USING RIPARIAN PROTECTION TO OFFSET TREATED WASTEWATER DISCHARGE

Kirsten Hogan, *Senior Environment Officer,* Goulburn Valley Water
Kirsten Roszak, *River Health Officer,* Goulburn Broken Catchment Management Authority

ABSTRACT

As populations rapidly grow on the urban fringe towns of Melbourne, water authorities are faced with increased inflows into their wastewater management facilities (WMF). Goulburn Valley Water (GVW) encountered this in Kilmore and needed to assess the future capacity of their WMF and options for reuse of the increased volumes of treated wastewater.

An options investigation was completed for alternative use of treated wastewater with discharge to the creek with a riparian offsets project deemed most viable. A proposal to remove nutrient input (Phosphorus) from other sources within the catchment was approved by the EPA in collaboration with the Goulburn Broken CMA. This included working with landholders along the Kilmore Creek catchment to undertake activities such as streamside fencing and revegetation.

Through the partnership with GVW and GB CMA, a strong community engagement process and an ongoing payment plan offered to landholders, we were able to achieve the 2025 offset target within the first 12 months of a 3-year plan.

Population growth in these once small rural towns provides opportunities for innovative projects, with strong environmental benefit, to be considered. Collaboration and co-design of projects between agencies and communities that benefit both the environment and accommodate the need for growth in these towns are at the forefront of river and land management.

1.0 INTRODUCTION

Goulburn Valley Water (GVW) provides water supply and sewerage services to the township of Kilmore, Victoria. Previously, sewage was treated at a lagoon-based wastewater management facility (WMF), with recycled water irrigated to land. Kilmore is located on the urban fringe of Melbourne and predicted to undergo significant population growth over the next 50 years. This will increase sewage volumes requiring management rendering the previous recycled water management method insufficient.

Traditional upgrade solutions, based around mechanical treatment, winter storage, and discharge to land posed several issues for this site. Upgrades to winter storage and irrigation was not viable, as land suitable, and of the scale required, is not available, making the traditional solution unsustainable. GVW investigated, and have implemented, a Riparian Offsets Scheme with a whole of catchment approach that sees additional recycled water returned to stream. This creates positive outcomes in terms of sustainable recycled water management and improved ecological values of the Kilmore and Kurkurac Creeks, currently in poor condition.

Extensive Ecological Risk Assessments (ERA) undertaken by ecologists were used to advise the offsets project. DELWP's Index of Stream Condition records Kurkurac Creek as in 'Poor' condition, and the ERAs identified Kilmore Creek to be in even poorer condition. The need to manage the nutrient concentrations in the recycled water was highlighted, particularly phosphorus and ammonia, and the importance of timing releases to the waterways to mimic natural flows and maximise environmental benefit.

The offsets project consisted of augmenting the existing WMF to reduce nutrient concentrations and disinfect the recycled water, utilising winter storages to allow for recycled water releases at specified times of the year to support ecological values, as well as catchment offsets to minimise sediment and nutrient transportation from farmland into waterways. The catchment works included stock exclusion, provision of off-stream watering points, riparian revegetation, and weed control.

Based on predicted discharge water quality and quantity, a phosphorus reduction target of 945 kg per annum was required to be offset through the implementation of catchment offsets. This includes a safety factor of 1.5 in accordance with the Water Quality Offsets Framework (Alluvium and Marsden Jacobs Associates, 2015). Through a partnership between GVW and Goulburn Broken Catchment Management Authority (GB CMA) the 2025 offset target was achieved within the first 12 months of a three-year plan.

This project was the first of its kind to be implemented in Victoria, with no precedence to provide assurance that the concept would be successful. With technical expertise, and knowledge in the processes proposed for the WMF upgrades, the understanding that the receiving waterways were in poor health, and initial engagement with landholders suggesting support to participate, GVW moved forward with confidence in the project.

2.0 DISCUSSION

The project objective was to improve the condition of Kilmore and Kurkurac Creeks through riparian protection works, and to satisfy the offset requirements under the EPA works approval and provide a method for the management of Kilmore's recycled water.

2.1 EPA Approval Process

This project was the first EPA works approval and licence amendment application in Victoria to include water quality offsets. GVW needed to provide confidence to the EPA that the proposed approach would be as effective as traditional point source controls and provide reassurance that no other more traditional option was suitable.

Prior to this project, GVW's EPA Licence for the Kilmore WMF only allowed for discharge to land. Discharge to water licence limits, informed by the ERAs, were agreed on with EPA prior to commencement of upgrade works. Once EPA were satisfied that augmentation works at the WMF were complete and offsets implemented according to the Works Approval, a Licence amendment was granted, allowing for discharge to creek.

2.2 Wastewater Management Facility Augmentation

Wastewater Management Facility (WMF) augmentation works were implemented to reduce nutrient levels in the final recycled water, prior to any discharge to waterway. Upgrades included additional aeration in treatment lagoons to assist ammonia reduction, and chemical dosing to reduce phosphorus load. Eight vertical flow wetland cells were constructed to further polish the recycled water, with UV disinfection prior to discharge to waterway.

2.3 Landholder and Community Engagement

The project success relied on frontage landholders to engage and participate in the offsets project. A total of 42 landholders in the offset zone along Kilmore and Kurkurac Creeks were individually consulted, accounting for 70% of the total possible landholders. These meetings explained the project and addressed questions or concerns, as well as gauging interest in participating in the project, and assessing works that may need to occur on each property. This allowed for more effective costings to be estimated for the project.

2.4 Options Analysis

When considering our approach to the implementation of this project, three key areas were considered and investigated.

- Would landholders participate to a level that ensured reaching the required offset?
- What would be the best process to ensure landholder participation in the project and how would this be delivered?
- How could we secure the required catchment offset into the future?

Several delivery options were proposed, and GVW proceeded with a fully funded incentives program with a yearly allowance paid to landholders based on the hectares protected. This additional payment provides landholders with funds for basic fence and site maintenance if needed and provides a 'loss of opportunity' payment.

2.5 Catchment Modelling

The Water Quality Model used in this assessment was developed for Melbourne Water by Central Queensland University (RMCG 2015). It was selected due to its ability to test a series of specific actions at property level and was used to estimate the amount of phosphorus that specific riparian works will intercept and therefore prevent from entering the waterway. Properties in the area are predominately used for mixed farming and grazing. After a review of the waterway and catchment condition using both aerial imagery and site visits, the actions identified included gully stabilization and rehabilitation, stock exclusion fencing (ha) and riparian revegetation (ha).

For each defined set of work the amount of phosphorus intercepted by a set unit of that action was modelled (Table 1). The model estimated the average annual kilograms of phosphorus reduction intercepted by these works.

Table 1: ***Description of works and modelled phosphorus reduction (RMCG 2015)***

Type of Work	Description	Model Output P reduction (kg/annum)	Units of Work
Gully Rehabilitation	1 gully is 5m wide x 300 m long, and 2 m deep	30	Per gully (300 x 5 x 2 m)
Riparian Fencing for stock exclusion	Fencing riparian area excluding 2 head of cattle (or equiv.) per hectare	12.7	Per hectare
Riparian buffer revegetation	Alter from pasture grasses to trees and medium density understorey	1.2	Per hectare

To deal with potential uncertainty of model predictions translating into practice, a safety

factor of 1.5 was allowed for, as in the Water Quality Offsets Framework (GVW, 2016).

The amount of phosphorus required to be offset was a combination of predicted discharge quantity and quality as well as the safety factor allowance. Table 2 below, shows the 2025 target for the average amount of phosphorus to be offset.

Table 2: ***Average recycled water volume***

Year	Average Discharge Volume (ML/ann.)	Average recycled water Phosphorus Concentration (mg/L)	Safety Factor	Average Phosphorus load to be Offset
2025	315	2	1.5	945

2.6 Implementation

Incentives were available to private landholders with frontage within the project scope of the Kilmore Creek, Kurkurac Creek and their tributaries. GVW provided financial support to landholders, fully funding targeted actions that would lead to the protection and management of riparian frontage and gully stabilisation, including fencing, revegetation and weed control. Landholders who required alternative water were provided with a capped monetary value dependent on the size of their protected area.

A total of 9 landholders signed up for the project. Table 3 outlines the completed outputs achieved and their phosphorus load offset.

Table 3: ***Project outputs per activity achieved***

Activity	Output	Phosphorus load offset by activity (Kg/ann.)
Landholder Agreement	9	n/a
Fencing (km)	17.07	n/a
Area Protected (ha)	77.7	986.79
Revegetation (ha)	46.2	55.44
Alternative Water Points	9	n/a
Total Offset (Target = 945)		**1,042.23**

2.7 Ongoing Monitoring

Various forms of monitoring have been implemented to assess the overall effectiveness of the offsets. A summary of these is outlined in Table 4.

Table 4: ***Summary of the monitoring program to assess the effects of offsets.***

Assessment	Indicator	Location/Area	Frequency
Management Actions	Length of frontage fenced (km)	Measured at all offsets works sites	At the end of each reporting period
	Area of revegetation (ha)		
Stream and riparian conditions	Nutrients and turbidity	Physio-chemical water quality sites	2 Monthly
	Macroinvertebrate fauna	Biological monitoring sites	Annually
	Riparian Intervention Monitoring (RIM) indicators	At nominated intervention and control sites	Pre intervention works and again in 3 years

Management Actions

The on-ground works implementation of the offsets project was scheduled over a three-year period. Year one was so successful that all targets were met in the first 12 months. Measures of all works including frontage fenced, and area revegetated have been recorded, and compared with the modelling, to inform that targets have been.

Water Quality

Fifteen physio-chemical and biological monitoring sites have been identified to assess for impact on the receiving waterways. These sites were originally established and monitored as part of the ERA process and include both control and impact sites. One site marks the end of the EPA's defined mixing zone in the Kilmore Creek, and will assist to assess mixing zone compliance, as well as the impact of the offsets located upstream. It will also inform potential to reduce the mixing zone over time. There has only been minimal discharge under the amended EPA Licence to date. A review of water quality results is currently underway to assess performance of the mixing zone and ensure minimal risk further downstream.

Riparian Intervention Monitoring

As a broad indicator of the effect of the offsets implemented, GVW funded a Riparian Intervention Monitoring (RIM) Assessment (Morris et al. 2015) of one of the sites participating in the project prior to completion of implementation works, combined with a control site. It is anticipated future assessments will show significant and positive change at the implementation site due to establishment of the offsets. Although not assessed, it can be assumed that similar results will be achieved at the other eight offsets sites.

Legal agreements and Annual site inspections

Riparian Offsets Management and Work Agreements have been established with participating landholders to ensure the ongoing integrity of the riparian offsets. Conditions include exclusion of stock, maintenance of stock proof fencing, and allowing access to GVW or their representatives to inspect the offsets works.

Site inspections are carried out annually, to allow GVW to assess the ongoing integrity of the offsets, necessity for weed control, and success of revegetation, while also maintaining the relationships with landholders that were so well established by the GB CMA.

Drone footage

GVW has been able to collect drone footage inhouse on an annual basis providing a visual record of change over time of the offsets properties. The most recent footage can be seen at https://youtu.be/Pqe1O1Tz70o.

3.0 CONCLUSION

The success of this project was attributed to several reasons, the most prominent being that of the poor condition of the Kilmore Creek and its tributaries. These waterways were, for the most part, unfenced with minimal to no riparian vegetation. This allowed for a large scope of potential offset sites. Additionally, landholders were positive about the project and took the opportunity to undertake riparian protection. Should the area have consisted largely of already protected frontages, or of waterways with higher pre-existing water quality, an offset project such as this may not have been the most viable option.

The management of the impact of rapidly growing townships by returning recycled water to stream in a controlled way whilst creating positive outcomes for the community and improved ecological values to a system in generally poor condition is a practical result of innovation.

A strong partnership and collaborative approach between GVW, GB CMA as well as support provided from the EPA, contributed to the success of this project. As regional specialists in establishing and implementing waterway health programs, GB CMA involvement provided the EPA with confidence in the effectiveness of the project (EPA 2018).

5.0 REFERENCES

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