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REPORT

Dinner Plain Integrated Water Cycle Management Investigations

Prepared for East Gippsland Water

June 2015

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REVISION SCHEDULE

Rev No	Date	Description	Signature or Typed Name (documentation on file).			
			Prepared by	Checked by	Reviewed by	Approved by
1	26/10/14	Interim Draft for Options Review	PL	KB	KB	JMS
2	5/11/14	Interim Draft for Options Review Revision 1	PL	KB	KB	JMS
3	3/02/15	Interim Draft for Options Review Revision 2	PL	KB	KB	JMS
4	20/02/15	Draft	PL	KB	KB	JMS
5	19/03/15	Draft R1	PL	KB	KB	JMS
6	24/04/15	Final	PL	KB	KB	SW
7	05/06/15	Final R1	PL	KB	KB	PK

Executive Summary

Introduction

Dinner Plain is a small alpine town at an elevation of approximately 1,500 m located on the Great Alpine Road 10 km south of the Mt Hotham Alpine Resort. Dinner Plain is largely a ski village so the population fluctuates significantly during the winter. While well established in Victoria as a winter destination, Dinner Plain continues seeking improvements to its infrastructure that will strengthen its winter focussed activities. In the long term, Dinner Plain envisions year round amenities and recreational offerings that contribute to creating not only a more liveable community but an economically more sustainable one as well.

East Gippsland Water has partnered with the Alpine Shire Council to initiate work towards the development of an integrated water cycle management plan for Dinner Plain. Adopting an integrated water cycle management process can support the collective efforts of East Gippsland Water and Alpine Shire Council in continuing to provide secure water supplies as efficiently, affordably and sustainably as possible in the next 50 years.

Following a number of meetings with the Alpine Shire Council and a meeting with the Dinner Plain Advisory Committee, it was identified that there is a need to provide sustainable water solutions for snowmaking and to increase fire protection capabilities within Dinner Plain. There is also a need to investigate sustainable recycled water reuse options, that would allow development opportunities at the current recycled water reuse site (Lot 2).

Options investigated include reducing water loss within the potable water supply network and reducing groundwater and rainfall runoff into the wastewater collection system. The feasibility of using alternative water source for snowmaking and firefighting purposes were also investigated, which are outside East Gippsland Water's services commitment. Alternative recycled water reuse and discharge options were also investigated.

These Options were compared to the current water servicing that assumes that potable water will be supplied to Dinner Plain from the existing groundwater source and all recycled water will continue to irrigate Lot 2. The Business as Usual case also assumes stormwater runoff will continue to discharge to the existing on site stormwater wetlands and surrounding landscape via the stormwater drainage system.

Business as Usual

No upgrades are required to potable water infrastructure to meet current and future demands calculated for Dinner Plain except reticulation water mains for new connections. However, there is insufficient winter storage for recycled water and additional winter storage is required.

The implication of this is that options short listed would need to demonstrate benefits such as reducing drinking water demands and improving environmental and social impacts, whilst maintaining economic viability to be acceptable. A multi-criteria assessment was used to allow comparison of the options.

Short List of Options

This study examined a range of alternative options for integrated water cycle management at Dinner Plain, including using alternative water sources for snowmaking and relocation of the existing recycled water irrigation site. Table E1 summarises the combined options evaluated.

Options X to Z consider the provision of alternative water supply for snowmaking and firefighting.

Options 4 to 8 consider the alternative reuse and discharge of treated recycled water.

All options include the ongoing works to reduce water loss within the potable water supply network, and groundwater and runoff inflow / infiltration into the wastewater network.

Table E1: Combined Options

Option		3	X	Y	Z
		Use potable water for snowmaking	Use untreated groundwater for snowmaking and firefighting	Use recycled water / rainwater for snowmaking and firefighting	Use recycled water / rainwater for snowmaking and use untreated groundwater for firefighting
		Leakage and inflow / infiltration reduction			
3	Recycled water irrigation to Lot 2	3 (BAU)			
4	Recycled water irrigation to Cobungra		X4	Y4	Z4
5	Recycled water irrigation to Flourbag Plain		X5	Y5	Z5
7	Recycled water discharge to waterways		X7	Y7	Z7
8	Recycled water discharge to aquifer		X8	Y8	Z8

Use of Lagoon 4 is required

Multi-Criteria Assessment

A multi-criteria assessment was carried out to differentiate between options. The alternative combined options were evaluated based on the following criteria as agreed by stakeholders:

- Socially Acceptable
- Practicality
- Environmentally Responsible
- Economically Viable

Findings from the Water Balance Assessment

The assessment of the Dinner Plain water cycle has the following findings:

- A slight incremental growth is expected to occur over the planning period. The estimated total permanent residential population in 2065 is 170 and the estimated total population during peak holiday season in 2065 is approximately 2,486.
- No upgrades are required to the existing potable water infrastructure to meet demands calculated for Dinner Plain, except reticulation water mains for new connections.
- A higher firefighting flow can be provided with the adoption of an alternative non-potable water source (implementation of Options X, Y and Z).
- All options including the Business as Usual meet the current groundwater extraction licence limit.
- Business as Usual requires upgrade of the winter storage immediately.
- No upgrades are required to the existing irrigation infrastructure to meet the recycled water discharge requirements calculated for Dinner Plain. However, regular ongoing reassessment of the site and an update of the Environment Improvement Plan is recommended to ensure the sustainability of the existing irrigation site.
- If Lagoon 4 is refurbished, the rainwater collected at Lagoon 4 is sufficient to meet the demand for snowmaking under current average climate conditions.

- A high percentage of inflow / infiltration to the wastewater system is observed within Dinner Plain by comparing the potable water flow with the wastewater flow into the treatment plant. However, the actual volume is relatively small compared with other EGW's service areas.

Findings from the Options Assessment

Comparison of options using a multi-criteria assessment was carried out and the following findings were made:

- All alternative combined options have a higher capital cost and net present value when compared against the Business as Usual option. The Flourbag Plain disposal option (5) has lower capital costs and net present value than other alternative options as it does not require extensive wastewater treatment plant upgrade compared to Option 7 and 8 (discharge to waterways and aquifer) and a relatively shorter transfer pipeline as compared to Option 4 (irrigation at Cobungra).
- The Cobungra and Flourbag Plain disposal options (4 & 5) have lower greenhouse emissions than other alternative options. This is because the wastewater treatment requirements are the same as the Business as Usual (Option 3) while Option 7 and 8 require operation of tertiary wastewater treatment processes to achieve the highest quality of recycled water.
- All alternative combined options score positively against the Socially Acceptable criteria as Lot 2 would be released for alternative economic uses.
- All alternative combined options score negatively against the Practicality criteria. Option X5 uses untreated groundwater for snowmaking and firefighting, and uses recycled water for irrigation at Flourbag Plain. Option X5 scores better than other alternative options against the Practicality criteria as it does not require upgrade and operation of a tertiary wastewater treatment plant as do Options 7 and 8 (discharge to waterways and aquifer). Option X5 also requires a shorter transfer pipeline as compared to Option 4 (irrigation at Cobungra).
- All alternative combined options score negatively against the Environmentally Responsible criteria except for Options X8, Y7, Y8 and Z8. Option 8 discharges recycled water into the aquifer and scores better than other alternative options against the environmentally responsible criteria as it has a positive impact on the soil health and erosion, and a higher recycled water quality would be achieved before discharging into the environment.
- All alternative combined options score negatively against the economically viable criteria. Option X5 irrigates Flourbag Plain with recycled water and scores better than other alternative options against the economically viable criteria as it has lower capital costs.
- EGW will continue to invest in essential capital works to maintain the water and wastewater level of services at Dinner Plain. However, the additional costs for the development and implementation of alternative options would need to be funded and balanced between groups of government agencies, local council, the community and other stakeholders.
- The Business as Usual option compares favourably against the alternative combined options based on the overall multi-criteria assessment score as shown in Figure E1. Option X5 (provision of untreated groundwater for snowmaking and firefighting and recycled water irrigation at Flourbag Plain) scores better than other alternative options overall.
- Business as Usual is the preferred option based on the available information at the time of this study.

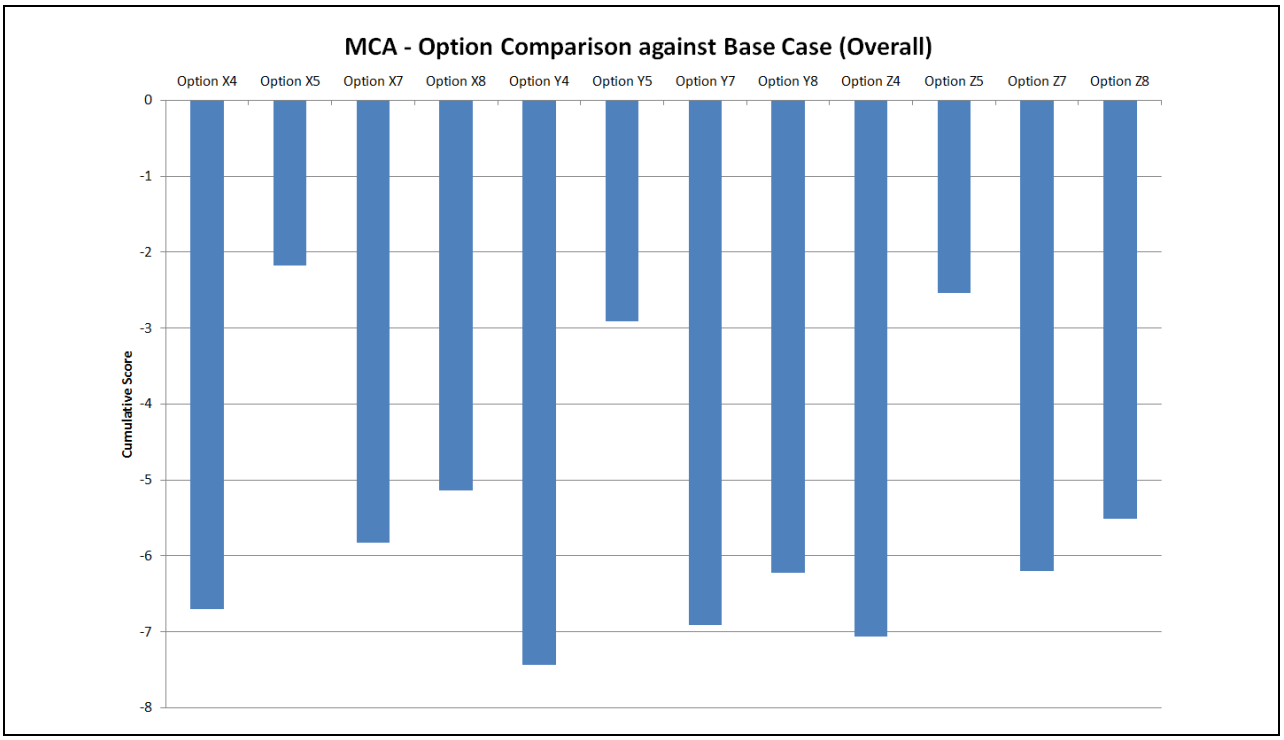

Figure E1: Multi-Criteria Assessment Overall Results

Issues and Opportunities

The following issues and opportunities were identified in association with the preferred and next best alternative:

- There are opportunities to reduce the excess effluent from the Wastewater Treatment Plant, by locating and addressing the sources of inflow and infiltration into the wastewater network. This applies to all options including the Business as Usual.
- If the inflow and infiltration measures are more successful than expected in reducing the water to be treated and disposed, the requirement for additional winter storage may reduce. However, if the inflow and infiltration measures are not successful and more wastewater is transferred into the Wastewater Treatment Plant, the requirement of winter storage would be larger and the current treatment processes may not be sufficient.
- There are opportunities to improve the efficiency of the operation of the Wastewater Treatment Plant under the Business as Usual and all alternative options.
- Flourbag Plain has a lower annual rainfall and a higher evapotranspiration compared with Dinner Plain (Lot 2). Therefore, Flourbag Plain theoretically has a higher irrigation requirement compared to Dinner Plain, depending on the type of plantation.
- As Flourbag Plain is privately owned, there would be a need to arrange a transfer of ownership to EGW or negotiate permission to use the land.
- The pipe route to Flourbag Plain would need to be investigated and permitted to ensure environmental and heritage requirements were met.
- As climate change progresses, the snow season is expected to shorten significantly. This represents a greater need for snow making to maintain and extend the snow season. Conversely, the conditions under climate change may not be suitable for snow making.
- The use of untreated groundwater for firefighting and snowmaking would require approval from Department of Health.
- The disposal of effluent under Option X5 would release Lot 2 for alternative economic uses.

- Climate change impacts such as decreasing rainfall, may present an opportunity to provide irrigation water under option X5 to meet greater soil and plant demands at Flourbag Plain than under the current climate conditions.
- Option X5 represents significant increases in both capital and ongoing maintenance and operation costs to the Dinner Plain community. A funding source for this option would be required.

Conclusions

- The current water servicing for Dinner Plain is the best option to service current and future water needs of the Dinner Plain community. However there are some opportunities for improvement without overly onerous investment.
- All alternative options considered have higher capital and ongoing costs when compared against the current water servicing. In order for an alternative option to be feasible, funding from outside of the Dinner Plain community, such as that from State or Federal Government or a Public Private Partnership funding arrangement would be required. This is because any of the alternative disposal options would require significant infrastructure and the size of the Dinner Plain community is small relative to the investment needs.
- There are opportunities to improve on the social, environmental, practical and economic outcomes for Dinner Plain, by adopting select measures identified in this study: inflow/infiltration reductions; leakage reductions; wastewater treatment plant process improvements; increasing winter storage; and use of non-potable water for firefighting.
- Further detailed investigation would be required before the some of these opportunities could be implemented.

Recommended Actions

Recommended actions in regards to the integrated water cycle management for Dinner Plain are shown in Table E2.

Table E2: Recommended Actions

	Recommended Actions	Timing
1	Adopt the BAU option as the preferred option at this stage	Immediate
2	Make results of the study available to stakeholders	Immediate
3	Undertake ongoing works to address inflow / infiltration at Dinner Plain, including: • Smoke testing • Repairs to inspection shafts, manholes and overflow relief gullies (ORGs)	Ongoing
4	Undertake ongoing efforts to minimise potable water losses through leakage	Ongoing
5	Investigate use of lagoon 4 either by lining / reed bed / constructed wetland to meet winter storage requirement	Immediate (1)
6	Consider improvement works at the Wastewater Treatment Plant as detailed in Appendix C to improve operation and treatment performance	Immediate (1)
7	Ongoing reassessment of the sustainability of the current irrigation site (Lot 2); Review and update the Environmental Improvement Plan after the implementation of inflow / infiltration reduction and increase in winter storage capacity	Every two years
8	Review options to ensure potential future issues at Lot 2, with respect to soil	2017

	Recommended Actions	Timing
	sodicity, nitrogen and phosphorous loads do not eventuate	
9	Review the Multi-Criteria Assessment to confirm the preferred option if the future development plans, climate and water demands for Dinner Plain change	Every two years
10	In consultation with Country Fire Authority and Department of Health, consider installation of Country Fire Authority fittings at the raw water tank to provide untreated groundwater for firefighting purposes	2017

(1) Investigation works to be carried out within Water Plan 3 and implementation within Water Plan 4

East Gippsland Water

Dinner Plain Integrated Water Cycle Management Investigations

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APPENDICES

1 Introduction

Driven by the commitment to respond to the needs of the communities we serve, East Gippsland Water (EGW) has begun scoping sustainable water solutions to support future growth in the township of Dinner Plain, Victoria. As the highest freehold alpine village in Australia, the community of Dinner Plain offers unique alpine recreational opportunities to Victoria. While well established in Victoria as a winter destination, Dinner Plain envisions year round amenities and recreational offerings that contribute to creating not only a more liveable community but an economically more sustainable one as well.

To help realise these benefits, EGW has partnered with the Alpine Shire Council (ASC) and has received funding through The Department of Environment, Land, Water and Planning (DELWP) to initiate work towards the development of an Integrated Water Cycle Management (IWCM) plan for Dinner Plain. Adopting an IWCM process can support the collective efforts of EGW and ASC in continuing to provide secure water supplies as efficiently, affordably and sustainably as possible.

Specific Issues driving the need for an IWCM include:

- The likely impacts of water services in Dinner Plain due to population and development growth in according to ASC's development strategies
- Potential development opportunity at the current recycled water reuse site (Lot 2)
- Responsible usage of water resources to support and extend winter focused activities
- Potential improvement in fire protection capability within Dinner Plain

The foundation of this work involves a review of the complete water cycle. Project work, to identify and trial IWCM opportunities for the community, will entail:

1. Collaborating with Alpine Shire and other local stakeholders to understand and address their goals and water needs;
2. Identifying suitable and beneficial uses of recycled water that optimises water use and supports a growing population;
3. Initiating trials to better understand long-term viability of certain alternatives; and
4. Engaging with stakeholders on the value of an IWCM approach as an integral part of long-term community planning.

This report documents the development and assessment of the short listed IWCM options.

2 Background Information

2.1 Dinner Plain Characterisation

Dinner Plain is a small alpine town at an elevation of approximately 1,500 m located on the Great Alpine Road 10 km south of the Mt Hotham Alpine Resort. Dinner Plain is largely a ski village so the population fluctuates significantly during the winter. It has been reported that there are more than 300 lodge and chalets for tourist accommodation which can accommodate over 1900 people.

2.2 Assumptions

Table 2-1 provides the key assumptions that were made for the development and assessment of Dinner Plain IWCM options, detailed in this report.

Table 2-1: List of Key Assumptions

Category	Assumption	Value	Comment
Climate Data	Rainfall	Recorded rainfall data at Mount Hotham in 2005 was used as the typical rainfall (Refer Section 2.4).	

Category	Assumption	Value	Comment
	Evaporation	Evaporation data at Mount Hotham was obtained from January 2009 to June 2014. The mean monthly evaporation was derived and used for the IWCM assessment and is shown in Figure 2-3.	
Population Projection	Permanent population	2065/66 = 170	2011/12 population is 143 based on 2011 census and 0.32% growth / annum based on 2014 Victoria in Future data
	Peak season population	2065/66 = 2486	Refer Section 2.3
Potable Water	Yearly potable water demand	2065/66 = 40.7 ML/yr	Refer Section 2.5
	Potable water demand seasonal variation	Refer to Figure 2-5. Derived based on 2011/12 town flow SCADA data.	
	Non–revenue water	Current – 35.4% of total groundwater extracted 2065/66 – 25% of total groundwater extracted	Average of 2006/07 to 2013/14 data Potential reduction of non-revenue water in the future with leakage reduction measures
Potable Water	Ultraviolet (UV) disinfection capacity	EGW advised that the UV disinfection system was replaced in November 2014 with a capacity of 25 L/s	
Firefighting	Firefighting demand	Options Presentation Workshop held on 6 November 2014 agreed that firefighting demands should be considered separate to the BAU (option 3)	
Snowmaking	Snowmaking demand	80 kL/d and 1.52 ML/yr	Assume 19 days of the year have suitable climate conditions for snowmaking in 2014. Future climate conditions will be commented on in the sensitivity analysis (Refer Section 6.2).
Wastewater	Wastewater Flow	95% of water used	Advised by EGW on 6 Nov 14.
	Groundwater inflow/infiltration	Current – 15 kL/d 2065/66 – 14 kL/d	Derived based on Wastewater Treatment Plant (WWTP) inflow SCADA and potable water demand Potential reduction of groundwater inflow / infiltration in the future with inflow / infiltration reduction measures
	Rainfall induced inflow/infiltration	Current – 4 %	Derived based on WWTP inflow SCADA and potable water demand
		2065/66 – 4 %	Assume no change
	Treatment	Class C quality is achieved under the current operation Class C quality is sufficient for woodlot / pasture irrigation	

Category	Assumption	Value	Comment
		Class A quality is required for discharge to waterways / aquifer recharge	
	Storage Lagoons	Storage lagoons will remain uncovered	
Irrigation / Discharge	Irrigation at Lot 2	No irrigation between June to October	
	Irrigation at Flourbag Plain	No irrigation between June to October	
	Irrigation at Cobungra Station	No irrigation between June to October	
	Discharge to Waterways	Recycled water treated to Class A quality before discharging to waterways and therefore it is assumed no constraints on discharge timing due to quality. It is also assumed that the waterway (Victoria River) proposed to received recycled water is not currently stressed and therefore has no constraints on discharge timing. This assumption would need to be tested if options including discharge to waterways were to be progressed.	
	Managed Aquifer Recharge	maximum allowable injection rate for a single injection site is 42 L/s or 3.6 ML/d.	Based on the estimated natural aquifer recharge range between 1,340 and 15,000 ML/annum (AECOM, 2010).

2.3 Dinner Plain Growth Projection

The Victoria in Future (VIF) 2014 data suggests a 6.64% population growth for the alpine statistical local area over a period of 20 years (between 2011 and 2031); this is equivalent to a growth rate of approximately 0.32% per annum. By adopting a consistent growth rate of 0.32% per annum between 2011 and 2065, this results in an overall population increase of approximately 27 persons.

According to the Dinner Plain Alpine Village Strategic Framework Plan 2008-2012 (ASC, 2008), the accommodation provision during peak holiday season is forecast to grow to an estimated 4,000 persons over a period of 10 to 15 years (between 2008 and 2023). However, consultation with ASC (email dated 12 September 2014) has indicated that the growth will be a lot less than forecast. ASC also advised that only one to two holiday houses are being built each year and the current bed base is approximately 2,200 with 95% occupancy during the peak holiday season.

Based upon the information available to date it is assumed that:

- Slight incremental growth (0.32% per annum) will occur within the permanent residential and commercial/industrial sector over the planning period. The estimated total permanent residential population in 2065 is 170.
- Total population during the peak holiday season (i.e. permanent residents and tourists) in 2014 is 2,090 (95% of 2,200). The estimated total population during peak holiday season in 2065 is approximately 2,486.
- Slight incremental growth of 6 persons / year for tourists over the planning period.

Figure 2-1 shows the forecast of population for Dinner Plain over the next fifty years.

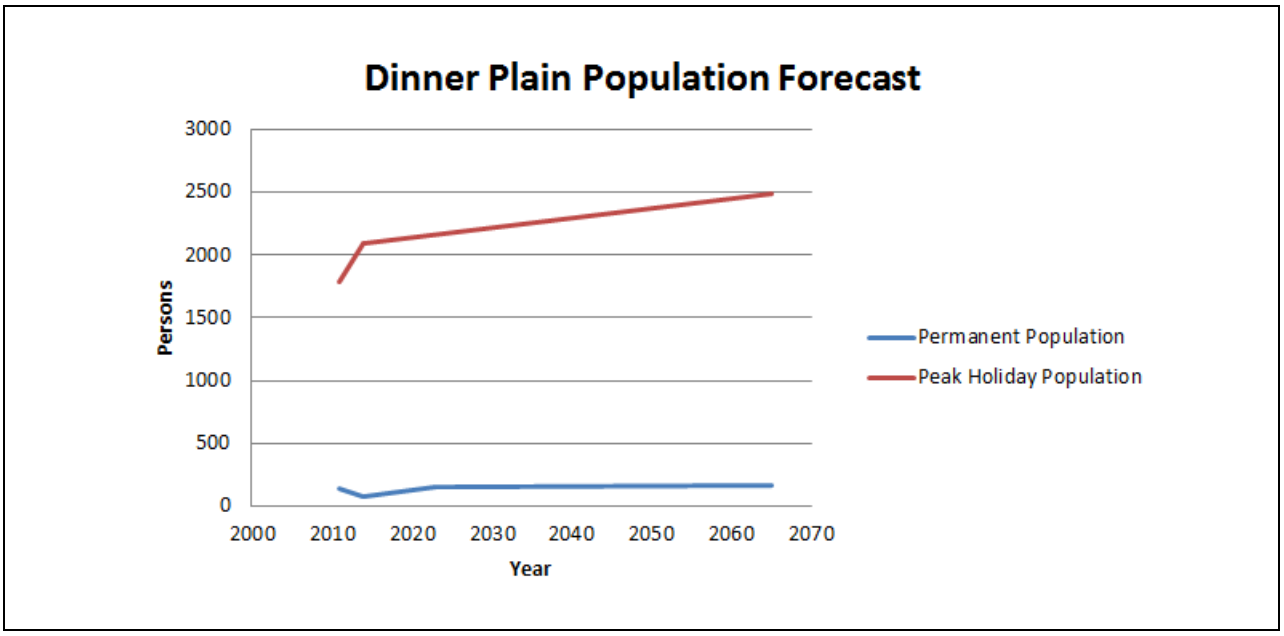


Figure 2-1: Forecast Population for Dinner Plain

2.4 Rainfall and Climate Data

There are three operating weather stations within the vicinity of Dinner Plain, as summarised in Table 2-2.

Table 2-2: Weather Stations in the Vicinity of Dinner Plain

Weather Station Location	Ownership	Status	Description
Dinner Plain	TAFCO	Open	• This weather station is located at Scrubbers End in Dinner Plain • Daily rainfall and evapotranspiration data is available from 01/08/2011
Mount Hotham	Bureau of Meteorology (BOM)	Open	• Station no. 083085 • Located approximately 12 km north west of Dinner Plain • Rainfall data available from year 1990 • Daily evapotranspiration data available from January 2009
Mount Hotham Airport	Bureau of Meteorology	Open	• Located approximately 12 km to the east of Dinner Plain • Daily rainfall and evapotranspiration data available from January 2009
Mount Hotham	Bureau of Meteorology	Closed	• Station no. 083081 • Located approximately 12 km to the north west of Dinner Plain • Rainfall data available from 1977 to 1990
Victoria Falls	Department of Environment and Primary Industries (DEPI)	Open	• Station no. 401823 • Located at Victoria Falls, Victoria River • Daily rainfall data available from 12/09/2006

Although there is a weather station located within Dinner Plain, only 3 years of data is available and this is not sufficient for the prediction of the frequency, magnitude and duration of rainfall events. As Mount

Hotham weather station has the most comprehensive data, 35 years of historical daily rainfall data recorded from 1978 to 2013 was analysed.

Figure 2-2 shows the yearly cumulative rainfall recorded at Mount Hotham from 1978 to 2013. The mean rainfall is approximately 1,600 mm per year. The accumulative rainfall recorded in 2005 is 1,601 mm and was selected as the typical rainfall recorded at Mount Hotham.

A comparison of the rainfall data obtained at Dinner Plain (owned by TAFCO) and Mount Hotham (owned by BOM) indicates that rainfall at Dinner Plain is approximately 20% less than that recorded at Mount Hotham. The typical rainfall recorded at Mount Hotham (2005) was lowered by 20% for the IWCM assessment at Dinner Plain. The mean annual rainfall adopted for Dinner Plain is approximately 1,280 mm per year.

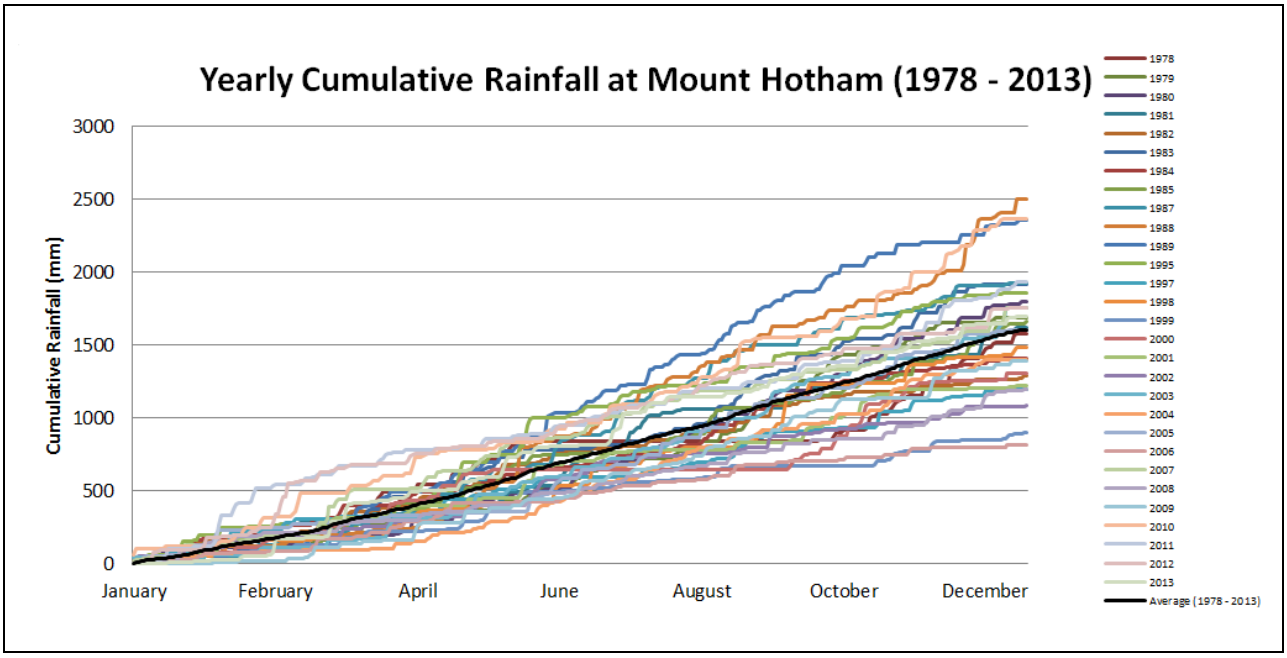


Figure 2-2: Mount Hotham 1978 to 2013 yearly cumulative rainfall

Referenced evapotranspiration data at Mount Hotham was obtained from January 2009 to June 2014. The mean monthly referenced evapotranspiration was derived and is shown in Figure 2-3.

A comparison of the referenced evapotranspiration data obtained at Dinner Plain (owned by TAFCO) and Mount Hotham (owned by BOM) indicates that evapotranspiration at Dinner Plain is approximately 8% higher than that recorded at Mount Hotham. The mean monthly referenced evapotranspiration was increased by 8% and used for the IWCM assessment.

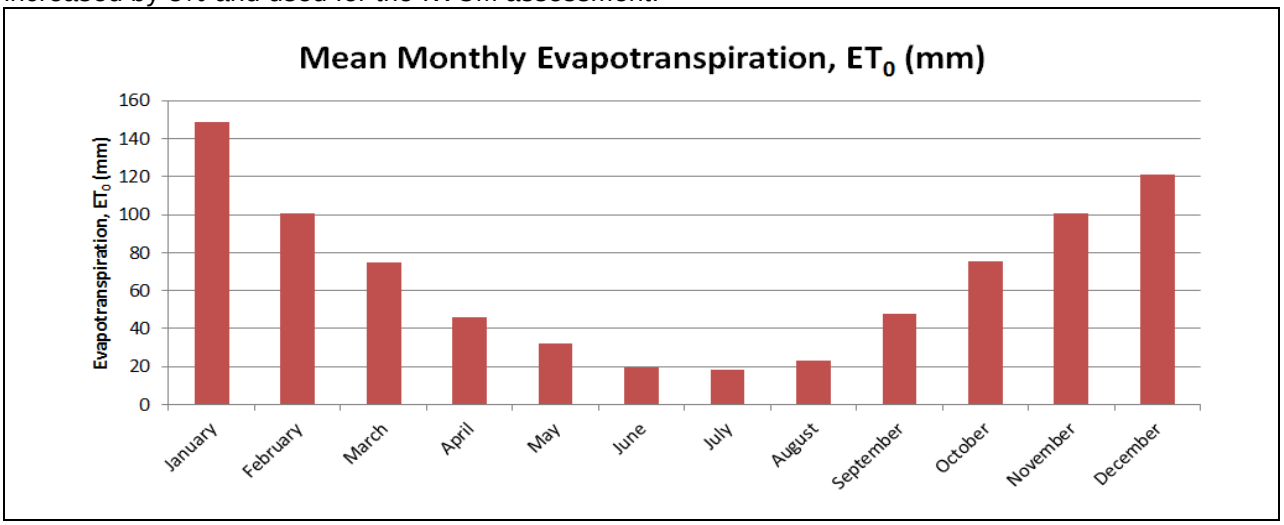


Figure 2-3: Mount Hotham mean monthly evapotranspiration

2.5 Potable Water Demands

Potable water demands have been forecast in accordance with historical data trends along with projected growth forecasts. Historical data of Groundwater Extraction, Water Consumption and Non-Revenue Water for the period 2006 - 2012 has been sourced via EGW annual reports.

Assumptions made when forecasting future water demands are summarised below:

- Groundwater Extraction – Total groundwater extraction has been calculated as water consumption with an additional non-revenue water allowance.
- Water Consumption – Total of residential and non-residential consumption
- Residential – Increased at the rate of peak holiday population increase (permanent + visitors)
- Non-Residential – Increased at the rate of permanent population increase
- Non-revenue water – Difference between groundwater extraction and water consumption. This includes water loss through leakage from reticulation water mains and water used that is not billed (e.g. inaccuracy of water meters, water use at fire hydrants). Non-revenue water has been an average of 35.4% of total groundwater extraction over the period 2006-2012 and is assumed to be reduced to 25% in 2065 with implementation of leakage reduction measures.
- Snowmaking Water Consumption – 80,000 L / night and 19 nights / year

Table 2-3 and Figure 2-4 display projected water demands for Dinner Plain over the next fifty years.

Table 2-3: Dinner Plain Water Historical and Projected Consumption and Groundwater Extraction

	2006/ 2007	2007/ 2008	2008/ 2009	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2065/ 2066
Groundwater Extraction (ML)	34.6	47.8	53	42.1	44.8	41.6	41.7	38.7	56.2
Water Consumption (ML)	27.9	27.3	25.6	27.6	29.2	30.7	26.0	25.0	42.2
Residential (ML)	22.2	21.0	19.3	21.1	21.6	20.6	17.0	16.0	28.6
Non-Residential (ML)	5.7	6.3	6.3	6.5	7.6	10.1	9.0	9.0	12.0
Non-Revenue Water (ML)	6.7	20.6	27.6	14.6	15.5	10.9	15.9	13.7	14.1
Snowmaking Flow (ML)									1.5

Based upon EGW annual reporting

Snowmaking demand does not form part of historical demand regimes

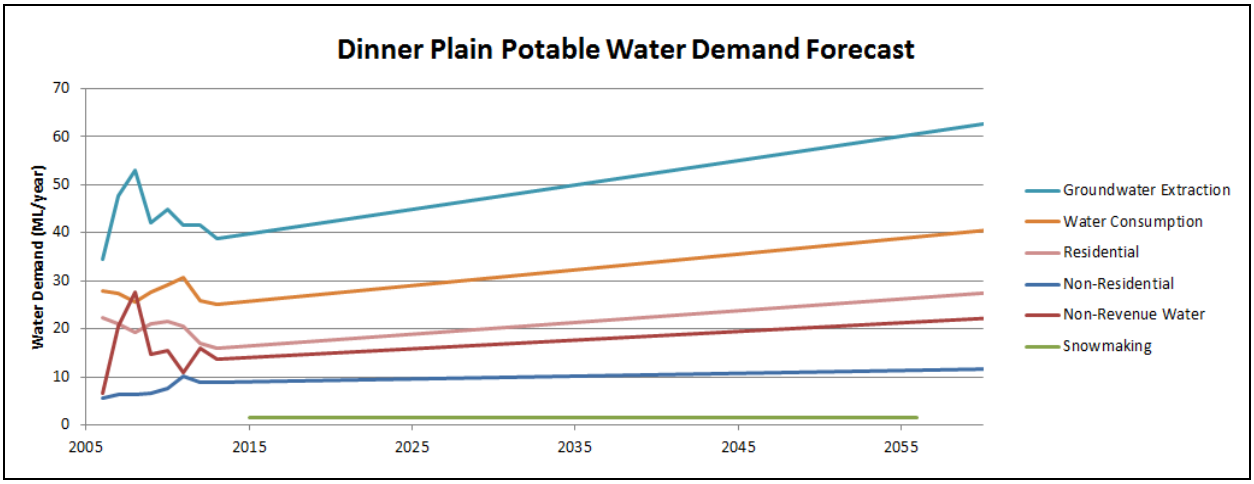


Figure 2-4: Potable Water Demand Forecast

Figure 2-5 shows the potable water demand seasonal pattern derived based on the 2011/12 SCADA flow recorded at the town potable water meter. The 2011/2012 SCADA flow record was used for the assessment as 2011/12 has the least data gaps compared with other financial years. The seasonal pattern shows that Dinner Plain is primarily a winter holiday destination and therefore has a peak potable water demand in winter, followed by smaller peaks during the Easter holidays and the Christmas / New Year holidays.

It is assumed that Dinner Plain will remain as a winter focused tourist town within the time frame of the study and therefore maintaining the peak potable water demand in winter. The impact of the potential shift from winter peak to summer peak due to climate change and Dinner Plain being developed into a year round holiday destination will be discussed in Section 6.2.

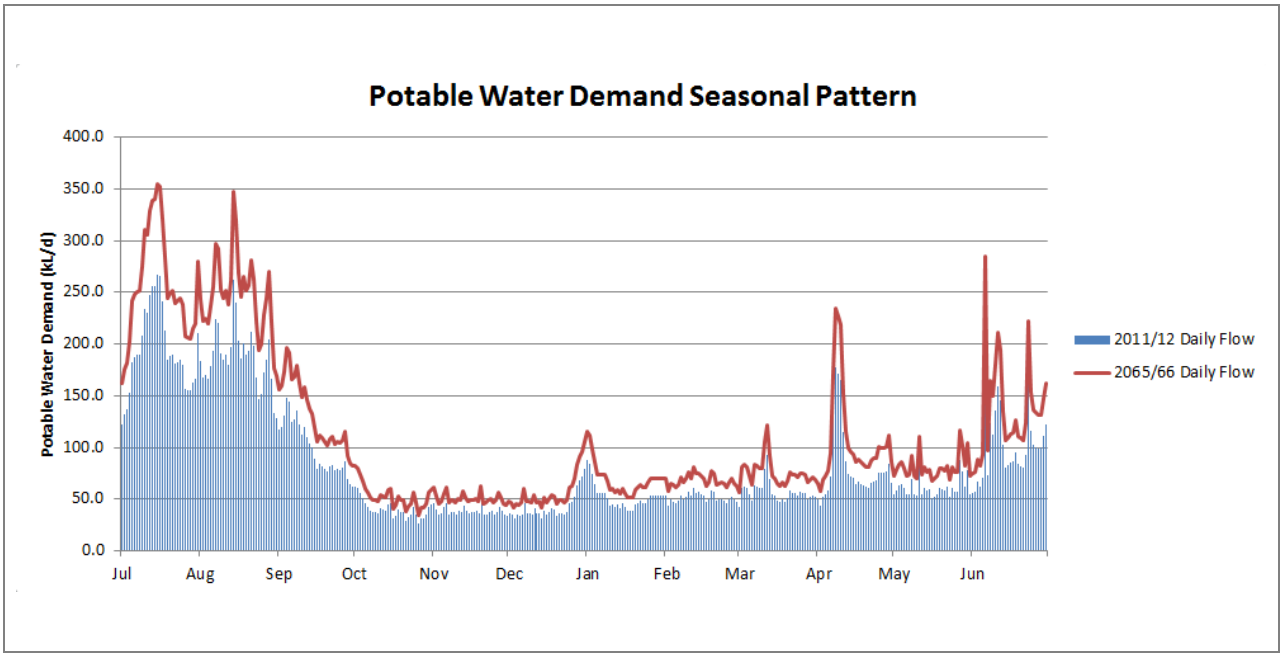


Figure 2-5: Potable Water Demand Seasonal Pattern

2.6 Wastewater Flows

Wastewater flows have been forecast based on the following assumptions:

- Average Dry Weather Flow – 95% of water used returns to sewers (based on EGW's adopted return to sewer factor)
- Groundwater Inflow / Infiltration (Base Flow) – derived as 15 kL/d by comparing the 2012 SCADA data recorded at the town supply potable water flow meter with the data recorded at the WWTP flow meter. It is assumed that the groundwater inflow / infiltration will be reduced to 14 kL/d in 2065 with implementation of inflow / infiltration reduction measures.
- Rainfall induced inflow / infiltration – derived as 4% of rainfall that falls onto the catchment infiltrating into the wastewater system. This is based on the 2012 SCADA data at the town supply potable water and WWTP flow meters, and the recorded rainfall at Dinner Plain.

2.7 Stormwater Flows

Houses within Dinner Plain are constructed without roof spouting and therefore do not direct roof water into the stormwater collection system. However, road and other runoff at Dinner Plain is collected and piped to nominated points of discharge into the surrounding landscape. The western side of the village has a constructed stormwater management system consisting of a combination of underground drains, roadside swale drains, riffle sediment ponds and treatment wetlands.

As discussed later in Section 4.2 (Options Review and Short Listing), none of the short listed options involved using stormwater as an alternative water source. All short listed options assume stormwater

runoff continues to discharge to the existing on site stormwater wetlands and surrounding landscape via the stormwater drainage system.

It is anticipated that risks in relation to flooding, erosion and nutrient discharge will remain the same as existing conditions. The possible effect of climate change on future stormwater management is provided in Section 6.2.

2.8 Firefighting Flows

Following a number of meetings with the ASC and a meeting with the Dinner Plain Advisory Committee (DPAC), it was understood that there is a desire to improve the fire protection capability within Dinner Plain. However, it should be noted that there is no specific fire flow provision requirements by the water supply system under EGW's current Customer Charter as stated in the Fire Protection Fact Sheet (EGW, 2011) (Appendix G). Instead firefighting flows were to be considered as a separate service to be provided by others e.g. Country Fire Authority (CFA).

It was also agreed in the Options Presentation Workshop held on 6 November 2014 not to include firefighting flows as a requirement. Instead firefighting flows were to be considered as a separate service to be provided by others e.g. Country Fire Authority (CFA). However, the flexibility and reliability of firefighting flows is considered in the IWCM options as a social benefit to the village.

2.9 Snowmaking Flows

In order to improve the reliability and to extend the winter activities in Dinner Plain, infrastructure and two snow guns were established in 2014 for snow production. It is estimated that 80 kL of water was used in a 7 hour operation, producing 172m^3 of snow based on 2014 snowmaking water usage. While the existing water supply network has sufficient capacity to provide potable water for snowmaking, it is not EGW's obligation to provide snowmaking services.

Based on Mount Hotham 2014 natural snow fall record, there are 19 days of reported natural snow fall. It is assumed that 19 days of the year have suitable conditions for snowmaking in Dinner Plain.

It should be noted that only one year of data was used to estimate the snowmaking demand due to insufficient data. The number of days of reported natural snow fall varies largely over the years. For example, there were only 6 days of reported natural snow fall in 2010 and 40 days of reported natural snow fall in 2012.

3 Methodology

IWCM approaches seek to optimise the provision of urban water services into the future by considering the interaction between water supply, wastewater and stormwater within a catchment context.

The generalised IWCM investigation process undertaken for Dinner Plain is summarised in Figure 3-1.

The process began with definition of the issues through a literature review. Option assessment criteria were then developed.

There are usually many IWCM options available to address issues. Development of a long list of options provides documentation for all options considered. Through consideration of the project goals and assessment criteria, some options can be discarded to form a short list of options. Individual options would then be combined to form IWCM options. Each combined option was assessed against the criteria and a preferred option was recommended for development as the IWCM strategy.

Community engagement was undertaken throughout the study to assess the expectations and priorities of the community and other stakeholders on specific issues. A community and stakeholder engagement plan was prepared and is attached in Appendix F.

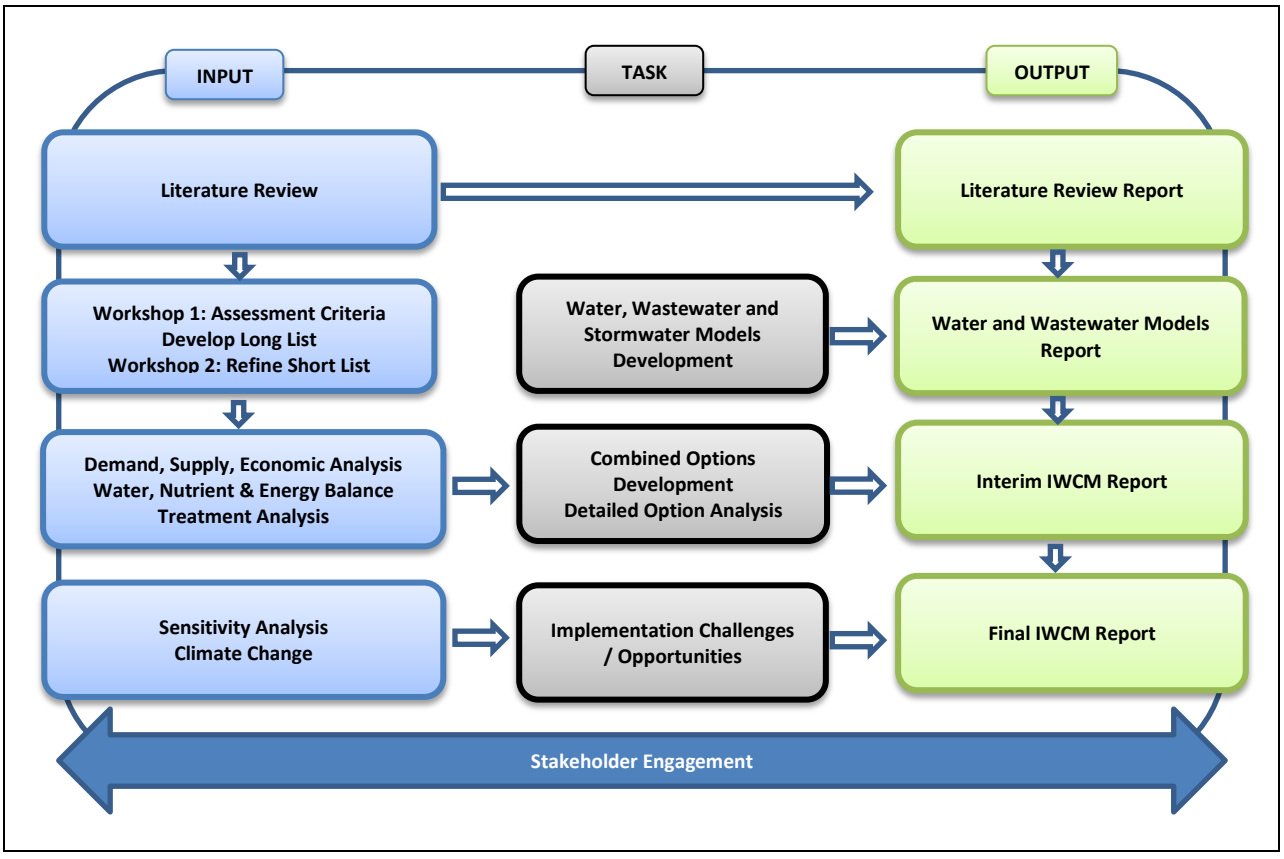


Figure 3-1: Overview of Project Methodology

4 Integrated Water Cycle Management Options

4.1 Long List of Options

A long list of fourteen (14) options was identified and these are summarised in Table 4-1. The performance of each option is to be compared to the performance of the Business as Usual (BAU) Option (Option 3).

As this IWCM study is an initial concept investigation into possible servicing options for Dinner Plain, further work will be required in later stages to resolve detailed issues such as asset ownership and maintenance responsibility, detailed costing and approvals.

4.2 Options Review and Short Listing

A workshop was held on 16 September 2014 with participants from EGW, ASC and DELWP to review the long listed options based on the assessment criteria. As an outcome of the workshop, the participants identified a short list of options for the development of combined options. Options that were disregarded from further consideration are highlighted in Table 4-1.

Table 4-1: Long List of Options

Option No.	Description
1a	**Snowmaking using groundwater (untreated)** • Option 1a involves the construction of a transfer pipeline from the groundwater bore sites to the snowmaking facility. • This option assumes that untreated groundwater would be supplied for snowmaking purposes in lieu of potable water.
1b	**Snowmaking using stormwater** • Option 1b involves the construction of a stormwater treatment plant, using Membrane Bioreactor (MBR) or Intermittently Decanted Extended Aeration (IDEA) with Reverse Osmosis (RO), to supply Class A treated stormwater for snowmaking purposes. • This option assumes that the stormwater would be harvested from the existing stormwater wetlands and / or the existing stormwater drainage system. • **This option will not be considered further as discussed in the Options Combination Workshop dated 16 September 2014 (refer Section 3.3).**
1c	**Snowmaking using recycled wastewater** • Option 1c involves upgrading of the existing Class C WWTP to provide Class A water for snowmaking purposes. • This option assumes that the WWTP would be converted to a Membrane Bioreactor or Intermittently Decanted Extended Aeration (IDEA) plant with Reverse Osmosis
2a	**Fire protection system for village using groundwater (untreated)** • Option 2a involves the installation of CFA fittings along the transfer pipeline between the groundwater bores and the water treatment plant. • This option assumes that water would be extracted from the groundwater bores directly in the event of fires.
2b	**Fire protection system for village using stormwater** • Option 2b involves the construction of a stormwater treatment plant, using a Membrane Bioreactor or Intermittently Decanted Extended Aeration (IDEA) plant with Reverse

Option No.	Description
	Osmosis to supply Class A treated stormwater for firefighting purposes. Storage tanks will be required to store the treated Class A water. • Similar to Option 1b, this option assumes that the stormwater would be harvested from the existing stormwater wetlands and / or the existing stormwater drainage system. • **This option will not be considered further as discussed in the Options Combination Workshop dated 16 September 2014 (refer Section 4.3).**
2c	**Fire protection system for village using recycled wastewater** • Option 2c involves upgrading of the existing Class C WWTP to provide Class A water for firefighting purposes. • This option assumes that the WWTP would be converted to a Membrane Bioreactor or Intermittently Decanted Extended Aeration (IDEA) plant with Reverse Osmosis .
3	**Do nothing, continue to irrigate on existing 32 Ha irrigation area** • Option 3 is the base case for IWCM. • The BAU option assumes that treated Class C water would continue to irrigate the existing 32 Ha irrigation area (Lot 2). • The BAU option assumes that additional potable water would continue to be supplied by groundwater extraction. The BAU option also assumes potable water would be supplied for snowmaking and firefighting purposes. • The BAU option assumes stormwater runoff continue to discharge to the existing on site stormwater wetlands and surrounding landscape via the stormwater drainage system.
4	**Transfer treated Class C water to Cobungra Station for irrigation** • Option 4 involves the construction of approximately 20 km gravity pipeline between Dinner Plain and Cobungra Station, transferring treated Class C water for irrigation. • Balancing storage will be required along with an irrigation system at Cobungra Station.
5	**Relocate the irrigation system to Flourbag Plain** • Option 5 involves the construction of a new transfer pipeline, balancing storage and irrigation system at Flourbag Plain approximately 4.5 km east of Dinner Plain. • Flourbag Plain is one of the two recorded State forest localities of the critically endangered Alpine Tree Frog (Litoria verreauxii alpine) (Department of Sustainability and Environment, 2009).
6	**Transfer treated Class C water to Mt Hotham for reuse** • Option 6 involves the construction of approximately 13 km pressurised pipeline to transfer treated Class C water to Mt Hotham. • This option assumes the treated Class C water will undertake further treatment to Class A quality at the existing Mt Hotham treatment facility and will be reused for snowmaking purposes. • Consultation with Mt Hotham Ski Resort shows that the resort is only recycling 50% of the existing wastewater for snowmaking and therefore there is no need for recycled water for snowmaking. • **This option will not be considered further.**
7	**Discharge treated Class A water to waterway** • Option 7 involves the upgrade of the existing Class C WWTP to Class A quality and

Option No.	Description
	discharge to a surface water body. • This option assumes that the WWTP will be converted to a Membrane Bioreactor or Intermittently Decanted Extended Aeration (IDEA) plant with Reverse Osmosis.
8	**Aquifer recharge / disposal of treated Class A water** • Option 8 involves the upgrade of the existing Class C WWTP to Class A quality and then injecting effluent into the aquifer.
9	**Relocate the irrigation system to Lot 3** • Option 9 is similar to Option 5 which involves the construction of a new transfer pipeline, and irrigation system at Lot 3. • **This option will not be considered further as discussed in the Options Combination Workshop dated 16 September 2014.**
10	**Inflow / Infiltration reduction** • It is understood that EGW undertakes ongoing works to address inflow / infiltration at Dinner Plain, including: ○ Smoke testing ○ Repairs to inspection shafts, manholes and overflow relief gullies (ORGs) • It was agreed in the Options Combination Workshop held on 16 September 2014 that this option would be included in all combined options.
11	**Leakage reduction** • It is understood that EGW has conducted leakage tests on the whole Dinner Plain system. One suspected leaking main has been identified to date. EGW will continue to have ongoing efforts to minimise losses. • It was agreed in the Options Combination Workshop held on 16 September 2014 that this option would be included in all combined options.
12	**Lining and use of lagoon 4** • This option explores the opportunity of utilising lagoon 4 for recycled water storage.
13	**Conversion of lagoon 4 to a reed bed** • This option explores the opportunity of converting lagoon 4 to a reed bed treatment system to store and improve the quality of recycled water.
14	**Conversion of lagoon 4 to a constructed wetlands** • This option explores the opportunity of converting lagoon 4 to wetlands treatment system to store and improve the quality of recycled water.

4.3 Combined Options Development

Since none of the initial long-listed options implemented in isolation would provide outcomes to meet all of the defined drivers for IWCM in Dinner Plain, the final options were required to be combinations of individual options. As an outcome of the Options Combination Workshop held on 16 September 2014, each of the shortlisted options were grouped together to form three alternative water supply options and four recycled water reuse or discharge options. The combination of these options is shown in Table 4-2 and Appendix D.

Table 4-2: Combined Options

Option		3	X	Y	Z
		Use potable water for snowmaking	Use untreated groundwater for snowmaking and firefighting	Use class A / rainwater for snowmaking and firefighting	Use Class A / rainwater for snowmaking and use untreated groundwater for firefighting
		Leakage and inflow / infiltration reduction			
3	Class C irrigation to Lot 2	3 (BAU)			
4	Class C irrigation to Cobungra		X4	Y4	Z4
5	Class C irrigation to Flourbag Plain		X5	Y5	Z5
7	Class A discharge to waterways		X7	Y7	Z7
8	Class A discharge to aquifer		X8	Y8	Z8

Use of Lagoon 4 is required

5 Combined Options Assessment

5.1 Option 3: Business As Usual

Assessment of Option 3 indicates that capital works is required to maintain the required level of service.

Option 3 would consist of the following major infrastructure:

- Lining of Lagoon 4 to provide sufficient winter storage
- WWTP operational improvement works

5.1.1 Water Balance

Figure 5-1 shows the schematic of Option 3 water balance.

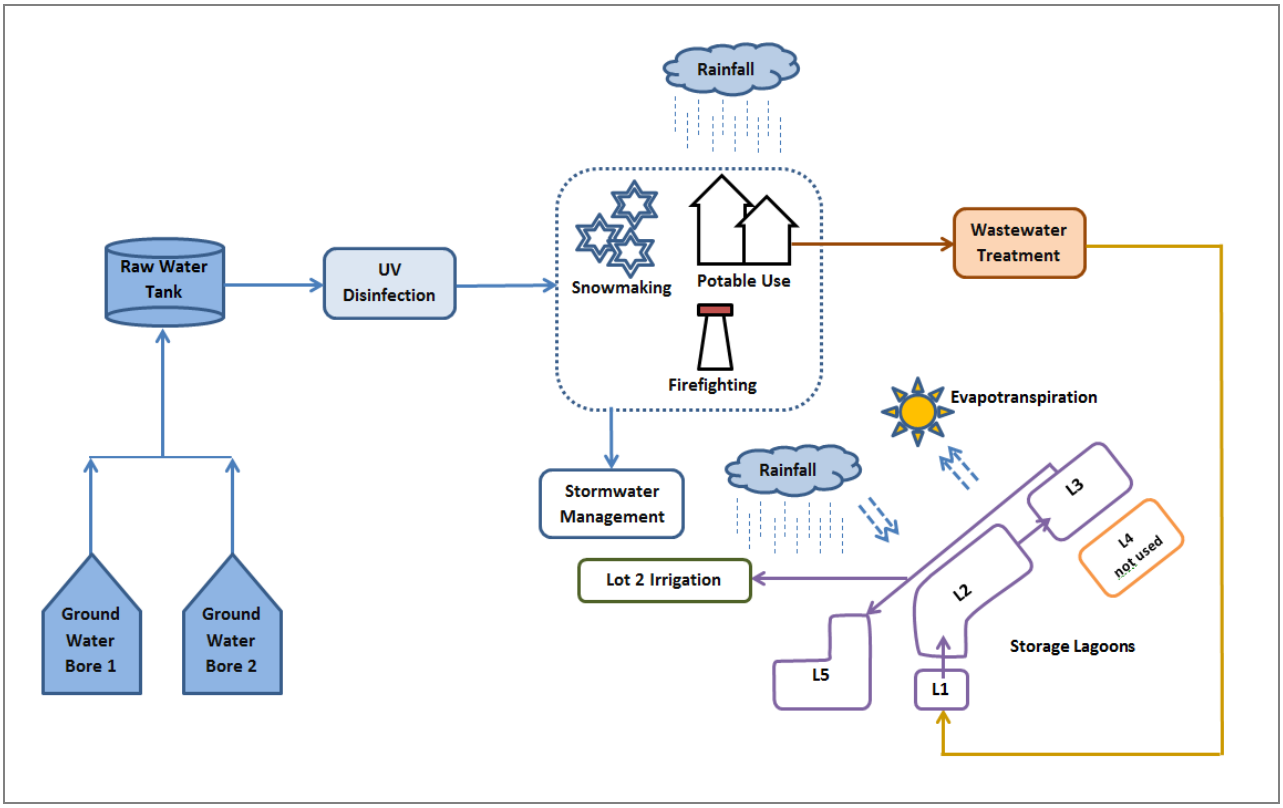


Figure 5-1: Option 3 – Water Balance

Water balance assessment of Option 3 indicates the following:

- The capacity of the existing groundwater bores, raw water tank and UV disinfection system is sufficient to provide snowmaking flows and potable water to customers. Provision of an additional groundwater bore is not required. The raw water tank has sufficient capacity to provide a minimum of 24 hours peak day demand storage.
- The UV disinfection system (which will be upgraded to 25 L/s) can provide 10.5 L/s firefighting flows during peak summer demand day (Easter Holiday) peak hour in 2065.
- There is sufficient winter storage (lagoons 2, 3 and 5) during mean rainfall and evaporation conditions at Dinner Plain theoretically.
- There is insufficient winter storage (lagoons 2, 3 and 5) during the 90th percentile rainfall and mean evaporation conditions at Dinner Plain and additional winter storage is required. EGW operations confirmed the existing winter storage is at capacity in years with higher rainfall.
- The annual recycled water to be irrigated at Lot 2 is approximately 65 ML in 2065. Based on the estimated irrigation demand using crop coefficients for pastures and eucalypts greater than 4

years old respectively, Lot 2 can theoretically receive approximately 76 ML to 100 ML of recycled water per year.

5.1.2 Dinner Plain Wastewater Treatment and Irrigation System

An analysis of the operation of the Dinner Plain wastewater treatment and irrigation system concluded the following:

- A number of operational issues were identified with the existing wastewater treatment plant (WWTP) (Option 3, 4 and 5) and operational improvement works are required. Please refer to Section 5.9.4 and Appendix C for details.
- The Dinner Plain recycled water irrigation system at Lot 2 comprises 22 irrigation bays with a total of 744 sprinklers. Each sprinkler can deliver approximately 0.3 to 0.5 L/s. The irrigation system is currently activated by tensiometers and is programed to irrigate for 3 days once activated. Each irrigation bay runs in turn for approximately 8 minutes (i.e. 22 bays x 8 minutes = 176 minutes per irrigation cycle). The existing irrigation system has a theoretical capacity of irrigating 1.14 ML/day and is sufficient to irrigate 65 ML / year in 2065.
- The current irrigation system is covering an area of approximately 37.2 hectares at Lot 2. The recycled water is supplying approximately 7 kg/ha of phosphorus and 20 kg/ha of nitrogen, based on the nutrient calculation as detailed in Section 5.9.2. Eucalyptus trees typically take up 15 kg/ha of phosphorus and 90 kg/ha of nitrogen per year, which is more than being applied in the recycled water.
- The 2014 Dinner Plain Soil Monitoring Report (Marriott, 2014) concluded that there are a number of potential future issues looming with soils in the Dinner Plain recycled water irrigation area. While the soils are coping well with the salt load applied in the recycled water there is evidence of problems developing in terms of sodicity, nitrogen and phosphorus. However, it is expected that these potential issues would also apply to other irrigation reuse options (i.e. Options 4 and 5). Options exist to address these potential issues and these should be investigated in detail.
- The basis of the Dinner Plain WWTP EIP Report (EGW, 2013) is unclear and it is recommended that an updated EIP to be prepared.

5.1.3 Current Inflow / Infiltration Reduction and Leakage Reduction Measures

It is understood that EGW will undertake ongoing works to address inflow / infiltration at Dinner Plain, including:

- Smoke testing
- Repairs to inspection shafts, manholes and overflow relief gullies

It is also understood that EGW has conducted leakage tests on the whole Dinner Plain potable water supply system. One suspected leaking main has been identified to date. EGW will continue to have ongoing efforts to minimise losses.

5.2 Option X: Use of untreated groundwater for snowmaking and firefighting purposes

Option X involves the provision of untreated groundwater for snowmaking and firefighting purposes.

The existing potable water supply network supplies potable water at fire hydrants within Dinner Plain for firefighting purposes. It is assumed the CFA will collect water directly from the raw water tank as a second source and no distribution network to fire hydrants is required.

Option X would consist of the following major infrastructure:

- Groundwater supply pipeline from the raw water tank to Scrubbers End ski slope
- Installation of CFA fittings at the raw water tank

Figure 5-2 shows a schematic of the infrastructure required for Option X.

Figure 5-2: Option X – Infrastructure Schematic

5.2.1 Water Balance

The Option X water balance was developed based on the assumptions outlined in Section 2.2.

Figure 5-3 shows the schematic of the Option X water balance.

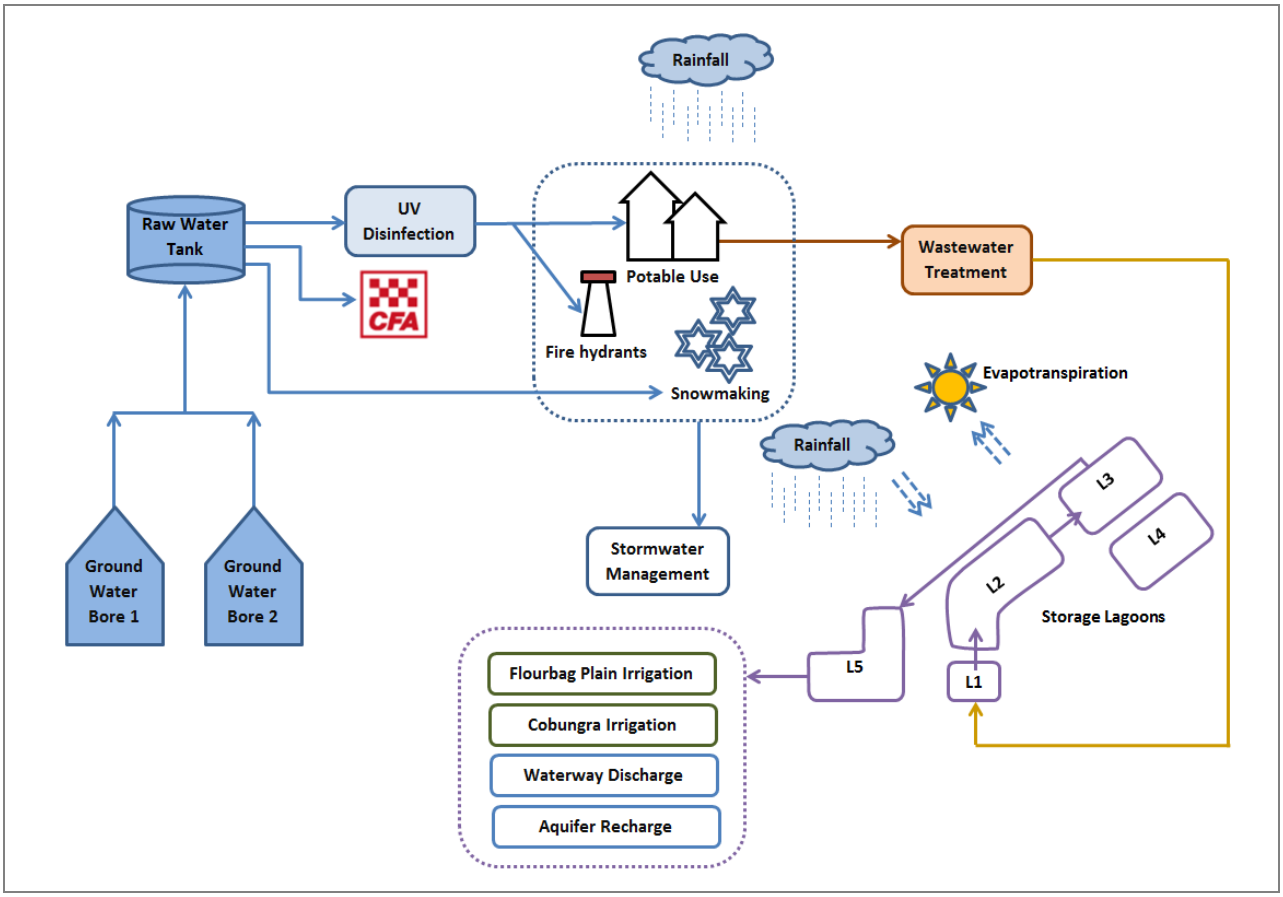


Figure 5-3: Option X – Water Balance Schematic

The water balance analysis indicates the following:

- The existing raw water tank has capacity to provide 20 L/s x 4 hours firefighting flow during peak summer demand day (Easter Holiday). As discussed in Section 5.1.1, the existing UV disinfection system can provide 10.5 L/s firefighting flows during the peak summer demand day (Easter Holiday) peak hour in 2065. A higher firefighting flow could be provided when the flows are supplied directly from the raw water tank, bypassing the UV disinfection system.

- The yearly Class C recycled water yield is the same as Option 3 (BAU).

5.3 Option Y: Use of recycled water / rainwater harvesting for snowmaking and firefighting purposes

Option Y originally involved the provision of Class A recycled water for snowmaking and firefighting purposes. However, it is noted that rainfall at Dinner Plain exceeds the actual evaporation and this provides a rainfall surplus on an annual basis. Water balance assessment shows that by utilising Lagoon 4 for capturing natural rainfall, the estimated yearly rainfall that falls upon the area of Lagoon 4 is sufficient to provide water for snowmaking. However, it should be noted that the reliability of rainwater harvesting using Lagoon 4 is highly influenced by uncertainty such as climate change, change in demand and yearly variability of rainfall. Effluent disposal Options 4 and 5 adopt rainwater harvesting as the water source for snowmaking and firefighting. Further investigation is required to confirm if additional treatment is required to ensure rainwater quality is fit for firefigting purposes. Measures to prevent contamination from adjacent wastewater lagoons and disposal of potential rainwater surplus would be required.

Option 7 (discharge to waterways) and Option 8 (aquifer recharge) involve the upgrade of the WWTP to provide Class A quality recycled water. If Option Y is combined with these two options, Class A quality recycled water can be provided for snowmaking and firefighting purposes, which will increase the reliability of the supply.

The existing potable water supply network supplies potable water at fire hydrants within Dinner Plain for firefighting purposes. It is assumed the CFA will collect water directly from the lagoons as a second source and no distribution network to fire hydrants is required.

Option Y would consist of the following major infrastructure:

- Lining of Lagoon 4 for rainwater harvesting (if combined with Option 4 or Option 5)
- Water supply pump station and pipeline from Lagoon 4 to provide rainwater to Scrubbers End ski slope (if combined with Option 4 or option 5)
- Water supply pump station and pipeline from storage lagoons to provide recycled water to Scrubbers End ski slope (if combined with Option 7 or Option 8)
- Installation of CFA fittings at the lagoons

Figure 5-4 shows a schematic of the infrastructure required for Option Y.

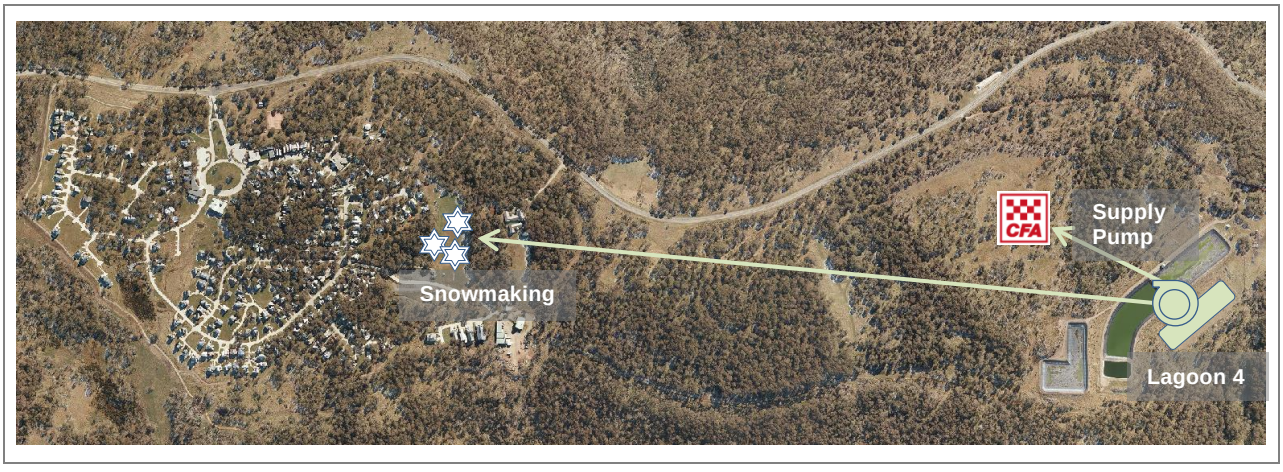


Figure 5-4: Option Y – Infrastructure Schematic

5.3.1 Water Balance

Figure 5-5 shows the schematic of Option Y water balance.

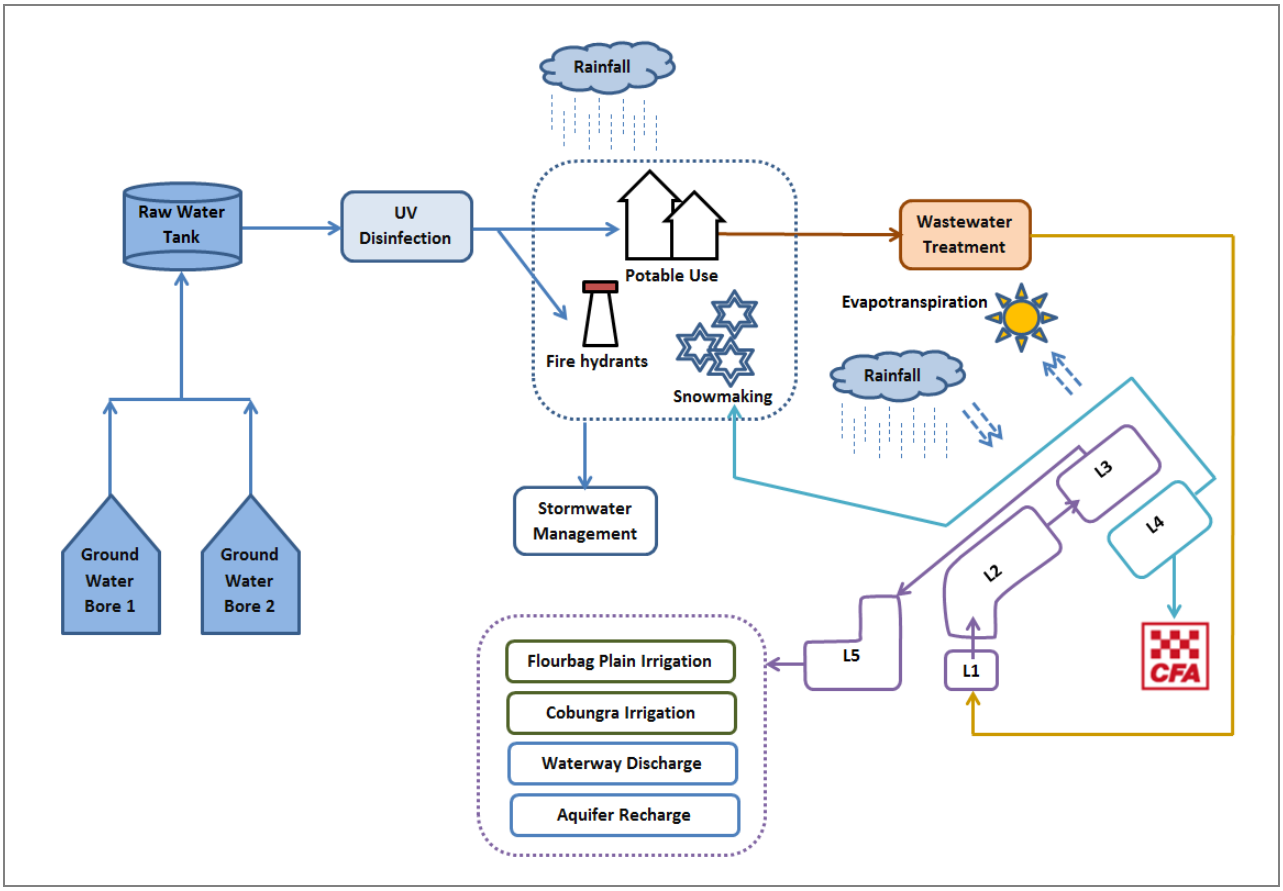


Figure 5-5: Option Y – Water Balance Schematic

The water balance analysis indicates the following:

- Rainwater collected at Lagoon 4 can theoretically provide sufficient water for snowmaking purposes if Option Y is combined with Option 4 and 5. The yearly rainwater collected at Lagoon 4 can provide approximately 20 L/s x 59 hours firefighting flow during the peak summer demand day (Easter Holiday).
- The yearly Class C recycled water yield is the same as Option 3 (BAU).

5.4 Option Z: Use of recycled water / rainwater harvesting for snowmaking and untreated groundwater for firefighting purposes

Option Z originally involved the provision of Class A recycled water for snowmaking and provision of untreated groundwater for firefighting purposes. Similar to Option Y, water balance assessment shows that by utilising Lagoon 4 for capturing natural rainfall, the estimated yearly yield is sufficient to provide water for snowmaking purposes. Further investigation is required to confirm if additional treatment is required to ensure rainwater quality is fit for snowmaking purposes. Measures to prevent contamination from adjacent wastewater lagoons and disposal of potential rainwater surplus would be required.

The existing potable water supply network supplies potable water at fire hydrants within Dinner Plain for firefighting purposes. Similar to Option X, it is assumed the CFA will collect water directly from the raw water tank as a second source and no distribution network to fire hydrants is required.

Similar to Option Y, if Option Z is combined with Option 7 (discharge to waterways) or Option 8 (aquifer recharge), Class A quality recycled water can be provided for snowmaking purposes, as Option 7 and Option 8 involve upgrading the WWTP to provide Class A quality recycled water.

Option Z would consist of the following major infrastructure:

- Lining of Lagoon 4 for rainwater harvesting (if combined with Option 4 or Option 5)
- Water supply pump station and pipeline from Lagoon 4 to Scrubbers End ski slope (if combined with Option 4 or Option 5)
- Water supply pump station and pipeline from recycled water storage lagoons to Scrubbers End ski slope (if combined with Option 7 or Option 8)
- Installation of CFA fittings at the raw water tank

Figure 5-6 shows a schematic of the infrastructure required for Option Z.

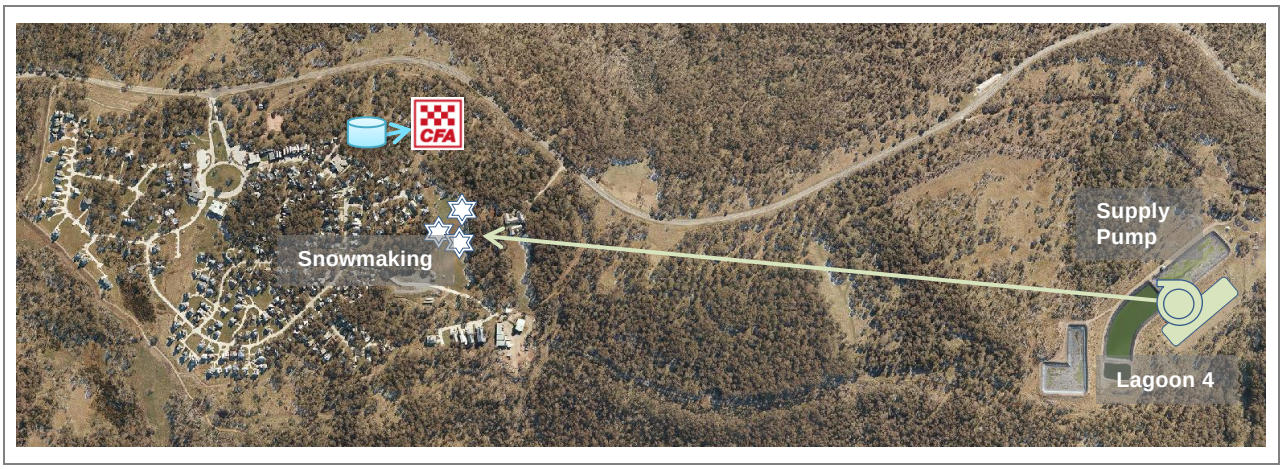


Figure 5-6: Option Z – Infrastructure Schematic

5.4.1 Water Balance

Figure 5-7 shows the schematic of Option Z water balance.

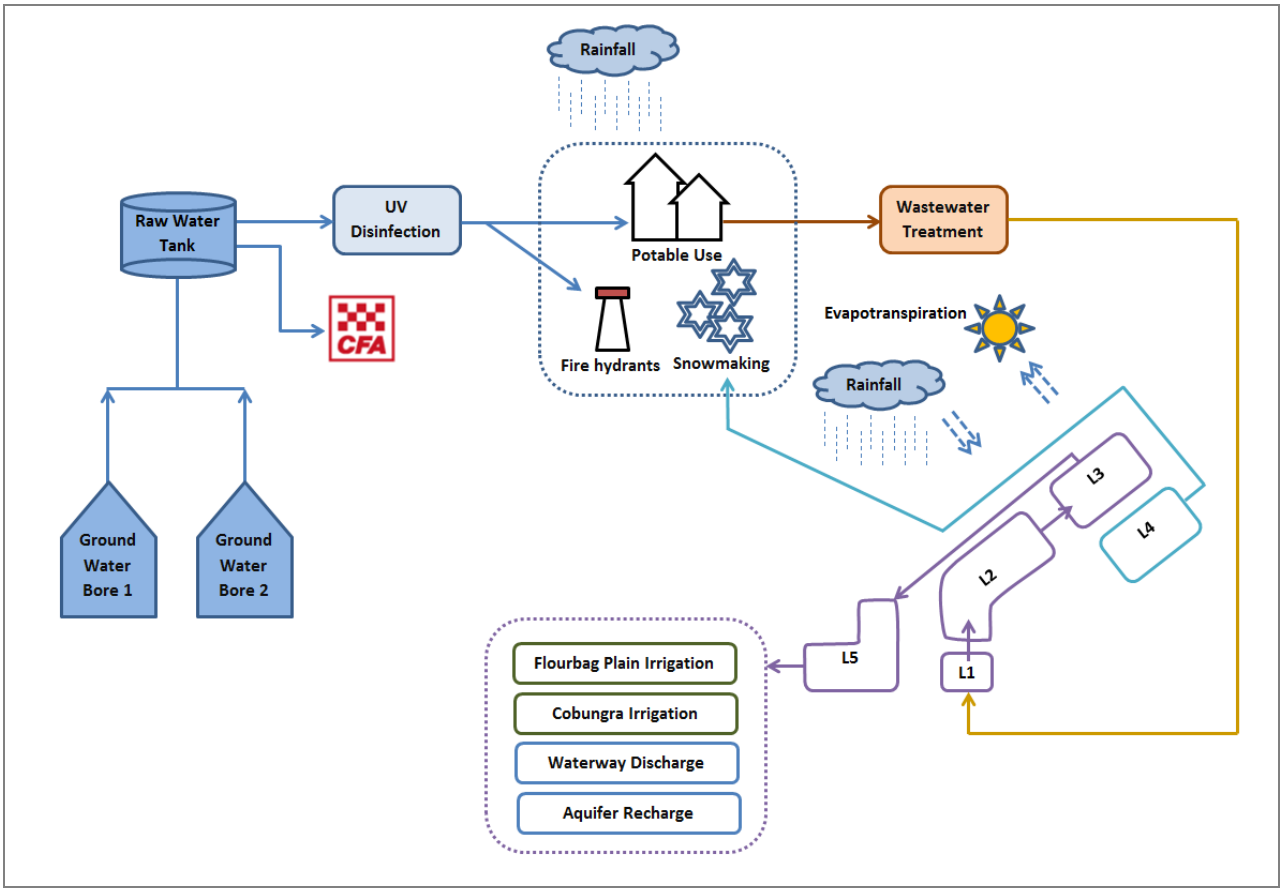


Figure 5-7: Option Z – Water Balance Schematic

The result of the water balance indicates the following:

- The existing raw water tank has capacity to provide 4 hours of 20 L/s firefighting flow during peak summer demand day (Easter Holiday).
- The yearly Class C recycled water yield is the same as Option 3 (BAU).

5.5 Option 4: Transfer to Cobungra

Cobungra Station is located 20 km east of Dinner Plain on the Great Alpine Road between Omeo and Dinner Plain and sits below the snow line at an elevation of 1,020 m (nearly 400m below Dinner Plain). Cobungra Station is the largest cattle station in Victoria and therefore consists of improved pasture to support the cattle grazing operations. Management of Cobungra Station have indicated their interest in receiving recycled water for irrigation (EarthTech, 2011). The irrigation demand at Cobungra Station is to be confirmed should this option be pursued further. It is assumed that Class C recycled water is sufficient for pasture irrigation at the station.

Assuming no irrigation between June and October because of low water requirements and low evaporation, the water balance assessment shows that the Class C recycled water yield between June and October exceeds the total storage capacity of Lagoons 2, 3 and 5. Utilisation of Lagoon 4 or construction of additional storage either at Dinner Plain or Cobungra would be required. If this option is to be combined with Option Y or Option Z, which will utilise Lagoon 4 for rainwater harvesting, utilisation of Lagoon 4 for winter storage will not be feasible. Therefore, it is assumed an additional storage tank at Cobungra would be constructed for the required winter storage.

Analysis of available climate data obtained at Mount Hotham and Victoria Falls indicates that the recorded rainfall at Cobungra is approximately 60% lower than the recorded rainfall at Mount Hotham. The average annual rainfall at Cobungra (in close proximity of Victoria Falls) is estimated to be 640 mm.

Water balance assessment estimated the area required for irrigation is approximately 25 ha, assuming a crop co-efficient for pasture.

A number of operational issues were identified with the existing wastewater treatment plant (WWTP) (Option 3, 4 and 5) which would require operational improvement works to address. Please refer to Section 5.9.4 and Appendix C for details.

Option 4 would consist of the following major infrastructure:

- 20 km transfer pipeline from Dinner Plain to Cobungra
- Additional storage tank at Cobungra
- Irrigation system at Cobungra
- WWTP operational improvement works

Figure 5-8 shows a schematic of the infrastructure required for Option 4.

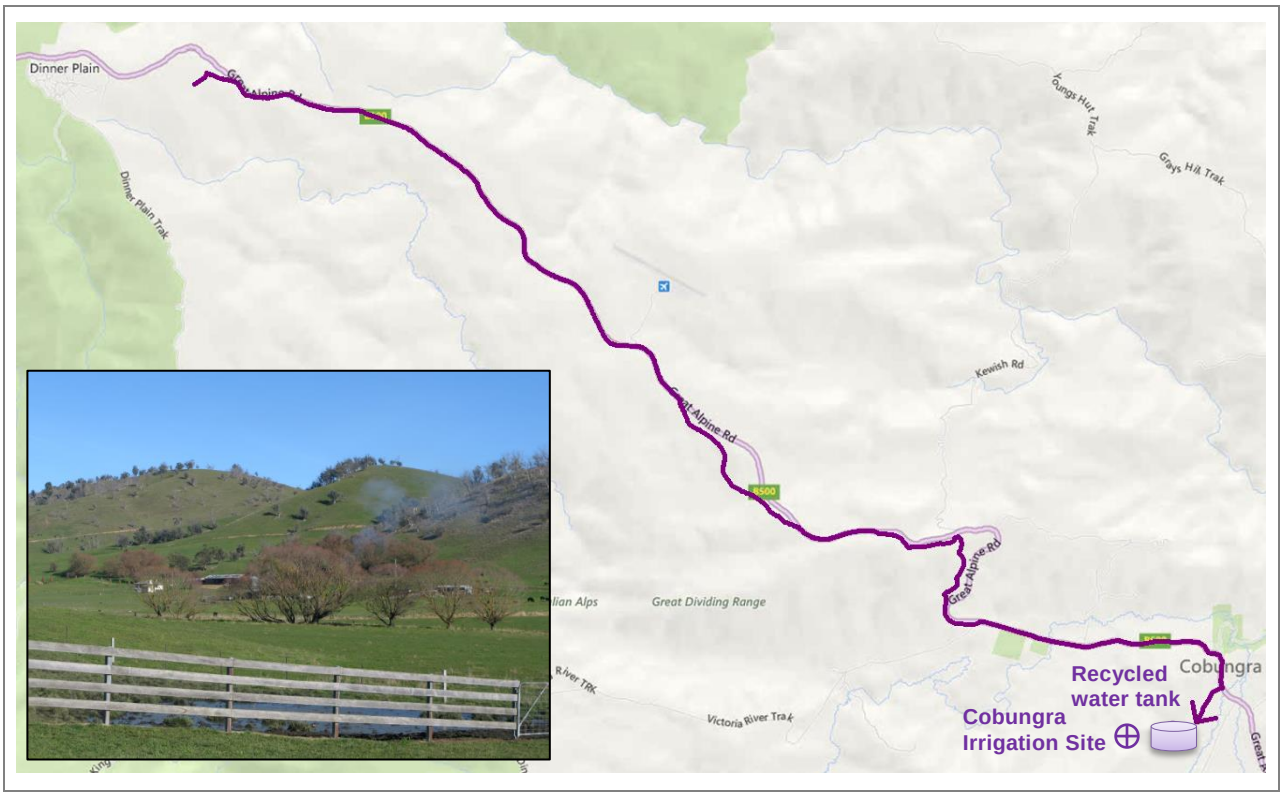


Figure 5-8: Option 4 – Infrastructure Schematic

5.6 Option 5: Transfer to Flourbag Plain

Option 5 involves relocating the irrigation site from Lot 2 to Flourbag Plain, located 4.5 km east of Dinner Plain.

It is noted that Flourbag Plain is one of the two recorded State forest localities of the critically endangered Alpine Tree Frog (Litoria verreauxii alpine) (Department of Sustainability and Environment, 2009). Flora, fauna and habitat survey would be required to confirm the presence / absence of any threatened species.

Similar to Option 4, the Class C recycled water yield between June and October exceeds the total storage capacity of Lagoons 2, 3 and 5. It is assumed an additional storage tank at Flourbag Plain would be constructed for the required winter storage.

Analysis of available climate data obtained at Mount Hotham and Mount Hotham Airport indicates that the recorded rainfall at Mount Hotham Airport is approximately 54% lower than the recorded rainfall at Mount Hotham. The average annual rainfall at Flourbag Plain (in close proximity of Mount Hotham Airport) is estimated to be 736 mm. Analysis of available climate data also indicates that the recorded evapotranspiration data at Mount Hotham Airport is approximately 17% higher than the recorded evapotranspiration at Mount Hotham.

Water balance assessment estimated the area required for irrigation at Flourbag Plain is approximately 25 ha, assuming a crop co-efficient for pasture.

A register title search indicates that Flourbag Plain is privately owned and therefore land acquisition would be required should this option be pursued further.

The irrigation demand and the possibility of transfer of land ownership of Flourbag Plain is to be investigated further should this option be pursued further.

A number of operational issues were identified with the existing wastewater treatment plant (WWTP) (Option 3, 4 and 5) which would require operational improvement works to address. Please refer to Section 5.9.4 and Appendix C for details.

Option 5 would consist of the following major infrastructure:

- 2.3 km transfer pipeline from Dinner Plain to Flourbag Plain
- Additional storage tank at Flourbag Plain
- Irrigation system at Flourbag Plain
- WWTP operational improvement works

Figure 5-9 shows a schematic of the infrastructure required for Option 5.

Figure 5-9: Option 5 – Infrastructure Schematic

5.7 Option 7: Discharge to Waterways

Option 7 involves the upgrade of the existing Class C WWTP to Class A quality for discharge to a surface water body. For Dinner Plain the surface water body would be the Victoria River.

It is noted that under the EPA guideline for the disinfection of treated wastewater (EPA Victoria, 2002), the need for Class A quality and helminth reduction is not specified for reclaimed water discharges into surface waters. The required reclaimed water quality will need to be agreed with EPA Victoria and other relevant stakeholders should this option be pursued further. Further investigation on the potential impact of any irrigation / extraction downstream of the discharge point is required.

For the purpose of assessment under this study, it is assumed recycled water of Class A quality is required before discharging into waterways. It is also assumed that the existing storage lagoons would be utilised to provide a minimum of 30 day's storage for helminth control as required under the EPA guideline for Class A reclaimed water (EPA Victoria, 2002).

Option 7 would consist of the following major infrastructure:

- Upgrade WWTP to provide Class A quality water
- Approximately 610 m of transfer pipeline from Dinner Plain to the stream connecting to the Victoria River

Figure 5-10 shows a schematic of the infrastructure required for Option 7. The transfer pipeline and discharge point shown on the plan are indicative only and the final locations are subject to further investigation.

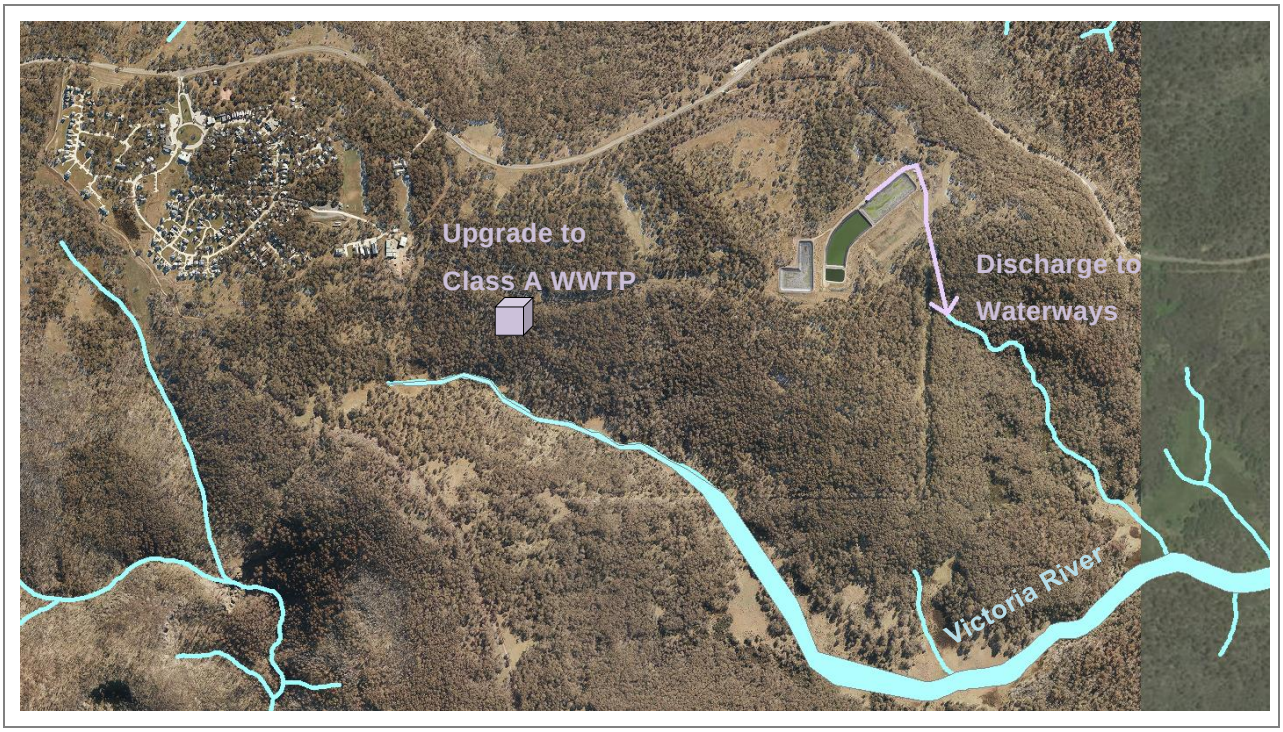


Figure 5-10: Option 7 – Infrastructure Schematic

Figure 5-11 shows the average flow and water level of the Victoria River recorded at Victoria Falls (near Cobungra) from May 1989 to June 2014 (data owned by Department of Environment and Primary Industries and obtained via BOM). Water balance indicates that the average flow of the Victoria River would increase by less than 1% (average 2.1 L/s) with the implementation of Option 7. It should be noted that due to limited data availability, further investigation is required to determine the impact of Option 7 discharges on the stream connecting to the Victoria River.

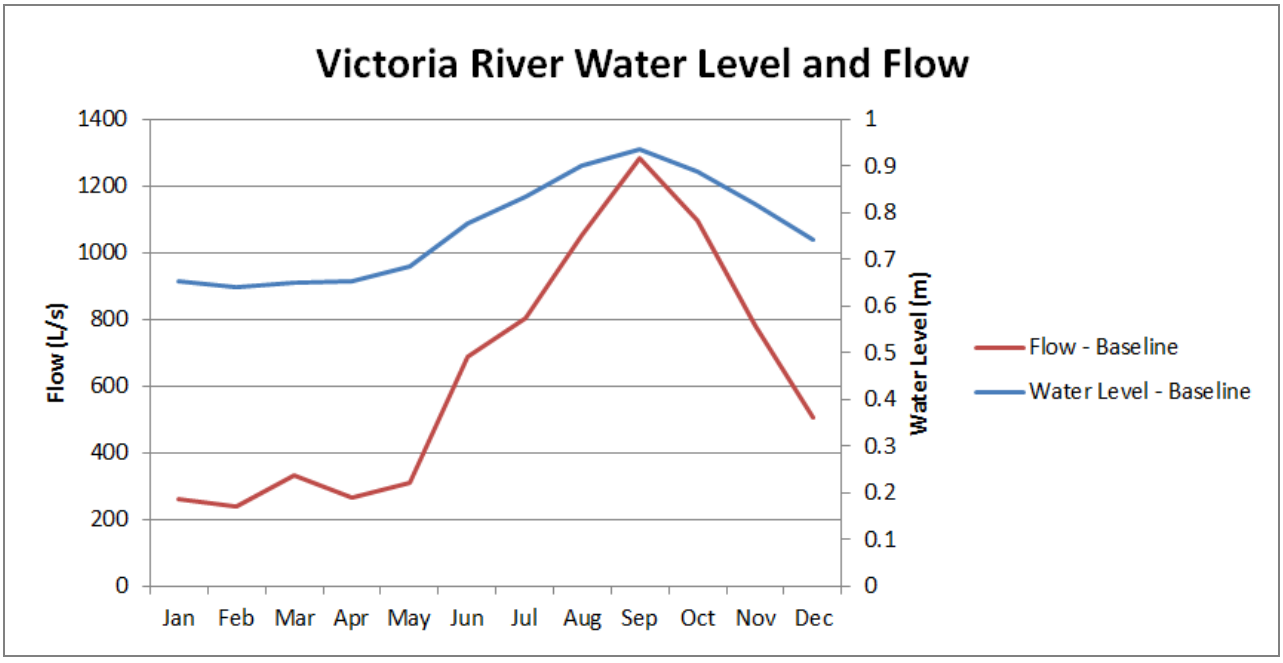


Figure 5-11: Victoria River Water Level and Flow recorded at Victoria Falls (Source: BOM)

5.8 Option 8: Managed Aquifer Recharge

The aquifer at Dinner Plain is fractured basalt with lenses of sand near the base and below the unit (GeoEng, 2001). Detailed information on the Dinner Plain aquifer accessed by the bores is available in the report entitled Dinner Plain Water Supply: Hydrogeological Evaluation of Aquifer Pumping Tests on Existing Water Supply Bores (SKM, 2006).

Option 8 involves the upgrade of the existing Class C WWTP to Class A quality and then injecting into the aquifer. It is assumed the aquifer injection site will be located down gradient of the water supply bores to minimise the risk of contamination.

For the purpose of assessment under this study, it is assumed recycled water of Class A quality is required before discharging into the aquifers. Approval from the Catchment Management Authority will be required and the required reclaimed water quality will need to be agreed with EPA Victoria and other relevant stakeholders should this option be pursued further. It is also assumed that the existing storage lagoons will be utilised to provide a minimum of 30 day's storage for helminth control as required under the EPA guideline for Class A reclaimed water (EPA Victoria, 2002).

Option 8 would consist of the following major infrastructure:

- Upgrade the existing WWTP to provide Class A quality
- Approximately 400m of transfer pipeline to aquifer injection site

Figure 5-12 shows a schematic of the infrastructure required for Option 8. Note that the aquifer recharge site shown on the plan is indicative only and the final location is subject to further investigation.

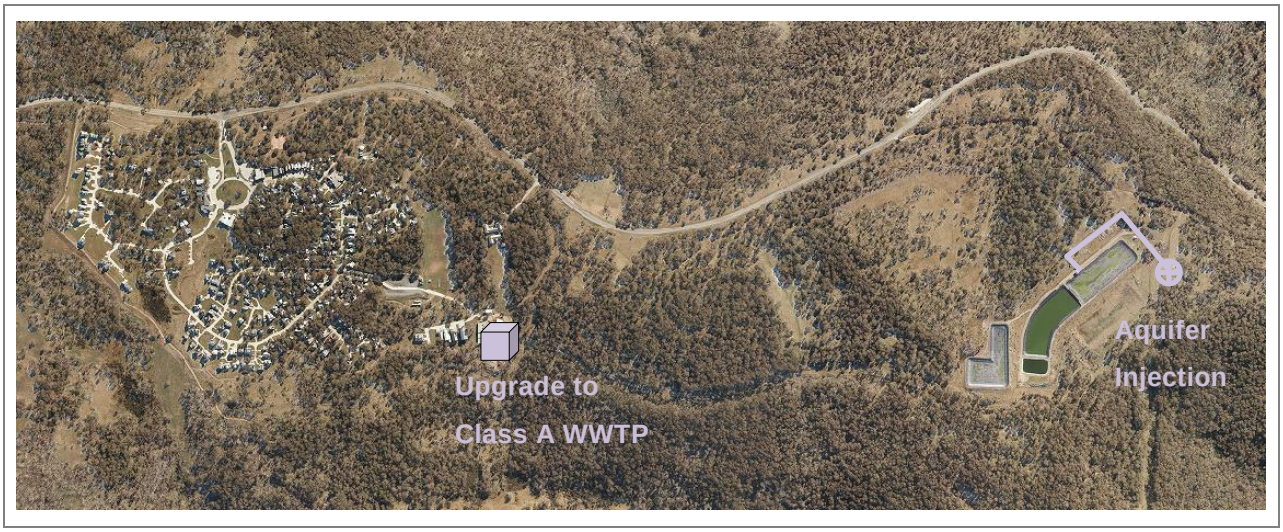


Figure 5-12: Option 8 – Infrastructure Schematic

Estimates of natural recharge to the aquifer range between 1,340 and 15,000 ML/annum (AECOM, 2010). Therefore, it is assumed the maximum allowable injection rate for a single injection site is 42 L/s or 3.6 ML/d, based on natural recharge rate of 1,340 ML/annum. The practical injection rate may be controlled by the high water table and is subject to further investigation.

The feasibility of converting of lagoon 4 to reed bed / wetland as a form of aquifer injection was investigated. Assuming a typical subsurface loss of 4 mm / day at lagoon 4, the annual subsurface loss within lagoon 4 is approximately 16.2 ML/year. Water balance indicates that 56 ML/year of Class A recycled water will be generated in 2065. Therefore conversion of lagoon 4 to reed bed / wetland as a form of aquifer injection is considered infeasible without any mechanical injection.

The proposed aquifer injection sites, injection rates, aquifer water quality and any limitation of the aquifer injection are subject to further investigation.

5.9 Option Comparison

The following sections provide details of considerations made when comparing and analysing the options.

5.9.1 Water Balance

Figure 5-13 illustrates the water demand distribution in Dinner Plain. It is envisaged that 72% of water is used to provide potable water to Dinner Plain customers. Only 3% of total water usage would be used for snowmaking purposes. Firefighting demand is considered outside of the normal water demand

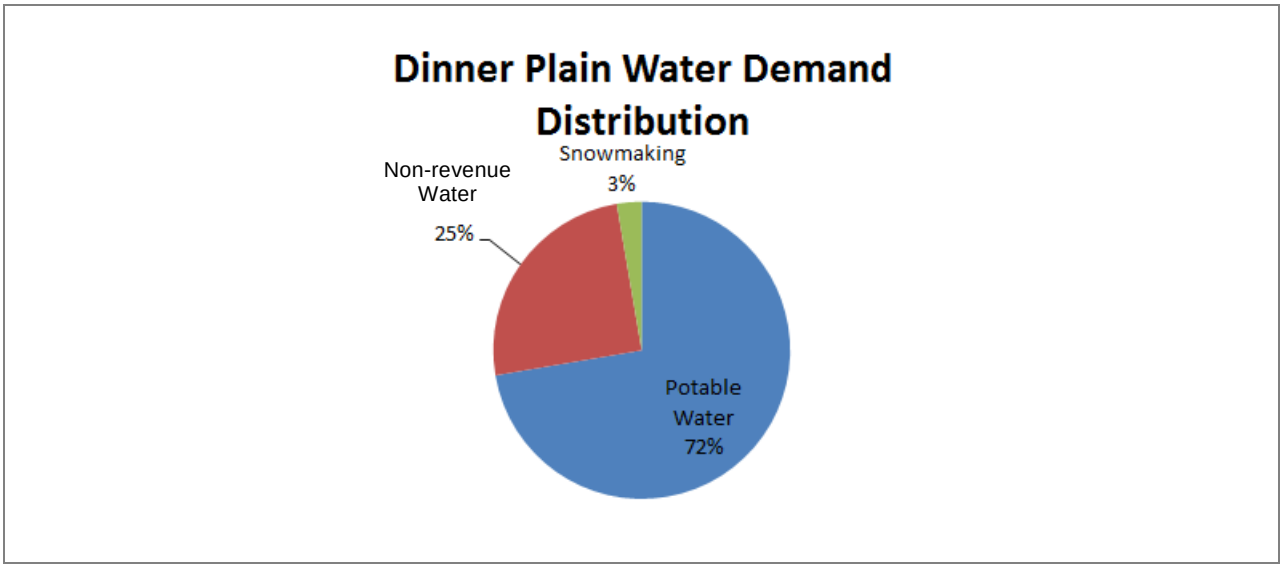
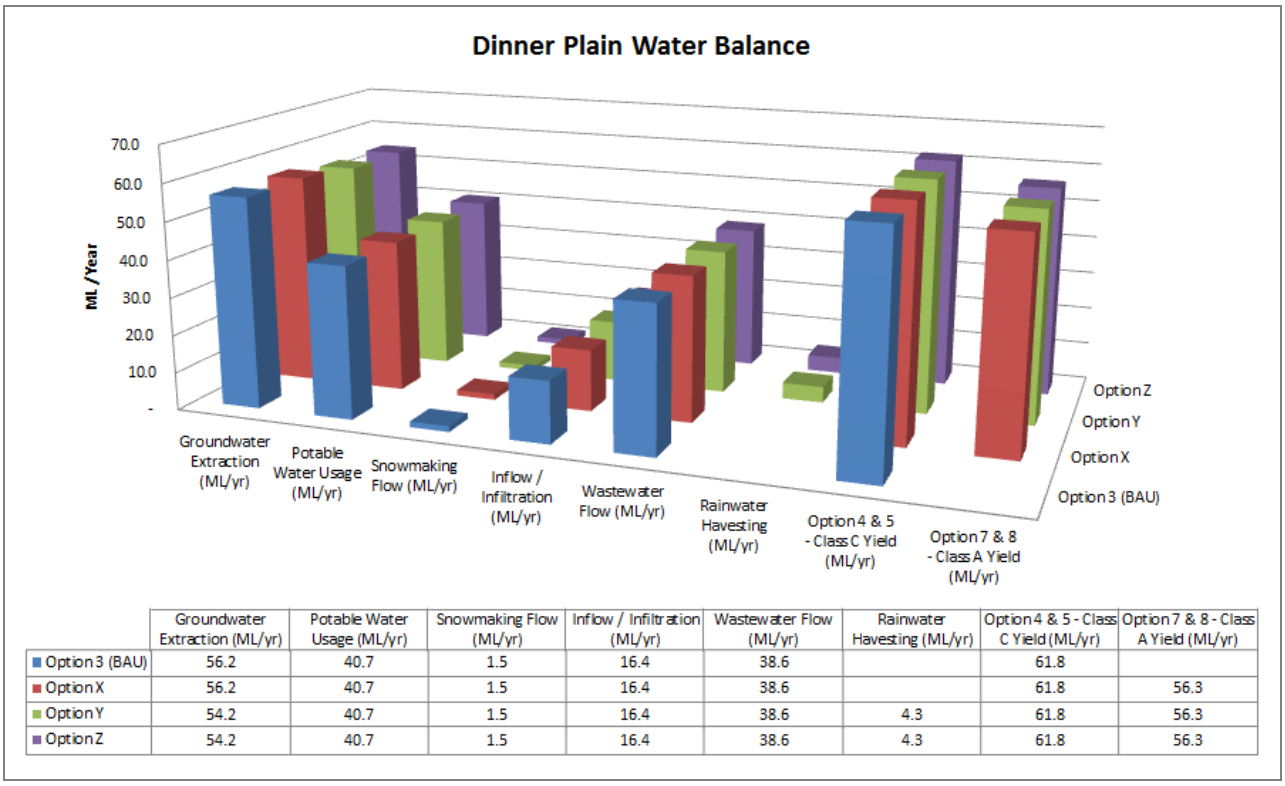


Figure 5-13: Water demand distribution in Dinner Plain

The result of the water balance shows the following:

- EGW currently has an annual groundwater extraction entitlement of 120 ML/yr and this is sufficient to supply the future potable and non-potable demand for the options considered, as shown in Figure 5-14.
- Option Y and Z involve using rainwater as an alternative resource for snowmaking purposes. These options provide a saving on the groundwater extraction volume of 3%. This would also result in savings in the cost of potable water treatment processes.
- As the options considered do not involve water saving measures for customer use, the amount of wastewater generated within Dinner Plain is the same for all options.
- The estimated recycled water yield depends on the type of treatment applied. It is estimated that Class A recycled water yield (Option 7 and Option 8) would be 10% less than Class C recycled water yield (Option 3, Option 4 and Option 5) due to higher mechanical loss during treatment processes for Class A recycled water.
- Inflow and infiltration (I/I) represent a large proportion (30%) of the total wastewater volume to be treated and disposed. However, the actual volume is relatively small compared with other EGW's service areas. Works to locate the source and address these are key in reducing the need for capital works such as additional winter storage. Reducing I/I would also result in lower on-going treatment costs.
- Annual rainfall at Dinner Plain exceeds the annual evaporation and this provides a rainfall surplus. This results in a higher recycled water yield than the wastewater flow as the storage lagoons are uncovered.
- Option 3 (BAU), Option 4 and Option 5 would require construction of additional storage for winter storage assuming no irrigation between June and October, as illustrated in Figure 5-15. EGW operations confirmed the winter storage is at capacity during years with high winter precipitation. Therefore it is assumed that additional winter storage is required immediately. For Option 3 this would be achieved with the use of Lagoon 4. For options 4 and 5 the additional storage may be at Cobungra or Flourbag Plain respectively.
- A number of operational issues were identified with the existing WWTP (Option 3, 4 and 5) and operational improvement works are required. Please refer to Section 5.9.4 and Appendix C for details.



	Groundwater Extraction (ML/yr)	Potable Water Usage (ML/yr)	Snowmaking Flow (ML/yr)	Inflow / Infiltration (ML/yr)	Wastewater Flow (ML/yr)	Rainwater Havesting (ML/yr)	Option 4 & 5 - Class C Yield (ML/yr)	Option 7 & 8 - Class A Yield (ML/yr)
Option 3 (BAU)	56.2	40.7	1.5	16.4	38.6		61.8	
Option X	56.2	40.7	1.5	16.4	38.6		61.8	56.3
Option Y	54.2	40.7	1.5	16.4	38.6	4.3	61.8	56.3
Option Z	54.2	40.7	1.5	16.4	38.6	4.3	61.8	56.3

Figure 5-14: Dinner Plain Water Balance Comparison for Year 2065

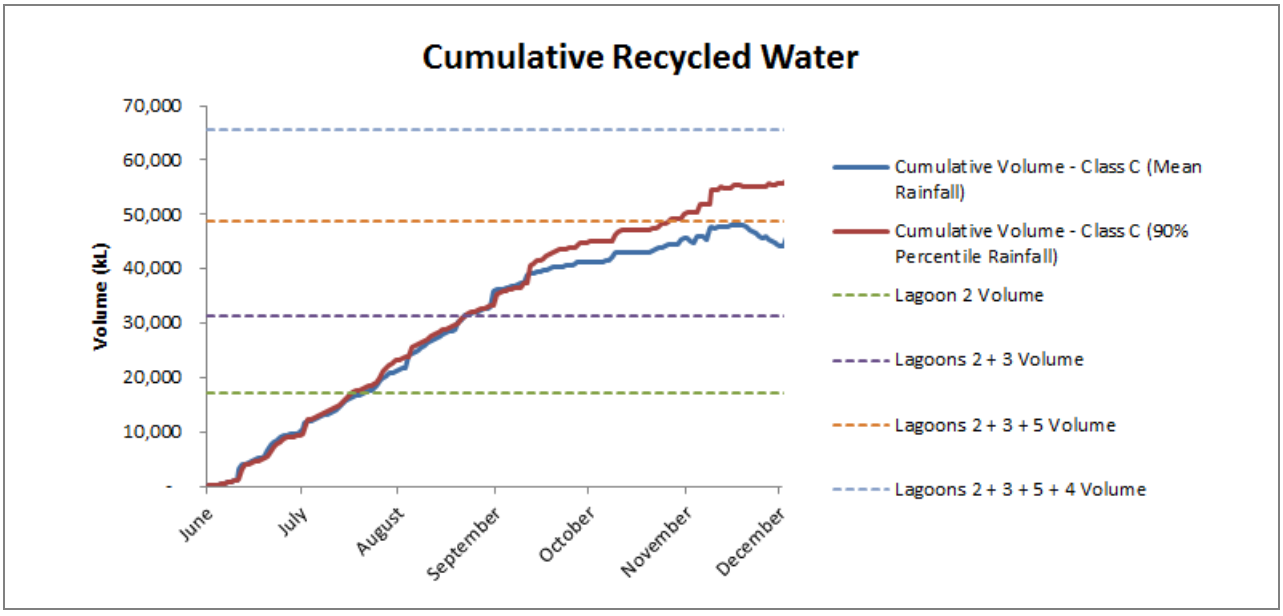


Figure 5-15: Dinner Plain Water Recycled Water Yield and Storage Lagoons Volume

5.9.2 Nutrients

Figure 5-16 provides the estimated annual environmental loads for each option. The annual environmental loads are derived based on the assumed water quality as shown in Table 5-1.

The assessment assumed the quality of Class C recycled water will remain unchanged and therefore the total nutrients for Option 4 and Option 5 are the same as Option 3 (BAU).

The potential increase in the environmental loads using untreated water / rainwater for snowmaking and firefighting in lieu of potable water was not analysed as under BAU groundwater is only disinfected using UV with no nutrient removal.

The result shows that Option 7 and Option 8 have significant reduction in the total environmental loads as wastewater is treated to Class A quality before discharge to the environment. However, as options 7 and 8 both discharge to water rather than to land as do the other options, further investigation into water quality requirements for options 7 and 8 is required.

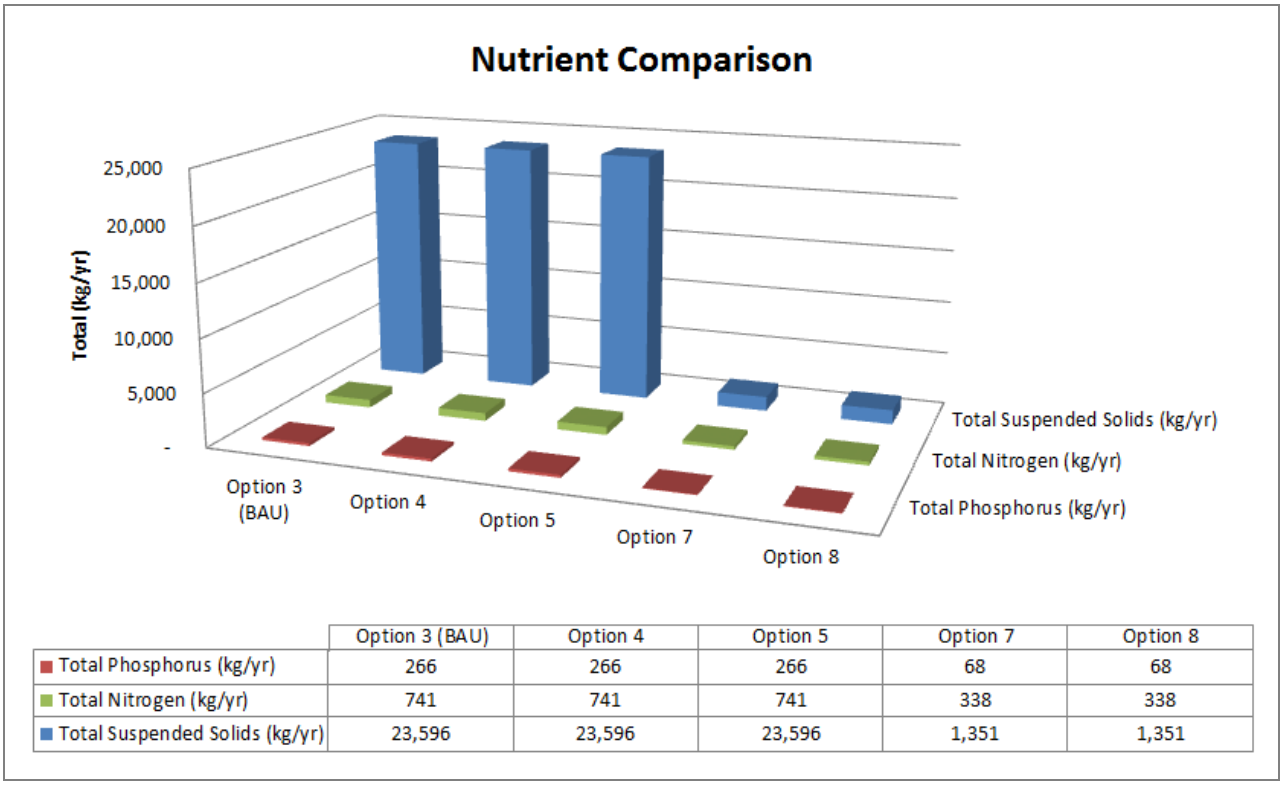
Table 5-1: Indicative Water Quality of Recycled Water

Parameters	Class C Recycled Water	Class A Recycled Water
Total Suspended Solids (mg/L)	240(1)	20(3)
Total Phosphorus (mg/L)	4.3(1)	1(2)
Total Nitrogen (mg/L)	12(1)	5(2)

(1) (Marriott, 2014) Dinner Plain Recycled Water Irrigation Site Soil Monitoring Report 2014

(2) (EPA Victoria, 2000) Guidelines for Environmental Management Use of Reclaimed Water

(3) Based on EPA licence conditions for EGW Lindenow discharge to water



	Option 3 (BAU)	Option 4	Option 5	Option 7	Option 8
Total Phosphorus (kg/yr)	266	266	266	68	68
Total Nitrogen (kg/yr)	741	741	741	338	338
Total Suspended Solids (kg/yr)	23,596	23,596	23,596	1,351	1,351

Figure 5-16: Dinner Plain Total Nutrient Comparison

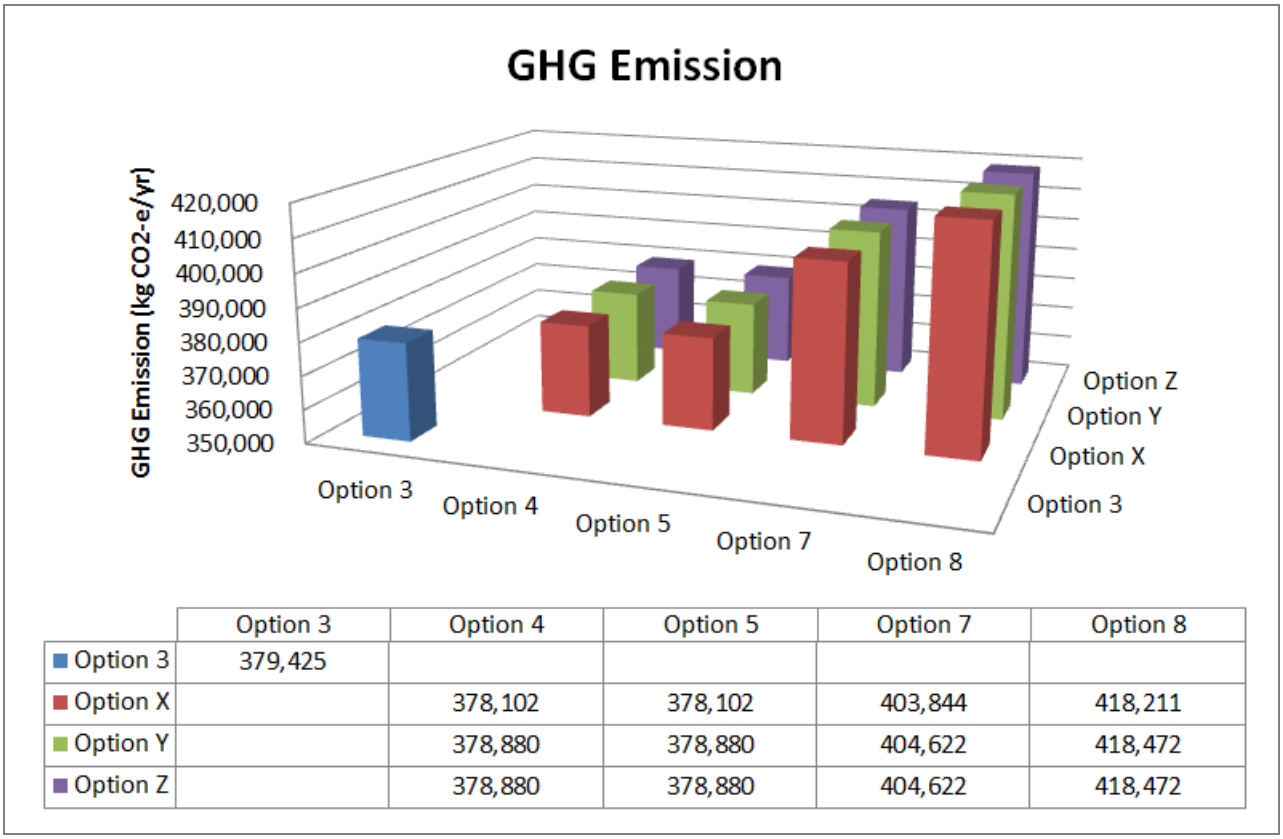
5.9.3 Energy

Figure 5-17 provides a high level estimate of the total green house gas (GHG) CO_2 emissions for each option. These estimates are based on the current emissions factor for Victoria, which is 1.17 $kgCO_2$-e/kWh and the following emissions calculation equation:

$$\text{Emissions } (kgCO_2) = 1.17 \times \text{Electricity Consumption (kWh)}$$

The results show that the Option X + Option 4 or Option 5 have the lowest overall GHG emissions. As Option X involves provision of untreated groundwater from the raw water tank for snowmaking purposes, it is assumed a supply pump is not required as the raw water tank has a higher elevation than the ski field. As Option 4 and Option 5 do not involve wastewater treatment to Class A quality, the GHG

emissions are relatively lower than that of Option 7 and Option 8 which involve operation of a Class A WWTP.



	Option 3	Option 4	Option 5	Option 7	Option 8
Option 3	379,425				
Option X		378,102	378,102	403,844	418,211
Option Y		378,880	378,880	404,622	418,472
Option Z		378,880	378,880	404,622	418,472

Figure 5-17: Dinner Plain Total Green House Gas Emission Comparison

5.9.4 Treatment Requirements

The Dinner Plain wastewater treatment plant (WWTP) currently consists of screening, primary settlement and a natural oxidation lagoon pond system that treats the effluent to Class C standard.

5.9.4.1 Class C Treatment

Option 3 (BAU), Option 4 and Option 5 will continue utilising the existing WWTP to provide Class C recycled water.

A review of the existing assets and their performance and the expected future performance of the Dinner Plain WWTP based on theoretical treatment processes was carried out. Please refer to Appendix C for details.

EGW Operations were consulted during the study to understand the current operational issues at Dinner Plain WWTP as detailed in Appendix C.

Based on the assessment and discussions with EGW, it is understood that there is a driver to reduce the operator attendance and related operating costs at the WWTP. Two options were considered:

1. Keep the plant configuration and upgrade the process units to improve performance
2. Decommission the primary treatment process and use a facultative oxidation pond process only

Option 1: Maintain current treatment process

The following works are proposed for Option 1:

- Provide power to the lagoons to de-commission the diesel generator and allow automated control of equipment
- Screen replacement, including:

  - Provision of a new screen to improve screenings capture
  - Provision of screen at the bypass overflow, using the existing reconditioned screen
  - Upgrade the grease trap to improve grease removal
- Automation of sludge withdrawal at primary sedimentation tanks, which will have a positive impact on process performance at a lower operating cost
- Retrofitting the sedimentation with lamellae plates to increase settling velocity could be considered if the tank hydraulic loading rate is too high, or sludge removal is poor
- Primary sludge removed from the tanks to be stored in a holding tank for further consolidation and easier removal of the sludge
- Electrical and automation upgrade

Option 2: Adapt treatment process to reduce operational expenses

The following works are proposed for Option 2:

- Removal of primary sedimentation that will:
  - avoid the cost of handling primary sludge
  - avoid the need for aerobic digestion of the primary sludge
- Upgrade the screening system to improve the screenings capture rate with screened bypass:
  - Move screening location to lagoon inlet
- Gravitate all flow to the facultative oxidation pond
- The following investigation works are required for Option 2:
  - Check that there is sufficient pond capacity to treat and to improve the wastewater BOD load on the primary solids loading (some aeration may be required at times to reduce BOD/ha to 65kgBOD/ha in the winter)
  - Assess the annualised pond sludge removal cost as sludge will be stored in the lagoon and will be removed every 10 to 15 years
  - Investigate requirements to supply power to equipment at new location
  - Consider vacating the existing inlet works building and make available to Council

It is noted that either option described above will not incur intensive capital asset improvement costs. Furthermore future drivers to improve water quality will not materially affect either option. The estimated cost for Option 1 has been included in the assessment for options comparison.

5.9.4.2 Class A Treatment

For the purpose of assessment under this study, it is assumed recycled water of Class A quality is required for Option 7 (discharge to waterways) and Option 8 (aquifer recharge). The recycled water quality requirement for Option 7 (discharge to waterways) and Option 8 (aquifer recharge) is to be confirmed with EPA/Department of Health (DoH) and therefore will impact the WWTP upgrade requirements.

The treatment requirement for Class A demand includes the following:

- Raw water quality for the Class A plant will require improved secondary process treatment
  - Suspended solids below 15 mg/L
  - Sand filtration to satisfy Helminth ova removal
  - Improved nutrient removal
  - RBC disk installation on effluent to nitrify and improve UV transmittance and solids reduction upstream of filtration

Combined Options Y or Z with 4 or 5 involves the provision of rainwater for snowmaking purposes. Further investigation is required to confirm if additional treatment is required to ensure rainwater quality. Measures to prevent contamination from adjacent wastewater lagoons and disposal of potential

rainwater surplus would also be required. If procurement of Class A treatment process is required, the following should be considered:

- Class A treatment capacity based on seasonal demand, or
- Provide a reservoir and treat water over the year for sufficient demand for the ski season

5.9.5 Capital Cost Estimates

The estimated capital cost and net present value of the proposed works for each option are summarised in Figure 5-18 and Figure 5-19.

The estimated capital cost is a high level cost estimate and is developed for the purpose of option comparison only. Please refer to Appendix A for assumptions adopted for the capital cost estimates.

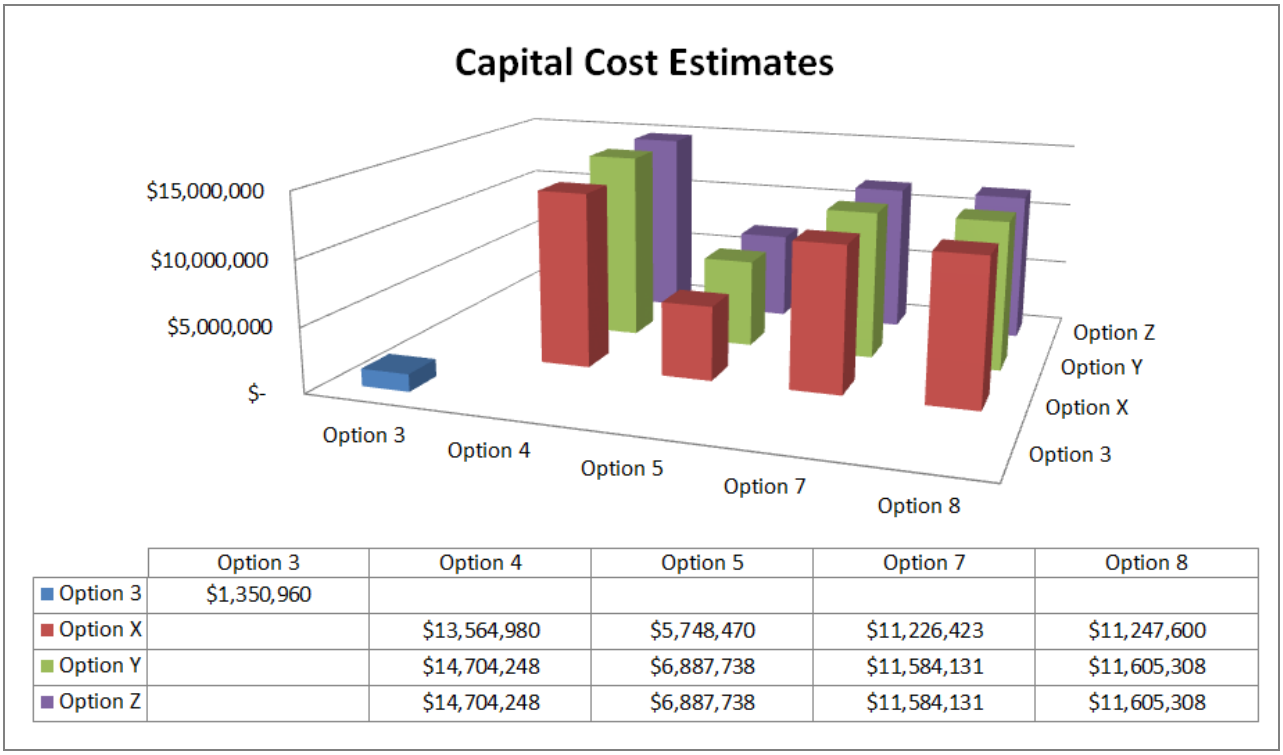
All alternate IWCM options have higher capital cost estimates than Option 3 (BAU).

The combination of Option X (snowmaking and firefighting with untreated groundwater) and Option 5 (Irrigation at Flourbag Plain) has the lowest capital cost estimate of the alternate options analysed. It is noted that 99% of the capital cost is in relation to the irrigation system at Flourbag Plain. Capital cost for the provision of untreated groundwater for snowmaking and firefighting purposes is less than 1% of the total cost as illustrated in Figure 5-20.

The net present value (NPV) assessment incorporated the initial capital cost, cost for asset replacement and operational and maintenance cost. It should be noted that these costs are a high level estimate and were developed for the purpose of option comparison only. Please refer to Appendix A for assumptions adopted for the operational and maintenance cost estimates.

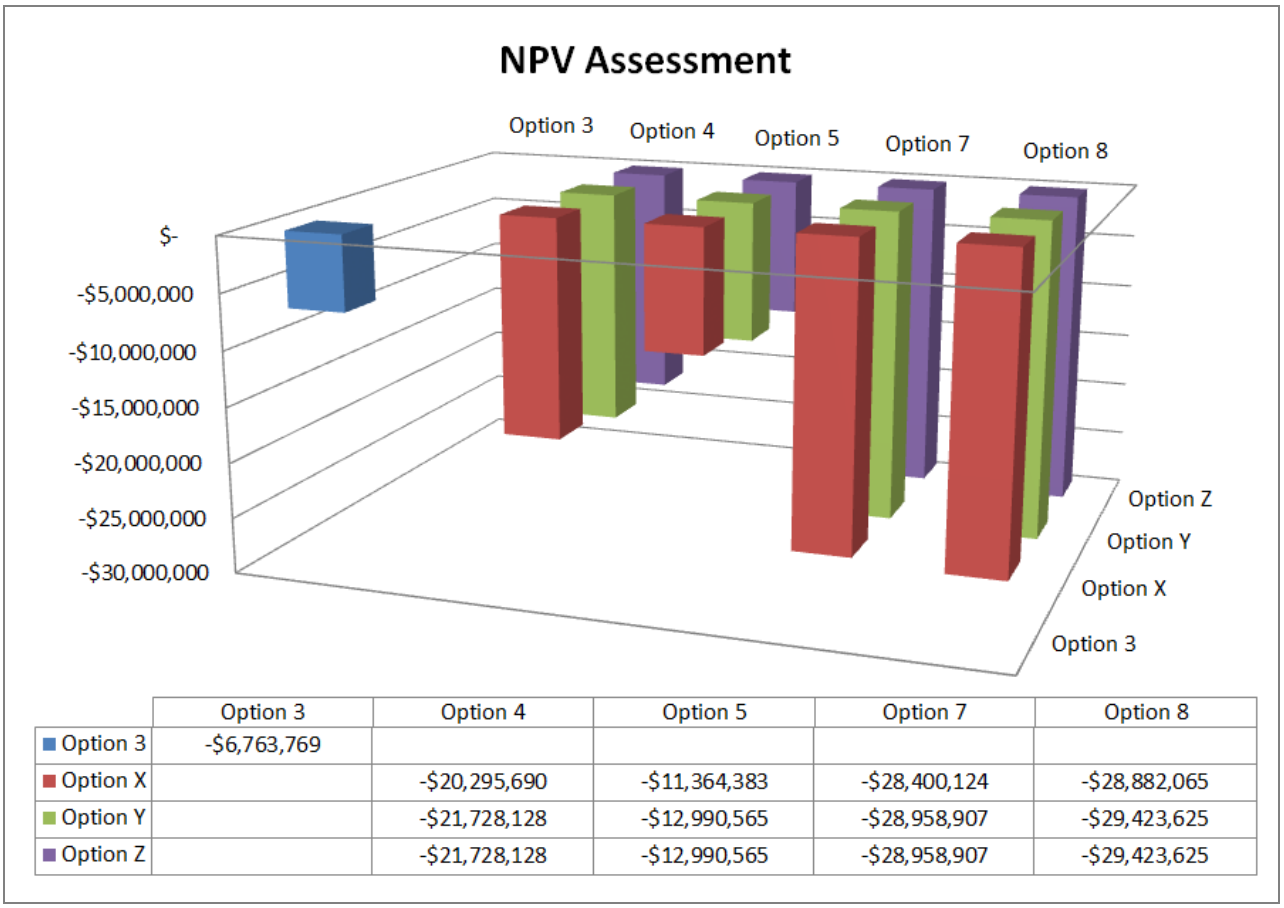
All alternate IWCM options have lower NPV than Option 3 (BAU).

The combination of Option X (snowmaking and firefighting with untreated groundwater) and Option 5 (Irrigation at Flourbag Plain) has the highest NPV amongst the alternate options analysed.



	Option 3	Option 4	Option 5	Option 7	Option 8
Option 3	$1,350,960				
Option X		$13,564,980	$5,748,470	$11,226,423	$11,247,600
Option Y		$14,704,248	$6,887,738	$11,584,131	$11,605,308
Option Z		$14,704,248	$6,887,738	$11,584,131	$11,605,308

Figure 5-18: Capital Cost Estimates Comparison



	Option 3	Option 4	Option 5	Option 7	Option 8
Option 3	-$6,763,769				
Option X		-$20,295,690	-$11,364,383	-$28,400,124	-$28,882,065
Option Y		-$21,728,128	-$12,990,565	-$28,958,907	-$29,423,625
Option Z		-$21,728,128	-$12,990,565	-$28,958,907	-$29,423,625

Figure 5-19: Net Present Value of Options

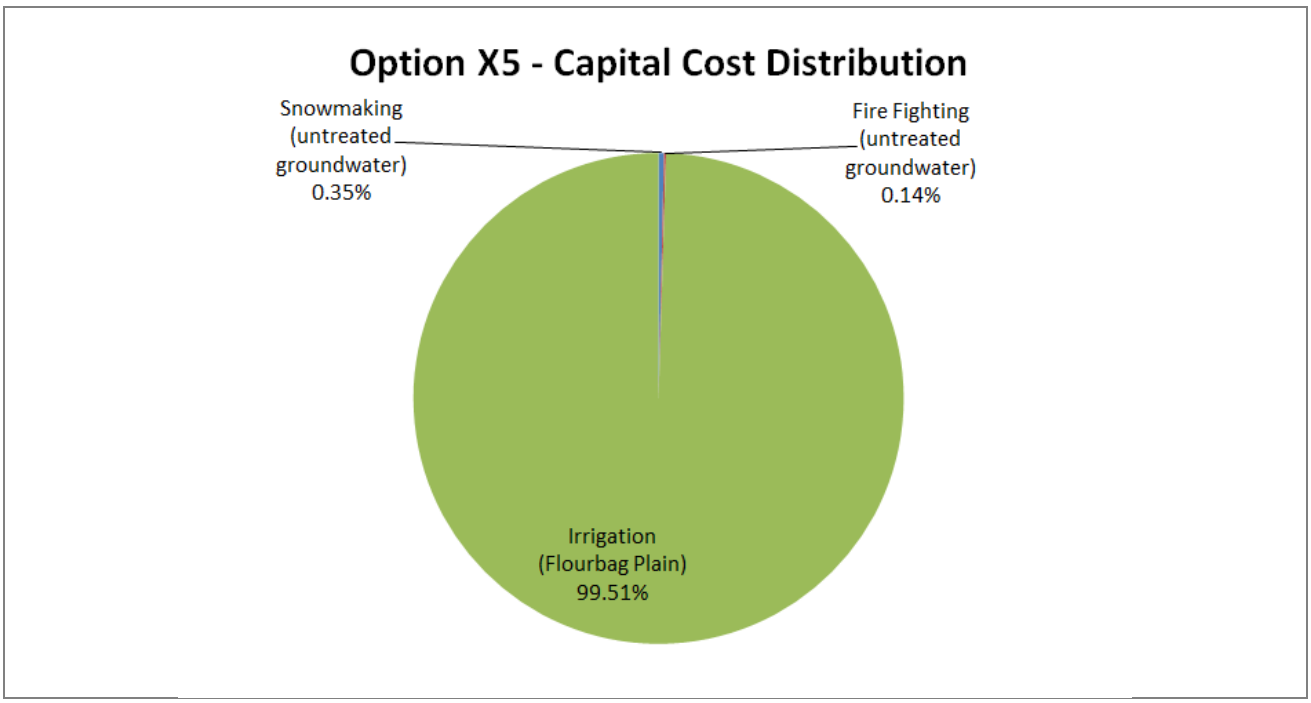


Figure 5-20: Capital Cost Distribution of Option X5

5.9.6 Staging Implications

A targeted key outcome of the IWCM is the ability to release the existing irrigation site (Lot 2) for recreational purposes as soon as possible whilst providing sustainable water services. To achieve the former outcome, new infrastructure would be required as soon as possible to allow alternative disposal of effluent. If the least cost alternate option to BAU was adopted (Option X5) the following order of priority is recommended for the implementation of works:

- On-going I/I investigation and remedial works
- On-going leakage detection and remedial works
- WWTP operational improvement works
- Groundwater supply pipeline from the raw water tank to Scrubbers End ski slope
- Installation of CFA fittings at the raw water tank
- Additional storage tank at Flourbag Plain
- 2.3 km transfer pipeline from Dinner Plain to Flourbag Plain
- Irrigation system at Flourbag Plain

For the BAU option the following order of priority is recommended for the implementation of works:

- On-going I/I investigation and remedial works
- On-going leakage detection and remedial works
- Lining of Lagoon 4 to provide sufficient winter storage during the 90th percentile rainfall.
- Improvement works at the WWTP

It should be noted that leakage and inflow / infiltration reduction is an ongoing process and therefore it is a constant investment over the planning horizon to 2065 for all options.

The water balance assessment also shows that the current winter storages are very close to capacity and so require a solution immediately under options 3 (BAU), 4 or 5.

5.10 Multi-Criteria Analysis

The multi-criteria analysis methodology for this project is detailed in Appendix B.

On 10 June 2014, a workshop was held with invitees from each of the three partnering organisations, East Gippsland Water (EGW), Alpine Shire Council (ASC) and Department of Environment, Land, Water & Planning (DELWP). A set of criteria to assess the options was agreed in the workshop.

The initial long list of 14 options was scored against the agreed assessment criteria and at a second workshop on 16 September 2014, representatives from each of the three partner organisations worked together to agree on a short list of combined options to be analysed in more detail.

5.10.1 Results of the Multi-Criteria Analysis

A discussion with EGW was held on 9 February 2015 and it was agreed that the weightings of the four criterion be changed to closer align with the Department of Treasury and Finance (DTF) guideline weightings, i.e. economically viable 40%; socially acceptable 20%; environmentally responsible 20%; and practicality 20%.

The results of the multi-criteria analysis are shown in Table 5-2 and in Figure 5-21 to Figure 5-25.

Table 5-2: Results of the Multicriteria Analysis

Option	X4	X5	X7	X8	Y4	Y5	Y7	Y8	Z4	Z5	Z7	Z8
Criterion	Weighted Score											
Socially Acceptable	5.3	5.0	6.0	6.0	5.3	5.0	5.7	5.7	5.3	5.0	6.0	6.0
Practicality	-3.4	-2.6	-3.4	-3.1	-4.6	-3.7	-4.6	-4.3	-4.0	-3.1	-4.0	-3.7
Environmentally Responsible	-0.6	-0.6	-0.4	0.0	-0.2	-0.2	0.0	0.4	-0.4	-0.4	-0.2	0.2
Economically Viable	-8.0	-4.0	-8.0	-8.0	-8.0	-4.0	-8.0	-8.0	-8.0	-4.0	-8.0	-8.0
OVERALL SCORE	-7	-2	-6	-5	-7	-3	-7	-6	-7	-3	-6	-6

Note: Score has been factored by 10 for ease of reading and comparison of results

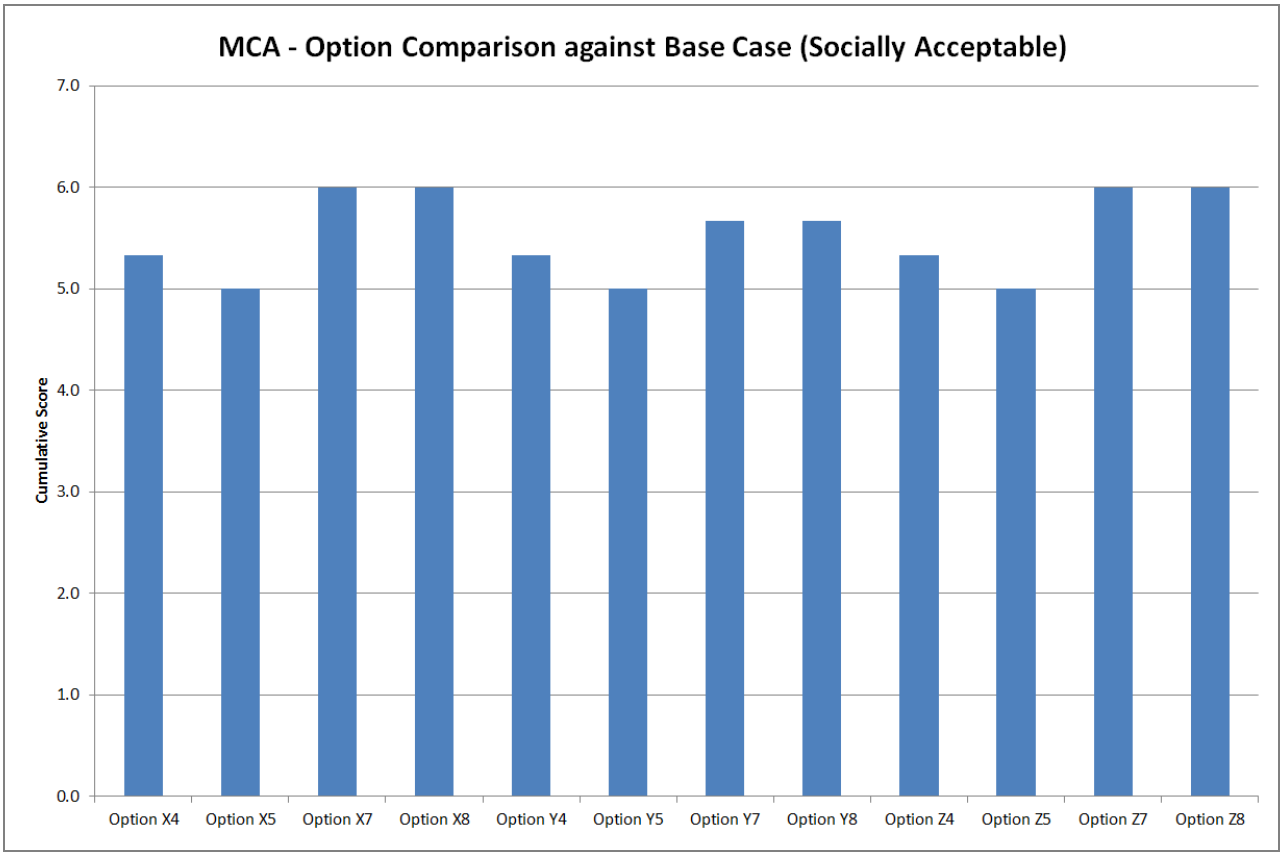


Figure 5-21: MCA – Option Comparison against Base Case (Socially Acceptable)

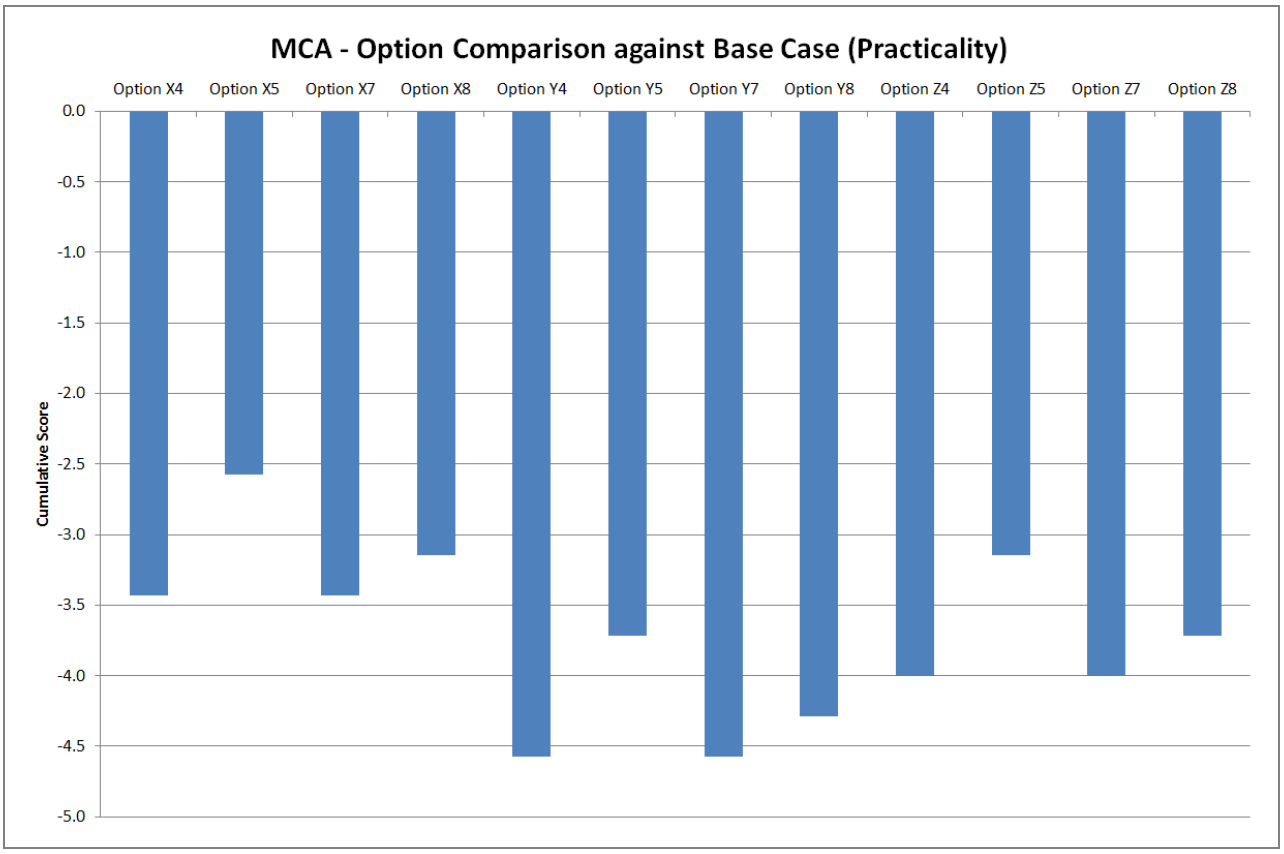


Figure 5-22: MCA – Option Comparison against Base Case (Practicality)

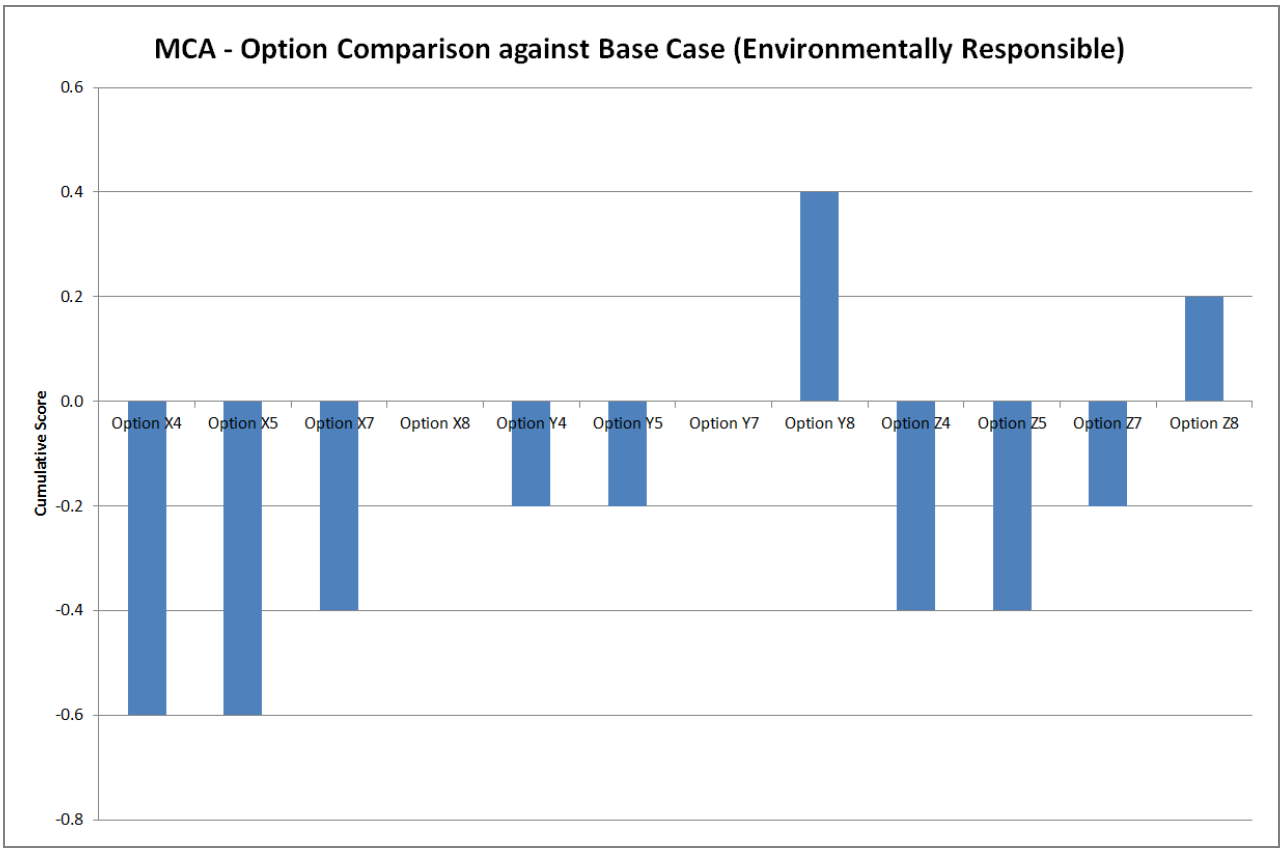


Figure 5-23: MCA – Option Comparison against Base Case (Environmentally Responsible)

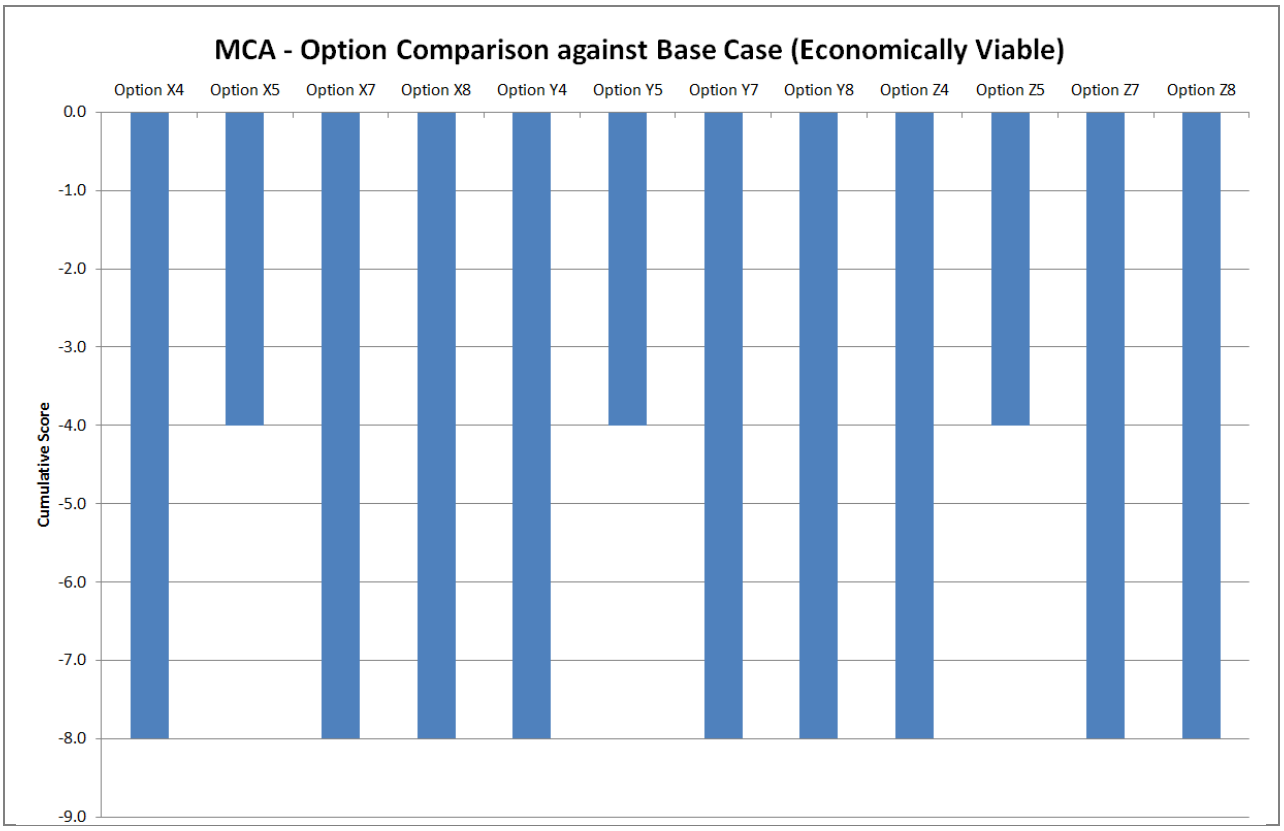


Figure 5-24: MCA – Option Comparison against Base Case (Economic)

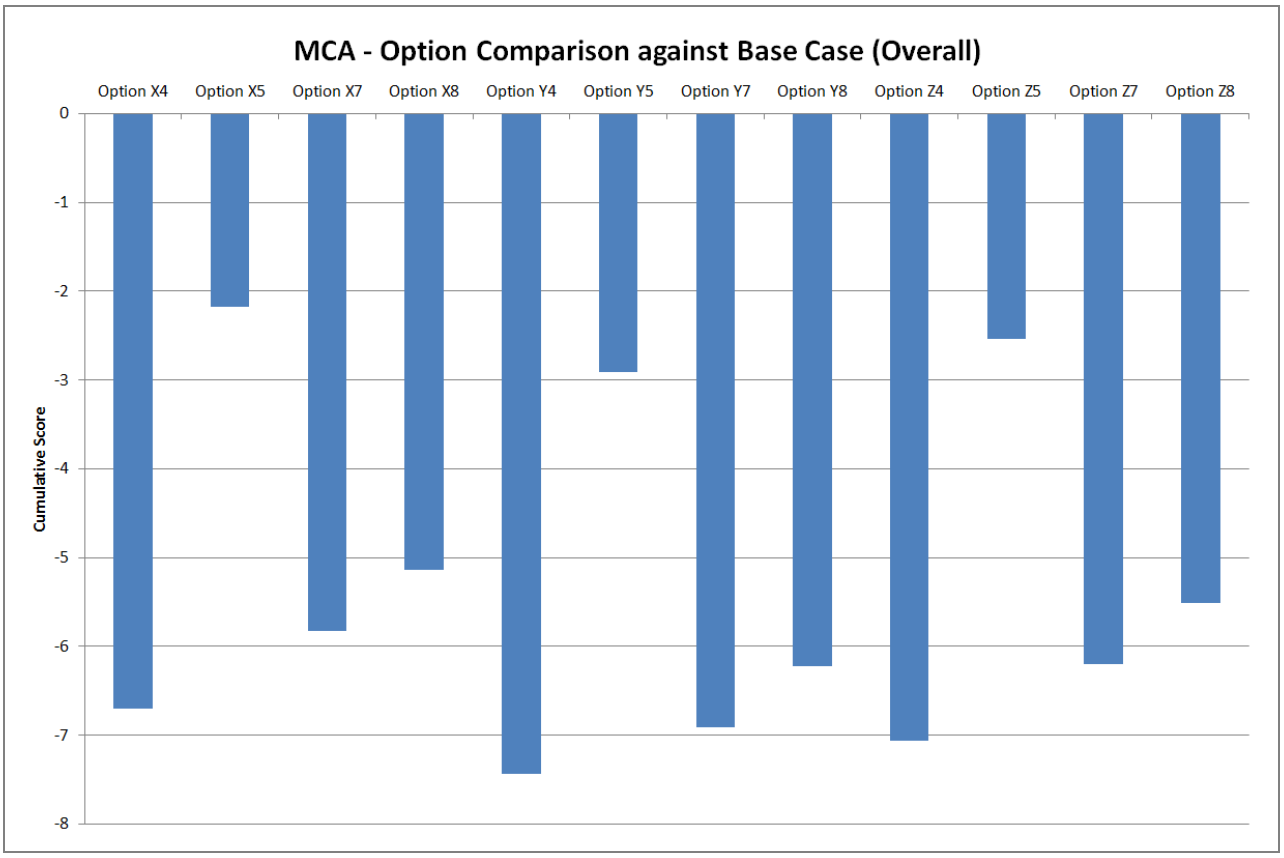


Figure 5-25: MCA – Option Comparison against Base Case (Overall)

6 Sensitivity Analysis

6.1 Demand Variation

- The overall demand is based on water use and also on growth.
- Water use may increase with increasing temperatures predicted with climate change.
- The peak demand period may shift from winter to summer if the projected climate change occurs in combination with Council's vision for Dinner Plain to be a year-round destination.
- The adopted permanent and tourist population is less than the original projections put forward by ASC. If the growth was to be in line with ASC's initial projections, significant demand increases would be expected; the magnitude of upgrades to the existing system would need to be increased, including groundwater extraction rate, potable water storage tank, winter storage and disposal capacity.
- If there was no growth (or negative growth) the upgrades to the system may not be required.

6.2 Climate Change

A review of the Australian Government's Department of Climate Change and Energy Efficiency report titled, "Caring for our Australian Alps" (Worboys, (2011)) was undertaken to determine likely climate change effects for the Dinner Plain area. The key points that emerged from the report with respect to climate changes that have already occurred in the Dinner Plain area are:

- Average temperatures have increased by 0.5 °C (compared to 30 year average from 1961 to 1990) in the north east region over the decade from 1998 to 2007.
- Average rainfall has fallen by 12% compared to the 1961 to 2007 average.
- Snow cover has declined on average by 15 metre-days per decade. [Metre days are calculated when the depth of snow is multiplied by the number of days at that depth and summing the weekly result to give a single figure for each year]. This is from 213 metre-days in the decade following 1954 to 146 in the past 10 years (Green and Pickering 2009 p214). Spring thaw has been occurring on average two days earlier per decade, with very low snow years (1999 and 2006) represented by the two earliest thaws on record (Green and Pickering 2009 p214).

Projections in climate change for the Dinner Plain area include:

- There are three emissions growth scenarios associated with climate change: low , medium and high growth
- By 2030 average annual temperatures will be around 0.9 °C warmer than in 1990.
- By 2030 reductions in rainfall of around 3% are expected (compared to 1990), with greatest reductions in spring (7%).
- Even under the lower emissions 1.5 °C temperature increases are expected by 2070 (compared to 1990). At the higher emissions scenario 2.9 °C increases are expected.
- Evaporation increases are expected.
- Climate change predictions identify that the "snow-covered-area" sustaining snow for more than 60 days may be reduced by up to 96% by 2050 (Hennessy et al, 2003).
- The overall amount of precipitation in the Alps is predicted to decrease by up to 24% by 2050 (Hennessy et al, 2003) and an increased number of droughts are predicted. Severe storms are predicted along with their implications for heavy rain and potentially excessive and rapid flooding events.
- Reduced spread of stream flows due to loss of snow, bogs and fens.

The ways in which the above projected climate change outcomes may affect the IWCM plan for Dinner Plain include:

- All of the above points to snow making measures being less viable as the number of days with the atmospheric conditions required to make snow lessening into the future; conversely the reduction in natural snow fall will increase the need for snow making if winter tourist numbers to Dinner Plain are to be maintained or increased.
- As Dinner Plain becomes drier and evaporation increases, increased irrigation to land may be possible and additional winter storage requirement may be reduced.
- Reduced rainfall may also decrease the annual amount of inflow and infiltration entering the sewerage system, which will assist to improve treatment and reduce the need for additional wastewater storage.
- Heavier and more frequent storms and flooding events are predicted with climate change; a review of the existing stormwater system's ability to cope with large events may be required.
- Option Y utilises Lagoon 4 for capturing natural rainfall, as rainfall at Dinner Plain exceeds the actual evaporation, this provides a rainfall surplus on an annual basis and the estimated yearly yield is sufficient to provide water for snowmaking; as climate change progresses, rainfall decreases and evaporation increases, the viability of using Lagoon 4 to collect rainfall for the purposes of snowmaking may decrease.
- Reduced spread of stream flows due to loss of snow, bogs and fens – may be important for Option 7 which discharges to the stream. Adding flow to the stream under Option 7 may be beneficial in this case due to increased environmental flow.

6.3 I/I and leakage reduction performance

- I/I reduction measures apply to all options including the BAU and so any change in the actual reductions achieved compared to those applied in the analysis will affect all options' outcomes.
- If I/I reduction measures are more successful in reducing the water to be treated and disposed, the requirement for additional winter storage may reduce.
- If I/I reduction measures are not successful and furthermore if I/I was to increase beyond the current levels, additional winter storage may be required. Furthermore the treatment processes applied may need to be supplemented.
- If leakage reduction measures are more successful, water storage and UV disinfection requirement may be reduced.
- If leakage reduction measures are not successful and furthermore if leakage was to increase beyond the current levels, additional potable water storage and UV disinfection may be required.

6.4 Cost Distribution

EGW will continue to invest in essential capital works to maintain the water and wastewater level of services at Dinner Plain. These include ongoing works to address inflow / infiltration, ongoing efforts to minimise water losses, and necessary upgrade works on the existing WWTP to maintain statutory requirements.

The additional costs for the development and implementation of alternative IWCM options would need to be funded and balanced between groups of government agencies, local councils, the community and other stakeholders.

7 Conclusion

7.1 Findings from the Water Balance Assessment

The assessment of the Dinner Plain water cycle has the following outcomes:

- A slight incremental growth is expected to occur over the planning period. The estimated total permanent residential population in 2065 is 170 and the estimated total population during peak holiday season in 2065 is approximately 2,486.
- The UV disinfection system (which will be upgraded to 25 L/s) can provide 10.5 L/s firefighting flows during peak summer demand day (Easter Holiday) peak hour in 2065. With the bypass of UV disinfection system under Options X, Y and Z, a higher firefighting flow can be achieved. The existing raw water tank capacity can provide 20 L/s for 4 hours of firefighting flows during the peak summer demand day (Easter Holiday) peak hour in 2065 under Options X and Z.
- All options including the BAU meet the current groundwater extraction licence limit of 120 ML/year.
- BAU option requires upgrade of the winter storage immediately to meet the 90th percentile rainfall requirement immediately.
- No upgrades are required to the existing irrigation infrastructure to meet the recycled water calculated for Dinner Plain. However, regular ongoing reassessment of the site and an update of the Environment Improvement Plan is recommended to ensure the sustainability of the existing irrigation site.
- If Lagoon 4 is lined, the rainwater collected at Lagoon 4 is sufficient to meet the demand for snowmaking under current average climate conditions.
- High inflow / infiltration to the wastewater system is observed within Dinner Plain by comparing the potable water flow with the wastewater flow into the treatment plant. However, the actual volume is relatively small compared with other EGW's service areas.

7.2 Findings from the Options Assessment

Comparison of options using a MCA was carried out and the following conclusions were made:

- All alternative combined options have a higher capital cost and net present value when compared against the Business as Usual option. The Flourbag Plain disposal option (5) has lower capital costs and net present value than other alternative options as it does not require extensive wastewater treatment plant upgrade compared to Option 7 and 8 (discharge to waterways and aquifer) and a relatively shorter transfer pipeline as compared to Option 4 (irrigation at Cobungra).
- The Cobungra and Flourbag Plain disposal options (4 & 5) have lower greenhouse emissions than other alternative options.as the wastewater treatment requirements is the same as Business as Usual (Option 3) while Option 7 and 8 requires operation of tertiary wastewater treatment processes to achieve the highest quality of recycled water.
- All alternative combined options score positively against the Socially Acceptable criteria as Lot 2 would be released for alternative economic uses.
- All alternative combined options score negatively against the Practicality criteria. Option X5 uses untreated groundwater for snowmaking and firefighting and recycled water irrigation at Flourbag Plain and scores better than other alternative options against the Practicality criteria.as it does not require upgrade and operation of a tertiary wastewater treatment plant compared to Option 7 and 8 (discharge to waterways and aquifer) and a relatively shorter transfer pipeline as compared to Option 4 (irrigation at Cobungra).
- All alternative combined options score negatively against the Environmentally Responsible criteria except for Options X8, Y7, Y8 and Z8. Option 8 discharges recycled water into the aquifer and scores better than other alternative options against the environmentally responsible

criteria as it has a positive impact on the soil health and erosion, and a higher recycled water quality would be achieved before discharging into the environment.

- All alternative combined options score negatively against the economically viable criteria. Option X5 irrigates Flourbag Plain with recycled water and scores better than other alternative options against the economically viable criteria as it has lower capital costs.
- EGW will continue to invest in essential capital works to maintain the water and wastewater level of services at Dinner Plain. However, the additional costs for the development and implementation of alternative options would need to be funded and balanced between groups of government agencies, local councils, the community and other stakeholders.
- The Business as Usual option compares favourably against the alternative combined options based on the overall multi-criteria assessment score. Option X5 (provision of untreated groundwater for snowmaking and firefighting and recycled water irrigation at Flourbag Plain) scores better than other alternative options overall.
- Business as Usual is the preferred option based on the available information at the time of this study.

7.3 Issues and Opportunities

The following issues and opportunities were identified in association with the preferred and next best alternative:

- There are opportunities to reduce the excess effluent from the Wastewater Treatment Plant, by locating and addressing the sources of inflow and infiltration into the wastewater network. This applies to all options including the Business as Usual.
- If the inflow and infiltration measures are more successful than expected in reducing the water to be treated and disposed, the requirement for additional winter storage may reduce. However, if the inflow and infiltration measures are not successful and more wastewater is transferred into the Wastewater Treatment Plant, the requirement of winter storage would be larger and the current treatment processes may not be sufficient.
- There are opportunities to improve the efficiency of the operation of the Wastewater Treatment Plant under the Business as Usual and all alternative options.
- Flourbag Plain has a lower annual rainfall and a higher evapotranspiration compared with Dinner Plain (Lot 2). Therefore, Flourbag Plain theoretically has a higher irrigation requirement compared to Dinner Plain, depending on the type of plantation.
- As Flourbag Plain is privately owned, there would be a need to arrange a transfer of ownership to EGW or negotiate permission to use the land.
- The pipe route to Flourbag Plain would need to be investigated and permitted to ensure environmental and heritage requirements were met.
- As climate change progresses, the snow season is expected to shorten significantly. This represents a greater need for snow making to maintain and extend the snow season. Conversely, the conditions under climate change may not be suitable for snow making.
- The use of untreated groundwater for firefighting and snowmaking would require approval from Department of Health.
- The disposal of effluent under Option X5 would release Lot 2 for alternative economic uses.
- Climate change impacts such as decreasing rainfall, may present an opportunity to provide irrigation water under option X5 to meet greater soil and plant demands at Flourbag Plain than under the current climate conditions.
- Option X5 represents significant increases in both capital and ongoing maintenance and operation costs to the Dinner Plain community. A funding source for this option would be required.

7.4 Conclusions

- The current water servicing for Dinner Plain is the best option to service current and future water needs of the Dinner Plain community. However there are some opportunities for improvement without overly onerous investment.
- In order for an alternative option to be feasible, funding from outside of the Dinner Plain community, such as that from State or Federal Government or a Public Private Partnership funding arrangement would be required. This is because any of the alternative disposal options would require significant infrastructure and the size of the Dinner Plain community is small relative to the investment needs.
- There are opportunities to improve on the social, environmental, practical and economic outcomes for Dinner Plain, by adopting select measures identified in this study: inflow/infiltration reductions; leakage reductions; wastewater treatment plant process improvements; increasing winter storage; and use of non-potable water for firefighting.
- Further detailed investigation would be required before some of these opportunities could be implemented.

7.5 Recommended Actions

The Dinner Plain IWCM study has identified the following recommended actions:

Table 7-1: Recommened Actions

	Recommended Actions	Timing
1	Adopt the BAU option as the preferred option at this stage	Immediate
2	Make results of the study available to stakeholders	Immediate
3	Undertake ongoing works to address inflow / infiltration at Dinner Plain, including: • Smoke testing • Repairs to inspection shafts, manholes and overflow relief gullies (ORGs)	Ongoing
4	Undertake ongoing efforts to minimise potable water losses through leakage	Ongoing
5	Investigate use of lagoon 4 either by lining / reed bed / constructed wetland to meet winter storage requirement	Immediate(1)
6	Consider improvement works at the WWTP as detailed in Appendix C to improve operation and treatment performance	Immediate(1)
7	No upgrades are required to the existing irrigation infrastructure to meet the recycled water discharge requirements calculated for Dinner Plain. However, regular ongoing reassessment of the site and an update of the Environment Improvement Plan is recommended to ensure the sustainability of the existing irrigation site	Every two years
8	Review options to ensure potential future issues at Lot 2, with respect to soil sodicity, nitrogen and phosphorous loads do not eventuate	2017
9	Review the MCA to confirm the preferred option if the future development plans, climate and water demands for Dinner Plain change	Every two years
10	In consultation with Country Fire Authority and Department of Health, consider installation of CFA fittings at the raw water tank to provide untreated groundwater for firefighting purposes	2017

(2) Investigation works to be carried out within Water Plan 3 and implementation within Water Plan 4

Appendix A Assumptions

A.1 Capital Cost Estimate Assumptions

Category	Assumption	Value	Comments
Recycled water	Irrigation system set up	$10,500 / ha	EGW email dated 18/04/12
Wastewater	Existing wastewater treatment upgrade	Provision of new switchboard and control panel / system - $200,000 Replace screen with new Rotomat Type - $125,000 Screen at overflow - $12,500 Grease Trap Upgrade - $10,000 Ventilation Upgrade - $17,500	EGW email dated 10 December 2014 and MWH estimates
Wastewater	Class A WWTP	estimates to upgrade the WWTP to Class A is at the upper end of range (i.e. range of $3.8 - $7 million provided during 2006), $7 million assumed for 2010. This was confirmed as appropriate by obtaining a budget quote from Innoflow to provide a Class A WWTP, this estimate was $5.3M but included supply and installation of the WWTP only.	(EGW, 2012) 044 Dinner Plain WWTP Reuse Arrangement Issues Optioneering Report Revision v4.1 (Trim Doc Ref. DOC/11/1608)
Recycled water storage	Lagoon 4 size	volume of lagoon 4 is 16,800 kL, surface area is 11,100 sqm	(EarthTech, 2011) Dinner Plain Reuse Options Report (unfinished)
Recycled water storage	Lagoon 4 size	Lagoon 4 lining area approx. 12,040 sqm	Estimated dimension 170m x 65.3m based on aerial map, assume 2m deep
Recycled water storage	Lagoon 4 lining	prepare lagoon service removal all rocks , stones, sticks debris etc and roll the surface to make smooth allow $10 /sqm (this depends on how rough rocky this existing service is all grass organic material would also require removal) supply and lay geofabric layer (required) allow $5 /sqm supply and lay 2mm PE liner allow $10 /sqm Associated works anchor trench inlet outlet structures $200,000	MWH estimates
All	Pipeline	Pressure pipeline cost = 1.3 x pipe diameter ($ /m)	assumed
Recycled water storage	Additional storage	excavation cost = $150 / m3 + other associated cost same as Lagoon 4 lining	MWH estimates
All	Design and Management	20% of Construction Cost	assumed
All	Contingency	30% of Construction + Design / Management Cost	assumed

A.2 Operational and Maintenance Cost Assumptions

Category	Assumption	Value	Comments
Wastewater	Class A wastewater treatment	annual maintenance cost = 7.5% of capital cost	used in CHW's BWEZ IWCM project
Wastewater	constructed wet land at Lagoon 4	annual maintenance cost = $25,694	derived based on MUSIC software, 2004 cost data factored with CPI index to 2014
All	Energy	$0.15 / kWh	assume
Recycled Water	annual irrigation maintenance cost	annual maintenance cost = $40,525 / 37.2 ha (incl. fuel) annual maintenance cost = $25,125 / 37.2 ha (excl. fuel)	Derived based on EGW O&M cost breakdown (email dated 12/11/14) 2013/14 $48,561 with $18,473 fuel (38%) 2012/13 $32,273 2011/12 $40,741
Recycled Water	annual irrigation operation cost	fuel cost = $264 / ML irrigation	Derived based on the following: * $18,473 on fuel / 70 ML ($264 / ML) recycled water irrigated for 2013/14 (EGW O&M cost breakdown & EGW Annual Report)
Wastewater	Class C wastewater treatment annual O&M cost	$1880 / ML wastewater	Derived based on EGW O&M cost breakdown (email dated 12/11/14)
Wastewater	Reticulation network annual maintenance cost	$38,640 / year (same for all options considered as length of sewer reticulation network are the same for all options)	Derived based on EGW O&M cost breakdown (email dated 12/11/14)
Potable Water	Reticulation network annual maintenance cost	$29,210 / year	Derived based on EGW O&M cost breakdown (email dated 12/11/14)
Potable Water	minor pump station annual maintenance cost	$13,040 / pump station	Derived based on EGW O&M cost breakdown (email dated 12/11/14)
Potable Water	UV disinfection annual O & M cost	$900 / ML	Derived based on EGW O&M cost breakdown (email dated 12/11/14) *2013/14 $32,528 - 38.7 ML *2012/13 $39,440 - 41.7 ML *2011/12 $6,916 - 41.6 ML (not used)
Potable Water	Water tank maintenance cost	$16,320 / year (same for all options considered)	Derived based on EGW O&M cost breakdown (email dated 12/11/14) *2013/14 $19,725 *2012/13 $13,539 *2011/12 $15,692

Category	Assumption	Value	Comments
Groundwater	Groundwater bore O & M cost	$500 / ML	Derived based on EGW O&M cost breakdown (email dated 12/11/14) *2013/14 $8,587 - 38.7 ML *2012/13 $20,023 - 41.7 ML *2011/12 $60,280 - 41.6 ML
Recycled Water	Aquifer recharge injection site O & M cost	$500 / ML	assume same as groundwater bores

A.3 NPV Assumptions

	Assumption
1	the start year for calculations is 2015/16.
2	the end year for calculations is 2065/66.
3	Proposed works are to be completed one year before the planning horizon, i.e. for works required to meet EGW's level of service for the 2018 planning horizon, the estimated cost for the works will be spent in 2017.
4	No Capital Price Index inflation has been applied
5	No Capital Cost Index has been applied
6	A discount rate of 5.5% has been applied
7	Economic Life of Assets as follows:

Asset	Economic Life (Years)
Pump Station and concrete structures	100
Pumps, SCADA and any associated electrical equipment	25
Pipelines and associated civil works	100

A.4 Energy Balance Assumptions

Category	Assumption	Value	Comments
Wastewater	Class C Treatment Energy Usage	4765 kWh/ML	assume 38% O & M cost spent on energy
Wastewater	Class A Treatment Energy Usage	5720 kWh/ML	assume 20% higher than Class C plant
Potable Water	UV Disinfection Energy Usage	UV system will be upgraded in Nov 2014 - 2 banks x 4 lamps	EGW email dated 13/10/14

Category	Assumption	Value	Comments
		- lamp life is 12,000 hours - power consumption: 1080 W/bank; 2160 W total	
Snowmaking	Supply Pump	Pump from Lagoon 4 to hydrants = 3.5 L/s @ 40m (5kW)	Derived based on MWH pump system tool with the following assumptions: * Length from Lagoon 4 to ski slope approx. 1,710m * static head approx. 20m * pressure head 15m to be provided * pump efficiency = 65% motor efficiency = 90% * pipeline size = 100mm
Aquifer Recharge	Injection Pump	7 L/s; 5.5kW	Assume aquifer recharge pump similar to groundwater pumps (7 L/s; 5.5kW)
Irrigation	Irrigation Energy Usage	495 kwh/ML	Derived based on the following: * $18,473 on fuel / 70 ML ($264 / ML) recycled water irrigated for 2013/14 (EGW Annual Report) * $1.60 / L fuel retail price => 165 L fuel / ML recycled water irrigated * power generation 3 kWh / L fuel (assumed) => 495 kWh / ML recycled water irrigated
Snowmaking	Snow Guns Energy Usage	Exclude energy used for running snowmaking guns as identical for all options	
All	GHG emissions factor	1.17 kg CO2-e/kWh	National Greenhouse and Energy Reporting (Measurement) Determination 2008 Schedule 1, Part 6

Appendix B Multi-Criteria Analysis

On June 10, 2014 a workshop was held with invitees from each of the three partnering organisations, East Gippsland Water (EGW), Alpine Shire Council (ASC) and Department of Environment, Land, Water & Planning (DELWP). Only invitees from EGW were present on the day of the workshop. The purpose of the workshop was to agree upon a set of criteria to assess the options to enable shortlisting of options and subsequently the selection of a preferred option/s.

The workshop agreed on an alignment of the criteria with EGW's existing themes used in their Issues Optioneering Report process. Table B1 provides a description of each of the categories and the sub-criterion within each of the categories, specific to the Dinner Plain IWCM investigation.

For each criterion, the option is given a score when compared against the baseline option, as detailed in Table B2. A score of 0 equates to an equal performance for that criterion when compared to the baseline option. If an option receives an overall positive score then it has performed better than the baseline option.

Each criterion falls into one of five categories. Each category is given a weighting of importance, as shown in Table B3. For each criterion the options score is multiplied by this weighting, to give a weighted score. The weightings of importance were initially assumed equal for all categories. Comment on the sensitivity of the analysis to the weightings is given below.

Refer to Section 5.10 for the results and discussion regarding the multi-criteria analysis.

Table B1: Initial Assessment Criteria Agreed in Workshop 1

SOCIALLY ACCEPTABLE	
Criteria	**Description**
Level of Service	Comparison between options of level of service achieved beyond that agreed with ESC
Health and Safety	Comparison between options of the inherent safety of operators and public
Continuity of Service	Comparison between options of the continuity of services in an emergency situation, particularly fire
Visitor Interpretation	Comparison between options of how well each lends itself to visitor interpretation
Amenity	Comparison between options of how well each facilitates enjoyment of national park and everything the village has to offer
PRACTICALITY	
Criteria	**Description**
Operability and maintainability	Comparison between options of the need for operator attendance
Constructability	Comparison between options of the ease of construction
Reasonable timeframe	Comparison between options of how achievable option is within a reasonable timeframe
Climate change adaptability	Comparison between options of how adaptable each is to predicted changes in climate
Adaptability to growth	Comparison between options of the flexibility of the option to growth
Approvals	Comparison between options of the ease of obtaining approvals (incl. planning permits, EPA, etc)

ENVIRONMENTALLY RESPONSIBLE	
Criteria	**Description**
Nutrient Release	Comparison between options of the water released to the Victoria River waterway and the impact on nutrient levels in the river
Soil health	Impact on soil health - e.g. sodicity levels, maintenance of soil moisture levels
Energy use	Comparison between options of the energy used and GHGs produced
Waste production	Comparison between options of the by-products produced including wastewater and bio waste
Aquifer health	Comparison between options of the impact on groundwater quality
Noise pollution	Comparison between options of impact on noise nuisance (ongoing noise, not including construction noise)
Alpine National Park and state forest	Comparison between options of impact on the Alpine National Park and State forest surrounding the village' maintenance of territorial habitat
Erosion	Comparison between options of erosion impacts
Environmental flows	Comparison between options of how each impacts pre-development environmental flows
Water Efficiency	Comparison between options of the conservation of water
POLITICALLY ALIGNED	
Criteria	**Description**
Reputation	Comparison between options of the enhancement of the reputation of Council and EGW
Policy Alignment	Comparison between options of alignment with DELWP, EPA DoH policy
Innovation	Comparison between options of the embrace of innovation (technical, process, other)
ASC Vision	Comparison between options of alignment with Alpine Shire Council's vision for Dinner Plain
Right Water	Comparison between options of appropriate use of water according to quality
Stakeholder Collaboration	Comparison between options of the level of collaboration achieved between the community, government agencies, ASC, and EGW
Knowledge sharing	Comparison between options of how technical knowledge is increased and shared
IWCM education & engagement	Comparison between options of how each increase the level of education about IWCM
ECONOMICALLY VIABLE	
Criteria	**Description**
Operation and maintenance costs	Comparison between options of the operational savings/costs; e.g. power, chemical costs, operator man-hours costs
Income	Comparison between options of income from sale of land/water/assets
Capital costs	Comparison between options of capital savings/costs
NPV	Comparison between options of the Net Present Value
Revenue	Comparison between options of increased revenue from services

Economic Viability of village	Comparison between options of how each adds to the economic viability of the village
Deferred capital works	Comparison between options of whether any planned capital works can be deferred
Customer affordability	Comparison between options of the impact on customer bills/ cost of living

Table B2: Options Analysis Scoring System[1]

Score	Description
4	Performed extremely better than baseline
3	Performed much better than baseline
2	Performed moderately better than baseline
1	Performed little better than baseline
0	Equal performance to baseline (no change)
-1	Performed little worse than baseline
-2	Performed moderately worse than baseline
-3	Performed much worse than baseline
-4	Performed extremely worse than baseline

1. Reference: Melbourne Water and the Department of Treasury and Finance's Triple Bottom Line Guidelines

Table B3: MCA Category Weighting Assigned in Workshop 1

Category	Weighting (%)
Socially Acceptable	20%
Practicality	20%
Environmentally Responsible	20%
Politically Aligned	20%
Economically Viable	20%

Shortlisting of Options using Multi-Criteria Analysis

At a second workshop on September 16, representatives from each of the three partner organisations worked together to agree on a short list of options that could be combined to form the short list of options to be analysed in more detail. In order to arrive at the shortlist, the initial long list of 14 options was scored against the assessment criteria agreed at Workshop 1.

Table B1 details the criteria against which each option was assessed. For each criterion each option was assigned a score when compared against the baseline option. Table B4 shows the results of the multi-criteria analysis.

Sensitivity of the MCA to Weighting

As a test of the MCA outcome's sensitivity to the weightings applied across the categories, the four weightings were changed to closer align with the DTF weightings, i.e. economically viable 40%; socially acceptable 20%; environmentally responsible 20%; and practicality 20%.

The MCA scores using the above weighting for the four criteria are shown in Table B5.

Using the above weightings, the ranking of the top option does not change. However the ranking of the other alternative options changed to exhibit less variation across the scoring. This may indicate some robustness in the nomination of Option X5 as the preferred alternative option.

Table B4: MCA Summary of Scoring to Aid Shortlisting at Workshop 2

	Snowmaking			Firefighting			Relocate Irrigation				Environmental Discharge with Class A		I/I	Leakage	Lagoon 4		
Criterion	Option 1a	Option 1b	Option 1c	Option 2a	Option 2b	Option 2c	Option 4	Option 5	Option 6	Option 9	Option 7	Option 8	Option 10	Option 11	Option 12	Option 13	Option 14
	Weighted Score																
Socially Acceptable	1.65	2.31	3.63	3.63	3.96	4.29	2	0.99	2.31	0	1.32	1.32	0.66	0.33	0	0.66	0.66
Practicality	-0.66	-2.31	-1.65	0	-1.65	-0.99	-1.98	-0.99	-1.98	-1.32	-2.31	-2.64	0.66	0.66	-0.33	-1.65	-1.65
Environmentally Responsible	0.66	0	2.97	0.66	0.33	3.63	2.97	-0.99	2.64	-0.66	-0.66	1.32	2.64	1.32	0	1.32	0.33
OVERALL SCORE	1.65	0.00	4.95	4.29	2.64	6.93	3.30	-0.99	2.97	-1.98	-1.65	0.00	3.96	2.31	-0.33	0.33	-0.66

Notes:

1. It was agreed in the Options Combination Workshop held on 16 September 2014 that sub-criteria “Politically Aligned” should be a given and therefore was no longer considered in the MCA assessment.
2. It was agreed in the Options Combination Workshop held on 16 September 2014 that sub-criteria “Economically Viable” was to be considered later and therefore was not considered for options combination.

Table B5: MCA Summary of Scoring with equal Weightings

Criterion	Option X4	Option X5	Option X7	Option X8	Option Y4	Option Y5	Option Y7	Option Y8	Option Z4	Option Z5	Option Z7	Option Z8
	Weighted Score	Weighted Score	Weighted Score	Weighted Score	Weighted Score	Weighted Score	Weighted Score	Weighted Score	Weighted Score	Weighted Score	Weighted Score	Weighted Score
Socially Acceptable	6.7	6.3	7.5	7.5	6.7	6.3	7.1	7.1	6.7	6.3	7.5	7.5
Practicality	-4.3	-3.2	-4.3	-3.9	-5.7	-4.6	-5.7	-5.4	-5.0	-3.9	-5.0	-4.6
Environmentally Responsible	-0.8	-0.8	-0.5	0.0	-0.3	-0.3	0.0	0.5	-0.5	-0.5	-0.3	0.3
Politically Aligned	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Economically Viable	-5.0	-2.5	-5.0	-5.0	-5.0	-2.5	-5.0	-5.0	-5.0	-2.5	-5.0	-5.0
OVERALL SCORE	-3	0	-2	-1	-4	-1	-4	-3	-4	-1	-3	-2

Note: Scores have been factored by 10 to aid ease of reading and comparison

Table B6: MCA Summary of Scoring with altered Weightings

Criterion	Option X4	Option X5	Option X7	Option X8	Option Y4	Option Y5	Option Y7	Option Y8	Option Z4	Option Z5	Option Z7	Option Z8
	Weighted Score	Weighted Score	Weighted Score	Weighted Score	Weighted Score	Weighted Score	Weighted Score	Weighted Score	Weighted Score	Weighted Score	Weighted Score	Weighted Score
Socially Acceptable	5.3	5.0	6.0	6.0	5.3	5.0	5.7	5.7	5.3	5.0	6.0	6.0
Practicality	-3.4	-2.6	-3.4	-3.1	-4.6	-3.7	-4.6	-4.3	-4.0	-3.1	-4.0	-3.7
Environmentally Responsible	-0.6	-0.6	-0.4	0.0	-0.2	-0.2	0.0	0.4	-0.4	-0.4	-0.2	0.2
Politically Aligned	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Economically Viable	-8.0	-4.0	-8.0	-8.0	-8.0	-4.0	-8.0	-8.0	-8.0	-4.0	-8.0	-8.0
OVERALL SCORE	-7	-2	-6	-5	-7	-3	-7	-6	-7	-3	-6	-6

Note: Scores have been factored by 10 to aid ease of reading and comparison

The outcome of the workshop was to shortlist the following options:

Shortlist Option (Measure)

- **I/I & Leakage Reduction (10 & 11)**
    - To be included in every combined option
- **Snowmaking Provision**
    - Only consider using untreated groundwater (1a) and Class A (1c)
- **Fire Flow Provision**
    - Only consider using untreated groundwater (2a) and Class A (2c)
- **Effluent Transfer / Discharge**
    - Transfer to Cobungra (4) or Flourbag Plain (5) subject to consent obtained;
    - Discharge to waterways (7) or aquifer (8)
- **Use of Lagoon 4 (lining, reed bed or wet land)**
    - Use of lagoon 4 (12, 13 & 14) will be considered together with 2c, 7 & 8 if appropriate

Combined Options

- The concept of combined options is:

  I/I & Leakage Reduction + Snowmaking + Fire Flow + Effluent Transfer / Discharge + Use of Lagoon 4 (if appropriate)
- The agreed combined options are:

  Option X: 10 + 11 + 1a + 2a + (4 or 5 or 7 or 8) + (12 or 13 or 14 if appropriate)

  Option Y: 10 + 11 + 1c + 2c + (4 or 5 or 7 or 8) + (12 or 13 or 14 if appropriate)

  Option Z: 10 + 11 + 1c + 2a + (4 or 5 or 7 or 8) + (12 or 13 or 14 if appropriate)

Appendix C Dinner Plain Wastewater Treatment Plant Review

MWH

BUILDING A BETTER WORLD

TECHNICAL NOTE

Dinner Plain Wastewater Treatment Capacity Review

Prepared for East Gippsland Water

April 2015

QUALITY STATEMENT

PROJECT MANAGER	PROJECT TECHNICAL LEAD
Jessica Maxfield / Simon Willis	Karrena Bethke

PREPARED BY		
Charles Mellish / Patricia Lee	…….....	……/……/……
CHECKED BY		
Karrena Bethke	…….....	……/……/……
REVIEWED BY		
Karrena Bethke	…….....	……/……/……
APPROVED FOR ISSUE BY		
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REVISION SCHEDULE

Rev No	Date	Description	Signature or Typed Name (documentation on file).			
			Prepared by	Checked by	Reviewed by	Approved by
0	4/2/15	Draft	CM / PL	KB	KB	JM
1	24/04/15	Final	PL	KB	KB	SW

East Gippsland Water

Dinner Plain Wastewater Treatment Capacity Review

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1 Introduction

A review of the existing assets and their performance and the expected future performance of the Dinner Plain Wastewater Treatment Plant (WWTP) based on theoretical treatment processes was carried out.

The assumptions made are based on the documentation provided and the limited monitoring results of the plant.

The operational challenges based on EGW Operations experience are also documented.

1.1 Dinner Plain Treatment Process

Dinner Plain WWTP currently consists of a natural oxidation lagoon pond system that treats the effluent to Class C standard. The treatment process includes the following:

- Inlet works screens and washpactor
- Primary sedimentation
- Aerobic treatment of the primary sludge
- Odour control and dispersion
- Oxidation ponds in series
    - Lagoon 1
    - Lagoon 2
    - Lagoon 3
    - Lagoon 4 (not in use)
    - Lagoon 5

The treated wastewater gravitates to the winter storage lagoon (Lagoon 5) that is used to store water for irrigation. The irrigation is limited to the period from October to April and is weather dependent. An aerial picture of the lagoons is provided in Figure 1-1 showing unused Lagoon 4 on the south eastern side of the plant.

Natural treatment process is affected by cold water temperatures that are experienced in alpine environments. Primary pond loading at low temperatures must be limited to less than 70kgBOD/ha.d. The pond retention is large which mitigates against poor treatment performance.

Figure 1-1: Aerial View of Dinner Plain Lagoons

2 Treatment Process

The treatment process at Dinner Plain WWTP, the performance and the operational issues are discussed in the following sections.

2.1 Screening

The pre-treatment process at Dinner Plain WWTP consists of screening, washing, storage of screening and a high overflow bypass.

The operating manual describes the control of the screen and washpactor. The operating manual provides details of the operation and maintenance of the equipment. Any operational problems should be referred to suppliers.

Operational Issues / Process Improvement Requirements

Discussions with EGW Operations have identified the following operational issues and potential process improvement requirements:

- The existing screen should be replaced with a new Rotomat inclined conveyor type.
- The overflow needs screening.
- The grease trap is ineffective and requires an upgrade.
- There are issues with process control and aging of electrical infrastructure

It should be noted that the inlet works screen has a very low replacement cost. Replacement of the screen type should only be considered if the annual maintenance cost is high in relation to the capital replacement cost, or if improved screenings capture is required to protect primary sludge equipment downstream of the screens.

2.2 Primary Sedimentation

Primary treatment is undertaken in up to three rectangular primary sedimentation tanks to remove settleable solids.

The requirements for the control of sludge withdrawal are provided in the operating manual. An important part of the advice is the sludge retention period. If the sludge is retained in the sludge hopper, anaerobic conditions will occur. Regular sludge withdrawal will avoid this condition and seasonal changes will be required to manage the varying influent flows.

Operational Issues / Process Improvement Requirements

Discussions with EGW Operations have identified the following operational issues / process improvement requirements:

- The scraper and outlet pump to silt buster can currently run simultaneously. However, there is little understanding of the current switchboard. The timing and interval of the sludge transfer pump and scraper are difficult to program.
- Due to the plant's configuration, EGW is unable to monitor the effectiveness of desludging to optimise transfer from the sedimentation tank, which may lead to over or under desludging. If sludge withdrawal continues for too long, as an example, excess water flows to the aerobic digester. This reduces the solids retention time in the digester resulting in poorly stabilised sludge.
- Inlet valves to the sedimentation tank are butterfly valves which can lead to blockages.

2.3 Aerobic Digestion

It is noted that the treatment system is not currently operated as an aerobic system. The primary sludge is stabilised using aerobic conditions within primary sedimentation tank no. 4. The sludge storage tank is currently receiving sludge from the silt buster and sludge from the sedimentation tank (via a sludge transfer pump close to the inlet of the step screen). These tanks have been fitted with a sand drainage layer to allow removal of excess liquor, and thus thickening of the digested sludge to reduce the volume to be disposed of. It was advised by EGW that approximately 8 loads (20kL) of sludge are taken away from the plant each year.

The sludge retention time of between 20 and 30 days is required and should be monitored in the winter period as the flows increase rapidly causing high sludge loading. While positive dissolved oxygen is not always an indication of stabilisation, the control of aeration is important to ensure complete mixing of the sludge and that adequate air is available for digestion.

Table 2 of the operating manual provides guidance to control solids retention time. No details about the blower are provided.

Appendix A, Table 4 of the operating manual provides troubleshooting advice.

It is likely that nitrification would occur with a long sludge retention period, followed by loss of alkalinity and subsequent decline in pH. This will affect the nitrification process and cause control problems.

The advice to reduce solids is not necessarily a solution to the water chemistry. Alternating aeration cyclically, will allow denitrification to occur, where alkalinity is recovered and pH stabilised. The process also reduces the total nitrogen in the supernatant. The no aeration cycle should have mixing to keep the mixed liquor in suspension to allow the reactions to occur.

Operational Issues / Process Improvement Requirements

Discussions with EGW Operations have identified the following operational issues / process improvement requirements:

- The original aerobic / mixing sludge digestion process has currently turned into an anaerobic / settling process.
- Excessive sludge dewatering time is experienced due to short circuiting during the sand filtration process.
- There is no ability to scour / backwash sand in the sludge filtration process.
- It is required to hose the sludge holding tank to breakup sludge during the sludge removal process. This leads to excessive operation time, risk of exposure to odour hazards and potential fall hazards due to awkward operation positions.
- Operation time on the sludge dewatering and supernatant removal during winter is excessive as the process is completed using a submersible pump in the sludge holding tank or via the sand filters in the sludge tank.

- Aerobic sludge stabilisation during winter time is not effective and generates a significant amount of odour.
- Over winter there is trouble storing sludge as there is too much water in the sludge tank.
- Consideration of a new dewatering device for sludge management has been raised to improve the operability of the plant.

The continued use of the primary sedimentation process could be reviewed. If the primary sedimentation sludge handling cost can be compared to the alternative of not using primary sedimentation and storing sludge in the lagoons, the savings will reduce operational input and be offset against the periodic lagoon desludging. This change will avoid the need to operate and maintain primary sedimentation and limit operator attendance. The operation of blowers and all the associated equipment would also not be required.

Generally natural systems do not need a great deal of operator attendance, which is one of their great advantages. The advantage of the primary sedimentation and sludge stabilisation is that it avoids the limitation of adverse climatic conditions reducing the requirement to rely on natural processes to treat the wastewater. However, in the case of Dinner Plain, primary sedimentation and aerobic sludge stabilisation adds unnecessary complexity to the plant operation.

2.4 Odour Treatment

No detail is provided in the operation manual regarding odour treatment.

The H_2S monitoring data at Dinner Plain WWTP recorded from 20 to 22 November 2014 was provided by EGW and is shown in Figure 2-1.

The monitoring data shows that the concentrations of H_2S are within the health risk level of 5 mg/L. However, EGW Operations indicated that the exhaust fans/odour control is currently inadequate, in particular during winter time. The onsite facilities (toilet / tea room) are located above the WWTP and are not sealed which have potential risks for gas accumulation, odour and poor hygienic conditions in the eating area.

Ventilation rates of 5 air changes per hour (ACPH) will ensure that the accumulation of H_2S is avoided and safe for operators to work in the screen area. Sealing of channels and treating the concentrated air usually results in the good capture and treatment of the polluted air, but if general ventilation of the building can be done, the investment in odour control equipment may be avoided. Sealing channels without ventilating the air space should be avoided as this will cause rapid corrosion of metal work and also causes concrete loss above the water line.

Confirmation of the building volume can provide a size for ventilation fans, which can be connected to a dispersion stack that avoids the need for any air treatment.

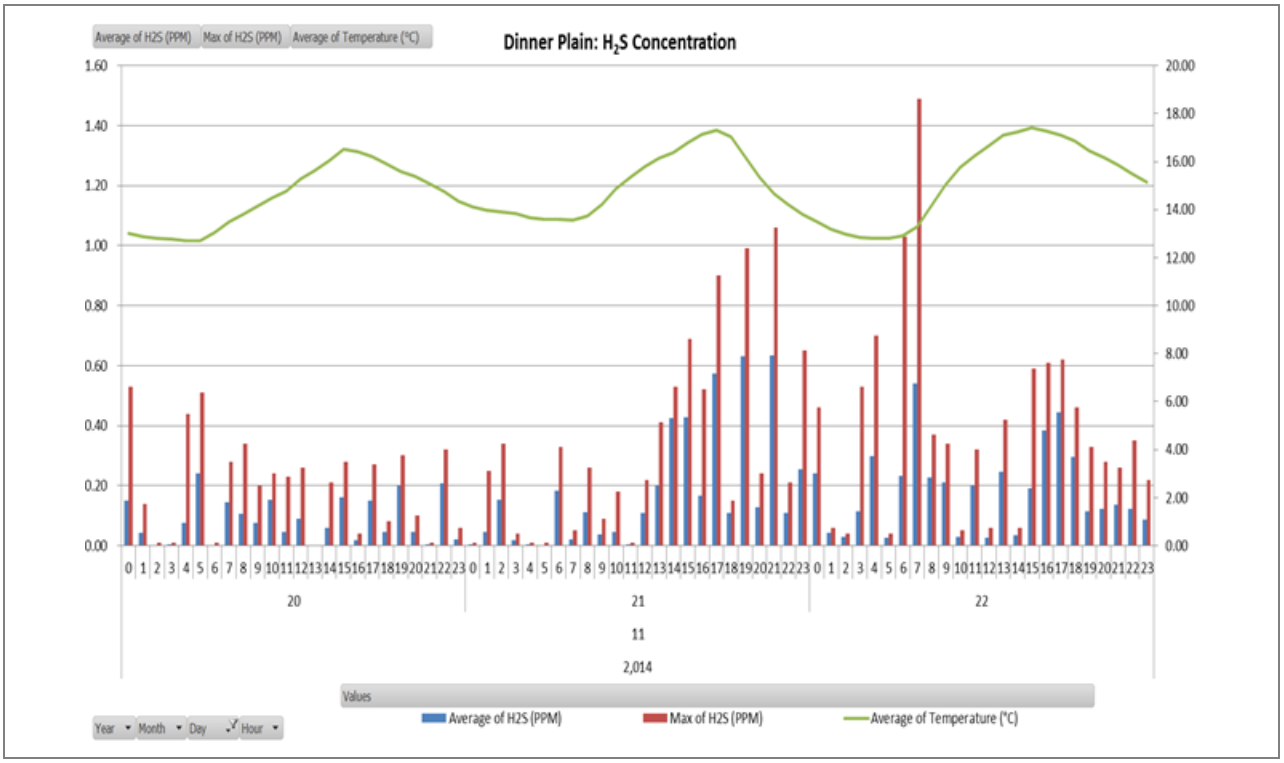


Figure 2-1: Dinner Plain WWTP H_2S Concentration

2.5 Oxidation Lagoons

The effluent from the primary sedimentation tanks gravitates to the oxidation lagoons for secondary treatment. A plant performance model was developed to estimate the theoretical lagoon performance.

A default influent BOD and SS concentration of 250mg/L was used to provide an organic load for the plant. It is expected that a 30% reduction in load occurs across the primary sedimentation tank. This has been assumed for the plant performance model.

The monthly plant flows have been converted into daily averages to test the plant treatment capacity. Figure 2-2 shows the monthly trend of flow into the natural lagoon system.

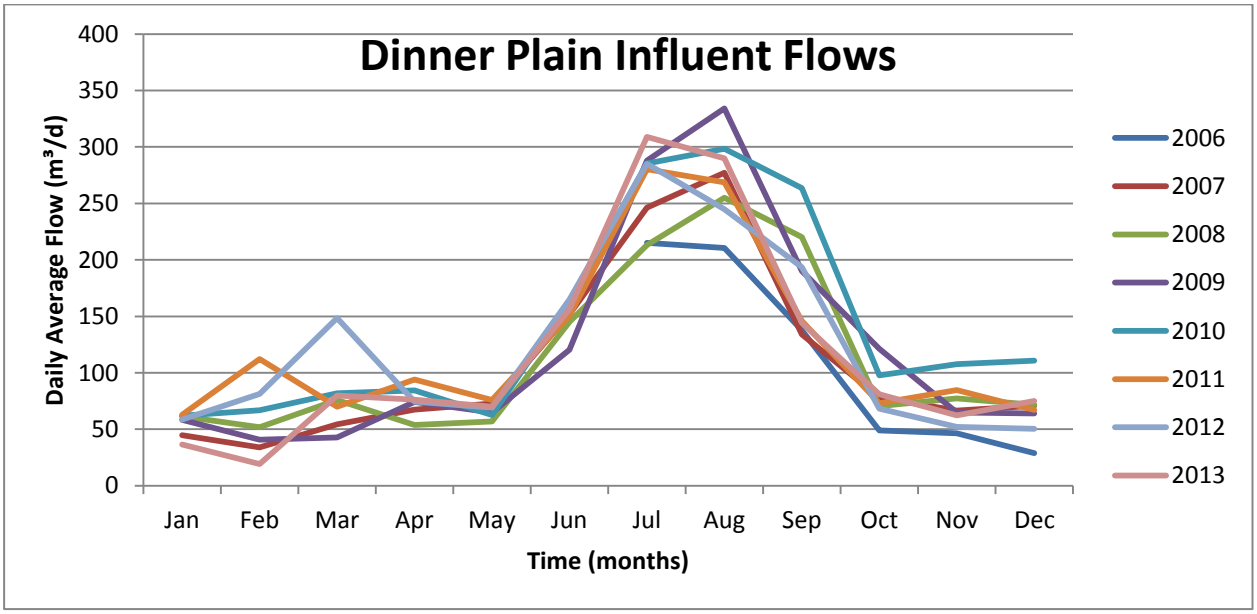


Figure 2-2: Dinner Plain Influent Daily Flows

The expected theoretical lagoon performance was modelled using empirical treatment formulae at two flows namely, a peak winter flow and an average flow of 400m³/d and 200m³/d respectively.

A theoretical estimate of the pond performance has been done using winter and summer water temperatures of 10°C and 18°C respectively to model the expected water quality with respect to BOD and pathogens (E Coli).

Table 2-1 provides the treatment across the lagoon system with improving quality as expected at Lagoon 5.

Although at 400m³/d, the E Coli may be above 1,000 cfu (EPA Class C guideline), it is possible that compliance can be achieved as the system retention is long. If the system is drained in summer to irrigate the wastewater, then the kinetics will be disrupted and the theoretical performance is not applicable.

Table 2-1: Theoretical Lagoon Performance

Lagoon	Surface Area (m²)	Surface Area (ha)	Volume (m³)	BOD Out at 10°C	BOD Out at 18°C	E Coli at 10°C	E Coli at 18°C
Lagoon 1	1,900	0.19	1,694	141.1	128.4	10,000,000	10,000,000
Lagoon 2	10,399	1.04	17,171	58.8	28.7	3,409,414	1,139,788
Lagoon 3	9,877	0.99	14,103	24.3	5.7	165,510	14,280
Lagoon 4[1]	11,100	1.11	16,800			9,681	217
Lagoon 5	8,840	0.88	17,488	9.3	1.2	1,694	11
Total	**31,016**	**3.10**	**50,456**				

The treated effluent water quality data from November 2012 to August 2014 was provided by EGW and is shown Table 2-2. The Dinner Plain wastewater effluent pH, BOD and suspended solids are above the limits suggested by the EPA Class C guidelines. However, it should be noted that the test results may be impacted by the presence of algae.

The high pH is a function of the summer seasonal conditions and there is not much that can be done to lower the pH. BOD and suspended solids are a function of the plant load and operational control. The limited winter storage influences the way the plant is operated and this makes it difficult to meet the quality set in the guideline.

Table 2-2: Dinner Plain Final Effluent Water Quality

Parameter	EPA Class C Guidelines	Dinner Plain Wastewater Effluent (3 year median)[1]
BOD (mg/L)	20	26
BOD filtered (mg/L)	-	10.5
E. Coli (org / 100mL)	1000	10
pH	6 – 9	9.4
Suspended Solids (mg/L)	30	45

1 Based on quality data from November 2012 to October 2014

[1] The theoretical quality is estimated with Lagoon 4 in operation. The actual data shows better quality than theoretical calculations. The high assumed influent quality will be lower after primary sedimentation. The theoretical calculations provide a reasonable estimate of performance if primary sedimentation is stopped and only pond treatment is used.

The post filter effluent water quality is provided in Figure 2-3. Pathogen reduction is consistently within the Class C water quality. However, suspended solids and BOD is fairly high after filtration, where lower concentrations should be expected. A check of the filter media and the filter performance may resolve this problem and avoid any further cost to improve the water quality.

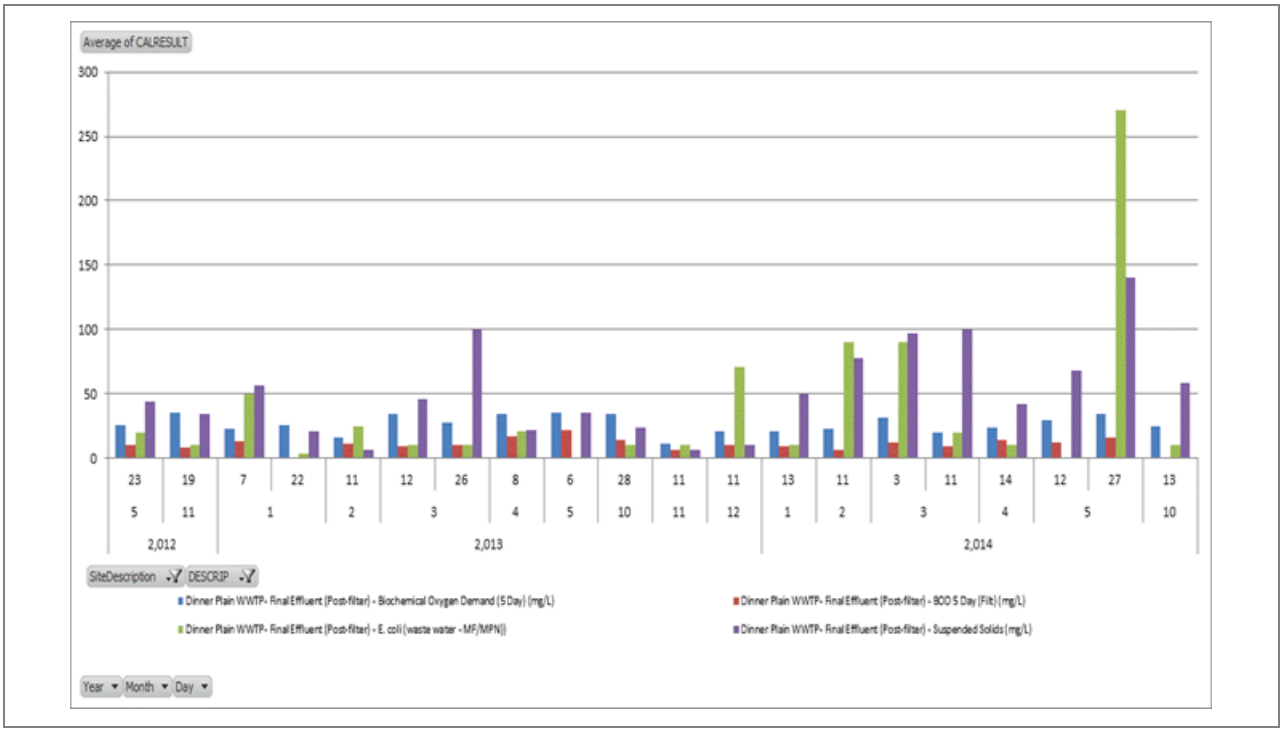


Figure 2-3: Dinner Plain Treated Effluent (Post Filtered) Water Quality

Operational Issues / Process Improvement Requirements

Discussions with EGW Operations have identified the following operational issues / process improvement requirements:

- Lagoon 1 is poorly lined and is not ideal for a primary (sludge settling) lagoon with potential issues in desludging in the future.
- Lack of aerobic activity during the peak winter season which requires additional retention time to be adequate.
- If additional storage was available water could be stored until the warmer months when aerobic activity is greater.
- There is stormwater runoff into lagoons during snow melt season.

The shortage of winter storage affects the conventional operation of the natural system. Additional winter storage will be driven by the impact of the disposal system on the environment, but if there are not any measurable adverse impacts, the current operation would not need to be changed. At present the ability to dispose of the wastewater is affected by overly wet conditions, which implies that Lagoon 4 should be commissioned.

3 Other Operational Issues

3.1 Operational Cost

EGW advised that the current Dinner Plain WWTP annual operational budget is $ 65k treating approximately 50 ML per year. As a comparison, Mallacoota WWTP has an operation budget of $ 40k treating approximately 120 ML per year.

The winter influx, cold conditions and isolated location make the operation of Dinner Plain WWTP a rather unique challenge. In the biosolids investigation for example, Dinner Plain had rates for dry sludge handling at least double that of Mallacoota and that was a function of the low volume processed at Dinner Plain and the distance required to transport the sludge as well as the short season to desludge the lagoon.

Table 3-1 summarises EGW's annual operational cost at Dinner Plain. The WWTP unit cost is approximately $ 1,700 / ML and is the highest amongst the water services components.

Table 3-1: Dinner Plain Water Services Operational Cost

Facility	2011-2012	2012-2013	2013-2014
1080 - D'Plain Bores	$31,670.09	$20,022.50	$8,587.16
1081 - D'Plain MWPS (minor water pump stations <30kW)	$11,697.65	$15,679.33	$15,162.10
1082 - D'Plain DP (disinfection plant)	$6,916.01	$39,439.88	$32,528.15
1083 - D'Plain MS&T (minor storages and tanks)	$15,692.06	$13,539.48	$19,725.23
1084 - D'Plain WN (water network)	$38,075.49	$28,743.43	$20,785.10
2080 - D'Plain SR (sewer reticulation)	$40,350.00	$36,414.68	$39,128.80
2081 - D'Plain STP (sewage treatment plant)	$87,354.00	$86,727.27	$76,393.32
2082 - Dinner Plain Reuse	$40,741.00	$32,273.21	$48,560.98
Annual Operating Cost	**$272,496.30**	**$272,839.78**	**$260,870.84**
Unit Total Operating Cost / ML	**$5,449.93**	**$5,456.80**	**$5,217.42**
Unit Treatment + Disinfection Cost / ML	**$1,885.40**	**$2,523.34**	**$2,178.43**

Improving current operational cost may be challenging without some investment in improvements to monitoring and control equipment or optimising the processes. In order to optimise the operation as best as one can to reduce the cost to operate, the total treatment cost was broken down into various activities to identify where the high costs are. An assessment was then carried out to optimise the operational activities.

Table 3-2 summarises the asset replacement cost of Dinner Plain WWTP components based on EGW's asset management information (Conquest). This provides an indication of high operation cost activities within the WWTP.

The expected cost of replacement of assets at Dinner Plain is shown in Figure 3-1 and there should not be a large investment of capital in the next two water plans. The analysis of and need for additional winter storage capacity will influence the capital investment more than asset maintenance and replacement.

Table 3-2: Asset Replacement Cost of Dinner Plain Wastewater Treatment Plain

Family Code	Asset Description	Asset Type	Replacement Cost ($)
002.003.001.003.001	S_DPL_TP_DPLAIN Dinner Plain STP	Treatment Plant Installation	224,000
002.003.001.003.001.001.002	S_DPL_TP_DPLAIN Dinner Plain WTP Primary WWTP Alarm Dialler	Alarm Dialler	4,200
002.003.001.003.001.001.003	S_DPL_TP_DPLAIN Dinner Plain WTP Primary WWTP PS Installation	Pump Station Installation	132,100

Family Code	Asset Description	Asset Type	Replacement Cost ($)
002.003.001.003.001.001.004	S_DPL_TP_DPLAIN Dinner Plain WTP Primary WWTP Flow meter Installation	Flow meter Installation	11,100
002.003.001.003.001.001.005	S_DPL_TP_DPLAIN Dinner Plain WTP Primary WWTP Inlet Works	Inlet Works Installation	59,000
002.003.001.003.001.001.006	S_DPL_TP_DPLAIN Dinner Plain WTP Primary WWTP Sedimentation Tanks	Sedimentation Tanks	890,700
002.003.001.003.001.001.007	S_DPL_TP_DPLAIN Dinner Plain WTP Primary WWTP Odour Control	Odour Control Installation	26,300
002.003.001.003.001.001.008	S_DPL_TP_DPLAIN Dinner Plain WTP Primary WWTP Aeration System	Aeration System Installation	82,00,0
002.003.001.003.001.001.009	S_DPL_TP_DPLAIN Dinner Plain WTP Primary WWTP Treatment Plant Building	Above Ground Building	66,700
002.003.001.003.001.001.010	S_DPL_TP_DPLAIN Dinner Plain WTP Primary WWTP Sludge Thickening Tank Installation	Sludge Thickening Tank Installation	205,000
002.003.001.003.001.001.011	S_DPL_TP_DPLAIN Dinner Plain WTP Primary WWTP Installation	Treatment Plant Installation	319,200
002.003.001.003.001.002	S_DPL_TP_DPLAIN Dinner Plain STP Lagoon	Treatment Lagoon Installation	99,900
002.003.001.003.001.002.002	S_DPL_TP_DPLAIN Dinner Plain WTP Lagoon Site Works	Site Works Installation	355,800
002.003.001.003.001.002.003	S_DPL_TP_DPLAIN Dinner Plain WTP Lagoon WPS Installation	Pump Station Installation	24,200
002.003.001.003.001.002.004	S_DPL_TP_DPLAIN Dinner Plain WTP Lagoon Storage Installation	Storage Installation	1,974,600
002.003.001.003.001.004	S_DPL_TP_DPLAIN_SCA Remote Telemetry Unit	Remote Telemetry Unit	12,000

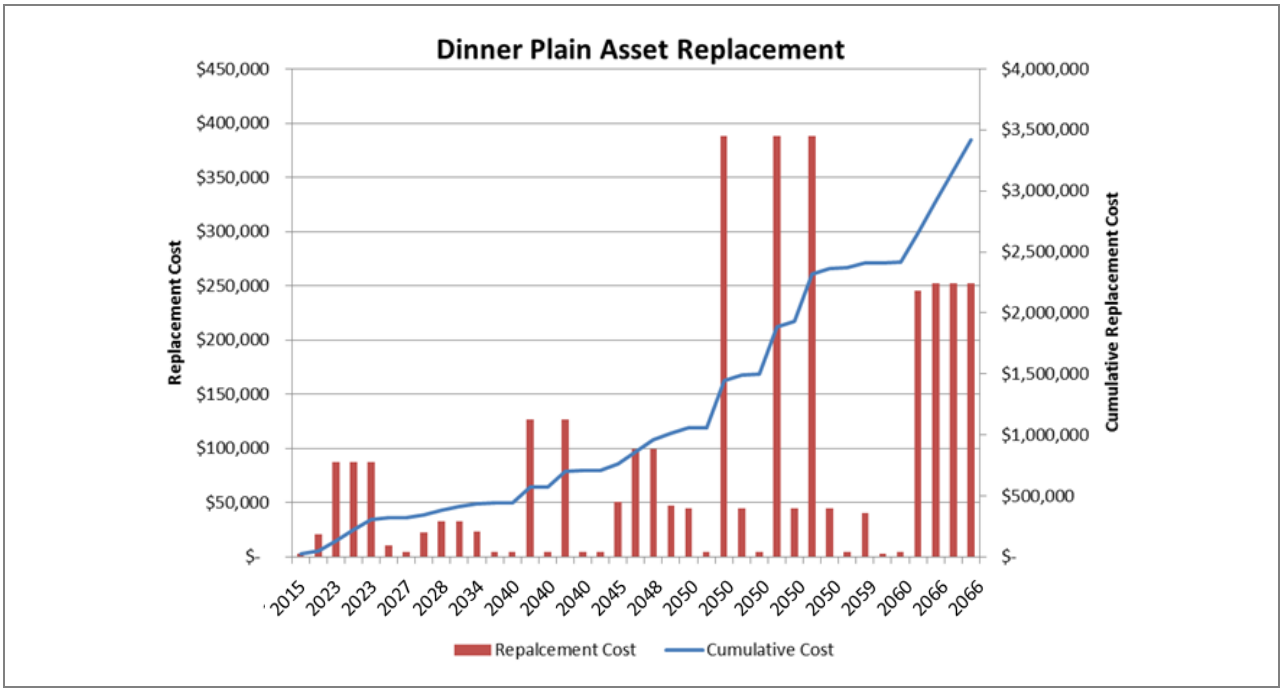


Figure 3-1: Dinner Plain Asset Replacement Cost

3.2 Health and Safety

Due to the remote location of the Dinner Plain WWTP, there are health and safety risks involved with call-outs particularly at night / winter time. It is important that travel to Dinner Plain is managed and vehicles are equipped to travel in black ice conditions.

One of the ways to avoid unnecessary call-outs is to use remote monitoring and control, which can go a long way to avoid unnecessary trips. If there is a good landline internet connection, webcams can provide visual access to the inlet works screen area or other areas that are needed to be visually inspected. A local contact could potentially eliminate the need for travel to the site.

4 Plant Optimisation

The current process performance and plant should be reviewed to improve operation efficiency.

The following activities will provide the information to confirm the theoretical assumptions and quantify changes to plant operation to improve performance.

- Check that screen performance is acceptable;
- Check operation of primary sludge control;
- Monitor aerobic digester performance;
- Analyse the aeration digester stabilisation by testing nitrate concentration and pH;
- Monitor lagoon health by
    - measuring algae populations and
    - measuring dissolved oxygen concentrations
    - Monitoring effluent quality

4.1 Plant Optimisation Options

Based on the assessment and discussions with EGW, it is understand that there is a driver to reduce the operator attendance and related operating costs at the WWTP. Two plant optimisation options were considered:

1. Keep the plant configuration and upgrade the process units to improve performance
2. Decommission the primary treatment process and use a facultative oxidation pond process only

4.1.1 Option 1: Maintain current treatment process

The following works are proposed for Option 1:

- Provide power to the lagoons to de-commission the diesel generator and allow automated control of equipment
- Screen replacement, including:
    - Provision of a new screen to improve screenings capture
    - Provision of screen at the bypass overflow, using the existing reconditioned screen
    - Upgrade the grease trap to improve grease removal
- Automation of sludge withdrawal at primary sedimentation tanks, which will have a positive impact on process performance at a lower operating cost
- Retrofitting the sedimentation with lamellae plates to increase settling velocity could be considered if the tank hydraulic loading rate is too high, or sludge removal is poor
- Primary sludge removed from the tanks to be stored in a holding tank for further consolidation and easier removal of the sludge

4.1.2 Option 2: Adapt treatment process to reduce operational expenses

The following works are proposed for Option 2:

- Removal of primary sedimentation that will:
    - avoid the cost of handling primary sludge
    - avoid the need for aerobic digestion of the primary sludge
- Upgrade the screening system to improve the screenings capture rate with screened bypass:

    - Move screening location to lagoon inlet
- Gravitate all flow to the facultative oxidation pond
- The following investigation works are required for Option 2:
    - Check that there is sufficient pond capacity to treat and to improve the wastewater BOD load on the primary solids loading (some aeration may be required at times to reduce BOD/ha to 65kgBOD/ha in the winter)
    - Assess the annualised pond sludge removal cost as sludge will be stored in the lagoon and will be removed every 10 to 15 years
    - To address possible issues with the watertightness of the Lagoon No 1, after summer irrigation, empty lagoon 1, add extra HDPE layer and re-commission without primary sedimentation
    - Investigate requirements to supply power to equipment at new location
    - Consider vacating the existing inlet works building and make available to Council

5 Conclusions and Recommendations

- A plant performance model was developed and the theoretical lagoon performance was analysed. The monitored effluent water quality was also compared with the EPA guideline for Class C quality. The assessment shows that the Dinner Plain wastewater effluent pH, BOD and suspended solids are above the limits suggested by the EPA Class C guidelines.
- Discussions with EGW Operations identified a number of operational issues within the Dinner Plain WWTP. The reduction in the operator attendance and related operating costs are the driver for capital asset investment. Reducing operations cost will allow the recovery of the invested funds.
- The drivers for any changes to the treatment process can only be determined once the requirements of land disposal and reuse are determined. The selection of Class A water quality would have a large impact on operating cost and increased operator attendance.
- Two plant optimisation options were considered for the existing WWTP and are discussed in Section 4. It is noted that either option described above will not incur intensive capital asset improvement costs. Furthermore future drivers to improve water quality will not materially affect either option.
- EGW operations confirmed that the present WWTP inflow is as much as 60 ML/year. The town water demand is less than 30 ML, which implies that inflow reduction will have a significant impact on capital investment. The wastewater reuse is the project driver with limited space available for woodlot irrigation. Investment to reduce inflow into the pipe network is crucial considering the reported total annual WWTP inflow is two times more than the water demand.

It is recommended that EGW:

- Consider implementation of WWTP optimisation options, either:
    - Keep the plant configuration and upgrade the process units to improve performance
    - Decommission the primary treatment process and use a facultative oxidation pond process only
- Consider network monitoring to identify measures in inflow reduction and to quantify the ability to make an improvement in this parameter or not.
- Analyse seasonal influent flow patterns to identify the infiltration impact as well as the snow melt response for the network.
- Establish Lagoon 4 to increase winter storage capacity.

Appendix D Combined Options

Short list option		BAU	Combined Options											
			Option X				Option Y				Option Z			
Snowmaking														
3	Potable water	✓												
1a	Untreated groundwater		✓											
1c	Recycled water						✓				✓			
Fire Flow Provision														
3	Potable water	✓												
2a	Untreated groundwater		✓								✓			
2c	Recycled Water						✓							
Irrigation / Discharge														
3	BAU – Lot 2	✓												
4	Cobungra		✓				✓				✓			
5	Flourbag Plain			✓				✓				✓		
7	Waterways				✓				✓				✓	
8	Managed Aquifer Recharge					✓				✓				✓
Leakage and Inflow / Infiltration Reduction														
9	Leakage Reduction	✓		✓				✓				✓		
10	Inflow / infiltration reduction	✓		✓				✓				✓		
Use of Lagoon 4														
12	Lining			✓				✓				✓		
13	Reed bed							✓				✓		
14	Wet land							✓				✓		

Appendix E Glossary of Terms

90th percentile	When expressed as a limit, ninety percent of the samples taken over a specified period must not exceed the prescribed value, that is, the 90th percentile of the available data's statistical distribution.
Average Dry Weather Flow (ADWF)	The average wastewater flow over a 24 hour period without the impact of rainfall.
Business As Usual	The normal execution of operations within an organisation.
Class A Recycled Water	Class A is the highest class of recycled water and is safe to use for a range of non-drinking purposes in Victoria.
Class C Recycled Water	May be used for a number of uses including cooked or processed human food crops including wine grapes and olives, livestock grazing and fodder.
CO_2-e	Carbon dioxide equivalent.
Constructed Wetland	Treatment systems that use natural processes involving wetland vegetation, soils, and their associated microbial assemblages to improve water quality.
Crop Coefficient	A factor relating crop water use to pan evaporation or potential evaporation over the same time.
Disinfection	A process that destroys, inactivates or removes micro-organisms.
Environmental Improvement Plan (EIP)	A plan covering the use of recycled water that manages identified risks and thereby ensures protection of the environment and human health.
Evapotranspiration	The term used to describe the part of the water cycle which removes liquid water from an area with vegetation and into the atmosphere by the processes of both transpiration and evaporation.
Groundwater Inflow / Infiltration	Entry of groundwater into the wastewater network through cracks in pipes or inadequately sealed joints etc.
Managed Aquifer Recharge	Involves the injection of water into aquifers for storage and later extraction.
Non-Revenue Water	The difference between the groundwater extraction and water consumption recorded at customer water meters at Dinner Plain. This includes water loss through leakage from reticulation water mains and water used that is not billed (e.g. inaccuracy of water meters, water use at fire hydrants)
Primary Treatment	Treatment involving sedimentation (sometimes preceded by screening and grit removal) to remove gross and settleable solids. The remaining settled solids, referred to as sludge, are removed and treated separately.
Rainfall Induced Inflow / Infiltration	Entry of stormwater directly into the wastewater network for example through poorly sealed manhole covers and direct stormwater connection etc.
Rainwater Harvesting	Involves the collection, storage and distribution of rainwater
Recycled Water	Water that has been derived from wastewater systems or industry processes and treated to a standard that is appropriate for its intended use.

Reed Bed	A natural treatment processes through the root zone of the reeds via physical, chemical and biological interactions between the wastewater, plants, micro-organisms, gravel and atmosphere.
SCADA	Supervisory control and data acquisition, a system operating with coded signals over communication channels so as to provide control of remote equipment.
Storage Lagoon	A lagoon used to store treated recycled water prior to application, either to maintain adequate supplies, or to assist meeting the State Environment Protection Policy requirement for on-site retention of all wastes up to a 90th percentile wet year.
Treatment Lagoon	Any large pond or holding used to contain recycled water while treatment processes including sedimentation and biological oxidation occur. Stabilisation and maturation lagoons are examples of treatment lagoons.
Victoria in Future	The Victorian Government's official population and household projections, incorporating 2011 Census data and current population estimates.
Integrated Water Cycle Management (IWCM)	An evidence-based approach to using all available water resources in ways that best deliver liveable, sustainable and productive communities.

Appendix F Community and Stakeholder Engagement Plan and Report

Dinner Plain Integrated Water Cycle Management Investigations: Engaging the community

Setting the scene:

Community engagement is strongly encouraged by the East Gippsland Water in the decision making of its agencies/bodies.

Community engagement has provided an invaluable opportunity for East Gippsland Water to inform, as well as to assess, the wishes, expectations and priorities of its customers and other stakeholders on specific issues.

This communications and engagement report considers that the following aspects of East Gippsland Water's Dinner Plain Integrated Water Cycle Management (IWCM) Investigations initiative were fixed and therefore non-negotiable:

- Development and analysis of the options

Aspects that were negotiable, to a varying degree, include:

- Selection of the preferred option

The purpose of this report is to document the community engagement that allowed stakeholders to consider the potential trade –offs of the economic, social and environmental impacts of the options for providing a sustainable water management approach for Dinner Plain. Early consultation with the appropriate stakeholders was a vital element to the success of the project. This consultation was based on the principles of IAP2 (International Association for Public Participation) which are designed to ensure effective participation.

Engagement of the community was undertaken at a number of levels. As this study is a high level, regionally focussed, feasibility investigation, it was appropriate to undertake consultation to seek the views of particular stakeholders in order to improve study outcomes.

The consultation approach (based on IAP2 International Association for Public Participation) had the following characteristics:

- Goal – to obtain stakeholders' feedback on analysis, alternatives and/or decisions
- Commitment – defined stakeholders were kept informed, listened to and their concerns and aspirations acknowledged and feedback given as to how public input influenced the decision

This goal and commitment was communicated to stakeholders throughout the engagement process.

Goal:

Ultimately East Gippsland Water sought:

- **A smart water solution for Dinner Plain delivering liveable, sustainable and productive communities**
- **To manage our water for Dinner Plain's growth and variable climate**
- **To support development in Dinner Plain**

THE PROJECT OBJECTIVES

The project ultimately informs and supports the development of a sustainable water supply in the township of Dinner Plain to support community growth:

The key objectives were to:

- Collaborate with the Alpine Shire to identify the community's projected water needs
- Identify cost-effective improvements within the water cycle
- Identify innovative alternatives for the beneficial use of recycled water in Dinner Plain
- Develop sustainable water solutions to support future community growth

PROJECT BENEFITS

IWCM in Dinner Plain delivers benefits far in excess of the provision of a sustainable water supply. These will include:

- Requisite information to support Alpine Shire Council community planning efforts
- Potential cost-savings with improved efficiencies in the water treatment processes
- Increased water supply available for alternative uses
- Economic benefits through increased development opportunities
- Enhanced liveability through increased recreational opportunities
- Improved fire defence capabilities

THE PROJECT PARTNERS

The pilot project was a partnership between East Gippsland Water (EGW) in association with:

- Alpine Shire Council (ASC); and
- The Department of Environment, Land, Water and Planning (DELWP)

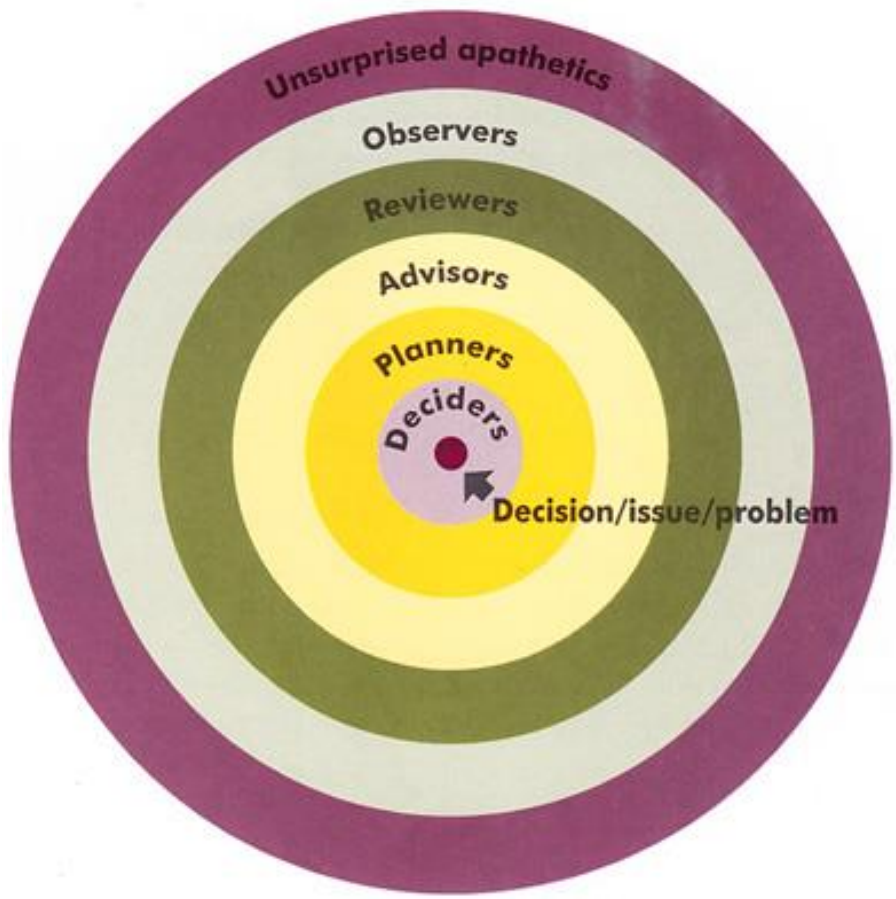
East Gippsland Water manages the potable, wastewater and recycled water for Dinner Plain and ASC has stormwater management and development planning rights for the township.

THE PROJECT FUNDING

- $66,000 East Gippsland Water
- $66,000 DELWP Living Victoria Fund

STAKEHOLDER CONSULTATION APPROACH

The 'Orbits of Public Participation' diagram below was used to help determine the likely level of participation expected by these stakeholders:



Stakeholders	Abbreviation	Level of Engagement (Participation)*
1. Department of Environment, Land, Water and Planning a	DELWP	Deciders
2. Alpine Shire Council	ASC	Deciders
3. East Gippsland Water	EGW	Deciders
4. Mt. Hotham Ski Company	MHSC	Planners
5. County Fire Authority	CFA	Planners
6. Dinner Plain Advisory Committee	DPAC	Advisors
7. North East Catchment Management Authority	NECMA	Reviewers
8. Goulburn Murray Water	GMW	Reviewers
9. Parks Victoria	PV	Reviewers
10. Department of Health	DOH	Reviewers
11. Environment Protection Authority, Victoria	EPA	Reviewers
12. Community of Dinner Plain	DP	Observers
13. Department of Planning & Community Development	DPCD	Observers
14. Developers	DEV	Unsurprised apathetics
15. Tourists	TOUR	Unsurprised apathetics

Based on the outcomes of the 'Orbits of Public Participation', there were the following options for engagement:

IAP2's Public Participation Spectrum

Increasing level of public impact →					
	Inform	**Consult**	**Involve**	**Collaborate**	**Empower**
Public participation goal	To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision-making in the hands of the public.
Promise to the public	We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.
Example techniques	• Fact sheets • Websites • Open houses	• Public comment • Focus groups • Surveys • Public meetings	• Workshops • Deliberative polling	• Citizen advisory committees • Consensus-building • Participatory decision-making	• Citizen Juries • Ballots • Delegated decision

Calculating the level of engagement that was adopted:

Public expectations

Average score indicates –
1-2 Very Low to Low
2-3 Low to Moderate – recommendation: at least Consult
3-4 Moderate to High – recommendation: probably Involve
4-5 High to Very High – recommendation: minimum Involve, consider opportunities to Collaborate and Empower, if feasible

Assessment questions	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
What is the probable level of difficulty in addressing the opportunity?			X		
What is the potential for public outrage related to the project?		X			
How important are the potential impacts to the public?			X		
How much do major stakeholders care about the opportunity to be addressed and decision to be made?					X
What degree of participation does the public appear to want?		X			
Count number of checks in each column	**0**	2	2	0	1
Multiply number of checks by the weight	**X1**	**X2**	**X3**	**X4**	**X5**
Enter column score	**0**	4	6	0	5
Add total of all five column scores	**15**				
Divide total score by the number of questions	**/5**				
Average score	**3.0**				

East Gippsland Water expectations

Average score indicates –

1-2 Very Low to Low
2-3 Low to Moderate – recommendation – at least Consult
3-4 Moderate to High – recommendation – probably Involve
4-5 High to Very High – recommendation – minimum Involve, consider opportunities to Collaborate or Empower, if feasible

Assessment questions	**Very Low**	**Low**	**Moderate**	**High**	**Very High**
1. What is the legally required level of public participation?		X			
2. To what extent do staff believe the public could help improve the outcome of this project?				X	
3. At what level do staff perceive public interest in this project?			X		
4. What is the potential for the public to influence the decision-making process?			X		
5. What level of media interest do you anticipate?		X			
6. What is the likelihood that decision-makers will give full consideration to public input?					X
7. What levels of resources are likely to be available to support public participation?	X				
8. What is the anticipated level for political controversy?	X				
Count number of checks in each column	2	2	2	1	1
Multiply number of checks by the weight	**X1**	**X2**	**X3**	**X4**	**X5**
Enter column score	2	4	6	4	5
Add total of all five column scores	21				
Divide total score by the number of questions	**/8**				
Average score	**2.625**				

Based on a public expectation score of 3.0 and an East Gippsland Water expectation score of 2.625, the recommendation was that East Gippsland Water adopt the following classes of public participation (ie. inform, consult, involve…) in relation to stakeholders: CONSULT

When to engage:

Progress on the Dinner Plain WOWCM Investigations followed five key stages, with the timeframes and stakeholder engagement undertaken indicated below:

Stage	Timeframe	Stakeholder engagement Planned	Stakeholder engagement Actioned
1. Project Definition and Management	September 2013 – March 2015	• Meet with ASC, CFA and other stakeholders to establish reuse opportunities • Conduct quarterly project control group meetings • Submit quarterly progress reports Nos 1 & 2 (of total 7) to DELWP	• Complete, EGW met with Dinner Plain Advisory Committee in December 2013 • 3 project control group meetings have been held to date being April 2014, October 2014, and April 2015 (combined with the project presentation) • Quarterly reports Nos 1 to 6 complete
2. Literature Review	May – July 2014	• Conduct quarterly project control group meetings • Provide extract of literature review to ASC, DELWP, EGW workshop participants • Conduct site visit with EGW operators to establish issues/constraints and verify desktop information • Provide copy of literature review to DELWP • Submit quarterly progress report No. 3 to DELWP	• June quarterly project control meeting postponed whilst confirmation of DELWP representative was being resolved • Literature review circulated prior to workshop 1 to develop assessment criteria 06/06/2014 • Site visit completed 11/06/2014 • Literature review submitted to DELWP with quarterly report 4 • Quarterly report 3 completed
3. Options Analysis	July to October 2014	• Conduct quarterly project control group meetings • Facilitate workshop with ASC, DELWP and EGW representatives to determine assessment criteria • Facilitate workshop with ASC, DELWP, EGW, EPA, CFA, MHSC, DPAC to combine options • Present interim option development to Project Control Group • Post project sheet No 1 onto ASC and EGW websites and to account holders at Dinner Plain • Post Tourist sign based on project sheet No 1 in appropriate location in Dinner Plain • Submit quarterly progress report No. 4 to DELWP	• Project control group meeting 2 held at DELWP offices on 9th October 2014. Meeting included representatives from EGW, DELWP, MWH and ASC • Assessment criteria workshop held 9th June 2014 at EGW's Bairnsdale office. DELWP and ASC were unable to attend. Caught up with ASC to go through the findings of the workshop during site visit the following day • Options combination workshop held 16th September 2014 at MWH offices in Melbourne. Attendees included representatives from MWH, EGW, DELWP and ASC. It was considered that it would be more appropriate to have more targeted discussion with other stakeholders once options had been detailed further • Interim option development was presented to representatives from EGW, and ASC on the 6th of November 2014 in Dinner Plain. DELWP was unable to attend • Quarterly report 4 completed
4. Community and Stakeholder Engagement	May -December 2014	• Conduct quarterly project control group meetings • Provide copy of community engagement report to DELWP • Submit quarterly progress report No. 5 to DELWP	• Quarterly project control meeting postponed until 2015 due to election • This report is the community engagement report • Quarterly report No 5 complete
5. Document in IWCM Report	October 2014 - June 2015	• Conduct quarterly project control group meetings • Provide copy of draft WOWCM report to DELWP, ASC, CFA, MHSC, EPA, DOH, PV, DPAC, GMW, NECMA • Provide copy of final WOWCM report to DELWP, ASC, CFA, MHSC, EPA, DOH, PV, DPAC, GMW, NECMA • Present WOWCM plan to DELWP, ASC, CFA, MHSC, EPA, DOH, PV, DPAC, GMW, NECMA • Post project sheet No 2 to EGW and ASC websites and to account holders at Dinner Plain • Post Tourist sign based on project sheet No 2 in appropriate Dinner Plain location • Submit quarterly progress report Nos. 6 and 7 to DELWP	• Project control group meeting 3 held on April 7th Meeting included representatives from EGW, and ASC (combined with presentation) • Draft IWCM report circulated to DELWP, ASC, and EGW on 20th March 2015 • IWCM plan presented to EGW, and ASC (also representing DPAC, CFA and MHSC), at the Community Hall in Dinner Plain on April 7th 2015. DOH, EPA, PV, GWM and NECMA was not consulted at this stage given the preferred option is business as usual. The use of lagoon 4 may require EPA works approval and EPA will be consulted as part of the planning process for the works. • Final IWCM report circulated to DELWP, ASC and EGW on 24th April 2015 • Website Project Sheet to be developed, report to be made publicly available instead of hard copy project sheet and tourist signs • Quarterly reports 5, 6 and 7 completed • EGW to contact landholders at Flourbag Plain and Cobungra prior to final report being made public • EGW to present findings to DPAC

Stakeholder Engagement Notes

- Since the project inception East Gippsland Water have been communicating regularly and working closely with the Alpine Shire Council and Department of Environment, Land, water and Planning, through regular emails, phone calls and face to face visits. Good working relationships and joint understanding between the 3 main partners was key to ensuring the success of this project
- Engagement with and getting feedback from the community in Dinner Plain was challenging. The community is largely absent with only 146 permanent residents compared to 546 rate payers. For this investigation project, we aimed to inform the general public only. Where specific feedback was required, the Dinner Plain Advisory Committee was approached. By building close relationships with Alpine Shire Council, East Gippsland Water was able to benefit from the extensive community engagement work that the council undertook as part of the project to develop a new Master Plan for the township.
- In addition to ASC, DELWP and the community of Dinner Plain a number of other key stakeholders were identified as listed in the community engagement plan. The level of involvement and engagement of these additional stakeholders was largely dependent on the preferred option selected. In order to determine the preferred option discussions and workshops with ASC, as the representative of the Dinner Plain community were undertaken.

NOTES

***Orbits (levels) of participation –**

Deciders

Those closest to the impacts of the decision that want to be intimately involved in the process. Includes those directly and personally affected, as well as the project team, sponsoring agency, etc.

Planners

Those that have an interest in participating via a give and take process where they help generate ideas and review alternatives with the project team.

Advisors

Stakeholders that want to offer ideas and responses to the project team but do not want the responsibilities associated with more in-depth participation.

Reviewers

Those that prefer to offer comments and suggestions based upon information and alternatives presented to them. Typically, these stakeholders do not want responsibility for generating ideas.

Observers

Stakeholders aware of the project/initiative but not seeking a participatory role. Typically, they are keeping an eye on what is going on and will become more involved if their expectations are not met.

Unsurprised apathetics

These stakeholders may be aware that there is a project or initiative; however, they choose not to be involved. However, if they perceive their values are impacted, they can change orbits quickly.

Prepared by: Karrena Bethke on behalf of the Dinner Plain Integrated Water Cycle Management Investigations Project Control Group

Date: 05/06/2015

Appendix G East Gippsland Water Fire Protection Fact Sheet

PURPOSE

There has been some misunderstanding and/or misinformation circulating within some sections of the community in recent times regarding the process and responsibilities for fire protection of private property and buildings. This fact sheet outlines the applicable processes and responsibilities, from East Gippsland Water's perspective.

APPROVAL

Dean Boyd – Executive Manager Infrastructure.

BACKGROUND

Service Standards

East Gippsland Water (EGW) has performance obligations for its services as set out in its Customer Charter (EGW Policy No. 045). The Charter, which reflects the service standards set by the Essential Services Commission (ESC), includes (among other things) minimum standards for water flow rates and quality requirements provided to EGW's customers. The water supply service standards include targets for; supply interruptions, water quality parameters, and minimum flow rates.

The current applicable minimum flow rate from an approved standard customer connection to a serviced property is 20 Litres per minute for a 20 mm dia. water supply connection, which varies depending on the size of the connection. For example, the minimum flow rate for a 32 mm connection is 60 L/min, rising to 160 L/min for a 50 mm connection.

Note that there is no minimum water pressure target.

The above identifies what can generally be described as providing a "domestic" level of drinking (potable) water for EGW customers.

It should be noted that water pressure and flow rate available to any particular property will vary according to location and diurnal/seasonal influences within the reticulation system. It should also be noted that there can be interruptions to services, where water supply to properties may be temporarily unavailable or restricted.

Customer Connections

EGW controls applications for customer connections to its network (per Consent to Connect – EGW Form No. 040). EGW's Policy No. 025, Customer Connections, defines approved standard customer connections. Non-standard services, for example; supplies by agreement and fire services, are exempt from these minimum standards.

EGW's responsibilities for maintenance generally end at the customer meter (for approved standard customer connections), and the property-owner is responsible from this point for all internal private plumbing works (the Plumbing Industry Commission is responsible for regulation of private plumbing works).

Fire Plugs

Section 165 of the Water Act 1989, provides that the Council may require EGW to install fire plugs on its water reticulation network, with maintenance of these fire plugs being at Council's cost. EGW is required to make water available from fire plugs but EGW is not required to make sure that water pressure is adequate for fire fighting.

In addition, the Water Supply Code of Australia (WSA 03-2011) identifies, in section 3.1.5, that EGW's water supply systems shall not be specifically designed for fire fighting capability.

Subdivisions and Land Development

The Planning and Environment Act 1987 is administered by the Responsible Authority (usually the Council), and EGW is a Referral Authority. Upon referral of a planning application (for subdivisions and other land development proposals) to EGW by the Council, EGW will consider whether the proposed development can be serviced (to the above minimum standards) and what infrastructure may be required, including connection of new lots/developments to reticulated water supply (and/or sewerage). Other EGW requirements may be included, and some developments may not be able to be serviced. Where included in EGW's requirements, minimum sized water mains would generally be required to be installed by the developer, to meet the minimum service standards.

Where a proposed development or subdivision seeks to provide service standards over and above these minimum levels, the property owner or developer must make their own arrangements, at their cost (for example, if a particular development needs a higher standard of water quality, pressure or flow rate). EGW can provide information on the available level of service (eg. static water pressure and/or flow rate) at a particular location upon request (fees may apply).

EGW cannot make requirements over and above the minimum service levels – this would trigger an "upsizing" which would be classed as a shared asset, under the ESC's Guidelines for New Customer Contributions, and would be at the full cost of EGW. Upsizing is also generally not appropriate due to poor water quality arising from larger diameter water mains, with relatively low consumption/turnover, as well as the additional cost burden on EGW customers (cost-shifting).

Note that the planning process, and EGW's determination of servicing requirements, usually occurs well before the building process is instigated by the property owner.

FIRE PROTECTION

EGW is not responsible for providing fire protection for private properties, and is not involved in setting the applicable fire protection standards or requirements, nor in implementing fire protection solutions.

Individual private buildings must comply with the Building Code of Australia (BCA). Building activity is regulated by the Building Commission and the Australian Building Codes Board, and designs are approved by Municipal and Private Building Surveyors. The BCA sets requirements for "internal" private fire hydrant systems according to building size and use. Australian Standard AS2419.1, Fire Hydrant Installations, sets requirements for private building fire protection hydrant systems, including internal pressure and flow requirements for hydrants. These requirements apply to the building owner/occupier and are completely separate from the service standards that EGW is required to meet for the reticulated water supply system.

Note that the references in BCA and AS 2419 to "hydrants" relates to the internal private fire protection system for a building, and is not to be confused with the "fire plugs" that are installed on EGW's water reticulation network. In some circumstances, the street fire plug or approved fire service connection from EGW's water mains may be sufficient for fire protection for certain private properties/buildings without augmentation (such as additional on-site water storage, booster pumping, etc), subject to the building complying with the BCA.

Property owners should seek specific advice from their building designer/contractor, Municipal or Private building surveyor, CFA representative, insurance company or independent building consultant in relation to determining their own property's fire protection needs.

Where, for private property fire protection purposes, a property owner requires water pressure and/or flow rates over and above the minimum levels available from the reticulation water mains, the property owner would need to arrange any additional water connection, fire service, water storage tanks, pressure booster pumps or other private infrastructure required to meet the building requirements at their own cost.

END OF DOCUMENT