Wonthaggi Recreational Reserve Stormwater Harvesting, Detention, Retention & Re-use

Williamson, H[1], Gervasi, L[2]***

[1]Optimal Stormwater

[2]Bass Coast Shire Council

* hwilliamson@optimalstormwater.com.au

** l.gervasi@basscoast.vic.gov.au

ABSTRACT

Bass Coast Shire Council requested a stormwater mitigation, harvesting and reuse design for the irrigation of the Wonthaggi Recreational Reserve in Wonthaggi, Victoria, 2 hours south-east of Melbourne. The design harvests stormwater from a 450mm pipe in Wonthaggi Recreational Reserve, incorporates a flood detention design using a bund to detain a 1/10year ARI storm and uses an innovative collection technique to be able to detain, retain and reuse the 10 year overland storm flows back into the underground storage tank.

The Wonthaggi recreational reserve stormwater harvesting design project is a rare project - one which combines stormwater harvesting with stormwater flood mitigation. Combining these in a single project is one of stormwater's trickiest problems. The end result is a stormwater harvesting, flood mitigation, flood retention, flood detention and stormwater treatment project which provides for the irrigation of two large sports fields using almost exclusively treated stormwater.

The project creates a drought proof supply of stormwater to irrigate the Council's reserves with a resource which was being wasted and causing flooding downstream. This project is the final project in Bass Coast Shire Council's plan of providing treated stormwater to irrigate every park within the Shire area. The project provides:

- Primary treatment via GPT
- Underground storage tank of 1ML
- Secondary & tertiary treatment
- Above ground detention, retention and reuse of a 1/10 year ARI storm event
- 98.6% reliability of supply for existing irrigation use
- 25% of Councils total potable water use has been removed
- 60% of Councils Park/Reserve potable water use has been removed
- Last oval to be removed from potable water usage in Bass Coast Shire

The project captures stormwater in the recreational reserve and runs it to an underground storage tank both via GPT treatment for the piped flow and biofiltration treatment for the overland flow with above ground detention which both go to the underground storage tank. This underground tank holds 1,000,000L & combined with the above-ground bund which can detain 4,000,000L, this provides up to 5,000,000L combined retention & detention providing the mitigation of a Q10 storm downstream. The underground raw water tank is treated upon request & the treated stormwater is placed into the existing irrigation header tank to provide treated stormwater for irrigation of the Wonthaggi Recreational Reserve. It stands in stark contrast to the backdrop of the Victorian Desalination Plant in Wonthaggi as an example of how a sustainable, community based future should be.

KEYWORDS

Stormwater Harvesting; Stormwater Detention; Stormwater Retention; Stormwater Reuse

1 INTRODUCTION & BACKGROUND

The project is located within *Wonthaggi Recreational Reserve* in Wonthaggi, Victoria. Wonthaggi is located within the Bass Coast Shire Council municipality; about 2 hours drive south-east of Melbourne.

Bass Coast Shire Council had a most unusual project description, they wanted to capture a Q10 storm event and harvest the lot for re-use on existing sports ovals at Wonthaggi. They wanted to catch a 10 year storm, because in events much less than this, the Bass Coast Highway would get cut by overland stormwater flow from this catchment.

Bass Coast Shire Council selected Optimal Stormwater for this tricky **stormwater treatment, stormwater harvesting, retention, detention, flood control, bioinfiltration** and **biodiversity enhancement project**.

2 DESIGN

The design solution harvests stormwater from a pipe flowing under Wonthaggi Recreational Reserve. But in larger events flow is coming overland, so the solution incorporates a flood detention/retention design using a significant bund/dam to detain a 10year ARI storm on a lower grassed area of the Reserve. Once captured, a bioinfiltration trench is used to collect and treat the water, and drain it to a one Million litre underground storage tank. Normal stormwater flows are treated by an offline CDS unit, with gravity flow into the 1,000,000L tank.

The captured “raw water” is then processed through an automated screen filter and then an automated media filter to get it to a condition appropriate for UV disinfection. The design and flows

were customised to allow reuse of an existing underground irrigation header tank, saving Council money on constructing additional infrastructure. Downstream of the flow control and harvesting, a second smaller dam/bund is to be built to detain waters within a natural marshland area that was draining too fast due to vandals cutting an earth channel.

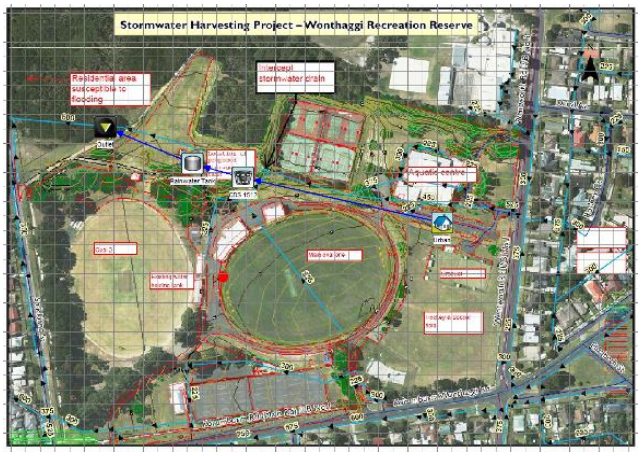

Figure 1: Irrigable areas Wonthaggi Recreational Reserve

2.1 Water Use

According to the information provided by Council, there is an annual average usage of 8ML/year with a maximum peak of 12.5ML/year and a low of 3 ML/year in drought years. This volume is based on annual consumption bills for the reserve from 2005 to 2011. The annual consumption is desired to be increased to 15ML/year on a permanent basis for usage by the sporting ovals

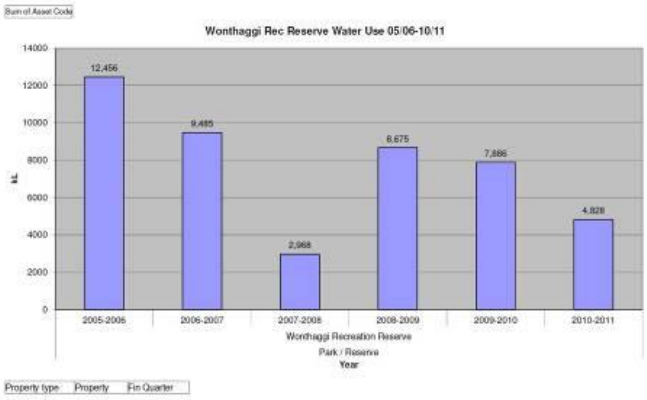

Figure 2 – Wonthaggi Recreational Reserve Water Usage 2005-2011

2.2 Catchment Area

The Wonthaggi Recreational Reserve catchment is 24ha in size with the reserve centrally located between the White Street catchment of 12 hectares to the north, and the Strickland Street catchment of 21 hectares to the south. All of the three catchments drain to the Bass Hwy in the

west. As the Wonthaggi Recreational Reserve catchment is located in proximity to the sports fields and existing irrigation infrastructure, with good drainage levels and space available for construction, it is this 24 hectare residential catchment which has been chosen to harvest from. Figure 1, below, shows the catchment extents and location of Wonthaggi Recreational Reserve

Figure 3 - Extent of the Wonthaggi Recreational Reserve catchment

2.3 Water Balance

A water balance was undertaken by Optimal Stormwater for the site based on the water supply from the catchment, the irrigation demand and the storage volume. An expected reliability of supply of 98.6% was achieved for 10ML/year, 88.55% for 15 ML/year and 76.35% for 20 ML/year which are excellent figures for a stormwater harvesting project. Normal goals of 70% to 80% are common, so this outcome is outstanding. This would allow Council to potentially expand the project in years to come with additional water for fire fighting, water features, irrigation of the school, offsite tankered irrigation and environmental flows to the wetland. The excess capacity of the system provides a lot of flexibility for Council in the future.

Node Water Balance - Rainwater Tank

	Flow (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	GP (kg/yr)
Flow In	86.99	16511.70	36.17	247.40	3656.11
ET Loss	0.00	0.00	0.00	0.00	0.00
Infiltration Loss	0.00	0.00	0.00	0.00	0.00
Low Flow Bypass Out	0.00	0.00	0.00	0.00	0.00
High Flow Bypass Out	54.67	10443.40	23.03	156.11	2295.41
Pipe Out	10.77	435.00	1.99	23.65	0.00
Weir Out	11.82	926.86	2.84	28.07	0.00
Transfer Function Out	0.00	0.00	0.00	0.00	0.00
Reuse Supplied	9.86	179.42	1.41	18.02	0.00
Reuse Requested	10.00	0.00	0.00	0.00	0.00
% Reuse Demand Met	98.59	0.00	0.00	0.00	0.00
% Load Reduction	11.19	28.50	22.97	15.99	37.22

Decimal Places 2

Figure 4 - Wonthaggi Recreational Reserve catchment water balance result for 10ML/year

2.4 Offtake & Primary Treatment

The most critical component of the stormwater harvesting scheme is the stormwater off-take. The functionality and reliability of the off-take is critical as a non-functioning, unreliable off-take leads to no harvested stormwater and no irrigation for Wonthaggi Recreational Reserve.

A Continuous Deflective Separation device (CDS Unit), model P1512 Gross Pollutant Trap (GPT) has been chosen as the offtake for the Wonthaggi Recreational Reserve stormwater harvesting design. There are two reasons for this. 1. The GPT can provide primary treatment at the same time as providing the offtake supply for the proposed underground storage tank, thus delivering Council significant savings on economies of scale by using a single piece of infrastructure for dual purposes; and 2. The reliability of supply of stormwater from a CDS will be substantially higher than other offtakes or GPTs that do block. This solution of using a CDS for the stormwater harvesting offtake & treatment is a well understood practice industry wide & it has worked very well for us in the past.

2.5 Raw Water Storage Tank

An underground storage tank of 1,000,000L was adopted for being able to combine flood storage capacity & cater for both current and future irrigation use. The Raw Water Storage Tank will be located in the low point of the recreational reserve. The designed tank is an Invisible Structures Rainstore^3 storage tank. This tank has been assessed as being able to deliver the best value for the size, quality and cost of a 1ML tank & has successfully been used on stormwater harvesting schemes in the past.

The advantage of the Invisible Structures tank is that it will be buried and out of site but accessible for maintenance and that it is flexible in shape as this is of particular advantage for the site and this tank provides significant flexibility with the sump for the submersible pump and cleaning access. It's a strong and durable solution that is well suited to this site & also is very environmentally friendly.

Figure 5 – Invisible Structures Rainstore^3 Tank

2.6 Secondary & Tertiary Treatment

The treatment system is proposed to be predominately made up of mechanical treatment. The mechanical treatment system offers a reliable, lower maintenance option for Council and will ensure the water will be treated to a level which is appropriate for irrigation. The treatment system will be housed within a purpose built treatment building/shed which will be located adjacent to the existing sheds behind the grand stands and allows ease of connection for the electrical supply.

The first stage is a 100 micron self backflushing screening filter which removes particles greater than 100 microns in size. The harvested water then passes through a media filter to further reduce this down to 5 microns, which then enables the UV to be effective. The final stage of the treatment is the tertiary stage. This will be made up of UV disinfection which will kill any microbes or coliforms which could be present in the harvested stormwater.

2.7 Existing Irrigation Tank

The existing below ground 10,000L irrigation header tank with 4 L/S irrigation pump is sufficient for the continuing irrigation of Wonthaggi Recreational Reserve for both Oval 1, Oval 2 and the future irrigation of Oval 3. Using the existing irrigation pump and header tank presents a significant cost and time saving for Council as it means the existing irrigation infrastructure can be continued to be used exactly as it did previously, even during the construction works. Once operational, a new level sensor will send a signal to the treatment system to start up and provide water, as soon as the irrigation cycle is commenced. The ease of utilising the existing irrigation system is also of benefit to Council in retaining the potable back up supply within the existing irrigation header tank.

Figure 6 – Existing irrigation header tank

2.8 Flood Detention

The 1/10year ARI storm event of 3,710m^3 is desired to be detained from the Wonthaggi Recreational Reserve catchment to minimise flooding downstream. This is possible to do with the

construction of a varying height natural earth bund, using spoil from the tank excavation, to a maximum height of 1m and a gradient of 1:3 to enable mowing to occur. This would be able to detain 4000m^3 or 108% of the 1/10 year ARI storm event. This is significant flood detention which will protect downstream properties.

Table 1 – Flood storm events, volumes and flow types

Flow type	ARI storm event	Total volume (m3)
Overland	**100 yr 2 hour**	**18,127**
Overland	10 yr 2 hour	3,710
Pipe	**100 yr 2 hour**	**2,224**
Pipe	10 yr 2 hour	1,956

2.9 Flood Retention

There is an innovative solution designed at the Wonthaggi Recreational Reserve which is to combine flood detention, retention and reuse through the utilisation of bioinfiltration trenches within the flood detention area to be able to harvest, treat and retain the overland flow by having it flow back into the underground storage tank through using a simple system of infiltration trenches containing gravel, sand and a slotted collection pipe within each trench that collects the water and conveys it to the Raw Water Storage Tank.

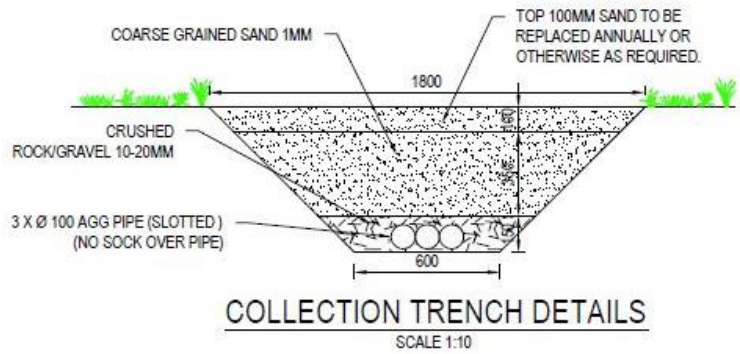

Figure 7 – Bio-infiltration trench details

3 RESULTS

This project is an exemplar of excellence in integrated stormwater design as it combines:

- Stormwater treatment – hard & soft engineering;
- Improved facilities for users, and high quality sports fields;
- Sustainability targets achieved through reduced potable use;

- Flood detention, up to 4 million litres and flood retention for reuse, up to 1 million litres;
- Improved environmental conditions in the wetland, via adjusting water level control;
- Improved amenability, liveability and sustainability through use of the sports fields;
- Great site aesthetics, due to predominantly underground works;
- It has an exceptionally high reliability of supply of 98.6%;
- It has multiple potential recipients of the water, and the benefits that the water brings;
- It has a lot of flexibility in its potential to be expanded in the future;
- It has a focus on practicality for construction, and ease of long term maintenance;
- It has the support from every department within the Council, as well as the Wonthaggi Reserve staff and businesses located there;
- 25% of Councils total potable water use will be eliminated;
- 60% of Councils Parks/Reserves potable water use will be eliminated; and
- It's the last irrigated oval to be removed from potable water usage in Bass Coast Shire.

It's rare to have so many stormwater elements all in one great project.

3.1 Acknowledgements

Optimal Stormwater would like to acknowledge Bass Coast Shire Council for the innovation in selecting the design, and Invisible Structures for their knowledge & technological tank design input.

3.2 Author Biographies

Hugh Williamson works in the position of Water Engineer for Optimal Stormwater & Henry & Hymas Consulting Engineers. Hugh graduated from RMIT University in Environmental Engineering with a major in Civil Engineering. Hugh worked previously at Hobsons Bay City Council as Student Engineer and Design Engineering Assistant and then worked at Melbourne Water as Investigation and Project Engineer in the Flood Mapping and Mitigation Team. Hugh has an interest in "stream daylighting" and has presented on this topic several times previously.

Laurie Gervasi holds the position of Asset Officer with Bass Coast Shire Council. Laurie has worked with Bass Coast Shire Council for a number of years and has overseen many stormwater harvesting projects.