjunction with neighbouring Water Corporations who service townships within these regional councils. Some of the key objectives and topics covered during these engagement sessions included;

- Purpose of the strategy;
- Discussion around service levels, community expectations, frequency and level of restrictions;
- Understanding of key green spaces and facilities that are important to maintain community liveability during periods of water shortages;
- Discussion of growth forecasts, commercial and industrial demands and development trends in serviced townships;
- Discussions of the park and garden water requirements, and continued integration of alternate water sources to displace potable needs;
- Discussion on working collaboratively to identify water supply systems that have surplus bulk water supplies and delivery capacities to strategically influence the location of future large customers to areas that have appropriate infrastructure capacity.

In addition to the above, SGW sought information from councils to prepare our Alternate Water Atlas plans. This information included spatial layers of key stormwater and other surface water resources that could be considered as part of the UWS preparation.

SGW completed detailed liaison with our large commercial and industrial customers which included:

- Purpose of the urban water strategy;
- Discussion on growth, supply and demand projections;
- Understanding of their business strategies, growth and demand requirements;
- Discussion on any risk and uncertainty that may impact bulk water supplies.

The outcomes of these discussions have been incorporated into the strategy.

1.6.3 Traditional Owners

SGW acknowledges the Traditional Owners of the land on which we are meeting. We pay our respects to their Elders, past and present, and the Elders from other communities.

A number of Traditional Owner groups are located within the SGW region, including:

- Gunaikurnai Land and Water Aboriginal Corporation (GLaWAC); and
- Gunaikurnai Traditional Owner Land Management Board (GKTOLMB).

As a part of this UWS, we have sought advice from Government representatives closest to the local Aboriginal community on the best approaches to identify opportunities to use water resources to enhance cultural values. This advice recommends that discussions need to be based on a foundation of trust and mutual respect within the community. Rather than rushing this process, SGW is committed to enhancing the relationship with the Aboriginal community and their representative bodies before actively consulting on specific opportunities to enhance or promote cultural values. This includes enhancing the existing relationships SGW has with local Aboriginal community groups.

SGW will continue to look for opportunities to strengthen this relationship with the Aboriginal community. This will include developing a Memorandum of Understanding between members of the Gippsland Water Alliance to work together towards shared objectives and opportunities that meet respective goals. This includes collaboration with the other Gippsland water corporations who have also established relationships with the regional Aboriginal community.

Within the scope of this UWS, the following actions can potentially enhance Aboriginal wellbeing and cultural values:

- Providing high quality potable water and wastewater services as a foundation for the health and wellbeing of the community;
- Providing access to potable water or treated waste water to Aboriginal assets of cultural significance such as wetlands, waterways and dig trees;
- Modifying existing discharge of treated waste water to maximise Aboriginal cultural values;
- One-off access to water for cultural activities and events;
- Public awareness campaigns around historical use of water by Aboriginal groups in the area.

SGW will utilise and build on the relationship developed with the Aboriginal community to pursue options identified in Chapter 6 of the Victorian Government's *Water for Victoria* policy, including:

- Recognising Aboriginal values and objectives of water;
- Including Aboriginal values and traditional ecological knowledge in water planning;

- Supporting Aboriginal access to water for economic development; and
- Building capacity to increase Aboriginal participation in water management.

SGW will pursue ideas to enhance Aboriginal cultural values for water which may include:

- Identification of water assets of cultural value and determine management objectives;
- Identification of options that align with SGW's services including re-use options;
- Determine volumes of water required to achieve management objectives;
- Develop business case for investment in shared outcomes;
- Involving other stakeholders; and
- Implementing the agreed and viable solutions.

1.6.4 Ongoing consultation

One of the outcomes of this UWS is a list of likely augmentation options for systems that don't meet the SGW level of service objective over the 50 year planning horizon. Although some option assessment has been completed, each augmentation will require more detailed feasibility, planning and design before implementation. Further consultation with relevant stakeholders will be necessary during future detailed planning work for each augmentation. In addition to customers and community, this is likely to include relevant Catchment Management Authorities, Southern Rural Water, neighbouring water utilities, Melbourne Water, DELWP and others.

2. Long-term Planning Objectives

2.1 Introduction

This section of the UWS outlines SGW's objectives in undertaking the UWS and the water supply objectives that have been set for customers.

2.2 Planning process objectives

The UWS is a strategy to ensure a reliable supply of water to SGW's customers over the next 50 years. The strategy was prepared within the current guidelines for the UWS as described in the *Guidelines for the Development of Urban Water Strategies and the Melbourne Water System Strategy* (DELWP, 2017). Specifically, this strategy aims to:

- Ensures safe, secure, reliable and affordable water supplies that meet societies long term needs;
- Plan for appropriate use of water resources – including rainwater, stormwater and recycled water and rainfall-independent supplies in ways that are efficient and fit-for-purpose, whilst ensuring that public and environmental health are protected;
- enhances the liveability, productivity, prosperity and environment of our cities and towns;
- ensures that the water needs of environmental assets are transparently considered; and
- provides for a transparent and rigorous decision-making process, with clear roles and responsibilities and accountabilities, which can adapt to the changing environment.

Key aspects of this current UWS are that it considers:

- The total water cycle, including demand reduction and alternative supply options;
- Environmental impacts on and risk to the aquatic ecosystems of waterways, wetlands and aquifers, both now and into the future;
- Population growth drawing upon the Victoria In Future population projections across the region
- The likelihood of economic growth for the region's primary industries including milk processing at Leongatha and Korumburra, and attraction of other food processing industries to the region;
- Land use changes, both gradual and event based; and
- Climate change risk.

The UWS will lead into subsequent feasibility studies, business case analyses and detailed design for proposed demand reduction and supply enhancement options. These will be undertaken prior to seeking Government approvals for the required works. The UWS provides indicative sustainability assessments for proposed demand and supply enhancement options.

2.3 Level of service objectives

SGW's current target level of service objectives for maintaining a reliable supply to customers are specified as follows:

- Any level of water restriction should not occur more frequently than 1 year in 10 (i.e. 10 years in 100)
- More severe restrictions (levels 3 and 4 of four stages) should not occur more frequently than 1 year in 15 (i.e. ~7 years in 100).
- In all droughts, a minimum level of service is provided for unrestrictable in-house and commercial and industrial use. This component of demand is what would be provided to customers under Stage 4 restrictions, as outlined in the Victorian Uniform Water Restriction Guidelines (Victorian Water Industry Association, 2011). In the context this UWS, yield estimates are constrained to avoid running out of water in the most severe drought over the historical climate sequence.

Stages 1 and 2 restrictions tend to restrict the times at which users can use water for certain activities, whereas Stages 3 and 4 restrictions tend to affect the activities that can be undertaken at any time. These level of service objectives for the frequency of restrictions are comparable with other non-metropolitan urban water authorities in Victoria. SGW has already implemented permanent water saving measures in line with the rest of Victoria.

SGW has engaged with their customer base to gauge the public response to restrictions. The outcomes of this discussion confirm that the current level of service objectives are still appropriate across the SGW region. However, SGW will continue to review the target levels of service in the future to reflect changes in customer attitudes and industry initiatives.

2.4 Defining yield

Water supply system yield is the amount of water that can be reliably harvested from a supply system. Yield can be affected by several factors, such as the amount of rainfall in SGW's supply catchments, the mix of water sources in each supply system, the available storage, operational rules that SGW must follow for extracting water and passing environmental flows, and SGW's target reliability for providing supply to customers without restrictions. Yield is defined by the Water Services Association of Australia as "the average annual volume that can be supplied by a water supply system subject to an adopted set of operational rules and a typical demand pattern without violating a given level of service standard" (Erlanger and Neal, 2005). For this Urban Water Strategy, water resource models for each supply system have been used to estimate how much water could be supplied over a long-term climate sequence (typically 40+ years) without experiencing restrictions more frequently than desired, and without running out of water in the most severe drought over that climate sequence. Yield at any point over the planning horizon (for the given climate forecasts) is defined for this strategy as the average annual demand at which the level of service objectives are just met. Using the average annual demand to define yield allows direct comparison with the future demand projections to determine when demand exceeds available yield.

An illustration of an example supply and demand curve over the planning horizon is shown in Figure 2-1. When projected demands exceed the available yield, it does not imply that SGW will no longer be able to supply its customers. For most supply systems it means that the frequency of restrictions would be expected on average over the long-term to be more frequent than desired by SGW's customers. Small deviations below the desired level of service are likely to be imperceptible to customers. For example, it is unlikely that customers would be able to perceive a difference if mild restrictions occurred on average in the long-term 1 year in 9 rather than 1 year in 10. Customers would however be likely to perceive a difference if restrictions were to occur 1 year in 5, which would be roughly double the desired frequency of restrictions.

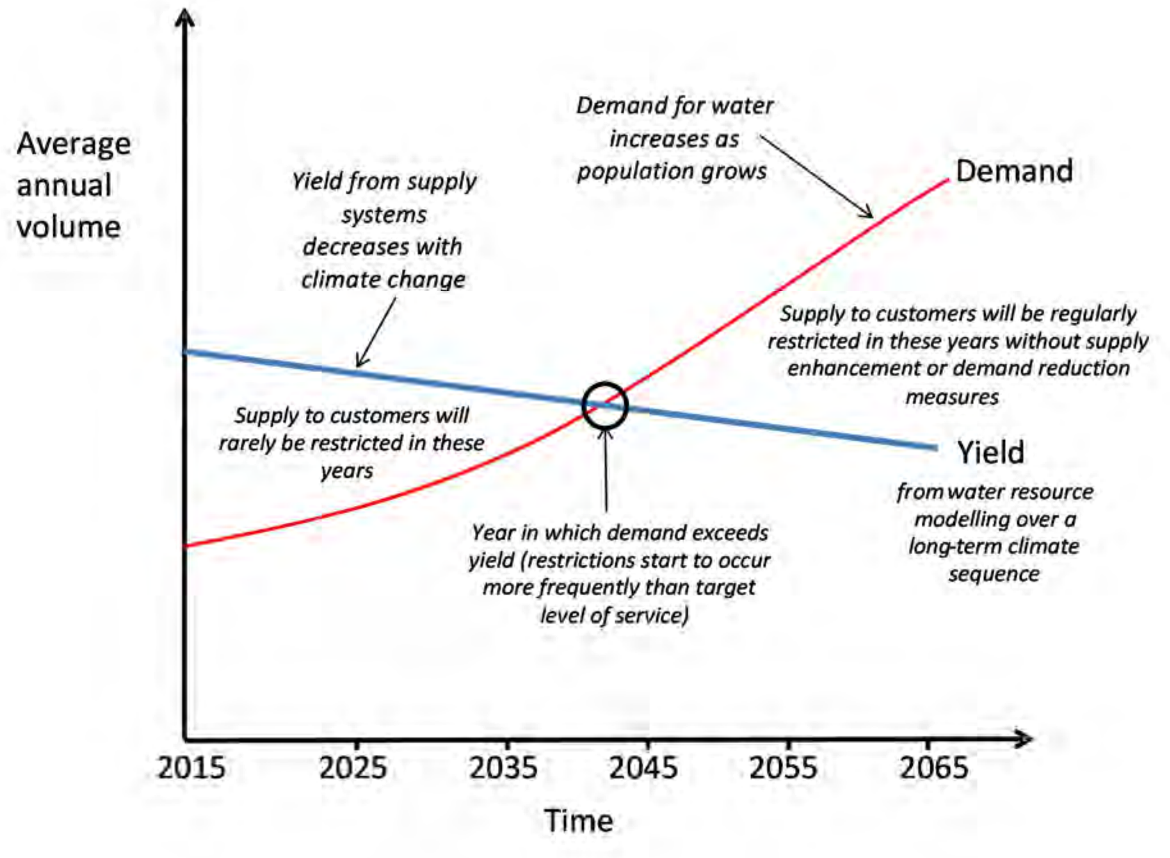


Figure 2-1 Yield and demand over the planning horizon – example only

Where yield is limited by the criterion to not run out of water in the most severe drought, any further increase in demand above this yield is likely to empty bulk water storages in a severe drought and contingency supplies could be required. The possibility of this event occurring in any given year will depend on prevailing climate conditions, but in the long-term will have a low probability of occurrence. For most supply systems a minimum of 40 years of climate data was used in the analysis, which would mean that the likelihood of requiring emergency supply measures is less than 2.5% in any one year. For some supply systems, longer climate sequences were used where available.

Where water is obtained from more than one supply source, the reported yield is for the combined water supply system. Where those two supply sources have a different reliability of supply, the resulting yield will often be greater than the sum of the two individual supply sources, particularly where the timing of supply shortfalls is complementary. Sources of water that are less responsive or unresponsive to climate, such as groundwater and desalination, will therefore often increase supply system yield to an extent greater than the sum of the yield from the individual supply sources.

3. Regulatory Framework Governing Current and Future Water Supply

3.1 Introduction

There are various legislative and regulatory controls when seeking additional sources of water. This section of the UWS discusses each of those controls and how they influence the decisions that SGW can make about its future demand reduction and supply enhancement opportunities. This includes discussion of surface water supply, groundwater supply and desalination.

3.2 Bulk entitlement from rivers

Bulk entitlements define a water corporation's entitlement to take water from water sources such as rivers, reservoirs or other sources of supply. These entitlements are issued to corporations under the *Water Act 1989*. SGW currently holds bulk entitlements totalling 15,643 ML, as shown in Table 3-1. This represents the maximum volume that SGW could harvest from its water sources in any given year, subject to availability. The supply from the Tarwin River West Branch is only available as an interim source of water until 30 June 2020, and the supply from the Powlett River is not operational because it would rely on infrastructure shared with connection to the Melbourne supply system.

Table 3-1 Bulk entitlements held by SGW

Source	Maximum annual volume (ML/yr)	Maximum diversion rate (ML/d)	Minimum passing flows
Little Bass River	420	2.7	Minimum of 0.5 ML/d or natural flow
Coalition Creek storage	1,000	4.8	Minimum of 0.6 ML/d or natural flow
Ness Creek		1.6	Minimum of 0.6 ML/d or natural flow
Bellview Creek		3.0	Minimum of 1.0 ML/d or natural flow
Ruby Creek	2,476	17.3	Minimum of 0.5 ML/d or natural flow
Coalition Creek at Spencers Road	1,800	6.0 (May-Nov)	Minimum passing flow 10 ML/d
Tarwin River West Branch at Koonwarra		5.0 (May and June)* 10.0 (July-Nov)* 5.0 (Dec-Apr)*	Minimum passing flow 60 ML/d or natural Minimum passing flow 100 ML/d or natural Minimum passing flow 20 ML/d or natural
Lance Creek	3,800	35	100 ML/yr when Lance Creek storage greater than 3000 ML at 1st December. No daily minimum passing flow.
Powlett River	1,800	10	As per Table 3-2. Winterfill (May-Nov) diversions only.
Tarwin River at Dumbalk	100	0.72	No minimum passing flows
Tarwin River at Meeniyan	200	1.3	No minimum passing flows
Deep Creek	326	3.5	Minimum of 0.2 ML/d or natural flow
Battery Creek	251	1.0	No minimum passing flows
Agnes River	1,617	4.8	Minimum of 1.0 ML/d or natural flow
Tarra River	853	As per Table 3-3.	As per Table 3-3.
Melbourne (Yarra River – Thomson Pool)	1,000	7.6	No minimum passing flows
TOTAL	15,643		

*Diversion only available until 30 June 2020 as an interim measure

Table 3-2 Powlett River bulk entitlement passing flow requirements

Flow in the Powlett River upstream of offtake, F (ML/d)	Flow available for diversion (ML/d)	Minimum passing flow (ML/d)
> 17	10	F – 10
12 – 17	5	F – 5
≤ 12	0	F

Note: F = flow in the Powlett River upstream of the offtake in ML/d.

Table 3-3 Tarra River bulk entitlement passing flow requirements

Flow in the Tarra River upstream of offtake weir, F (ML/d)	Flow available for diversion (ML/d)	Minimum passing flow (ML/d)
> 12	6	F – 6
6 – 12	0.5 * F	0.5 * F
3 – 6	F – 3	3.0
< 3	0	F

Note: F = flow in the Tarra River upstream of the offtake weir in ML/d.

3.3 Groundwater licences

SGW has groundwater licences for groundwater bores at Leongatha and Yarram. Details of these groundwater licences are listed in Table 3-4. One of the groundwater bores at Leongatha is shared with a local landowner. The period of groundwater pumping at Leongatha is restricted to the periods October to December when storage is less than 75% of capacity, and March to May when total system storage is less than 50% of capacity. In the March to May pumping period the pumping must cease when the storages reach 75% of capacity. SGW has obtained in-principle approval from the licensing authority Southern Rural Water to purchase up to 400 ML/yr of groundwater licences at Yarram for extraction at the SGW bore at a rate of up to 4 ML/d. At present, SGW holds licences at Yarram that total 214.2 ML/year.

Table 3-4 Current groundwater licences

Location	Annual licensed volume (ML/year)	Maximum extraction rate (ML/d)
Leongatha supply system		
Leongatha Bore S9025900/2	310.25	0.85
Leongatha Bore 138891 (shared)	40.0	0.25
Leongatha Bore S9026806/1	91.25	0.25
Leongatha Bore S9029805/2	273.75	0.75
TOTAL Leongatha Bores	386.4*	2.1
Yarram supply system		
Yarram – SGW bore WRK052356/WLE049377	214.2	4

*due to restrictions on the timing of pumping, the maximum annual extraction rate is less than the licensed volume of 715.25 ML/yr

There is also an emergency supply bore at Dumbalk. The unconfirmed yield of 1.5 L/s or 0.13 ML/d is considered insufficient to improve reliability of supply and in 2003 it was recommended that a new deeper bore should be drilled if groundwater was to remain an emergency supply (SKM, 2003a). SGW investigated the local groundwater availability and costs of providing a new deeper bore and concluded that the high estimated cost was not warranted for its low yield and minimal possible future use. The preferred option was to restrict supply during drought and cart water as a short-term emergency supply. Other long term augmentation options for Dumbalk are described in this UWS.

3.4 Future water supply

SGW has a range of potential future water supply sources available to meet increases in demand over the planning horizon. The regulatory framework governing these potential future water supply sources are discussed in turn in the following sections, and include:

- Future water supply from rivers and streams (Section 3.5), which includes a discussion of:
  - River basin caps on diversion;
  - Winter sustainable diversion limits from streams;
  - Streamflow management plans and local management rules for private diversions from streams;
  - Heritage rivers which can prevent some water source developments; and
  - Regional river health strategies, which highlight environmental condition of rivers and priorities for regional environmental management.
- Future groundwater supply (Section 3.6);
- Future supply from the Melbourne supply system (Section 3.7);
- Future supply from stormwater (Section 3.8); and
- Future supply from treated effluent (Section 3.9).

3.5 Future water supply from rivers and streams

3.5.1 River basin caps and Sustainable Diversion Limits

Basin caps limiting total water use in a river basin have been set for all river basins in Victoria. The South Gippsland Basin is one of the few in Victoria that has remaining entitlements available prior to the cap being reached. The current cap is set at the Sustainable Diversion Limit, which is described below and which is not available uniformly throughout the basin. When this cap is reached in particular rivers, this limits SGW's access to new resources, but it also creates a market for water trade which SGW could access to obtain entitlements at the market price.

The State Government has defined sustainable diversion limits for harvesting additional water from streams. Sustainable diversion limits only apply where a Streamflow Management Plan has not previously been prepared. Under sustainable diversion limits, new diversion from a catchment can only occur over winter months (July to October inclusive) and is subject to:

- **A maximum annual diversion** from the catchment – this ensures that the reliability of winterfill supply is at least 80%.
- **A maximum diversion rate** at any given time from the catchment – this is defined as the difference between the median winterfill flow exceeded in 50% and 80% of years, computed over the months July to October.

- **A minimum flow** at which diversions cease - this is defined as the maximum of (i) 30% of the mean daily flow from July to June and (ii) the median daily flow from July to October that is exceeded in 95% of years.

The annual volume available for diversion in the SDL catchment containing each of SGW's existing offtakes is shown in Table 3-5, along with the maximum diversion rate in the catchment and the minimum flow threshold. This table does not include any additional entitlements or licences granted since the SDL database was revised in 2014, this being the latest information available. It can be seen from this table that additional flow could be diverted in all catchments except Lance Creek (Wonthaggi, Cape Paterson and Inverloch supply) and Coalition Creek (part of Korumburra and Leongatha supply). Ruby Creek and Ness Creek are in the same SDL catchment as Coalition Creek. These catchments are already developed beyond their sustainable diversion limit.

The sustainable diversion limit is a precautionary value. The sustainable diversion limit does not necessarily represent an absolute upper limit on development, but rather it can be used as a trigger for undertaking more detailed studies under a streamflow management plan (SKM/CRCFE, 2002) or other environmental flow assessment process. This means that SGW could apply to harvest additional water from these catchments, however the granting of any diversion licences would need to be supported by environmental flow studies that indicate that the ecology of that particular waterway would not be adversely affected by the diversion.

For the overdeveloped catchments, diversion could occur from the adjacent catchments of Wilkur Creek and Tarwin River (for Coalition and Ruby Creeks) or Foster Creek (for Lance Creek). A map of the annual volume available for winter diversion across the region is shown in Figure 3-1, which highlights some of the potential alternative surface water sources for these over-allocated catchments. Greater detail in each supply area is shown in subsequent figures.

In some cases, the SDL catchment is larger than the catchment above SGW's offtake. This means that even if an SDL volume is available, it does not imply that there is sufficient streamflow to harvest this volume at every location within the SDL catchment. Further assessments would be required to confirm that streamflow is physically available for harvesting in catchments where the SDL area is much larger than the area upstream of the town offtake.

It should be noted that the SDL volumes presented in Table 3-5 are based on information from 2014. These SDL volumes are what is currently available at a local scale, and do not take into account any uptake of unallocated water that may have occurred since that time.

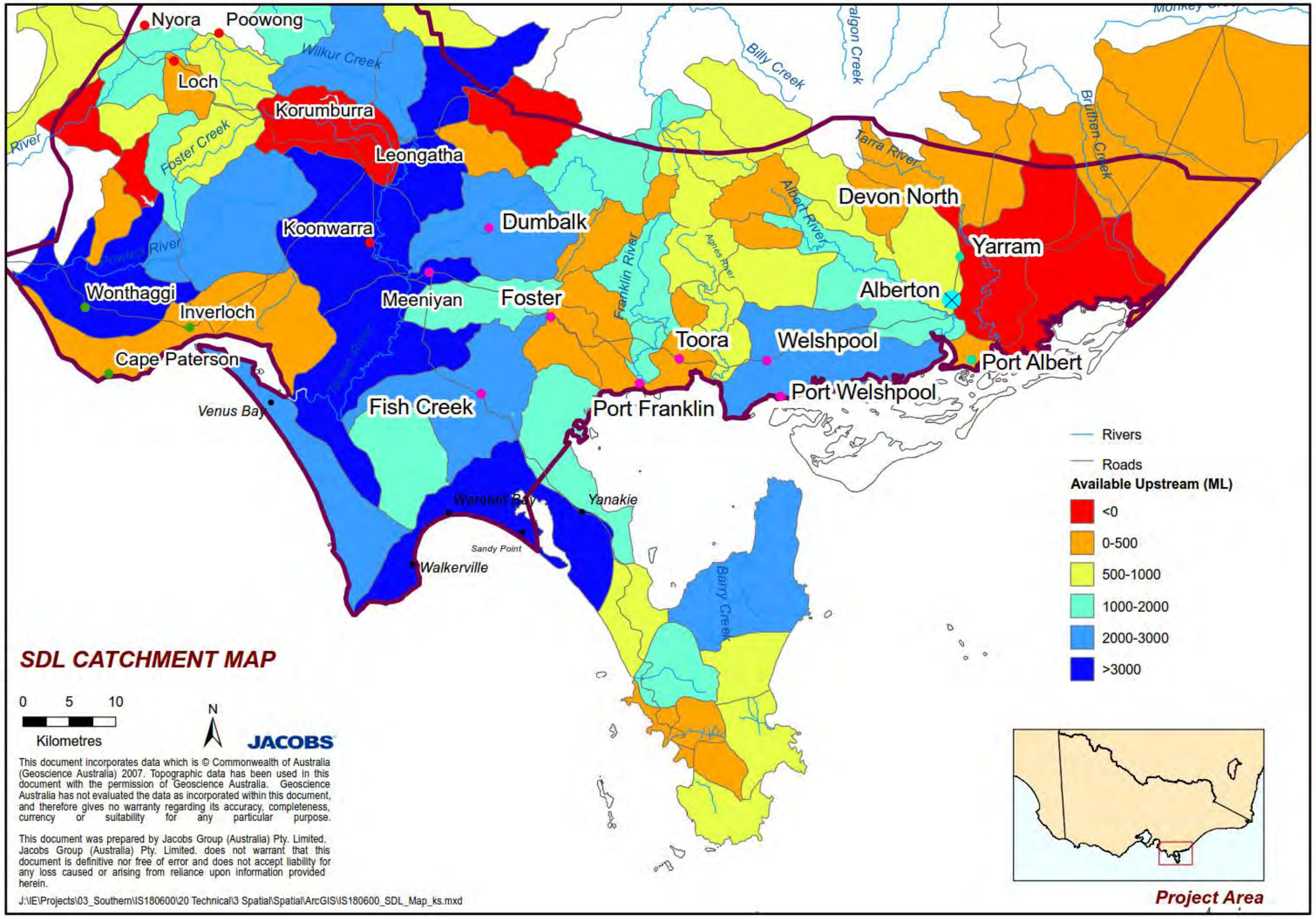
For the catchments where the SDL is currently exceeded, opportunity could also exist to purchase entitlements from other water users within the catchment such as upstream private diverters or catchment farm dams. The previous WSDS noted that this may not necessarily trigger an environmental flow assessment, particularly if entitlements are traded downstream (B.Hansen DSE pers.comm. 8/4/2004), which may allow SGW access additional to water within its existing supply catchments. This requirement has not been reconfirmed for the current UWS.

Table 3-5 Sustainable diversion limits in SDL catchments containing SGW water supply catchments^

Stream	SDL catchment number	SDL catchment area (km²)	Water available for winter diversion at SDL catchment outlet (ML/yr)	Catchment area at SGW offtake (km²)	Water available for winter diversion at SGW offtake (ML/yr)	Maximum diversion rate (ML/d)#	Minimum flow threshold (ML/d)#
Little Bass River	2270001	54	638	7.9	93	19.2	13.2
Bellview Creek				4.14	49		
Ruby Ck	2270208	99	-201	9.0	-18	22.9	19.8
Coalition Creek				0.55	-1		
Ness Ck				1.46	-3		
Lance Creek	2270105	19	-81	18	-77	5.8	4.5
Tarwin R at Dumbalk	2270211	126	1189	126	1189	29.6	29.6
Tarwin R at Meeniyan	2270213	1071	6436	1067	6412	252.6	178.4
Deep Creek	2270303	36	416	36	416	9.6	8.2
Battery Creek (Fish Creek)	2270216	152	868	2.2	13	40.2	29
Agnes River	2270402	67	943	67	943	20.1	24.6
Tarra River	2270604	216	487	31	70	37.1	32.4

This is the volume available at the SDL catchment outlet.

^Does not include any reduction in available water due to uptake of licences and bulk entitlements since the SDL viewer was last revised in 2014



n Figure 3-1 Water available for winter diversion across South Gippsland

3.5.2 Streamflow Management Plans and Local Management Rules

Streamflow management plans (SFMPs) govern water sharing rules at a local catchment scale in rivers with unregulated flows where water use is close to or exceeds water availability. No SFMPs exist across the South Gippsland Region. Some technical background studies on local ecology and water supply reliability were undertaken in anticipation of an SFMP for the Tarra River, but the undertaking of that SFMP has been deferred indefinitely. DELWP's preferred instrument for managing unregulated flows is now the use of local management rules, so SFMPs are unlikely to be prepared in the future.

Local management rules for private diverters are specified in the Agnes River, Albert River, Bruthen Creek, Franklin River, Tarra River and Tarwin River. These rules have been developed by Southern Rural Water and list the streamflow triggers at which private diverters are placed on rostering, restrictions and bans (SRW, 2013).

3.5.3 Heritage Rivers

The purpose of the *Heritage Rivers Act 1992* is to provide protection of public land in particular parts of rivers and river catchment areas in Victoria, which have significant nature conservation, recreation, scenic or cultural heritage attributes. The Act specifies whether impoundments or artificial barriers can be constructed and the degree to which new water diversions are permitted. There are no heritage rivers in South Gippsland and hence the Act will not restrict water resource development in the region.

3.5.4 Regional River Health Strategies

SGW's supply area is covered by two regional river health strategies. The Bass River catchment is covered by the Port Phillip and Westernport Regional River Health Strategy (Melbourne Water and PPWCMA, 2013), whilst the remainder of South Gippsland is covered by the West Gippsland Waterway Strategy (WGCMA, 2014). The condition of streams across the region, as identified from index of stream condition assessments in those river health strategies, ranged considerably as summarised in Table 3-6. Further information on the condition of individual river reaches can be found in the river health strategies and the latest Index of Stream Condition (DEPI, 2010). The reasons for poor river health can include factors not directly influenced by water availability, such as the presence of weeds along river banks. Water availability in Coalition Creek, downstream of Ruby Creek, is considered a significant issue. Further detail on environmental condition of local waterways is presented in the description of each supply system in subsequent chapters of the UWS.

Table 3-6 Stream condition in South Gippsland from DEPI (2010)

River	Condition
Bass River	Poor to moderate
Lance Creek and Powlett River	Poor to moderate
Tarwin River West Branch	Moderate
Tarwin River East Branch	Moderate to good
Coalition Creek (including Ruby Creek)	Moderate
Wilkur Creek	Moderate
Deep Creek	Moderate
Agnes River	Moderate
Tarra River	Moderate to good
Fish Creek (including Battery Creek)	Moderate

3.6 Future groundwater supply

Groundwater Management Areas (GMAs) are discrete areas where the groundwater resources have been (or can be) sufficiently developed to warrant careful management, or there is a risk to the groundwater resource in terms of water availability and/or quality. Groundwater Management Areas have been defined in many areas throughout Victoria due to the high level of groundwater development, or potential for development. GMAs cover both a surface area and an aquifer system, where the aquifer system is defined by a depth interval. For most GMAs, a Permissible Consumptive Volume (PCV) has been defined. The purpose of a PCV is to provide the licensing authority (Southern Rural Water) with a limit on groundwater extraction licences to be issued within a GMA, based on the long term sustainable yield of the aquifer system.

Water Supply Protection Areas (WSPA) are proclaimed under the *Water Act 1989* for the purpose of establishing management plans to ensure both groundwater and surface water resources are managed in an equitable and sustainable manner. This generally occurs when there is a greater degree of concern and/or uncertainty about the sustainability of extractions from the aquifer. Under the Water Act, the Minister would declare a GMA to be a WSPA when necessary, and a Consultative Committee would be formed to manage the WSPA.

A number of the aquifers in South Gippsland are regulated in Groundwater Management Areas (GMAs) shown in Figure 3-2. These include:

- The Leongatha GMA, managed at all depths
- The Yarram WSPA, which includes the management of deep aquifers (>200m)
- The Giffard GMA which includes the management of the confined Boisdale Formation aquifer between 50 and 200m
- The Tarwin GMA that includes the management of unconfined aquifers (0-25m).

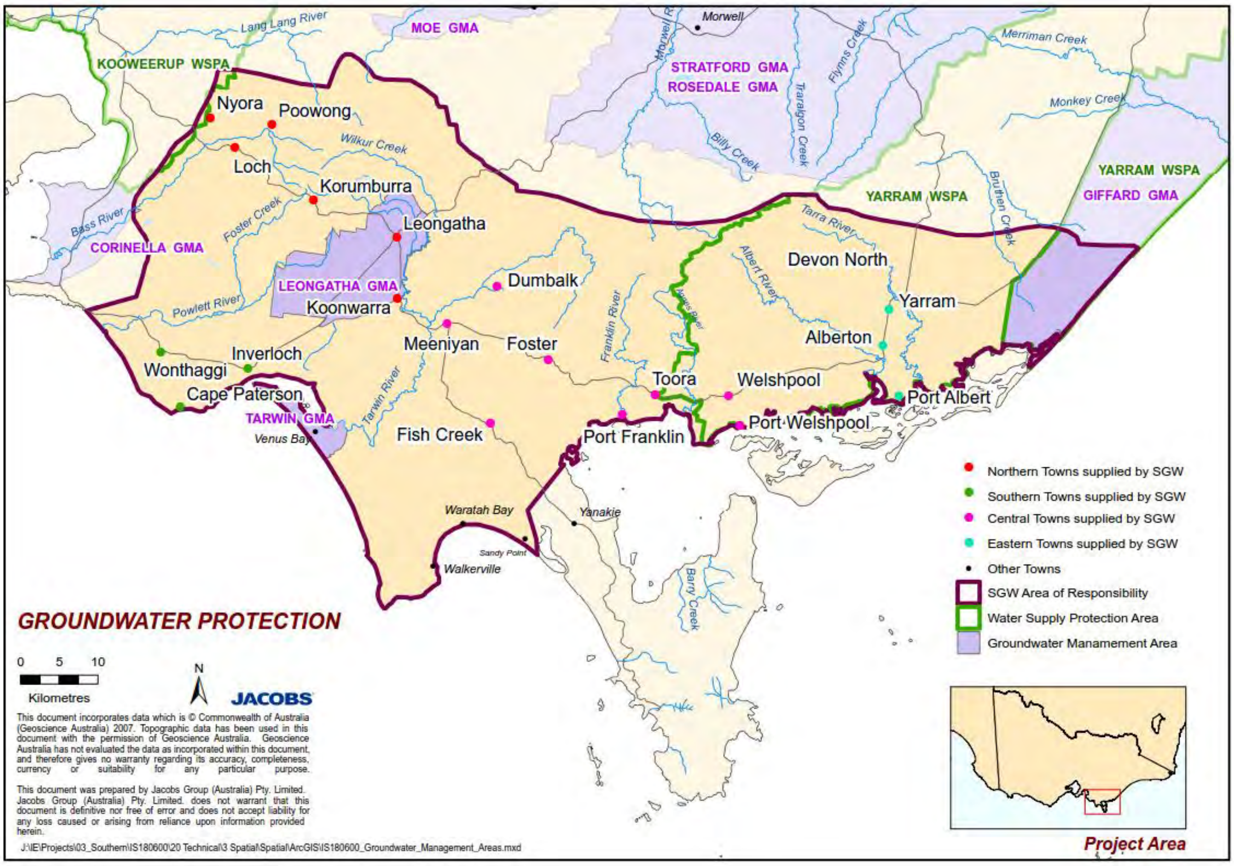


Figure 3-2 Groundwater management areas in South Gippsland

Southern Rural Water, which issues groundwater licences on behalf of the State Government, is not currently allocating new licences where current allocations are more than 70% of the permissible consumptive volume. New licences are not being allocated in the Giffard GMA, which is overallocated, and the Yarram WSPA. Total groundwater extraction is capped in these systems, with licences being able to be secured by transfer. Entitlement uptake is less than the permissible consumptive volume in the Tarwin and Leongatha GMAs and it may be possible to obtain licences for extracting water from these management areas. SGW's groundwater licence granted from the Leongatha GMA in 2010 contained a number of constraints which highlighted the difficulty of obtaining reliable access to additional groundwater from this GMA, such as complex pumping rules and limits. In the Tarwin GMA, there is a risk of saline intrusion and/or contamination by septic tanks due to the concentration of groundwater bores at Venus Bay.

Outside of GMAs and WSPAs, groundwater usage is low as the aquifers are lower yielding and less productive. Licences will generally be granted for new extractions subject to approval from Southern Rural Water.

Technical investigations into groundwater availability, ranging from desktop analyses to drilling investigations, have been undertaken by SGW at Leongatha, Korumburra, Wonthaggi, Poowong/Loch/Nyora, Toora, and Yarram (SKM, 2006 c,d; SKM 2007 d,e). The outcomes resulted in a series of groundwater bores being constructed in Leongatha and at Yarram. It was determined that suitable water was not available at the other locations.

3.7 Bulk entitlement from the Melbourne supply system

SGW's Bulk Entitlement to access water from the Melbourne system was originally established in 2010, however this was refined in 2014 to reflect the disaggregation of Melbourne's joint bulk entitlements into a source (harvesting) and delivery bulk entitlement model. Under this more recent arrangement, SGW has been assigned a delivery bulk entitlement with a quantified volume of water to be supplied from the Greater Yarra System – Thomson River Pool. This enables SGW to individually manage the water resources they hold in the Melbourne headworks system, subject to the rules specified in the Bulk Entitlement.

SGW were originally given the right to purchase up to 5 GL of water from the Melbourne system. To date, only 1 GL has been purchased. SGW retain the right to purchase the remaining 4 GL until 1 July 2024.

The volume that can be taken in any given year is subject to the annual allocation determination made by Melbourne Water. Information obtained for the purposes of this UWS suggests that this volume could be much lower than the bulk entitlement volume, depending upon the climate conditions of the time. SGW is also entitled to carryover any unused water allocation from season to season, subject to available airspace within the Melbourne system. As such, SGW can actively manage their use of this water by considering cost implications, seasonal allocations, carryover and seasonal forecasts.

3.8 Stormwater

Stormwater harvesting involves capturing rainwater from urban areas for storage, treatment and use within those urban areas. Stormwater can provide a valuable water resource in areas where water availability is limited and suitable storage and treatment facilities are available. Stormwater can only be collected from rainfall events, so stormwater must generally be stored after those events for use at times when conditions are dry. Harvested stormwater makes up a small proportion of currently used water resources in Victoria, however it is seen as having the potential to grow as a water resource in the future to alleviate pressure on other traditional sources (DSE, 2010).

More recently, DELWP (2016b) released their Water for Victoria Plan in which they seek to "make better use of alternative, fit-for-purpose supplies, including recycled water and stormwater, to reduce our call on rivers and to protect our environment". Specific plans include the use of stormwater and recycled water to help keep community spaces green, and investigation into the possible use of stormwater to deliver environmental water.

Stormwater harvesting schemes for towns have been most successfully implemented when combined with groundwater storage and/or water treatment through wetlands. The City of Salisbury in South Australia provides an example of such a scheme (City of Salisbury, 2010). It established one of the first stormwater harvesting Aquifer Storage and Recovery schemes in Australia, which involved increasing the amount of recharge to underground aquifers by gravity feeding or pumping stormwater into local aquifers for later extraction (Department of Water, Land and Biodiversity Conservation, 2010).

In a similar scheme, SGW investigated the feasibility of using water stored in the disused coal mines at Wonthaggi to augment long-term water supply to Wonthaggi, Inverloch, Cape Paterson and unserviced coastal towns (SKM, 2006). The mines would be recharged with stormwater. Water quality testing subsequent to the feasibility study found that the salinity of the water from the mines would be too poor to make the project feasible.

More recently, the Casey Clyde Integrated Water Management Project has been implemented in south eastern Melbourne (Westcott et al, 2015). This project is designed to provide sustainable water supplies to 50,000 households in the Casey Clyde area, including stormwater and wastewater harvesting to minimise potable water use and sewerage discharges. The project is considered to be a landmark approach to integrated water management with significant cooperation between Melbourne Water, DELWP, Metropolitan Planning Authority and South East Water. The integrated approach is expected to provide economic and environmental advantages to the community compared to traditional servicing models (South East Water, 2015). SGW will continue to monitor the progress of this nearby scheme during and after implementation to identify any leanings that may be relevant. Early observations highlight that IWCM is often best suited to new, large scale developments. This is evident in the outcomes from the Integrated Water Management Plan prepared by SGW for Poowong, Loch and Nyora (2014). This study identified that there was limited potential to retrofit water sensitive urban design alternatives in these towns. Land constraints and the existing drainage infrastructure restricts opportunities within Loch, whereas reuse schemes could be supplemented in the Poowong and Nyora systems.

The use and required quality of stormwater is not specifically regulated in Victoria however the right to harvest stormwater and to construct stormwater harvesting schemes is subject to some regulation (EPA Victoria, 2010). Although stormwater is an excellent alternative to drinking water in many situations, there are human health and environmental risks that must be managed before it can be used. Depending on the urban area where runoff has been collected, the stormwater may contain contaminants including pathogens, chemicals and litter. Individuals and organisations implementing a stormwater harvesting scheme have a duty of care to manage the risk to people and the environment. The Environment Protection Authority Victoria recommends specific guidelines compiled by CSIRO (CSIRO, 2006). Through Water for Victoria (2016b), DELWP in partnership with the EPA and Department of Health and Human Services will clarify the regulatory arrangements for stormwater use.

In addition to providing a valuable water resource, the collection and treatment of stormwater can reduce the environmental impact on natural waterways by reducing pollutant loads to those natural waterways (DSE, 2010b). Other benefits to urban environments include improved resilience to local flood risk (DELWP, 2016b).

3.9 Reuse of treated effluent

Reuse of treated effluent is governed under the *Environment Protection Act* 1970 with supporting *Guidelines for Environmental Management: Use of Reclaimed Water EPA Publication No. 464.2* prepared in 2003. These documents place limits on the quality of treated effluent required for specific uses. The Gippsland Region Sustainable Water Strategy (DSE, 2010) re-iterated that treated effluent can be used to substitute potable water supplies but is not suitable for use in drinking water supplies. More recently, the Victorian Water Plan confirmed that recycled water may be a reliable source of supply for some farm businesses (DELWP, 2016b).

As noted above, the Victorian Water Plan (DELWP, 2016b) has more recently confirmed the State Government objective to utilise alternate water sources, such as treated wastewater, more effectively to reduce the demand on potable water supplies. The Water for Victoria Plan includes actions to clarify the regulations around the use of recycled water and will work with the Essential Services Commission to consider approaches that could help increase the uptake of recycled water. Other specific plans include the use of recycled water to help keep community spaces green, and investigation into the possible use of recycled water to deliver environmental water

Discharge and reuse volumes from SGW's urban treatment plants and trade waste customers are shown in Table 3-7 and Table 3-8 respectively. The total volume available in 2015/16 was around 2.5 GL (excluding trade waste). This figure varies from year to year with changes in stormwater infiltration to the sewerage network under different climate conditions and changes in water demand. The discharge quality ranges from Class B (suitable for most agricultural and some industrial applications) to Class C (suitable only for a smaller range of agricultural and industrial applications such as livestock grazing and golf courses).

SGW currently utilises approximately 10% of wastewater from the wastewater treatment plants for pasture irrigation and the offset of potable water for recreational grounds in the regional towns. Potential exists for increasing the use of treated wastewater to offset potable mains water supply usage, supply for agricultural use, supplementing streamflow in streams where water is extracted for urban use, and for supply to wetlands. There are a number of studies underway to examine the feasibility of increased reuse of treated wastewater for offset of urban supply.

Table 3-7 Wastewater discharges and reuse by SGW in 2015/16

Wastewater Treatment Plant	Discharge Volume (ML/yr)	Target Discharge Quality	Current Treated Wastewater Use	Reuse plans and constraints
Korumburra	555	Class B	Discharge to Inland Waters.	Reuse water available at treatment plant stand pipe, environmental flow to Powlett River system. Limited occasional reuse at present. Potential for reuse for nearby farmland, however, no reuse infrastructure is set up for transfer and distribution.
Leongatha	524	Class B	Discharge to Inland Waters.	Reuse Water available at treatment plant stand pipe. Limited occasional reuse at present. Potential reuse for Golf Club or pasture irrigation ,however no infrastructure is set up for transfer and distribution. Environmental flow to Little Ruby Creek.
Cape Paterson	69	Class C	Discharge to Ocean Waters	No short term reuse plan due to high cost to provide storage facility and pipeline infrastructure
Inverloch	332	Class C	52 ML/y for pasture and crop irrigation during summer. Remaining volume discharged to ocean waters.	Infrastructure for transfer and distribution is set up for summer irrigation. Winter flow reuse would require winter balancing storage.
Wonthaggi	644	Class C	Discharge to ocean waters	Potential reuse for nearby farmland, however, no reuse infrastructure is set up for transfer and distribution.
Wonthaggi, Cape Paterson and Inverloch			*Potential for wetland use for all 3 systems downstream of the outlet junction point*	
Foster	114	Class C	Discharge to Ocean Waters	Proposed additional treatment with pasture irrigation and possible closure of outfall in the long term subject to feasibility assessment. Scheme currently being developed to use for watering recreational facilities, up to 45 ML/yr.
Toora	20	Class C	5ML used for irrigation and by Toora Football Club during summer	Potential reuse for nearby farmland, however, no reuse infrastructure is set up for transfer and distribution.
Tarraville (Yarram and Port Albert)	140	Class C	140ML/y used for pasture irrigation. No discharge to Tarra River	100% water recycled. Continue pasture irrigation in the future.
Welshpool	38	Class B	Discharge to Land	Infrastructure to transfer for pasture irrigation is set up, however irrigation is limited due to the high salinity of the treated wastewater in this system.
Waratah Bay	6	Class C	6 ML discharge to land	Total reuse on land
Meeniyan	16		16 ML used for irrigation	Total reuse on land
TOTAL	2,458		220 ML reuse	

n Table 3-8 Trade Waste Discharges in South Gippsland in 2015/16

Wastewater Treatment Plant	Discharge Volume (ML/yr)	Target Discharge Quality	Current Treated Wastewater Use	Plan for reuse
Leongatha Trade Waste	976	Class D	Discharged to Venus Bay Ocean outfall	High saline content – non pathogenic, non reusable
Korumburra Trade Waste	87	Partial treatment before discharge to Korumburra WWTP	Discharged to Korumburra WWTP	Included in Korumburra WWTP reuse plan

Proposal – SGW will pursue appropriate economic opportunities for regional and urban demand substitution through wastewater and stormwater reuse in all supply systems and continue developing opportunities for increased agricultural use and agricultural development as they arise.

3.10 Water for Victoria

The Victorian Government released the "Water for Victoria" Plan in 2016 (DELWP, 2016b) to set the long-term direction for managing Victoria's water resources. The plan takes into account the possible impacts of climate change and population growth across the State, to provide direction for a future with less water.

The plan sets out 69 actions under the nine themes of:

- Climate change;
- Waterway and catchment health;
- Water for agriculture;
- Resilient and liveable cities and towns;
- Recognising and managing for Aboriginal values;
- Recognising recreational values;
- Water entitlements and planning;
- Realising the potential of Victoria's water grid and water markets; and
- Jobs, economy and innovation.

These actions are aimed at supporting a healthy environment, prosperous economy with a growing agricultural production and thriving communities.

SGW are supporting of the State Government plan, and a number of the strategies and approaches identified in this UWS are compatible with the Water for Victoria actions, as outlined in Table 3-9.

n Table 3-9 Compatibility with Water for Victoria actions

Water for Victoria Action	SGW UWS commitment
Action 2.1: Achieve net-zero emissions in the water sector	The water supply augmentation options assessment considers carbon emission impacts.
Action 2.3: Lead climate change adaptation across Victoria's water system	The modelling of system yield presented in this UWS has been undertaken in accordance with the Guidelines for Assessing the Impact of Climate Change on Water Supplies in Victoria (DELWP, 2016a).
Action 3.3: Invest in integrated catchment management	SGW has undertaken a number of IWM initiatives as outlined in this UWS and will continue to pursue IWM opportunities in the future.
Action 4.1: Support regional development and change	Work underpinning the UWS has helped identify areas in the SGW region where water resources are available to support regional growth. The work also identifies areas where augmentation of supply to support growth is relatively inexpensive.
Action 5.1: Use diverse water sources to protect public spaces	SGW is supporting a study currently being undertaken by DELWP to build a shared understanding of the cost of water restrictions, to help inform water supply and demand management decisions. SGW also continues to investigate and use alternative water sources, particularly to irrigate community assets such as football ovals and golf courses.
Action 5.2: Better urban water planning to address key challenges	This UWS document incorporates climate and population projections, drought preparedness planning, and has investigate potable and non-potable water sources that may be available.
Action 5.3: Reinvigorate water efficiency programs for Melbourne and regional Victoria	Targets and programs are being developed, agreed and implemented in collaboration with DELWP. This includes the 'Target Your Water Use' program noted in other sections in this document.
Action 5.4: Make the most of our investment in wastewater	This UWS document includes long-term sewerage planning.
Action 5.7: Represent community values and local opportunities in planning	SGW will participate in the regional IWM forum to help identify and implement the use of alternative water resources to support community assets.
Action 5.8: Put integrated water management into practice	SGW will participate in actions with Government, including the development of common economic evaluation frameworks, promoting successful projects to demonstrate IWM, building capacity, supporting local government, and working with industry.
Action 8.7: Commence sustainable water strategy reviews	SGW will actively participate the review of the Gippsland Sustainable Water Strategy.
Action 9.2: Plan for future grid augmentations	SGW has an existing grid connection and is considering future use of grid water to secure water supplies.
Action 9.5: Develop the water market in south central Victoria	Development of the market could be central to SGW's future augmentation plans.

4. Water Demand Projections

4.1 Introduction

SGW is expecting growth in demand for water from:

- Residential population growth and
- Industrial and commercial expansion

Demand growth is also influenced by climate change. This section of the report sets out the background to the demand projections used in the UWS.

4.2 Types of demand

For the purposes of forecasting growth in demand, total demand has been split into various types. Different growth rates are applied separately to each type, and climate change impacts are included where appropriate. All demands include losses downstream of the service basin including water used at the treatment plant and losses in the distribution system. The demand components are:

- Residential/commercial demand – consists of domestic and non-domestic demand, but excludes major industrial customers. It includes some rural tappings.
- Major industrial demand – consists of major industrial customers such as dairy factories and meat processing.
- Supply by agreement and concessions – includes customers such as municipal parks and gardens, and rural tappings supplied by agreement. Concession holders include churches, scout halls, and not for profit groups.
- Environmental demand, which is provided for by SGW in minimum passing flows under bulk entitlements previously described in Section 3.2 and water not diverted or captured by SGW.

Urban demand is assumed to grow in proportion to population also taking into account the impact of climate change on consumption. Growth in major industrial demand is considered on a case by case basis. No growth is assumed for supply by agreement and concession holders.

4.3 Current demand

Current demand for water in SGW's supply systems is summarised in Table 4-1. The figures in this table represent the average annual supply from water sources and include treatment plant and distribution system losses. SGW currently extracts over 5.6 GL/yr of raw water, of which 53% is used to supply residential customers, 35% supplies major industrial/commercial customers, 7% is for stock and domestic customers and 5% is utilised across SGW's water treatment plants.

Table 4-1 Current average demand from supply sources(1)

Supply System	Towns Currently Supplied	Urban residential plus concessional (ML/yr)	Urban non-residential including major industrials (ML/yr)	Stock and domestic (ML/yr)	Treatment plant usage (ML/yr)	Total raw water demand (ML/yr)
Northern Towns						
Little Bass River	Poowong, Loch, Nyora	173	69	13	11	265
Coalition Creek	Korumburra	323	310	8	34	675
Ruby Creek	Leongatha, Koonwarra	554	994	25	66	1,639
Southern Towns						
Lance Creek	Wonthaggi, Cape Paterson, Inverloch	1,212	258	170	69	1,709
Central Towns						
Tarwin River East Branch	Dumbalk	8	1	3	2	14
Tarwin River	Meeniyan	40	4	13	9	66
Deep Creek/Foster Dam	Foster	123	34	9	11	177
Battery Creek	Fish Creek	53	4	49	19	124
Agnes River	Toora, Welshpool, Port Welshpool, Port Franklin	262	193	1	62	518
Eastern Towns						
Tarra River	Yarram, Alberton, Port Albert, Devon North	235	123	72	18	448
TOTAL		**2,984**	**1,990**	**361**	**304**	**5,635**

(1) Estimated at current level of population and industrial development over a long-term climate sequence (typically 40+ years) to account for differences in water demand in wet, average and dry years. The period of assessment is noted in Table 1-1.

Estimates of demand are based on a combination of bulk meter and property meter data, with adjustments made for longer term climate variability.

4.4 Growth in residential demand

Residential demand growth is made up of growth due to population increase and growth due to the impacts of climate change. Growth in residential demand due to population increase is initially based on the *Victoria in Future* population projections, produced by the Victorian State Government (DELWP, 2016c). Information is available for Local Government Areas (LGAs) and Victoria In Future Small Areas (ViFSAs) for the period 2011 to 2031 and for Victoria and major regions for the period 2011 to 2051. This reflects a change to the spatial representation of reporting areas compared to the data applied in the previous WSDS.

LGA and ViFSA population growth data was used to calculate the projected demands in accordance with DELWP guidelines for the UWS. There are five ViFSAs within the area supplied by SGW, as shown in Table 4-2. Each demand centre was assumed to have the same growth rate as the ViFSA in which it is located. The assigning of towns to each LGA was determined using the Australian Bureau of Statistics website (www.ausstats.abs.gov.au).

ViFSA population growth projections are only available to 2031. For the period 2032 to 2051, it was assumed that the population in each of the ViFSAs changed at the same rate as that forecast for regional Victoria. A fixed rate of growth was applied for the period 2052 to 2065, based on the projected rate of change for regional Victoria in 2051.

Table 4-2 Towns Located within Victoria In Future Small Areas

Victoria In Future Small Area	Towns supplied by SGW within ViFSA
Leongatha District	Leongatha, Koonwarra
Promontory District	Toora, Welshpool, Port Welshpool, Port Franklin, Dumbalk, Meeniyan, Fish Creek, Foster
Korumburra District	Korumburra, Poowong, Loch, Nyora
Wonthaggi District	Wonthaggi, Cape Paterson, Inverloch
Yarram District	Yarram, Alberton, Port Albert, Devon North

Figure 4-1 shows the projected growth rates for each of the ViFSAs and regional Victoria. It can be seen that the Promontory and Yarram districts have a projected decline in population. In contrast, the Wonthaggi district is projected to experience growth which is above the regional rate.

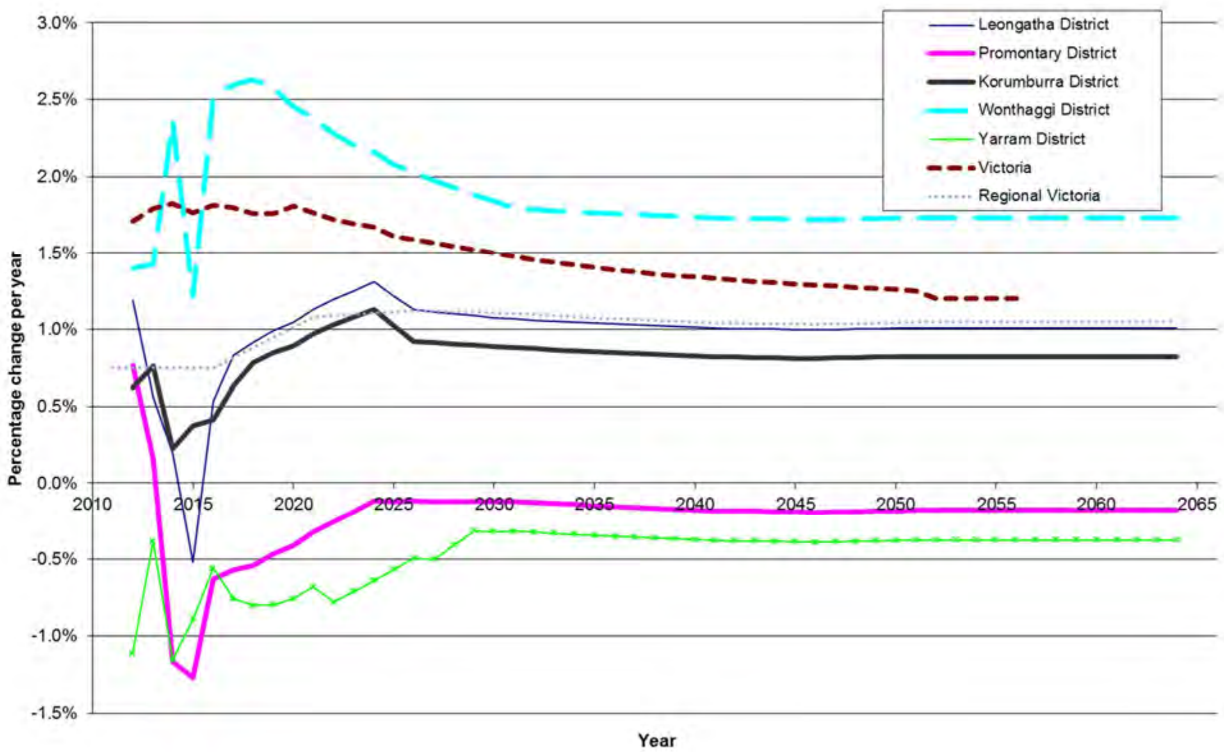


Figure 4-1 – *Victoria in Future* population growth rates for the South Gippsland region

Comparison against previous demand projections, which were based on the 2006 and 2011 census, is included within the discussion of each supply system. *Victoria in Future* growth in household numbers were also considered, however growth in number of households does not cover the full planning period of 50 years.

An alternative population data set has been generated by .id consultants (http://home.id.com.au/). This projection was developed in consultation with regional councils and other stakeholders to provide information on the population to 2036. The .id projections provide data for the South Gippsland Shire and the Bass Coast Shire Local Government Areas. Data for the Yarram LGA is not available through the .id data package. At a town scale, the .id forecasts were found to be substantially higher than the Victoria in Future projections. In addition, the .id data was not always consistent with historical growth rates. As such, the Victoria in Future data was used for this UWS.

Growth in residential demand due to climate change is accounted for by the models used to estimate demands. These are expressed as a function of climate, and for the 2040 and 2065 cases the climate inputs are adjusted by the projected percentage change in climate.

4.5 Growth in major industrial demand

Growth in industrial demand has been considered by coupling the Victoria In Future population growth scenario with SGW's estimate of future industrial demand based on best available information from those industrial water users. Long-term growth in major industrial demand is difficult to predict. Estimates of growth in major industrial demand are generally not forthcoming from major industries because their planning horizons are relatively short compared with the 50 year planning horizon of this Urban Water Strategy. Technological developments also play a major part in the ability of major industrial customers to reduce water consumption, which are difficult to predict as well.

Since the last WSDS was completed, local industrial consumers have progressed their water efficiency projects, with a general trend in reduced demands over the past 10 years. However the expected reduction in demands has not been fully realised. SGW's role in planning for the future needs of the Leongatha water system must consider possible future water requirements of industrial water users. SGW is of the view that there are significant risks that water savings targets may not be met due to unrealised savings and/or increases in production, and the demand scenario applied in this UWS for Leongatha assumes industrial water demands will remain at current levels. The uncertainty surrounding future long-term demand for industrial water use means that SGW will continue to communicate with these significant water users about their ongoing water requirements.

The previous WSDS incorporated a demand for the Barry Beach port development into one of the two demand scenarios considered. This proposal has not been captured in the current demand modelling as there is some uncertainty as to whether it will proceed.

No further growth in major industrial demand is anticipated in the remaining supply systems at the current time. This includes assuming that major industrial demand will not alter due to climate change.

n Table 4-3 Major industrial demand assumptions

Supply system	Major industrial consumption
Northern Towns	
Poowong, Loch, Nyora	69 ML/yr over the planning horizon
Korumburra	310 ML/year over the planning horizon
Leongatha	994 ML/yr over the planning horizon
Southern Towns	
Wonthaggi, Cape Paterson, Inverloch	258 ML/yr over the planning horizon

4.6 Growth in supply by agreement and concessions demand

Growth in supply by agreement and concession holders was assumed to be zero for most supply systems. This was based on identification of the end use of water and discussions with a sample of those water users by Consulting Environmental Engineers, as noted in SGW (2007) and is consistent with the approach used in the previous WSDS.

4.7 Summary of demand projections

The anticipated growth in demand for SGW's supply systems based on *Victoria in Future* (ViF) predicted growth rates for the next 50 years assuming medium climate change is summarised in Table 4-4. Any sensitivity analyses on these growth rates are discussed in the section on each supply system in this report. Total demand for raw water under this *Victoria in Future* scenario would be expected to increase from the current 5.6 GL/yr to around 8.1 GL/yr.

Table 4-4 *Victoria in Future* long-term average annual demands for the year 2065 under medium climate change

Supply System	Towns Currently Supplied	Urban residential plus concessional (ML/yr)	Urban non-residential including major industrials (ML/yr)	Stock and domestic (ML/yr)	Treatment plant utilisation (ML/yr)	Total raw water demand (ML/yr)
Northern Towns						
Little Bass River	Poowong, Loch, Nyora	256	69	13	14	352
Coalition Creek	Korumburra	476	318	8	43	845
Ruby Creek	Leongatha, Koonwarra	933	994	26	84	2,037
Southern Towns						
Lance Creek	Wonthaggi, Cape Paterson, Inverloch	3,007	258	177	154	3,596
Central Towns						
Tarwin River East Branch	Dumbalk	8	1	3	2	14
Tarwin River	Meeniyan	39	4	14	9	66
Deep Creek/Foster Dam	Foster	121	34	10	11	176
Battery Creek	Fish Creek	48	4	53	18	123
Agnes River	Toora, Welshpool, Port Welshpool, Port Franklin	254	196	1	61	512
Eastern Towns						
Tarra River	Yarram, Alberton, Port Albert, Devon North	202	123	76	17	418
TOTAL		**5,344**	**2,001**	**381**	**413**	**8,139**

4.8 Unserviced towns

A number of towns within the SGW region are currently unserviced. At present, the servicing of these towns is not a priority for the customers located in these towns. As such, these demands have not been explicitly incorporated in the demand forecasts for SGW's supply systems. Information on the unserviced towns is limited and previous estimates of demand utilised assumptions based on the number of lots within the towns and an average consumption rate. Based on this approach, the demand for water from unserviced towns was estimated at around 680 ML/yr, as shown in Table 4-5.

These estimates remain unchanged from the previous WSDS (2011). There remains much uncertainty about what future impact the unserviced towns may have on existing supply systems. Innovative approaches to the supply to these communities may result in water requirements being much less than assumed. Conversely, development in some locations, such as Venus Bay, may have caused increases in water consumption compared to previous estimates. No additional information is available to support a more up to date estimate for this UWS. Instead, for the purposes of this UWS, SGW are mindful that customers may seek connection in the future, and the strategies developed for the UWS are compatible with the possible future connection of these towns.

n Table 4-5 Unserviced towns and future potential developments (SGW, 2011)

Town or development	No. of lots	Estimated Current Demand (ML/yr)
Bena	54	19
Tarwin	12	2
Venus Bay - existing	1,436	261
Tarwin Lower	92	17
Harmers Haven	65	12
Walkerville	167	43
Waratah Bay	110	28
Sandy Point	633	162
Yanakie	100	26
Greenmount	35	15
Won Wron	27	12
Woodside	55	24
Woodside Beach	46	20
Robertson's Beach	46	20
Manns Beach	20	5
McLoughlins Beach	50	13
TOTAL	**2,948**	**679**

4.9 Current demand reduction initiatives

SGW continues to promote initiatives that aim to result in per capita demand reduction over time. SGW is part of the Smart Approved WaterMark scheme to help promote water savings and water efficiency. Further information on the scheme is available at www.smartwatermark.org. The site provides resources to encourage water conservation at home, in the garden and within business.

In recent years, water conservation efforts by the water utilities and the Victorian Government have targeted all major aspects of residential water use with an emphasis on education and behaviour change. A number of rebate schemes for water conservation have been in place over the past decade, including the Water Smart Gardens and Homes Rebate Scheme, the Living Victoria Water Rebate Program and Community Rebates. The most noteworthy regulatory changes affecting residential indoor water use have been:

- The introduction of a mandatory water efficiency labelling for appliances (commencing 2006) under the national Water Efficiency Labelling and Standards Scheme (WELS);
- The introduction of rising block tariffs, which result in higher charges for high water users; and
- The Six Star Home standards were introduced in May 2011, and require all new homes in Victoria to have water efficient showerheads, tapware, a pressure reducing valve where mains pressure is over 50 m, and either a solar hot water heater or a rainwater tank connected to the toilet (or equivalent saving through a

dual pipe system). Renovations may also require compliance with the Six Star Standard, depending on the nature of the works.

Outdoor water use has been targeted through the introduction of permanent water saving measures, which include the requirement for a trigger nozzle on hoses, restricted times for garden watering, no hosing of paved areas and notification to be given to SGW when filling a new pool. These Statewide measures are estimated to have resulted in a 2% reduction in total demand (TWGWSA, 2005).

SGW also has an active program promoting water conservation through local measures. This includes:

- Information brochures on water efficient devices such as shower heads, through the savewater! ™ initiative;
- Newsletters to customers accompanying each rate notice;
- Regular press releases;
- Displays and presentations at local community events;
- Schools education program;
- Regular meetings with high water consumption users;
- Grants to community groups for installation of facilities to reduce potable water demand;
- Interest free loans to rural customers for installation of water saving measures to reduce summer demand; and
- Consultation with issues and advisory based community groups.

The impact of SGW's water savings initiatives are evident in the fact that historical water use across the region has declined over the past five years. The previous WSDS (2011) noted a total water use of 6 GL across all of SGW's systems. As noted in Table 4-1, the total raw water demand is now 5.6 GL, despite an increase in the number of connections serviced. It is also clear that demands in a number of SGW's supply systems have decreased significantly since the 2006/07 drought. Some of these shifts are attributable to specific events, such as step changes in major industrial demand, however most are likely to be a result of demand management actions being undertaken by SGW including more permanent shifts in customer water use patterns following in some cases extended restriction periods. The magnitude of these shifts is discussed in the sections of this report dealing with each supply system.

Estimating per capita demands in South Gippsland is problematic because of the difficulty in accurately assessing the population being serviced. The estimate of population from census information is only collected in winter and therefore significantly underestimates peak summer and Easter populations, which swell due to an influx of tourists to the region. The population at Inverloch, for instance, can increase significantly during peak holiday periods. Per capita demand estimates using census population data can result in an overestimate of per capita demand. Estimating a change in per capita demand over time is equally problematic without knowledge of changes in seasonally weighted populations. This is because a change in winter population does not necessarily translate directly into a change in summer population, which is affected by the state of the economy (influencing disposable income and therefore travel decisions), weather conditions and accommodation capacity.

In order to understand local and seasonal water use patterns, meter data was analysed for SGW's connections in Leongatha and Wonthaggi. This specifically considered the water use associated with existing and new (less than 10 years old) residential dwellings between November 2012 and July 2016. This approach was used to test the hypothesis that new dwellings are built with improved water efficiency compared to existing dwellings, with devices such as water saving shower heads, toilets, washing machines and rainwater tanks installed as standard.

Outcomes from this analysis provide an indication of the average water consumption in Wongthaggi and Leongatha, which ranges between 110 – 150 kilolitres per household per year. This converts to average daily per capita consumption rate of 150 – 200 L/person/day, based on the 2011 census population data (noting the caveats above). Per capita residential demand in South Gippsland is relatively low compared to other parts of Victoria because the climate is wetter and because many dwellings are only occupied during the summer months. SGW's average annual household consumption, reported to the Essential Services Commission in 2015-16 (ESC, 2016), was 125 kilolitres per household per year.

The analysis of meter data from Wonthaggi and Leongatha also confirmed that a greater proportion of new properties have a lower consumption rate compared to existing dwellings. On average, new dwellings were found to use approximately 20% less water than existing properties. Given these observations, it was considered a reasonable assumption that similar behaviour would be evident in other towns if data was available for analysis. As such, lower consumption rates were applied across all SGW supply systems for the demand forecasts used in this UWS, assuming that per capita water use rates will reflect the water efficiencies associated with new residential dwellings.

4.10 Future demand reduction initiatives

SGW will actively pursue demand reduction in each supply system. A range of actions by SGW and the State Government will be required to meet these targets. It is anticipated that the majority of these actions would be driven by the State Government and Melbourne's urban water utilities. Specific actions by SGW include the following:

- SGW will continue to work with its major customers to reduce the water use of those major customers. This includes current negotiations to formalise the water required by industrial users to provide certainty to both SGW and customers.
- SGW will continue to keep abreast of technological developments in water saving measures currently being investigated by Melbourne's urban water utilities through SGW's membership of the Victorian Water Industry Association.
- SGW will continue to pursue options for the implementation of other integrated water management initiatives. This includes the continual support of initiatives currently in place plus the establishment of new initiatives where possible.

SGW has been supported by the Victorian State Government's Target Your Water Use program. This water efficiency program includes the Schools Water Efficiency Program and the Community Rebate Program. On 1 December 2016, the Minister for Water officially reactivated the voluntary Target 155 water efficiency program for metropolitan Melbourne and announced a new program, Target Your Water Use, for regional Victoria. Target Your Water Use, like Target 155, focusses on taking a long-term view of our water usage habits while providing locals with east to access information to support informed decisions about the amount of water they use.

The extent to which demand reduction targets are achievable in any given year will be influenced by the age profile of assets, particularly in small supply systems, of which SGW operates several. As assets such as pipelines approach the end of their useful life, they are more likely to leak or burst, increasing water losses. The Battery Creek system is a prime example of this situation where the aging infrastructure is recognised to significantly contribute to water losses. A program of maintenance works is planned to refurbish or replace the aging infrastructure which will help to minimise the losses. In this case, it is anticipated that the water savings will be sizable and may significantly reduce the current supply and demand imbalance. In larger systems such as the Ruby Creek system supplying Leongatha, losses through aging infrastructure will be balanced to a greater extent by having a range of assets of different ages at any given time, meaning that there is unlikely to be a significant demand reduction benefit that can be achieved by ongoing asset renewal works.

4.11 Uncertainties surrounding future demand projections

There are many uncertainties surrounding future demand projections and hence these figures should be regarded as a guide to be reviewed as information is collected for subsequent UWS updates every five years. There are uncertainties in population growth, which is largely affected by local, interstate and international migration, uncertainties in future household sizes, lot sizes and the availability and uptake of water saving technologies. There are also uncertainties related to the magnitude of climate change and the impact this will have on demands.

Changes in social patterns, including smaller families and people living longer mean that the number of persons per household continues to decline. This impacts on water use, because houses with lower occupancy rates use more water per person. For example, in Melbourne a single person house typically uses 240 L/cap/day, a two person house uses around 160 L/cap/day and a three person house uses around 140 L/cap/day SmartWater Fund, 2013). Thus the trend to fewer persons per household translates to an increased demand for water per head of population. Running against this trend is the tendency towards smaller lot sizes and apartment dwellings, which have a much lower outdoor water use than a detached house.

Towns served by SGW have a relatively high proportion of households with a single, elderly person. When these houses are turned over to families of two or more persons, water use per property would be expected to increase.

The estimates of water demand draw upon the most recent census data and the Victoria In Future population projections. This data set provides information at spatial scales that do not fully align with the SGW supply systems. As such, some assumptions have been applied when utilising the data set in order to estimate current and future populations across the regions. The datasets are too broad to provide meaningful information for small towns, particularly the unserviced towns within SGW's area of operation.

There are also many uncertainties surrounding future commercial / industrial demand projections, and for this reason as well it will be necessary to update the UWS at least every 5 years.

Climate change projections for the region and the influence they have on demands has changed since the last WSDS, and are likely to change in future. This also gives cause for 5 yearly updates of the UWS.

5. Sustainability Assessment Method for Demand and Supply Options

5.1 Approach

There are a range of different demand reduction and supply enhancement options that are available for individual supply systems. This section provides an overview of the method used to assess options against a range of economic, environmental and social criteria to enable broad scale comparison between options.

The assessment criteria help to identify critical potential impacts of each option and provide early warning of potential conflicts or opportunities presented by the option. The outputs of this assessment can be used to better inform the decision making process, but it does not provide a definitive answer of which is the best option.

5.2 Assessment criteria and scoring

The assessment criteria and method developed for the Sustainable Water Strategies has been employed in this assessment (Table 5-1). These criteria and scoring systems were developed by the Department of Environmental, Land, Water and Planning (known as Department of Sustainability and Environment at the time) through extensive consultation with water authorities and have been adopted for WaterSmart and the Eastern Water Recycling Proposals as well as the Sustainable Water Strategies. This approach is also consistent with that applied in SGW's previous WSDS.

The sustainability assessments for the demand reduction and supply enhancement strategies shown in subsequent sections of the UWS have been prepared for conceptual assessment only. SGW will be undertaking functional design, environmental analysis and heritage studies to further assess sustainability impacts at the appropriate time to obtain the relevant Government approvals for demand reduction and supply enhancement works.

n Table 5-1 Assessment Criteria

Criteria	Metric
Economic	
Net Present Cost	$/ML
Effect on GDP (local) and development	Estimated effect on local GDP
Environmental	
Greenhouse Gas Emissions	Average kg CO_2 equivalent per ML per year
Impact upon environmental flow objectives	Estimated relative impact
Impact on surface, ground and marine water quality	Estimated relative impact
Impact on terrestrial ecosystems	Estimated loss or gain of significant ecological vegetation classes
Social	
Acceptability	Estimated degree of opposition or acceptance by the local community

All criteria are scored on a scale from -5 to +5, where -5 generally represents a relatively negative impact or cost and +5 generally represents a relatively high degree of benefit. Scores around 0 are generally neutral impacts or mid-range costs.

-5	-4	-3	-2	-1	0	1	2	3	4	5

Details of the scoring system for each indicator are described below.

5.2.1 Net Present Cost

The net present cost is a financial assessment of the option. The values included as part of this assessment have been calculated based on potential volumes of recoverable water together with the estimated capital and operating and maintenance costs over a 50 year period. The figures represent the Net Present Cost (5.2% discount rate) divided by the total volume generated by the option over the 50 year period. The scoring approach is presented below. These categories have been escalated since the 2011 WSDS to reflect 2017 prices.

Score	Descriptor
-5	>$2,000/ML
-4	$1,800-2,000/ML
-3	$1,600-1,800/ML
-2	$1,400-1,600/ML
-1	$1,200-1,400/ML
0	$1,000-1,200/ML
1	$800-1000/ML
2	$600-800/ML
3	$400-600/ML
4	$200-400/ML
5	<$200/ML

5.2.2 Effect on Local Gross Domestic Production (GDP)

GDP, a measure of the total value of produced goods of a region, is considered to be broadly representative of the economic flow-on benefits (such as employment) derived from additional water being made available for a major industry (e.g.: irrigated agriculture). For the purposes of this assessment the direct (or first order) regional economic impacts have been assessed only, that is those felt outside the SGW region are considered to be negligible for each option, hence this criteria has been re-interpreted as effect on Local GDP.

The criteria has been scored according to the anticipated increase or decrease in GDP derived from the allocation of the water to new (not existing) agriculture. Compensating ‘flow-on’ effects to other regions or industries have not been included nor has the indirect benefits and costs passed to society (e.g. existence values relating to environmental quality). In practice, this comes down to whether the option makes new water available for irrigated agriculture within the region (a positive impact) or alternatively, results in less water available for irrigated agriculture. The base case is assumed to be no impact on the status quo (zero). The scoring approach is presented below.

Score	Descriptor
-5	*Extreme* negative impact on local GDP (25% immediate output reduction for major industry)
-4	*Significant* negative impact on local GDP (10% immediate output reduction for major industry)
-3	*Moderate* negative impact on local GDP (25% immediate output reduction for minor industry)
-2	*Small* negative impact on local GDP (10% immediate output reduction for minor industry)
-1	*Marginal* negative impact on local GDP (negative impact to potential growth opportunities to minor or major industry)
0	Insignificant change to net regional output
1	*Marginal* increase in local GDP (positive impact to potential growth opportunities for minor or major Industry)
2	*Small* increase in local GDP and employment (10% Immediate output expansion for minor industry)
3	*Moderate* increase in local GDP and employment. Minor Industry; 25% Immediate output expansion
4	*Significant* increase in local GDP and employment. Major Industry; 10% Immediate output expansion
5	Extreme increase in local GDP and employment. Major Industry; 25% Immediate output expansion

5.2.3 Greenhouse Gas Emissions

This indicator reflects the estimated emissions (kg of CO_2 equivalent) per ML, based on the energy (assumed to be sourced from Victorian Brown coal) consumed in Operations and Maintenance of each option since this is assumed to be the major source of greenhouse gas emissions. It does not include the greenhouse gas emissions incurred in the construction or decommissioning stages of each option. The scoring approach is presented below.

Score	Descriptor
-5	15,000 Kg/CO2e/ML/yr
-4	10,000 - 14,999 Kg/CO2e/ML/yr
-3	5,000 – 9,999 Kg/CO2e/ML/yr
-2	1,500 - 4,999 Kg/CO2e/ML/yr
-1	700 – 1,499 Kg/CO2e/ML/yr
0	580 - 699 Kg/CO2e/ML/yr
1	450 - 579 Kg/CO2e/ML/yr
2	200 - 449 Kg/CO2e/ML/yr
3	0 - 199 Kg/CO2e/ML/yr
4	-10,000 - -1 Kg/CO2e/ML/yr
5	-22,000 – 10,001 Kg/CO2e/ML/yr

5.2.4 Impact upon environmental flow objectives (river health)

Contribution to meeting environmental flow objectives was evaluated using a qualitative assessment (based on specialist advice) of the impact of each option on river health. In assessing the scores for River Health, the first step involved determining the relative importance of flow to the health of the river, and the current health of the river (or catchment). Once this was established, the impact of each option is scored, taking into account the volume and the timing of extractions or additions, and how these influenced the different components of the flow (e.g. base flow, bank full, over bank, freshes and flood events). The scoring approach is presented below.

Score	Descriptor
-5	*Extreme decline* in River Health from reduced flows.
-4	*Significant decline* in River Health from reduced flows.
-3	*Moderate decline* in River Health from reduced flows.
-2	*Small decline* in River Health from reduced flows.
-1	*Marginal decline* in River Health from reduced flows.
0	No change in flows and River Health from current condition.
1	*Marginal improvement* in River Health from improved flows.
2	*Small improvement* in River Health from improved flows.
3	*Moderate improvement* in River Health from improved flows.
4	*Significant improvement* in River Health from improved flows.
5	*Extreme improvement* in River Health from improved flows.

5.2.5 Surface, ground and marine water quality

For surface, ground and marine water quality, each option was assessed on the anticipated impact on the existing beneficial uses of the water resource affected. Where possible, existing data was used to inform the qualitative assessment, but in general this criterion has relied on specialist, general advice. Where appropriate, it also takes into account consideration of the impact of the released water from some of the options on the receiving environment and potential for leakage into groundwater from new irrigated agriculture. The scoring approach is presented below.

Score	Descriptor
-5	Extreme decline in water quality with inability to meet existing beneficial uses all of the time.
-4	Significant decline in water quality with inability to meet existing beneficial uses for most of the time.
-3	Moderate decline in water quality with inability to meet existing beneficial uses some of the time.
-2	Small decline in water quality with inability to meet existing beneficial uses for limited periods.
-1	Marginal decline in water quality but continues to meet existing beneficial uses all of the time.
0	No change in water quality and beneficial uses from current conditions.
1	Marginal improvement in water quality for the existing beneficial uses all of the time.
2	Small improvement in water quality with ability to meet additional beneficial uses for limited periods.
3	Moderate improvement in water quality with ability to meet additional beneficial uses some of the time.
4	Significant improvement in water quality with ability to meet additional beneficial uses most of the time.
5	Extreme improvement in water quality with ability to meet additional beneficial uses all of the time.

5.2.6 Effect on terrestrial ecosystems

The impacts on terrestrial ecosystems have been assessed using a broad level qualitative approach based on general issues associated with each option and mapping using readily available GIS datasets. Ecological Vegetation Classes (EVCs) distinguish vegetation types on the basis of floristic communities, bio-geographic range and habitat requirements. This is a qualitative assessment that does not profess to take into account the precise location of infrastructure options (such as options involving significant pipelines). The scoring approach is presented below.

Score	Descriptor
-5	*Extreme* decline in ecosystem condition as represented by loss of significant EVCs
-4	*Significant decline* in ecosystem condition as represented by loss of significant EVCs
-3	*Moderate decline* in ecosystem condition as represented by loss of significant EVCs
-2	*Small decline* in ecosystem condition as represented by loss of significant EVCs
-1	*Marginal decline* in ecosystem condition as represented by loss of significant EVCs
0	No change from current conditions
1	*Marginal improvement* in ecosystem condition as represented by gain of significant EVCs
2	*Small improvement* in ecosystem condition as represented by gain of significant EVCs
3	*Moderate improvement* in ecosystem condition as represented by gain of significant EVCs
4	*Significant improvement* in ecosystem condition as represented by gain of significant EVCs
5	*Extreme improvement* in ecosystem condition as represented by gain of significant EVCs

5.2.7 Recreation and heritage

The extent of support or opposition to the option as described has been estimated by considering likely changes in recreational use, aboriginal heritage and other cultural heritage.

Score	Descriptor
-5	*Extreme decline* in cultural, heritage or recreational value
-4	*Significant decline* in cultural, heritage or recreational value
-3	*Moderate decline* in cultural, heritage or recreational value
-2	*Small decline* in cultural, heritage or recreational value
-1	*Marginal decline* in cultural, heritage or recreational value
0	No change from current conditions
1	*Marginal improvement decline* in cultural, heritage or recreational value
2	*Small improvement decline* in cultural, heritage or recreational value
3	*Moderate improvement decline* in cultural, heritage or recreational value
4	*Significant improvement decline* in cultural, heritage or recreational value
5	*Extreme improvement* in cultural, heritage or recreational value

5.2.8 Acceptability

The extent of support or opposition, and perceived fairness, of the option as described has been estimated based on our understanding of the community. Where information is directly available from the community consultation sessions, this has been incorporated into the assessment. The measure of this metric will be further tested as the various options continue to be discussed with the community.

Score	Descriptor
-5	*Extreme opposition* by the community
-4	*Significant opposition* by the community
-3	*Moderate opposition* by the community
-2	*Small opposition* by the community
-1	*Marginal opposition* by the community
0	Option is neither supported nor opposed by the community
1	*Marginal support* across the community
2	*Small support* across the community
3	*Moderate support* across the community
4	*Significant support* across the community
5	*Extreme support* across the community

5.2.9 Confidence of Success

Confidence is a measure of the extent of evidence base and reflects the inherent uncertainty in a preliminary assessment. Confidence will vary according to the extent of information available to support the particular option.

Score	Descriptor
1	*Low confidence*: Lack of understanding of risks that may impact on volumes being realised over the long term. Limited evidence in support.
2	*Medium confidence:* Reasonable understanding of risks that may impact on volumes being realised over the long term. Reasonable evidence in support.
3	*High confidence:* Wide agreement, multiple findings supported by research, high degree of consensus, considerable evidence. Considerable evidence in support.

6. Overall Approach to Assessing Demand Reduction and Supply Enhancement Options

The previous sections of this document present background information on the long-term planning objectives (Section 2), the regulatory framework within which the supply systems are managed and planned for (Section 3), current and projected demands over the 50 year planning horizon (Section 4), and a description of the assessment method used to compare the sustainability of alternative demand reduction and supply enhancement options (Section 0). The following sections of this document present, for each supply system:

- The supply and demand projections for each supply system over the planning horizon;
- Whether level of service objectives are currently being met and whether they will continue to be met over the 50 year planning horizon with current operation and infrastructure; and
- Actions proposed by SGW to reduce demand and/or increase supply to continue to meet level of service objectives over the 50 year planning horizon, if required.

For a number of supply systems, current water availability is sufficient to meet projected demands over the next 50 years and no further actions are required, other than to continue demand management activities in line with other supply systems and to continue to manage operations efficiently and effectively.

For the supply systems where level of service objectives are unlikely to be met over the planning horizon with current operation and infrastructure, a range of options have been considered. In addition to these systems, SGW are aware of other issues such as water quality, asset age and asset condition that may influence reliability of supply in their systems, or provide opportunities for cost savings in works to concurrently improve water availability. Asset replacement/renewal works are known to be required for a number of systems, irrespective of the consideration of the long-term supply and demand balance. A consultative approach was used to identify a long list of possible options for each of the systems where water availability improvements are relevant. A preliminary assessment was made to synthesise the long list of options to a short list of viable alternatives. The outcomes from this preliminary assessment are presented in Appendix A. Only the shortlisted options from this process have been carried forward into this UWS.

The towns of Poowong, Loch, Nyora, Korumburra, Leongatha and Koonwarra are referred to collectively as SGW's "northern towns", whilst Wonthaggi, Cape Paterson and Inverloch are referred to as SGW's "southern towns". SGW has already established an interconnection to the southern towns for partial supply from the Melbourne system via the Lance Creek system, and will extend this connection to Korumburra, Poowong, Loch and Nyora in 2019. There is also the possibility to expand this interconnected supply system to Leongatha during the UWS planning horizon. Given the possibility of this supply system integration, the supply and demand projections for each individual supply system are presented first under current operation and infrastructure arrangements in Sections 7 through to 11. A collective strategy for these northern and southern towns is then presented in Section 12.

For the central towns, there is the potential to collectively supply Toora, Foster and Fish Creek. While the supply systems for Meeniyan and Dumbalk fall within the "central towns" region, these systems are not proposed for connection to the other central towns. In fact, it is more relevant to merge these supply systems with potential connection to Leongatha. This decision is driven by an attempt to minimise water treatment and supply costs and the potential strategic benefit for SGW and the region that could be gained by ceasing the use of the Tarwin River catchment for potable water supply. The supply and demand projections for each individual system in the central towns region are presented first under current operation and infrastructure arrangements in Sections 13 through to 17. A collective strategy for these towns is then presented in Section 13.

For the eastern towns of Yarram, Port Albert, Alberton and Devon North, which form the Tarra River supply system, the supply and demand projections under current operation and infrastructure are presented alongside the demand reduction and supply enhancement options in Section 19.

There are a number of unserviced towns within the SGW area of operation. These have not been assessed with the same level of detail as the serviced towns, since the servicing of these towns is not a priority for the local customers. Section 20 provides a summary of the strategy for these currently unserviced towns.

7. Environmental Condition

The environmental condition for the catchments within SGW's water supply systems is presented below.

7.1 Little Bass

Little Bass River is a tributary of the Bass River and flows into the Bass River south of Poowong. At Poowong the Little Bass River flows through steep and undulating cleared farmland, increases in width to about 4m downstream of Poowong with pools up to 110cm deep and riffles to 20cm deep (DPI, 2007). The river is in a stable condition with good riparian vegetation. The Little Bass River has rubble, gravel and sand substrate with areas of debris and excellent fish habitat (DPI, 2007). The river contains some brown trout (*Salmo trutta*) and short-finned eels (*Anguilla australis*) and also possibly other species that also occur in the Bass River. There are no Index of Stream Condition (ISC) sites on the Little Bass River and other information about the stream is limited.

It is difficult to assess the impact of changes in flow on the condition of the Little Bass River as detailed data on the flora and fauna is limited. However, the main risks would be from actions that reduced summer flows. Reduced summer flows could result in shallower pools with degraded water quality and reduced available habitat for fish and other aquatic fauna. In addition riffles may dry up reducing connectivity between pools along the river.

Lloyd Environmental et al. (2008) provided flow recommendations for the Little Bass River. The study reported that short periods of cease to flow provide conditions suitable for germination and growth of the herbs and sedges which run between natural pools. Summer low flows are required to maintain perennial habitat for semi-emergent aquatic vegetation, fringing emergent vegetation, fish and macroinvertebrate communities. A spring-summer recession flow was recommended to ensure successful recruitment of flat-headed gudgeon, river blackfish and to facilitate the parallel expansion of the macroinvertebrate population. Two low flow freshes per year were considered to allow local fish passage as well as supporting a range of other objectives, whilst less frequent low flow freshes of a higher volume were associated with short-finned eel migrations. Winter baseflows were associated with maintaining aquatic plants, whilst high flow freshes contributed to maintaining shrubland vegetation and promoting fish spawning. Bankfull flows were important for maintaining sediment transport to downstream reaches, whilst overbank flows at this location were not linked to any particular ecological objective and were considered insufficient to dislodge the build up of macrophytes in this reach.

7.2 Coalition Creek, Ness Creek and Bellview Creek

Three creeks form the primary supply to Korumburra, namely Coalition Creek, Ness Creek and Bellview Creek. Coalition Creek is a tributary of the Tarwin River West Branch and is joined by Ruby Creek (supplying Leongatha) just before its confluence with the Tarwin River West Branch. Information about the environmental condition of Coalition Creek was assessed for SGW in SKM (2006a) *Coalition Creek Preliminarily Environment Assessment*. The key outcomes of that assessment of relevance to the UWS are:

- The creek flows through a predominantly rural setting through land that has been cleared for dairy farming.
- Many sections of the creek are infested with willows and other weeds, however some willow removal has occurred and revegetation at these sites is now starting to provide shade to the creek.
- Willow removal and subsequent revegetation is planned for a number of locations along the creek, which will require available water to assist in maintaining seedlings during the summer months.
- Pockets of remnant native vegetation require streamflows to be maintained to ensure maintenance of existing mature trees and to promote establishment of seedlings.

- The creek ceases to flow in summer, but in some areas there are permanent water pools which are an important summer refuge for aquatic fauna. Any premature drying of the pools due to changes in summer flow regime could impact on ability of small bodied fish to avoid larger predatory species.
- Water quality in the creek is generally poor and the benefit of permanent water pools for summer refuge may be reduced by poor water quality.
- In a previous fish survey, no native fish species were found in the creek. Access to Coalition Creek by many of the native migratory fish in the Tarwin River catchment would be limited by flow regime and existing fish barriers.

Ness Creek is a major tributary of Coalition Creek and the health of Coalition Creek largely reflects the health of Ness Creek. There are no Index of Stream Condition sites or water quality data on Ness Creek and available information is limited. It is difficult to assess the impact of changes in flow on the condition of Ness Creek, however the main risks to the aquatic fauna and flora are probably degradation of water quality, reduction of available habitat for aquatic fauna, and impacts that may affect the riparian vegetation.

The above assessment was confirmed in the environmental flow assessment for Coalition Creek in SKM (2009). The environmental flow assessment linked the provision of low flows to maintaining connectivity between pools, maintaining water quality in pools and to provide moisture for riparian and fringing plants. Summer freshes were important for preventing colonization of riparian areas by terrestrial plants, to entrain organic matter and transport nutrients downstream. Winter low flows were designed to maintain habitat and prevent colonisation of weeds, while high flow freshes were intended to maintain channel forming processes and to facilitate the upstream migration of Tupong and juvenile fish species. Bankfull flows were recommended to maintain channel forming processes and no overbank flows were specifically recommended.

Bellview Creek is a tributary of the Bass River. The conditions in the Little Bass River previously presented in the environmental description of that river for the Poowong, Loch and Nyora supply would be similar to Bellview Creek.

Information about the environmental condition of Tarwin River West Branch and the Tarwin River downstream of the confluence of the East and West Branches was assessed for SGW in SKM (2006b) *Tarwin River Preliminarily Environment Assessment*. The main relevant outcomes of that assessment are discussed below.

Around 30 fish species have been recorded in the Tarwin River downstream of its confluence with the West Branch. One fish species (Australian grayling, *Prototroctes maraena*) recorded in the study area is listed nationally as vulnerable under the Environment Protection Biodiversity Conservation Act 1999 (National) and as threatened in Victoria under the Flora and Fauna Guarantee Act 1988 and one species (Australia whitebait, *Hyperlophus vittatus)* is listed as threatened in Victoria under the FFG Act 1988. The list of species found also included the two exotic species of carp and brown trout.

Work by DELWP has recorded substantial populations of Australian grayling in the Tarwin River immediately below the weir at Meeniyan. Consequently, both branches of the Tarwin River have been identified as having significance for populations of Australian grayling (Justin O'Connor, pers. com. DELWP, Freshwater Ecology). Australian grayling spawn from about April through to July. At the time of spawning the juveniles move downstream and then move back upstream in October to November. It is believed Australian grayling need an increase in river flow to induce spawning (Justin O'Connor, pers. com.). Installation of a fish ladder at the weir at Meeniyan was identified as a priority by DELWP (Justin O'Connor, pers. comm.) and has now been installed.

Water quality was found to be poor at the site on the West Branch of the Tarwin River near Koonwarra and was above the State Environment Protection Policy guideline values.

This assessment was confirmed in the environmental flow assessment for the Tarwin River West Branch in SKM (2009), consistent with that noted for Coalition Creek above.

7.3 Ruby Creek

Ruby Creek is a tributary of the lower Coalition Creek and the Tarwin River West Branch. Information about the environmental condition of Ruby Creek is limited, however many of the assessments and conclusions drawn about Coalition Creek and below about Wilkur Creek are likely to be broadly representative of those expected for Ruby Creek. The main difference between Ruby Creek and these neighbouring streams is the presence of Leongatha's four water supply storages, which act as a fish barrier and significantly reduce streamflows in the creek from natural flow conditions. Passing flow downstream of the reservoirs is 0.5 ML/d or natural flow, whichever is higher. The presence of these reservoirs inhibits the ability to achieve ecological improvements in Ruby Creek and lower Coalition Creek.

Information about the environmental condition of Tarwin River West Branch was assessed for SGW in SKM (2006b) *Tarwin River Preliminarily Environment Assessment.* The main relevant outcomes were previously presented in the discussion of the ecological condition of water sources for Korumburra, in the section immediately above.

7.4 Lance Creek

Lance Creek is a tributary of the Powlett River. It is a small (1-4m wide) creek with high steep banks. Downstream of the Lance Creek Reservoir it is deeply entrenched in flat farmland, with riparian vegetation of swamp paperbark, blackberry and wattles (DPI, 2007). The creek has riffles up to 20cm deep, and small pools up to 70 cm deep. There is good habitat for small native fish but no information is available on fish species present (DPI, 2007). There are no Index of Stream Condition sites located on the creek. It is difficult to assess the impact of a change in flow on the condition of Lance Creek as detailed data on the flora and fauna is limited. However, the main risks to the aquatic fauna and flora in Lance Creek are probably from reduced flows during summer that may result in degradation of water quality and loss of connectivity between pools.

Two Index of Stream Condition (ISC) sites on the Powlett River were assessed in 2010. The site below Foster Creek was given a rating of poor. Water quality data recorded in the Powlett River downstream of Foster Creek (gauge# 227236) indicated that water quality in the river is poor.

An environmental flow assessment of the Powlett River downstream of SGW's offtake near Wonthaggi was undertaken in Alluvium (2008). The environmental flow assessment linked the provision of low flows to maintaining habitat in pools for eels, galaxias, tupong, gudgeon and pygmy perch, as well as providing refuge from trout for small fish, preventing water quality decline, providing fish migration and maintaining clonal spread of swamp paperbark. Summer freshes were important for maintaining water quality, species migration, sediment transport, nutrient entrainment, sexual recruitment of swamp paperbark and to facilitate colonization of rushes and reeds. High flow freshes were and bankfull flows were considered to provide similar benefits to low flow freshes, but also promote fish migration and trigger spawning. No overbank flows were recommended due to the absence of identifiable ecological values on the floodplain.

No environmental flow recommendations were set for the Powlett River estuary in Alluvium (2008), however the report emphasised the importance of flow events to maintain estuary processes, such as keeping the estuary mouth open and periodically inundating salt marsh communities with fresh water.

7.5 Dumbalk

Dumbalk is located on the Tarwin River East Branch. Dumbalk currently extracts a negligible proportion of the available flow in the Tarwin River, even during low flow conditions, and therefore has little influence on environmental condition. The Tarwin River East Branch flows from the Strzelecki Ranges in the north and east, flowing downstream to join the West Branch at Meeniyan. The river then flows into Andersons Inlet at Tarwin Lower. There are a few small undefined tributaries and drainage lines from low lying swamps that enter the river in the reaches below Meeniyan. The main tributary is Fish Creek which flows into the Tarwin River from the east a few kilometres upstream of Tarwin Lower.

Information about the environmental condition of Tarwin River West Branch and the Tarwin River downstream of the confluence of the East and West Branches was assessed for SGW in SKM (2006b) *Tarwin River Preliminarily Environment Assessment*. The outcomes of that assessment, has been documented in the section on the Korumburra systems. This includes descriptions of the local fish species.

Clearing for agriculture and willow plantings have impacted on the structure and condition of riparian vegetation along the Tarwin River East Branch. In general, ISC assessments record the streamside zone and physical form of the river as moderate. Tarwin River East Branch has a degraded riparian zone with little native vegetation. There are some bank instabilities that extend to the toe of the bank. The catchment is moderately flow stressed with greater stress in summer than in winter. Aquatic life ratings were excellent. In the basin downstream, artificial barriers are likely to affect migration of fish species. The degraded condition of the instream habitat and the riparian zone in the mid and lower parts of the catchment must be seen as a significant threat to the native fish community within the Tarwin River.

The above assessments were confirmed in the environmental flow assessment for the Tarwin River East Branch in SKM (2009), consistent with the comments noted above for Coalition Creek.

7.6 Meeniyan

Meeniyan is located on the Tarwin River just below the confluence of the East and West Branches. Meeniyan currently extracts a negligible proportion of the available flow in the Tarwin River, even during low flow conditions and therefore has little influence on flow volumes in the river. The Tarwin River flows from the Strzelecki Ranges in the north to Andersons Inlet at Tarwin Lower. There are a few small undefined tributaries and drainage lines from low lying swamps that enter the river in the reaches below Meeniyan. The main tributary is Fish Creek which flows into the Tarwin River from the east a few kilometres upstream of Tarwin Lower.

Information about the environmental condition of Tarwin River downstream of the confluence of the East and West Branches was assessed for SGW in SKM (2006b) *Tarwin River Preliminarily Environment Assessment*. The main relevant outcomes of that assessment are described above in the descriptions provided for the Korumburra supply system catchments.

Water quality and Index of Stream Condition were generally found to be moderate along the Tarwin River.

The above assessment was confirmed in the environmental flow assessment for the Tarwin River in SKM (2009), consistent with the comments noted above for Coalition Creek.

7.7 Deep Creek

Deep Creek is a tributary of the Franklin River. No environmental condition assessment has been undertaken for Deep Creek. There are no Index of Stream Condition sites on Deep Creek, although the Index of Stream Condition for the lower Franklin River was assessed as moderate.

7.8 Fish Creek

Fish Creek is the main tributary that flows into the lower Tarwin River. Hoddle Creek and Battery Creek are tributaries of Fish Creek and it can be assumed that the health of Fish Creek partially reflects the health of Hoddle Creek and Battery Creek.

Water quality data provided for Fish Creek in WGCMA (2006), showed water quality was poor with low dissolved oxygen, high pH, EC and turbidity and orthophosphate (phosphorus) concentrations. SIGNAL scores for macroinvertebrates indicate mild pollution was probably occurring. In addition, there was greater than 80% of aquatic weeds and algae present which indicates high concentrations of nutrients in the river at this site. Results from the two ISC sites along Fish Creek rate Fish Creek as moderate (DEPI, 2010).

There were no ISC sites located on Battery and Hoddle Creeks and there is limited information is available on the ecology of these streams. Consequently, is difficult to assess the impact of changes in flow on the condition of these creeks.

The above assessments were confirmed in the environmental flow assessment for Fish Creek in SKM (2009). The findings for Fish Creek are consistent with those presented above for Coalition Creek.

7.9 Agnes River

The Agnes River is a perennial stream that rises on the southern slopes of the Strzelecki Ranges in South Gippsland. The headwaters of the stream are within the Strzelecki State Park, but downstream of the park, sections of the upper catchment are under plantation and some areas have been cleared for agriculture (mainly grazing and dairy). The middle and lower catchment have been totally cleared for agriculture on the hills with some pockets of native vegetation along the river where the river is confined between steep hills.

The river flows out of the Strzelecki Ranges to the coastal plain near the township of Agnes. On the coastal plain, the river continues to flow south through a small section of paperbark swamp (*Melaleuca ericifolia*) and mangroves (*Avicennia marina*) to enter Corner Inlet and Noorumunga Marine and Coastal Parks at Barry Beach.

Information about the environmental condition of Agnes River was assessed for SGW in SKM (2007) *Agnes River Preliminarily Environment Assessment*. The key outcomes of that assessment of relevance to the UWS are:

- The Agnes River Falls are 59 m high and a natural barrier to fish movement through the catchment.
- There is limited native riparian vegetation and extensive willow infestation along the river in most parts of the middle and lower catchments. Willows have been removed in some reaches of the river and successfully revegetated with native riparian species.
- The main risks to the aquatic fauna and flora in the Agnes River downstream of the Agnes River Falls from reduced flows as a result of a reduction in low flows are likely to be:
  - potential degradation of water quality;
  - reduced available habitat for aquatic fauna (i.e. native fish); and
  - potential impact on the condition of riparian vegetation and revegetation.
- Water quality data indicates turbidity, total phosphorus and total nitrogen are above State Environment Protection Policy guideline values. Consequently, any reduction in flow may result in further lowering of water quality.
- Willow removal and subsequent revegetation is planned for a number of locations along the creek, which will require available water to assist in maintaining seedlings during the summer months.
- Pockets of remnant native vegetation require streamflows to be maintained to ensure maintenance of existing mature trees and to promote establishment of seedlings.
- Fourteen native fish species have been recorded in the Agnes River. Cox's Gudgeon (*Gobiomorphus coxii*) and Australian Grayling (*Prototroctes maraena*) are considered threatened in Victoria. Specifically, Cox's Gudgeon is considered *endangered* and Australian Grayling is considered *vulnerable.* Both species are

listed under the Victorian *Flora and Fauna Guarantee Act* (FFG) 1988 and Australian Grayling is also listed as *vulnerable* under the Commonwealth *Environment Protection and Biodiversity Conservation Act* (EPBC) 1999. There is no record of the number of each of these species and it is uncertain whether these two species are still present in the catchment as they have not been reported in recent surveys.

- Water pools are an important summer refuge for aquatic fauna. Any premature drying of the pools due to changes in summer flow regime could impact on ability of small bodied fish to avoid larger predatory species.
- Water quality in the creek is generally poor and the benefit of permanent water pools for summer refuge may be reduced by poor water quality.

Two ISC sites are located on the Agnes River, and both rated as having moderate environmental condition (DEPI, 2010).

7.10 Tarra River

The Tarra River catchment lies on the south face of the Strzelecki Ranges. Three tributaries join the Tarra River, namely Macks Creek, Greig Creek and Bodman Creek. Spring Creek joins Bodman Creek upstream of the Tarra River confluence. The Tarra River, Macks Creek and Greig Creek originate within the Tarra Bulga National Park. The Tarra Bulga National Park has mountainous terrain characterised by high rainfall and is covered by tall open forest of Mountain Ash (*Eucalyptus regnans*), Messmate (*Eucalyptus obliqua*) and Blackwood (*Acacia melanoxylon*) on the hills and slopes and cool temperate rainforest of Myrtle Beech (*Nothofagus cunninghamii*), Southern Sassafras (Atherosperma moschatum), Austral Mulberry (*Exocarpus cupressiformis*) and Banyallas (*Pittosporum bicolor*) within the gullies (WGCMA, 2005). After leaving the national park, the Tarra River flows through lowland hills in a predominantly rural landscape. The main landuse in the area consists of sheep grazing and dairy production. From the hills, the change of slope for the catchment is quite rapid and the mid to lower sections are quite flat and characterised by lower rainfall than the upper catchment with an average annual rainfall of 600mm compared to greater than 700 mm in the upper catchment (WGCMA, 2005). The Tarra River flows for approximately 57 km from the headwaters, through Yarram, and continues to flow south to the estuary before discharging to the sea downstream of Tarraville (Lieschke and Zampatti, 2001).

Information about the environmental condition of Tarra River was assessed for the West Gippsland Catchment Management Authority in SKM (2006c). The key outcomes of that assessment of relevance to the UWS are:

- The Tarra River has been identified as a Representative River in the Victorian River Health Strategy and supports a number of significant species that have evolved with or rely directly or indirectly on the natural flow regime of the Tarra River.
- The natural flow regime of the Tarra River system has been significantly altered since European settlement by the diversion of water for off stream uses. The change in flow regime has had the greatest impact during the summer low flow period. There has been an increase in the duration of low flows and a reduction in the magnitude of high flows following significant rain events.
- Once the rivers and creeks emerge from the Tarra Bulga National Park there is little native vegetation along the creeks except for some pockets of remnant vegetation.
- Water quality is generally moderate to good throughout the Tarra River catchment.
- Nineteen species of native freshwater and estuarine species and one exotic fish species were surveyed within the reaches of the Tarra River catchment. A number of marine species have also been recorded in the river mouth and estuarine sections of the river (Lieschke and Zampatti, 2001). Eleven of the native species are migratory and two are considered threatened in Victoria. Cox's Gudgeon (*Gobiomorphus coxii*) is listed as endangered within Australia and the Australian Grayling (*Prototroctes maraena*) is listed as vulnerable within Victoria under the *Flora and Fauna Guarantee Act* 1988) (Lieschke and Zampatti,

2001). Australian Grayling is also listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act* (EPBC) 1999.

- The presence of Mountain Galaxias (*Galaxias olidus*) was confirmed in a survey in Spring Creek which is outside its normal altitudinal range of this species (Lieschke and Zampatti, 2001).

Two species of burrowing crayfish, classified as rare in Victoria, have been recorded in the catchment. These are the south Gippsland Spiny Crayfish (*Euastacus neodiversus*) and the Strzelecki Burrowing Crayfish (*Engaeus rostrogaleatus*) (Lieschke and Zampatti, 2001).

A number of ISC sites are located along the Tarra River. Three of these are rates as moderate environmental condition, while the upper reaches is considered to have a good condition. The streamside zone is considered to be in excellent quality in the upper reaches of the river, however this degrades in the downstream reaches.

8. Supply and Demand Projections for Poowong, Loch and Nyora with Current Operation and Infrastructure

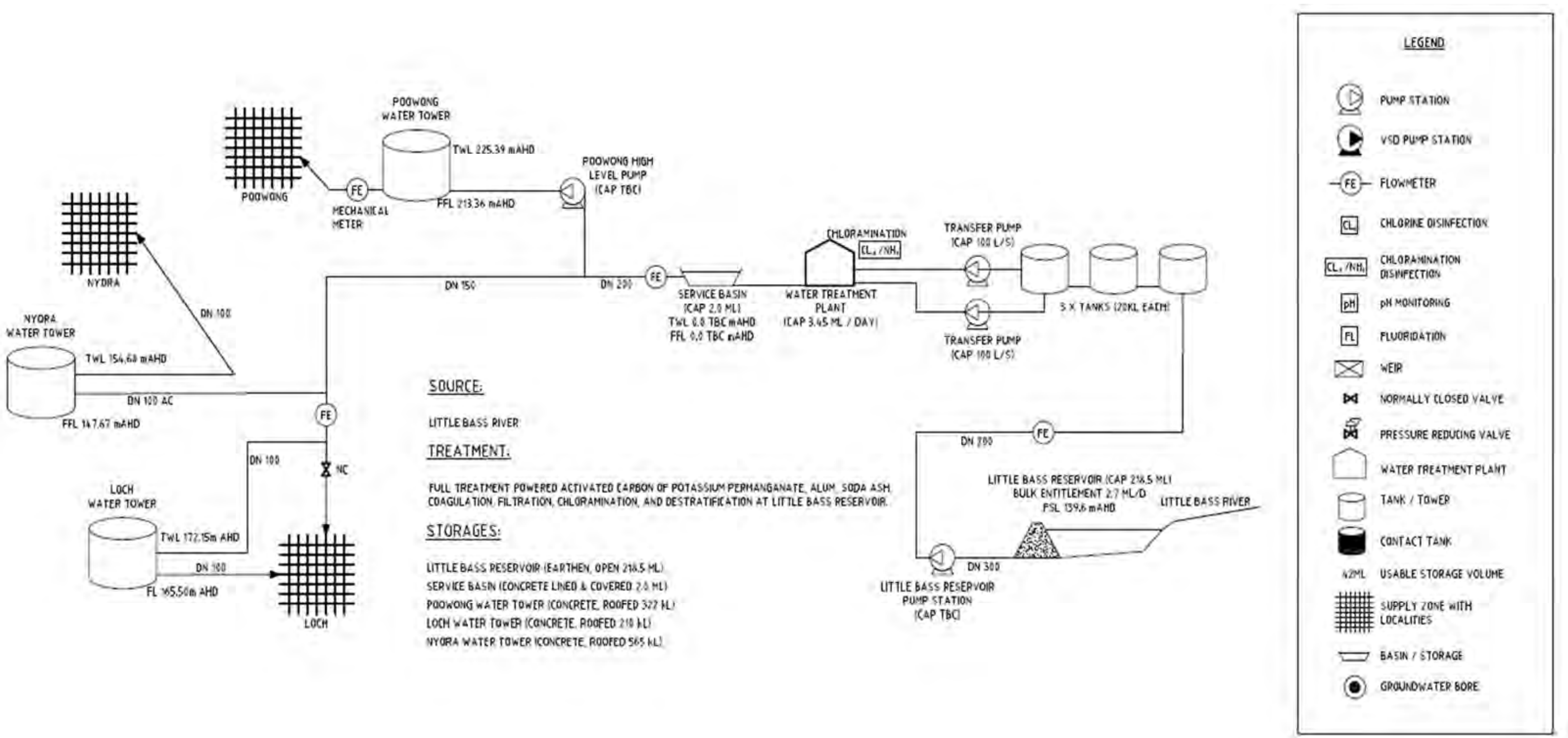
8.1 Introduction

This section of the UWS outlines the supply and demand projections for Poowong, Loch and Nyora over the next 50 years assuming current operation and infrastructure. It includes an overview of the current supply system configuration, current demand for water and current supply. It also includes supply and demand projections under future climate change over the 50 year planning horizon. SGW's response to any shortfall in demand under the current operation and infrastructure scenarios is presented in Section 12 in conjunction with nearby towns.

8.2 Current water supply and demand

8.2.1 Supply system description

The Little Bass River supply system services the townships of Poowong, Loch and Nyora. A schematic representation of this system is shown in Figure 8-1. The system is supplied from the Little Bass Reservoir on the Little Bass River, approximately 2.5 km south-east of Poowong. The storage has a capacity of 218 ML. A pump operates at approximately 1.7 ML/d at the Little Bass Reservoir to pump water up the hill to the treatment plant.



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n Figure 8-1 Little Bass Water Supply System Schematic

8.2.2 Current legal entitlements to water

The bulk entitlement for Poowong, Loch and Nyora allows SGW to divert up to a maximum of 420 ML/yr from the Little Bass River at the Little Bass Reservoir. The daily bulk entitlement is shown in Table 8-1.

Table 8-1: Bulk entitlement volume for Poowong, Loch and Nyora

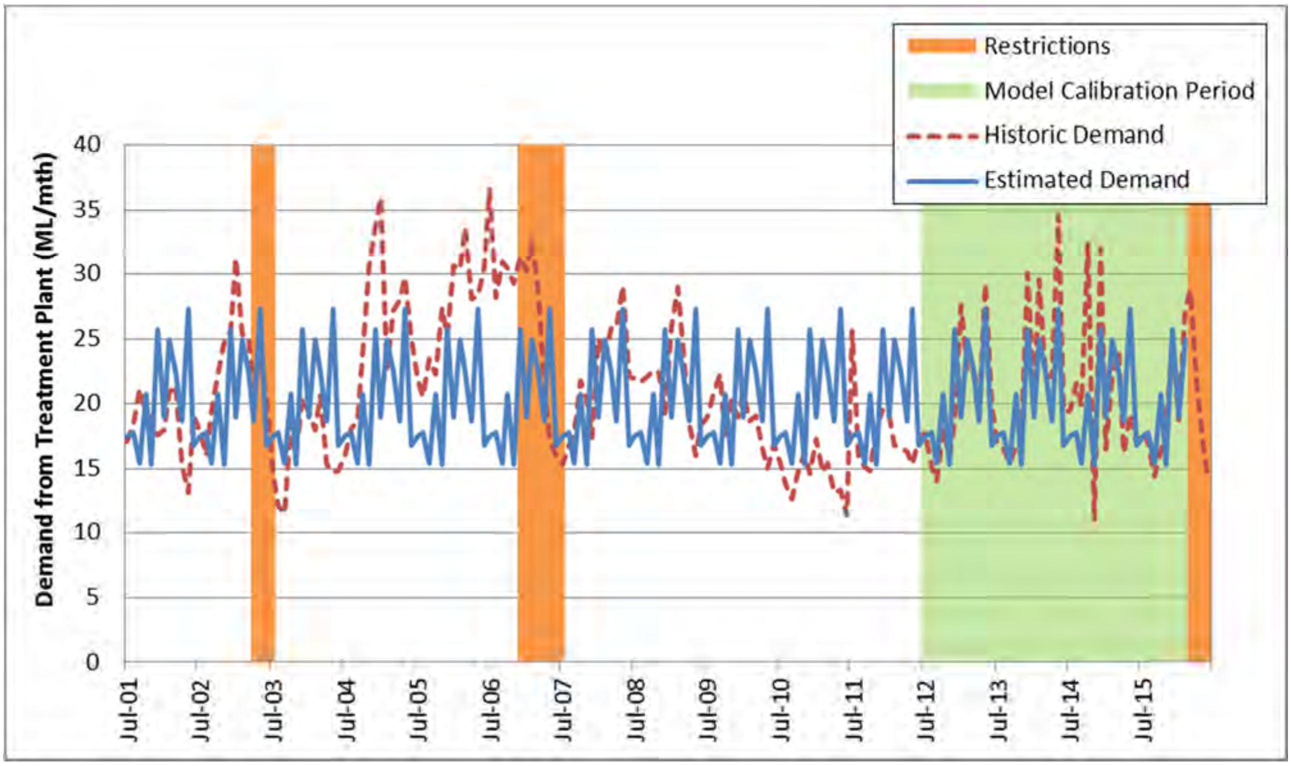
Source	Maximum annual volume (ML/yr)	Maximum diversion rate (ML/d)	SGW's share of flow	Minimum passing flow (E) ML/d
Little Bass River	420	2.7	All the flow entering Little Bass reservoir after meeting passing flow requirements and flow to other bulk entitlements or licenses	When F ≤ 0.5 ML/d, E = F When F > 0.5 ML/d, E = 0.5 ML/d

F is flow immediately upstream of Little Bass Reservoir
E is flow immediately downstream of Little Bass Reservoir

SGW also has a bulk entitlement to access up to 1,000 ML/yr from the Melbourne system (Greater Yarra System – Thomson River Pool) to potentially supply Korumburra, Poowong, Loch and Nyora. Work is currently underway to establish the connection between Poowong and the Melbourne supply system, and it is anticipated that this source will become available during the life of this current UWS.

8.2.3 Current demand

Poowong, Loch and Nyora had populations of 311, 161 and 671 respectively in the 2011 Census data excluding visitors (SAR, 2013). This corresponds to a total of 1,143 people for the three towns. A demand model was fitted to the recent unrestricted data to estimate a long-term average annual demand, which takes into account how current demands would vary under a wider range of natural climate variability. The historical and estimated long-term current demand is shown in Figure 7 2. The estimated long-term current (baseline) demand is 265 ML/yr at SGW's treatment plant inlet, of which around 4% is utilised on average through the treatment plant. The variation in estimated demands throughout the year is shown in Figure 7 2, which shows that there is a relatively high unrestrictable (base) demand and that there is not a clear seasonal pattern of demand. This is believed to be due to the variable water use associated with the major customer of the Poowong Abattoir.



n Figure 8-2 Long-term current monthly demands for Poowong, Loch and Nyora

8.2.4 Current reliability of supply

Over the last decade, restrictions at Poowong, Loch and Nyora were put in place in 2015/16. Prior to that, restrictions were applied in 2006/07. Reliability of supply modelling over the period January 1950 to June 2016 indicated that restrictions at the current level of demand would be required more frequently than has occurred over the last decade, with restrictions being required once every 4 years on average (i.e. 76% annual reliability). This does not meet SGW's level of service objectives to not restrict supply more frequently than 1 year in 10. The estimate of current reliability of the supply system has decreased since the previous WSDS estimate in SGW (2011) due to the revised demand and climate assumptions. Further details on the water resource model used to assess reliability of supply (and yield) can be found in SKM (2017).

8.3 Water supply and demand projections with current operation and infrastructure

8.3.1 Historical trends

Historical demands at Poowong, Loch and Nyora were steadily increasing until the Millennium Drought before declining to date (see Figure 8-3). Bulk raw water supply has declined over the last two years to 236-251 ML/yr from the peak of 260 ML/yr in 2013/14, but remains above the historical lows seen in 2009/10-2011/12 (historical low of 173 ML/yr in 2010/11). The slight decline over the last two years appears to be driven by a reduction in consumption by the local dairy factory, with their annual usage in 2015/16 dropping to only 2 ML/yr. In the peak demand year of 2013/14, supply to this dairy was almost 30 ML/yr. The dominant longer term influence on water consumption in this supply system is the abattoir. Water consumption at the abattoir remains highly variable, but in 2015/16 was similar in magnitude to the previous three years. When total system demand was historically low, the demand for water at the abattoir was also much lower than average.

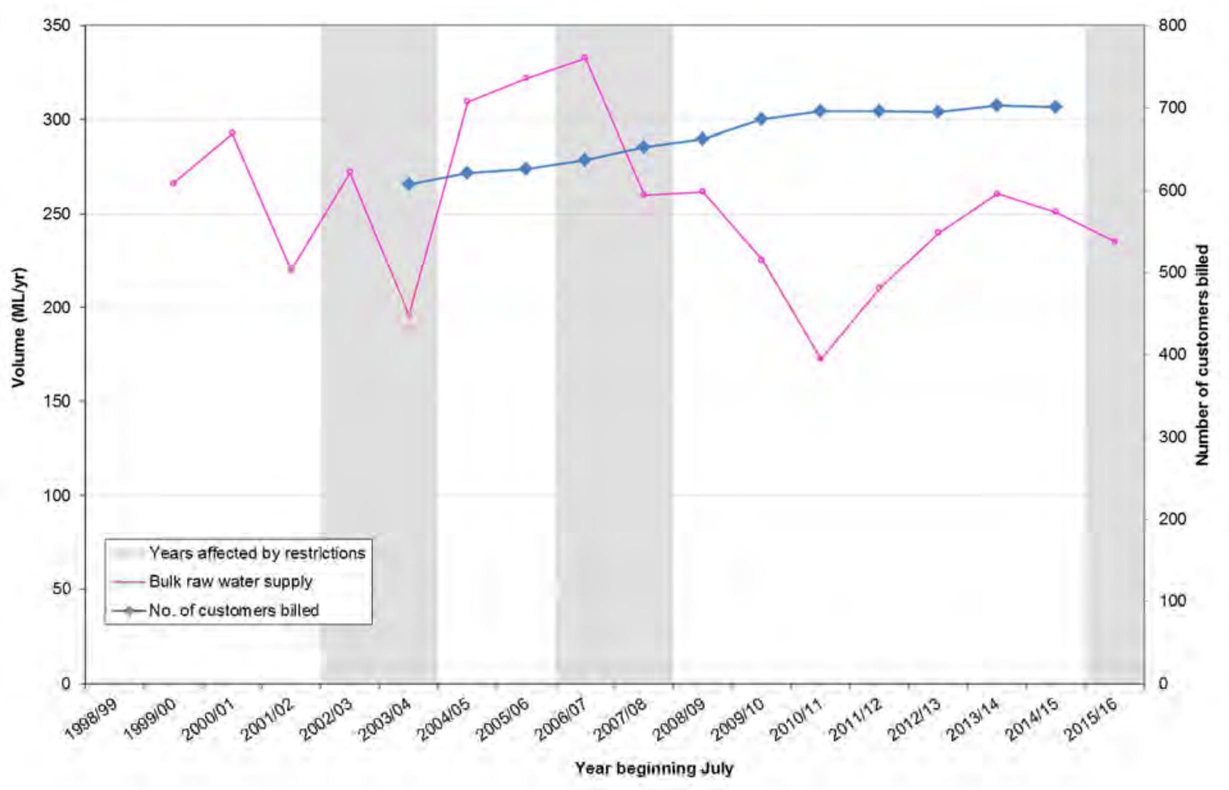


Figure 8-3 : Historical raw demands and number of customers billed at Poowong, Loch, Nyora

The population of Nyora has grown steadily over the last two decades, with population of the other two towns remaining relatively constant. The total population of the three towns from 971 people in 2006 to 1143 people in 2011, as seen in Figure 8-4. Between 2001 and 2006 however there was a slight decline in population, due to a decline in population at Poowong and Loch and only a modest increase in population at Nyora. However, the population and number of dwellings have increased between 2006 and 2011.

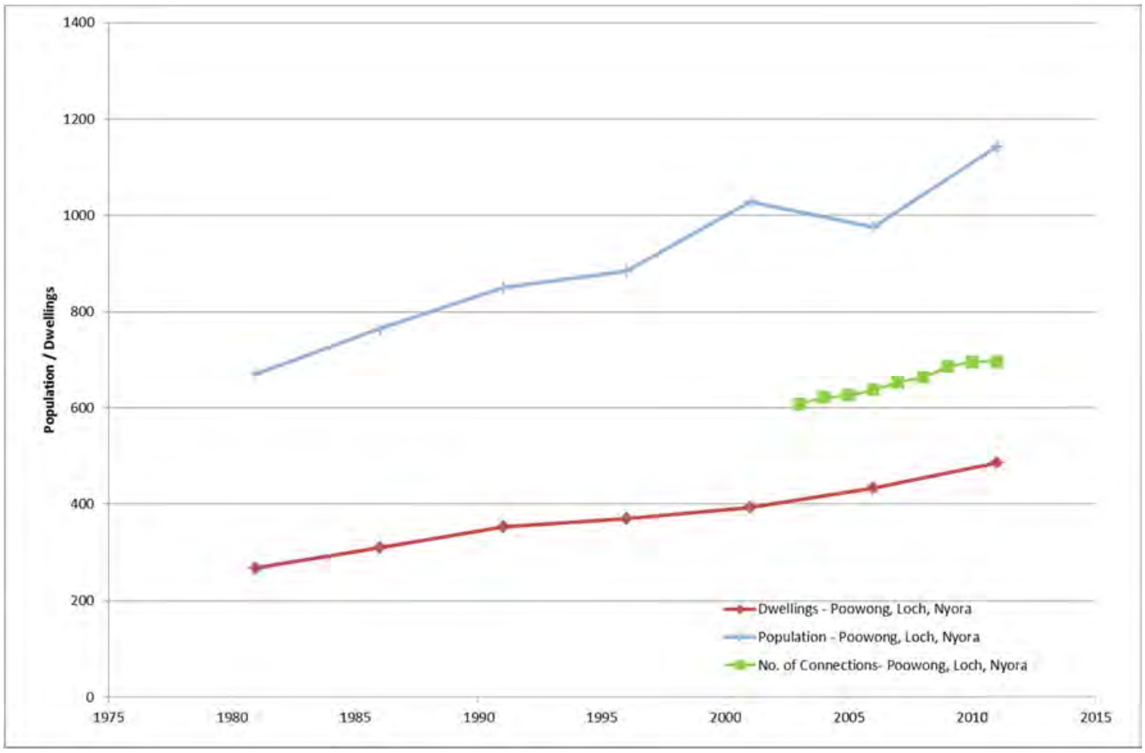


Figure 8-4 : Historical population in Poowong, Loch and Nyora

8.3.2 Future demand projections

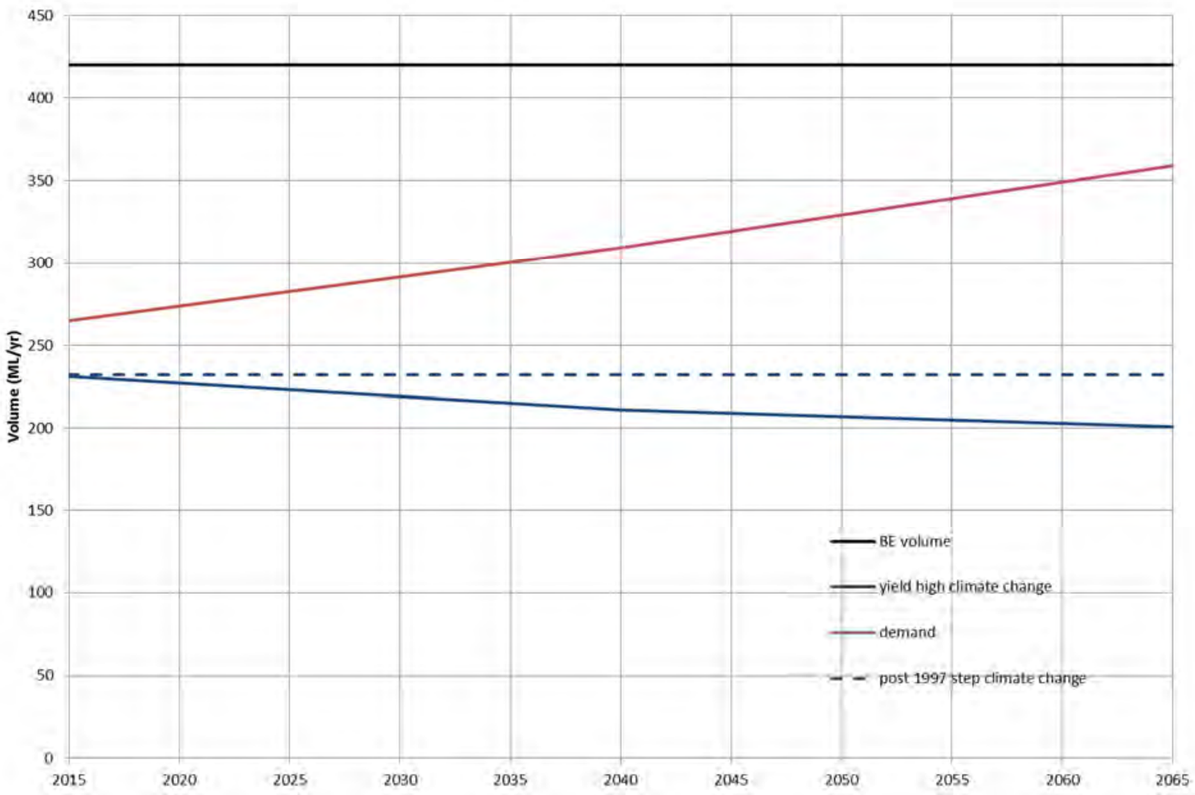
Future growth in PLN was estimated using Victoria in the Future estimates, which are available at a Statistical Local Area (SLA) level. There are five SLA's covering SGW's water supply area. Poowong, Loch and Nyora are located within the South Gippsland Shire West SLA and account for around 12% of the population within the SLA.

The population projections estimate a growth of between 0.6% and 1.2% per year with no change in major industrial demand. The urban and stock and domestic demand is not assumed to change, as the demands in these towns have been found to be independent of climate.

8.3.3 Future supply projections with current operation and infrastructure

Given the vulnerability of the system, the high climate change scenario was modelled for the existing arrangement for Poowong, Loch and Nyora. High climate change assumes that there is a 17% reduction in streamflow by 2040 and 45% reduction by 2065.

The forecast demand exceeds the yield at the current climate scenario, indicating that South Gippsland's level of service objective is not currently being not met. The medium climate change scenario was not assessed for the Poowong, Loch and Nyora system, since SGW are already implementing plans to connect these towns to the Lance Creek system in the next few years. These augmentation plans for Poowong, Loch and Nyora are addressed in Section 12.3.



n Figure 8-5 : Water supply and demand for Poowong, Loch and Nyora with current operation and infrastructure

8.4 Sensitivity of projections

Three potential land use changes within the catchments supplying Poowong, Loch and Nyora were investigated to understand the potential risk they could pose to available supply.

Bushfires: Only 8% of the Little Bass River catchment has vegetation cover. This means that the risk of catchment yield decreasing significantly due to the effects of bushfires is low. There is no record of bushfires occurring in the catchment over the last few decades.

Logging: No logging is undertaken under regional forestry agreements in the water supply catchment for this supply system.

Plantations: There are no plantations in the water supply catchment for this supply system.

Future development: It is speculated that future residential development at the growth rates adopted may occur because the towns are within commuting distance to parts of Melbourne and because reticulated sewerage is now available.

8.5 Summary of the supply and demand for Poowong, Loch and Nyora with current operation and infrastructure

In summary for Poowong, Loch and Nyora under the Current Operation and Infrastructure supply and demand scenarios:

- Existing supply is not currently sufficient to meet SGW's level of service objectives. In the absence of the actions currently being implemented by SGW, this situation would worsen in future under the high climate change scenario considered.
- Demand for water has fallen in recent years due to a reduction in major industrial water demand at the dairy. This reduction in total demand has occurred despite an increase in the number of dwellings, population and connections.

SGW's strategy to address this future supply shortfall is presented in Section 12.3.

9. Supply and Demand Projections for Korumburra with Current Operation and Infrastructure

9.1 Introduction

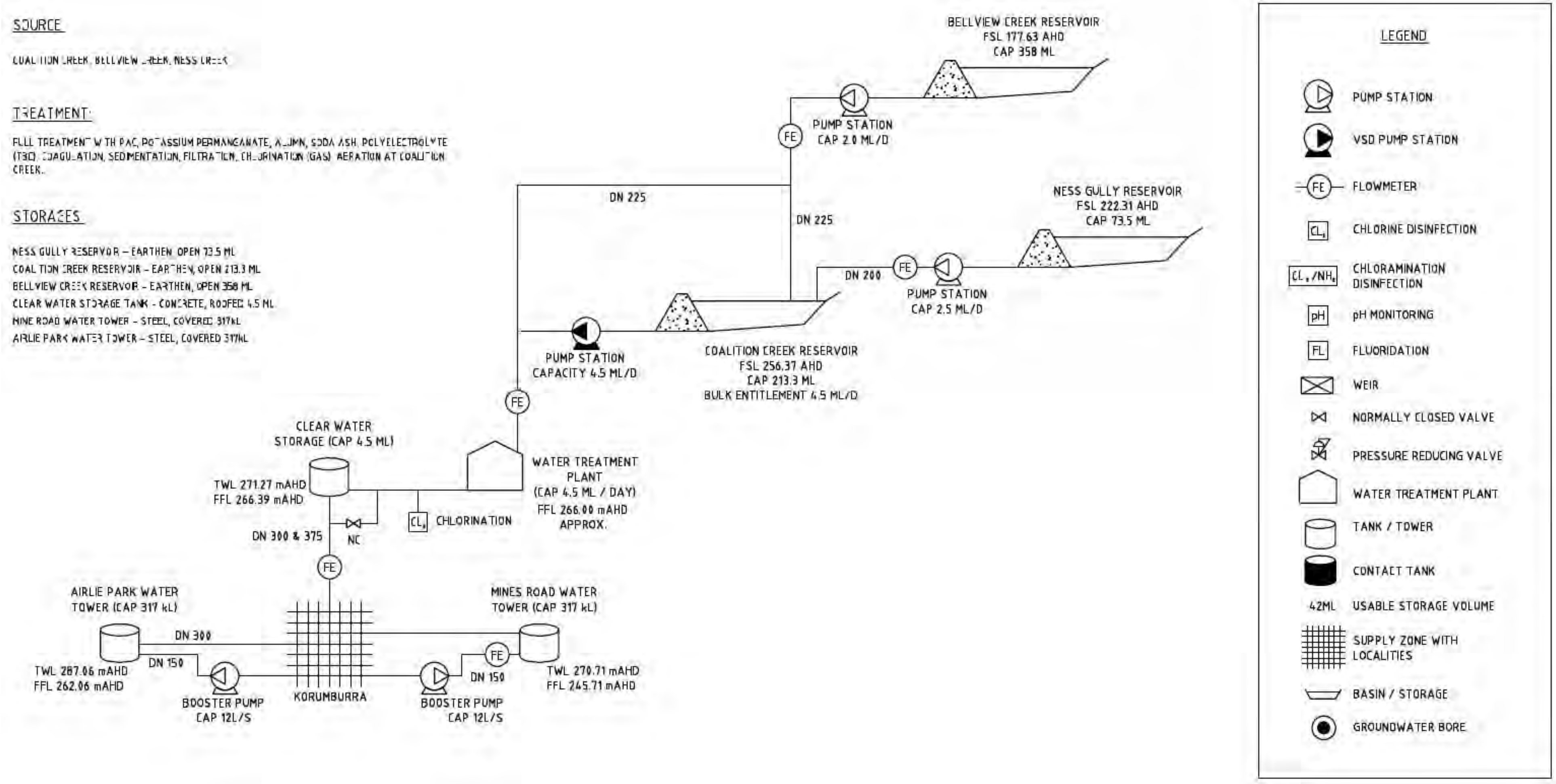
This section of the UWS outlines the supply and demand projections for Korumburra over the next 50 years assuming current operation and infrastructure. It includes an overview of the current supply system configuration, current demand for water and current supply. It also includes supply and demand projections under future climate change over the 50 year planning horizon. SGW's response to any shortfall in demand under the current operation and infrastructure scenarios is presented in Section 12.3 in conjunction with nearby towns.

9.2 Current water supply and demand

9.2.1 Supply system description

The Coalition Creek system supplies Korumburra from three service reservoirs. The town's water supply is drawn from the No. 1 Reservoir on Coalition Creek which has a current capacity of 213 ML with an operational capacity of 143 ML due to dam safety risks. The outlet capacity from the No. 1 storage is 4.5 ML/day and water from the No. 2 Reservoir (Ness Creek - total capacity 74 ML) is pumped into the No. 1 Reservoir to top up the storage between mid-spring and mid-summer. The capacity for water transfer from the No. 2 storage to the No. 1 storage is 10 L/s. When the live volume in No. 1 storage drops below 160 ML, water is pumped from the No. 3 Reservoir (Bellview Creek, total capacity 358 ML) into the No. 1 storage. The outlet capacity from the No. 3 storage is 2 ML/d. If necessary, water can be pumped directly from the No. 3 Reservoir to the treatment plant. A schematic representation of the system is presented in Figure 9-1

A supplementary supply is also available from the Tarwin River West Branch during periods of drought.



n Figure 9-1 : Coalition Creek schematic

9.2.2 Current legal entitlements to water

The bulk entitlement for Korumburra allows SGW to divert up to a maximum of 1000 ML/yr from Coalition, Ness and Bellview Creeks, and up to 1,800 ML/yr from the Tarwin River West Branch via a supplementary supply. Daily bulk entitlements are shown in Table 9-1.

n Table 9-1 Daily Bulk Water Entitlement and equivalent monthly volumes for Korumburra

Source	Maximum annual volume (ML/yr)	Max diversion rate (ML/d)	Max diversion rate (ML/mth)	Minimum passing flows
Coalition Creek	1000	4.8	145.9	Minimum of 0.6 ML/d (18.24 ML/mth) or natural flow
Ness Creek		1.6 (Oct-Dec) 0.0 (Jan-Sep)	48.6 (Oct-Dec) 0.0 (Jan-Sep)	Minimum of 0.6 ML/d (18.24 ML/mth) or natural flow
Bellview Creek		3.0	91.2	Minimum of 1.0 ML/d (30.4 ML/mth) or natural flow
Tarwin River West Branch at Koonwarra	1800(1)	10.0 (May-Nov) 5.0 (Dec-Apr)	304.0 (May-Nov) 152.0 (Dec-Apr)	Minimum passing flow 90-100 ML/d Minimum passing flow 15-20 ML/d

(1) Less any water diverted under the Leongatha bulk entitlement from the Tarwin River West Branch or lower Coalition Creek. The diversion to Leongatha is currently in poor conditions and is not operated.

The Current Operation and Infrastructure scenario for the UWS assumes that pumping from the Tarwin River West Branch to Korumburra and Leongatha only occurs until January 2020. Further detail on the assumed operation of the diversion from these sources is shown in Table 9-2. It should be noted that the supply from the Tarwin River West Branch to Leongatha utilises existing obsolete infrastructure that is complex and difficult to operate, and is currently not used. There are several groundwater bores within access of Korumburra and Leongatha, which are currently only used to supply Korumburra.

Table 9-2 Tarwin River West Branch Diversion Rules for Current Operation and Infrastructure Scenario

Pumping Rule	Tarwin River at Koonwarra (pumping to Ruby Creek Storages and Ness Gully Storage)	Coalition Creek at pump site (pumping to Ruby Creek Storages)
Minimum passing flow (ML/day)	100	10
Extraction volume (ML)	1800 minus Coalition Ck volume	800
Extraction period	May-Nov	May-Nov
Upper limit on pumping capacity (ML/day)	5 minus Coalition Ck rate	5
Capacity Sharing (Ruby Ck No 4 : Ness Gully No. 2)	3 ML/day maximum to Leongatha (1), 3 ML/day maximum to Korumburra)	To Ruby Creek Storages(2)
Pipe capacities	5 ML/d at extraction point. 3ML/d to Ness Gully, 3ML/d to Ruby Ck storages	5 ML/d

(1) This supply to Leongatha is currently complex and difficult to operate and not operated. It is only suitable for use in severe drought.

(2) Modelling assumes supply to No.4 reservoir. Current connection only extends to No. 3 reservoir, but temporary pumping arrangements could transfer up to No. 4 reservoir if required in practice.

9.2.3 Current demand

Korumburra had a population of 3,271 people excluding visitors in the 2011 census. A demand model was fitted to the recent unrestricted data to estimate a long-term average annual demand, which takes into account how current demands would vary under a wider range of natural climate variability. The historical and estimated long-term current demand is shown in Figure 9-2. The estimated long-term current (baseline) demand is 675 ML/yr at SGW's treatment plant inlet, of which around 5% is utilised on average through the treatment plant. Of this demand, approximately 310 ML/yr is consumed by Burra Foods. The analysis found that there are no clear climate drivers of the variability in demand at Korumburra. This is possibly due to the combination of non-climate variability in Burra Foods demand (which affects total demand variability) and metering uncertainty. As a result, average monthly demands were adopted for this supply system over the demand calibration period.

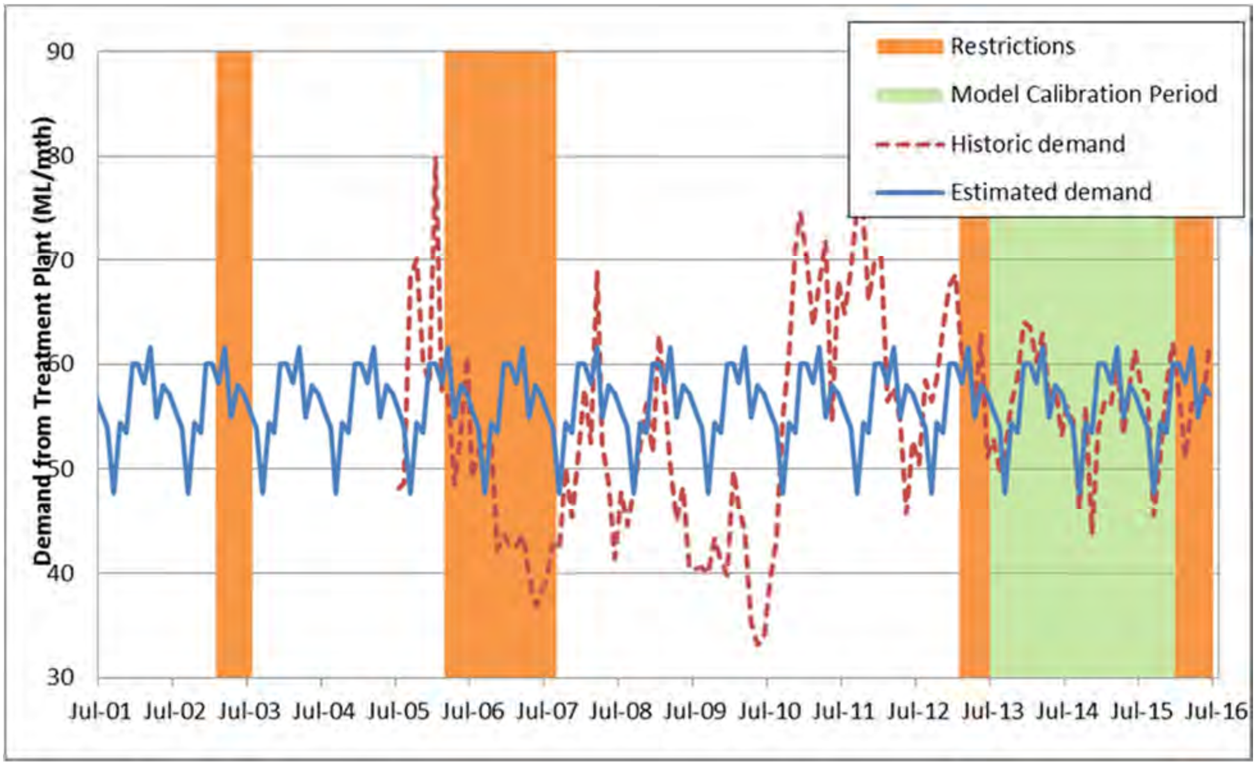


Figure 9-2 : Long term current monthly demands for Korumburra

9.2.4 Current reliability of supply

Since the Millennium Drought, restrictions have occurred in Korumburra in 2012/13 and 2015/16. During restriction periods, the supply and demand balance has been improved through a reduction in demand and the development of revised restriction triggers. Reliability of supply modelling over the period July 1950 to June 2016 indicated that restrictions would be required 1 in 3 years under baseline climate conditions, which does not meet SGW's level of service objective for restrictions. This drop in reliability has been attributed to the decrease of nearly 100 ML of storage capacity at Coalition Creek Reservoir, showing how sensitive the existing system is to storage capacity (reservoir operating level has been reduced to minimise dam safety risks to an acceptable level). Further details on the water resource model used to assess reliability of supply (and yield) can be found in Jacobs (2017).

9.3 Water supply and demand projections with current operation and infrastructure

9.3.1 Historical trends

Historical demand decreased significantly from 2004/05 before increasing again in 2010/11. Bulk potable water supply has remained between 700-780 ML/yr since the last major jump in annual demand in the 2010/11 year (see Figure 9-3). These demands are recorded at the clear water storage outlet and do not include an allowance for treatment plant utilisation. The number of customers billed has increased slightly despite the reduction in demand. This potentially indicates that significant water savings have been achieved by SGW and its customers in recent years. Major industrial demand for water at Korumburra since 2010/11 has remained relatively constant and accounts for only a small portion of the observed variability in demand over the last few years.

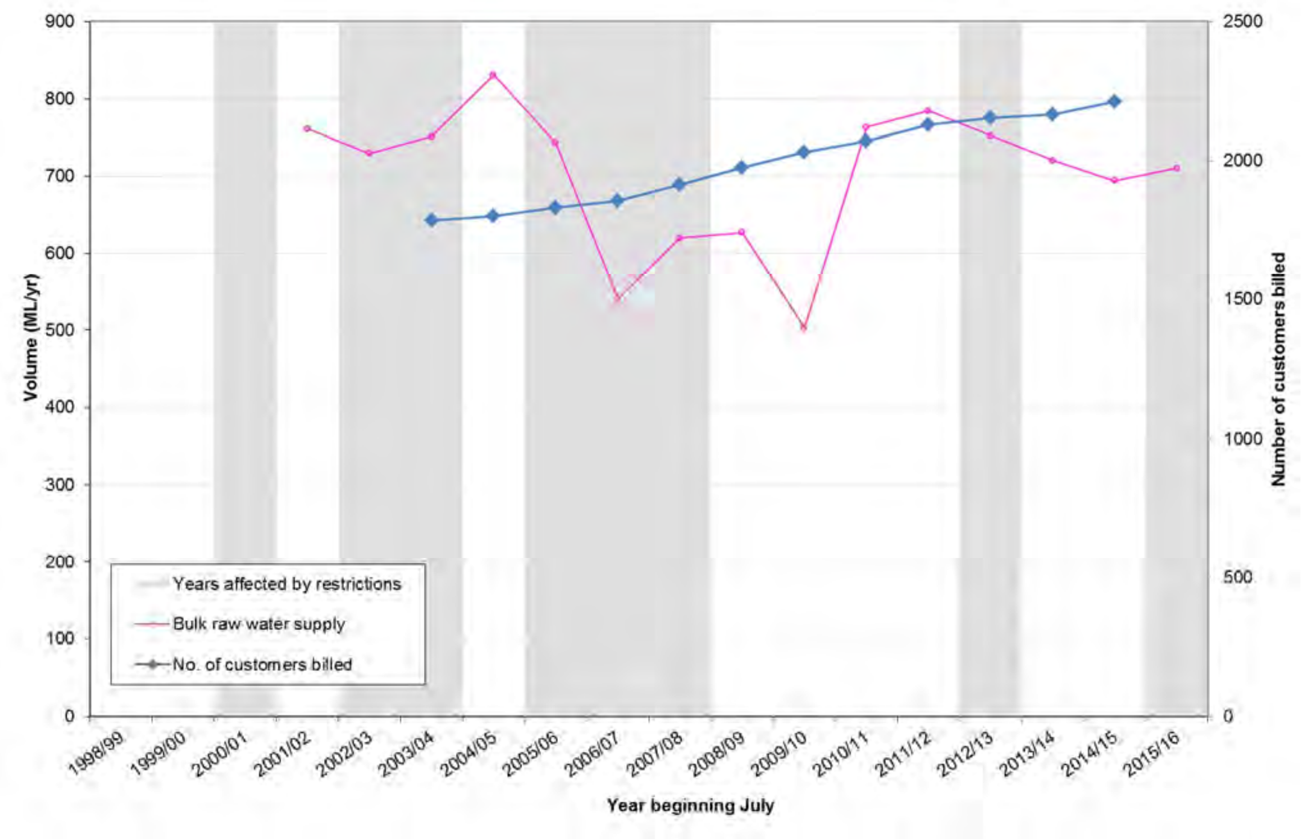


Figure 9-3 : Historical demand and number of customers billed at Korumburra

The population in Korumburra has increased slightly after remaining stagnant for the last few decades, as seen in Figure 9-4. The population has increased from 2,974 in 2006 to 3,271 in 2011, its most significant increase for many years. The number of dwellings has been consistently increasing since 1981.

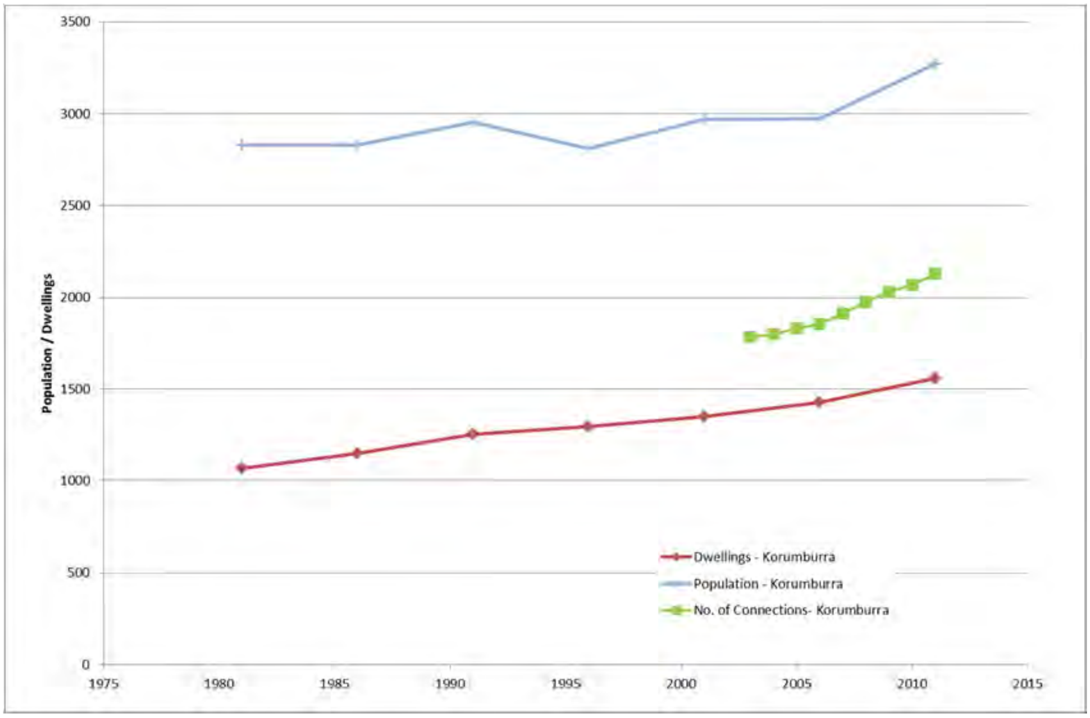


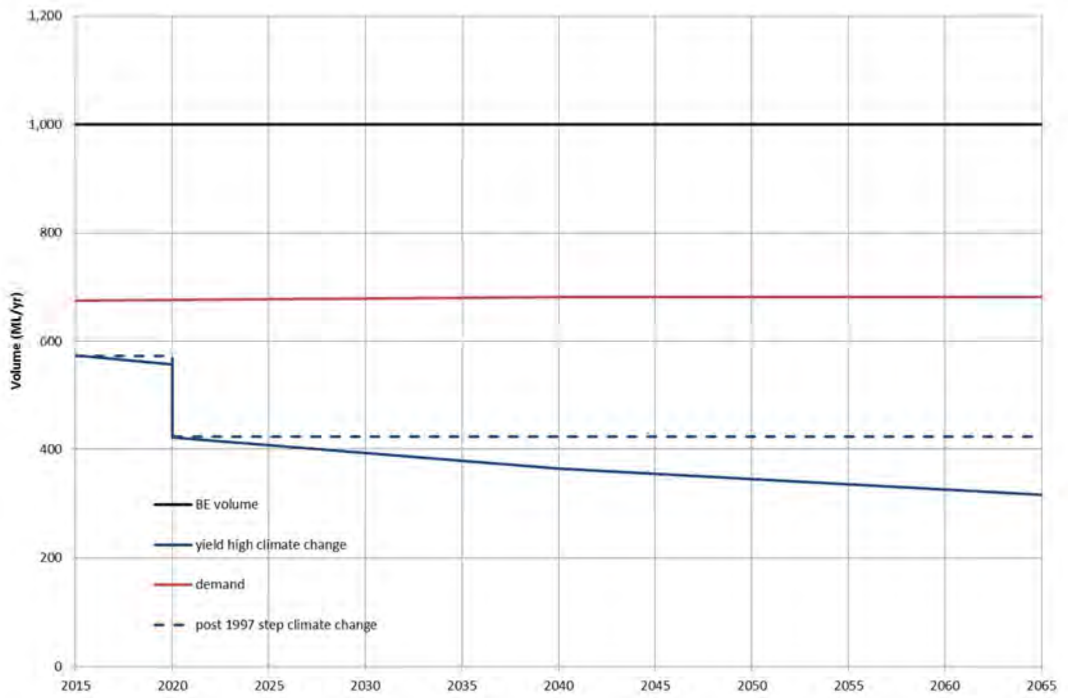
Figure 9-4 : Historical population in Korumburra

9.3.2 Future demand projections

Future growth in Korumburra was estimated using Victoria in the Future estimates. The population projections estimate a growth of between 0.6% and 1.2% per year with no change in major industrial demand. The demands for Korumburra were not factored for climate as the usage data was found to be independent from climate.

9.3.3 Future supply projections with current operation and infrastructure

The future supply projections have accounted for the current BE rules that include the sunset clause on the supplementary supply in the year 2020. This is shown by a step change in yield, as seen in Figure 9-5. The current demand exceeds the supply indicating that action needs to be taken by SGW in the near future to meet level of service objectives for the town. Future demands remain relatively consistent over the planning horizon due to the relatively small growth forecast at this location. Due to the system’s current vulnerability to fluctuations in climate, the high climate change scenario has been modelled looking forward. However, given the existing plans in place to connect Korumburra to the Lance Creek system over the coming years, the medium climate change scenario has been applied when considering the augmentation of this system (refer to Section 12).



- Figure 9-5 : Water supply and Demand for Korumburra with Current Operation and Infrastructure

9.4 Sensitivity of projections

Three potential land use changes within the catchments supplying Korumburra were investigated to understand the potential risk they could pose to available supply.

Bushfires: Only 12% of the Coalition, Ness and Bellview Creek catchment has vegetation cover. This means that the risk of catchment yield decreasing significantly due to the effects of bushfires is low. There is no record of bushfires occurring in the catchment over the last few decades.

Logging: No logging is undertaken under regional forestry agreements in the water supply catchment for this supply system.

Plantations: There are no plantations in the water supply catchment for this supply system.

9.5 Summary of the supply and demand for Korumburra with current operation and infrastructure

In summary for Korumburra under the Current Operation and Infrastructure supply and demand scenarios:

- Existing supply does not currently meet SGW's level of service objectives, and would continue to not be met under the high climate change scenario considered;
- The supplementary supply from the Tarwin River West Branch is currently only legally available up to the year 2020; and
- Demand for water has fallen in recent years, whilst population, connections and the number of dwellings have all increased. Major industrial demand has remained fairly static.

SGW's strategy to address this future supply shortfall is presented in Section 12.3.

10. Supply and Demand Projections for Leongatha and Koonwarra with Current Operation and Infrastructure

10.1 Introduction

This section of the UWS outlines the supply and demand projections for Leongatha and Koonwarra over the next 50 years assuming current operation and infrastructure. It includes an overview of the current supply system configuration, current demand for water and current supply. It also includes supply and demand projections under future climate change over the 50 year planning horizon. SGW's response to any shortfall in demand under the current operation and infrastructure scenarios is presented in Section 12.4 in conjunction with nearby towns.

10.2 Current water supply and demand

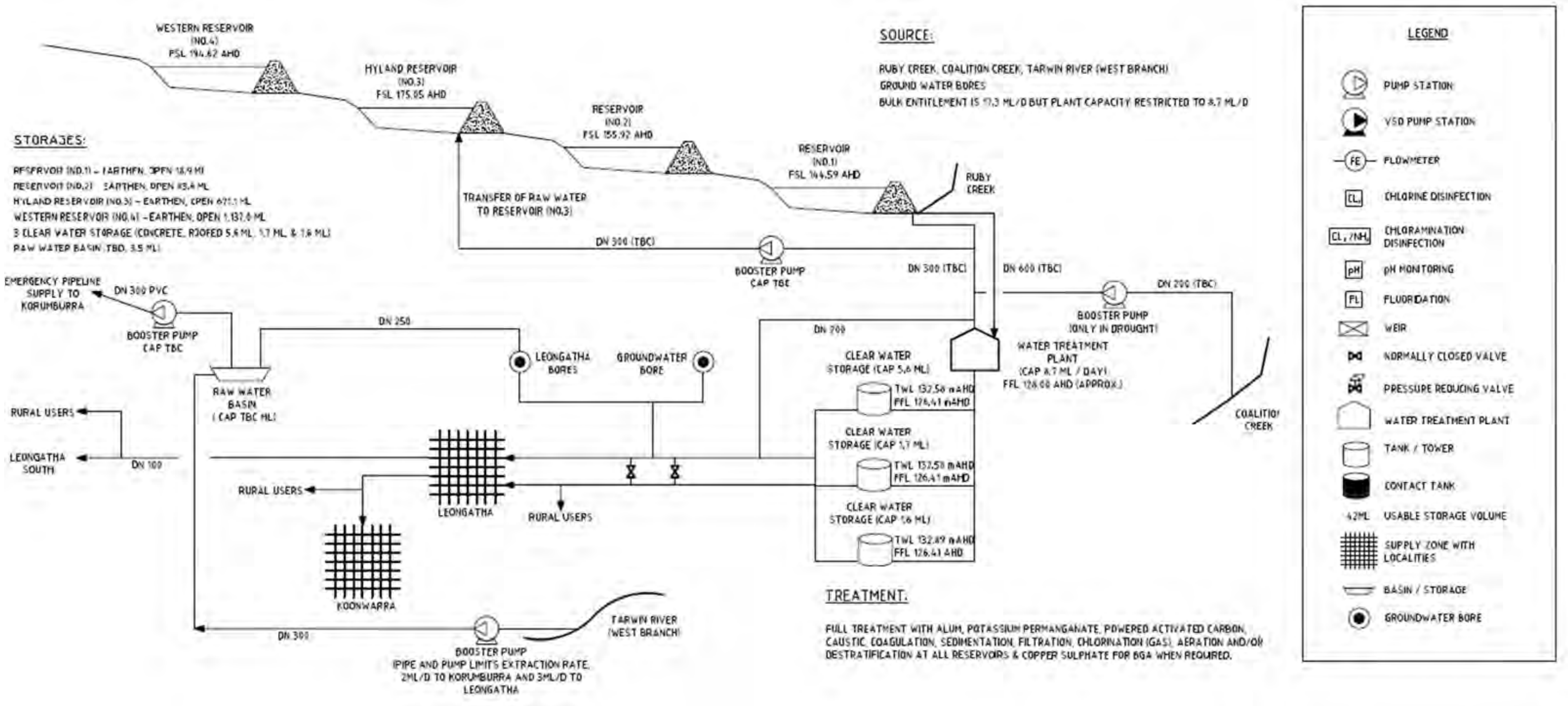
10.2.1 Supply system description

Leongatha derives its water supply by gravity from four reservoirs on Ruby Creek. These four reservoirs have a combined capacity of 1,911 ML with no dead storage. The capacity and construction history for each storage is shown in Table 10-1. The Ruby Creek system is the only source of supply for the township of Leongatha/Koonwarra and for several rural properties. It is also the supply source for the local dairy factory. Figure 10-1 shows a schematic representation of the system.

Leongatha is also connected to a supplementary supply from the Tarwin River West Branch and local groundwater bores, however this infrastructure is obsolete and difficult to operate and is currently not in service.

Table 10-1 Leongatha water supply reservoirs (SGW, 2017)

Reservoir	Year constructed	Capacity (ML)
Reservoir No. 1	1906	19
Reservoir No. 2	1928	84
Reservoir No. 3 (Hyland)	1960	671
Reservoir No. 4 (Western)	1980	1,137
Total		**1,911**



n Figure 10-1 : Ruby Creek System Schematic

10.2.2 Current legal entitlements to water

The bulk entitlement for Leongatha allows SGW to divert up to a maximum of 2,476 ML/yr from Ruby Creek. A supplementary supply from Tarwin River West branch is also legally available, however is not currently active due to infrastructure integrity issues. Daily bulk entitlements are shown in Table 10-2.

Table 10-2 Daily Bulk Water Entitlement and equivalent monthly volumes for Korumburra

Source	Maximum annual volume (ML/yr)	Max diversion rate (ML/d)	Minimum passing flows
Ruby Creek	2,476	17.3	Minimum of 0.5 ML/d (15 ML/mth) or natural flow
Coalition Creek at Spencers Road	1800[1]	6.0 (May – Nov)	Minimum passing flow 10 ML/d
Tarwin River West Branch at Koonwarra		10.0 (May - Nov 5.0 (Dec- April)[2]	Minimum passing flow 90-100 ML/d Minimum passing flow 15-20 ML/d

(1) Supply to Leongatha via the Tarwin River West Branch is difficult to operate and is not currently active

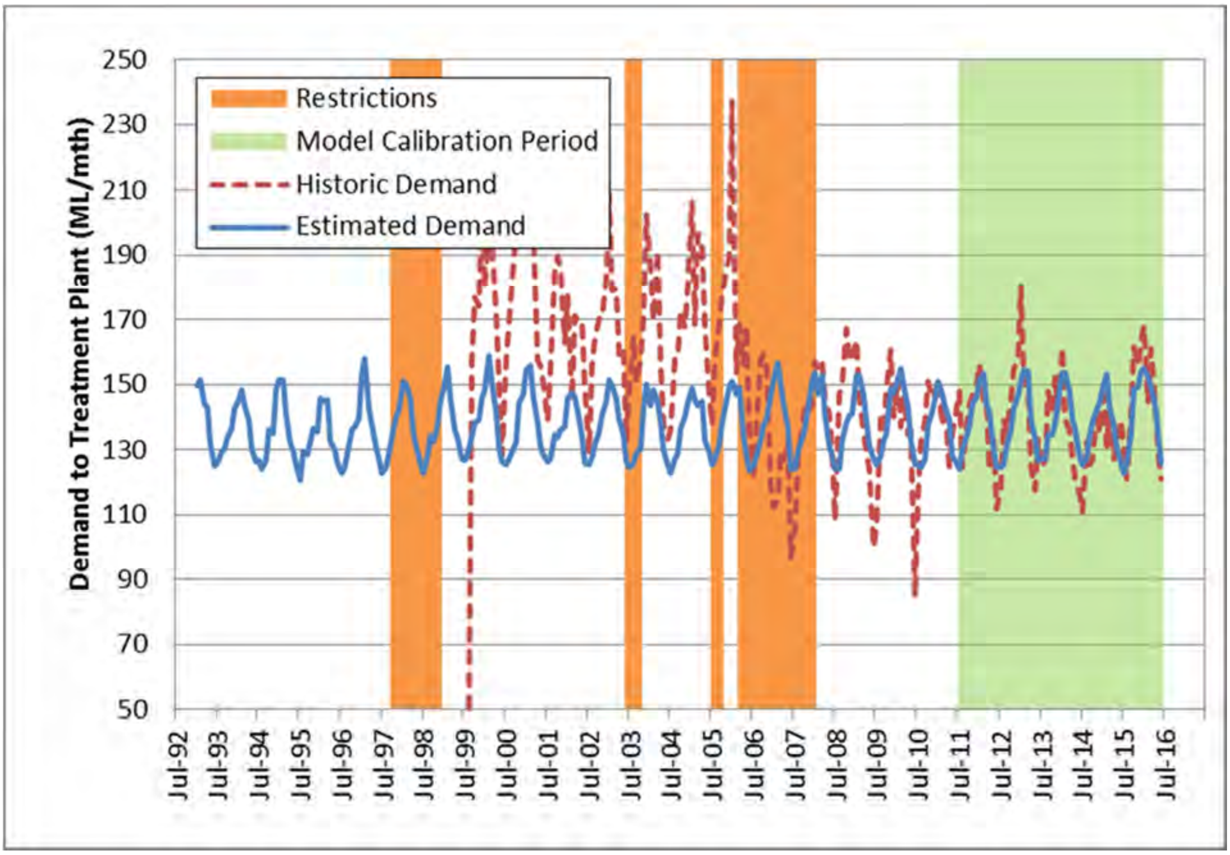
(2) Only available until June 2020

The Current Operation and Infrastructure scenario for the UWS assumes that pumping from the Tarwin River West Branch to Korumburra and Leongatha only occurs until June 2020. The diversion is switched off for the Ruby Creek system. There are several groundwater bores within access of Korumburra and Leongatha, however they are assumed to be not in use for the existing infrastructure arrangement scenario.

SGW also has a bulk entitlement to access water from the Melbourne system to potentially supply Leongatha. A physical connection between Leongatha and the Melbourne supply does not currently exist, so this supply source could only be accessed if SGW decides to connect Leongatha to the Melbourne system as an augmentation option.

10.2.3 Current demand

The current population for Leongatha is 4,697 people excluding visitors in the 2011 census. Separate population data was not available for Koonwarra. A demand model was fitted to the recent unrestricted data to estimate long-term average annual demand, which takes into account how current demands would vary under a wider range of natural climate variability. The historical and estimated long-term current demand is shown in Figure 10-2. The estimated long-term current (baseline) demand for Leongatha and Koonwarra is **1,709 ML/yr** at SGW's treatment plant inlet, of which around 4% is utilised on average through the treatment plant. The variation in demands throughout the year is shown in Figure 10-2, which shows that demand varies seasonally with climate. There is a relatively high base demand due to the local milk factory, which currently accounts for around 60% of total water use at Leongatha.



n Figure 10-2 : Long term monthly demands for Leongatha and Koonwarra

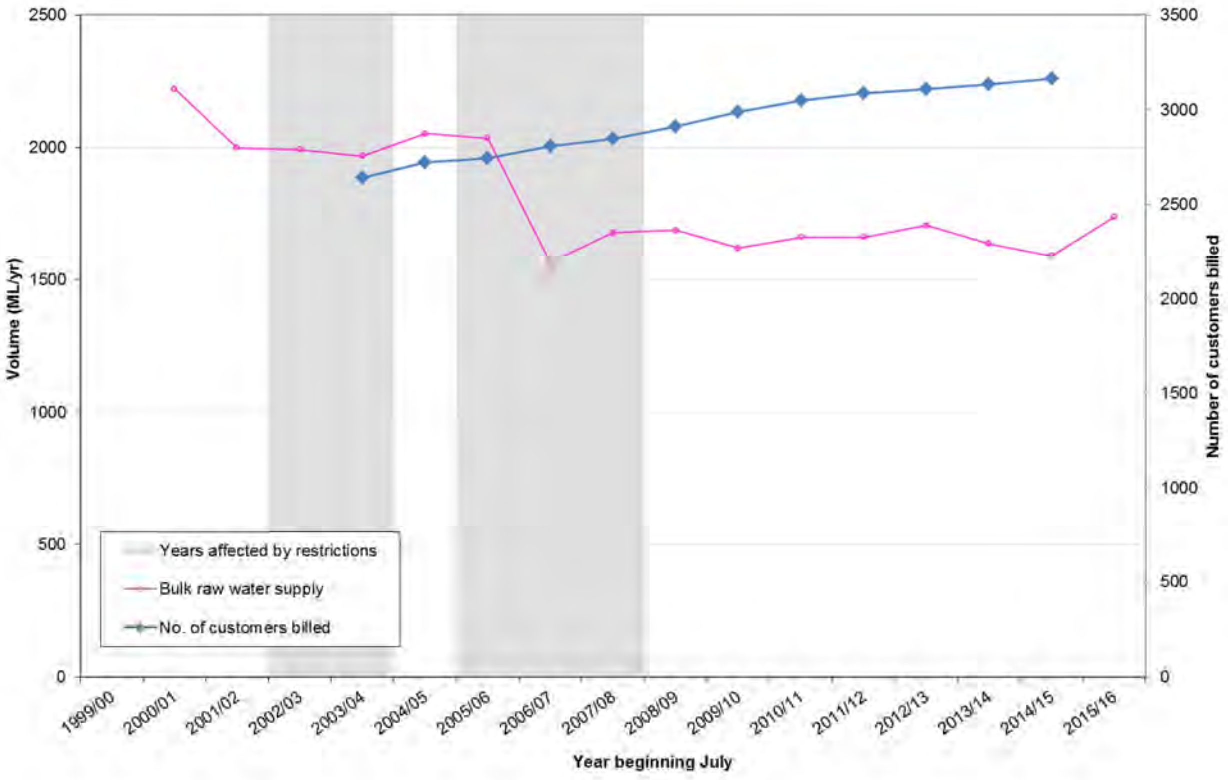
10.2.4 Current reliability of supply

Leongatha has not had restrictions since the Millennium Drought, last implementing stage 4 restrictions in 2006/07. The modelling has shown that under the current infrastructure arrangements (no supplementary supply or groundwater access) restrictions are expected 1 in every 4 years on average in the long-term (77% annual reliability). This does not meet SGW's level of service objective for restrictions. This estimate is considerably lower than that presented in the 2011 WSDS, because it was previously assumed that supplementary supply would be available to Leongatha. In practice, due to infrastructure and operational issues, this is no longer assumed to be the case. Further details on the water resource model used to assess reliability of supply (and yield) can be found in Jacobs (2017).

10.3 Water supply and demand projections with current operation and infrastructure

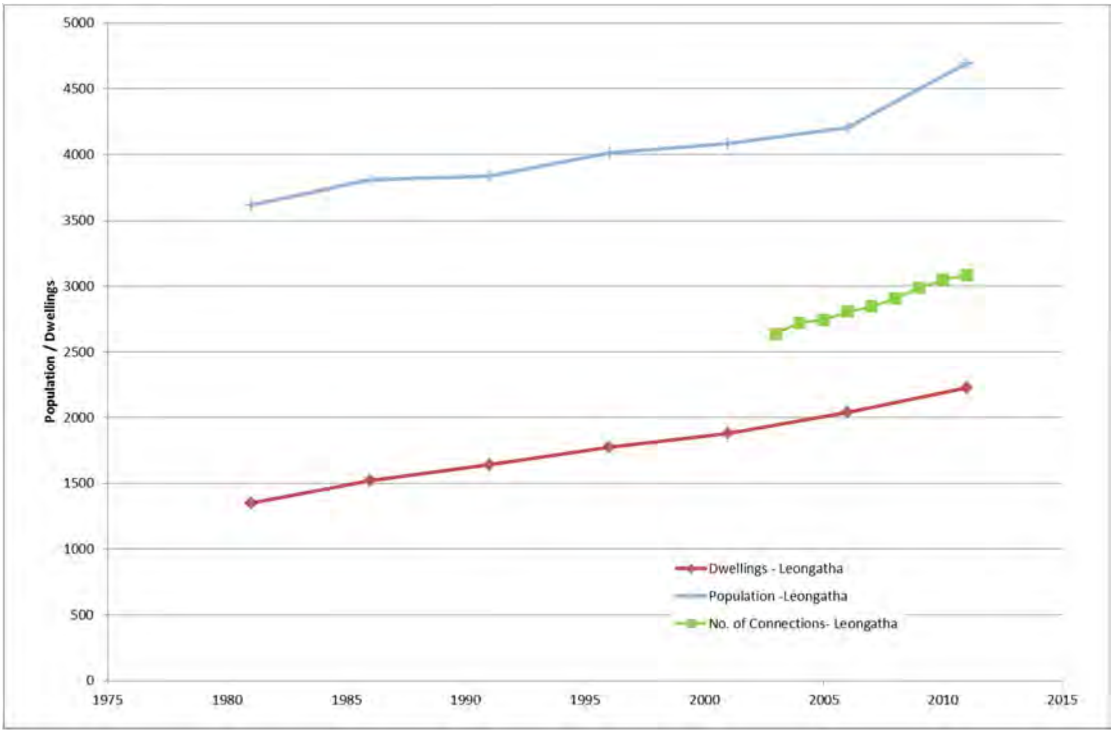
10.3.1 Historical trends

Historical demands for Leongatha and Koonwarra have remained relatively stable since the last decline prior to 2006/07, as seen in Figure 10-3. The demands shown are the bulk raw water supply, prior to entering the treatment plant. The drop in demand can be attributed to the implementation of restrictions during the Millennium drought. Whilst the demand has stabilised, the number of customers billed has slowly increased over the recent years. This potentially indicates that significant water savings have been achieved by SGW and its customers in recent years.



n Figure 10-3 : Historical demands and number of customers billed at Leongatha and Koonwarra

The population has grown steadily over the last two decades, with a particularly sharp increase in population in 2011, as seen in Figure 10-4. The population has increased from 4,202 in 2006 to 4,697 in 2011. The number of dwellings has increased at a similar rate.



n Figure 10-4 : Historical population in Leongatha and Koonwarra

10.3.2 Future demand projections

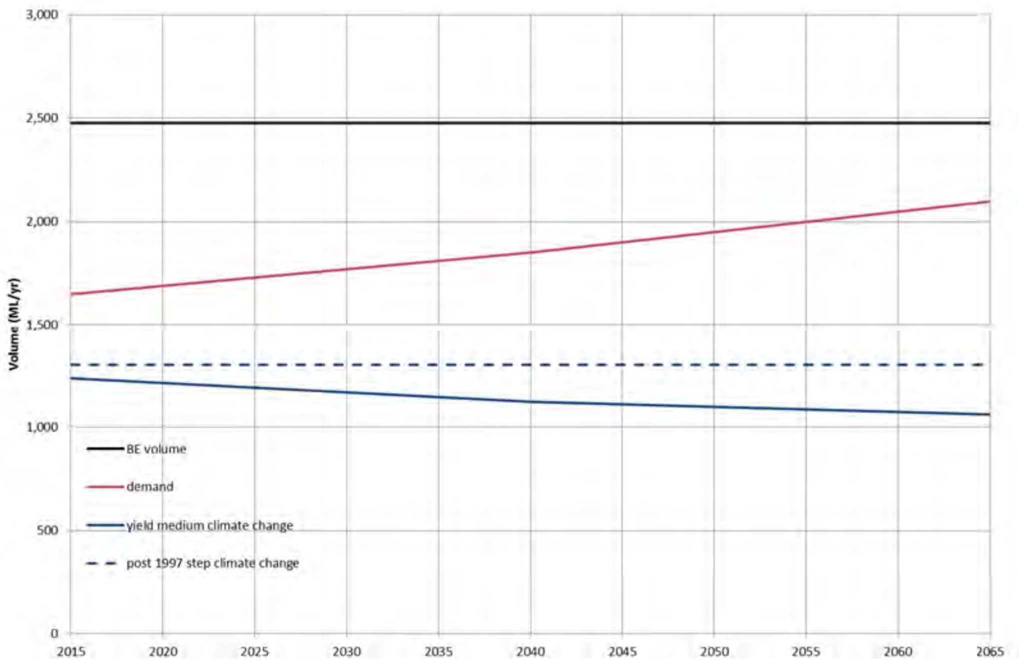
Future growth in Leongatha was estimated using Victoria in the Future estimates, which are available at a Statistical Local Area (SLA) level. There are five SLA's covering SGW's water supply area. Leongatha and Koonwarra are located within the South Gippsland Shire Central SLA and account for around 33% of the population within the SLA.

The population projections estimate a growth of between 0.5% and 1.3% per year with no change in major industrial demand. The urban demands and stock and domestic demand have assumed to increase up to 4% in accordance to the medium climate change scenario. This increase is due to increased water use activities such as garden watering under drier and hotter climate change conditions and is consistent with DELWP recommendations (DELWP, 2016a).

10.3.3 Future supply projections with current operation and infrastructure

Under the medium climate change scenario, runoff in the South Gippsland Basin in the year 2065 relative to the year 2015 is estimated to decrease by 17%, with a range of reduction of 1.6% to 45% under low and high climate change scenarios. Under the medium climate change scenario, this change in streamflow would be driven by a 4.5% reduction in rainfall and a 7% increase in evaporation.

The current operation and infrastructure water supply and demand situation for the Ruby Creek system is shown in Figure 10-5. This has been modelled using the medium climate change parameters outlined above. The medium climate change scenario yield is below the level of service objective for SGW. The high and low climate scenario also exhibited a shortfall in water reliability. Augmentation options for the Ruby Creek system are investigated in Section 12.4.



- Figure 10-5 : Current Operation and Infrastructure Water Supply and Demand for Leongatha and Koonwarra

10.4 Sensitivity of projections

Three potential land use changes with the catchments supplying Leongatha and Koonwarra were investigated to understand the potential risk they could pose to available supply.

Bushfires: Only 14% of the Ruby Creek catchment has vegetation cover. This means that the risk of catchment yield decreasing significantly due to the effects of bushfires is low. There is no record of bushfires occurring in the catchment over the last few decades.

Logging: No logging is undertaken under regional forestry agreements in the water supply catchment for this supply system.

Plantations: There are no significant plantations in the water supply catchment for this supply system.

10.5 Summary of the supply and demand for Leongatha and Koonwarra with current operation and infrastructure

In summary for Leongatha and Koonwarra under the Current Operation and Infrastructure supply and demand scenarios:

- Existing supply does not currently meet SGW's level of service objectives, which would continue to not be met under the medium climate change scenario without action by SGW;
- The existing supply does not include water from the Tarwin River West Branch, because the supply pipeline is currently not in an operational condition; and
- Demand for water has not increased in recent years, whilst population and the number of dwellings have increased.

SGW's strategy to address the potential future supply shortfall is presented in Section 12.4.

11. Supply and Demand Projections for Wonthaggi, Cape Paterson and Inverloch with Current Operation and Infrastructure

11.1 Introduction

This section of the UWS outlines the supply and demand projections for Wonthaggi, Cape Paterson and Inverloch over the next 50 years assuming current operation and infrastructure. It includes an overview of the current supply system configuration, current demand for water and current supply. It also includes supply and demand projections under future climate change over the 50 year planning horizon. SGW's response to any shortfall in demand under the current operation and infrastructure scenarios is presented in Section 12.2 in conjunction with nearby towns.

11.2 Current water supply and demand

11.2.1 Supply system description

The source of supply for the Wonthaggi/Inverloch system is from the 4,200 ML Lance Creek Reservoir with a dead storage of 200 ML. A treatment plant located at Lance Creek Reservoir services supplies to Wonthaggi, Inverloch and Cape Paterson. Water from the reservoir gravitates 4 km downstream via a 34.4 ML/d capacity pipeline to the junction with the Inverloch supply pipeline. It then travels a further 9 km via an 18.6 ML/d capacity pipeline to a 9 ML low level storage basin at the junction with the Wonthaggi-Cape Paterson pipeline.

The main supply to Inverloch consists of one 18.4 ML/d gravity main from the Inverloch junction to a 7.5 ML storage tank. Flow is boosted to the storage tank in peak demand periods. From the tank, flow gravitates directly to Inverloch's reticulation system via a 10.7 ML/d capacity pipeline.

Pumping stations, located adjacent to the 9 ML low level concrete-lined service basin at the Wonthaggi-Cape Paterson junction, supply the townships of Wonthaggi at a rate of 16 ML/d and Cape Paterson at a rate of 8 ML/d.

Water from the Melbourne supply pipeline can be transferred at a rate of 7.6 ML/d from Cardinia Reservoir into the clear water storage tank. Supply from Cardinia into the Wonthaggi system has never been used and would require new treatment equipment (chemical dosing) to be used. A schematic of the supply system is shown in Figure 11-1.

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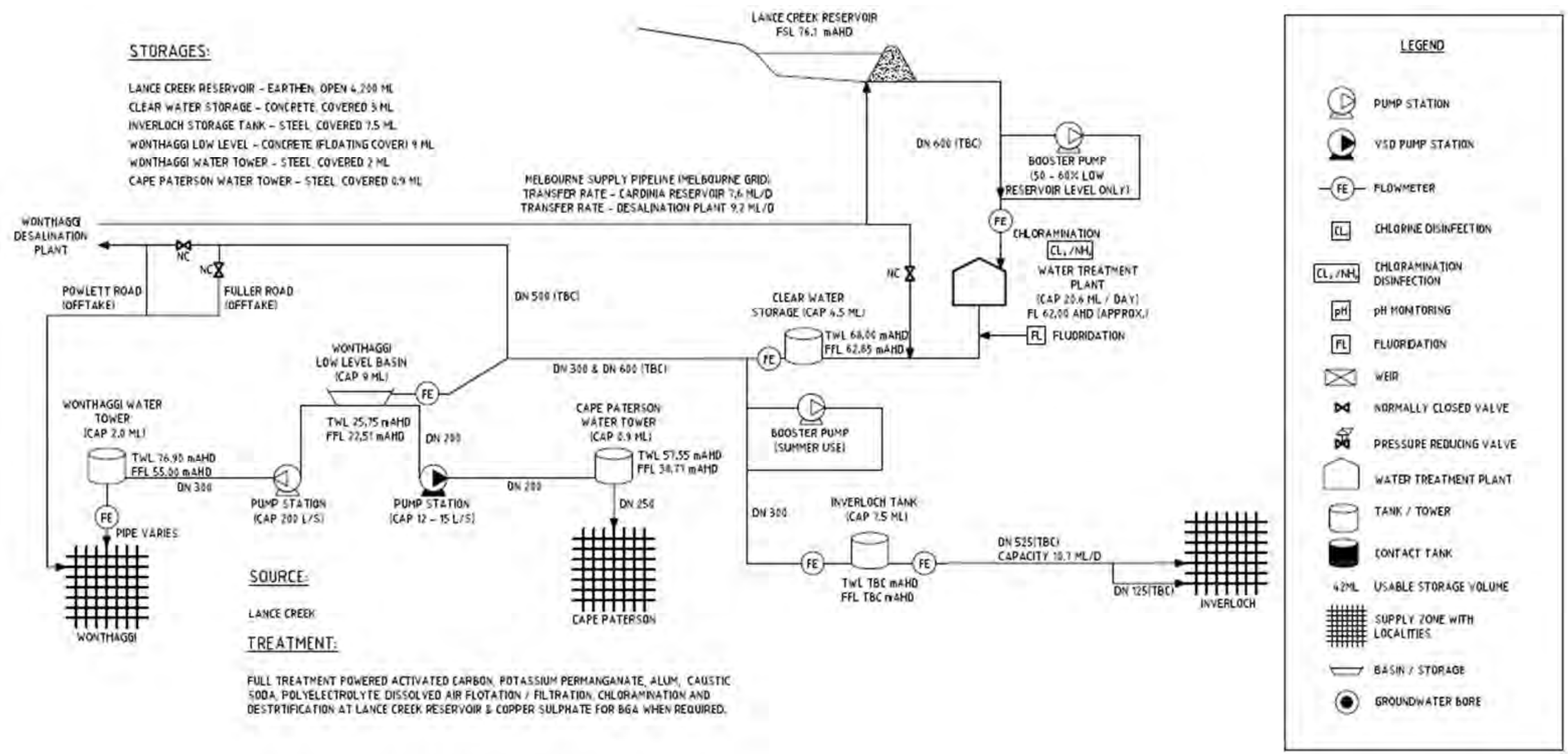


- Figure 11-1 : Lance Creek Schematic

11.2.2 Current legal entitlements to water

The bulk entitlement for Wonthaggi/Inverloch allows SGW to divert up to a maximum of 3,800 ML/yr from Lance Creek and 1,800 ML/yr from the Powlett River. The bulk entitlement details are shown in Table 11-1 and Table 11-2. The Powlett River entitlement is not currently utilised, and the supply infrastructure has been decommissioned.

Table 11-1 Bulk entitlement volume for Lance Creek

Source	Maximum annual volume (ML/yr)	Maximum diversion rate (ML/d)	Minimum passing flows
Lance Creek	3,800	35	100 ML/yr when Lance Creek storage greater than 3,000 ML in December (wet years). No daily minimum passing flow.
Powlett River	1,800	10	As per Table 11-2. Winterfill diversions only.
Melbourne system (Yarra River – Thomson Pool)	1,000	7.6	N/A

Table 11-2 Powlett River bulk entitlement

Flow in the Powlett River upstream of offtake, F (ML/d)	Flow available for diversion (ML/d)	Minimum passing flow (ML/d)
> 17	10	F – 10
12 – 17	5	F – 5
≤ 12	0	F

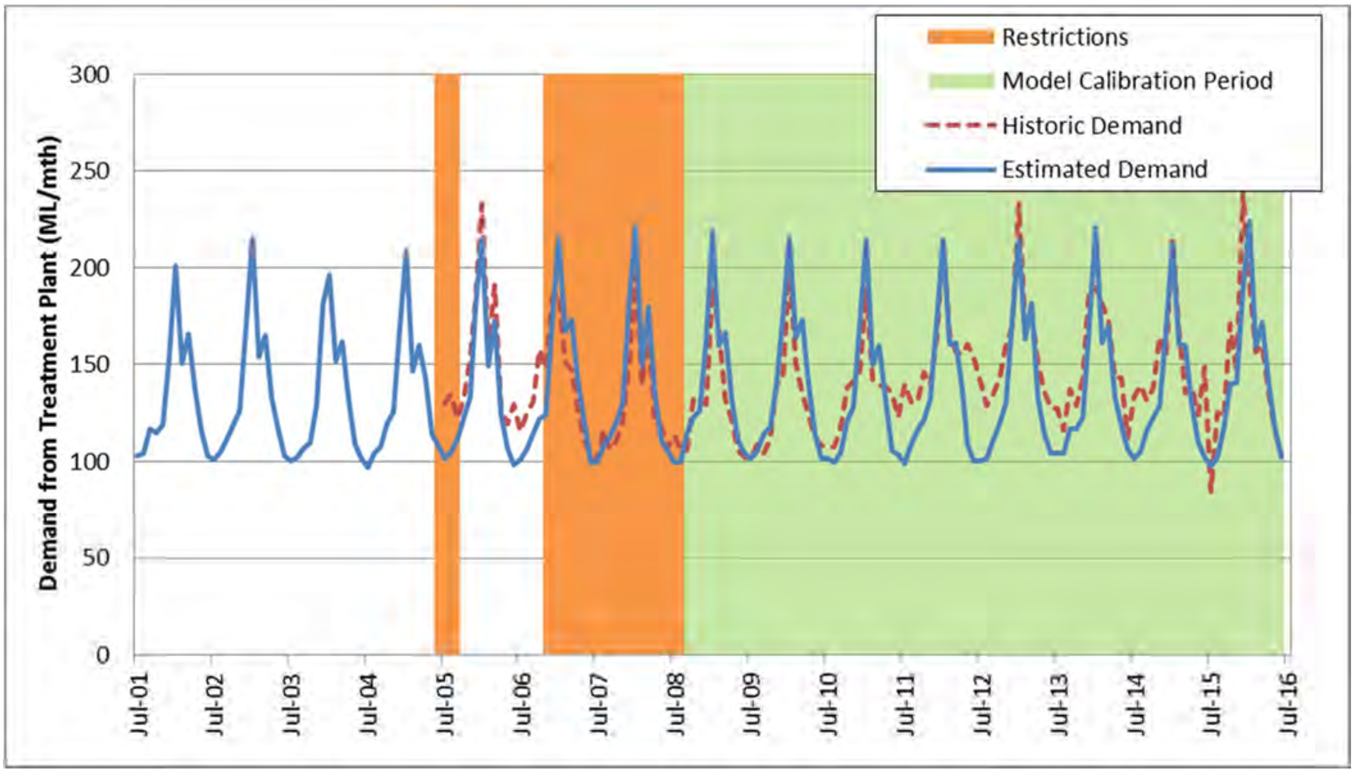
Note: F = flow in the Powlett River upstream of the offtake in ML/d.

SGW's bulk entitlement to access up to 1,000 ML/yr from the Melbourne system is available to supply Wonthaggi, Cape Paterson and Inverloch. A physical connection of 7.6 ML/d between Lance Creek and the Melbourne supply has been constructed and can be used to access the Melbourne supply. This UWS incorporates Melbourne Water's guidance on the annual allocation available under different climate assumptions and at different times over the 50 year planning horizon. These allocation forecasts have been explicitly incorporated into SGW's modelling. For reference, the annual allocation available to SGW for the current climate reflects approximately 70% of SGW's bulk entitlement (Melbourne Water, 2017). Future allocations under dry climate conditions are anticipated to drop even further.

The proposed operation of the Melbourne supply is yet to be finalised. In the short-term it is expected that SGW will develop operational triggers that could be used to best utilise the Melbourne supply which ideally take into account the cost of the Melbourne supply, the cost of restrictions, customer satisfaction associated with blending supply sources, and the physical ability to supply water from the Melbourne system to each demand centre. Where possible, this logic has been applied in the modelling undertaken for the UWS.

11.2.3 Current demand

Wonthaggi, Cape Paterson and Inverloch had populations of 7,252, 807 and 4,553 respectively in the 2011 census excluding visitors. This corresponds to a total of 12,612 people for the three towns. It is estimated that an additional 4,000 to 5,000 tourists visit the towns in the summer months. A demand model was fitted to the recent unrestricted data to estimate a long-term average annual demand, which takes into account how current demands would vary under a wider range of natural climate variability. Due to the influx of visitors to Inverloch and Cape Paterson, the demand model for this supply system assumes seasonal changes in population, as well as a relationship with air temperature. The historical and estimated long-term current demand is shown in Figure 11-2. The estimated long-term current (baseline) demand is **1,709 ML/yr** at SGW's treatment plant inlet, of which around 4% is utilised on average through the treatment plant. Winter demands increased in 2011 and 2012 due to supply to the desalination plant. Reduction since that time is also attributable to a recent reduction in industrial demands.



n Figure 11-2 : Long term monthly demands for Wonthaggi, Cape Paterson and Inverloch

Lance Creek services Cape Paterson, Inverloch and Wonthaggi, with the supply to each town shown in Table 11-3. As different growth rates are projected for the three Lance Creek towns, including a relatively high growth rate for Inverloch, the proportion supplied to each town will vary over the long term. As such Table 11-3 provides the 2002 – 2012 average annual split of the Lance Creek demands as well as the monthly range in individual years.

n Table 11-3 : Proportion of Lance Creek monthly demand

Outlet Flow Location	Average proportion of Lance Creek monthly demand	Range of proportion of Lance Creek monthly demand
Wonthaggi Tower	44%	35% - 55%
Inverloch Tank	36%	25% - 45%
Cape Paterson	6%	3% - 9%

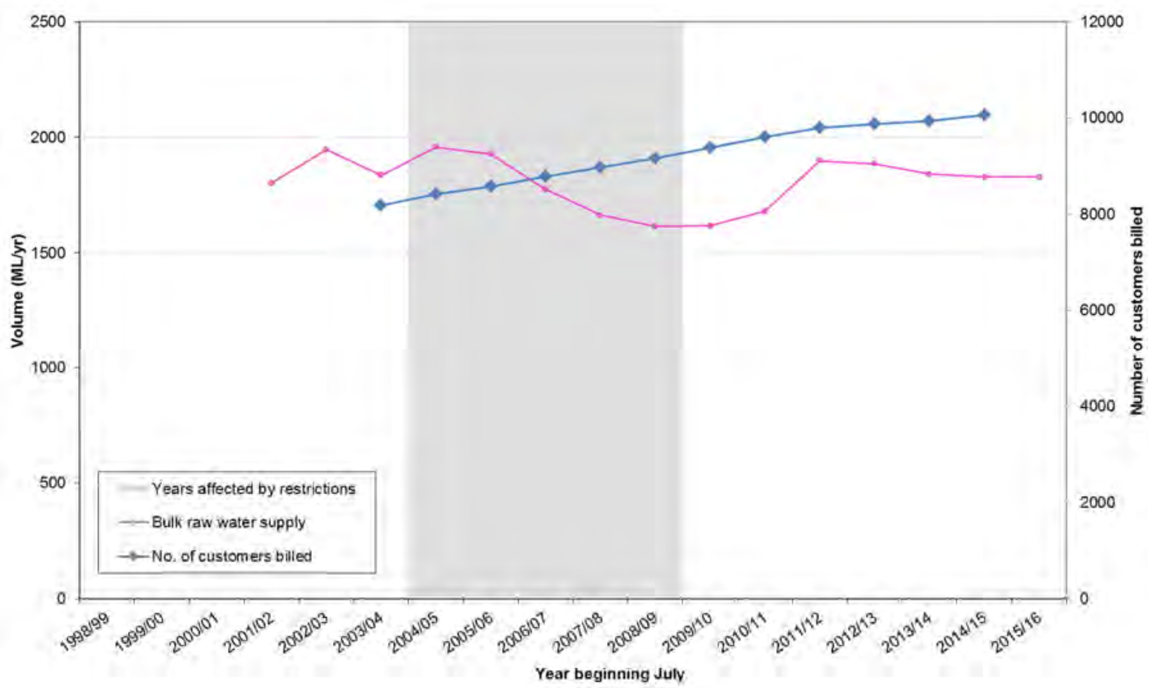
11.2.4 Current reliability of supply

Prior to 2005, there were no instances of water restrictions in this supply system. From 2005 to 2008 there was some form of restriction in every year, including Stage 4 restrictions in 2006/07. There have been no restrictions since 2007/08. The volume of dead storage in Lance Creek Reservoir has been reduced due to the use of a temporary pump, and drought response triggers have been adjusted accordingly. Reliability of supply modelling indicated that this system is currently meeting SGW's level of service objectives. Further details on the water resource model used to assess reliability of supply (and yield) can be found in Jacobs (2017).

11.3 Water supply and demand projections with current operation and infrastructure

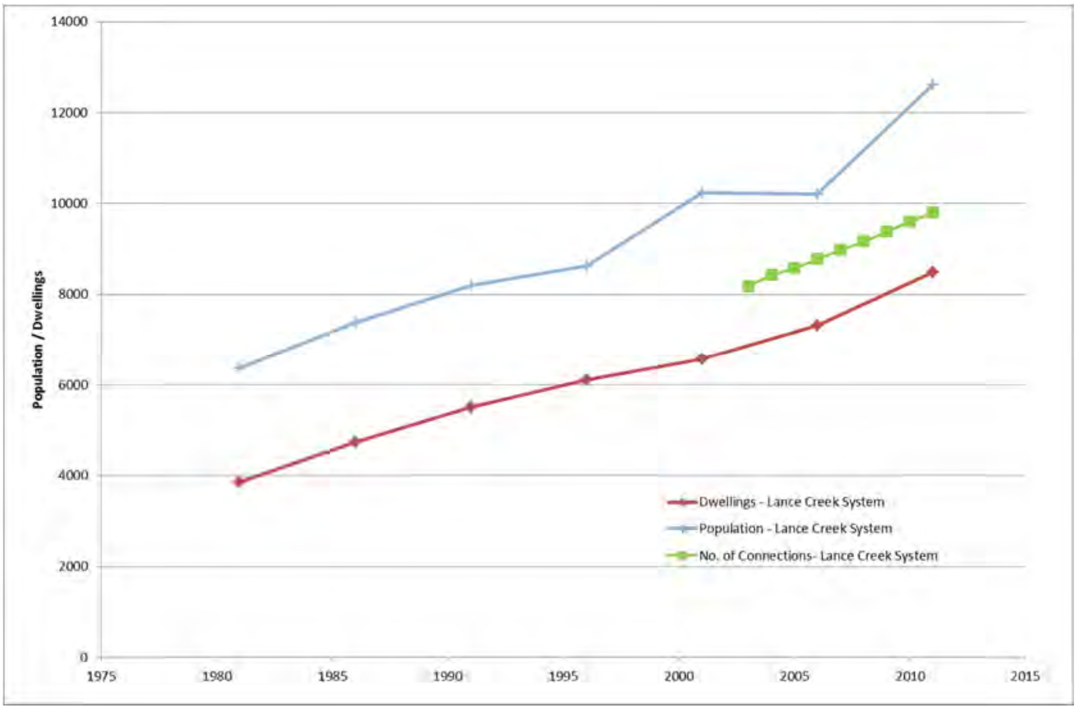
11.3.1 Historical trends

Bulk water supply from the Lance Creek system has increased since the end of the restriction period in 2009, as seen in Figure 11-3. However, this has since stabilised. The number of customers billed in this supply system has been consistently increasing since the early 2000's. This potentially indicates that significant water savings have been achieved by SGW and its customers in recent years. Major industrial demand has declined slightly over recent years.



■ Figure 11-3 : Historical diversions and number of customers billed at Wonthaggi, Cape Paterson and Inverloch

The populations of all three towns have grown significantly over the last two decades, as shown in Figure 11-4, particularly in the five years prior to the last census in 2011. The population has increased from 10,206 in 2006 to 12,612 in 2011. The number of dwellings have steadily increased in a manner consistent with the increase in population.



■ Figure 11-4 : Historical population in Wonthaggi, Cape Paterson and Inverloch

11.3.2 Future demand projections

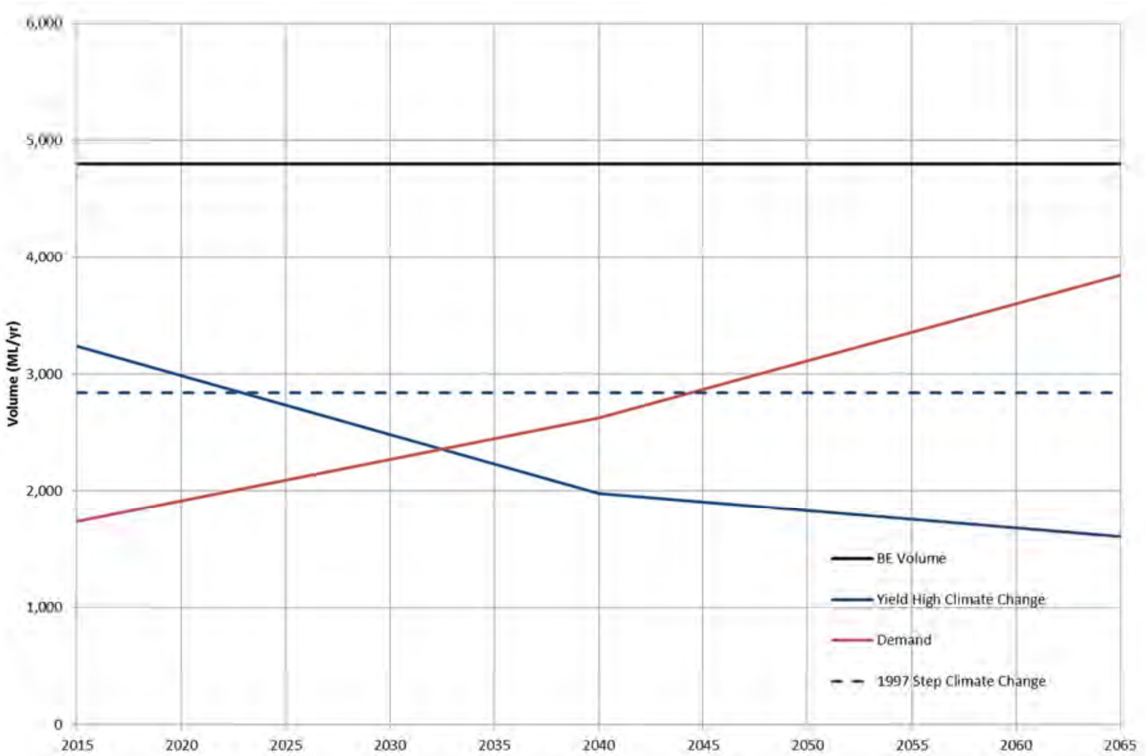
Future growth in Wonthaggi, Cape Paterson and Inverloch was estimated using Victoria in the Future projections, which are available at a Statistical Local Area (SLA) level. There are five SLA's covering SGW's water supply area. Wonthaggi, Cape Paterson and Inverloch are located within the Bass Coast Shire Central SLA and account for around 55% of the population within the SLA.

The population projections estimate a growth of between 1.7% and 2.6% per year with no change in major industrial demand. The stock and domestic and urban demands have assumed to increase up to 4% in accordance to the medium climate change scenario. This increase is due to increased water use activities such as garden watering under drier and hotter climate change conditions and is consistent with DELWP recommendations (DELWP, 2016a).

11.3.3 Future supply projections with current operation and infrastructure

The current operation and infrastructure supply and demand situation for the Lance Creek supply system using the Victoria in Future population projections are shown in Figure 11-5. The current operation and infrastructure scenario includes 1 GL entitlement from Melbourne, that can be accessed in accordance the carryover and allocation rules of Melbourne Water. The results shown in Figure 11-5 are for high climate change. With the current infrastructure and bulk entitlement arrangement, SGW's level of service objectives would be exceeded in around 2032.

Under the conditions of the Melbourne Bulk Entitlement, SGW has the option to purchase an additoinal 4 GL before June 2024. From 2019, Korumburra, Poowong, Loch and Nyora will be connected to the Lance Creek system. Given these changes to the supply system, the current system configuration was not assessed for other climate change scenarios. Instead, the system enhancements are presented in the strategy in Section 12, including consideration of the different climate assumptions.



n Figure 11-5 : Current operations and infrastructure water supply and demand for Wonthaggi, Cape Paterson and Inverloch

11.4 Sensitivity of projections

Three potential land use changes within the catchments supplying Wonthaggi, Cape Paterson and Inverloch were investigated to understand the potential risk they could pose to available water supply.

Bushfires: Only 5% of the Lance Creek catchment has vegetation cover. This means that the risk of catchment yield decreasing significantly due to the effects of bushfires is low. There is no record of bushfires occurring in the catchment over the last few decades.

Logging: No logging is undertaken under regional forestry agreements in the water supply catchment for this supply system.

Plantations: There are no plantations in the water supply catchment for this supply system.

Sensitivity is also dependent on future residential growth in Wonthaggi, Cape Paterson and Inverloch.

11.5 Summary of the supply and demand for Wonthaggi, Cape Paterson and Inverloch with current operation and infrastructure

In summary for Wonthaggi, Cape Paterson and Inverloch under the Current Operation and Infrastructure supply and demand scenarios:

- Existing supply meets SGW’s current level of service objectives for the next 15 years under the driest (high) climate change scenario considered;
- Demand for water over the 50 year planning horizon is expected to exceed available supply at SGW’s level of service under the Victoria in Future growth scenario, due to substantial projected population growth; and
- Demand for water has fallen in recent years, as has major industrial water use, whilst population and the number of dwellings have increased.

SGW’s strategy to address the potential future supply shortfall under the Local Growth scenario is presented in Section 12.2.

12. Strategy for SGW's Northern and Southern Towns

12.1 Introduction

This section of the document presents the demand reduction and supply enhancement strategy for towns west of the Tarwin River in SGW's northern and southern regions. These towns include Poowong, Loch, Nyora, Korumburra, Leongatha, Koonwarra, Cape Paterson, Inverloch and Wonthaggi. The strategy for these towns is considered collectively, because some of the supply options involve the development of an integrated system that sources water for all of these towns from Lance Creek Reservoir and the Melbourne supply system.

The strategies developed through previous WSDSs (2007, 2011) have been actioned by SGW over the past few years, with a pipeline connecting the Lance Creek system to the Melbourne supply system now operational. This pipeline was originally used by SGW to supply water for the construction of the desalination plant, however is now available to operate in reverse to supplement the water supplied to Cape Paterson, Inverloch and Wonthaggi. Furthermore, an interconnection from this system to Korumburra, Poowong, Loch and Nyora is currently being constructed and is due to commence operation in 2019. After this time, the headworks in the Coalition Creek and Little Bass systems will be decommissioned or re-commissioned for an alternative use.

As such, the strategy presented below consolidates the actions currently underway for the connection of Korumburra, Poowong, Loch and Nyora to the Lance Creek system. The strategy also presents options for the Leongatha system that either enhance the existing SGW headworks or add a connection to the Melbourne system via Lance Creek, or both.

When outlining these strategies, infrastructure has been sized to meet the requirements of the *Victoria in Future* demand projections. The medium climate change scenario has been used as the basis for establishing the yield available and the timing required for system upgrades. Information from alternative climate change scenarios has been used to provide an indication of the sensitivity of the strategy to growth and climate change assumptions.

A sustainability assessment comparing the strategies is presented in Section 12.5 followed by an action plan for SGW in Section 12.6.

12.2 Strategy for Wonthaggi, Inverloch and Cape Paterson

The current operation and infrastructure supply and demand projections presented in Section 11.3 of this document highlighted that existing supply is sufficient to meet SGW's current level of service objectives at least until the planned connection of Korumburra, Poowong, Loch and Nyora in 2019. The Lance Creek Connection Project will alter the current configuration of the Lance Creek system.

12.3 Connecting Korumburra, Poowong, Loch and Nyora to Lance Creek and the Melbourne system

The Lance Creek system is currently configured to supply Cape Paterson, Inverloch and Wonthaggi, drawing upon the local catchment and a 1GL bulk entitlement from the Melbourne system. Under this arrangement, treated water is available from the Melbourne system at a rate of 7.6 ML/d from Cardinia Reservoir. SGW have the option to purchase an additional 4 GL of bulk entitlement from the Melbourne system before 30 June 2024.

Estimates of the annual volume available to entitlement holders on the Melbourne system have been provided by Melbourne Water for the various climate scenarios and time periods of relevance to the UWS. This information indicates that the annual volume available to SGW on average, and in any given year, may be much lower than the maximum annual volume available under the bulk entitlement. The annual allocation to SGW is provided from the Greater Yarra System - Thomson River Pool, and is independent of the annual allocations to other water corporations from the operation of the Victorian Desalination Plant.

For the purposes of this strategy, information on potential allocations, excluding the operation of the desalination plant, have been used to modify the annual volume assumed to be available to SGW over the UWS planning horizon. Over time, more specific accounting rules may put in place by the resource managers for the Greater Yarra System – Thomson River Pool and the desalination plant, which would be expected to preserve the integrity of resource available under the Greater Yarra System – Thomson River Pool without operation of the desalination plant.

From 2019, the supply configuration for the system incorporates the Lance Creek Connection Project, which links Korumburra, Poowong, Loch and Nyora to the Lance Creek system. After 2019, the existing raw water supply and treatment plant infrastructure currently used to supply the Coalition Creek and Little Bass systems will be decommissioned or re-commissioned for an alternative purpose. Supplementary supplies from the Tarwin River West Branch and groundwater will no longer be available to supply Korumburra. Lance Creek Reservoir and the Melbourne connection will service the entire demands of Wonthaggi, Inverloch, Cape Paterson, Korumburra, Poowong, Loch and Nyora. As the treatment plant losses for the Lance Creek system are comparable to those in the Coalition Creek and Little Bass systems, the expected losses when these demands are linked will be similar to those currently observed in the individual systems.

The supply and demand projections for this scenario are presented in Figure 12-1. This suggests that additional bulk entitlement would be required from the Melbourne system in order to meet the future demands within the expanded Lance Creek system. The additional demands associated with Korumburra, Poowong, Loch and Nyora will fully utilise the existing water available shortly after connection, suggesting that SGW should purchase an additional 1GL of bulk entitlement from the Melbourne system in approximately 5 years.

The existing bulk entitlement agreement provides SGW with the option to purchase a total of 5 GL of bulk entitlement prior to 30 June 2024. Only 1 GL of this entitlement has been purchased at present. Under this agreement, the price for the additional bulk entitlement is fixed based on the method defined for the Melbourne system in 2009 and is therefore not subject to any shifts in market price or behaviour of individual sellers. Any additional entitlement obtained by SGW under this agreement would require the redistribution of entitlements held by other entitlement holders, which is likely to enhance water scarcity among users. This could impact on the market value of entitlements for any trading of allocations. Furthermore, demands on the Melbourne system are likely to increase in the future, further increasing scarcity.

As such, it is considered prudent for SGW to investigate the best way to purchase additional bulk entitlement from the Melbourne system. This investigation will take into account factors such as the sunset clause on the agreement to make an additional 4 GL available to SGW, the fixed price of bulk entitlements and the likely market price for water purchased from the future South Central Market. It is currently anticipated that 1 GL will be required in 2022 while the purchase of the remaining 3 GL (from the existing agreement) can be delayed until 2024 to minimise unnecessary costs. Access to this entitlement is required in the future, and will help maintain the level of service for the total demands on the interconnected Lance Creek system beyond 2050, as shown in Figure 12-1. Purchase of an additional 2 GL in 2053 is expected to meet the future demands over the long term planning horizon, although it is noted that this additional purchase would require negotiation between SGW and other entitlement holders.

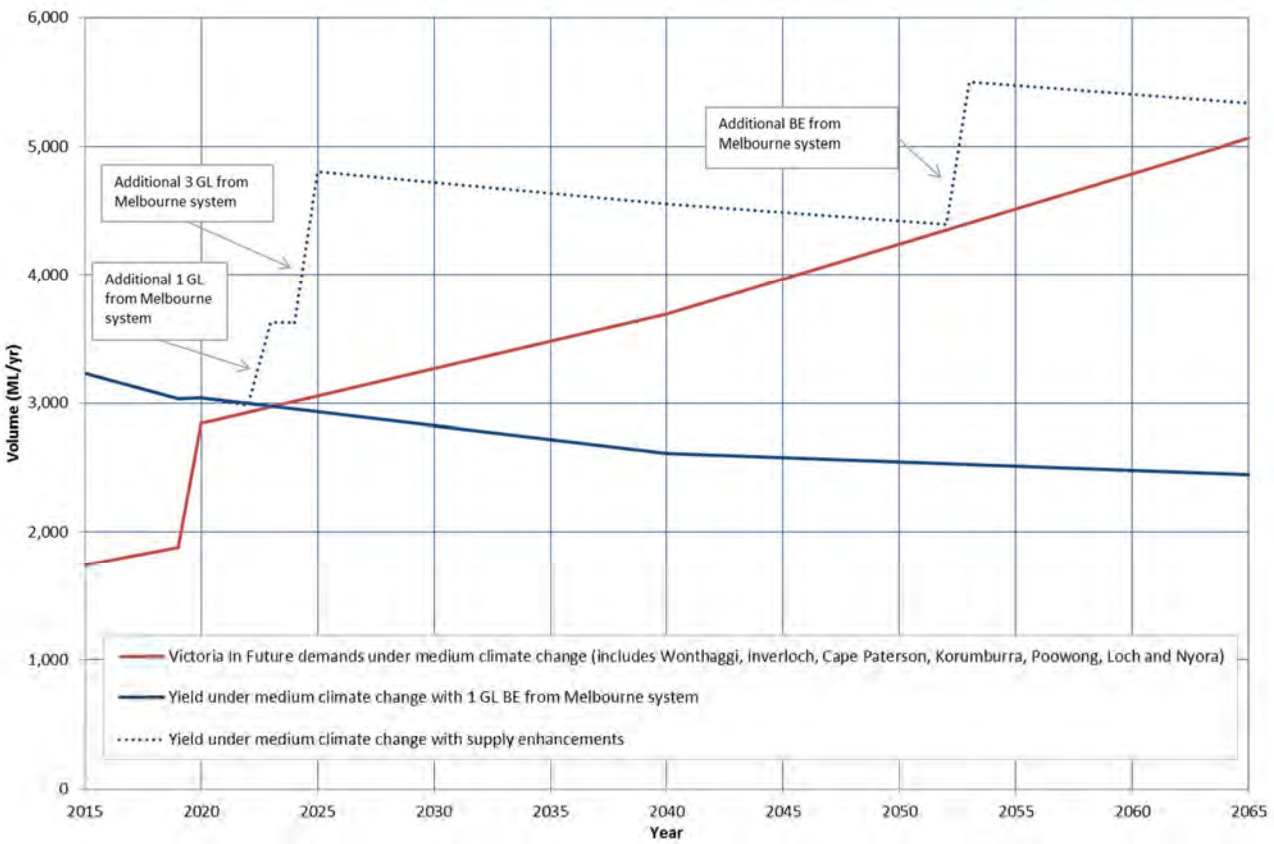


Figure 12-1 : Supply from Melbourne for Wonthaggi, Cape Paterson, Inverloch, Korumburra, Poowong, Loch and Nyora

SGW should also actively manage their carryover account associated with the Melbourne bulk entitlement. Under the conditions of the entitlement, carryover attached to the account can increase within the constraints of the available airspace within the Melbourne storages. If the use of the Melbourne entitlement is managed effectively, SGW could maximise the volume held in their carryover account, which would then be available to supplement other supplies in times of drought and allow purchase of additional bulk entitlement at the optimum time to minimise future fixed costs associated with the purchase.

The current capacity constraints associated with the pipeline infrastructure connecting the Melbourne pipeline to the Lance Creek system are also relevant for consideration when making decisions on the use of water from the Melbourne system. The existing pipeline has a capacity of 7.6 ML/d. It is expected that it will be necessary to duplicate this pipeline to support the increased water requirements over the planning horizon. This current pipeline will be suitable to provide the expanded Lance Creek system up to 2,700 ML/year. Based on the medium climate change scenario conditions, it is estimated that pipeline duplication would be required in approximately 20 years.

This strategy is based on an assumption of the prevalence of medium climate conditions. Contrary to the assumptions at the time of the previous WSDS, the connection to the Melbourne system does not offer a solution that is independent of rainfall. In contrast, the allocation provided from the Melbourne system could be significantly reduced in the event of extended dry climate conditions. Conversely, wetter conditions in the future could provide an increased allocation compared to that available under current climate conditions. The urgency associated with purchasing additional bulk entitlement from the Melbourne system is influenced by the assumed climate outlook. Dry climate conditions would require additional bulk entitlement to be available as soon as Korumburra, Poowong, Loch and Nyora are connected to the Lance Creek system, and additional entitlement would be required throughout the planning horizon to offset the reduced annual allocations from the Melbourne system. Under wetter than average conditions, the current 1 GL bulk entitlement is expected to be sufficient until the late 2020s. However, in this case, SGW should still consider the option to purchase the additional 4 GL of entitlement before the sunset clause in 2024. This may offer significant cost benefits compared to purchasing water on the open market. The Lance Creek system with a total 5 GL entitlement from Melbourne could provide the required level of service until at least 2060 under a wet climate change scenario.

12.4 Supply enhancements for Leongatha and Koonwarra

Over the past five years, the integrity of the supplementary supply pipeline to the Leongatha reservoirs has deteriorated and SGW no longer use the Lower Coalition Creek, the Tarwin River West Branch and local borefields to supply Leongatha and Koonwarra. In addition, the population forecasts and demand estimates have been updated in this latest UWS, which includes revised assumptions for the industrial demands. Demand reduction initiatives undertaken by industrial users are now operational, whereas the previous WSDS incorporated two alternative demand forecasts to represent different future potable water assumptions. The volume supplied by SGW to local industrial users has reduced compared to their demands in the early 2000's, however have remained constant since the end of the Millennium drought.

Consequently, SGW's level of service objectives are not achieved for Leongatha and Koonwarra and supply enhancement is required in the short term.

A number of supply enhancement options were identified through the development of this UWS. This includes upgrade of the supplementary supply pipeline from the Tarwin River West Branch, the development of groundwater resources, connection of Bellview Creek Reservoir to the Ruby Creek system and connection to the extended Lance Creek system via Korumburra.

12.4.1 Supplementary supply from the Tarwin River West Branch

SGW currently hold a bulk entitlement to extract water from the Lower Coalition Creek and Tarwin River West Branch. Despite the known water quality issues associated with this water source, this supply is designed to supplement the volume of water available within both the Ruby Creek and Korumburra storages during periods of drought. The current bulk entitlement is available until 30 June 2020 and allows for extractions all year, however the volume available during summer is minimal in order to provide environmental flows. The pipeline that connects the supplementary supply to the Ruby Creek storages is currently in a poor condition and is not operational. All extractions from the Tarwin River West Branch are currently provided to Korumburra.

The replacement of this supplementary supply pipeline has been assessed as an enhancement option for Leongatha. The general engineering concept is presented in Figure 12-2.

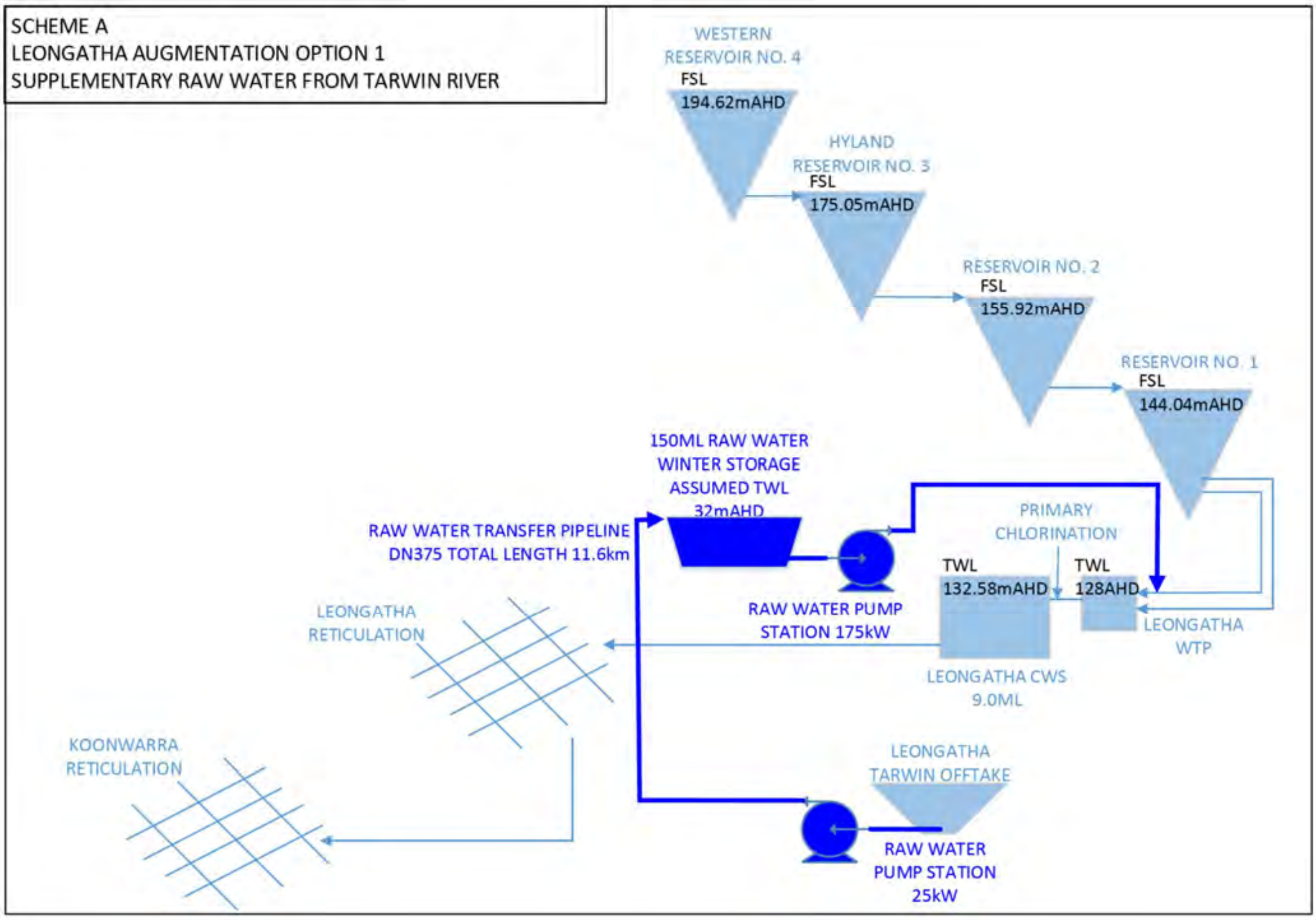


Figure 12-2 : Engineering concept for reinstatement of Tarwin River West Branch supplementary supply

This assumes that SGW could renegotiate the bulk entitlement to extend the current sunset clause associated with this extraction, particularly given that urban demands from the Korumburra catchments that feed into the Tarwin River would decrease. Under this arrangement, the water harvested by the Ruby Creek storages would be used preferentially. Nominal triggers for the activation of the supplementary supply would initiate pumping during periods of low inflows into Ruby Creek, subject to the availability of airspace in the storages to facilitate the harvesting of winter and spring runoff into the storages.

Known water quality issues associated with the Tarwin River West Branch make the treatment of this water source more complex than water harvested from Ruby Creek and Bellview Creek Reservoir.

Modelling results indicate that the reinstatement of the Tarwin River West Branch supply could provide an additional 280 ML/year of yield under baseline climate conditions. This volume is insufficient to meet Leongatha's service objectives under the current level of demands (Figure 12-4). In order to meet SGW's level of service objectives, the reinstatement of the Tarwin River West Branch supplementary supply would be required in combination with other supply enhancements.

12.4.2 Reinstatement of groundwater extraction

SGW currently hold groundwater licences in the Leongatha area. The bores are linked to the town water supply via the supplementary supply pipeline. The licence conditions attached to the bores are complex, making it difficult for SGW to operate these bores. The bore licences also place seasonal constraints on pumping. These issues mean that the current bores are not utilised.

Given the integrity of the connecting pipe infrastructure, reinstating the extraction of groundwater resources would also require the upgrade to the supplementary supply pipeline. This is possible if completed in combination with the option presented above. The general engineering concept presented in Figure 12-2 is also relevant for this option. Accessing the current groundwater bores to supplement Leongatha's water supply system increases the yield by approximately 50 ML/year compared to the operation of the supplementary supply alone (Figure 12-4). The total 320 ML/year of additional yield (when combined with the Tarwin River West Branch supplementary supply) is not sufficient to meet SGW's level of service objectives, unless developed in combination with other augmentation options.

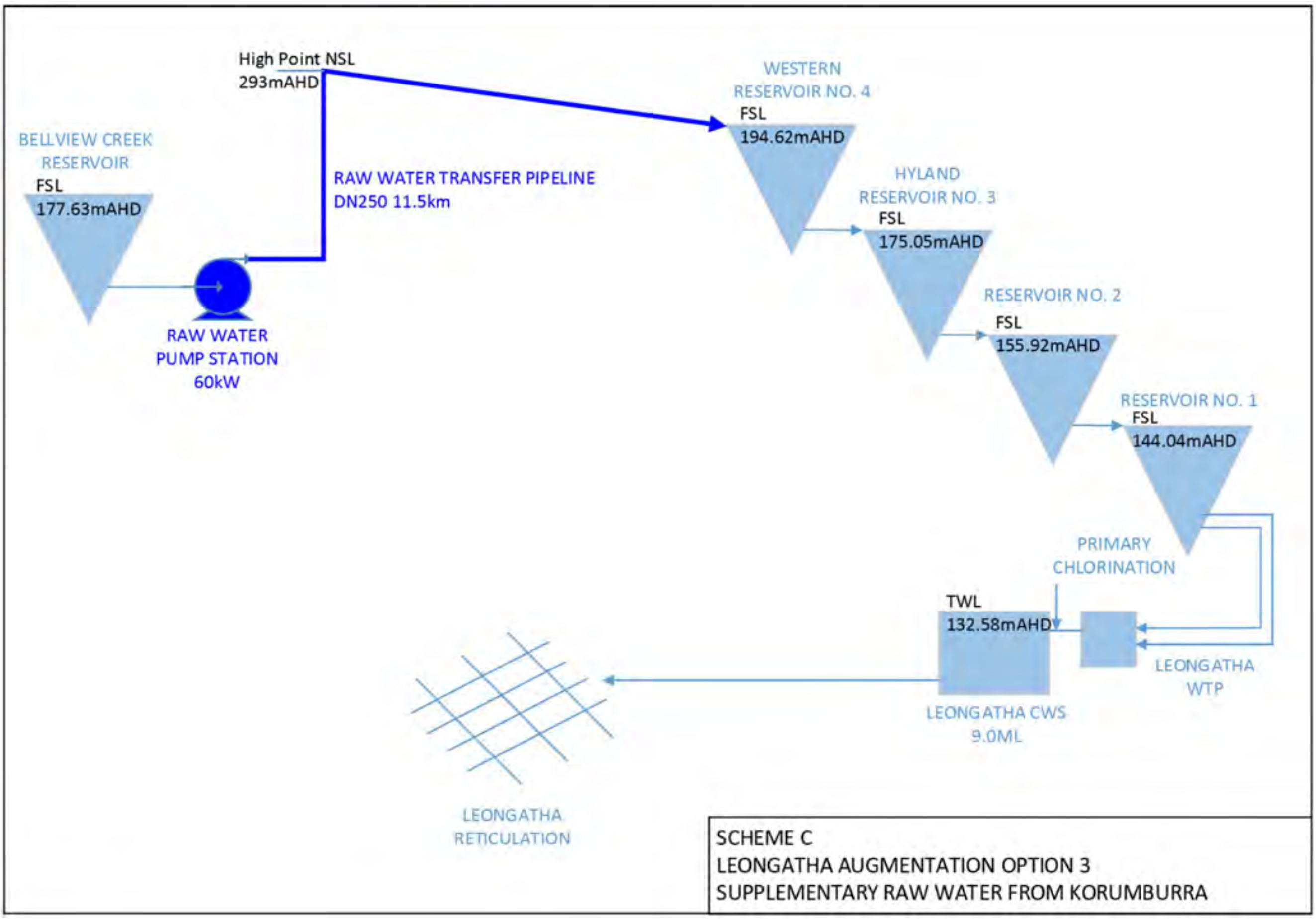
This assessment has been undertaken based on the current licence volume and conditions for the Leongatha bores. However, it is understood that local groundwater resources are not fully committed and it may be possible to increase this bore volume or negotiate a more relaxed set of operating conditions that improve yield in this system, in collaboration with Southern Rural Water. New bores may be suitable to meet the non-potable demands of the local football oval and golf course, subject to the findings of location, cost and groundwater yield assessments. Given the uncertainty of the outcomes of this process, yield assessments for these options have not been undertaken as a part of this UWS.

12.4.3 Connection of Bellview Creek Reservoir to the Ruby Creek system

Korumburra is scheduled to be connected to the Lance Creek system from 2019. Once connected to the Lance Creek system, Korumburra will no longer be connected to its existing storages. While SGW plans to lower or decommission the Ness Gully Storage and Coalition Creek (Number 2) Storage due to structural integrity concerns, Bellview Creek Reservoir may offer an option to augment the Leongatha system. This has the added benefit of reducing the decommissioning costs associated with the Korumburra system. Under this arrangement, the volume harvested from Bellview Creek would be available for transfer to the Ruby Creek system. The engineering concept associated with this option is presented in Figure 12-3.

For the purposes of assessing the potential yield gains from this option, it has been assumed that the current Bellview Creek bulk entitlement limits would apply. This allows a maximum extraction rate of 3 ML/d, with an annual limit of 1000 ML. In practice, this bulk entitlement would need to be transferred from the Korumburra system to the Leongatha system subject to the approval of the State Government. Details associated with the operation of this transfer have not yet been developed, so current yield estimates do not incorporate rules to constrain the use of this transfer that account for pumping costs or other operational limitations. The practical implementation of this transfer may need to be considered in more detail.

Based on these assumptions, modelling suggests that the connection of Bellview Creek Reservoir to the Ruby Creek system would provide additional yield to meet Leongatha's current and future demands until the late 2020's (Figure 12-4) under a medium climate change scenario with further augmentation required in the early 2020's (under the high climate scenario) or as late as 2050 (under the low climate change scenario). As such, this provides an enhancement option to resolve the current supply and demand imbalance, however further augmentation would be required within the planning horizon of this UWS.



n Figure 12-3 : Engineering concept for the connection of Bellview Creek Reservoir to the Ruby Creek system

12.4.4 Enhanced headworks system with Bellview Creek Reservoir, Tarwin River West Branch and groundwater

Given the above augmentation options do not fully meet SGW's level of service objectives when considered in isolation, an enhanced Ruby Creek system that combines a connection to Bellview Creek Reservoir with access to the Tarwin River West Branch supplementary supplies and local groundwater bores has been investigated. The engineering concept associated with this option reflects a combination of the options presented in Figure 12-2 and Figure 12-3.

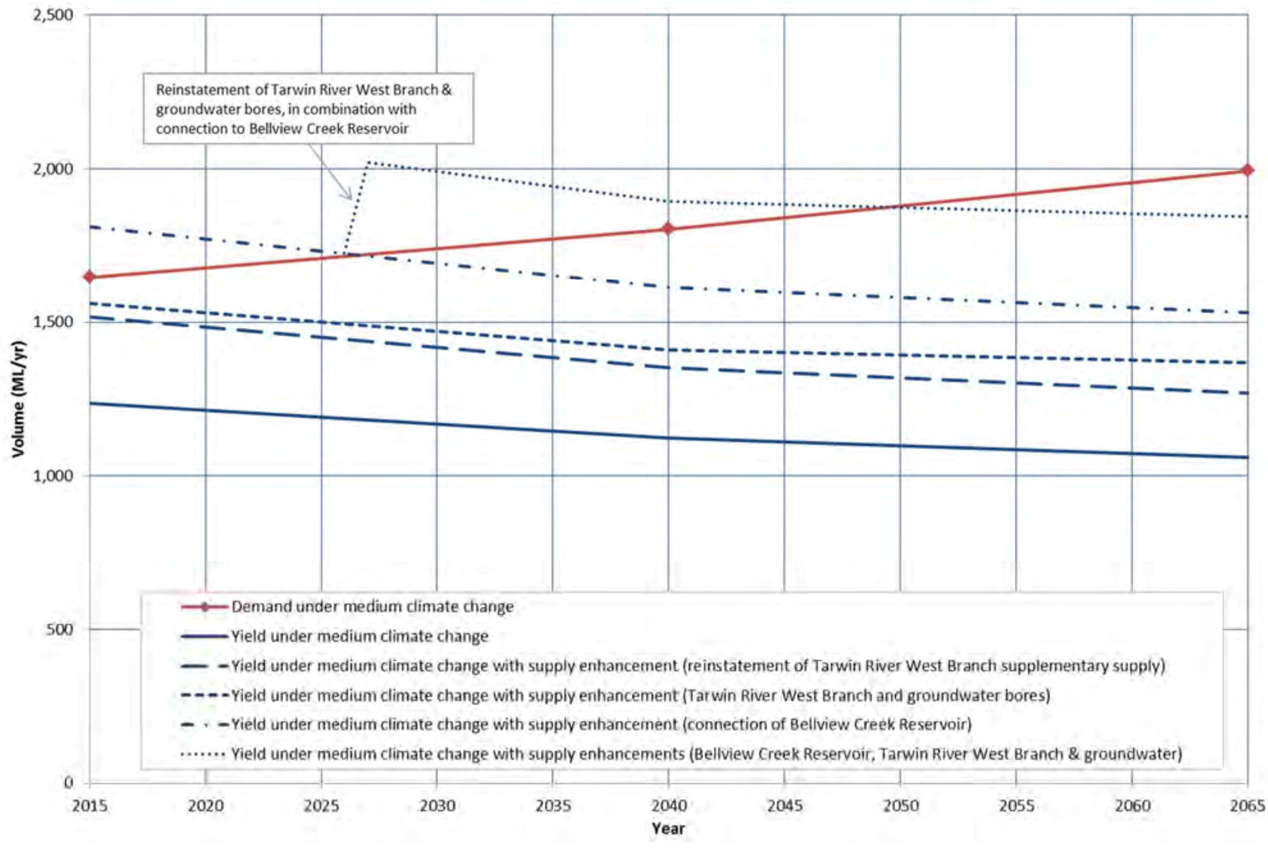
It is assumed that the Bellview Creek Reservoir connection would be commissioned in the short term, with the Tarwin River West Branch supplementary supply and local groundwater bores to be reinstated at some time following. This enhanced system would provide adequate yield to meet the demands until approximately 2050 under the medium climate change scenario.

Construction of an offstream storage has previously been flagged as an option to improve the capacity to extract water from the Tarwin River West Branch. This would provide additional storage to enable opportunities for the uptake of winter and spring extractions, since the airspace in the Ruby Creek storages may be limited during these seasons due to relatively high inflows from the local catchment. Assuming the offstream storage were sized appropriately, this would provide adequate water resources to fully supply Leongatha over the UWS planning horizon.

Preliminary cost estimates suggest that this option has a high capital infrastructure cost due to the replacement of the supplementary supply pipeline, and high ongoing costs associated with the pumping of water from the Tarwin River West Branch. The resulting Net Present Value estimate is greater than for other system enhancement options that include connection to the Lance Creek system via Korumburra.

This option also relies upon SGW being able to negotiate an amendment to the current Leongatha bulk entitlement to allow extractions from the Tarwin River West Branch to continue indefinitely. There is some uncertainty as to whether this extension would be granted, given local environmental risks and the constraints that this may place on future development in the upper Tarwin River catchment. This negotiation would also need to consider the latest information on the volume available within the Sustainable Diversion Limit for the catchment. The relatively poor water quality of the Tarwin River West Branch would require improvements to the Leongatha treatment plant.

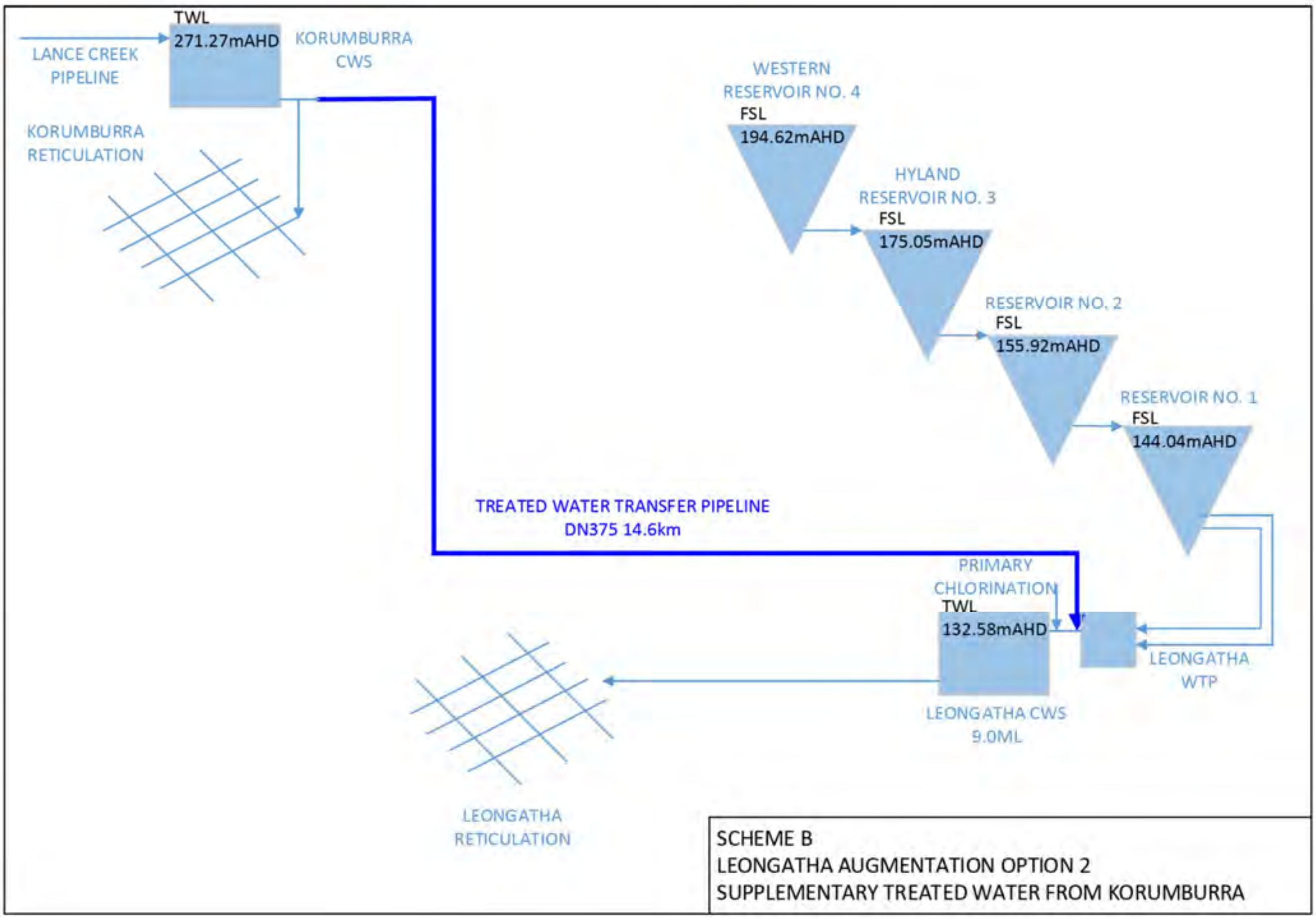
Given these challenges, this option is not the preferred approach for enhancing supply to Leongatha.



n Figure 12-4 : Supply to Leongatha from existing SGW headworks

12.4.5 Connection to the Lance Creek system via Korumburra

An alternative to local supply enhancement is to connect Leongatha from Lance Creek Reservoir and the Melbourne system. This option involves connection via Korumburra to supply Leongatha and Koonwarra, and the general engineering concept is presented in Figure 12-5. Two alternative options were considered, with the Lance Creek connection to either augment the existing Ruby Creek system or fully replace the current arrangement, with the Ruby Creek storages assumed to be decommissioned.



n Figure 12-5 : Engineering concept for the connection of Leongatha to the Lance Creek system via Korumburra

The connection of Leongatha and Koonwarra to Korumburra and Lance Creek creates an interlinked northern and southern towns system. As noted earlier, SGW would need to purchase additional bulk entitlement from the Melbourne system in order to maintain supply to Wonthaggi, Inverloch, Cape Paterson, Korumburra, Poowong, Loch and Nyora into the future. The addition of Leongatha and Koonwarra to this system would accelerate the need for additional bulk entitlement.

SGW would require a total of approximately 10 GL of bulk entitlement from the Melbourne system in order to meet the full demands of Leongatha, Koonwarra and the other northern and southern towns over the 50 year planning horizon, under a medium climate change scenario. This assumes that the existing Ruby Creek storages would be decommissioned and that Lance Creek Reservoir and the Melbourne system fully supplies Leongatha and Koonwarra. There is a significant cost associated with using water from the Melbourne system, including costs for the water as well as high pumping costs. In this instance, the pipe length and pump head means that the power costs for this arrangement are likely to be significant.

However, by reducing the volume to be pumped, the connection to Lance Creek becomes more viable. Retaining the Ruby Creek storages and supplementing the system with water from Lance Creek Reservoir and the Melbourne system provides SGW with a flexible and cost effective arrangement. Implementing this connection in combination with other supply enhancement options, such as the connection of Bellview Creek Reservoir, has also been assessed.

Supplementing the existing Ruby Creek system with water from Lance Creek and the Melbourne system brings forward the need for bulk entitlement purchase compared to that described for the extended Lance Creek system in Section 12.2. SGW may still take up the option for the full 5 GL entitlement from the Melbourne system before June 2024. Subsequent purchases of entitlement should be made incrementally to delay any unnecessary costs. These would be required during the period 2040 – 2055. This is presented in Figure 12-6, with the timing of bulk entitlement purchases assumed in order to meet the estimated demands.

If Bellview Creek Reservoir were also connected to the Ruby Creek system, the interconnection of Leongatha to the other northern and southern towns could be delayed until the late 2020s under the medium climate change scenario. It is assumed that SGW would have access to 5 GL of entitlement from the Melbourne system at this time, which would be sufficient to meet the total demands until almost 2050 under this climate change scenario, as shown in Figure 12-6. Additional entitlement would be required at this time.

Preliminary cost assessments indicate that there is little difference in NPV for these options that deliver supplementary supplies to the Ruby Creek system from Lance Creek via Korumburra, and that these options are much more cost effective than the reinstatement of the Tarwin West Branch supplementary supply. As such, it is expected that the northern towns would be fully connected at some stage in the future, with the timing of this connection subject to decisions on the suitability of linking Bellview Creek Reservoir to the Ruby Creek system.

The capital costs of connecting Bellview Creek Reservoir are broadly consistent with the cost of purchase and pumping water from Lance Creek via Korumburra. Further detailed design and costings would be required to differentiate between these two alternatives and provide a recommendation for the preferred approach. To help support this decision, it is anticipated that the details associated with the Melbourne bulk entitlement will be clarified over time, including the cost of water on the open market, the allocations provided under different climate regimes and the conditions attached to carryover accounts. Yield modelling would need to be revised in the future to refine the assumptions around the supply and demand balance of the broader connected system, and the timing requirements of additional bulk entitlement purchases. This would also enable the operation of the Lance Creek Connection Project (the connection of Korumburra, Poowong, Loch and Nyora) to be monitored and any operational refinements to be incorporated into that modelling.

Regardless of the decision on the connection of Bellview Creek Reservoir, it is relevant for SGW to consider the most appropriate strategy for the purchase of additional entitlements required for the extended Lance Creek system. There are fixed cost implications associated with entitlements from the Melbourne system that are payable regardless of the volume used. The cost of pumping water from Korumburra to Leongatha is also significant. As such SGW must balance a number of complex aspects to strategically utilise the connection to the Melbourne system. The recommendations for additional bulk entitlement purchases noted in this UWS assume that it is preferable to delay the cost until absolutely essential. In practice, SGW may have operational or strategic reasons to make purchases earlier or later than suggested, such as prevailing climate conditions, access to a large carryover account or significant changes to pumping costs.

The current capacity constraints associated with the pipeline infrastructure connecting the Melbourne pipeline to the Lance Creek system are also relevant for consideration when making decisions on the use of water from the Melbourne system. Based on the current limitations of 7.6 ML/d, it would be necessary to duplicate this pipeline to support the increased water requirements over the planning horizon. This current pipeline will be suitable to provide the interlinked northern and southern town system up to 2,700 ML/year. Based on the medium climate change scenario conditions, pipeline duplication would be required before 2040.

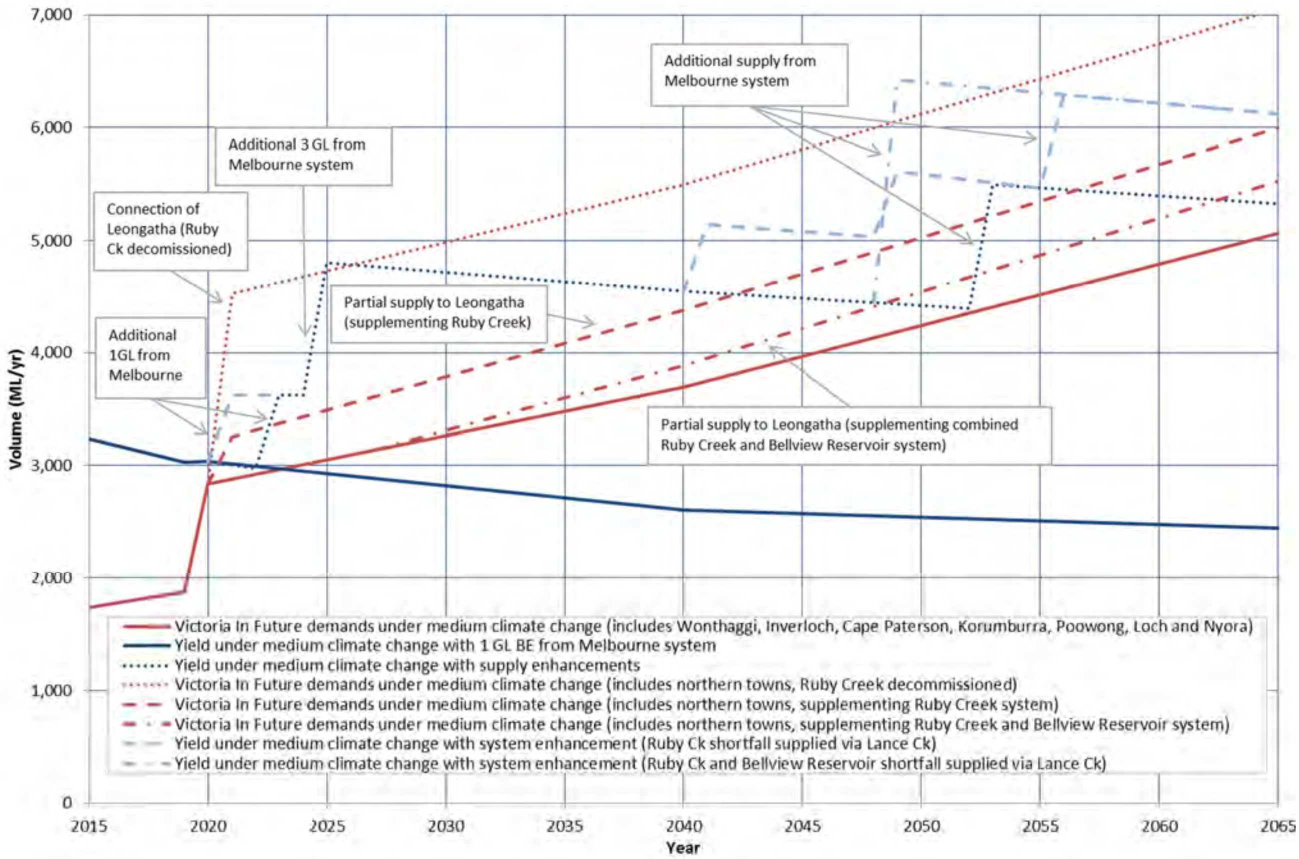


Figure 12-6 : Supply from Lance Creek Reservoir and Melbourne for all northern and southern towns

The resilience of this option was examined by considering the impacts of alternative climate scenarios. This analysis suggests that more immediate purchase of additional bulk entitlement would be required in the event of a drier climate. This would occur irrespective of whether Bellview Creek Reservoir is connected to the Ruby Creek system. Under these conditions, purchases of bulk entitlement from Melbourne would be required more urgently and to a greater total volume.

The converse is true under the low climate change scenario, with 5 GL from the Melbourne system sufficient to meet the level of service objectives until at least 2050 in the event that Bellview Creek Reservoir is not connected to the Ruby Creek system. The need for additional supply from the Melbourne system could be delayed until after 2055 if the Bellview Creek Reservoir connection to Ruby Creek were also implemented under the low climate change scenario.

12.5 Sustainability assessment of options

The introduction of demand reduction measures in line with other towns supplied by SGW will serve to minimise infrastructure costs and delay the need for supply augmentations. On a sustainability assessment, demand reduction measures will be preferable to augmenting the supply system, however in order to meet future demands both actions will be required.

The sustainability assessment for the northern and southern towns is specifically focused on the augmentation options available for Leongatha. The strategy presented for the other northern and southern towns is already in progress. This assessment compares the option to supply Leongatha from the local headworks to the options that involve connection to the Lance Creek Reservoir and Melbourne system. The outcome of the sustainability assessment is presented in Table 12-2, which confirms that the options that maintain the existing Ruby Creek infrastructure and add a connection to the Lance Creek system are preferable. The final preferred option requires additional detailed engineering designs, cost estimates and sustainability assessments to determine whether it is relevant to connect Bellview Creek Reservoir to the Lance Creek system. Key points to note about the sustainability assessment are as follows:

- The NPV estimates for the various options range from $48 million to $68 million, or $1485-2075/ML (Table 12-1). The greatest costs are associated with the supply of all Leongatha demands from the Lance Creek system coupled with the decommissioning of Ruby Creek storages. The enhancement of the existing headworks system is also more expensive that the options that include supplementing the existing Ruby Creek system with supplies from Lance Creek. These cost estimates are based on preliminary engineering concepts, prepared in 2017 with a 5.2% discount rate. Further refinement of costs is anticipated as the options are developed in more detail.

Table 12-1 : Cost estimates for options (based on high level concept engineering costs prepared in 2017, with 5.2% discount rate)

Option	Discounted capital costs ($million over the 50 year planning horizon)	Discounted operating costs ($million over the 50 year planning horizon)	NPV ($million over the 50 year planning horizon)	NPV ($/ML)
Enhanced Ruby Creek headworks - Connection of Bellview Creek Reservoir - Reinstatement of Tarwin River West Branch supplementary supply - Groundwater pumping	$43.5	$10.6	$54.1	$1650/ML
Decommission Ruby Creek storages and connect to the Lance Creek system	$20.4	$47.6	$68.0	$2075/ML
Existing Ruby Creek arrangement with demand shortfall supplied from Lance Creek	$27.0	$21.7	$48.7	$1485/ML
Existing Ruby Creek arrangement plus connection of Bellview Creek Reservoir with demand shortfall supplied from Lance Creek	$36.5	$12.3	$48.8	$1490/ML

- All options would support more regional development, both through the construction phase and by providing potable water supply to more customers. Options that include connection to the Lance Creek system provide greater flexibility to service demands under higher growth and drier climate change scenarios towards the end of the 50 year planning horizon, assuming all additional bulk entitlement is available for purchase from the Melbourne system. Options that draw upon the existing Ruby Creek storages as well as the Lance Creek system inherently include a backup supply in the event that the local system fails.
- The greenhouse gas emissions are relatively high for all options that include connection to the Lance Creek system, given the high pumping effort involved in transporting the water from Korumburra to Leongatha. The pumping energy requirements are less for the option that includes the connection to Bellview Creek Reservoir since this reduces the volume to be pumped. Reinstatement of the Tarwin River

West Branch supplementary supplies requires significant pumping, however the pump head and associated energy consumption is significantly lower than required for the Lance Creek connection. As such, this has the best greenhouse gas emissions outcome in the absence of carbon offsets.

- There is likely to be a net improvement in river health under the option that involves the decommissioning of the Ruby Creek storages, due to the increase in flows in the catchment following decommissioning. In contrast, enhancing the current headworks system would have a negative impact on flows in the Tarwin River West Branch. There is not likely to be a significant change in river health for those options that retain the Ruby Creek storages.
- Catchment water quality under the option to augment the existing headworks would be expected to marginally decrease due to changes to dilution flow in local streams in the Tarwin River catchment outlined above. Water quality is not expected to be impacted for other options.
- Other ecosystems are unlikely to be significantly affected as a result of either proposal. There is the possibility of a reduction in marine ecosystem health due to decreased river flows to the Tarwin River estuary under the option to enhance the existing headworks. For all options, vegetation may need to be cleared along proposed pipeline routes if those routes cannot be located in an existing cleared serviced corridor.
- All options are unlikely to have any impact on recreation and heritage activities in the area.
- SGW has undertaken a number of community consultation activities as a part of the development of this UWS, and feedback from the Leongatha customer base confirmed their desire for a solution that offers improved water security over the long term planning horizon. Customers were less interested in low cost or short term solutions. As such, solutions that connect Leongatha to the Lance Creek system are considered most acceptable, since this offers the flexibility for continued growth in the region and the ability to respond dry climate conditions. Decommissioning the Ruby Creek storages is deemed to be less favourable as this reduces the flexibility in the system.
- There is little difference in the confidence associated with each option. The options that provide a connection to the Lance Creek and Melbourne system offer a secondary water source in the event that the local Ruby Creek system fails, which is advantageous. However, there is some uncertainty in the future allocations that will be available from the Melbourne system, particularly towards the end of the 50 year planning horizon. Additional uncertainty is associated with the major industrial demand. Any significant change in their water requirements could alter the requirements for augmentation of the Leongatha system. Confidence in the demand reduction measures is slightly lower, reflecting the uncertainty in uptake of these initiatives.

Table 12-2 : Sustainability assessment of options for northern and southern towns (1)

Net present cost	Regional development	Greenhouse emissions	River health	Water quality	Other ecosystems	Culture, recreation and heritage	Social acceptability	Confidence flag
Option: Demand reduction measures								
5	1	5	1	0	0	0	3	1
Option: Enhanced Ruby Creek headworks system - connection of Bellview Reservoir - supplementary supply from Tarwin River West Branch - groundwater pumping								
-3	1	2	-2	-2	-1	0	-1	2
Option: Connection to the Lance Creek system - Ruby Creek storages decommissioned - all Leongatha demands supplied from Lance Creek system								
-5	2	-2	1	0	-1	0	1	2
Option: Connection to the Lance Creek system - Ruby Creek storages remain in service - demand shortfall supplied from Lance Creek system								
-2	3	-2	0	0	-1	0	3	2
Option: Connection to the Lance Creek system - Ruby Creek storages remain in service - Bellview Reservoir connected to the Ruby Creek system - demand shortfall supplied from Lance Creek system								
-2	3	-1	0	0	-1	0	3	2

(1) For broad comparison of options only. See Section 5 for further details of the function of this sustainability assessment within the planning process.

12.6 Strategy summary

There is some uncertainty in both the future demand and supply availability for SGW's northern and southern towns. SGW's planning approach is to monitor demand on an ongoing basis and adjust its plan of action accordingly. SGW's monitoring activities in relation to long-term planning for these towns are shown in Figure 12-7. This monitoring also includes monitoring of asset condition for some of its ageing assets or those in need of upgrade for other reasons, such as dam safety. In parallel with this monitoring, SGW will complete its planning investigations and preliminary design so that it can make a final decision on the preferred supply enhancement options available. Undertaking these planning investigations and preliminary design will also prepare SGW to implement supply enhancement quickly if changes in supply or demand occur. Once the preferred strategy is confirmed, SGW will then complete a detailed design and seek planning approvals before finally commissioning the new infrastructure. SGW will implement its demand reduction initiatives throughout this process and will continue to consult with its customers on the outcomes of its ongoing planning activities.

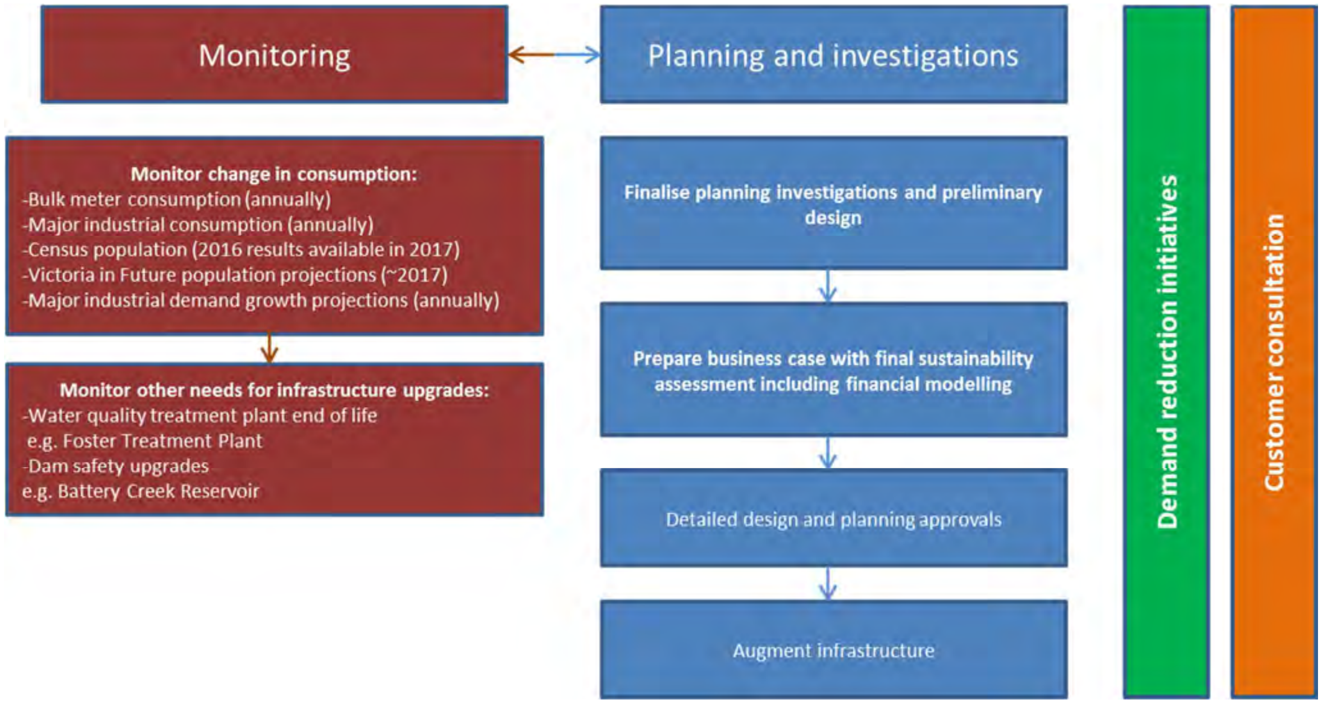


Figure 12-7 : SGW strategy for northern and southern towns

Whilst the course of action will vary subtly depending on the final preferred approach, the fundamental requirements of the options are generally consistent:

- Detailed investigations into the preferred option for Leongatha will commence in the short term;
- Regardless of the decision regarding the connection of Bellview Creek Reservoir to the Ruby Creek system, it is expected that Leongatha will be connected to the Lance Creek system via Korumburra at some stage in the future;
- Additional bulk entitlements from the Melbourne system are expected to be required to service the full demands of the interconnected system for the northern and southern towns; and
- The pipeline connecting Lance Creek to the Melbourne network will require duplication to support the increased transfer of water from this source.

Korumburra, Poowong, Loch and Nyora will be connected to the Lance Creek system in 2019 and forms the basis of any extension of this system to Leongatha.

The approximate timing associated with infrastructure augmentation is presented in Table 12-3. This highlights that SGW is expecting to implement augmentation options quickly after confirming the preferred option. Other actions will be timed to align with dam safety and treatment plant upgrades where practicable. As mentioned previously, the timing of these actions is subject to change as more information is collected by SGW. The timing of the purchase of bulk entitlement from the Melbourne system is assumed in order to meet the forecast demand estimates. In practice, SGW may bring forward or defer these purchases based on other factors, such as volume held in their carryover account, prevailing climate conditions, and expenditure budgets.

n Table 12-3 : Approximate timing of SGW infrastructure augmentation for the Northern and Southern Towns

Approximate Timing	Actions	
	Lance Creek	Leongatha
2019	Connect Korumburra, Poowong, Loch and Nyora to the Lance Creek system. Start planning and consultation for re-commissioning / decommissioning of existing Coalition Creek and Little Bass water treatment plants and raw water storages.	Initiate detailed investigation of Leongatha augmentation options and confirm preferred approach to supplement the Ruby Creek system. Alternative 1: Connection to Bellview Creek Reservoir and Lance Creek Alternative 2: Direct connection to Lance Creek
Next 5 years	Plan strategy for purchase additional BE from the Melbourne system for the connected Lance Creek system	Implement preferred Leongatha augmentation option Phase 1 (connection to Bellview Creek Reservoir or direct to Lance Creek)
Next 10 years	Purchase additional BE from the Melbourne system for the connected Lance Creek system	If relevant, implement Leongatha augmentation option Phase 2 (connection to Lance Creek)
From 2040	Planning to secure additional yield, (purchase additional BE from the Melbourne system, trade, local system augmentation)	

Immediate and ongoing actions which are applicable to both options are listed in Table 12-4. These include actions to monitor demands.

n Table 12-4 : Actions for SGW's northern and southern towns

Strategy	Actions
Reduce uncertainty in current estimate of consumer demand	Compare quarterly or four monthly consumption data from property and bulk meters
Reduce uncertainty in future estimate of consumer demand	Examine long-term trends in bulk water use independent of climate variability.
	Continue monitoring Burra Foods demand and request an annual update on longer term water demand forecasts
	Continue tracking Murray Goulburn and steam plant demand and request an annual update on its progress to achieve water savings
Encourage demand reduction	Pursue additional demand reduction options
	Continue ongoing program of system leak reduction and inspections for unmetered tappings

13. Supply and Demand Projections for Dumbalk with Current Operation and Infrastructure

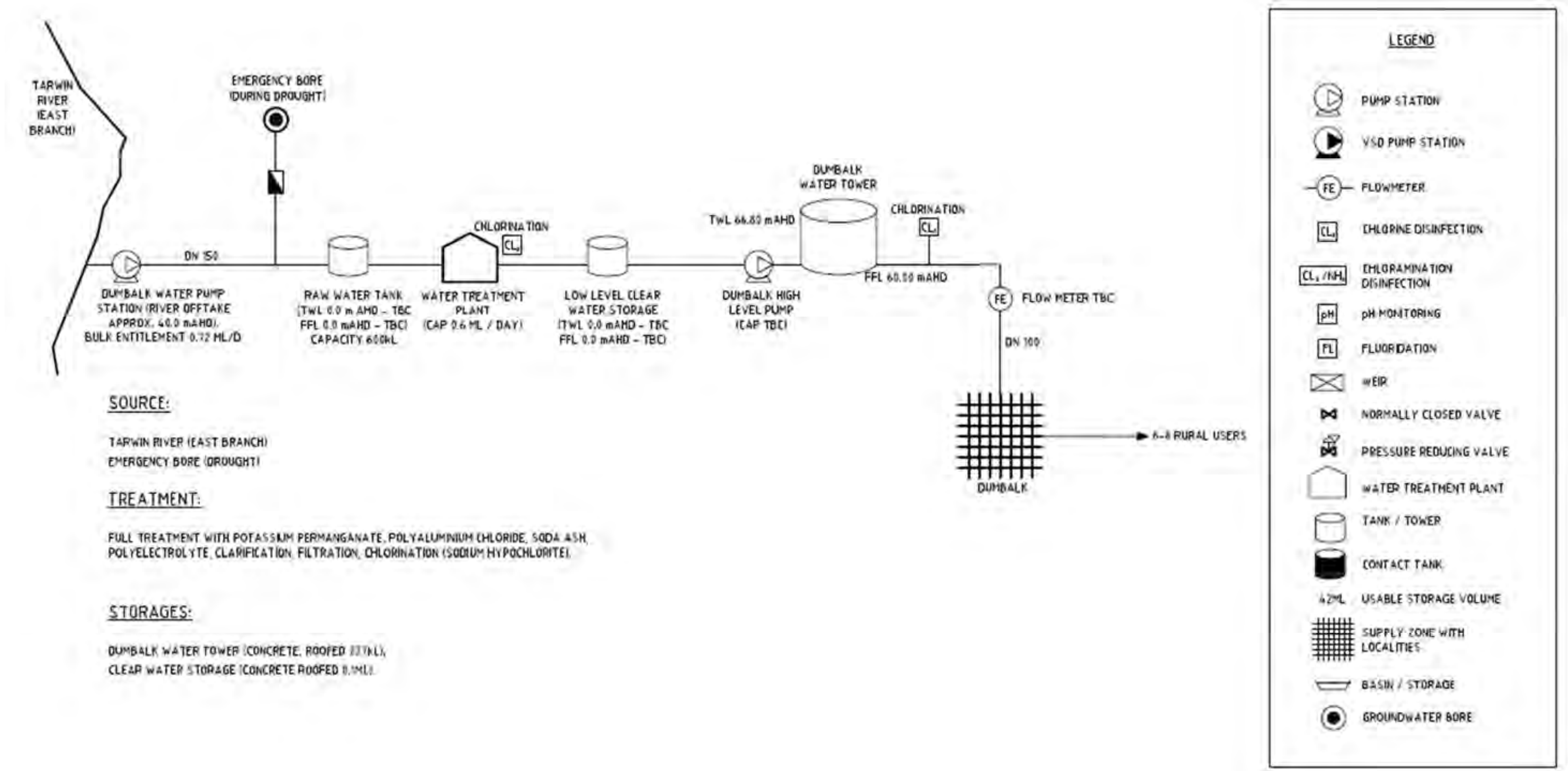
13.1 Introduction

This section of the UWS outlines the supply and demand projections for Dumbalk over the next 50 years assuming current operation and infrastructure. It includes an overview of the current supply system configuration, current demand for water and current supply. It also includes supply and demand projections under future climate change over the 50 year planning horizon. SGW's response to any shortfall in demand under the current operation and infrastructure scenarios is presented in Section 18 in conjunction with nearby towns.

13.2 Current water supply and demand

13.2.1 Supply system description

Dumbalk receives water directly from the east branch of the Tarwin River via a pump station which is located adjacent to the river. The pump station transfers water to the water treatment plant via a 150 mm diameter rising main. The capacity of the pumped diversion is 0.7 ML/d (21.3 ML/mth). The water treatment plant has a capacity of 0.4 ML/d (12.2 ML/mth). A schematic of the Dumbalk water supply system is shown in Figure 13-1.



- Figure 13-1 : Tarwin East (Dumbalk) Water supply system schematic

13.2.2 Current legal entitlements to water

The bulk entitlement for Dumbalk allows SGW to divert up to a maximum of 100 ML/yr from the Tarwin River. The daily bulk entitlement is shown in Table 13-1.

Table 13-1 Bulk entitlement volume for the Tarwin River at Dumbalk

Source	Maximum annual volume	Maximum diversion rate	Minimum passing flows
Tarwin River at Dumbalk	100 ML/yr	0.72 ML/d (21.9 ML/mth)	No minimum passing flows

13.2.3 Current demand

Dumbalk had a population of 147 people excluding visitors in the 2011 census. A demand model was fitted to the recent unrestricted data to estimate a long-term average annual demand, which takes into account how current demands would vary under a wider range of natural climate variability. The historical and estimated long-term current demand is shown in Figure 13-2. The estimated long-term current (baseline) demand is **14 ML/yr** at SGW's treatment plant inlet. There are 16% losses across the treatment plant.

Figure 13-2 shows that the long-term current demand is much lower than that which occurred historically and has been sustained for the last two years. This appears to be driven by reductions in the volume of non-revenue water, which is at historically very low values.

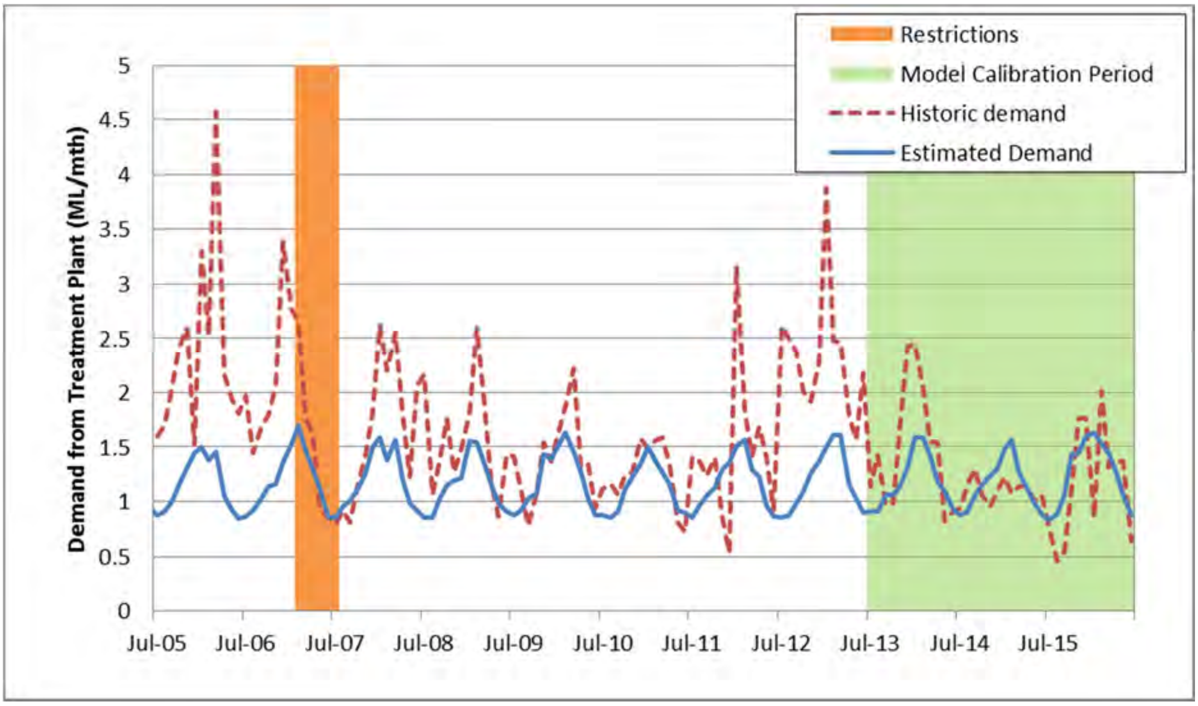


Figure 13-2 : Long term monthly demands for Dumbalk

13.2.4 Current reliability of supply

Restrictions have not been implemented in Dumbalk since 2007. Reliability of supply modelling over the period July 1950 to June 2016 indicated that restrictions are required 1 in 10 years over that period under a repeat of baseline climate conditions. This meets SGW's level of service objective for restrictions. It should be noted however that it has been reported that in the 1967/68 and 1982/83 droughts there was a need to sandbag the Tarwin River East branch to secure supply for the town. Further details on the water resource model used to assess reliability of supply (and yield) can be found in Jacobs (2017).

13.3 Water supply and demand projections with current operation and infrastructure

13.3.1 Historical trends

Historical demands have decreased significantly over the last few years, as shown in Figure 13-3. There was a peak in demand in 2012/13 after over 5 years of stable demand. The demands are raw water demands prior to the input to the treatment plant. The number of customers billed in this supply system has remained relatively static. The recent change in demand reflects a reduction in non-revenue water, however may include some water savings made by local customers.

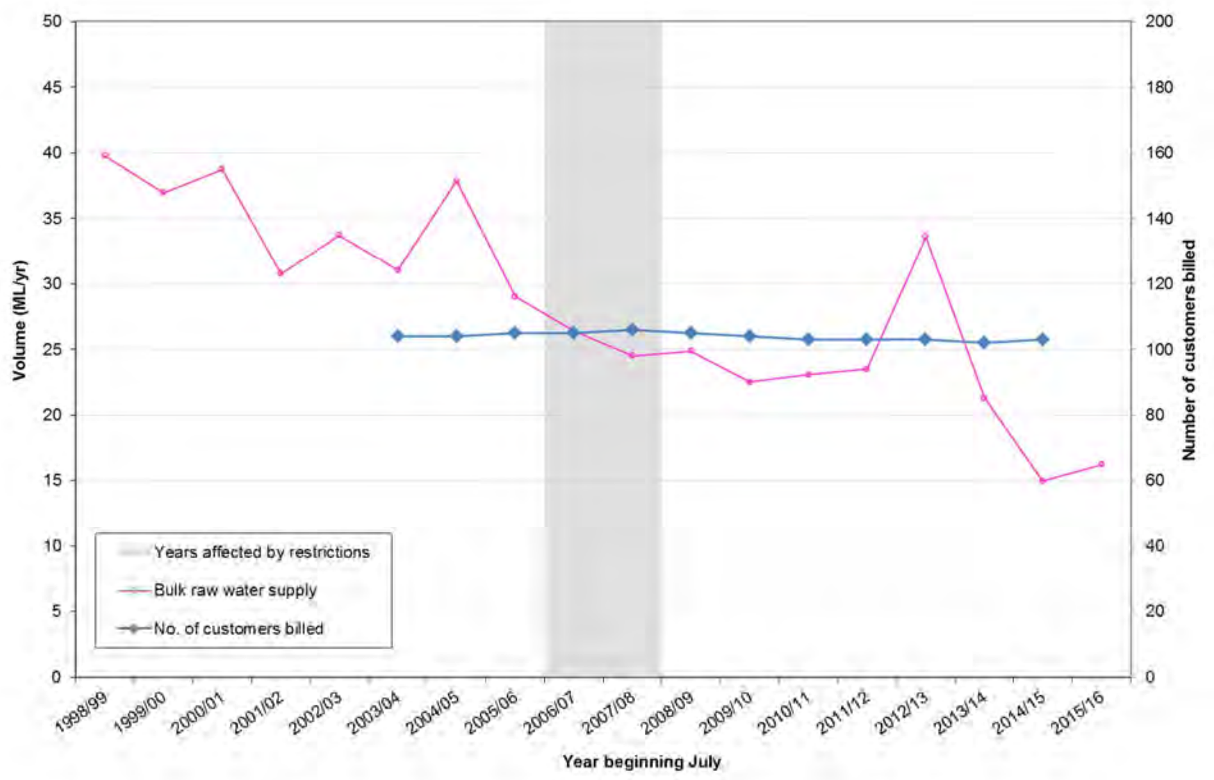


Figure 13-3 : Historical demands and number of customers billed at Dumbalk

The population of Dumbalk has fluctuated between approximately 140 – 190 people, with a slight decline in the last ten years, as seen in Figure 13-4. The number of dwellings have marginally increased in recent years, while the number of connections has remained stable.

n Figure 13-4 : Historical population in Dumbalk

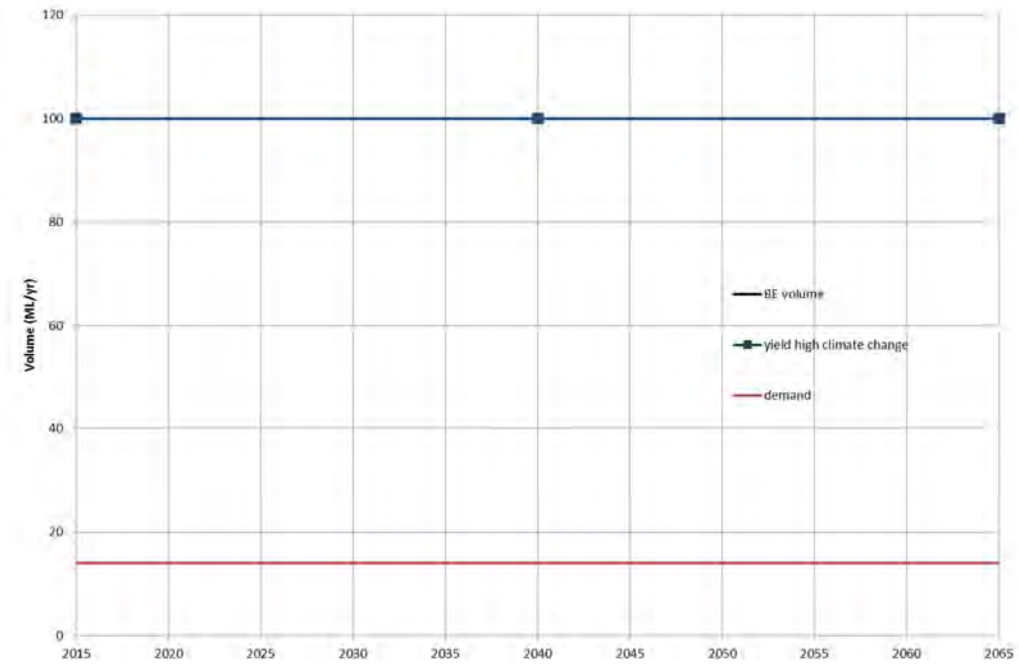
13.3.2 Future demand projections

Future growth in Dumbalk was estimated using Victoria in the Future estimates, which are available at a Statistical Local Area (SLA) level. There are five SLA's covering SGW's water supply area. Dumbalk is located within the South Gippsland East Shire SLA and account for around 3% of the population within the SLA. Hence, SLA projections are only likely to be broadly representative of growth in Dumbalk.

The population projections estimate a decrease of between 0.1% and 0.6% per year with no change in major industrial demand. The urban and stock and domestic demand has been assumed to increase by up to 14% in accordance to the medium climate change scenario. This increase is due to increased water use activities such as garden watering under drier and hotter climate change conditions and is consistent with DELWP recommendations (DELWP, 2016a).

13.3.3 Future supply projections with current operation and infrastructure

The current operation and infrastructure water supply and demand situation for the Dumbalk supply system at high climate change is shown in Figure 13-5. This shows that SGW's level of service objective is not exceeded within the planning horizon. Demands in this system appear flat due to the decline in population being balanced by the expected influence of climate change. The full bulk entitlement can be supplied over the full planning horizon, which is reflected in the flat yield curve.



- Figure 13-5 : Current operation and infrastructure water supply and demand for Dumbalk

13.4 Sensitivity of projections

Three potential land use changes within the catchment supplying Dumbalk were investigated to understand the potential risk they could pose to available supply.

Bushfires: Only 31% of the Tarwin River catchment upstream of Dumbalk has vegetation cover. This means that the risk of catchment yield decreasing significantly due to the effects of any future bushfires is low. There is no record of bushfires occurring in the catchment over the last few decades.

Logging: No logging is undertaken under regional forestry agreements in the water supply catchment for this supply system.

Plantations: There are no plantations in the water supply catchment for this supply system.

13.5 Summary of the supply and demand for Dumbalk with current operation and infrastructure

In summary for Dumbalk under the Current Operation and Infrastructure supply and demand scenarios:

- Existing supply is sufficient to meet SGW's current level of service objectives over the 50 year planning horizon, even under the high climate change scenario; and
- Demand for water has fallen in recent years and population has slightly increased.

A summary of SGW's strategy for Dumbalk in the context of SGW's strategy for the central towns is presented in Section 18.

14. Supply and Demand Projections for Meeniyan with Current Operation and Infrastructure

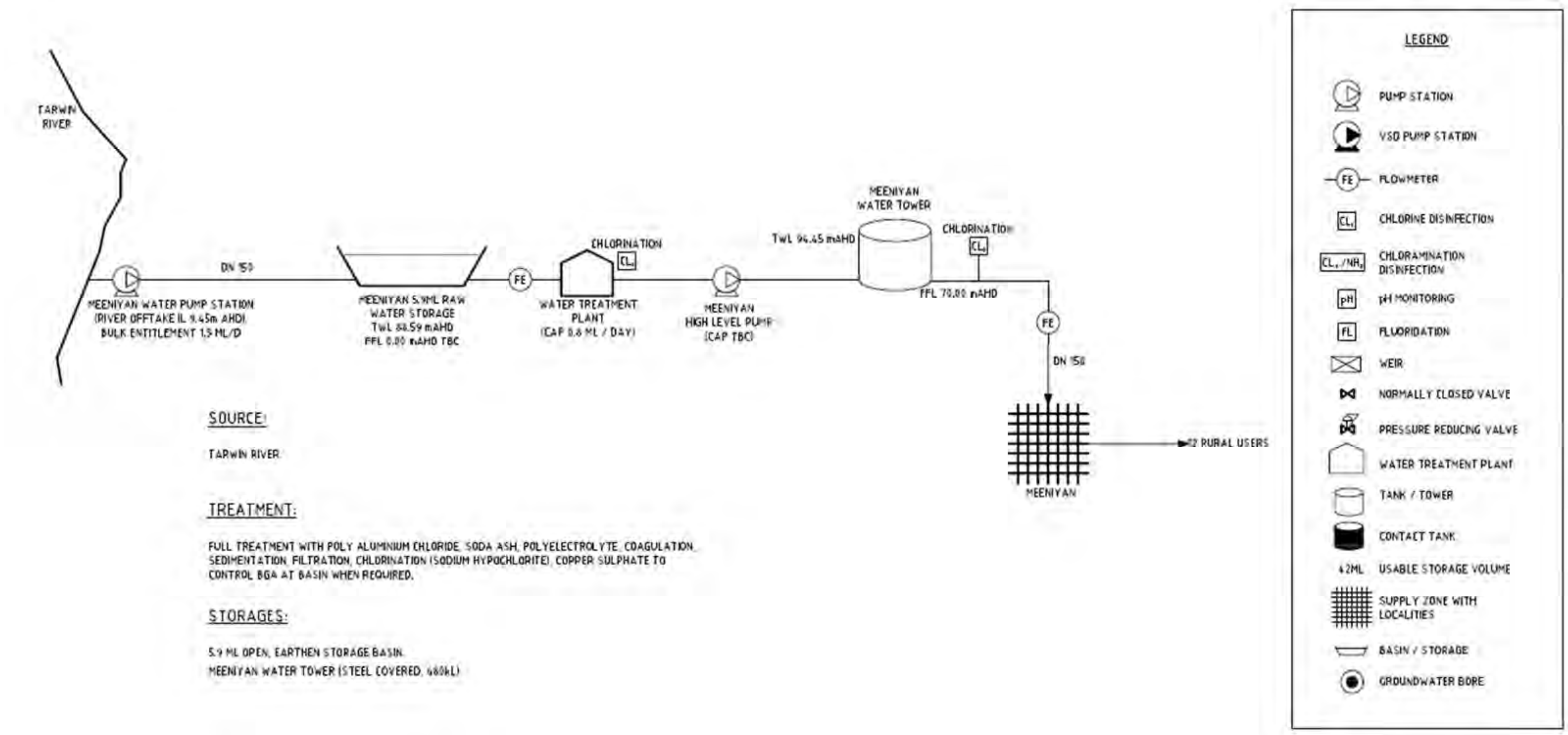
14.1 Introduction

This section of the UWS outlines the supply and demand projections for Meeniyan over the next 50 years assuming current operation and infrastructure. It includes an overview of the current supply system configuration, current demand for water and current supply. It also includes supply and demand projections under future climate change over the 50 year planning horizon. SGW's response to any shortfall in demand under the current operation and infrastructure scenarios is presented in Section 18 in conjunction with nearby towns.

14.2 Current water supply and demand

14.2.1 Supply system description

Meeniyan's water supply is taken directly from the Tarwin River at Meeniyan (downstream of 227202). A pump station located adjacent to the river transfers water via a 150 mm diameter pipe to a small water storage basin (5.5 ML) located south of the town centre. A schematic of the Meeniyan water supply system is shown in Figure 14-1.



- Figure 14-1 : Tarwin River (Meeniyan) Water supply system schematic

14.2.2 Current legal entitlements to water

The bulk entitlement for Meeniyan allows SGW to divert up to a maximum of 200 ML/yr from the Tarwin River. The daily bulk entitlement is shown in Table 14-1. A qualification of rights to this entitlement was granted in 2008, which allowed up to 1,800 ML/yr to be diverted from Gwyther's Siding Road to supply Leongatha and Korumburra. This qualification of rights has since been formalised in the entitlements for Leongatha and Korumburra, with a limitation on extractions until 2020. This discussed in detail in the sections of this WSDS for those supply systems.

Table 14-1 Bulk entitlement volume for the Tarwin River at Meeniyan (SGW, 2007)

Source	Maximum annual volume	Maximum diversion rate	Minimum passing flows
Tarwin River at Meeniyan	200 ML/yr	1.3 ML/d (39.5 ML/mth)	No minimum passing flows

14.2.3 Current demand

Meeniyan had a population of 440 people excluding visitors in the 2011 census. A demand model was fitted to recent unrestricted data to estimate long-term average annual demand, which takes into account how current demands would vary under a wider range of natural climate variability. The historical and estimated long-term current (baseline) demand is shown in Figure 14-2. The long-term average annual demand is **66 ML/yr** at SGW's treatment plant inlet, of which around 14% is utilised on average through the treatment plant. Demands have increased slightly over recent years.

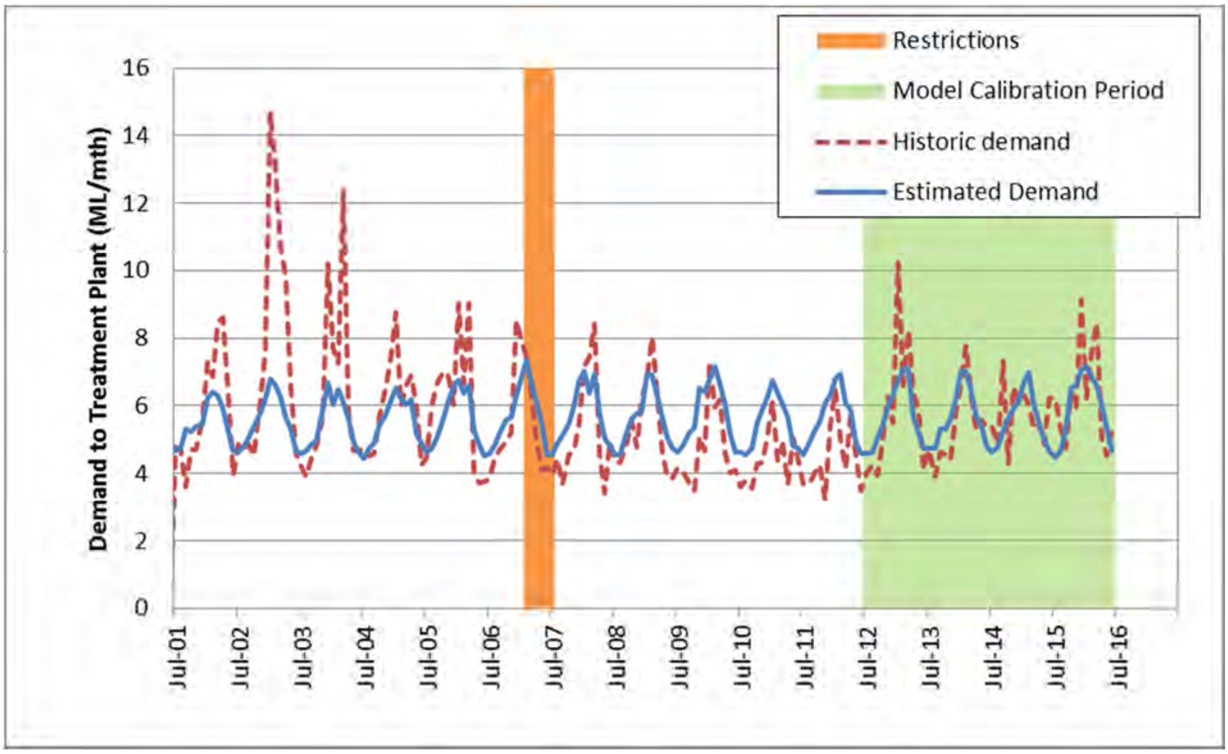


Figure 14-2 : Long term monthly demands for Meeniyan

14.2.4 Current reliability of supply

Restrictions were introduced at Meeniyan from February to June 2007, which included several months of Stage 4 restrictions. However, there have been no restrictions since that time. Reliability of supply modelling over the period July 1950 to June 2016 indicated that restrictions would have been required 1 in every 30 years under a repeat of baseline climate conditions. This meets SGW's level of service objective for restrictions. Further details on the water resource model used to assess reliability of supply (and yield) can be found in Jacobs (2017).

14.3 Water supply and demand projections with current operation and infrastructure

14.3.1 Historical trends

Historical demands have increased steadily over the last few years, as shown in Figure 14-3. Bulk potable water supply varied between 65-75 ML/yr since the last significant increase in demand in 2012/13. The number of customers billed in this supply system has increased marginally, with this increase occurring over periods of both reducing and increasing demand.

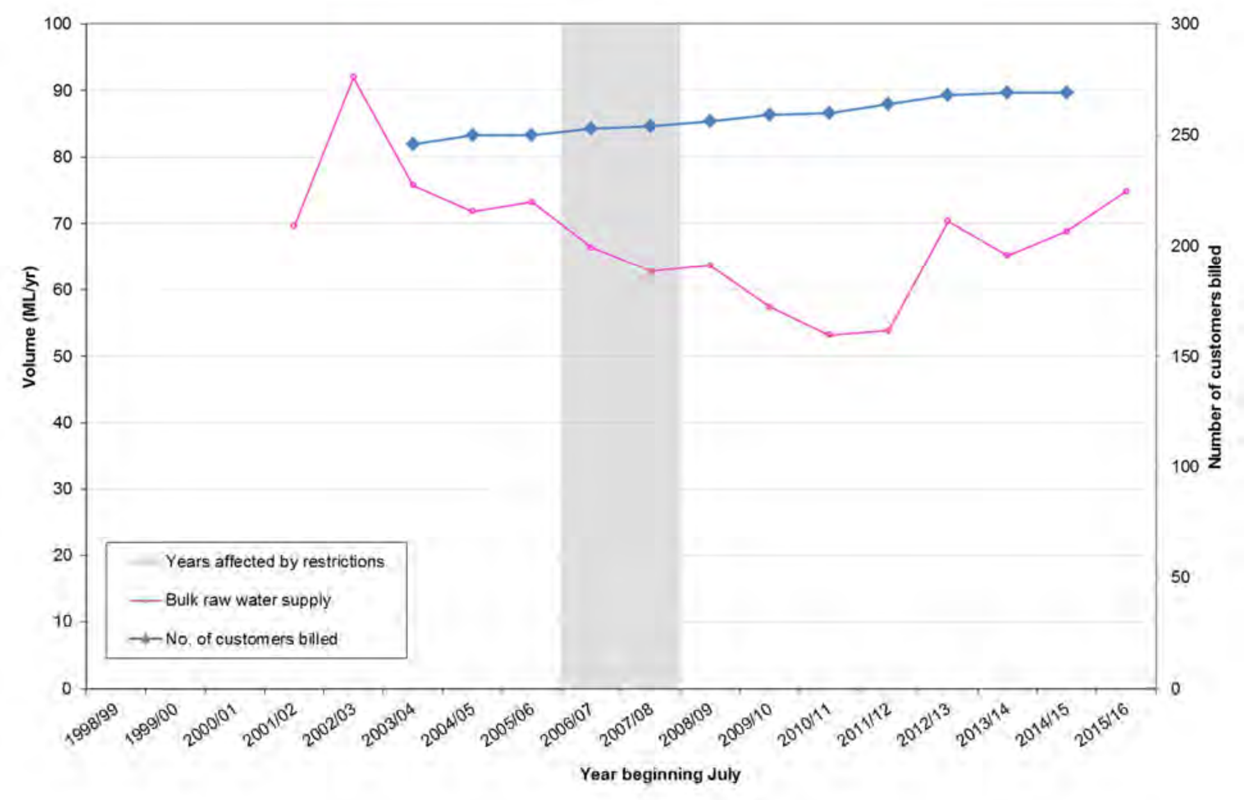
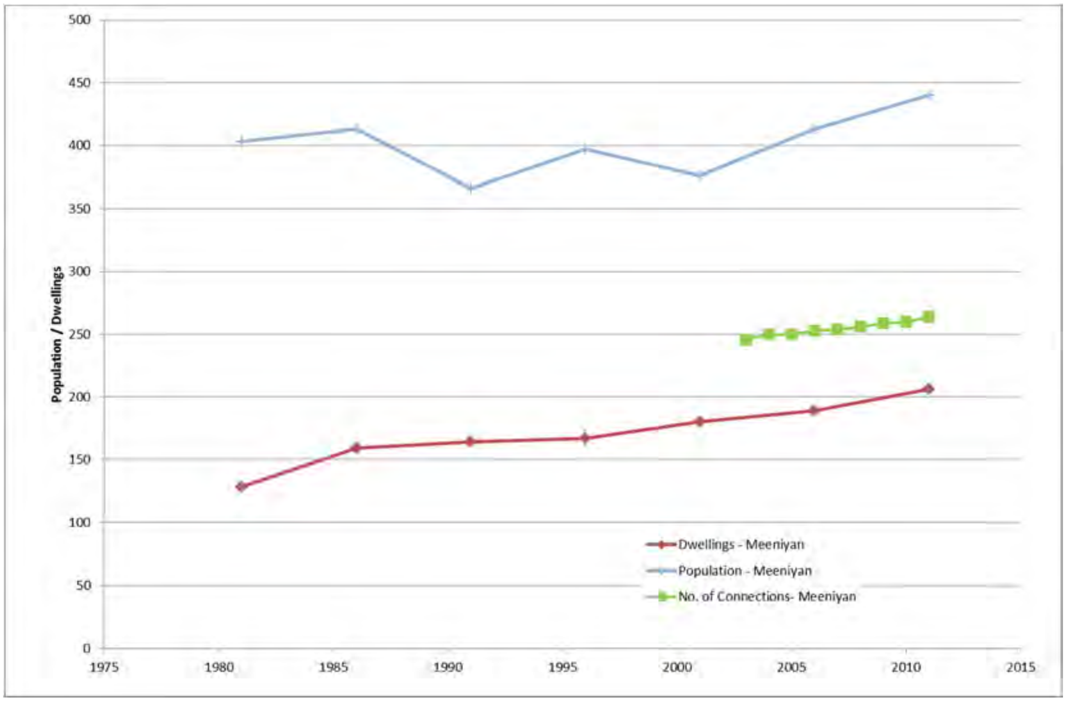


Figure 14-3 : Historical demands and number of customers billed at Meeniyan

The population of Meeniyan has fluctuated between 360 – 450 people over the last few decades, with a slight increase in population over the last 10 years, as seen in Figure 14-4. The number of dwellings and connections has increased marginally in recent years.



n Figure 14-4 : Historical population in Meeniyan

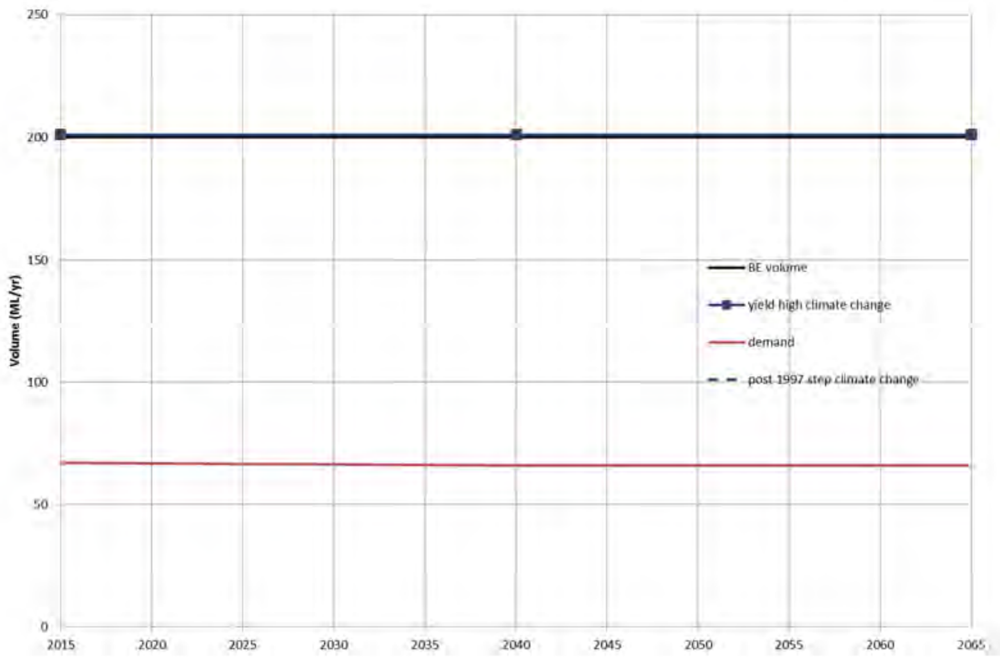
14.3.2 Future demand projections

Future growth in Meeniyan was estimated using Victoria in the Future estimates, which are available at a Statistical Local Area (SLA) level. There are five SLA's covering SGW's water supply area. Meeniyan is located within the South Gippsland Shire Central SLA and account for around 3% of the population within the SLA. Hence, SLA projections are only likely to be broadly representative of growth in Meeniyan.

The population projects estimates growth of between 0.5% and 1.3% per year with no change in major industrial demand. The urban and stock and domestic demand has been assumed to increase by up to 7% in accordance with the medium climate change scenario. This increase is due to increased water use activities such as garden watering under drier and hotter climate change conditions and is consistent with DSE recommendations (DELWP, 2016a).

14.3.3 Future supply projections with current operation and infrastructure

The Current Operation and Infrastructure water supply and demand situation for the Meeniyan supply system for high climate change is shown in Figure 14-5. This figure illustrates that demand is not expected to exceed available supply in the foreseeable future under this drier climate change scenario, meeting SGW's level of service objective. Demands appear flat due to the relatively small degree of growth forecast for this location. The full bulk entitlement can be supplied over the full planning horizon, which is reflected in the flat yield curve.



- Figure 14-5 : Current operation and infrastructure water supply and demand for Meeniyan

14.4 Sensitivity of projections

Three potential land use changes within the catchment supplying Meeniyan were investigated to understand the potential risk they could pose to available supply.

Bushfires: Only 18% of the Tarwin River catchment upstream of Meeniyan has vegetation cover. This means that the risk of catchment yield decreasing significantly due to the effects of future bushfires is low. There is no record of bushfires occurring in the catchment over the last few decades.

Logging: No logging is undertaken under regional forestry agreements in the water supply catchment for this supply system.

Plantations: There are no plantations in the water supply catchment for this supply system.

14.5 Summary of the supply and demand for Meeniyan with current operation and infrastructure

In summary for Meeniyan under the Current Operation and Infrastructure supply and demand scenarios:

- Existing supply is sufficient to meet SGW's current level of service objectives over the 50 year planning horizon under the high climate change scenario, which was the driest climate change scenario considered; and
- Demand for water has risen slightly in recent years, population has increased and the number of dwellings has increased, but demands remain well below bulk entitlement limits.

A summary of SGW's strategy for Meeniyan in the context of SGW's strategy for the central towns is presented in Section 18.

15. Supply and Demand Projections for Foster with Current Operation and Infrastructure

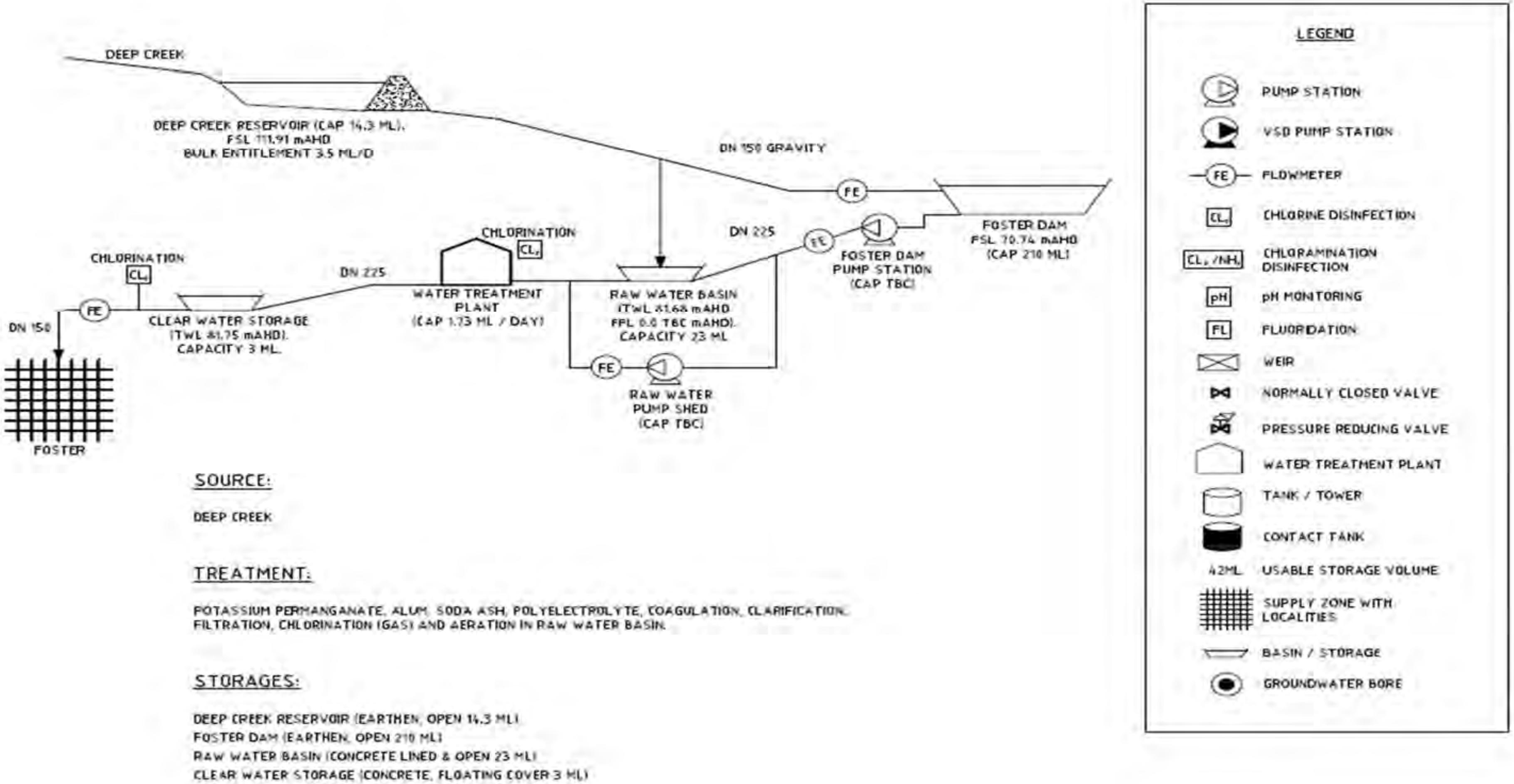
15.1 Introduction

This section of the UWS outlines the supply and demand projections for Foster over the next 50 years assuming current operation and infrastructure. It includes an overview of the current supply system configuration, current demand for water and current supply. It also includes supply and demand projections under future climate change over the 50 year planning horizon. SGW's response to any shortfall in demand under the current operation and infrastructure scenarios is presented in Section 18 in conjunction with nearby towns.

15.2 Current water supply and demand

15.2.1 Supply system description

The Foster Water Supply System is comprised of an on-stream weir (total storage capacity = 19 ML, dead storage = 5 ML) located on Deep Creek and an off-stream storage constructed in 1997 (Foster Dam 233 ML, dead storage = 10 ML). Water is diverted from Deep Creek Reservoir all year round to Foster Dam storage through a gravity pipeline of 3.5 ML/d capacity. When the on-stream storage stops spilling there is no transfer of water to Foster Dam or the treatment plant via the supply pipeline, although it continues to supply raw water to 12 rural customers. From Foster Dam, the water is pumped to the treatment plant raw water basin. The pump and pipeline capacity from the basin to Foster is 2.6 ML/d. Figure 15-1 shows a schematic representation of the supply system.



n Figure 15-1 : Deep Creek water supply system schematic

15.2.2 Current legal entitlements to water

The bulk entitlement for Foster allows SGW to divert up to a maximum of 326 ML/yr from Deep Creek. The daily bulk entitlement is shown in Table 15-1.

Table 15-1 Bulk entitlement volume for Foster

Source	Maximum annual volume (ML/yr)	Maximum diversion rate (ML/d)	Minimum passing flows
Deep Creek	326	3.5	Minimum of 0.2 ML/d or natural flow

15.2.3 Current demand

Foster had a population of 1,063 people excluding visitors in the 2011 census. A demand model was fitted to recent unrestricted data to estimate long-term average annual demand, which takes into account how current demands would vary under a wider range of natural climate variability. The historical and estimated long-term current (baseline) demand is shown in Figure 15-2. The estimated long-term average annual demand is **180 ML/yr** at SGW's treatment plant inlet, of which around 6% is utilised on average through the treatment plant. The demand has been relatively stable over the last five years.

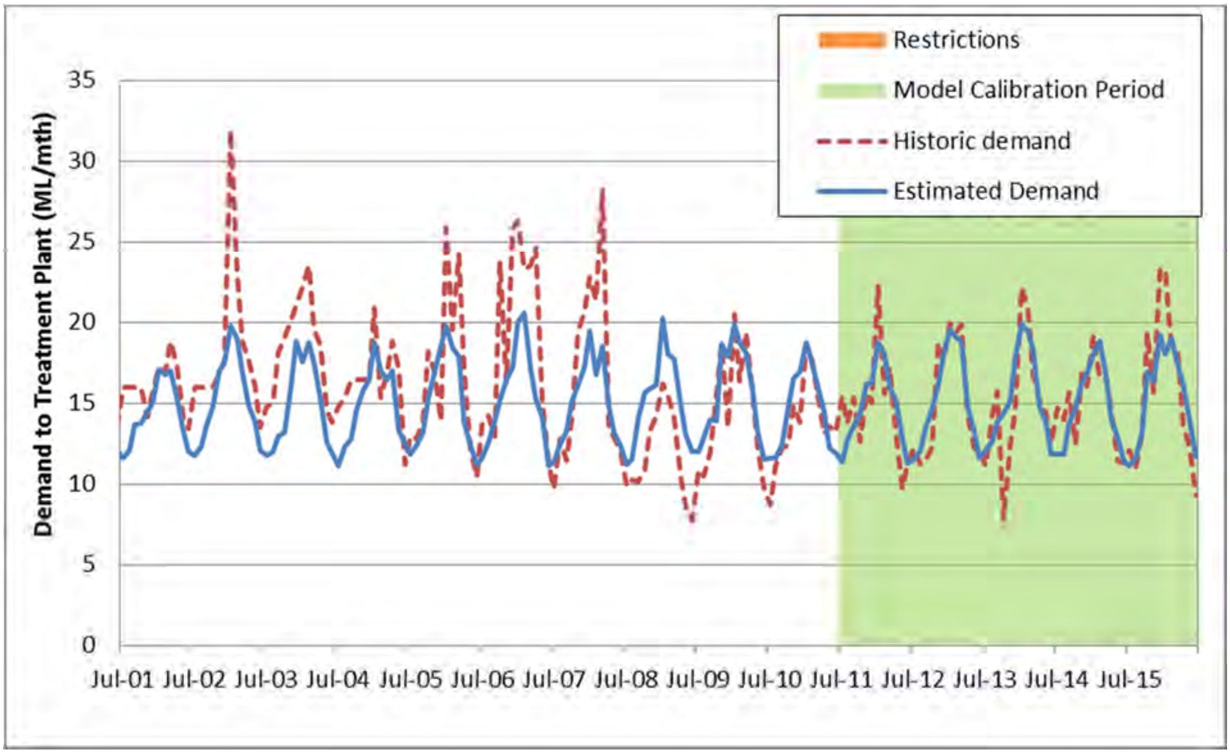


Figure 15-2 : Long term monthly demands for Foster

15.2.4 Current reliability of supply

There have been no recent water restrictions in Foster and the supply system currently meets level of service objectives. Reliability of supply modelling over the period July 1963 to June 2016 indicated no restrictions would have been required at current (baseline) demands over this baseline climate period. Further details on the water resource model used to assess reliability of supply (and yield) can be found in Jacobs (2017).

15.3 Water supply and demand projections with current operation and infrastructure

15.3.1 Historical trends

Since the drop in annual demand in 2008/09, the raw water demand has slowly increased at Foster, as seen in Figure 15-3. The number of customers billed in this supply system has increased over the last few years, with that growth in being broadly in line with demand increases since around 2009/10.

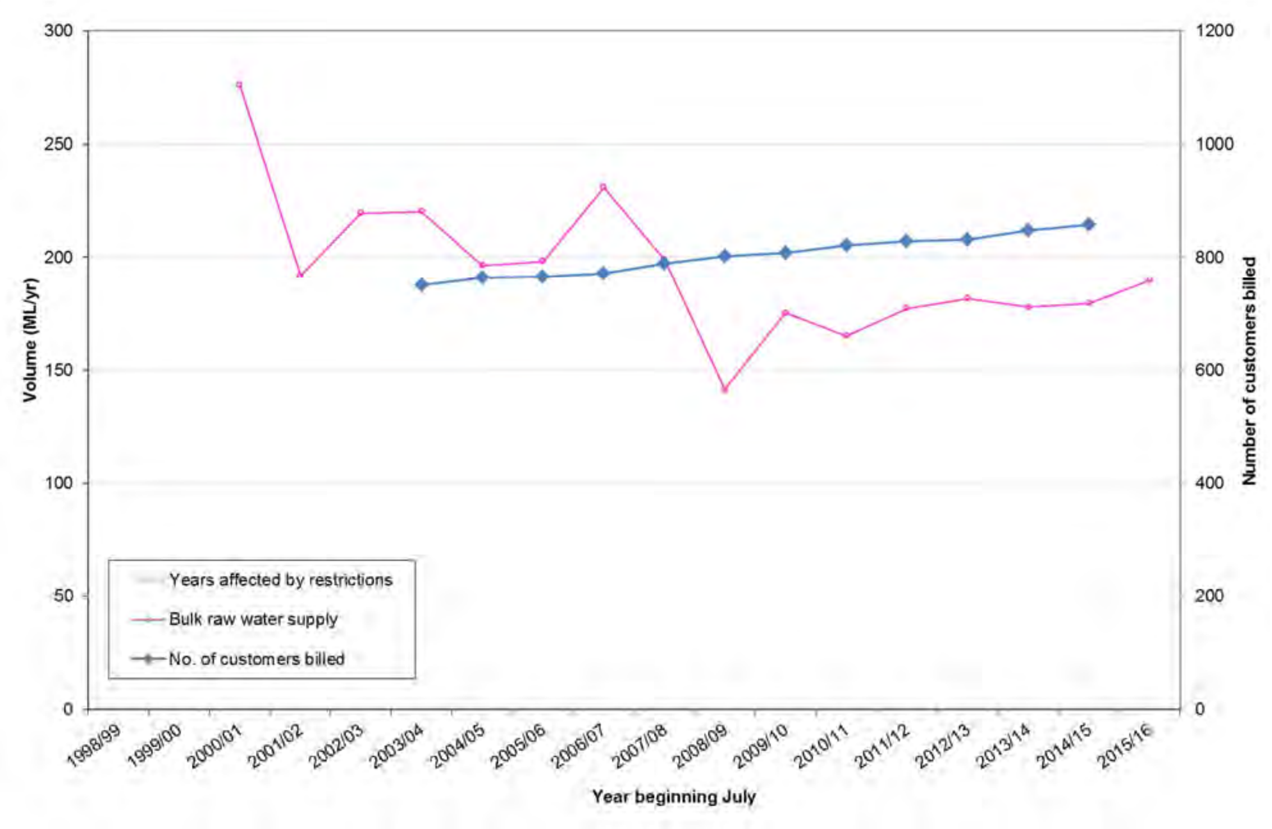
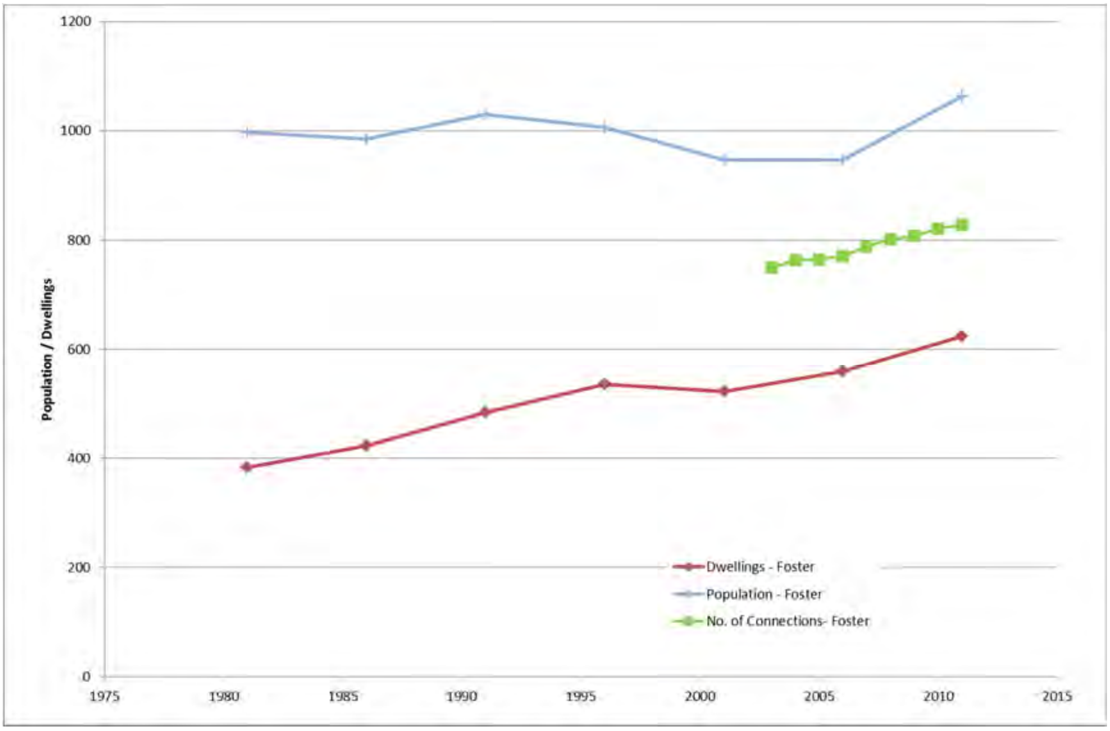


Figure 15-3 : Historical demand and number of customers billed at Foster

The population at Foster had been declining prior to the 2011 census, when it increased again, as shown in Figure 15-4. The total population increased from 947 in 2006 to 1,063 in 2011. This recent population increase is reflected in an increase in number of dwellings.



n Figure 15-4 : Historical population in Foster

15.3.2 Future demand projections

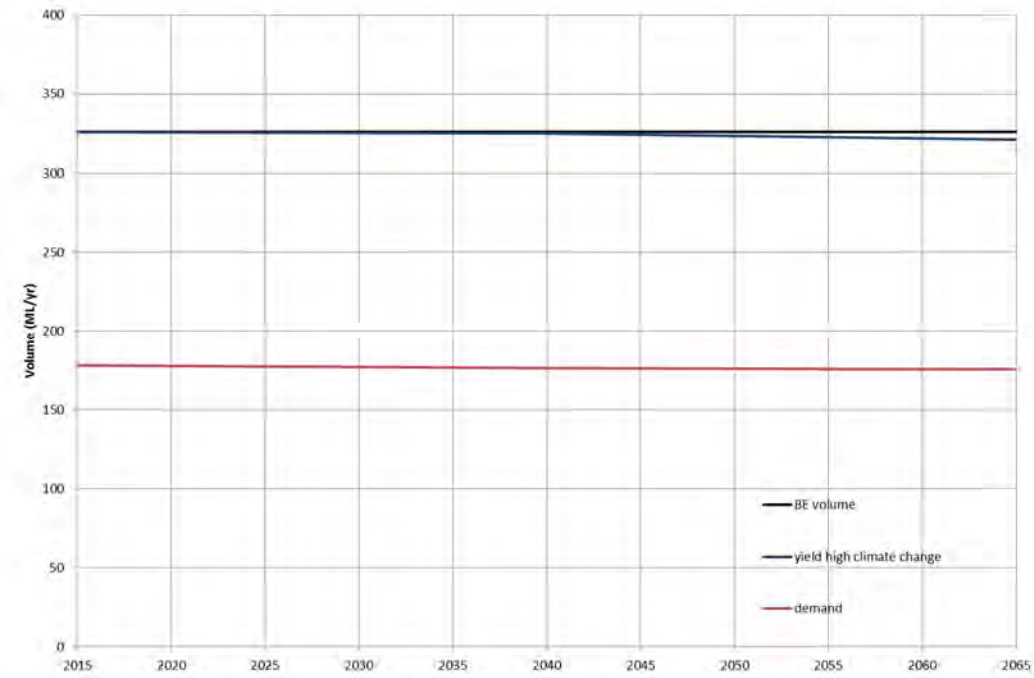
Future growth in Foster was estimated using Victoria in the Future estimates, which are available at a Statistical Local Area (SLA) level. There are five SLA's covering SGW's water supply area. Foster is located within the South Gippsland Shire East SLA and accounts for around 16% of the population within the SLA.

The population projection estimates a decrease of between 0.1% and 0.6% per year with no change in major industrial demand. The urban and stock and domestic demand has assumed to increase by up to 8% in accordance with the medium climate change scenario. This increase is due to increased water use activities such as garden watering under drier and hotter climate change conditions and is consistent with DSE recommendations (DELWP, 2016a).

15.3.3 Future supply projections with current operation and infrastructure

The Current Operation and Infrastructure water supply and demand situation for the Deep Creek supply system for the high climate change scenario is shown in Figure 15-5. This figure illustrates that demand is not expected to exceed available supply for the foreseeable future under the high climate change scenario, which meets SGW's level of service objective. Both the demand and yield curves for this system are flat, due to the low level of growth forecast.

In light of this, there may be scope to connect nearby unserviced towns to Foster system at some stage in the future, should there be appetite within the local communities. Foster may also offer potential to support a large-scale development, residential or industrial, in the event that a high water user is seeking to establish a business in the South Gippsland region. This possibility should be assessed against the strategy presented in Section 18 and any supporting assessments that are being completed in parallel with this UWS.



- Figure 15-5 : Current operation and infrastructure water supply and demand for Foster

15.4 Sensitivity of projections

Three potential land use changes within the catchment supplying Foster were investigated to understand the potential risk they could pose to available supply.

Bushfires: The maximum reduction in runoff after a bushfire typically occurs at around 10-20 years after the fire has occurred, and thereafter runoff progressively increases back to pre-bushfire levels. Approximately 55% of the Deep Creek catchment upstream of Foster has vegetation cover, however there is no record of recent bushfires occurring in the South Gippsland region. The effects of bushfire on catchment yield will therefore only be a concern if fires occur in this area in the future.

Logging: No logging is undertaken under regional forestry agreements in the water supply catchment for this supply system.

Plantations: There are no plantations in the water supply catchment for this supply system.

15.5 Summary of the supply and demand for Foster with current operation and infrastructure

In summary for Foster under the Current Operation and Infrastructure supply and demand scenarios:

- Existing supply is sufficient to meet SGW's current level of service objectives over the 50 year planning horizon under the high climate change scenario, which was the driest climate change scenario considered; and
- Demand for water has marginally increased in recent years, in line with small increases in population and the number of dwellings.

A summary of SGW's strategy for Foster in the context of SGW's strategy for the central towns is presented in Section 18.

16. Supply and Demand Projections for Fish Creek with Current Operation and Infrastructure

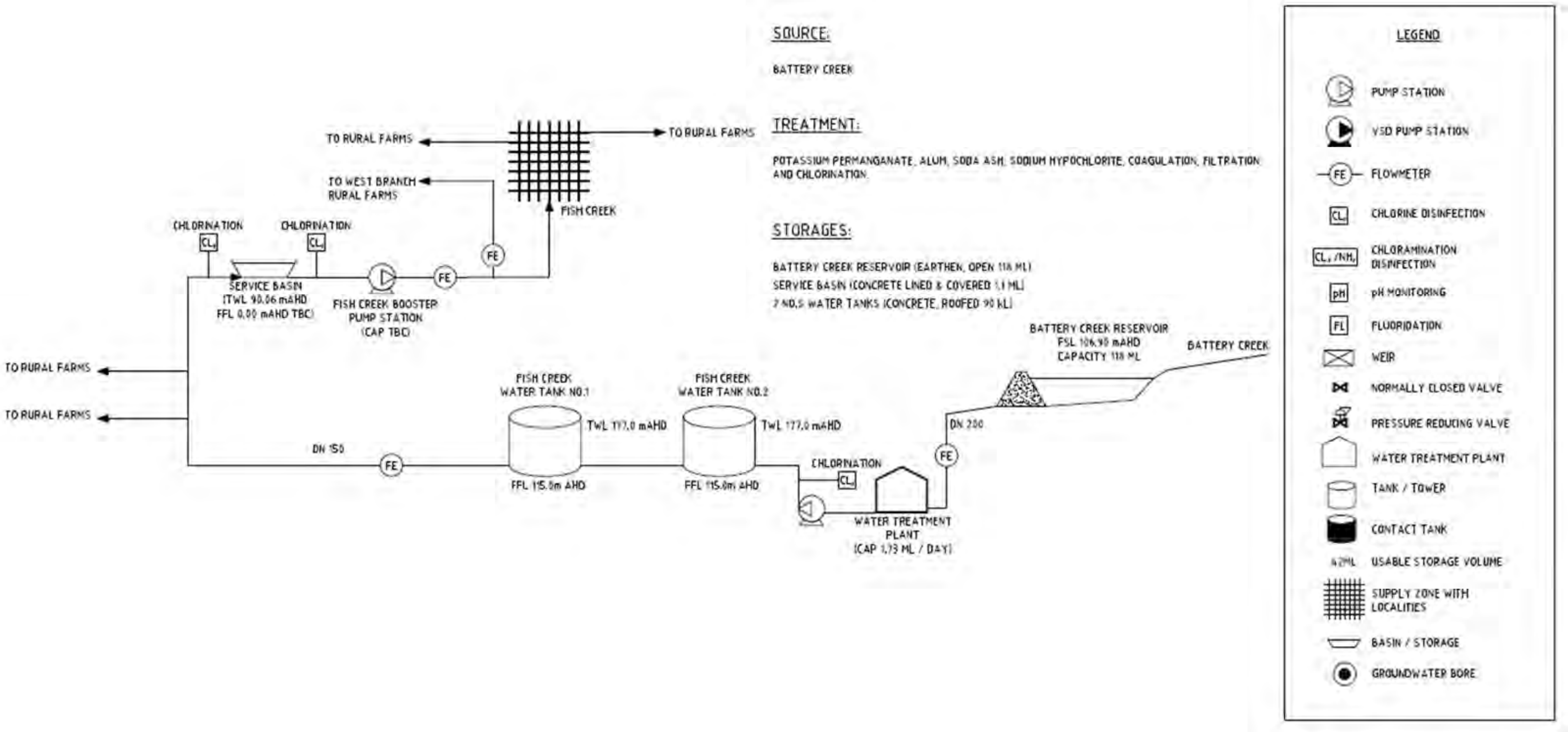
16.1 Introduction

This section of the UWS outlines the supply and demand projections for Fish Creek over the next 50 years assuming current operation and infrastructure. It includes an overview of the current supply system configuration, current demand for water and current supply. It also includes supply and demand projections under future climate change over the 50 year planning horizon. SGW's response to any shortfall in demand under the current operation and infrastructure scenarios is presented in Section 18 in conjunction with nearby towns.

16.2 Current water supply and demand

16.2.1 Supply system description

The township of Fish Creek and the surrounding rural areas are supplied from a 119 ML reservoir (total storage of 123 ML including dead storage of 4 ML) located on Battery Creek. The water is transferred from the storage to a treatment plant of 2 ML/day (60.8 ML/mth) capacity through a pipeline of 1.7 ML/day (51.7 ML/mth) capacity, into a 1.1 ML lined and covered basin. The water is then supplied directly to the town via the mains pipes, and the rural demands are supplied via the same system. A schematic of the supply system is shown in Figure 16-1.



n Figure 16-1 : Battery Creek water supply system schematic

16.2.2 Current legal entitlements to water

The bulk entitlement for Fish Creek allows SGW to divert up to a maximum of 251 ML/yr from Battery Creek. The daily bulk entitlement is shown in Table 16-1.

Table 16-1 Bulk entitlement volume for Fish Creek

Source	Maximum annual volume	Maximum diversion rate	Minimum passing flows
Battery Creek	251	1.0 ML/d (30.4 ML/mth)	No minimum passing flows

16.2.3 Current demand

Fish Creek had a population of 165 people excluding visitors in the 2011 census. A demand model was fitted to the recent unrestricted data to estimate a long-term average annual demand, which takes into account how current demands would vary under a wider range of natural climate variability. The historical and estimated long-term current (baseline) demand is shown in Figure 16-2 . The long-term average annual demand is **124 ML/yr** at SGW's treatment plant inlet, of which around 15% is utilised on average through the treatment plant. The demand was much higher in the early 2000's however it has stabilised in recent years, despite very dry conditions in 2015/16 in this region. This is attributable to demand reduction initiatives, which provided incentives for some rural users to develop on-farm water supplies instead of relying on supply from SGW. Therefore this lower demand of recent years is considered to be more representative of current demand for Fish Creek than historical values prior to 2009.

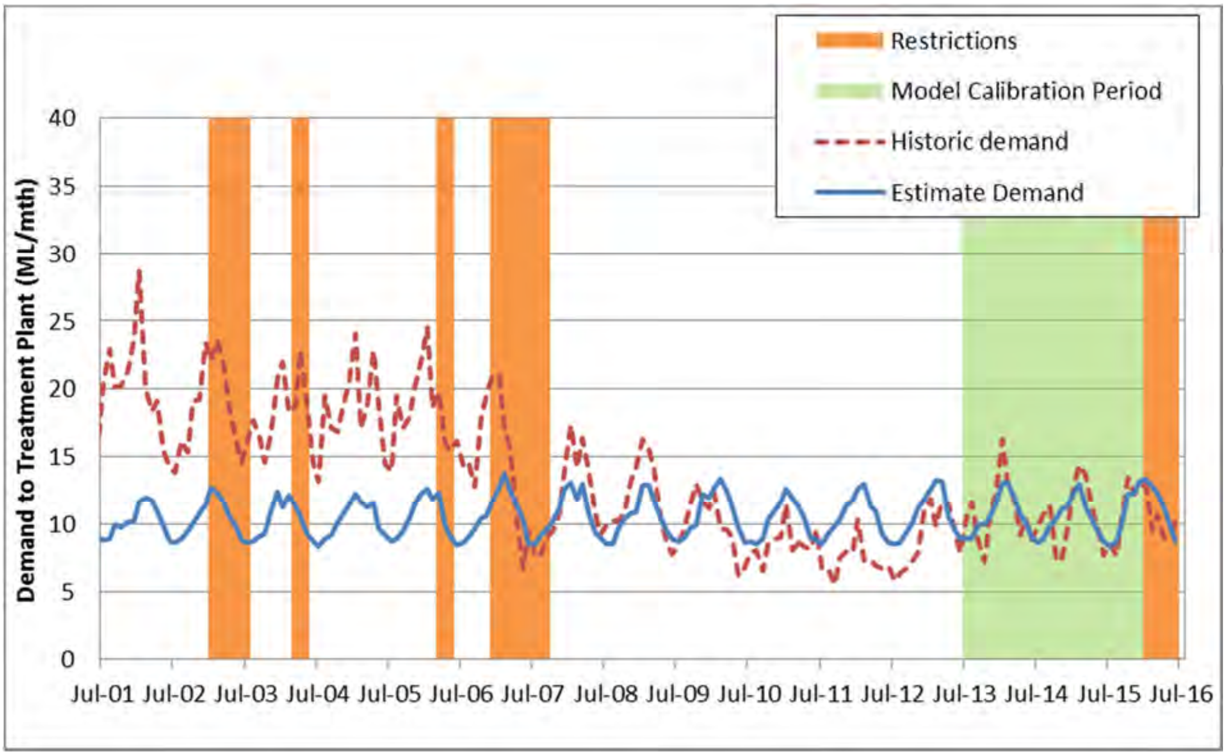


Figure 16-2 : Long term monthly demands for Fish Creek

16.2.4 Current reliability of supply

During the Millennium Drought, Fisk Creek was experiencing restrictions every second year. In more recent years restrictions have only been implemented in 2015/16. Reliability of supply modelling over the period July 1950 to June 2016 indicated that restrictions would have been required 1 in every 10 years. This corresponds to an annual reliability of supply of 89%, which does not meet SGW's level of service objectives. Further details on the water resource model used to assess reliability of supply (and yield) can be found in Jacobs (2017).

16.3 Water supply and demand projections with current operation and infrastructure

16.3.1 Historical trends

Bulk raw water supply has remained low and relatively invariable since the end of the Millennium Drought, as seen in Figure 16-3. This is attributable to SGW's program around the end of the Millennium Drought to support rural water users to develop their own on-farm water supplies, rather than relying on SGW's supply system. Spring 2015 was the driest on record in this region, and there was some concern at the time that previously supported rural customers would temporarily re-connect to SGW's supply system in response to those dry conditions. This led to the introduction of restrictions in January 2016 for several months. Despite these concerns, water consumption for 2015/16 was similar to previous years and did not significantly increase in response to the dry conditions. This suggests that the demands have remained stable, even in dry years, and that potential increases in rural water demand in dry years were reasonably managed through the introduction of water restrictions. The number of customers billed has remained relatively constant over the past decade.

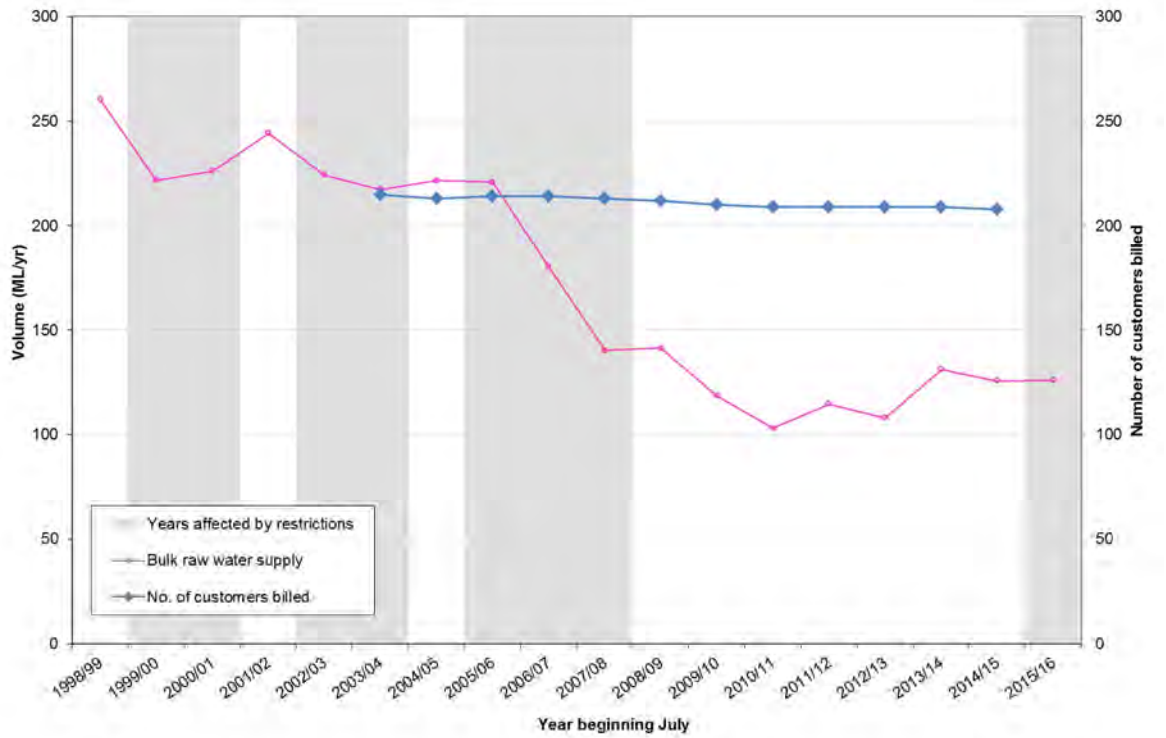


Figure 16-3 : Historical demands and number of customers billed at Fish Creek

The population of Fish Creek has recently increased, after declining for the previous decade, as seen in Figure 16-4. The total population has increased from 144 in 2006 to 165 in 2011. The number of dwellings has been slowly increasing over the past two decades.

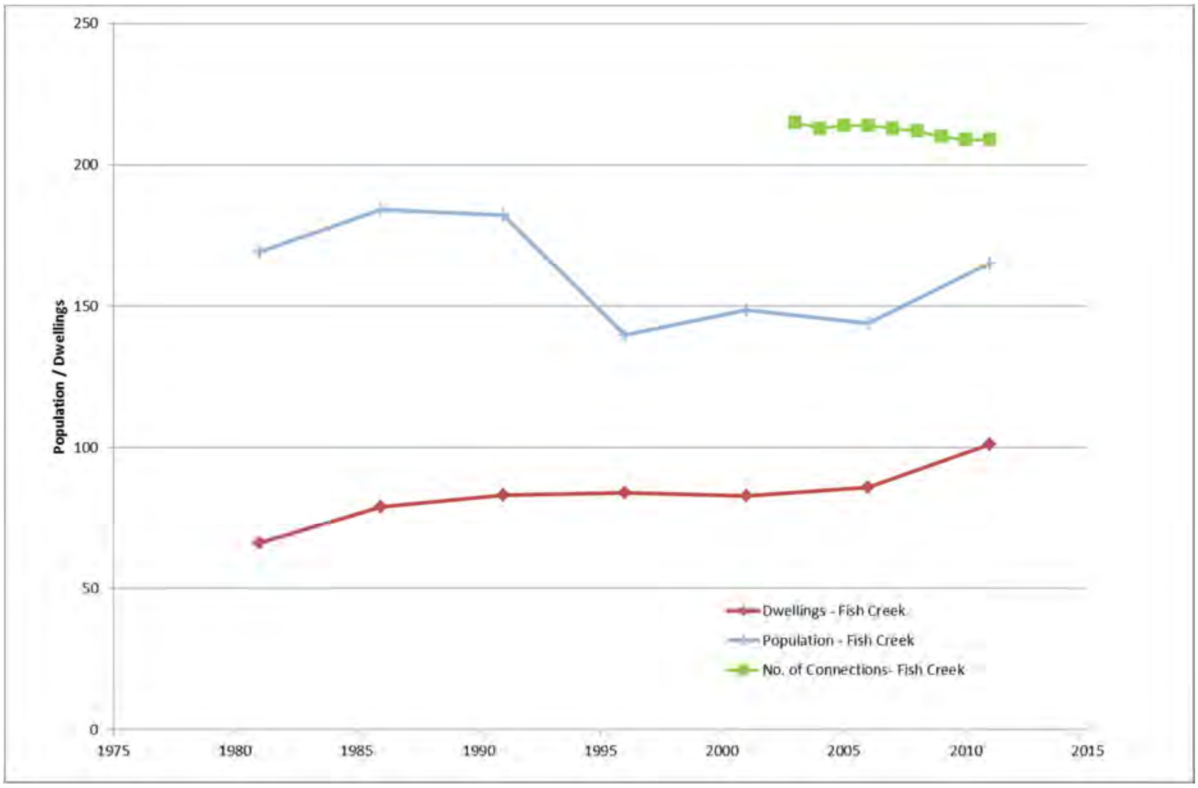


Figure 16-4 : Historical population in Fish Creek

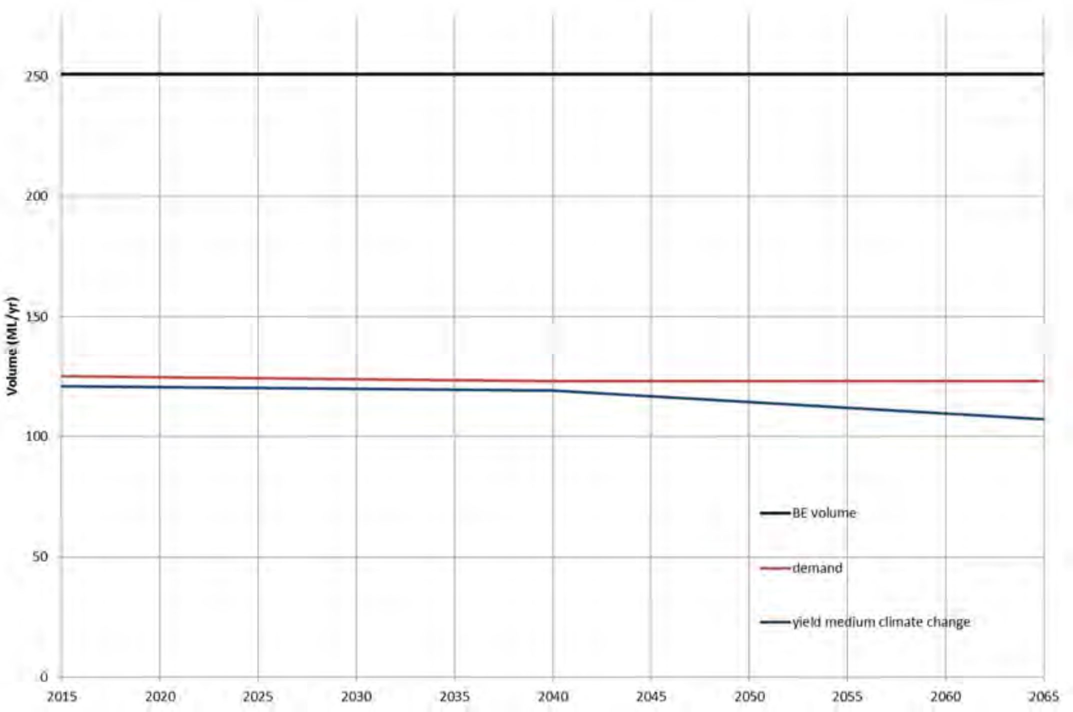
16.3.2 Future demand projections

Future growth in Fish Creek was estimated using Victoria in the Future estimates, which are available at a Statistical Local Area (SLA) level. There are five SLA's covering SGW's water supply area. Fish Creek is located within the South Gippsland Shire East SLA and accounts for around 2% of the population within the SLA.

The population projections estimate a decrease of between 0.1% and 0.6% per year with no change in major industrial demand. The urban and stock and domestic demand has been assumed to increase up to 8% in accordance with the medium climate change scenario. This increase is due to increased water use activities such as garden watering under drier and hotter climate change conditions and is consistent with DELWP recommendations (DELWP, 2016a).

16.3.3 Future supply projections with current operation and infrastructure

The current operation and infrastructure water supply and demand situation for the Battery Creek supply system under the medium climate change scenario is shown in Figure 16-5. This figure illustrates that demand currently exceeds available supply at SGW's level of service objective under the medium climate change scenario if no further action is taken, and if growth in demand for water occurs in accordance with population projections. The demand curve appears flat in this figure as the population decline is balanced by the increase in demand due to future climate.



- Figure 16-5 : Current operation and infrastructure water supply and demand for Fish Creek

16.4 Sensitivity of projections

Three potential land use changes within the catchment supplying Fish Creek were investigated to understand the potential risk they could pose to available supply. Additional information on potential future growth in demand for rural customers, who are a significant component of this supply system, is also presented.

Bushfires: Only 27% of the Battery Creek catchment has vegetation cover. This means that the risk of catchment yield decreasing significantly due to the effects of bushfires is low. There is no record of bushfires occurring in the catchment over the last few decades.

Logging: No logging is undertaken under regional forestry agreements in the water supply catchment for this supply system.

Plantations: There are no plantations in the water supply catchment for this supply system.

16.5 Summary of the supply and demand for Fish Creek with current operation and infrastructure

In summary for Fish Creek under the Current Operation and Infrastructure supply and demand scenarios:

- Existing supply is not quite sufficient to meet SGW's current level of service objectives under medium climate change.

A summary of SGW's strategy for Fish Creek in the context of SGW's strategy for the central towns is presented in Section 18.

17. Supply and Demand Projections for Toora, Welshpool, Port Welshpool and Port Franklin with Current Operation and Infrastructure

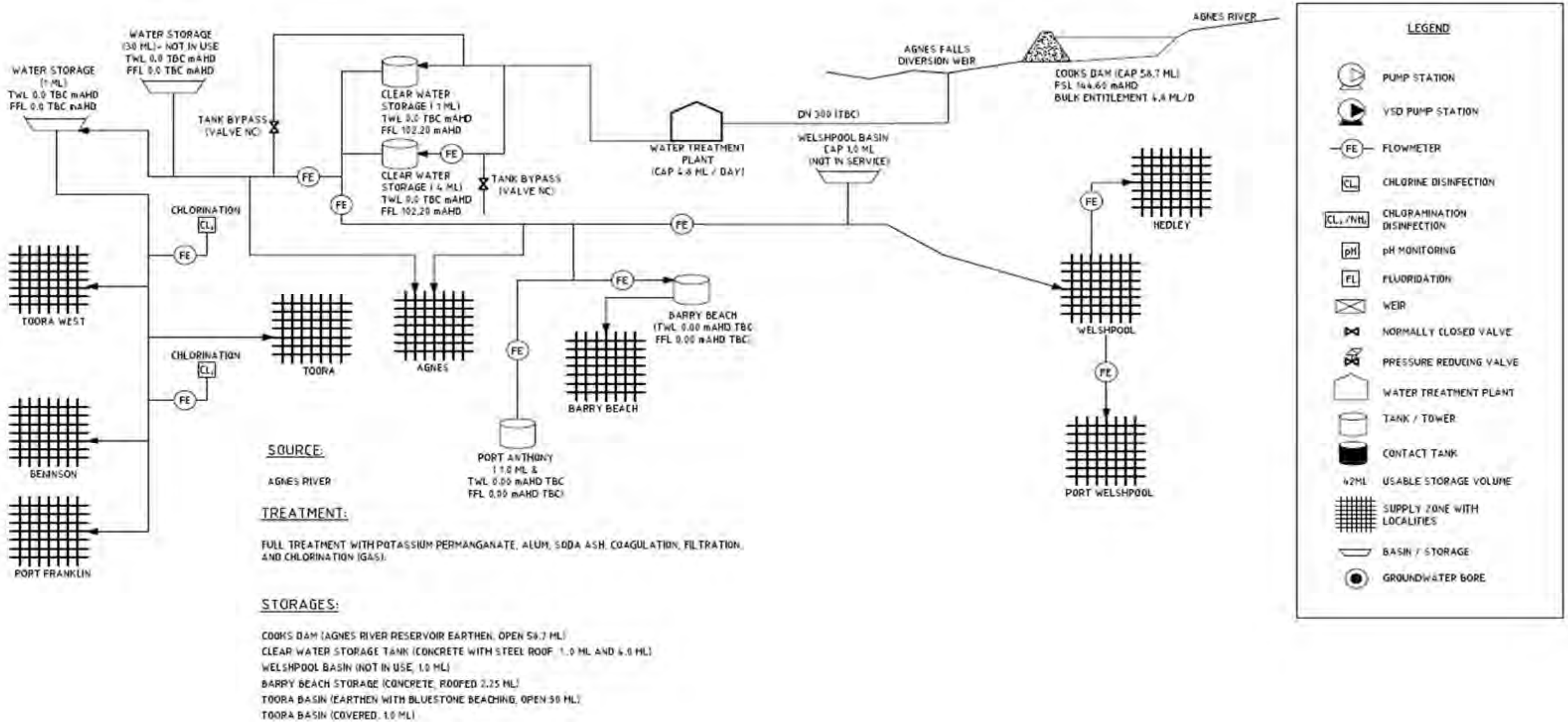
17.1 Introduction

This section of the UWS outlines the supply and demand projections for Toora, Welshpool, Port Welshpool and Port Franklin over the next 50 years assuming current operation and infrastructure. It includes an overview of the current supply system configuration, current demand for water and current supply. It also includes supply and demand projections under future climate over the 50 year planning horizon. SGW's response to any shortfall in demand under the current operation and infrastructure scenarios is presented in Section 18 in conjunction with nearby towns.

17.2 Current water supply and demand

17.2.1 Supply system description

The Agnes River water supply system consists of a 58.7 ML storage at Cooks Dam on the Agnes River, with a diversion weir located 2 km downstream of the storage. Cooks Dam is used to provide additional security to the system when the flows are low in dry periods. From the diversion weir a 4.8 ML/day pipeline supplies water to the treatment plant and is then distributed to customers. A schematic is shown of the system in Figure 17-1.



- Figure 17-1 : Agnes River water supply system schematic

17.2.2 Current legal entitlements to water

The bulk entitlement for Toora allows SGW to divert up to a maximum of 1,617 ML/yr from the Agnes River. The daily bulk entitlement is shown in Table 17-1.

Table 17-1 Bulk entitlement volume for Toora

Source	Maximum annual volume (ML/yr)	Maximum diversion rate (ML/d)	Minimum passing flows
Agnes River	1617	4.8	Minimum of 1.0 ML/d or natural flow

17.2.3 Current demand

Toora, Welshpool, Port Welshpool and Port Franklin had populations of 442,142, 168 and 125 people respectively in the 2011 census excluding visitors. This corresponds to a total of 877 people for the four towns. A demand model was fitted to the recent unrestricted data to estimate a long-term average annual demand, which takes into account how current demands would vary under a wider range of natural climate variability. The historical and estimated long-term current (baseline) demand is shown in Figure 17-2. Data prior to July 2006 was subject to meter errors and was not used in the estimation of current demands. Annual demands at Toora have been fairly consistent since 2008/09 and remain around half of the values seen during the Millennium Drought. The long-term average annual demand is **518 ML/yr** at SGW's treatment plant inlet meter, of which around 12% is utilised on average through the treatment plant.

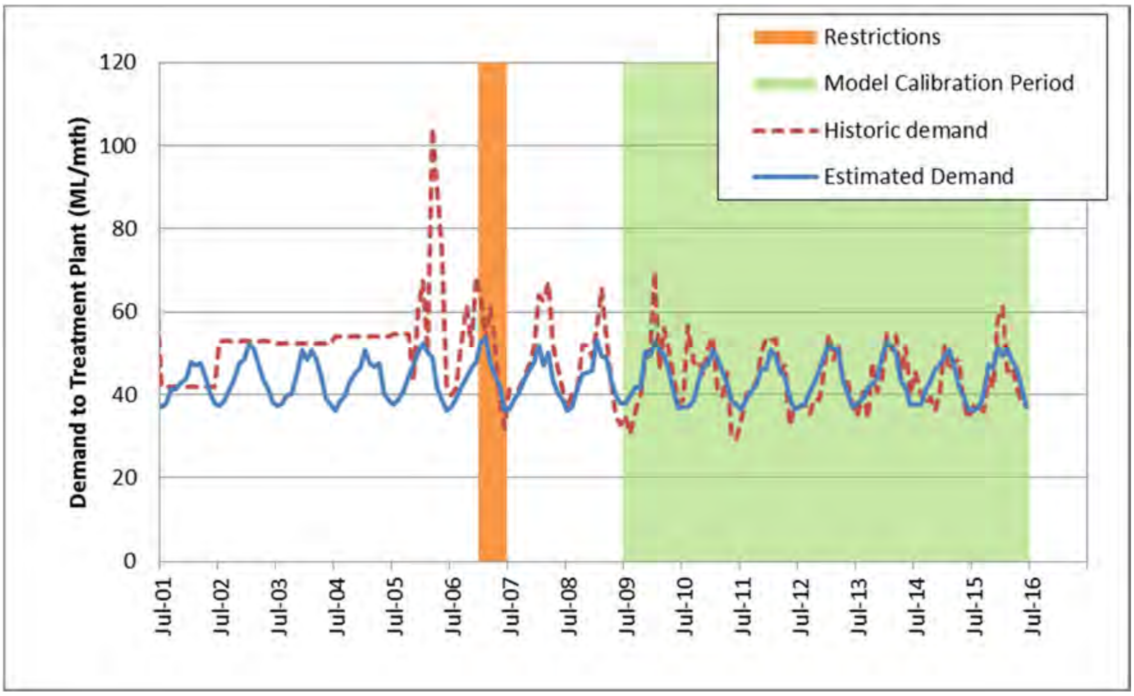


Figure 17-2 : Long term monthly demands for Toora, Welshpool, Port Welshpool and Port Franklin

17.2.4 Current reliability of supply

Since the restrictions in 2006/07, there have been no restrictions implemented. Reliability of supply modelling over the period July 1950 to June 2016 indicated that restrictions would have been required only 1 in 50 years when using the current set of restriction triggers at the current (baseline) level of demand. This corresponds to an annual reliability of supply of 98%, which meets SGW's level of service objective. Further details on the water resource model used to assess reliability of supply (and yield) can be found in Jacobs (2017).

17.3 Water supply and demand projections with current operation and infrastructure

17.3.1 Historical trends

Bulk raw water supply to Toora, Welshpool, Port Welshpool and Port Franklin has stabilised over recent years, as seen in Figure 17-3. These diversions are recorded at the clear water storage outlet and do not include an allowance for treatment plant utilisation. The decrease in diversions is largely associated with reductions in major industrial demand, with the closure of the local dairy in 2006 being the main reason for the decline. Since then, the supply has stabilised. The number of total customers billed has increased marginally over the last few years.

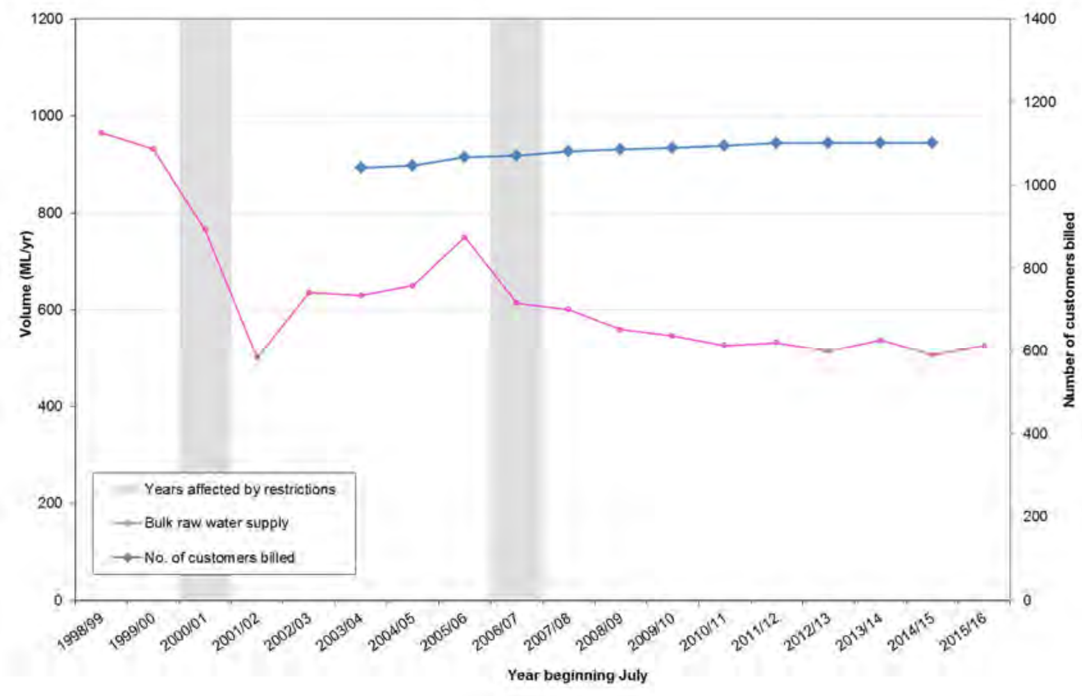
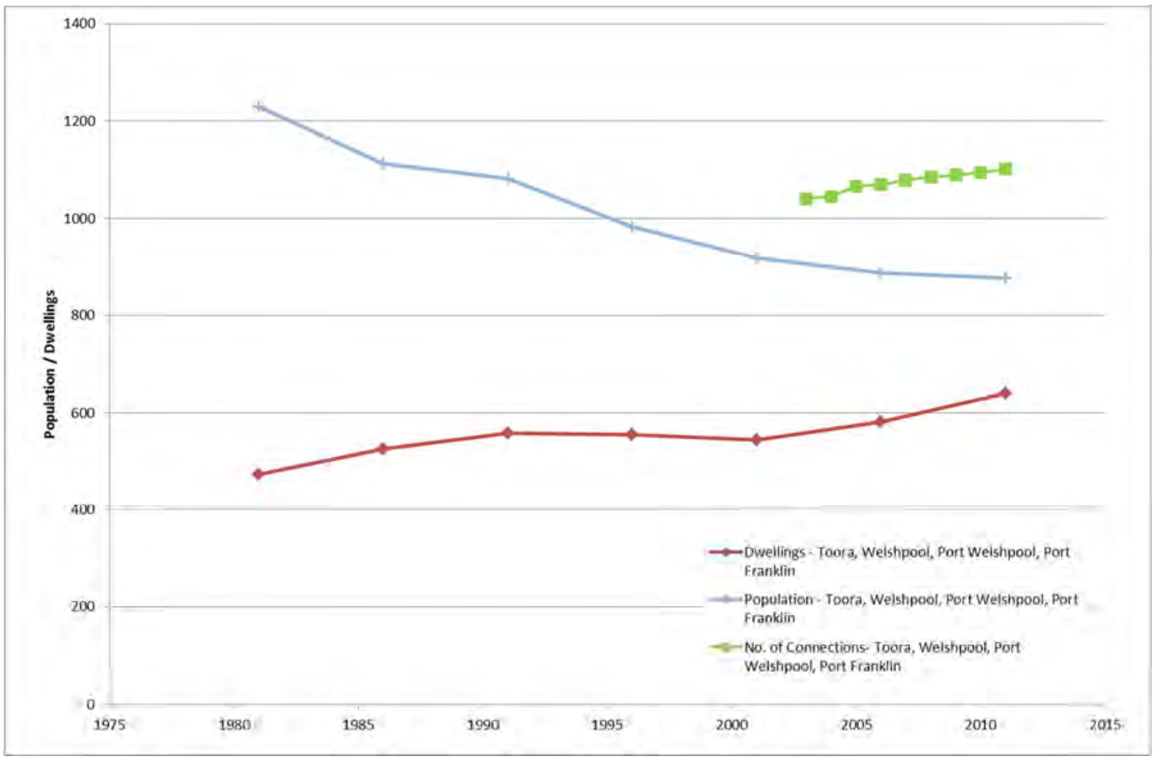


Figure 17-3 : Historical raw demands and number of customers billed at Toora, Port Welshpool, Welshpool and Port Franklin

The population of the four towns has decreased marginally over the last two decades, as shown in Figure 17-4. The population decreased from 887 in 2006 to 877 in 2011. The number of dwellings increased slightly over the period 2001 to 2011.



n Figure 17-4 : Historical population in Toora, Port Welshpool, Welshpool and Port Franklin

17.3.2 Future demand projections

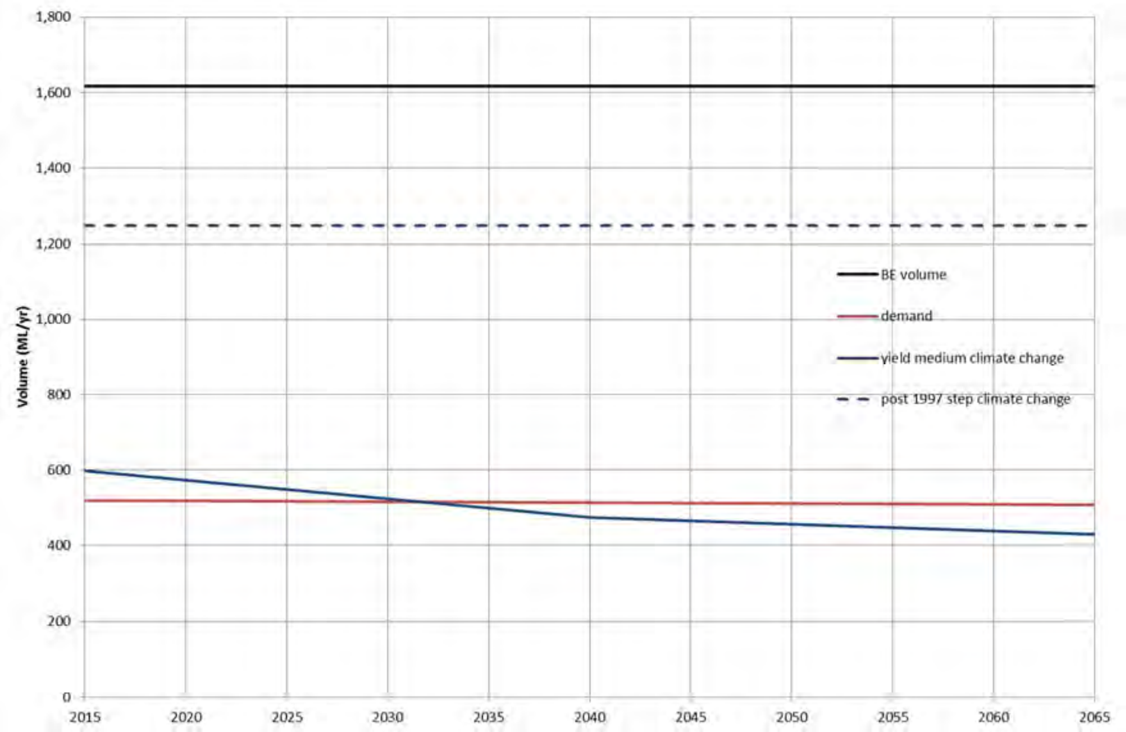
Future growth in Toora, Welshpool, Port Welshpool and Port Franklin was estimated using Victoria in the Future estimates, which are available at a Statistical Local Area (SLA) level. There are five SLA's covering SGW's water supply area. Toora, Welshpool, Port Welshpool and Port Franklin are located within the South Gippsland Shire East SLA and account for around 15% of the population within the SLA.

The population projections estimate a decrease of between 0.1% and 0.6% per year with no change in major industrial demand. The urban and stock and domestic demand has been assumed to increase by up to 5%in accordance with the medium climate change scenario. This increase is due to increased water use activities such as garden watering under drier and hotter climate change conditions and is consistent with DELWP recommendations (DELWP, 2016a).

17.3.3 Future supply projections with current operation and infrastructure

The current operation and infrastructure water supply and demand situation for the Agnes River supply system under medium climate change is shown in Figure 17-5. SGW's level of service objective under medium climate change is exceeded in 2032. Under the high climate change assumptions, the level of service objectives are no longer met from the mid 2020's (not shown). The demand line appears flat as the decline in population is balanced by the forecast increase in demand due to climate change.

Modelling undertaken as part of the UWS identified a high degree of sensitivity of yield to climate change assumptions for this supply system, with yield and reliability for the historic and current (baseline) climate scenarios being very different in magnitude and in the mode of failure. This was due to the moderation of the 1967/68 historical drought event under the baseline (post-1975) climate scenario, whereby these very low flows were factored up by 50% to reflect the flow exceedance properties of the post-1975 period. The 1967/68 historical drought, as recorded at gauge 227211 (downstream of the town offtake and Cook's Dam), was more severe than the 2006/07 drought. There are many possible causes for this recorded behaviour, but isolating them is difficult. Therefore, the pragmatic approach adopted was to undertake preliminary modelling of climate change behaviour assuming the historic climate baseline, as this provided more conservative estimates of yield.



n Figure 17-5 : Current operation and infrastructure water supply and demand for Toora, Welshpool, Port Welshpool and Port Franklin (with historical climate)

17.4 Sensitivity of projections

Three potential land use changes within the Agnes River catchment were investigated to understand the potential risk that they could pose to available supply.

Bushfires: The maximum reduction in runoff after a bushfire typically occurs at around 10-20 years after the fire has occurred, and thereafter runoff progressively increases back to pre-bushfire levels. 60% of the Agnes River catchment upstream of Cooks Dam has vegetation cover, however there is no record of recent bushfires occurring in the South Gippsland region. The effect of bushfire on catchment yield should therefore only be a problem if fires occur in this area in the future.

Logging: No logging is undertaken under regional forestry agreements in the water supply catchment for this supply system.

Plantations: Plantations over a large proportion of a catchment can significantly reduce runoff to downstream areas, particularly when those plantations are established on previously cleared land. Up to one third of the Toora water supply catchment is covered by plantations, so this may have a significant effect on catchment yield, depending on the age profile of the plantations.

17.5 Summary of the supply and demand for Toora, Welshpool, Port Welshpool and Port Franklin with current operation and infrastructure

In summary for Toora, Welshpool, Port Welshpool and Port Franklin under the Current Operation and Infrastructure supply and demand scenarios:

- Existing supply is not sufficient to meet SGW's current level of service objectives;
- Under the medium climate change scenario, demand for water is expected to exceed available supply by the mid 2030's, or as early as the mid-2020s under the high climate change scenario; and
- Demand for water has fallen from historically high levels in the early part of the Millennium Drought, primarily due to a reduction in major industrial water use.

A summary of SGW's strategy for Toora, Welshpool, Port Welshpool and Port Franklin in the context of SGW's strategy for the central towns is presented in Section 18.

18. Strategy for Central Towns

18.1 Introduction

This section of the document presents the demand reduction and supply enhancement strategy for towns in SGW's central region. These include the towns of Dumbalk, Meeniyan, Foster, Fish Creek, Toora, Welshpool, Port Welshpool and Port Franklin. The strategy for these towns is considered collectively, because a number of supply options involve interconnecting the supply systems.

The pros and cons of two broad strategies were considered by SGW:

Supply from existing separate SGW headworks – This strategy involves upgrading SGW's existing supply infrastructure and operating the supply systems independently. Details of this approach for each town are presented below.

Supply from a linked system – This strategy involves options that connect Agnes River, Deep Creek and/or Battery Creek systems to supply existing towns. Options for Dumbalk and Meeniyan include merging these systems and/or connection to the Leongatha Ruby Creek system. Details of these strategies for each town are presented below.

18.2 Supply from existing SGW headworks for Foster

The current operation and infrastructure supply and demand projections presented in previous chapters of this document highlighted that existing supply is sufficient to meet SGW's current level of service objectives over the 50 year planning horizon under the driest (high) climate change scenario considered. If operated as a standalone supply system, no supply enhancement options would be required for the Foster system. A number of the options presented below for Toora and Fish Creek include the connection to the Foster system. Further details of these augmentation options are described in Sections 18.4 and 18.5.

The yield available in the Foster system offers the potential for future development to connect the currently unserviced towns or to support a new industrial development. Section 22 provides further information on this possibility.

18.3 Supply for Dumbalk and Meeniyan

The current operation and infrastructure supply and demand projections presented in previous chapters of this document highlighted that existing supply is sufficient to meet SGW's current level of service objectives over the 50 year planning horizon under the driest (high) climate change scenario. If operated as standalone supply systems, no supply enhancement options would be required for these systems.

However, enhancements may be relevant for these systems for other reasons, for instance due to aging infrastructure, to minimise treatment costs, and development considerations within the catchment. Options to reconcile these challenges include the connection of Dumbalk and Meeniyan to Leongatha, and a combined offtake for both Dumbalk and Meeniyan on the Lower Tarwin River.

Given the existing Dumbalk and Meeniyan systems are anticipated to meet SGW's level of service objectives over the full planning horizon, water supply is not the key driver for augmentation at these locations. Instead, the condition of water treatment plants, increasing stringency of water quality requirements, and planning objectives within the upper Tarwin River catchment will influence the strategy developed for these towns. The timing of capital expenditure is also fundamental, so that SGW can adequately manage the upgrades within their program of works. Relative to a connection to Leongatha, supply from a common extraction point on the Tarwin

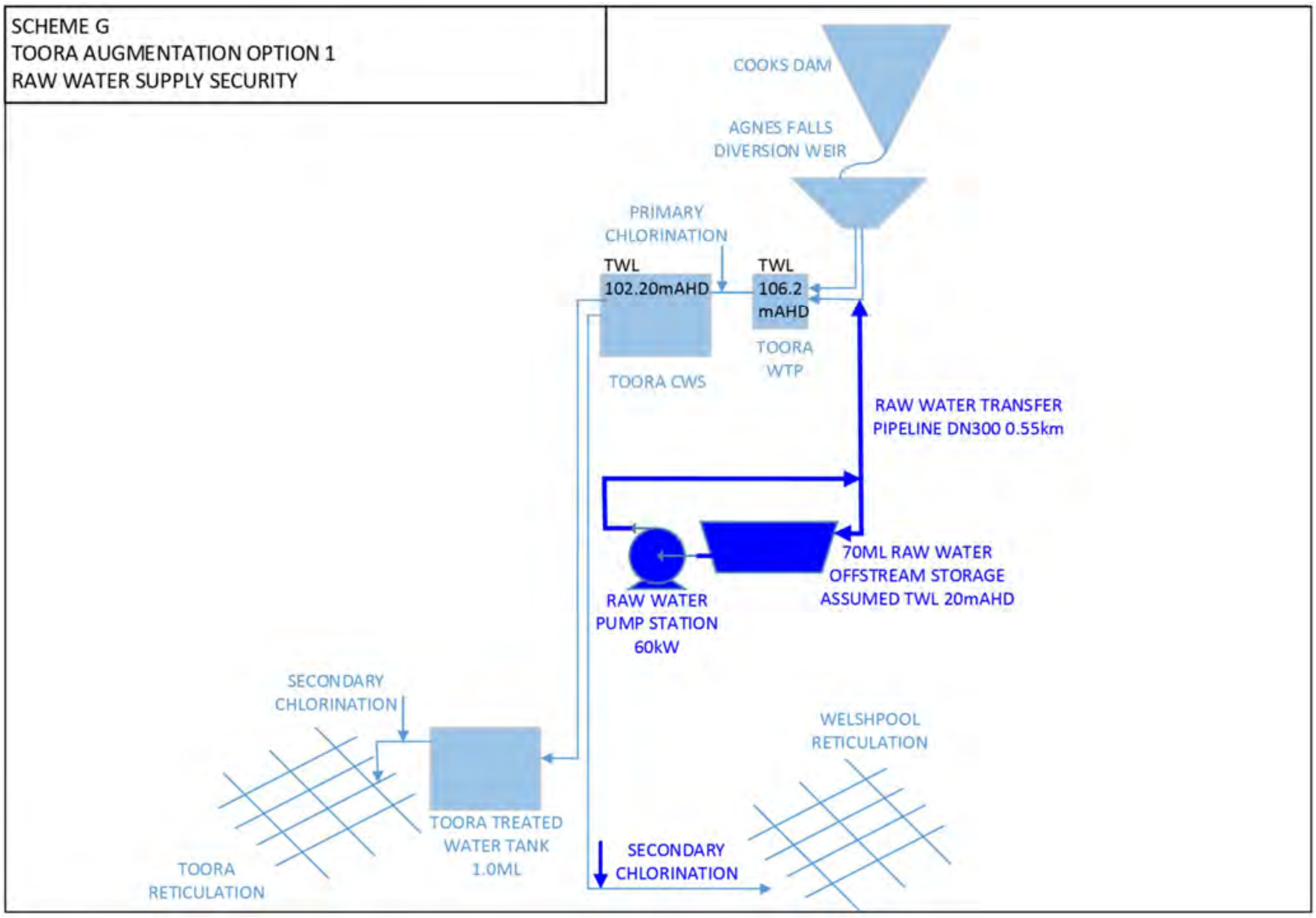
River would not promote development in upstream areas, because the requirement to limit septic tank density upstream of the town offtake would remain.

No timing expectations are placed on these potential upgrades at the current time.

18.4 Supply enhancements for Toora, Welshpool, Port Weshpool and Port Franklin

Previous supply enhancement options for the Toora (Agnes River) system have included significant investigation into the potential for an offstream storage. The 2007 WSDS indicated that an additional 50 ML of storage would be sufficient, however the previous WSDS (2011) noted that a larger storage (total of 250 ML) could be required in order to meet the potential demands associated with the proposed Barry Beach development. For this UWS, demand assumptions do not include any increase in the Barry Beach demand. As such, a 70 ML offstream storage has been estimated to provide a yield to meet future demand under the medium climate change scenario (with a historical climate baseline). Cook's Dam is assumed to have a reduced active storage in this assessment (20 ML capacity; total system storage of 90 ML with the offstream storage), to reflect the fact that the current practical capacity is less than the theoretical capacity.

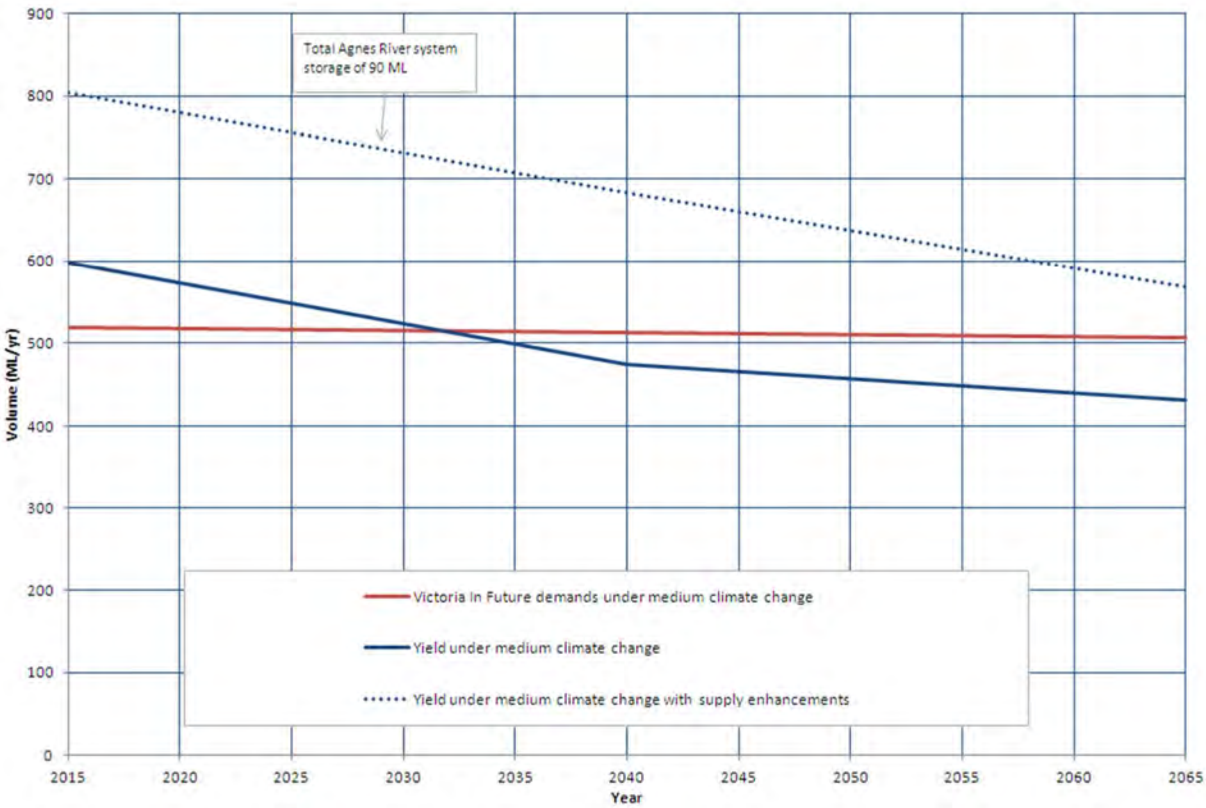
The general engineering concept associated with this option is presented in Figure 18-1.



n Figure 18-1 : Engineering concept for an off-stream storage in the Agnes River system

Under the demand assumptions in the UWS, this results in yield exceeding projected demands, however there is a high degree of uncertainty in future demands, which could be much larger if future developments were to proceed. Decisions around an appropriate future storage size are also affected by water quality considerations. The supply demand balance with this supply enhancement option is shown in Figure 18-2.

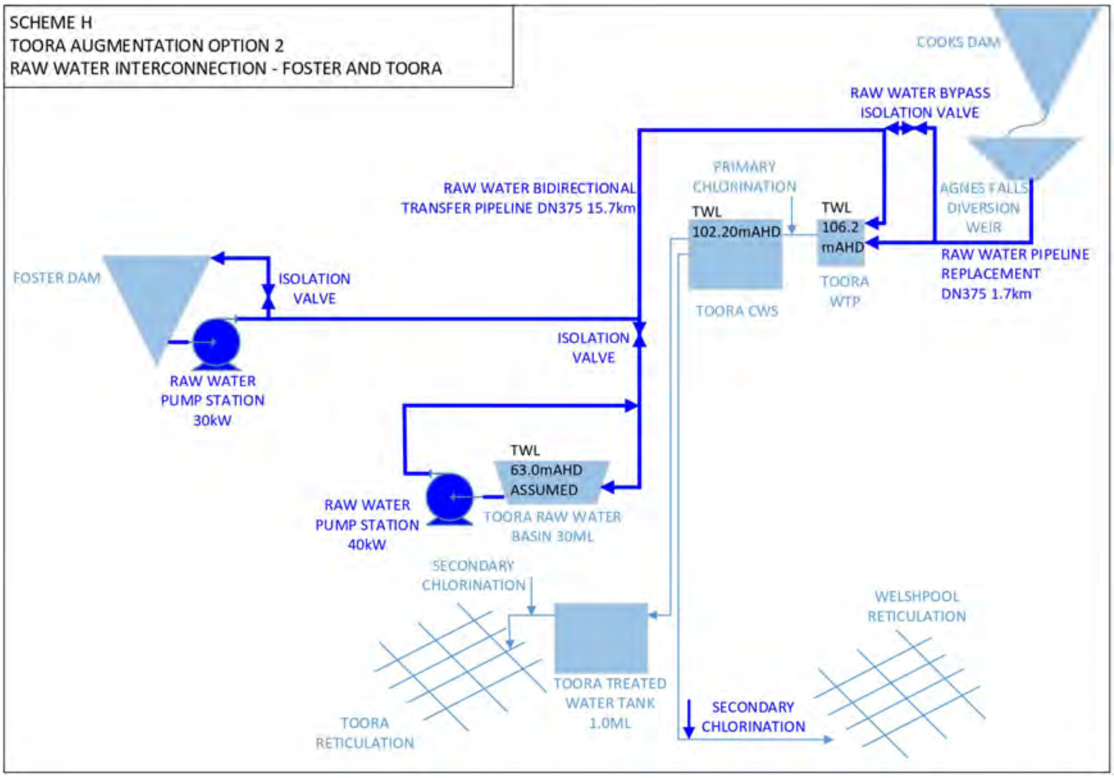
An increased storage capacity would be required if future climate conditions are drier than assumed. Approximately 130 ML of storage would be required to meet the level of service objective over the full planning horizon under the high (dry) climate change scenario. This could be achieved by improving the integrity of the existing Cook's Dam structure, making the full 59 ML available, in combination with a 70 ML offstream storage. Cook's Dam alone is not sufficient to support the demands in this system under both the medium and high climate change scenarios.



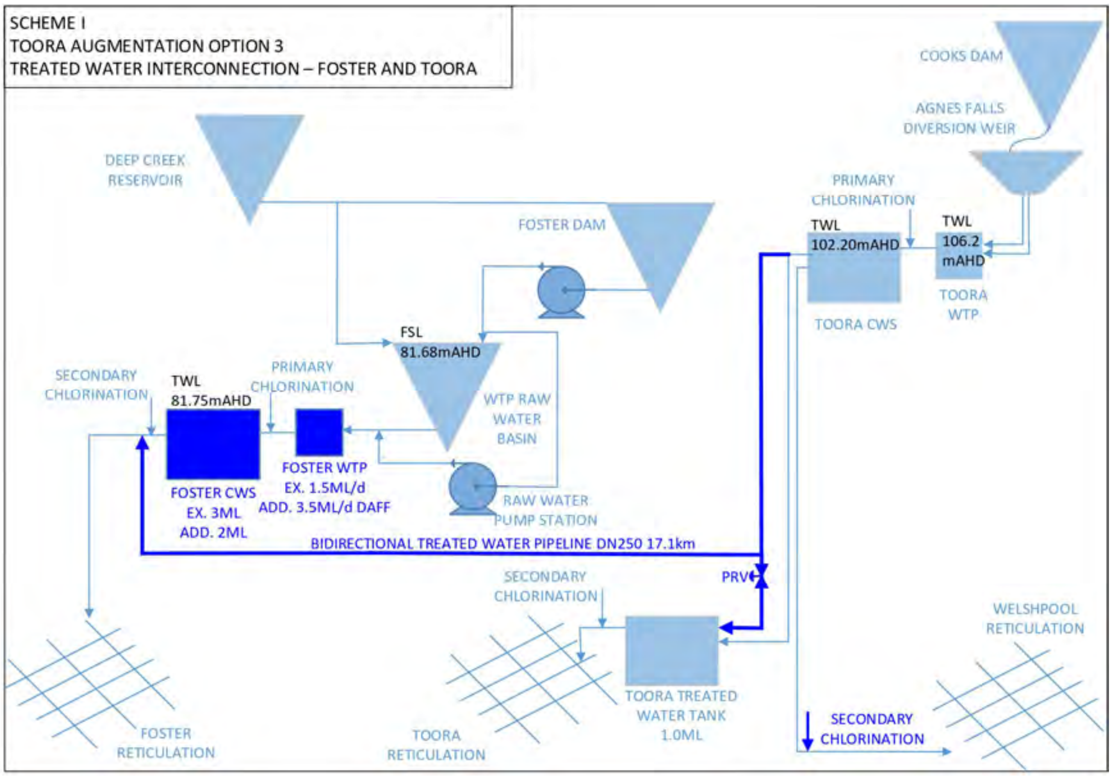
n Figure 18-2 : Effect of supply enhancement for the Toora system under medium climate change

As an alternative to the local supply enhancement options for Toora, the option of linking this system to the Foster (Deep Creek) system has been considered. This includes three alternatives: either a raw water connection or a treated water connection or a centralised treatment facility.

For the raw and treated water options, the configuration would allow water to opportunistically be transferred in both directions to share water supplies across the Foster and Toora towns as necessary. Existing water treatment plants would be utilised in Toora and Foster. The engineering concepts associated with these options are presented in Figure 18-3 and Figure 18-4.



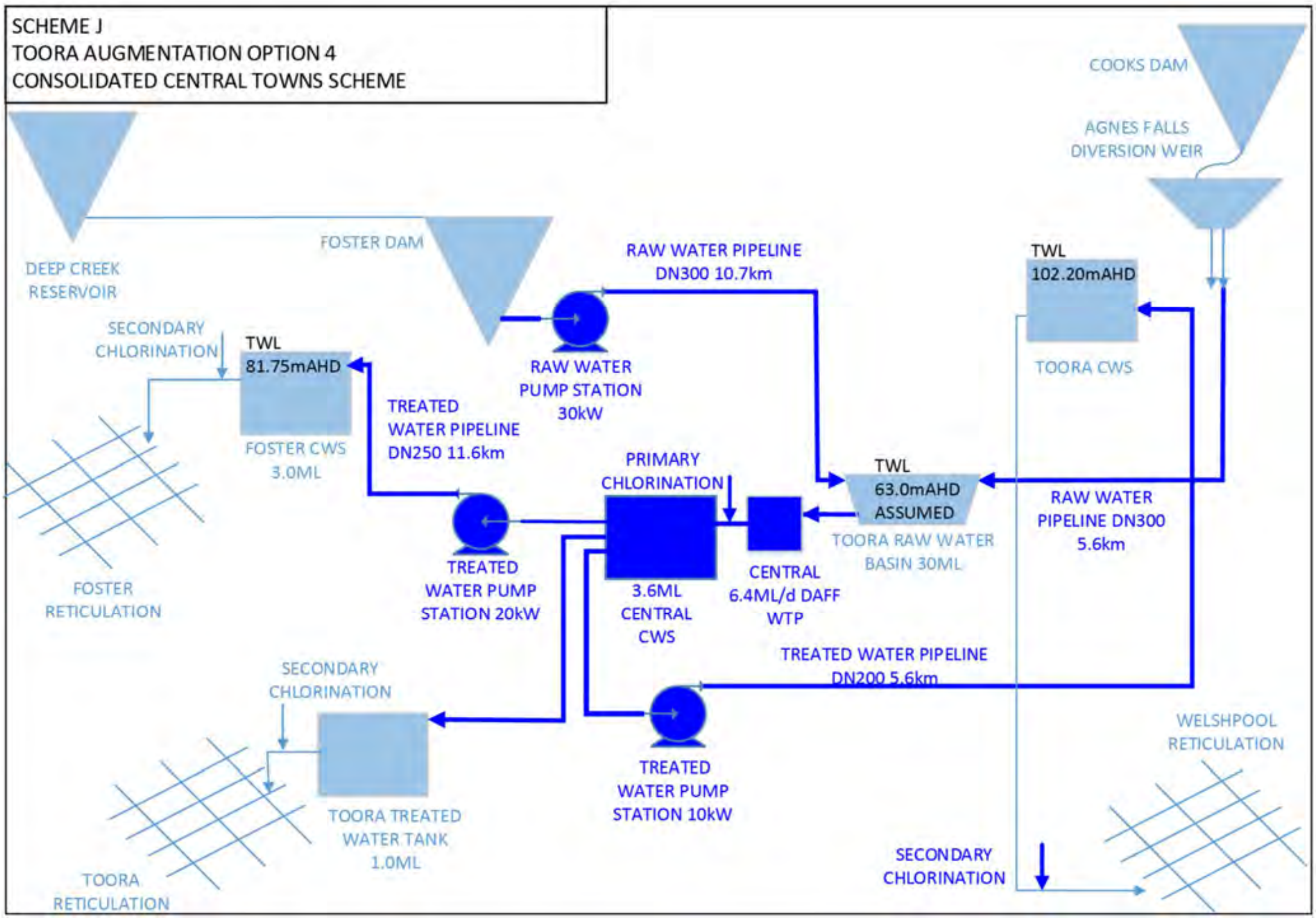
n Figure 18-3 : Engineering concept for a raw water connection between Toora and Foster



n Figure 18-4 : Engineering concept for a treated water connection between Toora and Foster

Given the excess yield available within the Foster system, these options provide more than sufficient supplies to meet the demands of both Toora and Foster for the full duration of the 50 year planning horizon, as shown in Figure 18-6. There is little difference in the yield that can be obtained from these two supply alternatives. These system enhancements would also meet the required level of service under dry climate change conditions. The preliminary cost estimates for these interconnections are also similar.

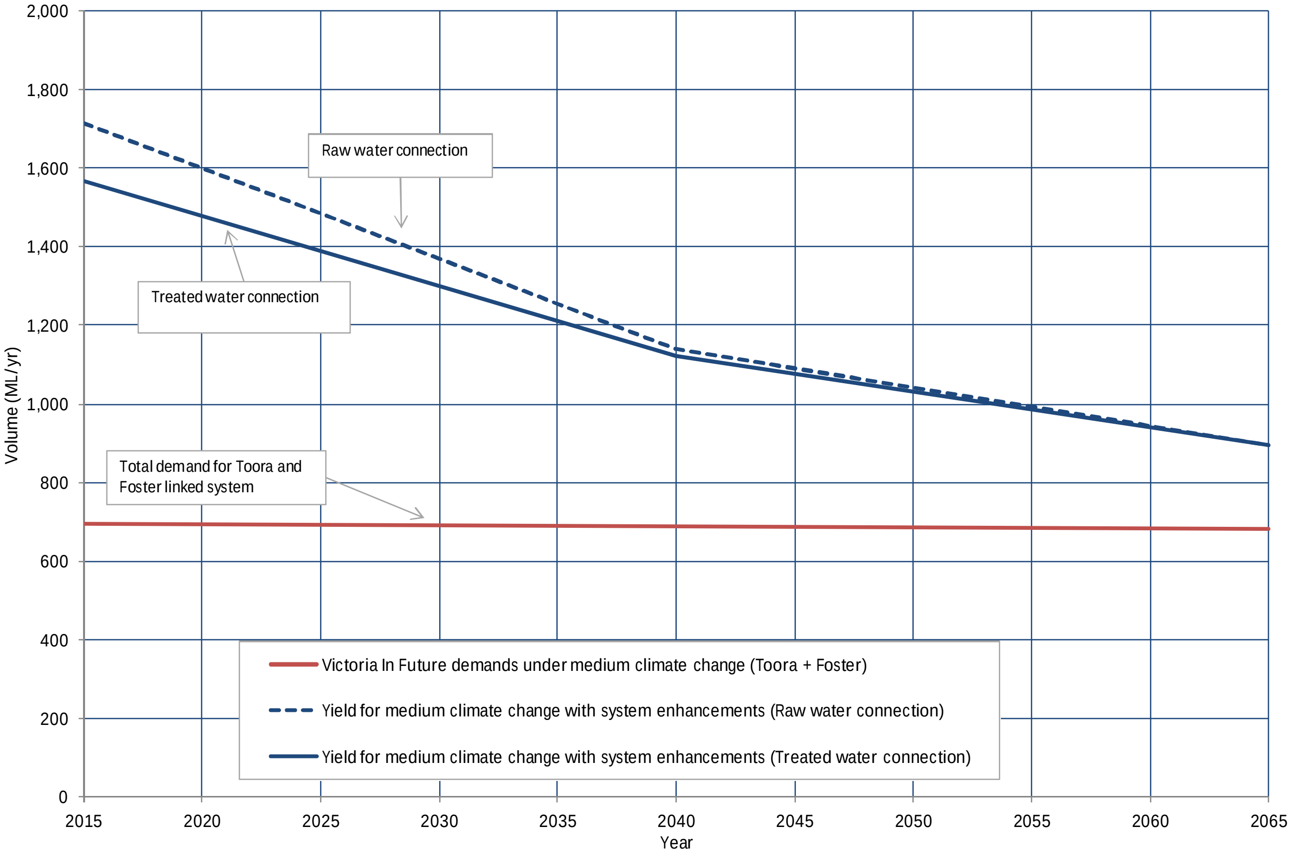
For the centralised treatment facility, a new treatment plant would be constructed to replace the existing Foster and Toora plants. This new treatment plant would treat water harvested from both the Agnes River and Deep Creek catchments. Treated water would then be redistributed to the Toora and Foster towns. This concept is presented in Figure 18-5



n Figure 18-5 : Engineering concept for a centralised scheme for Toora and Foster

The yield outcomes are similar to those for the raw and treated water connections, and are shown in Figure 18-6. This arrangement meets SGW's level of service objectives over the full planning horizon for all climate change scenarios considered. Given the requirement to construct a new treatment plant and pipelines to transfer water to and from this plant, and the associated pumping costs, this option is significantly more expensive that the other connected options presented above.

While these options would provide yield to meet the demands, the use of the excess water available at Foster in this way may prevent any future opportunity to connect the unserviced towns in the region.



n Figure 18-6 : Supply for a connected Toora and Foster system under medium climate change

The above supply enhancement options have all been developed using the historical baseline. A greater yield is available under the current climate baseline scenario compared to the historical climate baseline. The above options have not been re-considered with the current climate baseline assumption, however it is expected to delay the need for implementation compared to the timeframes presented above.

18.5 Supply enhancement for Fish Creek

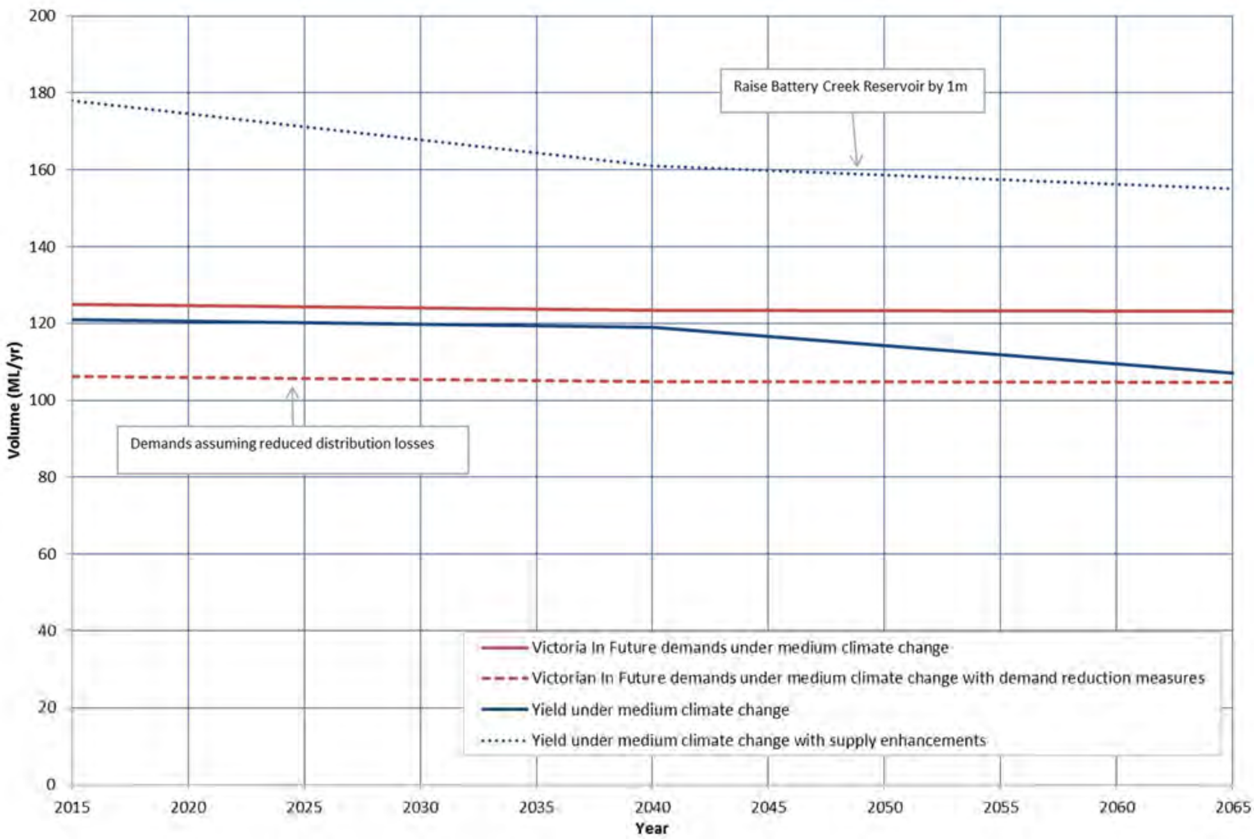
Available supply to Fish Creek is not sufficient to cater for the current and future demands at SGW's level of service objectives. However, it is well known that significant losses occur in the distribution system, and SGW has a schedule of works that will refurbish these aging pipe assets. At present, the system demands incorporate a 30% distribution loss. Following the completion of the maintenance work, SGW is aiming for a 15% distribution loss in the system (15% loss is typically regarded as the optimum balance of the costs of water loss and cost of pipeline renewal). This level of demand reduction would delay the timing for augmentation in the Battery Creek system. Under medium climate change conditions, the existing Fish Creek system would be able to meet SGW's level of service objective over the full planning horizon. Drier climate change conditions would mean that the reduced level of demands would be met until approximately 2025, at which time system enhancements would be required.

It is prudent to note that these ongoing maintenance works will occur over a period of time, and confirmation of the total savings will require a period of observation following the completion of the improvement works. As such, it is relevant to consider additional augmentation options to be prepared in the event that savings are not as significant as anticipated, or if demands increase faster than projected.

Water supply options considered in the previous WSDS included raising Battery Creek Reservoir and diverting water from the nearby Hoddle Creek. These options were again considered in light of the revised information available for this current UWS.

Battery Creek Reservoir is known to have leakage and stability problems, which has dam safety risk implications if remedial works are not undertaken. The need for remedial works provides an opportunity for SGW to save costs by undertaking both the remedial works and raising of the dam wall at the same time. Raising Battery Creek Reservoir by 1m would increase the capacity to a total of 152 ML, which is sufficient to increase the yield to meet current and future demands at Fish Creek (Figure 18-7) under the medium climate change scenario. The resilience of this option to future climate conditions was assessed by considering the high (drier) and low (wetter) climate scenarios. This system would meet SGW's level of service objectives over the whole planning period under both the high and low climate change conditions, assuming distribution losses are minimised.

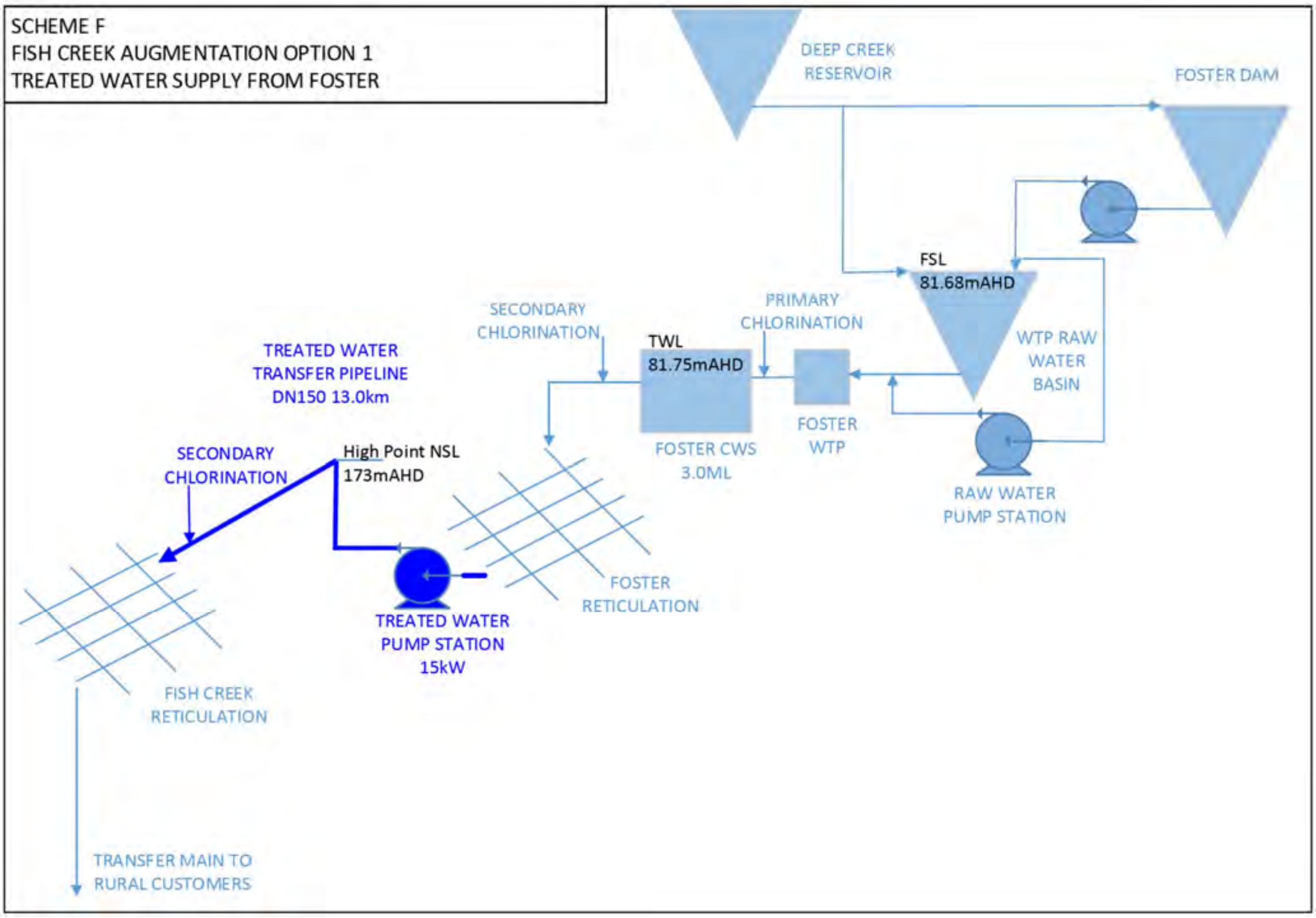
Supply from Hoddle Creek was previously found to add limited supply to Fish Creek unless it was accompanied by additional storage. This is because additional supply from Hoddle Creek would be within the Sustainable Diversion Limits during the winterfill period only. This logic remains relevant within the context of the current UWS. Given that raising Battery Creek storage without the Hoddle Creek connection is sufficient to meet future demands, the option to connect to Hoddle Creek was not considered any further.



n Figure 18-7 : Demand reduction and supply enhancement for Fish Creek

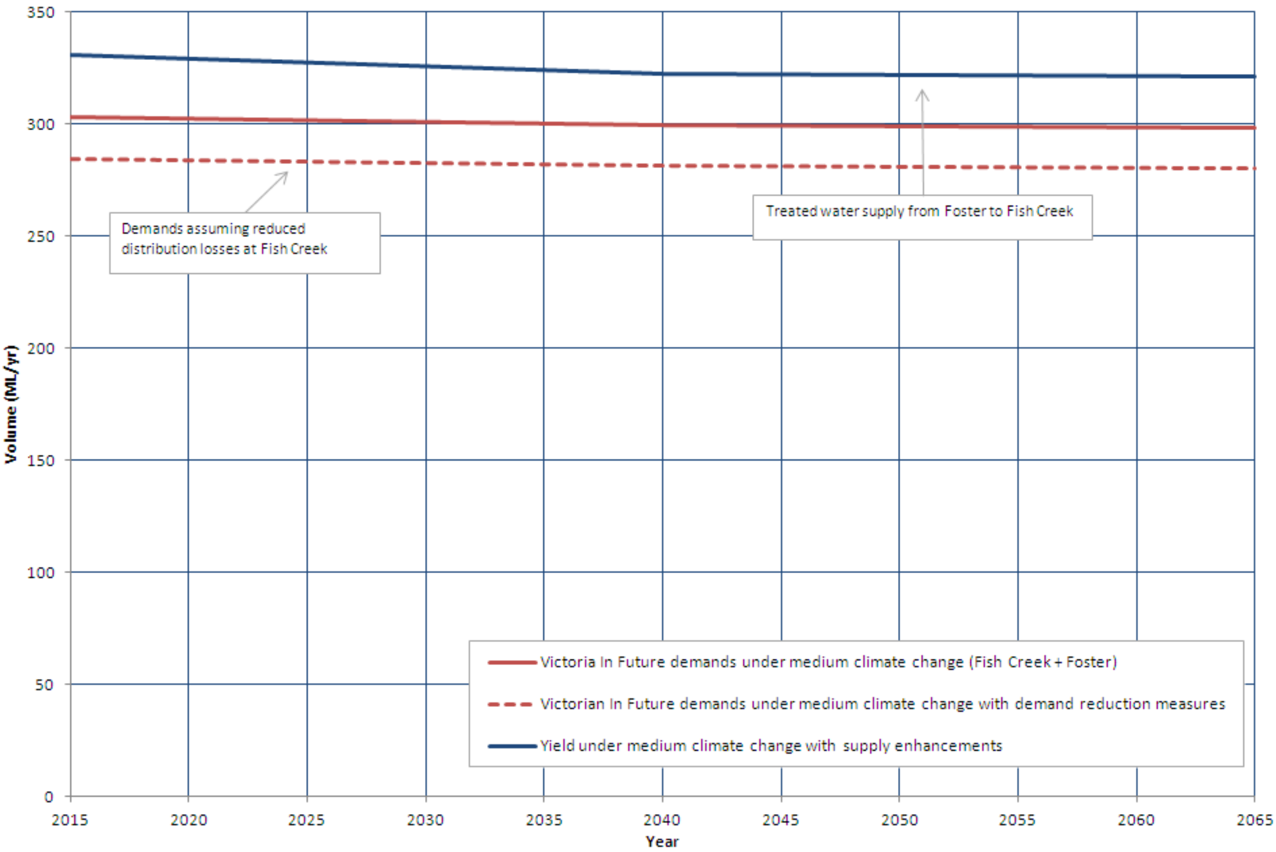
As an alternative to the local supply enhancement options for Fish Creek, the option of linking this system to the Foster (Deep Creek) system has been considered. This could be implemented in combination with the proposed connection between Toora and Foster or in isolation. This connection would involve the decommissioning of the

Battery Creek Reservoir and the one-way transfer of treated water from the Foster treatment plant. The general engineering concept for the Foster to Fish Creek connection is presented in Figure 18-8.



n Figure 18-8 : Engineering concept for treated water connection between Foster and Fish Creek

While this option would provide yield to meet the demands, the use of the excess water available at Foster in this way may prevent any future opportunity to connect the unserviced towns in the region. Figure 18-9 presents the yield outcomes for the connection of Fish Creek to Foster, while Figure 18-6 includes the Fish Creek demands to demonstrate the fully connected system under medium climate change. The connected systems were estimated to be able to supply the required demands to meet the service objectives, including when it was sensitivity tested under the high (drier) climate change conditions.



n Figure 18-9 : Supply for a connected Fish Creek and Foster system

18.6 Sustainability assessment of options

The introduction of demand reduction measures in line with other towns supplied by SGW would serve to minimise infrastructure costs and delay the need for supply augmentations. On a sustainability assessment, demand reduction measures would be preferable to augmenting the supply system, however in order to meet future demands both actions are expected to be required for some towns.

The sustainability assessment for the central towns provides a comparison of the options presented for each system. The outcome of the assessment is summarised in Table 18-2. In most cases, a definitive preferred strategy is dependent on the outcomes of further financial analysis, plus consideration of other aspects which will be progressed by SGW. This will consider asset lifespan and other operational risks in the case of Dumbalk and Meeniyan, and the possible reduction in distribution loss in the case of Fish Creek. These issues may resolve or significantly delay the need for any augmentation works.

The supply from an interlinked system has the advantage of greater flexibility and robustness to potential future changes in demand. However the possibility of future connection from the unserviced towns may be limited if yield is fully taken up by Toora, Foster and Fish Creek demands.

Key points to note about the sustainability assessment are as follows:

- The cost of options to enhance the Toora system range from $12 million to $21.9 million ($1240/ML to $2250/ML). The total NPV and price per ML associated with an offstream storage at Toora is less than the cost associated with connecting the Agnes River and Deep Creek systems (Table 18-1). There is little cost difference between the raw and treated water connection options for Toora. The total cost associated with a centralised system is significantly more than any other option. Options for Fish Creek should be reassessed following the maintenance works to reduce distribution losses as this may resolve the water supply imbalance or delay the need for augmentation. Any delays to the upgrade works could significantly reduce the NPV estimates, which could impact on the cost estimates presented below.

n Table 18-1 : Cost estimates for options (based on high level concept engineering costs prepared in 2017, with 5.2% discount rate)

Option	Discounted capital costs ($million over the 50 year planning horizon)	Discounted operating costs ($million over the 50 year planning horizon)	NPV ($million over the 50 year planning horizon)	NPV ($/ML)
Agnes River off-stream storage	$8.8	$3.2	$12.0	$1240/ML
Raw water connection between Toora and Foster	$16.1	$3.9	$20.0	$2060/ML
Treated water connection between Toora and Foster	$17.5	$4.4	$21.9	$2250/ML
Raise Battery Creek Dam wall	$10.3	$0.9	$11.3	$5340/ML
Treated water connection between Fish Creek and Foster	$15.5	$1.5	$17.0	$8000/ML
Centralised treatment for connected Toora, Fish Creek and Foster system	$27.9	$6.7	$34.6	$3566/ML

- Options that incorporate elements of connection between systems would support more regional development by providing greater flexibility to service the demands in the future. Conversely, if these options utilise all available yield within the existing headworks it may not be possible to connect the unserviced coastal towns in the future.
- Greenhouse gas emissions associated with the options are significant for the fully connected options due to the large volumes being pumped. The greenhouse gas emission costs associated with construction have not been included in this assessment.
- River health would be expected to decline for those options where there are increased extractions form the local catchments. While this is relevant for all options, the impact of the Dumbalk and Meeniyan options is considered to be relatively insignificant given the relatively small change from the current arrangement. In all cases the volume harvested would be within SGW’s current legal entitlements for water, which include passing flows for river health. Improved river health would be expected for those options that involve the decommissioning on storages.
- Changes in water quality in local waterways would be expected to be negligible under all options.
- All options would have a minor impact on other ecosystems. Vegetation would need to be cleared along new pipeline routes if these cannot be aligned in an existing cleared service corridor. There would also be a minor loss of terrestrial habitat at the Agnes River off-stream storage site.
- None of the options are likely to have any impact on recreation and heritage activities in the area. Interlinking the Deep Creek and Agnes River systems would allow more water to flow over the Agnes River Falls, however the change in flow for recreational purposes may not be noticeable to visitors.
- All options are likely to be socially acceptable, however some individuals may be affected by the placement of new infrastructure. Raising Battery Creek Reservoir may result in the loss of some private land due to

inundation, whereas the connecting pipes for the interlinking option may need to cross private land, depending on the final pipeline route selected.

- There is a moderate degree of confidence associated with all options. The confidence associated with the interlinked system is slightly higher, because it is less reliant on a single supply source if water availability in any one of the Agnes River, Deep Creek or Battery Creek were to change under climate change. Confidence in the demand reduction measures is slightly lower, reflecting the uncertainty in uptake of these initiatives.

Table 18-2 Sustainability Assessment of Options for Central Towns(1)

Net present cost	Regional development	Greenhouse emissions	River health	Water quality	Other ecosystems	Culture, recreation and heritage	Social acceptability	Confidence flag
Option: Demand reduction measures								
5	1	5	1	0	0	0	3	1
Option: Agnes River offstream storage								
-1	1	3	-1	0	-1	0	3	2
Option: Raw water connection between Toora and Foster								
-5	2	3	-1	0	-1	0	3	2
Option: Treated water connection between Toora and Foster								
-5	2	tbc	-1	0	-1	0	3	2
Option: Raise Battery Creek dam wall								
-5	1	tbc	-1	0	-1	0	-1	2
Option: Treated water connection between Fish Creek and Foster								
-5	0	2	-1	0	-1	0	2	2
Option: Centralised treatment for connected Toora, Fish Creek and Foster system								
-5	2	2	-1	0	-1	0	3	2

(1) For broad comparison of options only. See Section 5 for further details of the function of this sustainability assessment within the planning process.

18.7 Strategy summary

While there is no requirement for system enhancements for the town of Foster, some augmentation options for Toora and Fish Creek involve an interconnected system.

For the Agnes Creek system, the addition of a 70 ML offstream storage would provide yield to meet future requirements in a cost-effective manner. This option maintains a stand-alone system to supply Toora.

Maintenance works to reduce distribution losses are fundamental to reduce the demand within the Battery Creek system. If these losses can be halved, it is expected that the existing supply system would be adequate without any further need for augmentation. If demand reduction measures are less successful, system improvements may be required. Based on current assessments, raising the Battery Creek dam wall is the preferred option as this resolves the current dam safety issues, provides adequate yield to meet future demands, and maintains flexibility in the Foster system to connect unserviced demands at a later date. However SGW should revisit this cost estimate and sustainability assessment based on the outcomes from the loss reduction works. Any opportunity to defer the capital expenditure will significantly alter the NPV.

For Dumbalk and Meeniyan, system enhancements are not being driven by water supply issues. In these locations, SGW plans to rigorously assess the condition of existing treatment plants, water quality concerns and planning drivers in the upper Tarwin River catchment to determine if any changes are required, and when. It is recognised that the timing of any capital expenditure may be driven by the ability to fit these enhancements into SGW's broader program of works. As such, it is not appropriate to make a recommendation on the preferred option at this stage.

The approximate timing of infrastructure augmentation under each option is shown in Table 18-3.

Table 18-3 Approximate timing of SGW infrastructure augmentation for the Central Towns

Approximate Timing	Actions	
	Fish Creek	Agnes River (Toora)
Next 5 years	Implement program of works to reduce distribution losses in Fish Creek system	
Next 10 years	Review success of loss reduction works. Reassess requirement for augmentation works. If required, raise Battery Creek Reservoir by 1 metre in combination with dam safety upgrade works.	
From 2030		Construct 70 ML off-stream storage at Toora

Immediate and ongoing actions which are applicable to both options are listed in Table 18-4. These include actions to monitor demands.

Table 18-4 Immediate and Ongoing Actions for Central Towns

Strategy	Actions
Reduce uncertainty in current estimate of consumer demand	Compare quarterly or four monthly consumption data from property and bulk meters
Reduce uncertainty in future estimate of consumer demand	- Examine long-term trends in water use independent of climate variability
Encourage demand reduction	- Pursue additional demand reduction options - Continue ongoing program of system leak reduction and inspections for unmetered tappings - Arrange interest free finance to farmers for installation of facilities to reduce demand

19. Strategy for Eastern Towns

19.1 Introduction

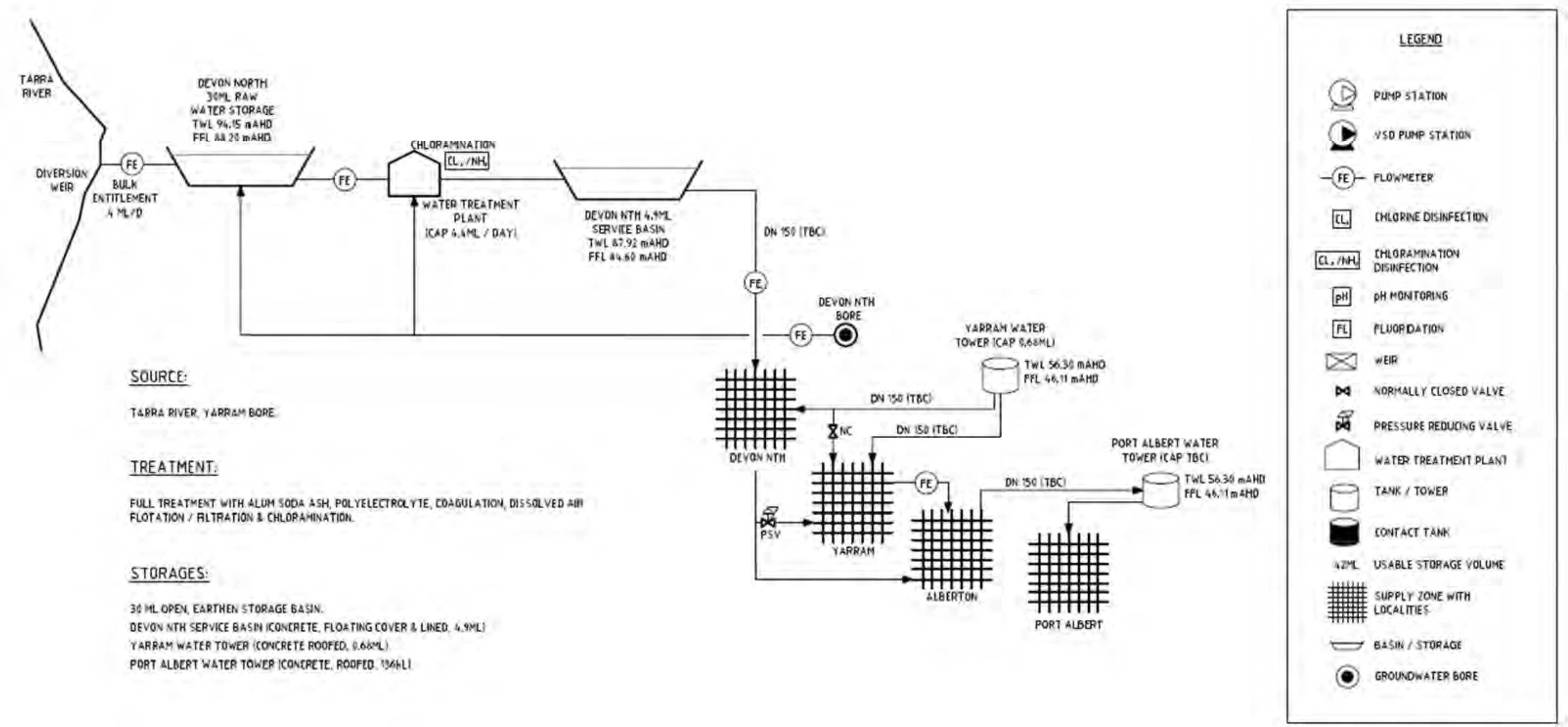
This section of the UWS outlines the demand and supply strategy for Yarram, Port Albert, Alberton and Devon North over the next 50 years. It includes an overview of the current supply system configuration, current demand for water and current supply. It also includes Current Operation and Infrastructure supply and demand projections under future climate change and any actions required to ensure that demand does not exceed supply in the long-term.

19.2 Current water supply and demand

19.2.1 Supply system description

An offtake weir on the Tarra River supplies water to the townships of Yarram, Alberton, Port Albert and rural areas in their proximity including Devon North. A schematic of the supply system is shown in Figure 19-1. The river supplies other parties including rural users who utilise it for domestic and stock purposes. From the offtake weir the supply gravitates to two storages at Devon North of 3.4 ML and 30 ML capacity respectively. The 30 ML storage acts as raw water storage. From here it passes through a treatment plant and is then transferred to the covered and lined 3.4 ML clear water storage. From here the supply gravitates to Yarram, Alberton and Port Albert. The useable storage ("live" storage) in the system is estimated to be 31 ML. At Yarram there is a 270 kL capacity elevated tower, but this is not used because the minimum hydraulic grade line in the reticulation system is always higher than the top water level of the tank. There is a 136 kL elevated tower at Port Albert. Enroute from the Devon North storages to Yarram, supply is provided to the community of Devon North and adjoining rural areas. Other rural supplies are provided to properties between Yarram and Port Albert. Supply under specific agreement is provided to properties between the offtake weir and the Devon North storages. Included in the agreement is provision requiring the consumer to install security water storage tanks with a minimum capacity of 45.4 kL. These properties are outside the SGW's district and the supply is unchlorinated.

SGW has obtained in-principle approval from the licensing authority Southern Rural Water to purchase up to 400 ML/yr of groundwater licences at Yarram for extraction at the SGW bore at a rate of up to 4 ML/d. To date, licences totalling 212.4 ML/yr have been purchased. This groundwater bore provides water to the raw water basin at Devon North. SGW also has a licence to extract groundwater from a bore at the Yarram Golf Club at a rate of 1.0 ML/d up to a total annual volume of 60 ML. This groundwater bore is not directly connected to the reticulated supply of the Yarram supply system and temporary arrangements have to be made in times of drought to make this emergency supply functional.



n Figure 19-1 : Tarra River Water Supply System schematic

19.2.2 Current legal entitlements to water

The bulk entitlement for Yarram allows SGW to divert up to a maximum of 853 ML/yr from the Tarra River. The daily bulk entitlement is shown in Table 19-1.

Table 19-1 Bulk entitlement volume for Yarram

Source	Maximum annual volume (ML/yr)	Flow in Tarra River upstream of offtake weir, F (ML/d)	Flow available for diversion (ML/d)	Minimum passing flow (ML/d)
Tarra River	853	> 12	6	F – 6
		6 – 12	0.5 * F	0.5 *F
		3 – 6	F – 3	3.0
		< 3	0	F

Note: F = flow in the Tarra River upstream of the offtake weir in ML/d

Details of SGW's groundwater licences at Yarram are shown in Table 19-2.

Table 19-2 Groundwater licence for Yarram

Location	Annual licensed volume (ML/yr)	Maximum extraction rate (ML/d)
Yarram – SGW Bore	214.2 ML	4

19.2.3 Current demand

Yarram, Port Albert and Alberton had populations of 1,687, 239 and 168 respectively excluding visitors in the 2011 census. This corresponds to a total of 2,104 for the three towns. Population data for Devon North was not available. A demand model was fitted to the recent unrestricted data to estimate a long-term average annual demand, which takes into account how current demands would vary under a wider range of natural climate variability. The historical and estimated long-term current (baseline) demand is shown in Figure 19-2. The long-term average annual demand is **448 ML/yr** at SGW's treatment plant inlet, of which around 4% is utilised on average through the treatment plant. Annual demands at Yarram have been fairly consistent since the end of the Millennium Drought except for the 2014/15 year. Demands at Yarram were elevated in 2014/15 due to high non-revenue water, but demands have returned to lower levels in 2015/16, presumably due to loss reduction.

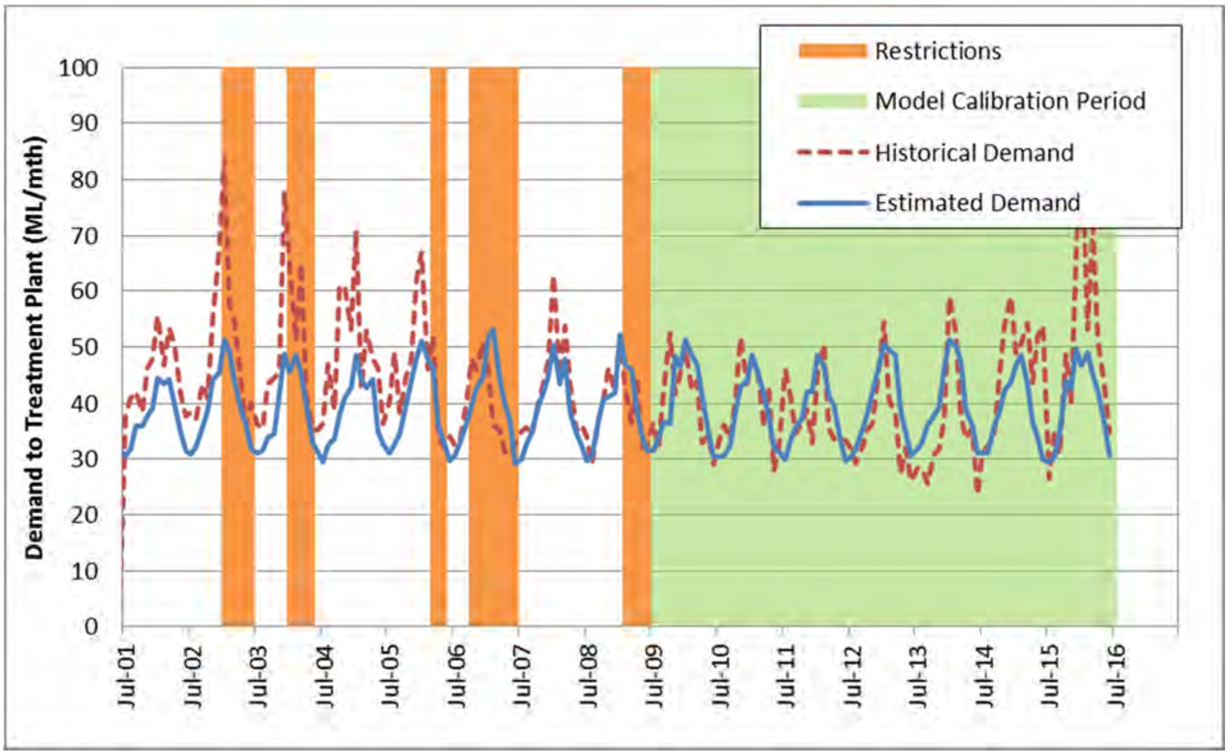


Figure 19-2 : Long term monthly demands for Yarram, Port Albert, Alberton and Devon North

19.2.4 Current reliability of supply

Restrictions occurred relatively frequently during the Millennium Drought at Yarram, being implemented around every second year on average. Restrictions have not been implemented since 2008/09. Reliability of supply modelling, which incorporates 214 ML/yr of additional groundwater supply, indicated that restrictions would be implemented every 1 in 50 years (98% annual reliability) at current (baseline) demands over the period of modelling from July 1961 to June 2015. This meets SGW's level of service objectives to have restrictions not more frequently than in 10% of years. Further details on the water resource model used to assess reliability of supply (and yield) can be found in Jacobs (2017).

19.3 Water supply and demand projections with current operation and infrastructure

19.3.1 Historical trends

Historical diversions to Yarram, Port Albert, Alberton and Devon North have declined slightly in recent years before a sudden increase in 2014/15, as seen in Figure 19-3. The number of customers billed in this supply system has increased slightly over the last few years. This potentially indicates that significant water savings have been achieved by SGW and its customers in recent years, or changes to non-revenue water.

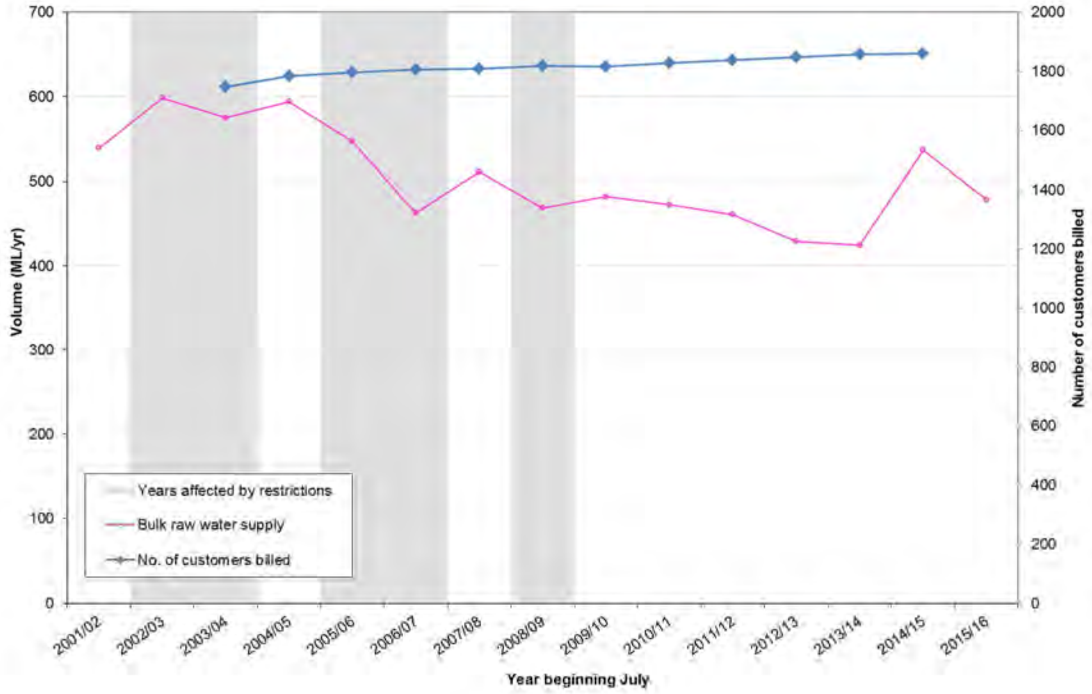


Figure 19-3 : Historical diversions and number of customers billed at Yarram, Port Albert, Alberton and Devon North

The population in the Tarra River system has increased in recent years after declining for the previous decade, as seen in Figure 19-4. The total population has increased from 1,974 in 2006 to 2,104 in 2011. The number of dwellings and connections were shown to increase steadily over the last two decades.

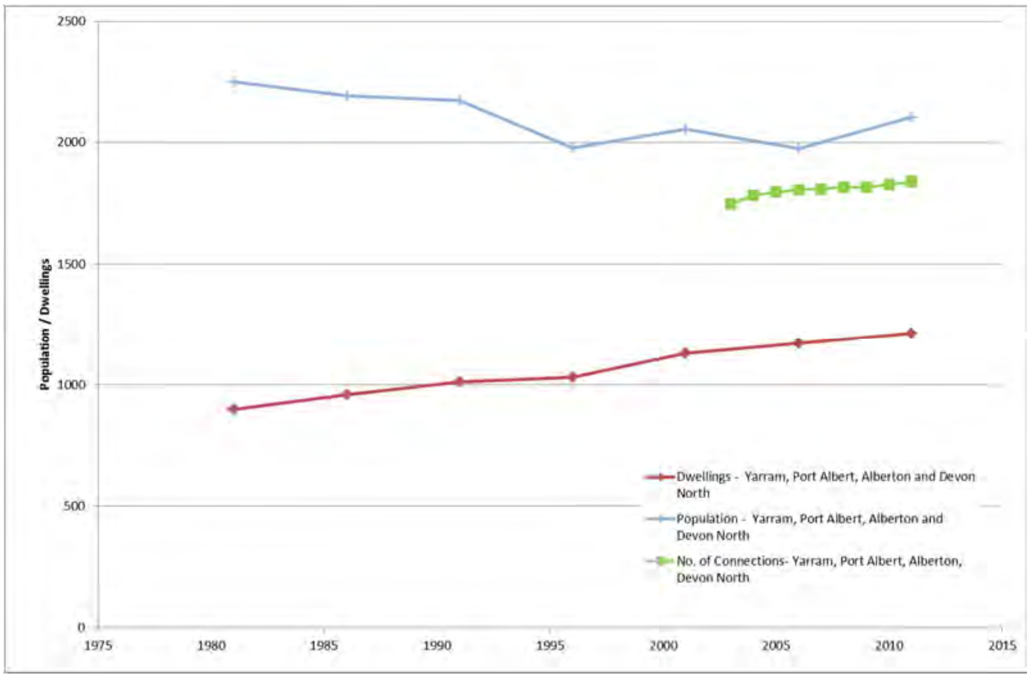


Figure 19-4 : Historical population in Yarram, Port Albert, Alberton (data not available for Devon North)

19.3.2 Future demand projections

Future growth in Yarram, Port Albert, Alberton and Devon North were estimated using Victoria in the Future estimates, which are available at a Statistical Local Area (SLA) level. There are five SLA's covering SGW's water supply area. Yarram, Port Albert, Alberton and Devon North are located within the Wellington Shire Alberton SLA and account for around 35% of the population within the SLA.

The population projections estimate a decrease of between 0.3% and 0.8% per year with no change in major industrial demand. The urban and stock and domestic demand has been assumed to increase by up to 7% in accordance with the medium climate change scenario. This increase is due to increased water use activities such as garden watering under drier and hotter climate change conditions and is consistent with DELWP recommendations (DELWP, 2016a).

19.3.3 Future supply projections with current operation and infrastructure

The current operation and infrastructure water supply and demand situation for the Tarra River supply system for high climate change scenario is shown in Figure 19-5. This figure illustrates that the current demand is not expected to exceed available supply over the planning horizon under the high climate change scenario. Given the high climate scenario is expected to meet SGW's level of service objectives, no other climate scenarios were assessed.

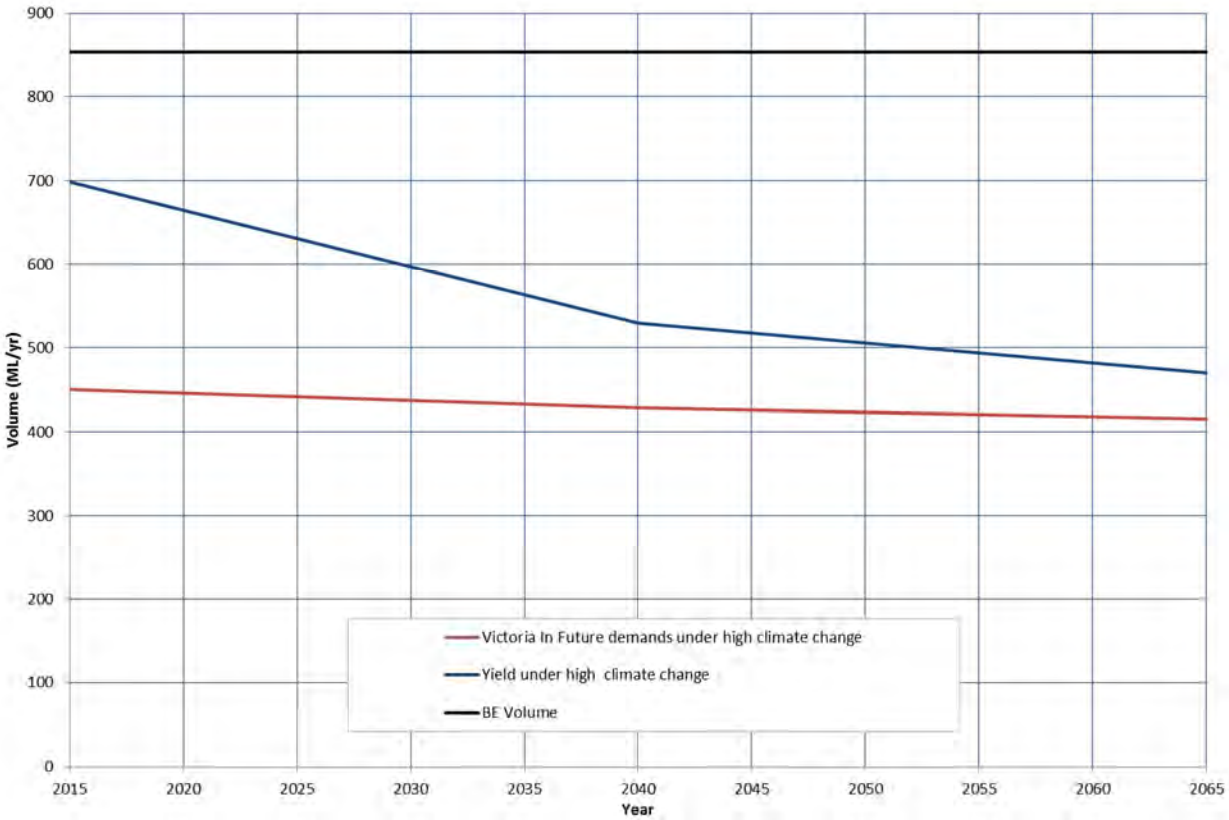


Figure 19-5 : Current operation and infrastructure water supply and demand for Yarram, Port Albert, Alberton and Devon North

In light of this, there may be scope to connect some of the unserviced towns to the Yarram system at some stage in the future, should there be appetite within the local communities. Yarram may also offer potential to support a large scale development, residential or industrial, in the event that a high water user is seeking to establish business in the South Gippsland region. Purchase of additional groundwater licences may be required to support any significant development. This possibility should be assessed against the strategy for Yarram and any supporting assessments that are being completed in parallel with this UWS.

19.4 Sensitivity of projections

Several potential land and water use changes within the Tarra River catchment were investigated to understand the potential risk that they could pose to available supply.

Bushfires: The maximum reduction in runoff after a bushfire typically occurs at around 10-20 years after the fire has occurred, and thereafter runoff progressively increases back to pre-bushfire levels. Approximately 88% of the Tarra River catchment upstream of the Yarram offtake is covered by vegetation and could be susceptible to bushfire. There is no record of bushfires occurring in this water supply catchment in recent decades. The effects of bushfire on catchment yield will therefore only be a concern if fires occur in this area in the future.

Logging: Only a very small proportion (<5%) of the water supply catchment is covered by areas subject to logging under Regional Forestry Agreements. Water supply to Yarram is therefore not considered to be at risk due to logging.

Plantations: A significant proportion (~40-60%) of the Yarram water supply catchment is covered by plantations. Plantations over a large proportion of a catchment can significantly reduce runoff to downstream areas, particularly when those plantations are set up on previously cleared land or where the species is switched from native forest to pine plantations. A significant proportion of the Yarram water supply catchment is covered by plantations, so this may have a significant effect on catchment yield, depending on the age profile of the plantations. Local operators estimate the age of the plantations to be around 25-35 years, that they consist of a mixture of eucalypt and pine plantations and that they were originally planted on previously cleared land. On this basis, it is likely that streamflow yields per unit catchment area have changed over time such that the historical streamflow record does not accurately represent current streamflow conditions. DELWP utilise a tool for estimating changes in runoff associated with changes in land use type, which may provide SGW with useful information about how its water availability will change over time as a result of harvesting and replanting of the plantations.

Groundwater level decline: Groundwater levels in the Gippsland coastal region near Yarram have been declining at around 1 m/yr for the last twenty years predominantly due to off-shore oil, water and gas extraction (SRW, 2010). This trend is expected to continue for the next few decades. SGW has designed its groundwater bore and pump to be able to cope with regional reductions in groundwater level over the design life of the bore. The Yarram WSPA Groundwater Management Plan (SRW, 2010), which governs the management of groundwater extraction in the region, acknowledges this decline. There are not currently any defined triggers for cessation or restriction of groundwater pumping across the region associated with the decline. The Groundwater Management Plan is subject to annual reporting by Southern Rural Water, which would indicate any proposed changes to plan rules. Any such changes must be publically consulted on prior to adoption.

19.5 Supply enhancement options

Available supply is expected to remain above future demands, even after considering climate change, hence Yarram does not require any supply enhancement over the 50 year planning horizon of this strategy.

Since the previous WSDS (2011) SGW has proactively purchased groundwater licences to supply the Yarram system. Licences totalling 214.2 ML/year have been purchased to date. While SGW have in principal approval to obtain up to 400 ML/year, it is not currently anticipated that this total volume will be required. However, having access to additional bore licences will provide suitable system enhancement if required in the future.

19.6 Sustainability assessment of options

The only actions for SGW in managing its eastern towns is to utilise the current groundwater licences during periods of drought and secondly to introduce demand reduction measures in line with other towns supplied by SGW. Whilst there is no specific need for demand reduction for the eastern towns, implementing demand reduction initiatives in these towns will ensure a consistent demand reduction message across South Gippsland. It will also provide a buffer if strong growth does subsequently occur, despite current predictions. The installation of water efficient devices, such as shower heads, will have a design life of several decades and retrofitting is an expensive exercise.

Table 19-3 Sustainability assessment for Yarram, Alberton, Port Albert and Devon North (1)

Net present cost	Regional development	Greenhouse emissions	River health	Water quality	Other ecosystems	Culture, recreation and heritage	Social acceptability	Confidence flag
Option: Demand reduction measures								
5	1	5	1	0	0	0	3	2

(1) For broad comparison of options only. See Section 5 for further details of the function of this sustainability assessment within the planning process.

19.7 Strategy summary

A summary of the long-term Water Supply Demand Strategy for Yarram, Alberton, Port Albert and Devon North is shown in Table 19-4 and Table 19-5.

Table 19-4 Strategy for Yarram, Alberton, Port Albert and Devon North

Strategy	Action	Timing
Reduce uncertainty in current estimate of consumer demand	Compare quarterly or four monthly consumption data from property and bulk meters	Immediate
Reduce uncertainty in future estimate of consumer demand	- Examine long-term trends in water use independent of climate variability	Ongoing
Encourage demand reduction	- Pursue additional demand reduction options - Continue ongoing program of system leak reduction and inspections for unmetered tappings	Ongoing
Maintain reliability of supply	- Monitor groundwater use and instantaneous yields to assess if additional licences are required to supply during periods of low flows	Immediate

Table 19-5 Action Plan for Eastern Towns

Approximate Timing	Action
Ongoing	Monitor ongoing demands to identify the need for further groundwater licence purchase

20. Strategy for Unserviced Towns

There are a number of small towns in the South Gippsland region that are not currently connected to water or sewerage services. The previous WSDS (2011) included consideration of specific augmentation options to support the future connection of these towns. However since that time, community consultation has confirmed that there is no current desire for the residents of these towns to be connected. SGW recognise that this may change during the UWS planning horizon, and have incorporated this qualitative strategy to support the management of the towns not currently connected to the potable water supply network.

The unserviced towns can be clustered based on geographical location and the likely connection point should these towns ever be connected to the SGW systems. This includes:

- Lance Creek system (following connection with Korumburra, Poowong, Loch and Nyora): Venus Bay, Tarwin Lower and Bena
- Battery Creek system: Walkerville, Waratah Bay, Sandy Point and Yanakie
- Leongatha: Tarwin
- Yarram system: Greenmount, Won Wron, Woodside, Woodside Beach, Robertson's Beach, Manns Beach and McLoughlins Beach

Current and future demands for these towns were presented in Table 4-5 and totalled 679 ML/year of additional demand based on current demand estimates.

As previously noted, there remains much uncertainty about what future impact unserviced towns may have on existing supply systems. It may well be that innovative approaches to how additional water is provided to such existing communities will result in water requirements being much less than the values assumed in this study. Alternatively, the estimated demands may increase under different climate change conditions in the future.

Some preliminary investigations have been undertaken for these unserviced towns. A discussion of the general pros and cons of various alternative water supply options to these unserviced towns is presented in Appendix C. An investigation into the water shortages at Yanakie has also been completed, which identified approximately 20 farms that experienced water shortages in 2014 and 2015 which were dry periods with successive years with low or no runoff during the spring period. One possible solutions was a pipeline from the Foster system.

Given that there is currently no demand for a reticulated supply in the unserviced towns and given the likely high cost of supplying water to these small towns, SGW is not pursuing further investigations into supplying these unserviced towns at the current time.

21. Integrated Water Management Actions

SGW has been proactive in implementing Integrated Water Management (IWM) actions in line with State Government Policy, such as Water for Victoria (DELWP, 2016b).

Table 21-1 provides a summary of the integrated water management actions undertaken by SGW, in collaboration with other stakeholders, across their systems. This table highlights the significant effort that SGW has invested in IWM activities over an extended period.

In the context of this UWS, a number of the options presented will offer further opportunities to expand on the IWM activities, specifically:

- SGW has a program of works planned to replace aging infrastructure in the Fish Creek which will help to reduce the distribution losses in this system.
- Discussions are being undertaken with Murray Goulburn to better understand the nature of their demands and to implement demand management strategies in collaboration. This will help to formalise the Murray Goulburn demands on the system and provide certainty to both SGW and Murray Goulburn.
- Groundwater opportunities have been identified to use groundwater to water recreational reserves such as football grounds and golf courses. This approach would remove these demands from the potable water supply, to help manage the demands across the system.
- Water recycling and stormwater reuse opportunities continue to be pursued across the system. The application of this water for irrigation of community sporting facilities or agriculture may help to reduce the demands on the potable water supply system. Recycling will also help to reduce the volume discharged to rivers and the ocean.

Beyond this, SGW will continue to explore opportunities to improve the security of supplies and defer system augmentation by seeking and, where appropriate, implementing additional IWM opportunities. SGW expects to take an active role in the planned regional IWM forum to develop a comprehensive regional IWM Plan that will influence detailed augmentation plans for individual water supply systems. It is anticipated that the next Urban Water Strategy will incorporate actions and outcomes from the regional IWM Plan. Table 21-1 identifies activities that remain ongoing or are still to be implemented (in design or feasibility stage). These actions, and new opportunities developed through the IWM forums, will be progressed over the coming years.

n Table 21-1 Integrated Water Management Actions

Source / Savings	Project	Status	Volume/yr	Collaborators	Comments
Alternative water source	Raw water stand-pipe for rural customers at Foster Dam	Completed and available for future use	NA	SGW, DELWP, Local farmers	A raw water standpipe was built near the Foster Dam to allow rural water uses emergency access to raw water supplies via road tanker, thereby saving treatment plant losses if these users were to draw from the potable water supply system.
Alternative water source	Raw water supply from Coalition Creek Dam to Korumburra Golf course	Operational	10,000 kL/yr	SGW, Korumburra Golf Course	Korumburra Golf Course draws irrigation water directly from the adjacent Coalition Creek Dam as raw water, thereby saving treatment plant losses.
Water savings	Incentives and support for installation of water efficient appliances for customers in Poowong, Loch and Nyora	Completed	5000 kL/yr	SGW, DELWP, customers	Volume saved is an initial estimate and will be confirmed by monitoring over time
Alternative water source	Reuse of a disused open raw water storage at Inverloch for rural customers during dry spring / summer of 2015 / 2016	Completed and available for future use	< 227,000 kL when basin used	SGW & local farmers	Storage is offline and doesn't have a significant catchment. Up to 227 ML stored could be used for emergency irrigation water supply to avoid draw on SGW's potable water supply.
Alternative water source	Reuse of treated wastewater from Welshpool for agriculture	Not in use	NA	SGW & local farmers	Irrigation scheme is set up, however supply of recycled water hasn't occurred for two years due to high TDS. Recycled water was being shandied with groundwater for irrigation scheme.
Alternative water source	Reuse of treated wastewater from Meeniyan for recreation and agriculture	Operational	15-20,000 kL/yr	SGW and local sports clubs and farmers	Recycled water used to irrigate Meeniyan recreation reserve, Stony Creek football ground and Meeniyan Golf Course. Recycled also used for agricultural reuse on SGW site

Source / Savings	Project	Status	Volume/yr	Collaborators	Comments
					adjacent to lagoons.
Alternative water source	Reuse of treated wastewater from Toora to irrigate recreation grounds	Operational	5-6000 kL/yr	SGW and local sports club	Recycled water used to irrigate recreation reserve. No agricultural reuse in place at time of writing.
Alternative water source	Reuse of treated wastewater from Waratah Bay for agriculture	Operational	6-10,000 kL/yr	SGW and local farmers	Recycled water used for agricultural irrigation on SGW land. Land is leased to neighbour for cattle grazing.
Alternative water source	Reuse of treated wastewater from Leongatha for multiple purposes	Operational	Minimal	SGW and local businesses	Occasional use of Class B standpipe for dust suppression or weed control. Very limited usage currently. No reuse in 2015/16.
Alternative water source	Reuse of treated wastewater from Korumburra for multiple purposes	Operational	<1,000 kL/yr	SGW and local businesses	Occasional use of Class B standpipe for dust suppression or weed control. Very limited usage currently.
Alternative water source	Reuse of treated wastewater from Inverloch for agriculture	Operational	Up to 50,000 kL/yr	SGW and local farmers	A portion of recycled water from Inverloch WWTP is used for 3rd party agricultural reuse at a nearby property. Up to 50ML used each year, however some years no irrigation is undertaken.
Alternative water source	Reuse of treated wastewater from Tarraville for agriculture	Operational	Up to 150,000 kL/yr	SGW and a local farmer	100% of recycled water is used for third party agricultural irrigation.
Alternative water source	Reuse of treated wastewater from Poowong, Loch and Nyora for agriculture	Under construction	Up to 50,000 kL/yr	SGW and SEW	Wastewater is transferred to the South East Water (SEW) treatment plant at Lang Lang. SEW have established users and an established distribution system for recycled water. This is still be developed to satisfy demand.
Alternative water source	Potential raw water supply to Yanakie for rural uses	Feasibility study	Up to 195,000 kL/yr	SGW, DELWP, DEDJTR and local	SGW together with DELWP, DEDJTR and consultants are investigating whether raw water from Deep Creek and the Foster dam can be used to supplement rural supplies for Yanakie.

Source / Savings	Project	Status	Volume/yr	Collaborators	Comments
				farmers	Potential demand during dry years is 195 ML. Alternatives to supply from the Deep Creek / Foster Dam option included enhancement and interconnection of local supplies.
Alternative water source	Reuse of treated wastewater from Foster to irrigate recreation grounds and golf course	Design	12,500 kL/year initially rising to a maximum potential use of 45,000 kL/year	SGW, South Gippsland Shire Council and local community	Scheme being designed at time of writing in 2017.
Alternative water source	Implementation of on-farm water capture and savings to reduce rural water use from farms near Fish Creek	Operational	Up to 30,000 kL/yr	SGW and local farmers	SGW offered advice and financial incentives for rural water users near Fish Creek to capture and use on-farm water sources rather than treated water from Fish Creek WTP.
Water savings	Capture, treatment and reuse of washwater supernatant from Fish Creek, Foster and Devon North, Lance Creek, Korumburra Treatment Plants	Operational	Up to 200,000 kL/yr	SGW	Systems to capture and reuse WTP supernatant have been installed and are operational. Savings are estimating assuming that supernatant accounts for 5% of a treatment plant throughput.
Alternative water source	Develop alternative raw water source for major customer in Poowong	Operational	Up to 65,000 kL/yr	SGW and customer	SGW facilitated development of an alternative raw water source for a major customer in Poowong.
Alternative water source	Investigation of alternative raw water sources for rural customers near Toora	Feasibility study-for 2018	TBC	SGW and local farmers	SGW is planning to investigate potential benefits of incentivising use of on-farm water resources to reduce demand on the Agnes River / Toora system.

Source / Savings	Project	Status	Volume/yr	Collaborators	Comments
School Water Efficiency Programme	This programme is available to all Victorian schools supported by the Department of Environment, Land, Water and Planning and the Department of Education and Training. Participating schools track and analyse their water consumption using water meter data loggers. Nineteen schools in SGW's region participate in this programme.	Operational	Up to 26,000 kL to date	SGW, Department of Education and local schools	
Water Management Action Plan (Water MAP)	This programme started in 2007. Organisations that use more than 10,000 kL/yr drinking water develop and report on water saving action. At present this programme is applicable to customers uses more than 5,000 kL/yr water on a voluntary basis.	Operational	Up to 330,000 kL/yr	SGW and local businesses	Majority of savings were achieved by the major customers from their re-use systems within their plants.
Small Community Grant Scheme	This scheme is designed to help local businesses and community organisations invest in water saving measures. 11 grants have been awarded since 2012.		Up to 6,000 kL/yr.	SGW and local businesses	

22. Potential for future development

This UWS highlights those systems where supply enhancement options are required at some stage over the 50 year planning horizon and presents a number of strategies to work towards improving the supply and demand balance.

It is also relevant to note that some systems are anticipated to have yield over and above that required to meet the anticipated population and climate change impacts in the future. These systems are shown in Figure 22-1 and include:

- Wonthaggi
- Korumburra
- Foster

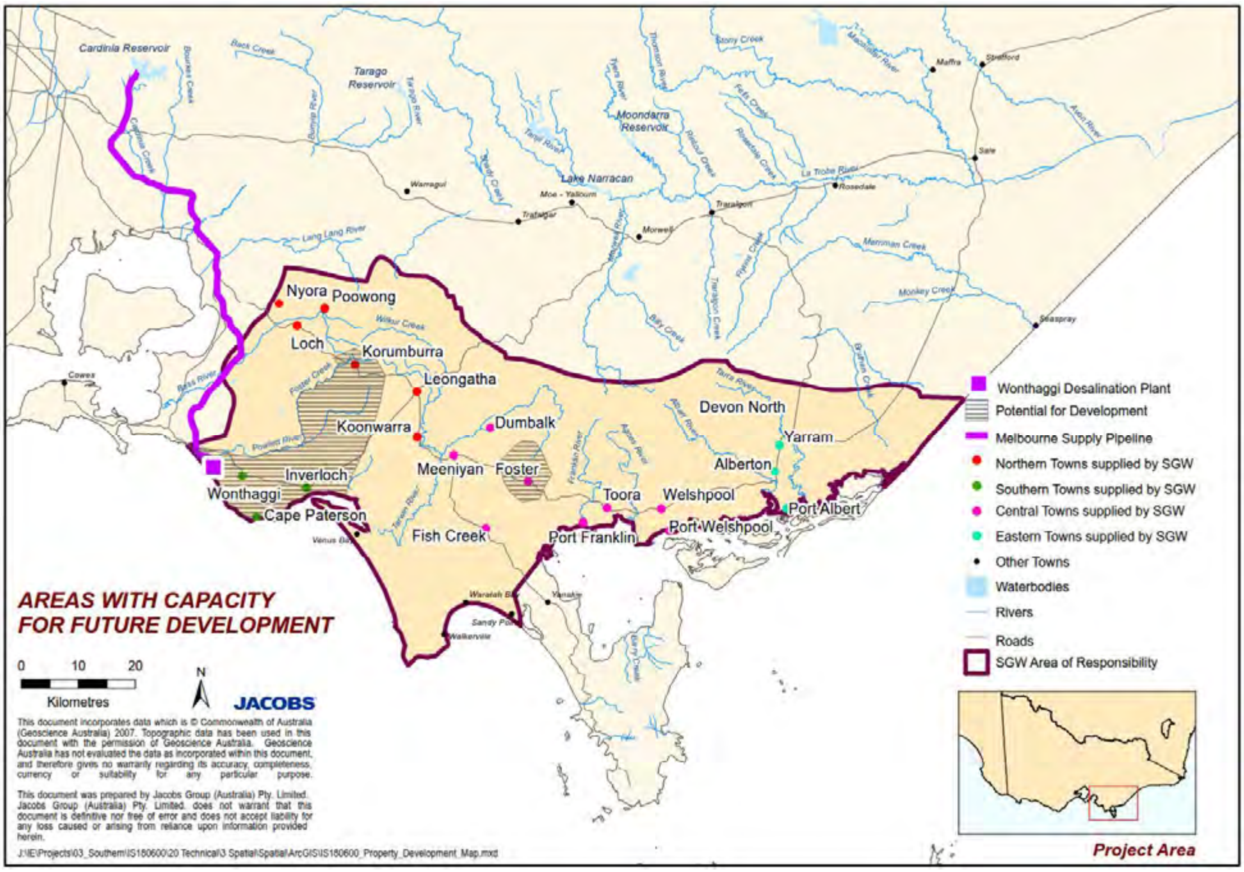


Figure 22-1 : SGW towns with capacity for future development

Significant developments may be possible within the Lance Creek system, including following the connection to Korumburra, due to the connection to the Melbourne system. With this extensive interconnected system, the Lance Creek system may be able to accommodate additional development, in particular water intense commercial and industrial businesses. Wonthaggi and Korumburra towns may be suitable locations for any large scale industry seeking to develop in the South Gippsland region.

The Foster system also has the capacity to support increased development, with the future project demands able to be supplied from the available yield. This includes the possibility for high water using industries. Given the close proximity to some unserviced towns, the available yield may also help to support the future connection of nearby unserviced towns if this becomes a priority for local communities. For instance, this could include the connection of Yanakie farmers to resolve the water shortages they experience during extended periods of low inflows.

Further detailed investigations would be required to consider any proposal for a new intense water user in the region, including infrastructure requirements, demand volume and pattern, location, wastewater, and other factors. Local augmentation of pipeline infrastructure may also be required to accommodate high water using industries. Any development should also be assessed against the strategy options presented in this UWS, and any supporting assessments that are being completed in parallel with this UWS.

Table 22-1 provides a summary of the bulk water capacity available within these systems to support future development.

Table 22-1 : Possible capacity for future development

Development location	Approximate capacity for potential development	Comments
Wonthaggi	SGW has the option to purchase up to 5 GL of BE from the Melbourne system by 2024. Additional entitlement may be available after this time, subject to market conditions.	Connection to the Melbourne system offers a unique potential for development, with a reasonably reliable water source available. Future climate and population projections will influence the annual volume available.
Korumburra	SGW has the option to purchase up to 5 GL of BE from the Melbourne system by 2024. Additional entitlement may be available after this time, subject to market conditions.	Korumburra will be connected to the Lance Creek system from 2019. Future climate and population projections will influence the volume available.
Foster	Approximately 150 ML/year	The current system arrangement can meet the predicted demands in the system. Future climate and population projections will influence the volume available.

To a lesser degree, some development may be possible within the Yarram, Dumbalk and Meeniyan systems. Dumbalk and Meeniyan are supplied from the Tarwin River system. Theoretically, there is some capacity to increase the demands within these systems before the bulk entitlement limits are exceeded, however the water treatment facilities are not suitable to support significant increases in demand. The Yarram system may have scope to support the connection of nearby unserviced towns at some stage in the future, should there be appetite within the local communities. This is not currently being pursued however it may be investigated in the future if required. Yarram may also have capacity to support small scale development in the future, either residential or industrial.

23. Conclusions

This Urban Water Strategy (UWS) for SGW provides a 50 year outlook of the supply and demand balance for each of SGW's supply systems. Future planning has primarily been based on the medium climate change scenario impacts on water yield, with high (drier) and low (wetter) climate change scenarios used to as a check of the system resilience and potential range of timing for augmentation. The UWS has also been prepared with an allowance for anticipated future population and industry growth. The key outcomes from the UWS assessment process were:

- SGW's customers have responded well to calls to reduce water consumption. Consumption has reduced significantly since the Millennium Drought (1997-2009) and these reductions have been sustained. In many cases this has been achieved despite increases in population and the number of dwellings. SGW's demand reduction measures targeting specific user groups have also been successful, such as the incentives available to customers in Poowong, Loch and Nyora for the installation of water efficient appliances, the Small Community Grant Scheme available to help businesses and community organisations invest in water saving measures, and the WaterMAP program for industrial customers. Water conservation remains a top priority to help balance supply and demand.
- Additional water savings have been made within SGW's treatment facilities, with the capture, treatment and reuse of washwater supernatant from Fish Creek, Foster, Devon North, Lance Creek and Korumburra Treatment Plants.
- SGW has invested in and supported a number of Integrated Water Management programs that provide alternative water sources to customers. These include the supply of raw water or the reuse of treated wastewater for rural customers and watering of public facilities (such as golf courses and football ovals), alternative water storages for emergency irrigation supplies during drought, and incentives for on-farm water capture to reduce potable demands.
- In some cases, demand reduction measures alone are expected to be insufficient to maintain supply at SGW's level of service objective for reliability of supply in some supply systems over the 50 year planning horizon. Supply augmentation is likely to be required in these systems.
- In some systems, SGW is aware of issues such as poor raw water quality events, asset age and asset condition that may influence reliability of supply in their systems, or provide opportunities for cost savings in works to concurrently improve water availability. Asset replacement/renewal works are known to be required for a number of systems, irrespective of the consideration of the long-term supply and demand balance.
- A number of towns within SGW's region are currently unserviced, including Sandy Point, Walkerville, Waratah Bay, Yanakie, Venus Bay and Tarwin Lower. The connection of these towns has not been explicitly tested, however all augmentation options for existing towns have considered their compatibility with possible future connection to these unserviced towns.
- **For SGW's northern and southern towns**, which includes Poowong, Loch, Nyora, Korumburra, Leongatha, Wonthaggi, Cape Paterson and Inverloch:
  - Supply enhancement is required for Poowong, Loch, Nyora and Korumburra, as previously planned. These towns will be connected to Melbourne via the Lance Creek system in 2019 to increase supply security. The Lance Creek system already has a connection to the Melbourne supply system. In the interim, SGW's Drought Preparedness Plan provides options for the management of the system under dry conditions, if they occur in individual years prior to 2019.
  - The Lance Creek system, including the current 1 GL Bulk Entitlement from the Melbourne system, meets the current demands of Wonthaggi, Cape Paterson and Inverloch. It is also estimated to meet the combined demands following the Lance Creek Connection Project (incorporating Poowong, Loch, Nyora and Korumburra) in the short term. SGW expects to take up the opportunity to purchase additional Bulk Entitlement from the Melbourne System to help support the growing demands of these

towns into the future. The purchase of an additional 4 GL of entitlement from the Melbourne system (bringing the total entitlement to 5 GL) will help meet the future demands for approximately 35 years under a medium climate change scenario. If drier conditions occur, this 5 GL entitlement would meet SGWs service objectives for approximately 20 years, whereas this entitlement volume would be sufficient for 50 years under wetter conditions.

- Supply enhancement options for Leongatha are required in the near future to maintain security of supply. This brings forward the need for augmentation compared to the 2011 WSDS because anticipated demand reductions were not fully realised. A number of alternative options have been considered for Leongatha. These include the refurbishment of obsolete infrastructure, connection to the Bellview Creek Reservoir, decommissioning of the Ruby Creek infrastructure or an interlinked system connected to Lance Creek Reservoir and the Melbourne supply, as well as various combinations of these alternatives.
- Preliminary outcomes from this UWS indicate supply to the Leongatha system would be best served by retaining the existing Ruby Creek infrastructure, with future augmentation by connection to Melbourne via the Lance Creek system. A detailed assessment is required to determine the viability of connecting Bellview Creek Reservoir to the Ruby Creek system. This is planned to be completed in the short term. The outcomes of this assessment will confirm the timing of the future interconnection of Leongatha to the Lance Creek system, either directly or in combination with the Bellview Creek Reservoir connection. In combination with these infrastructure upgrades, SGW would need to purchase additional Bulk Entitlements from the Melbourne System. The volume and timing of the purchase of additional entitlement will consider issues such as prevailing conditions, market price for water, availability of entitlement, trade, and other aspects.

· **For SGW's central towns**, which includes Dumbalk, Meeniyan, Foster, Fish Creek, Toora, Port Welshpool, Welshpool and Port Franklin:
  - Dumbalk, Meeniyan and Foster are projected to have sufficient supply to meet demands at SGW's level of service objective for reliability of supply over the 50 year planning horizon. Future enhancements for Dumbalk and Meeniyan may be assessed based on water quality, cost and development considerations.
  - Supply enhancement is required for Fish Creek and towns currently supplied by the Agnes River (Toora, Port Welshpool, Welshpool and Port Franklin) under all climate assumptions considered.
  - Two alternative supply strategies were considered for the central towns, namely enhancing existing SGW headworks or supply from an interlinked system connecting Foster to Fish Creek and/or Toora.
  - Preliminary results from this UWS suggest that the enhancement of the existing systems with increased storage capacity at Toora and Fish Creek would provide adequate supply and help to maintain SGW's diversity in water supply. These alternatives also maintain the possibility of future connection of the unserviced towns to the Foster system.

· **For SGW's eastern towns**, which include Yarram, Port Albert, Alberton and Devon North:
  - SGW has progressed the strategy recommended in the 2011 WSDS, namely to purchase groundwater licences to enhance supply to the eastern towns. The current bore licence of 214 ML/yr is projected to be sufficient to meet SGW's level of service objective for reliability of supply over the 50 year planning horizon.

A plan of system wide actions is shown in Table 23-1, along with specific actions for each group of towns in Table 23-2 to Table 23-4.

The UWS will be reviewed and updated every 5 years to incorporate additional hydrologic data, changes in demand for water, changes to supply system configuration, changes in community expectations and improvements in scientific knowledge. There are several areas of uncertainty for SGW in developing the UWS, which will need to be monitored on an ongoing basis.

Table 23-1 Action plan – system wide actions

Priority	System wide actions
A. Demand Management	
1	Reduce uncertainty in current and future estimates of consumer demand through ongoing monitoring and metering, particularly for major industrial water users
2	Continue current successful water conservation initiatives, including the WaterMap program for major industrial and rural customers
3	Actively pursue opportunities for the use of treated wastewater and other IWM options to offset potable supply
B. System Management	
4	Reduce water leaks and wastage in reticulation systems and water treatment processes
5	Secure dams against leakage and future failures
C. Management for Forward Planning	
6	Monitor stream flows and possible climate change
7	Monitor catchments to ensure reliable supply and quality of water
8	Encourage the use of alternative water sources where appropriate
9	Monitor public appetite for the connection of water supplies to unserviced towns
10	Monitor demographic trends, and hence potential demand for water, in cooperation with DELWP, Local Government and other planning authorities

Table 23-2 Action plan for northern and southern towns

Approximate Timing	Actions	
	Lance Creek	Leongatha
2019	Connect Korumburra, Poowong, Loch and Nyora to the Lance Creek system. Start planning and consultation for re-commissioning / decommissioning of existing Coalition Creek and Little Bass water treatment plants and raw water storages.	Initiate detailed investigation of Leongatha augmentation options and confirm preferred approach to supplement the Ruby Creek system. Alternative 1: Connection to Bellview Creek Reservoir and Lance Creek Alternative 2: Direct connection to Lance Creek
Next 5 years	Plan strategy for purchase additional BE from the Melbourne system for the connected Lance Creek system	Implement preferred Leongatha augmentation option Phase 1 (connection to Bellview Creek Reservoir or direct to Lance Creek)
Next 10 years	Purchase additional BE from the Melbourne system for the connected Lance Creek system	If relevant, implement Leongatha augmentation option Phase 2 (connection to Lance Creek)
From 2040	Planning to secure additional yield, (purchase additional BE from the Melbourne system, trade, local system augmentation)	

- Table 23-3 Action plan for central towns

Approximate Timing	Actions	
	Fish Creek	Agnes River (Toora)
Next 5 years	Implement program of works to reduce distribution losses in Fish Creek system	
Next 10 years	Review success of loss reduction works. Reassess requirement for augmentation works. If required, raise Battery Creek Reservoir by 1 metre in combination with dam safety upgrade works.	
From 2030		Construct 70 ML off-stream storage at Toora

- Table 23-4 Action plan for eastern towns

Approximate Timing	Action
Ongoing	Monitor ongoing demands to identify the need for further groundwater licence purchase

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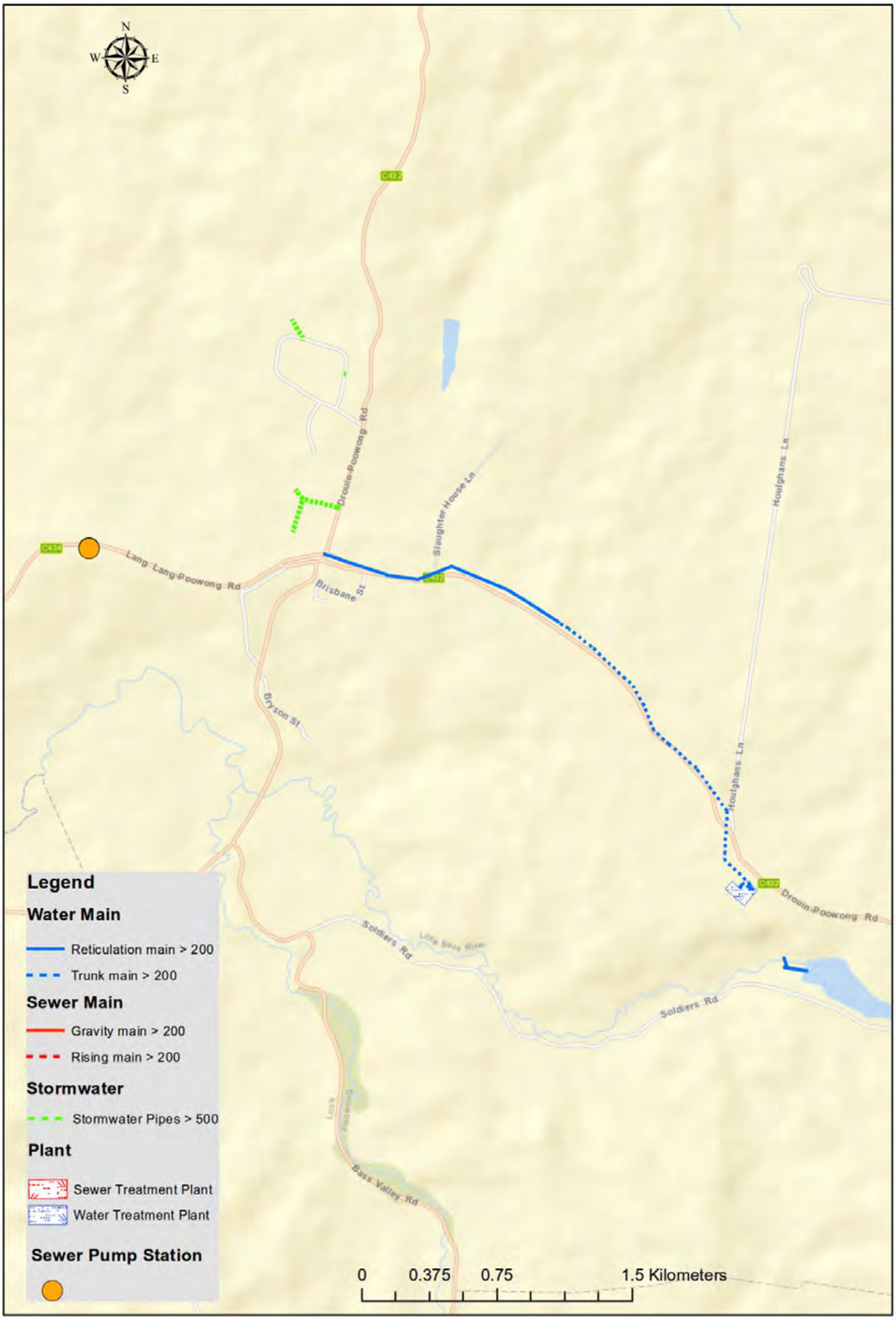
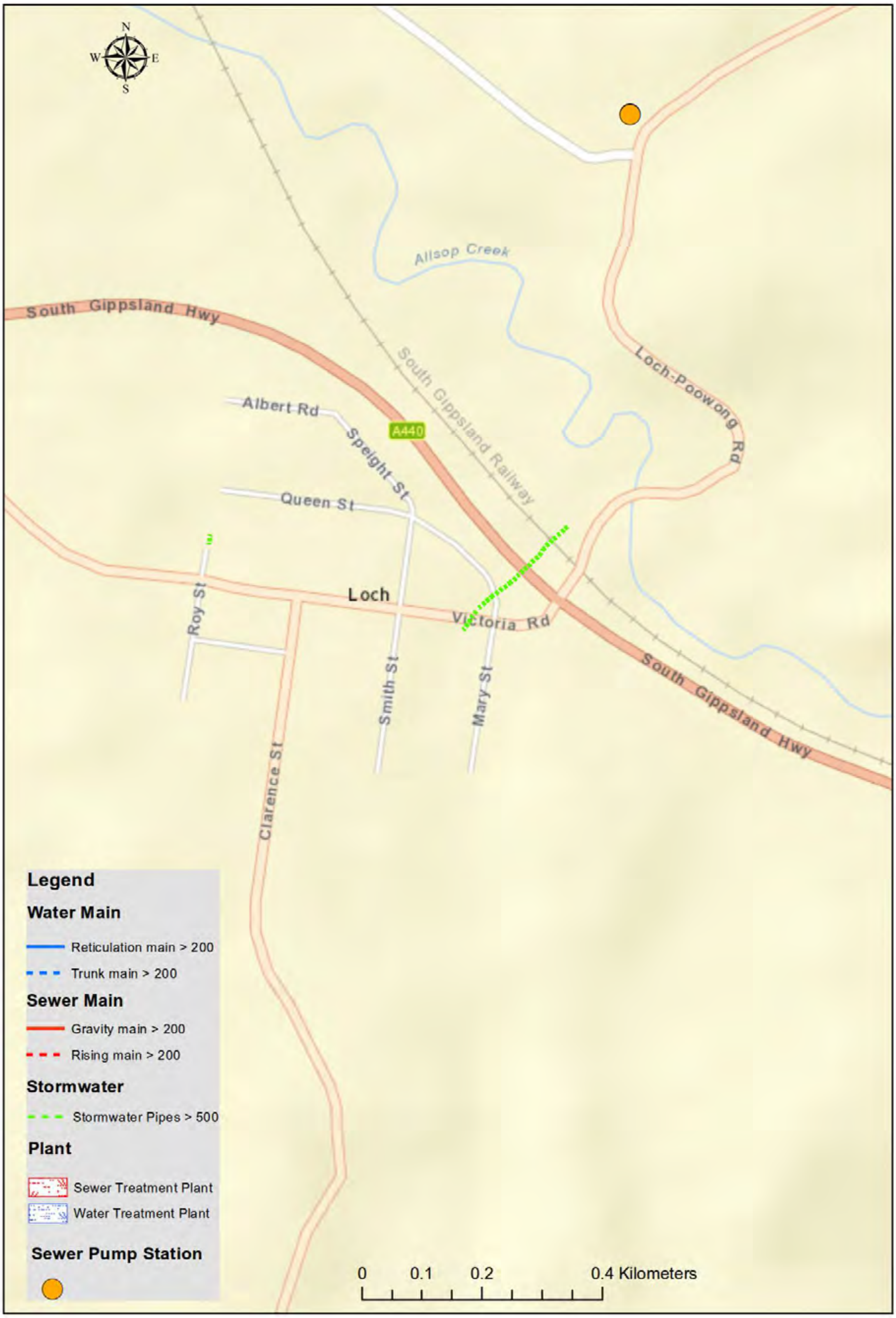
Appendix A. Water Systems Atlas

A.1 Poowong



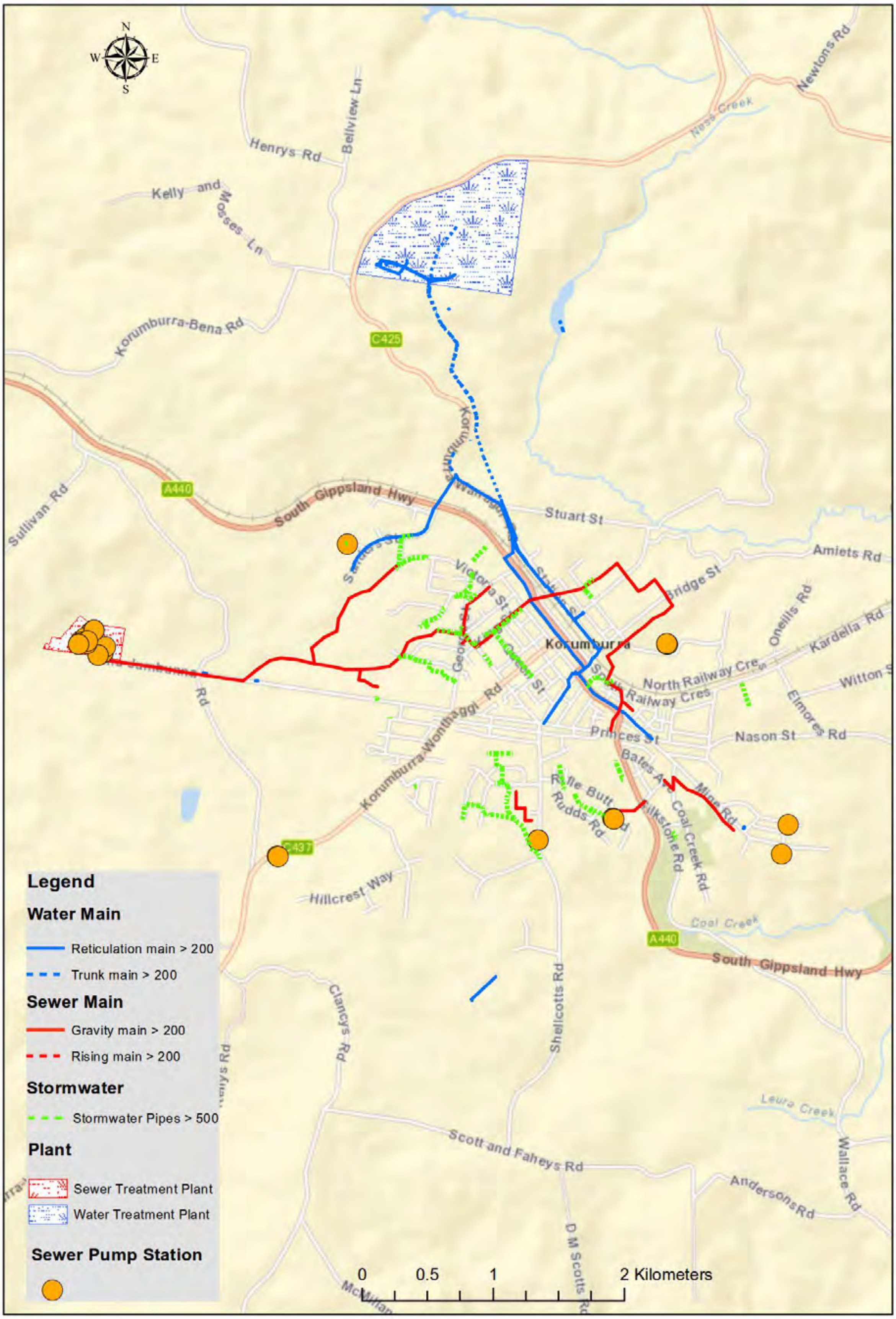
A.2 Loch


Allsop Creek
South Gippsland Hwy
South Gippsland Railway
Loch-Poowong Rd
Albert Rd
A440
Speight St
Queen St
Loch
Victoria Rd
Roy St
Smith St
Mary St
Clarence St
Legend
Water Main
Reticulation main > 200
Trunk main > 200
Sewer Main
Gravity main > 200
Rising main > 200
Stormwater
Stormwater Pipes > 500
Plant
Sewer Treatment Plant
Water Treatment Plant
Sewer Pump Station
0 0.1 0.2 0.4 Kilometers

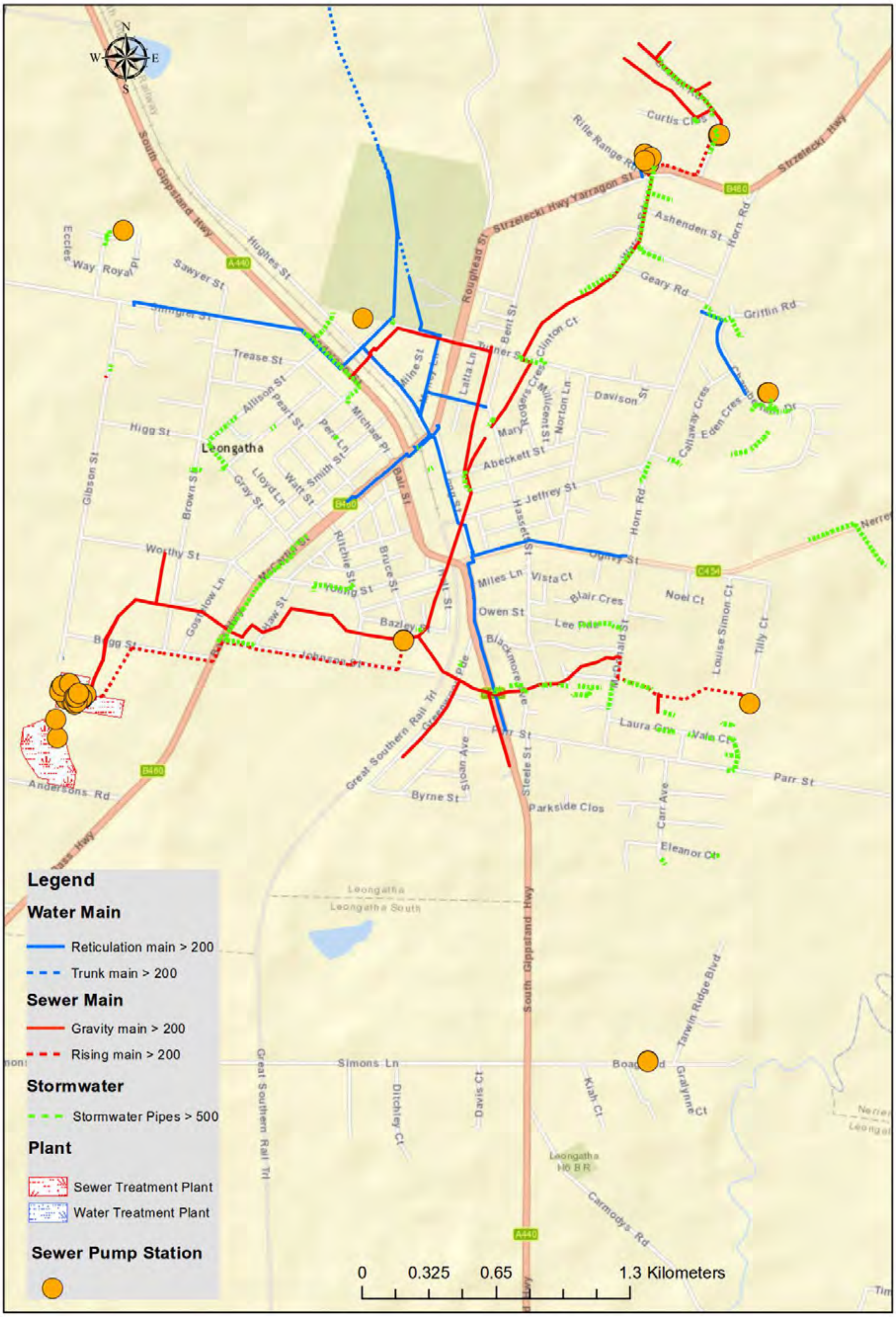
A.3 Nyora


N
S
E
W
Glovers Rd
Glovers Rd
Hogans Rd
Yannathan Rd
Forster Dr
Hatchs Rd
Patman Dr
Watts Rd
Grayden St
Watts Rd
Nyora Railway Station HA
Nyora
C434
Lang Lang-Poowong Rd
Henley St
Mitchell St
Hewson St
Follett Dr
Lang Lang-Poowong Rd
Grundy Ave
Cornishs Rd
Cornishs Rd
Henley St
Henrys Rd
Mia Cres
Berrys Rd
Carlisle Clos
Carlisle Clos
C434
Henrys Rd
Anna Clos
Legend
Water Main
Reticulation main > 200
Trunk main > 200
Sewer Main
Gravity main > 200
Rising main > 200
Stormwater
Stormwater Pipes > 500
Plant
Sewer Treatment Plant
Water Treatment Plant
Sewer Pump Station
0
0.175
0.35
0.7 Kilometers

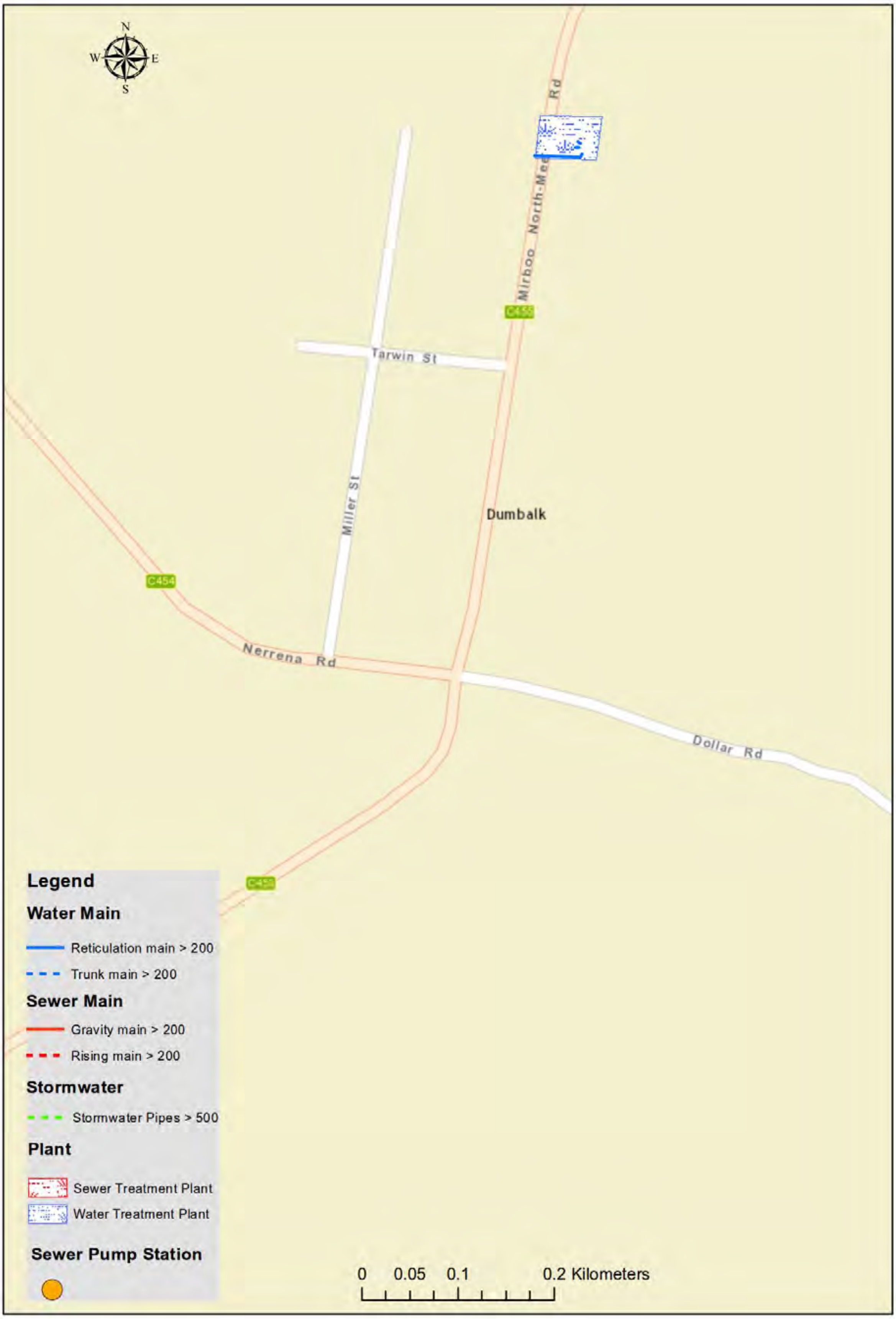
A.4 Korumburra



A.5 Leongatha



A.6 Dumbalk


N
W
E
S
Mirboo North-Meeniyan Rd
C455
Tarwin St
Miller St
Dumbalk
C454
Nerrena Rd
Dollar Rd
C455
Legend
Water Main
Reticulation main > 200
Trunk main > 200
Sewer Main
Gravity main > 200
Rising main > 200
Stormwater
Stormwater Pipes > 500
Plant
Sewer Treatment Plant
Water Treatment Plant
Sewer Pump Station
0 0.05 0.1 0.2 Kilometers

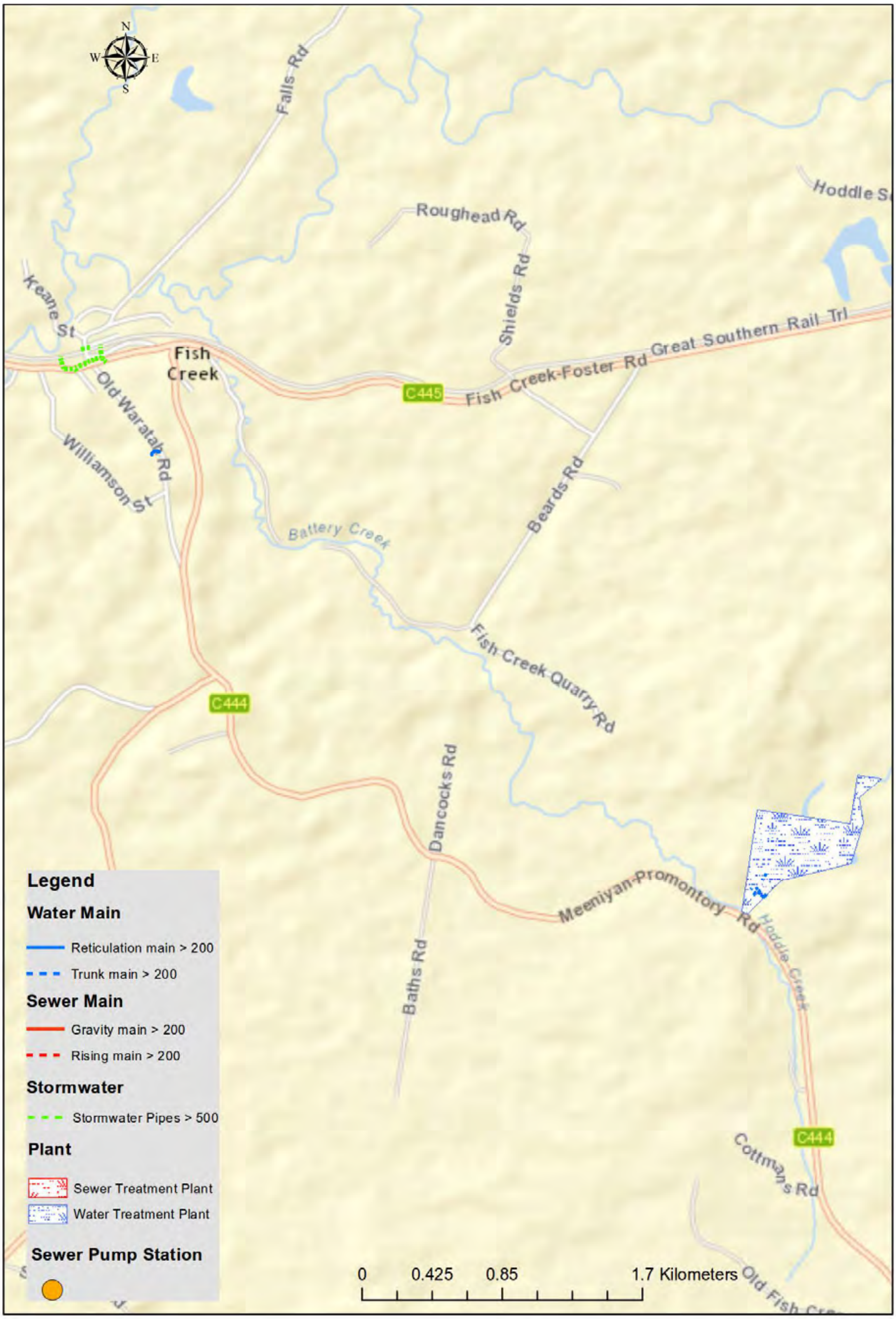
A.7 Meeniyan


Geales Rd
Meeniyan-Nerrena Rd
Mirboo North-Meeniyan Rd
C455
Great Southern Rail Trl
Meikle St
Royston St
A440
South Gippsland Hwy
Scholes St
McLean Ln
Griffin St
McKitterick St
Welsford St
Ross St
Geale St
Meeniyan-Promontory Rd
Stony Creek Rd
Brendan St
Meeniyan
C444
Mcilwaine St
Legend
Water Main
Reticulation main > 200
Trunk main > 200
Sewer Main
Gravity main > 200
Rising main > 200
Stormwater
Stormwater Pipes > 500
Plant
Sewer Treatment Plant
Water Treatment Plant
Sewer Pump Station
0 0.275 0.55 1.1 Kilometers
Helms Rd

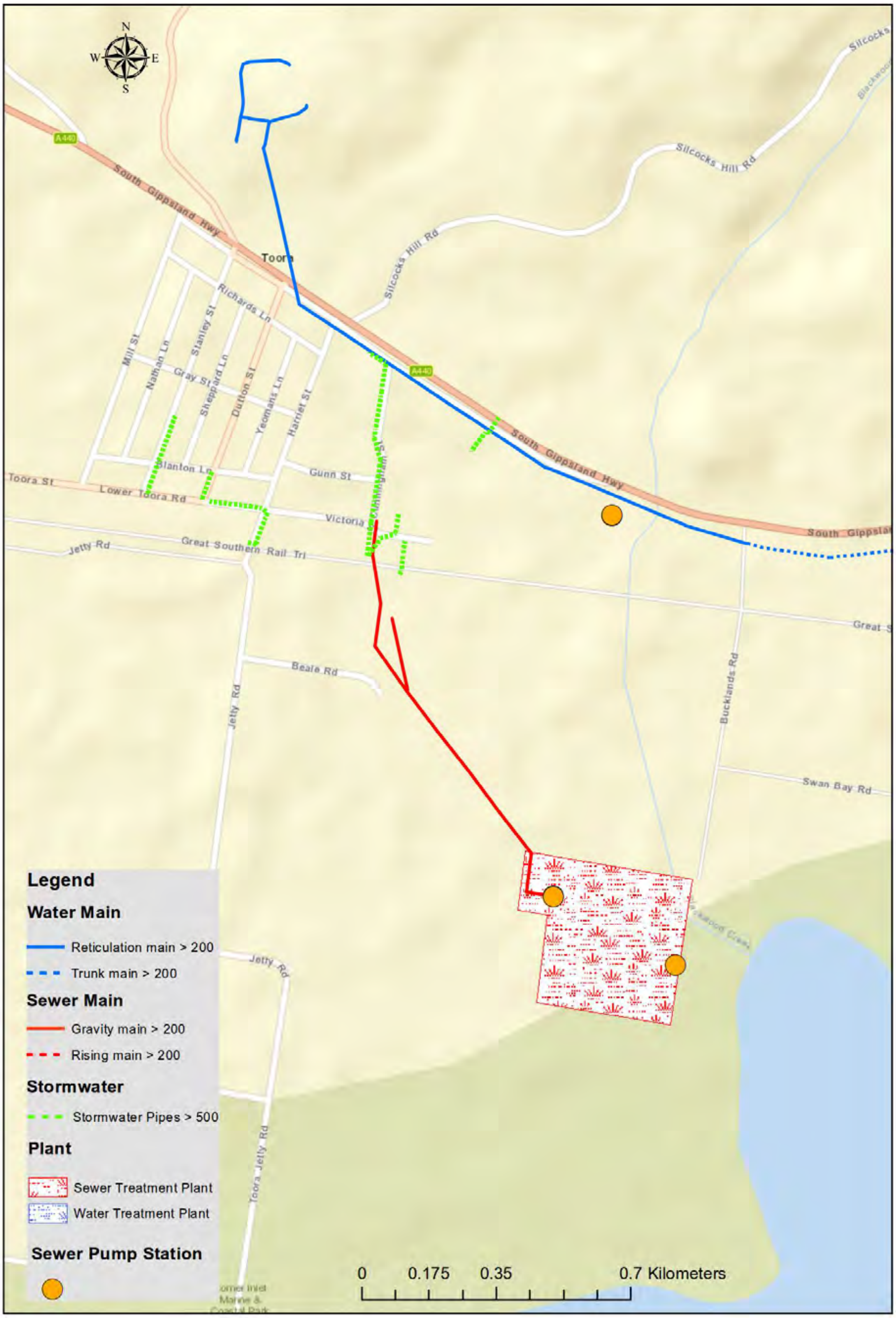
A.8 Foster


N
S
E
W
South Gippsland Hwy
A440
Hobsons Rd
Stubbins Rd
Ameys Track Rd
Boolarra-Foster Rd
Bonnie Brae SS R
Gardiners Rd
Law Rd
Winchester St
Collis St
New Zealand Hill F R
Victoria Ave
Coopers Rd
Gibbs St
Fleet St
Foster
Main St
Kaffir Hill Rd
Wilson Rd
Whipstick Gully N F R
Jacksons Rd
Wood Rd
Landy Rd
Nelson St
Pioneer St
Fish Creek-Foster Rd
Van Park
Station Rd
Jones St
Charity Ln
Great Southern Rail Trl
Elphicks Rd
Franklin Rd
Fullers Rd
Lower Franklin Rd
Rail Trl
Legend
Water Main
Reticulation main > 200
Trunk main > 200
Sewer Main
Gravity main > 200
Rising main > 200
Stormwater
Stormwater Pipes > 500
Plant
Sewer Treatment Plant
Water Treatment Plant
Sewer Pump Station
0
0.35
0.7
1.4 Kilometers

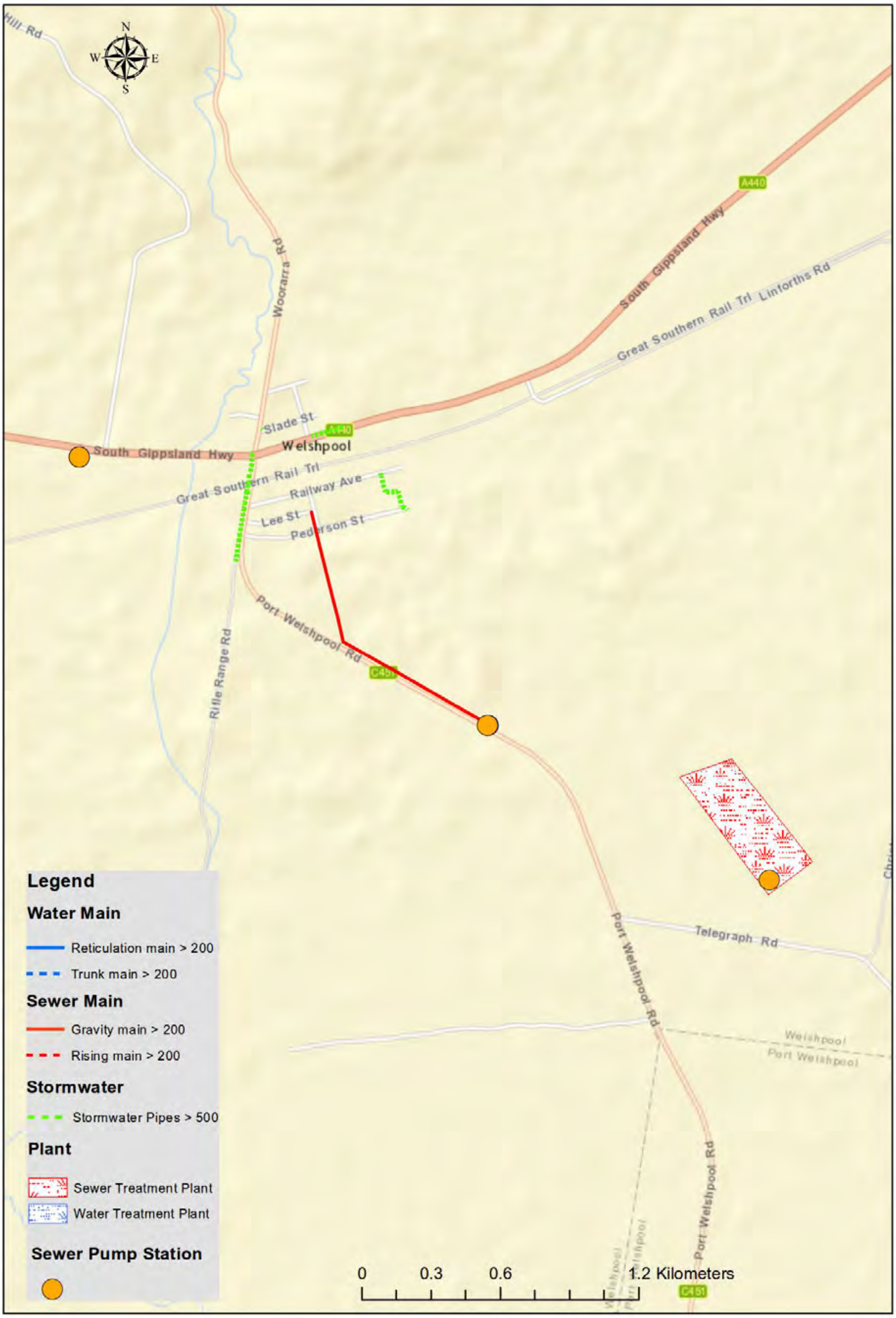
A.9 Fish Creek



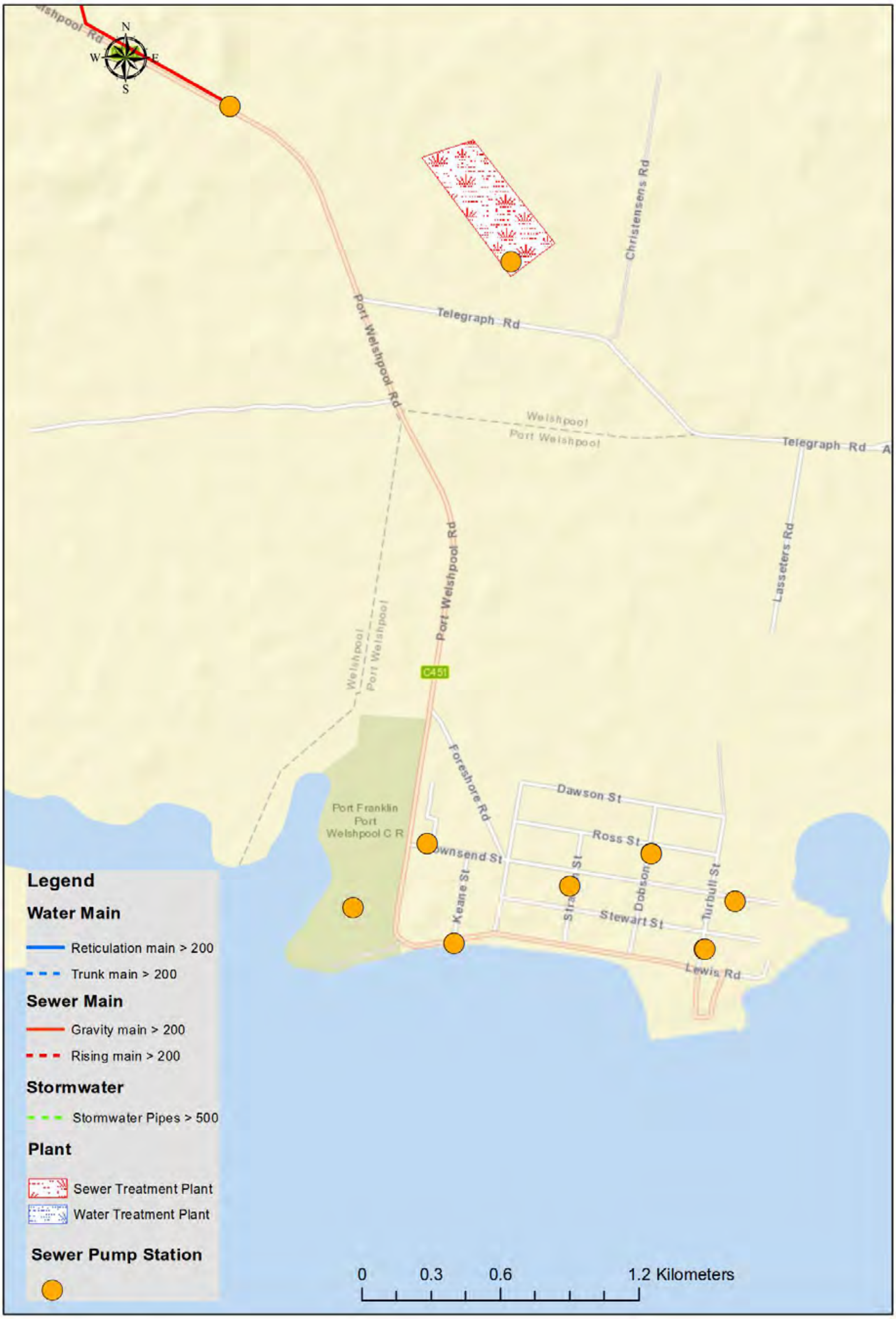
A.10 Toora


N
S
W
E
A440
South Gippsland Hwy
Toora
Richards Ln
Silcocks Hill Rd
Mill St
Nathan Ln
Stanley St
Gray St
Sheppard Ln
Dutton St
Yeomans Ln
Harriet St
Blanton Ln
Gunn St
Toora St
Lower Toora Rd
Victoria
Jetty Rd
Great Southern Rail Trl
Beale Rd
Bucklands Rd
Swan Bay Rd
Toora Jetty Rd
Legend
Water Main
Reticulation main > 200
Trunk main > 200
Sewer Main
Gravity main > 200
Rising main > 200
Stormwater
Stormwater Pipes > 500
Plant
Sewer Treatment Plant
Water Treatment Plant
Sewer Pump Station
0
0.175
0.35
0.7 Kilometers

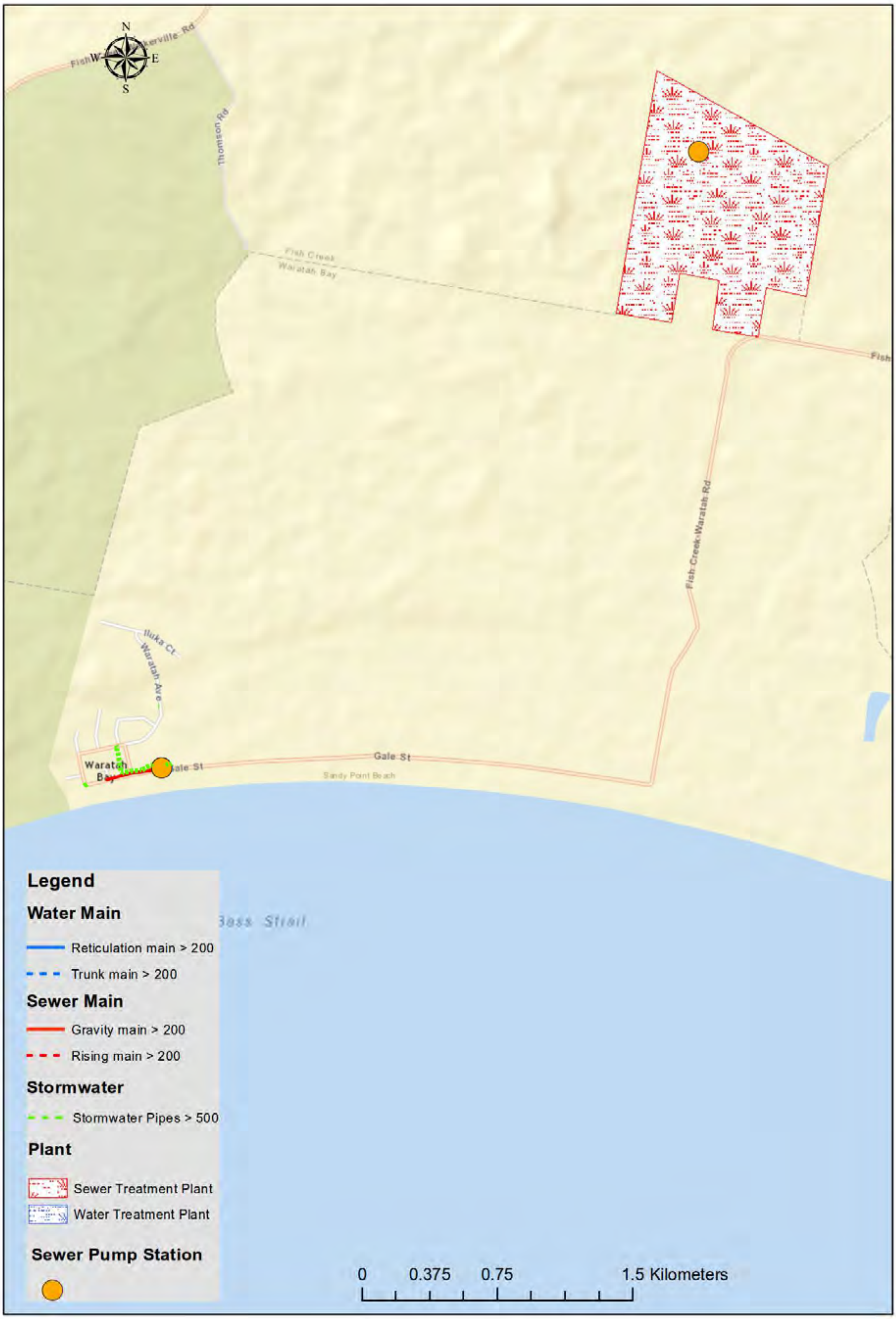
A.11 Welshpool



A.12 Port Welshpool



A.13 Waratah Bay



Appendix B. Preliminary assessment of long list options

A preliminary assessment was made to synthesise the options into a short list of viable alternatives.

Each system is documented in the sections below, with the various augmentation and demand management option considered against a number of variables:

- Whole of life cycle costs;
- Customer price impacts;
- Service standards associated with options;
- Resilience to climate change;
- Risks and uncertainties related to water supply;
- Degree to which options can be staged;
- Environmental sustainability;
- Energy use;
- Regulations, legislation and Government policy;
- Future viability;
- Ease of implementation;
- Strategic (local/regional) benefit; and
- Compatibility with future connection of unserviced towns.

For each option, the following tables summarise the outcome of the assessment process noting whether the option is:

- Not shortlisted – option has significant limitations that are unlikely to be overcome. These options will not be considered any further
- Operational action – these options represent activities that will help to improve the efficiency of SGW's systems, and may result in slightly deferring other actions, but are not likely to fully address projected reductions in levels of service. These actions may include maintenance and refurbishment works which are relevant (and often necessary) for asset management, regardless of longer-term drivers to balance supply and demand. These operational actions also include short term drought contingency measures (such as water carting or restrictions).
- Short-list option – these options are likely to be viable and advantageous, and warrant more detailed consideration
- Further information required – for some options, further information is required in order to support a decision on whether the option is likely to be a preferred option. By default these will be short-listed, but the level of assessment possible at the current time will be lower, pending further investigations to address knowledge gaps over the life of this UWS.

B.1 Lance Creek

Augmentation / demand management option	Qualitative review against metrics	Assessment outcome	Summary
Manage rural users	Previous experience suggests this is a cheap and effective solution, although relatively low uptake D&S users represent approximately 10% of demands so further gains in demand management may be achievable Simple solution, low cost, low energy use, ongoing demand reduction benefits. Investment involves SGW staff time. Can be implemented concurrently with other solutions For instance, ongoing use and management of Inverloch basin	Further consideration warranted.	Operational action
Leakage reduction	High distribution system losses require improvement as part of ongoing system maintenance Reduction in losses would improve system efficiency, operating costs, sustainability and energy consumption. Compatible with other augmentation projects and potential future connection to unserviced towns	Work currently in progress to help reduce losses. Make note of this in UWS. Assess improvements following completion of this work to consider if further gains are achievable.	Operational action
Trading of allocation and entitlement	SGW able to buy or sell with other Melbourne system BE holders Buying water a short term option to water shortage issues Trade of unused entitlement would prevent accumulation of carryover, which may constrain SGW during dry periods. Water supply risks and uncertainties require annual management Relevant for consideration in part of staged approach	Temporary purchase of water may provide a short term solution	Shortlist
Purchase additional entitlement following the connection of PLN and Korumburra	Additional 4GL available for purchase Agreed pricing strategy for BE purchase ($380 per ML) relevant until 30 June 2024. Purchase, renegotiate or allow price agreement to lapse at this time. Compatible with other augmentation projects and potential future connection to unserviced towns High energy use for pumping Minimise risk and uncertainty of water supply	Timing and volume of purchase of additional entitlement to be considered further	Short list
Connection to Powlett River	Low flows during summer period when water required Relevant only when Melbourne supply not operating, so may be able to strategically manage extraction Poor public perception Sustainability concerns, future viability limited Reinstatement of infrastructure, high pumping costs and energy use Cost unknown – compare to price of additional BE purchase to support assessment	Limited capacity to improve water security Cost relative to BE purchase unknown	Not shortlisted
Further modelling to look at effect of allocations and carryover assumptions	Assessment not relevant as this is not an augmentation option Relevant to help optimise for above augmentation options	Not augmentation option however relevant to better inform decisions on above options	Shortlist

B.2 Little Bass

Augmentation / demand management option	Qualitative review against metrics	Assessment outcome	Summary
IWCM opportunities	Relatively low D&S water use, therefore limited scope to reduce rural demands Poowong, Loch and Nyora IWCM investment demonstrates local appetite for demand reduction programs. Relatively cheap programs to implement	Demonstrate existing IWCM initiatives in UWS Continue to look for IWCM opportunities	Operational action
Leakage reduction	High distribution system losses require improvement as part of ongoing system maintenance Reduction in losses would improve system efficiency, operating costs, sustainability and energy consumption. Compatible with other augmentation projects and potential future connection to unserviced towns	Work currently in progress to help reduce losses. Make note of this in UWS. Assess improvements following completion of this work to consider if further gains are achievable.	Operational action
Restrictions	Manage through restrictions in the short term Local farm dam provides supplementary supply to support water use until Lance Creek connection commissioned	Manage through restrictions in the short term	Operational action

B.3 Coalition Creek

Augmentation / demand management option	Qualitative review against metrics	Assessment outcome	Summary
IWCM opportunities	Golf course already uses raw water Whole of water cycle management options analysis undertaken, with no IWCM options suitable to meet the total shortfall needs.	Demonstrate existing IWCM initiatives in UWS	Operational action
Groundwater	Previously considered mine water use but not a viable long term supply	Not relevant for long term supply	Not shortlisted
Improve supplementary supply pipeline (prior to Lance Creek connection)	Supplementary supply pipeline is poor quality, costly to maintain and operate Upgrade and maintenance difficult and costly Poor energy use, sustainability, cost	Manage supplementary supply challenges until Lance Creek connection commissioned	Operational action (as needs management of issues rather than full refurbishment)
Connection to Lance Creek; maintain Burra Foods connection to raw water storage	February 2019 commissioning of Lance Creek connection Long term strategic solution Minimises risk and uncertainty, reduces treatment plant capacity constraints		Shortlist

Augmentation / demand management option	Qualitative review against metrics	Assessment outcome	Summary
Water trading	SGW able to buy or sell with other Melbourne system BE holders Buying water a short term option to water shortage issues Trade of unused entitlement would prevent accumulation of carryover, which may constrain SGW during dry periods. Water supply risks and uncertainties require annual management Relevant for consideration in part of staged approach (i.e. may benefit Leongatha via extended Lance Creek connection)	Temporary purchase of water may provide a short term solution	shortlist

B.4 Deep Creek

Augmentation / demand management option	Qualitative review against metrics	Assessment outcome	Summary
IWCM opportunities	Unserviced towns have local collection of water supplies and treatment of sewerage	Demonstrate existing IWCM initiatives in UWS Continue to look for IWCM opportunities	Operational action
Connection to Agnes River and Fish Creek	Deep Creek system yield exceeds Foster demands, therefore no local requirement for augmentation Central towns strategy to improve water supply to Toora and Fish Creek	Progress augmentation option based on Agnes River and Fish Creek needs	Noted in Agnes River and/or Battery Creek system review

B.5 Ruby Creek

Augmentation / demand management option	Qualitative review against metrics	Assessment outcome	Summary
IWCM opportunities	Golf course and football oval Substitution of rural users to help increase environmental flows Sustainable option that helps reduce potable demands on Ruby Creek system, reducing risks to other consumers Cost implications unknown	Further consideration warranted.	Operational action
Groundwater	Local groundwater resources not fully committed Current supplementary supply bores not fully utilised; licence conditions restrictive and pipeline integrity poor (although only relatively short section used for GW bore) New bores may suit golf course and football field. Suitable location, cost and possible yield currently unknown Sustainable option that helps reduce potable demands on Ruby Creek system, reducing risks to other consumers Existing bore licence conditions heavily restrict their use, possibly due to local interference with other bores.	Consider new bore options	Shortlist
Establish agreement with Murray Goulburn	Provides confidence on upper limit of MG extractions, helping to inform system operation to better manage available water for other users Long term strategic solution Minimises risk and uncertainty	Negotiate and implement agreement as priority	Operational action
Extend supplementary supply for winter BE past 2020 (Tarwin)	Poor pipeline integrity requires significant upgrade to reinstate/replace, with focus on short sections: $24.4 million (SGW, 2016) Additional storage required to benefit from winter extractions (adds $12.7 million to cost) Supplementary supply is labour and energy intensive (although less energy than Lance Ck connection) Requires renegotiation with Government to extend BE; Need to demonstrate ability to maintain Tarwin environmental flows		Shortlist
Connection to Lance Creek	Estimated cost $11.7 million (SGW, 2016) High pumping costs Minimises risks (water quality, security of supply, environmental flows) Able to access Melbourne system BE	Greater yield at lower cost compared to Tarwin River connection	Short list
Connect to Coalition Creek storages	Most suited to Bellview Reservoir (other Coalition Creek storages would require significant upgrade) Upgrade of pumpstation and pipeline required. Energy and capital cost of pumping Limited yield benefit during dry periods due to Coalition Creek BE conditions Little improvement in risk and uncertainty in Leongatha supplies	Cost to connect uncertain	Shortlisted

B.6 Agnes River

Augmentation / demand management option	Qualitative review against metrics	Assessment outcome	Summary
Use Integrated Water Management for S&D	Relatively high proportion of D&S demands in Agnes River system Fish Creek experience suggests low uptake Simple solution, low cost, low energy use, ongoing demand reduction benefits. Investment involves SGW staff time. Can be implemented concurrently with other solutions.	Further consideration warranted.	Operational action
Minimise losses	High distribution system losses require improvement as part of ongoing system maintenance Reduction in losses would improve system efficiency, operating costs, sustainability and energy consumption. Compatible with other augmentation projects and potential future connection to unserviced towns	Work currently in progress to help reduce losses. Make note of this in UWS. Assess improvements following completion of this work to consider if further gains are achievable.	Operational action
Water carting	Short term solution to water supply & water quality issues. Suitable for implementation in combination with other augmentation options. High daily demand makes this option costly and unsustainable. Relatively simple solution, however labour intensive to implement. Doesn't provide long term resilience to climate and other risks. No strategic advantage to this option.	Not viable as planned enhancement measure due to high daily demand. May be necessary during unforeseen drought circumstances	Not shortlisted
Groundwater (GW)	Yarram WSPA provides local GW option, however GW levels are declining due to existing extractions. GW licences are at capacity. New licence would require trade from existing user. Treatment plant at top of hill. Aquifer low yielding in this area and pumping rates high. High energy use and cost for pumping No strategic advantage	Low priority option due to cost, energy use and likely GW yield.	Not shortlisted
Investigation of streamflow and catchment behaviour for 1967/68 drought	Relatively small investment Water quality, infrastructure maintenance and water supply issues require attention regardless of the outcomes of data analysis.	Low priority as this analysis does not consider the full suite of risks in the catchment.	Not shortlisted
Re-instatement of 30 ML off-stream storage	Requires strategy to avoid recontamination from treatment plant (cover and line) – cost and health regulations to be considered Transfer to/from treatment plant requires pumping energy use and costs. Compatible with other augmentation projects and potential future connection to unserviced towns Treatment plant and distribution system infrastructure requires maintenance in addition to this option High cost option that requires refurbishment of storage and pipeline infrastructure 30ML storage is an issue for treated water (water age) so only really a possibility for raw water	Water quality risks costly to overcome	Not shortlisted

Augmentation / demand management option	Qualitative review against metrics	Assessment outcome	Summary
Additional off-stream storage	Previous analysis identified 280 ML storage required, but smaller volume now likely given revised demands and less severe climate scenarios Preliminary cost estimate (GHD, 2012) indicates $5.6 million capex for 150 ML storage Compatible with other augmentation projects and potential future connection to unserviced towns Treatment plant and distribution system infrastructure requires maintenance in addition to this option High cost option that requires additional storage and pipeline infrastructure	Capital costs roughly consistent with raw water interconnection to Foster	Shortlist
Raw water from Foster Dam	Preliminary capital cost of $5 million (GHD, 2012) for 5ML/d raw water interconnection High pumping transfer energy use and costs Compatible with other augmentation projects and potential future connection to unserviced towns Toora treatment plant and distribution system infrastructure requires maintenance in addition to this option ($8.9 million for refurbishment or new system)	Capital costs roughly consistent with new storage option	Shortlist
Treated water from Foster	Preliminary capital cost estimate of $8 million (GHD, 2012) for 2ML/d treated water interconnection and replacement of Foster treatment plant May delay the need for Toora treatment plant upgrade works however would require significant upgrade/replacement of Foster treatment plant High pumping transfer energy use and costs Compatibility with other augmentation projects and potential future connection to unserviced towns dependent on increase in pipe and treatment plant capacity		Shortlist
Consolidation of Deep Creek and Agnes River Systems	Centralised treatment plants to supply Toora and Foster Estimated cost of $11.8 million for construction of new centralised 7 ML/d plant (GHD, 2012) Compatible with other augmentation projects and potential future connection to unserviced towns High pumping transfer energy use and costs Staged approach that can be implemented after raw water interconnection		Shortlist

B.7 Battery Creek

Augmentation / demand management option	Qualitative review against metrics	Assessment outcome	Summary
Manage rural users	Previous experience suggests this is a cheap and effective solution, although relatively low uptake D&S users represent approximately 30% of demands so further gains in demand management may be achievable Simple solution, low cost, low energy use, ongoing demand reduction benefits. Investment involves SGW staff time. Can be implemented concurrently with other solutions For example, given the connection to the Central Towns, the Battery Creek storage could be managed differently to supply rural users.	Further consideration warranted.	Operational action
Leakage reduction	High distribution system losses require improvement as part of ongoing system maintenance Reduction in losses would improve system efficiency, operating costs, sustainability and energy consumption. Compatible with other augmentation projects and potential future connection to unserviced towns	Work currently in progress to help reduce losses. Make note of this in UWS. Assess improvements following completion of this work to consider if further gains are achievable.	Operational action
Groundwater (GW)	Outside of WSPA and GMA	Groundwater not relevant	Not shortlisted
Raise dam wall (as part of required dam works)	Dam requires upgrade to meet ANCOLD requirements (over 20 year horizon). Cost estimates suggest $2.2 million for refurbishment, $4.8-5.6 million if also raised (SMEC, 2007) Potential challenges in implementation (water supply during construction works) Compatible with other augmentation projects and potential future connection to unserviced towns	Not relevant in short term (based on current dam safety upgrade requirements) but worth consideration in medium to longer term.	Shortlist
Winterfill diversion from Hoddle Creek	Staged solution that requires Battery Creek storage upgrade (raise dam wall) to hold additional winterfill harvest Similar assessment review to dam wall raising Compatible with other augmentation projects and potential future connection to unserviced towns	Not relevant in short term (based on current dam safety upgrade requirements) but worth consideration in medium to longer term.	Shortlisted (when combined with additional storage)
Pipeline from Foster to Fish Creek (raw and treated)	Foster to Fish Creek pipeline cost $4.7 million (GHD, 2012) Decommissioning of Battery Creek storage and Fish Creek treatment plant requires increase in Foster treatment plant capacity Compatible with other augmentation projects and potential future connection to unserviced towns High pumping transfer energy use and costs Current trunkmain losses eliminated by transferring direct to storage basin		Shortlist

B.8 Dumbalk and Meeniyan

Augmentation / demand management option	Qualitative review against metrics	Assessment outcome	Summary
Water carting	Short term solution to water supply & water quality issues. Suitable for implementation in combination with other augmentation options. High daily demand makes this option costly and unsustainable. Relatively simple solution, however labour intensive to implement. Doesn't provide long term resilience to climate and other risks. No strategic advantage to this option.	Short term solution that can be used to support the Dumbalk and Meeniyan system while longer term options are implemented.	Operational action
Groundwater	Local groundwater bore but never utilised Yield assessment required to consider viability	Yield assessment required to determine suitability	Further information required
Connection to Leongatha (Ruby Creek)	Significant treatment plant renewal works required to continue to supply Dumbalk and Meeniyan in current arrangement. Connection to Lance Creek helps to minimise/eliminate these water quality risks and upgrade costs. Estimated cost $5.1 million (SGW, 2016) to connect Dumbalk and Meeniyan to Ruby Creek High pumping costs Able to access Melbourne system BE if Leongatha connected to the Lance Creek system	Relevant for consideration in longer term	Short list

B.9 Tarra River

Augmentation / demand management option	Qualitative review against metrics	Assessment outcome	Summary
IWCM opportunities	D&S water use represents approximately 15% of total demands, therefore limited scope to reduce rural demands Shire of Wellington proactive about IWCM initiatives	Demonstrate existing IWCM initiatives in UWS Continue to look for IWCM opportunities	Operational action
Leakage reduction	High distribution system losses require improvement as part of ongoing system maintenance Reduction in losses would improve system efficiency, operating costs, sustainability and energy consumption. Compatible with other augmentation projects and potential future connection to unserviced towns	Work currently in progress to help reduce losses. Make note of this in UWS. Assess improvements following completion of this work to consider if further gains are achievable.	Operational action

Augmentation / demand management option	Qualitative review against metrics	Assessment outcome	Summary
Groundwater	Yarram bore supply adequate in most instances (recommend condition assessment to confirm long term yield) Additional short term licence available from SRW to supplement existing bore licence in drought Blending of bore and river water may be appropriate if bore yield declines after period of intensive use	Undertake condition assessment of bore to confirm long term yield Manage with temporary licences as required	Operational action (manage shortages as required)
Restrictions (if bushfire, for instance)	Manage water supply through restrictions and bore use in the short term Efficient management of offstream storage (keep full) helps minimise water quality risks in event of bushfire or other incident impacting on Tarra River	Manage through restrictions in the short term	Operational action

B.10 Unserviced towns

Augmentation / demand management option	Qualitative review against metrics	Assessment outcome	Summary
IWCM opportunities	Unserviced towns have local collection of water supplies and treatment of sewerage Cost for connection to SGW systems often prohibitive, IWCM become more viable	Demonstrate existing IWCM initiatives in UWS Continue to look for IWCM opportunities	Operational activity
Connection to existing systems	No current driver for connection Compatibility of future connection is captured in assessment of augmentation options noted for each system above	Customer consultation to track customer desire for connection	Operational activity

Unserviced town connections will be investigated for feasibility if customer desire and willingness to pay is identified during the planning horizon.

Appendix C. Alternative Water Supply Options for Unserviced Coastal Towns and Developments

This appendix provides an introduction to alternative water supply options for unserviced coastal towns and developments. Most the coastal towns in the South Gippsland region are remote from SGW's existing infrastructure. This means that connecting them to SGW's existing supply network is not necessarily the most cost-effective solution, because of the long pipe and pump networks required. It may therefore be more viable to develop local alternative supply options. This appendix discusses some of the advantages and disadvantages associated with five different alternative supply options for isolated coastal towns:

- Bore water
- Rain water
- Grey water
- Storm water
- Local desalination of sea water

A.1 Summary

The relative advantages and disadvantages of each alternative supply option can vary for each particular coastal town, however general statements can be made about each option for the region, as listed in Table 24-1. Each of these options has been assessed in qualitative terms relative to one another and not relative to connecting to SGW's existing water supply network. Key points to note are as follows:

- **Only groundwater and desalination provide a total water supply solution**. Rainwater, greywater and stormwater can be valuable components of an alternative water supply system, but will not be adequate in isolation because of low reliability and/or high treatment costs to create a potable supply.
- **Desalination viability is relatively invariable**, subject to environmental sensitivities surrounding discharge of the waste stream at individual sites.
- **Groundwater viability is highly site specific**, as groundwater quality and yield vary considerably from site to site.
- **Existing unserviced towns will already have rainwater tanks.** The incremental cost of supplying unserviced towns will be lower if existing rainwater tanks can be utilised as part of the water supply system for these towns.
- **Rainwater, greywater and stormwater can be important source substitution measures for new developments.** The cost effectiveness of introducing rainwater tanks, greywater systems and stormwater systems can be greatly improved if these systems are integrated into the design of new developments. This requires the Authority to work closely with developers to provide them with appropriate design parameters.

Table 24-1 Summary of relative advantages and disadvantages

Relative performance measure	Alternative supply option				
	Groundwater	Rainwater	Greywater(1)	Stormwater(1)	Local Desalination
Capital cost	Moderate	Low	Low	Moderate	High
O&M cost	Moderate	Low	Low	Moderate	High
Reliability of supply	High	Low	Moderate	Low	High
Energy consumption	High	Low	Low	Low	High
Health risk	Low	Moderate	High	High	Low
Suitability for potable supply	High	High	Low	Low	High

(1) Assumed to be untreated for non-potable use only

Coming up with an integrated solution will need to consider the costs and benefits of each option, as well as combinations of options for each individual town or development. The incremental cost to SGW customers associated with the preferred supply option combination will then need to be estimated and consulted upon with the relevant community.

More information on each particular alternative supply option is provided below.

A.2 Bore water

Groundwater has the advantage of being generally cheaper than other supply options if aquifers are located close to towns and because the supply is generally very reliable. Groundwater has historically been a less favoured source of supply for SGW because aquifers close to towns are typically low yielding and often have high iron and manganese content which can be difficult to treat as part of a blended supply.

High yielding, good quality aquifers to the east of Yarram (for Greenmount, Robertsons Beach, Manns Beach, Won Wron, Woodside, Woodside Beach and McLoughlins Beach) are already fully allocated within the Yarram Water Supply Protection Area and cannot be accessed without purchasing licences from existing licence holders.

Yields across much of Gippsland can be as low as 15 ML/yr per bore, as documented in SKM (2004) for each of SGW's supply systems, indicating that dispersed borefields rather than individual bores would be required at most unserviced towns.

Groundwater supply was considered for supplying the unserviced towns of Sandy Point, Waratah Bay, Yanakie and Walkerville in SKM (2004), which concluded that such a supply would only be financially feasible for the two smaller towns of Yanakie and Walkerville and that there was significant uncertainty surrounding the technical feasibility without further drilling investigations. Groundwater will continue to be a supply option for servicing small towns from local aquifers and as a drought response measure, but is not considered a feasible alternative to cheaper surface water options in this region of relatively low yielding aquifers.

A groundwater management area has been declared around the Tarwin area despite relatively low groundwater usage in the area. This is because of concerns about seawater intrusion and contamination of regional groundwater by septic tanks at Venus Bay. Appropriate strategies to deal with potential health risks would need to be taken into account in the feasibility of supplying towns in the vicinity of Venus Bay with groundwater.

A.3 Rainwater

Rainwater is used widely in rural Australia for domestic purposes such as drinking, food preparation and bathing. Rainwater can provide a practical way of supplementing a town's water supply as it is a low health risk alternative to reticulated water supply.

The quality of water collected in household tanks is generally understood not to be as consistently high as that provided through a reticulated system[1]. This is because maintenance of the system is the responsibility of householders, who do not necessarily undertake that maintenance regularly or appropriately. Poor water quality has also been linked to the presence of lead flashing on some roofs. There is also a particular risk for sub-surface tanks in which surface run-off can infiltrate into the water supply causing contamination, but these types of tanks are generally rare in domestic applications.

Rainwater tanks are increasingly being used for non-potable use, such as watering gardens and toilet flushing. The Victorian Government's five-star home standards requires new homes to have a rainwater tank that provides water for toilet flushing (or equivalent volumes delivered through communal stormwater or reuse) if a solar hot water system is not included in the design[2].

Rainwater is not recommended as a sole source of water as it is generally not sufficiently reliable. On a national scale, the Bureau of Meteorology classifies annual rainfall variability in South Gippsland as low to moderate, indicating that rainfall has historically been very reliable[3]. Rainfall in South Gippsland in individual years can nevertheless vary considerable. Under dry conditions, rainwater tanks are at risk of failure and residents are likely to require water sourced by other means.

[1] EnHealth (2004) *Guidelines for the use of Rainwater Tanks*
[2] Watersmart (2006) *Water Supply-Demand Strategy for Melbourne 2006-2055.* Draft.
[3] Bureau of Meteorology (2006) http://www.bom.gov.au/climate/map/variability/VARANN.GIF

A.4 Greywater

Grey water encompasses all household wastewater excluding that derived from toilets and urinals. The quality of greywater varies significantly depending on the source and activity within the household but it can contain microbial pathogens, cleaning solutions and other contaminants. In light of this, it has the potential to be hazardous to human health if not adequately treated.

Although it is possible to treat grey water to a level that is safe for human consumption it is not cost effective to treat it to a level which is suitable for drinking, food preparation, personal washing and spa and pool top-ups[4]. In addition to cost considerations, the human health consequences of treatment failure are potentially high.

The risks associated with use of greywater for laundry trough, toilet flushing, outdoor use, fire-fighting and surface irrigation are classed as medium. Treatment systems must consistently achieve a high standard of treatment due to the potentially high degree of pathogens that may be present.

Greywater is a diffuse source of water, meaning that it is difficult to collect and supply at anything other than a property scale. An example of community greywater recycling is the Bridgewater development in Western Australia, where all greywater from 380 homes is recycled for irrigation. This scheme is effective at a community scale because it was integrated into the design of the new development rather than being retrofitted.

A.5 Stormwater

Stormwater in urban surface water runoff captured from rain events. The quality of stormwater varies according to the source area. Stormwater may contain a variety of contaminants including microbial pathogens, oils and grease, leachate from vegetation and nutrients.

Like greywater it is possible to treat stormwater to a standard suitable for domestic purposes such as drinking and food preparation. This treatment is costly and the risk to human health of failure of treatment is considerable[5]. In light of this the use of stormwater for these purposes is not recommended.

The risk for personal washing, swimming pools and spas, laundry trough and washing machines is classified as medium after treatment[6]. For multiple sites, treatment should include catchment management, storage management, clarification (removal of solids) and disinfection.

Stormwater has been successfully harvested in the City of Salisbury in South Australia[7]. This particular scheme uses an artificial wetland to capture and treat stormwater, let it infiltrate into groundwater and then later pump that water from groundwater when it is required to meet urban demands. Since the development of that scheme, a range of other stormwater and rainwater harvesting schemes have been implemented in Victoria.

Applications for residential water use tend to be less favoured than other source substitution options such as rainwater tanks and recycling of treated effluent. Stormwater is typically generated in large volumes over short periods of time and therefore usually needs to be stored if it is to be used for urban use. The cost of storage is greater than most other alternative supply options presented in this paper. Stormwater harvesting at a scale larger than an individual property can also require a third pipe system to deliver the stormwater. Third pipe systems (for recycling of treated wastewater) have been installed for example in the Aurora (Victoria) and Mawson Lakes (South Australia) residential developments[8].

Harvesting stormwater can have water quality benefits to downstream waterways. Ladson et.al. demonstrated a relationship between the amount of impervious area in a catchment with water quality of downstream waterways[9].

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[4] Hyder Consulting (2005) *Alternative Urban Water Supplies- Regulatory Review*
[5] Hyder Consulting (2005) *Alternative Urban Water Supplies- Regulatory Review*
[6] Hyder Consulting (2005) *Alternative Urban Water Supplies- Regulatory Review*
[7] Hyder Consulting (2005) *Alternative Urban Water Supplies- Regulatory Review*
[8] http://www.goldcoast.qld.gov.au/t_gcw.asp?pid=5894
[9] Ladson et.al. (2005) *Improving Stream Health in Urban Areas by Reducing Runoff Frequency from Impervious Surfaces.* 29th Hydrology and Water Resources Symposium, Canberra, 21-23 February 2005.

A.6 Local desalination of sea water

Desalination is a process which separates dissolved minerals and impurities from sea water, salty water or treated wastewater. Desalinated water is suitable for drinking and food preparation.

The key advantage of desalination is that it uses sea water and therefore is independent of climate variability. This means that is provides a reliable source of water and removes the pressure from existing surface and groundwater sources.

Although the cost of the technologies used in desalination of seawater has reduced significantly it is still a costly option. There are also environmental concerns associated with desalination. In the first instance it is a high energy option and therefore has consequences in terms of greenhouse gas emissions if those energy costs are not offset. In addition, the removal of fresh water means that hyper-saline solution is discharged into the sea. This can have negative consequences for the marine environment and can require costly diffusers extending into the sea over long distances. Desalination package plants of 0.5 ML/d can typically be installed for several hundred thousand dollars, with the costs of disposing of the waste brine stream being in addition to this.