

Is my river health intervention project working? Results and lessons learned from 10 years of riparian works monitoring in the Melbourne region.

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Key Points

- Since 2006, Melbourne Water has collected regular riparian vegetation and physical form condition data at 39 intervention sites across the Melbourne region.
- This large monitoring program provides data from which to assess the success of riparian intervention programs within the medium term.
- A case site provides an example of the trajectory of site recovery, and enables an assessment of the effectiveness of the Index of Stream Condition field monitoring method to detect change within a 10 year period.
- A broader analysis of works success will be possible over the coming years as more sites are assessed 10 year post works.

Abstract

Waterway managers invest significant resources into works aimed at improving waterway condition, yet very few assessments of the impact and effectiveness of these interventions are completed. This lack of data limits the capacity of our industry to apply adaptive management, and restricts our ability to clearly demonstrate the outcomes and value of these investments.

In 2017/18, the first 10 year post-work monitoring data has been collected within Melbourne Water's Capital Works Monitoring Program. The Program was established in 2006 as the 'gold' standard of condition change monitoring following investment in river health improvement projects. Sites are assessed using components of the Victorian Government's Index of Stream Condition (ISC) before the works are delivered, and then at 1, 3, 6 and 10 years post-work intervals.

The data collected to date demonstrates measurable changes in condition resulting from intervention works over 3, 6 and 10 year timeframes. Data gathered from the Capital Works Monitoring provides a valuable resource to inform adaptive management and advance work practices. Importantly, it provides evidence to support a common assumption applied by waterway managers; that waterway intervention works result in an improvement in waterway condition. As more sites are assessed 10 years post works, we will continue to validate the evidence behind these assumptions.

Keywords

Riparian rehabilitation; riparian vegetation; evidence based practice; works monitoring; Index of Stream Condition

Introduction

Waterway managers invest significant funding in river rehabilitation, with over \$700 million invested between 1995 and 2007 (Price et al. 2009, Fryirs et al. 2013). Despite this significant investment, monitoring to assess the success of interventions is rarely undertaken effectively (Hale et al. 2018). As a result, data demonstrating outcomes from investment in river rehabilitation remains largely unavailable

(Reich et al. 2016). This lack of data limits the capacity of waterway managers to apply adaptive management, and restricts our ability to clearly demonstrate the outcomes and value of these investments.

Riparian zones play a vital role in supporting healthy waterways. Healthy riparian vegetation moderates water quality, is a primary source of nutrients for waterway ecosystems and processes, and provides habitat for numerous instream and terrestrial species (Hale et al. 2018). Riparian interventions are by far the most common form of river rehabilitation in Australia (Reich et al. 2016), with projects typically focusing on restoring the structure of riparian vegetation. For example, between 2013 and 2016 over 700 km of vegetation was established along waterways in the Melbourne region, and more than 7000 km of vegetation management was undertaken in the same period.

Here, we present a case study of the results from a 10 year experiment established across the greater Melbourne area to assess how riparian vegetation structure and composition responded to interventions such as livestock removal, bank stabilization, weed control and revegetation. Our aim was to assess if the condition of the riparian zone improved following intervention, and to identify which intervention approaches were most successful. In doing so, we also aimed to test if the Index of Stream Condition methodology was an effective method of detecting results within a 10 year timeframe.

Methods

Study sites

We selected sites to be representative of a range of riparian vegetation types and conditions across the Melbourne region. Thirty-one sites were established between autumn 2006 and spring 2009 (Figure 1). Interventions included woody and herbaceous weed control (e.g. willow, blackberry, thistles), revegetation, riparian fencing, bed and bank stabilization, in various combinations (see Figure 1).

Revegetation was guided by Melbourne Water's revegetation templates, based from the modelled pre-European settlement Ecological Vegetation Class (EVC) and local conditions at the site. Livestock were removed prior to revegetation. The majority of sites were located on private or leased crown land frontages in rural landscapes. An initial period of revegetation establishment was provided by Melbourne Water (2-3 years), after which the site was returned to the landholder to manage with the option of grant based support from Melbourne Water.

For each works site, complementary control sites were established upstream and/or downstream. Where possible, control sites were chosen where the riparian vegetation and physical form were similar to the works site in terms of vegetation type, structure and condition. The nominated control sites were free from the influence of management, and were to have no management plans for the following 5 years. At each waterway, measuring sites were usually 430 m long, with the controls located as close as possible upstream and downstream. Control sites were assessed using the same methods applied at works sites.

Vegetation and physical form monitoring

Vegetation and physical form were assessed either during the autumn or spring prior to the intervention activity, and then at one, 3, 6 and 10 years post works. At each site sampling was completed during the same season as the initial, pre-works assessment. Monitoring was undertaken using the 2004 (2nd edition) Index of Stream Condition (ISC)(DSE 2006) and permanent photopoints. The ISC assesses various components of the vegetation and physical form of the waterway, including the quality and quantity of riparian vegetation, along with channel stability and amount of physical habitat. Full ISC methods are available here: http://ics.water.vic.gov.au/ics/files/ISC_field_manual_main_report.pdf. ISC sub index scores for condition were calculated and site results were assessed against the control locations

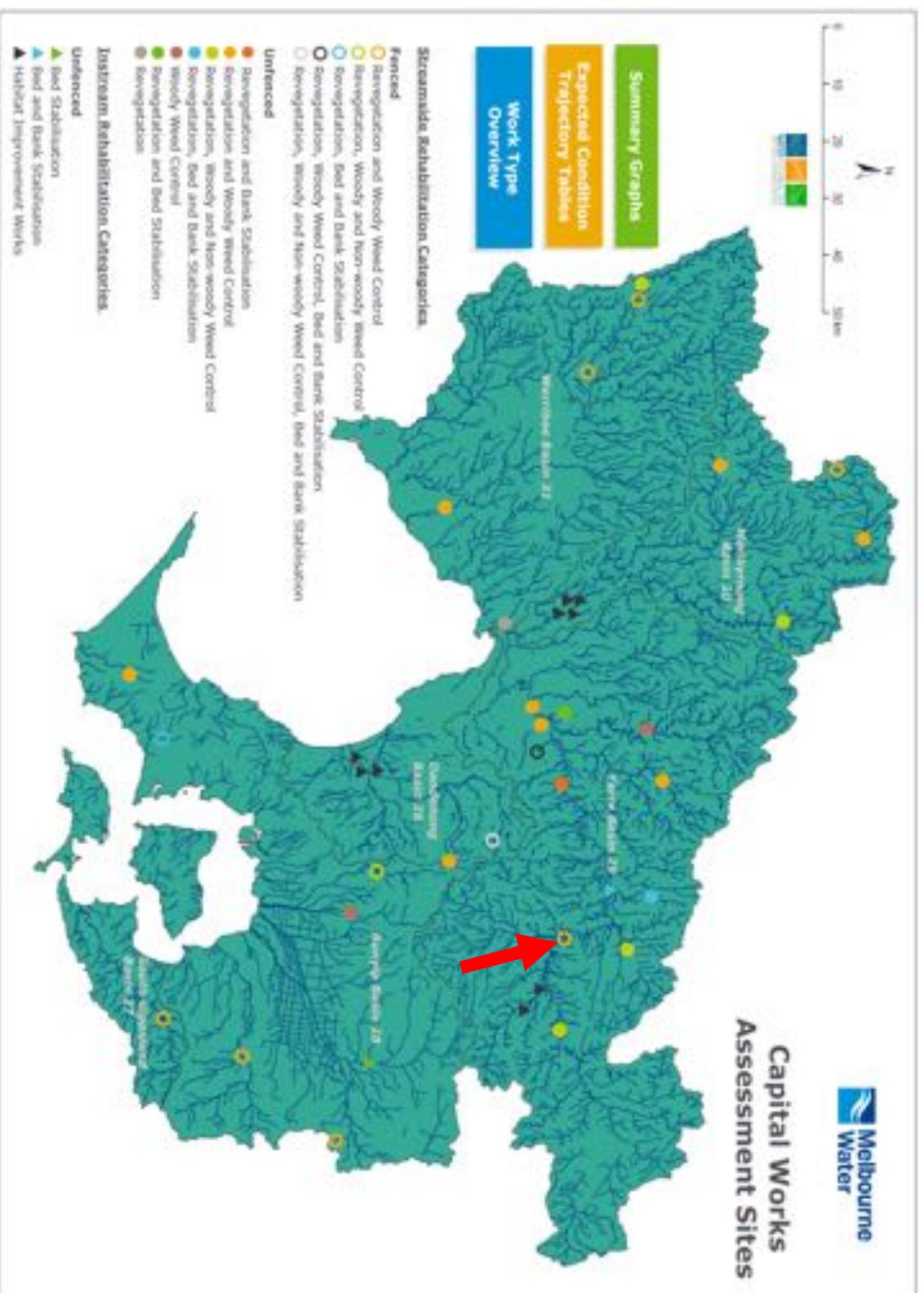


Figure 1: Map of study sites within Melbourne Water region. Red arrow identifies location of case study project site.

Results

The data collected to date demonstrates measurable changes in condition resulting from intervention works over 3, 6 and 10 year timeframes. The results show that different types of interventions express varying rates of condition change over time, and that pre-intervention condition can greatly influence the rate of change at a site. Here, we present an individual site examination of ISC condition metric trends over 10 years.

A works site on the Yarra River upstream of Healesville has been selected to examine how the ISC condition metrics have responded over 10 years following riparian intervention works. This site was selected as it underwent a common form of intervention (i.e. willow and other weed control, fencing and revegetation) to protect the site from the most common threats (i.e. weed invasion/competition and grazing pressure).

Baseline or pre-works condition

The site was openly grazed and the frontage contained crack willow and a number of weeds including Hawthorn, Blackberry, Jerusalem Cherry and Tradescantia. The native vegetation was mostly limited to mature Silver Wattle and the occasional Manna Gum.



Figure 0-1 Yarra River upstream from Transect 1 - willow infested pre-works and established native vegetation 10yr post works

Works undertaken and follow up maintenance

Willows were felled, the shoot system removed with stumps painted with herbicide and left in situ to rot. Other weeds were controlled and the frontage was revegetated with a range of tree, shrub and ground layer species. The entire frontage, approximately 450 m long, was fenced with an offset of approximately 15 m from top of bank. Most of the follow up maintenance, principally weed control, has been undertaken by the landholder.

How the overall Sub-index scores have reacted over time

- **Physical Form** – The Physical Form showed an initial decline 1yr post works due to a slight reduction in the instream large wood score. This is likely due to many willow branches/trunks being removed from the

river during the willow control works. That metric improved in the following five years and then fell back to baseline condition level at the 10yr assessment.

- **Streamside Zone** – The Streamside Zone showed improvement in condition immediately after works and continued to improve to the 6yr post works assessment before slipping down in condition at the 10yr post works assessment.

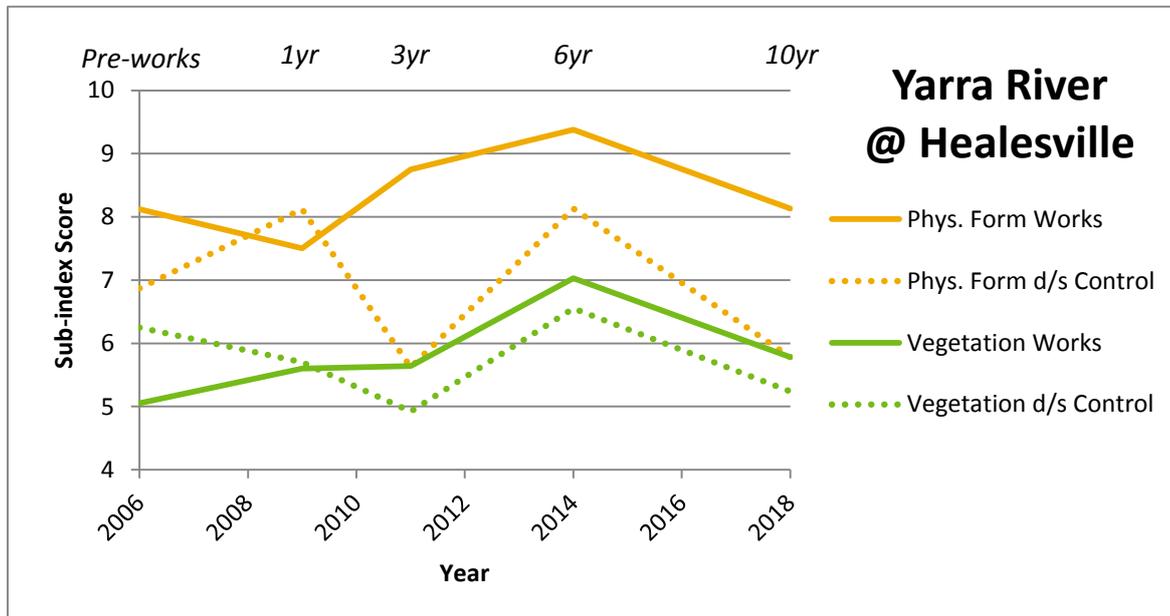


Figure 0-2 Yarra River @ Healesville Sub-index score movements up to 10 years post works

Analysis of individual condition metric movements:

In order to understand how and why the Sub-index condition scores have changed over time, the individual condition metric movements have been examined.

Physical Form Sub-index metrics

This Sub-index contains only three metrics, with ‘Bank Condition’ more heavily weighted.

- **Bank Condition** – The banks had limited erosion (very minor) at baseline, 1yr and 10yr. The banks were considered stable during the 3yr and 6yr assessments. Limited erosion is minor and can be caused by animal movement (e.g. deer or wombats)
- **Instream Large Wood** – Wood loads in the river had reduced slightly following works. This was likely to be due to willow debris was removed from the river during works. The river has subsequently recruited more logs and has returned to pre-works densities.
- **Fish Barriers** – The fish barrier rating is unchanged since pre-works with unimpeded fish movement to the site.

Streamside Zone Sub-index metrics

This Sub-index contains nine condition metrics with 'Understorey' carrying the highest weighting.

- **Understorey** – Although the understorey improved from the first year (more native lifeforms present), the improvement was not sufficient to trigger an increase the score until the 6yr post assessment. This occurred when \geq half the Ecological Vegetation Class (EVC) benchmark lifeforms were recorded. Interestingly, due to the dry conditions leading up to the 10yr assessment, one less lifeform (large herbs) was identified and the score dropped substantially. The identification of one less lifeform accounted for an appreciable reduction in Sub-index score between the 6yr and 10yr assessments.
- **Weeds** – This metric steadily improved up until the 10yr assessment when it fell slightly due to a slight increase in woody weed cover.
- **Longitudinal Continuity** – This site has always maintained a maximum score through continuous woody vegetation along the length of the measuring site.
- **Width** – The width improved after works were implemented, however, this metric cannot increase further as it is constrained by the fence that was installed to control grazing pressure.
- **Large Trees** – This metric requires trees to grow and exceed the EVC benchmark large tree size. If remnant trees, just smaller than the large tree size, are present, this score can increase in the short to medium term. However, revegetation will take a considerable length of time (i.e. at least 40 years) to reach large tree size and influence the score. In addition, existing large trees can fall and may reduce the score.
- **Recruitment** – This metric improved initially through revegetation. Natural recruitment followed as plants matured and the frontage was protected from grazing pressure through fencing. The recruitment score stayed high through to the 10yr post works assessment. Recruitment has reduced at other 10yr sites as the revegetation matures and fills the frontage, leaving limited light and too much competition for seedlings to establish.
- **Tree Canopy Cover** – This metric showed a steady increase post works until the 10yr assessment when the score dropped appreciably because the cover was too high. The EVC benchmark specifies a cover percentage that is likely found in a 'mature and apparently long-undisturbed state of the same vegetation type'. If the canopy cover is greater than 150% of the prescribed benchmark cover, the score is reduced. As tree revegetation matures, it is found to be reaching canopy classification around the 10yr mark and has relatively dense projective foliage cover compared to a 'mature and long-undisturbed state'. Over the longer term this canopy will thin and is expected to return to a projective foliage cover closer to benchmark.
- **Organic Litter** – This metric is very difficult to assess consistently, particularly across a large transect area. This score fluctuated slightly between assessments with no real trend apparent.
- **Logs** – The log score reduced slightly after works, presumably due to willow shoot systems and debris being removed and burnt during works. This score increased slightly with each reassessment up to 6yr and remained the same at the 10yr assessment.



Figure 0-3 Tree growth from 6yr (sub-canopy lifeform) to 10yr (canopy lifeform)

Control Site score movements

The control site is located downstream of the works site and showed a similar decline in condition between the 6yr and 10yr assessments. As had occurred at the works site, the Physical Form Sub-index score fell due to a decline in bank condition. The Vegetation Sub-index fell due to a decline in condition in three metrics; Understorey, Weeds and Tree Canopy. The Understorey score was reduced as fewer native vegetation life forms were observed, namely herbs, and likely due to the dry conditions experienced leading up to the assessment. Blackberries had become more abundant over much of the frontage, leading to a reduction in weed score. The Canopy metric also fell in response to slightly decreased cover and health.

Conclusions

Monitoring has been undertaken for 10 years post works at 6 riparian rehabilitation sites. While this level of available monitoring data is extremely rare, it still represents only the early trajectory of response post intervention. However, it does provide valuable insights into the early responses of riparian zone condition following management interventions, and allows us to test the accuracy of our assumed responses.

There are also less measurable benefits in re-engagement during repeat assessments. Most landholders are keen to know how their frontages are performing, are curious about the changes and wanting to improve their management practices. Re-engagement helps to reinforce the relationships (even if undertaken by contractors) and provides the opportunity to encourage and commend landholders, and provide follow up assistance where required (advice or works).

Lessons and limitations of the Index of Stream Condition assessment method

The ISC method overall has proven to be sensitive enough to detect condition change at riparian intervention works sites over relatively short periods of time. Clear trends in condition have been measured and therefore can be predicted for a range of works and management actions.

An interesting limitation of the method is that some condition metrics have responded negatively in the medium term (10 years) despite, arguably, the frontage showing an ongoing improvement in condition. Two condition metrics that have responded negatively are Recruitment and Canopy Cover. Recruitment naturally declined or ceased as the frontage became full of woody cover, thereby shading and outcompeting potential seedlings. With the frontage being so 'full', there is no need for recruitment yet the score declines. Canopy cover is scored down if there is too much canopy, a legacy of the method being using a referential approach to condition based on a "mature and apparently long-undisturbed state of the same vegetation type" (DSE 2007). The trees in the frontage are growing vigorously and aggressively competing for light. Over the longer term these trees will thin and the projected foliage cover will reduce closer to benchmark levels. Meanwhile the score will remain lower until the natural thinning occurs. As the thinning occurs, or as trees senesce and fall, more light and resources will become available and some level of recruitment is likely.

This initial data gathered from the Capital Works Monitoring program provides a valuable resource to inform adaptive management and advance work practices. Importantly, it provides evidence to support a common assumption applied by waterway managers; that waterway intervention works result in an improvement in waterway condition. As more sites are assessed 10 years post works, we will continue to validate the evidence behind these assumptions.

Acknowledgments

Melbourne Water would like to thank the landholders who have permitted access and reassessment of the works and control sites over a prolonged period. It should be noted that since initial contact and repeat assessments, sometimes with new landholders, access has never been denied.

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