Tried, true and new: An ever-evolving riparian vegetation monitoring program

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Key points

- A repeatable, large-scale monitoring program is successfully generating consistent, long-term data on riparian vegetation condition.
- Riparian vegetation condition has remained broadly stable between 2021 and 2025, indicating no major regional-scale decline or improvement.
- Deer impacts have increased significantly and, together with differing catchment trajectories, highlight important localised changes.
- These findings demonstrate the need for more targeted, catchment-specific and adaptive management responses to address emerging threats.

Abstract

Understanding riparian vegetation condition across the Port Phillip and Westernport region is critical for guiding investment and managing emerging threats. The Streamside Vegetation Assessment (SVA) program, first implemented in 2021, was repeated in 2025 across 506 sites to support long-term monitoring of condition and trajectory. Results indicate that overall, vegetation condition has remained broadly stable, but with some localised differences between catchments and a significant increase in deer impacts, now affecting approximately one-third of sites. Increases in deer presence were particularly evident within the Yarra, Werribee and Maribyrnong catchments. The program has also evolved to support additional applications, including research on remote sensing and habitat suitability modelling. These findings highlight both the value of ongoing monitoring and the need for targeted management responses to emerging threats.

Keywords

Riparian vegetation, vegetation condition, deer threat

Introduction

Riparian areas, critical for the health and amenity of waterways, face numerous anthropogenic pressures, including climate and land-use change and impacts from invasive species. These impacts have led to the degradation of numerous stream ecosystems across the country (Naiman et al., 1993). Riparian vegetation improvement and management is a core activity for Melbourne Water. The Healthy Waterways Strategy (HWS) (2018) is the overarching planning document for the management of rivers, wetlands and estuaries in the Port Phillip and Westernport region (PPWP) that includes many targets that relate to maintaining or improving the extent and condition of riparian vegetation.

Understanding vegetation condition and trajectory across the PPWP region is essential to understand risks to vegetation and to guide prioritisation of investment. Prior to the establishment of the SVA there was limited fit-for-purpose monitoring data available to inform long-term target setting and condition improvement planning.

The SVA program was established to address key questions relating to long-term native vegetation condition across the region - including the impacts of climate change and associated threats - and to enable vegetation condition to be assessed at the appropriate scale critical for strategy planning and evaluation (Dell, M., 2020, Melbourne Water, 2020). The first round of monitoring was undertaken in 2021 and the second round in 2025 with the intent of continuing monitoring every ~5 years.

Water Technology was engaged by Melbourne Water to assess vegetation condition at 506 sites, across the five major catchments of the PPWP region in 2025/26. To support consistency, many of the assessors who completed the 2021 surveys were also part of the 2025 program. At each site a rapid assessment method called Vegetation Visions was applied, and at 80 of these sites a detailed assessment (hereafter referred to as Detailed) was also conducted. The sites were assessed during spring and summer.

Methodology

The monitoring method, originally established by Dell (2020) combines a rapid vegetation assessment method (based on Melbourne Water Vegetation Visions) at 506 sites across the region with a more detailed method at a subset of 80 sites. This paper discusses results of the rapid assessment; however, some aspects of the detailed methods and locations are shared to more thoroughly represent the purpose of the program.

Study area and sites

The SVA site locations conducted in 2025 are presented below in Figure 1. Seventeen of the original sites from 2021 needed to be relocated, primarily due to issues with obtaining access to private land. When site relocation was required, new locations were chosen in the same sub-catchment and, where possible, matching the Ecological Vegetation Class (EVC) of the original location. The number of sites in each catchment is presented in Table 1.

Figure 1 Site locations for riparian vegetation assessments 2025. Rapid assessment locations are depicted with pink circles and detailed assessment sites with green stars. The five major Melbourne Water catchment boundaries are marked. The 17 locations of the 2021 sites moved in 2025 are shown in grey crosses

Table 1 Sites catchment summary

Catchment	Vegetation Visions	Detailed Assessments	Moved sites
Werribee	102	13	3
Maribyrnong	56	11	4
Yarra	185	30	7
Dandenong	36	4	0
Western Port	127	22	3
Totals	**506**	**80**	**17**

Vegetation Vision assessment

In 2025 the Vegetation Visions assessment method incorporated some important new updates to evolve the program to support a broader range of data uses. The method was originally a scoring scale of ordinal measures of vegetation condition, determined for five main variables that were scored out of 5 (0 being very low, 5 being very high): vegetation structure, native plant diversity, patch shape and fragmentation, instream vegetation composition and natural regeneration. The ratings apply to a representative area of 20 m wide to 100 m long along one side of the waterway. Maps using georeferencing coordinates from 2021 were used to locate sites. In 2025, more detailed instream species measures were included in the method to support research efforts to explore the development of instream vegetation habitat suitability models. Additionally, invasive weed cover was added as a separate measure to overall weed score to highlight priority weed threats.

Site information, including date, time, assessor names, upstream and downstream coordinates, ecological vegetation class (EVC), and vegetation type was recorded at each site. Individual component scores were combined to derive a summed condition score. This score was then converted to a relative condition score by dividing the summed score by 5 (the number of variables measured).

Additional observations were recorded to determine site condition. This included instream vegetation composition, weed cover, and the presence of key threats and disturbance indicators, including deer impacts, rabbit activity, fox activity, native vegetation clearing, soil surface erosion, bank collapse, and other terrestrial disturbance features observed during site assessments

The original method (Dell, 2020) was adapted to include a more detailed assessment of instream vegetation, incorporating the identification of instream lifeforms, the presence or absence of key aquatic plant species, and an estimate of instream weediness.

Detailed riparian vegetation condition assessment

A Detailed Riparian Vegetation Condition assessment was undertaken following the methodology outlined by Dell (2020). At each site, a 20 x 20 m plot was marked in 2021 with hardwood stakes adjacent to the waterway and re-established in 2025. Within this plot, 3 transects were positioned at right angles to the channel, 10m apart. Along each transect, five 2x2 m sub-plots were surveyed at 5 m intervals, totaling fifteen subplots per site. Within each sub-plot, the frequency, growth form and structure of all vascular plant species was recorded. Maximum height was measured to characterise vegetation strata. After plot sampling, the site was surveyed to capture additional species not detected within the sub-plots. Leaf litter was recorded at the outside endpoints of the horizontal and vertical intersects.

Canopy condition was assessed along transects using point intercept measures to estimate cover and dieback. Broader structural attributes were also recorded, including canopy height, basal area, recruitment, number of standing dead trees, and the size and length of large logs.

Data analysis

A high-level data comparison between 2021 and 2025 data was undertaken to visualise changes in vegetation condition, weediness and threat presence between the two assessment periods. Analyses were conducted at both site and catchment scales to examine spatial and temporal variability across the Melbourne Water region.

Results

Program implementation

One of the significant challenges faced when managing the deployment of a large program with 5-year intervals is the practicalities associated with obtaining permission from private landholders. As the site locations by design aim to be representative of the region, many are invariably on private land. Observationally, landholder turnover between 2021 and 2025 was considerable, and even more notable was how difficult it was to contact landholders. Letters were mailed out, often followed by two or three attempts to visit. Obtaining contemporary landholder information was challenging to coordinate across 36 municipalities. It is estimated that the last 40 sites (10%) took over a month to complete. Many landholders were cooperative and very accommodating and equally others were definitively not interested, or even threatening regarding the request to access waterways through private land.

Anecdotally, pairing junior and senior botanists together benefited both parties, particularly those that were involved in the Detailed assessments. Sharing tips on species identification was enjoyed by both parties and has clear benefits for younger staff who are building skills.

Vegetation Vision assessment

Changes in Vegetation Visions relative condition scores between 2021 and 2025 are presented in Figure 2. The relative condition score was derived by combining structure, richness, patch and regeneration sub-scores to produce a total score between 0 and 20, which was subsequently classified into a relative condition category ranging from 1 (lowest condition) to 5 (highest condition). Site-level condition trajectories were used to examine patterns of condition improvement, decline or stability between survey periods and catchments. Comparison of condition score distributions between 2021 and 2025 provided additional context for the observed catchment-scale condition changes across the monitoring locations (Figure 3).

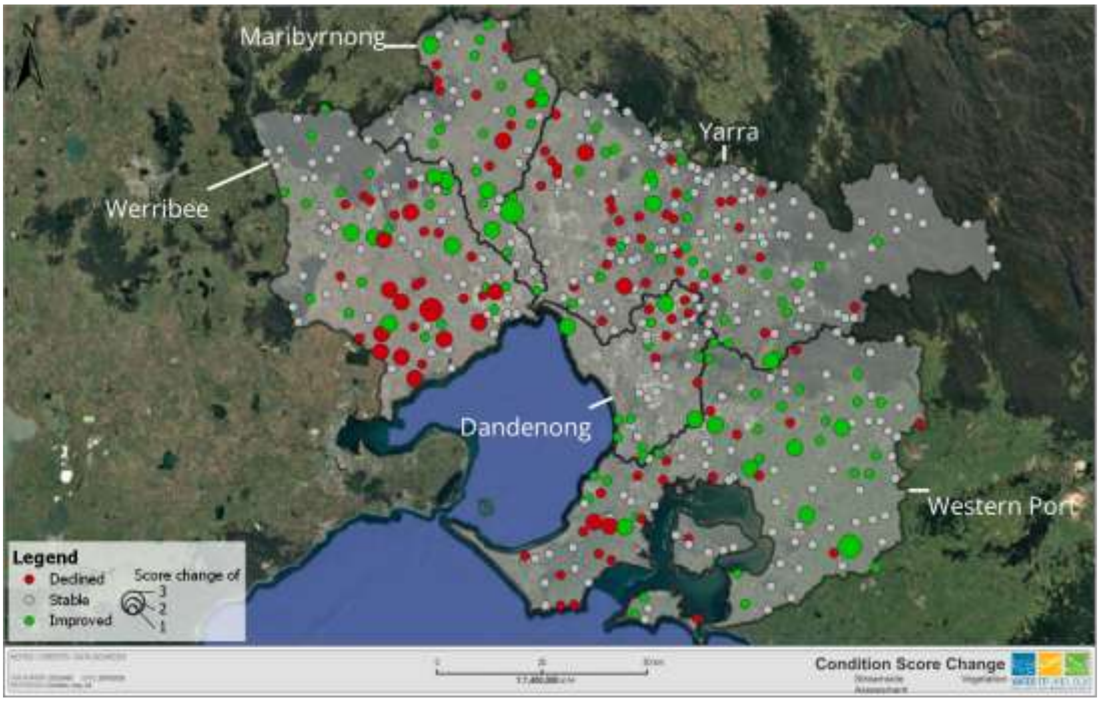

Figure 2 Site-level relative condition score differences between 2021 and 2025. Relative site score ranges 1-5. Point colour represents declining (red), stable (grey) or improving (green) condition scores, while point size represents the magnitude of condition score change between 2021 and 2025. Large dots represent score changes of 3, medium dots score changes of 2 and small dots score changes of 1.

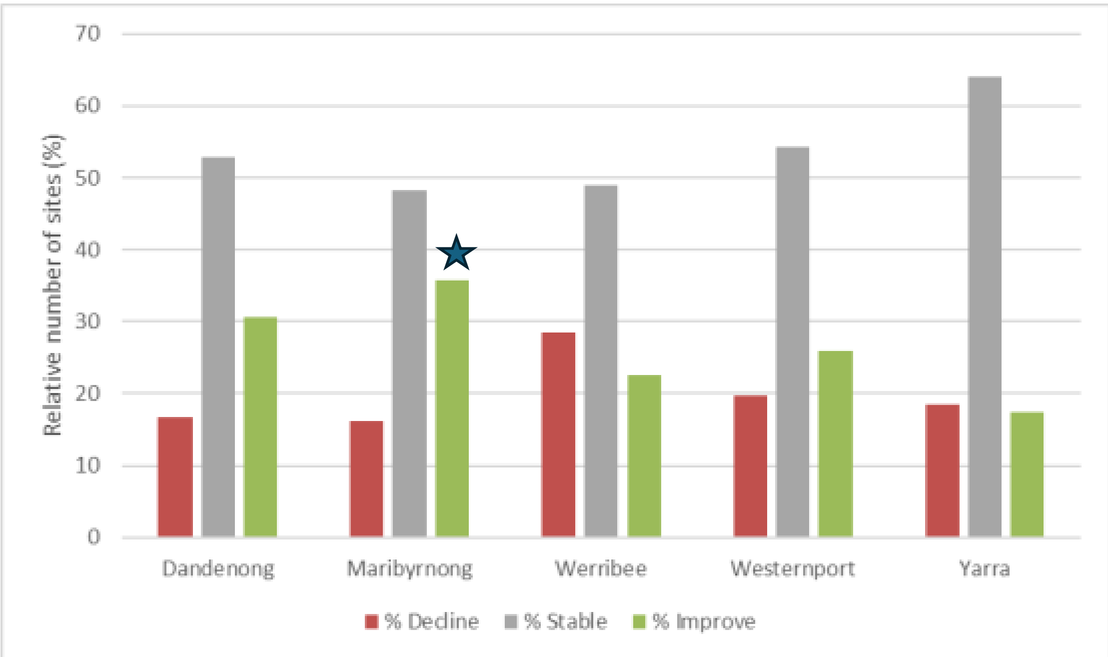

Figure3 Percentage of sites within each catchment showing condition score decline, improvement or stability between 2021 to 2025. Star indicates Maribyrnong conditions score improvement (p=0.018)

Vegetation condition scores were broadly stable across the monitoring network between 2021 and 2025, with no significant overall difference detected between years (Figure 3, p = 0.142). However, condition trajectories differed significantly between catchments (p = 0.028). Maribyrnong was the only catchment to demonstrate a significant increase in mean condition score between surveys (p = 0.018), increasing from an estimated mean condition score of 3.32 in 2021 to 3.59 in 2025. In contrast, no significant changes at catchment scale were detected in Dandenong, Werribee (p = 0.127), Westernport (p = 0.141) or Yarra (p = 0.930).

Analysis of site-level condition trajectories demonstrated that the magnitude of condition change differed significantly between catchments (Figure 2, p = 0.004). Werribee exhibited the greatest average magnitude of change (mean absolute change = 0.70 condition classes), while Yarra exhibited the lowest (mean absolute change = 0.40 condition classes). When the direction of change was considered, catchment differences were significant (p = 0.028), with Maribyrnong exhibiting the most positive overall trajectory (+0.27 condition classes) and Werribee exhibiting a slight net decline (-0.13 condition classes).

Comparison of threat data between 2021 and 2025 highlighted changes in the occurrence of key threats across all the sites (Figure 4). Deer presence increased significantly across the region between 2021 and 2025 ($p < 0.001$) with deer impacts detected at almost 1/3 of all monitoring sites representing a 20% increase since 2021.

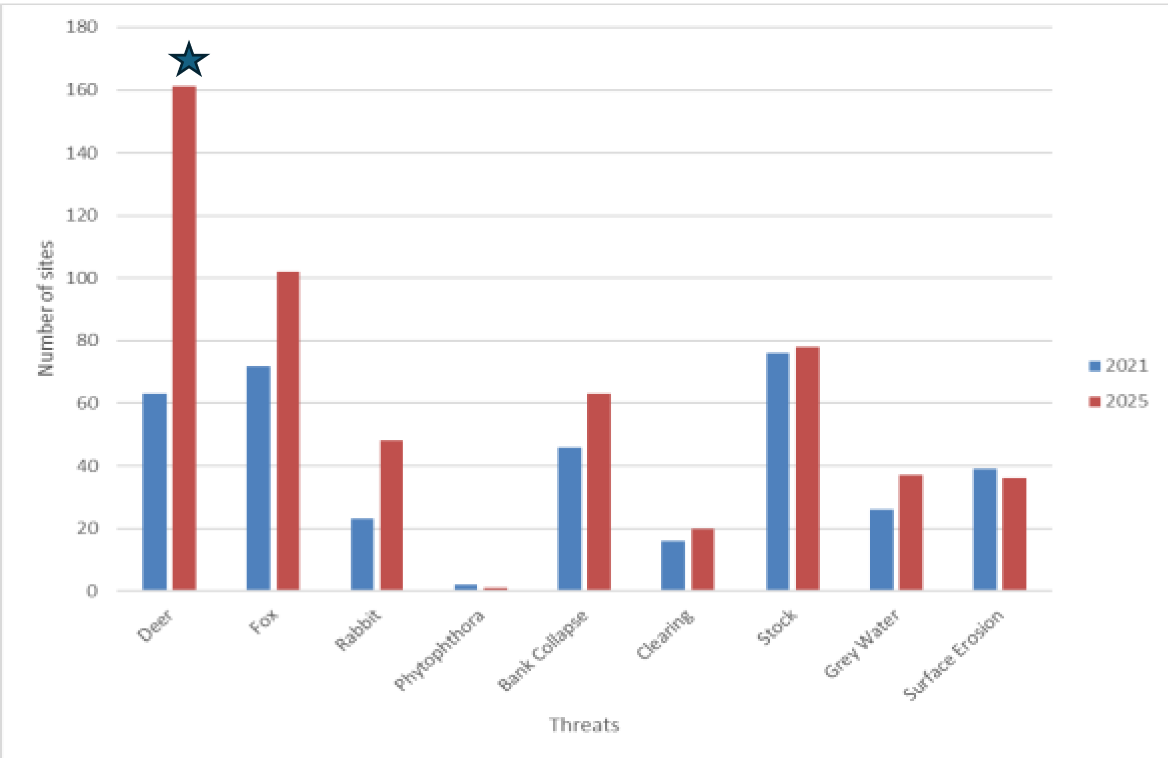

Figure 4 Number of monitoring sites where individual threats were recorded during 2021 and 2025 rapid assessments across all locations. Star indicates significant increase in deer (p<0.001)

The number of sites with recorded deer impacts increased across most catchments, with particularly strong increases observed in Yarra and Werribee (Figure 5). The increase observed in the Werribee catchment is notable as deer-related threats were not recorded anywhere in the catchment during the 2021 surveys.

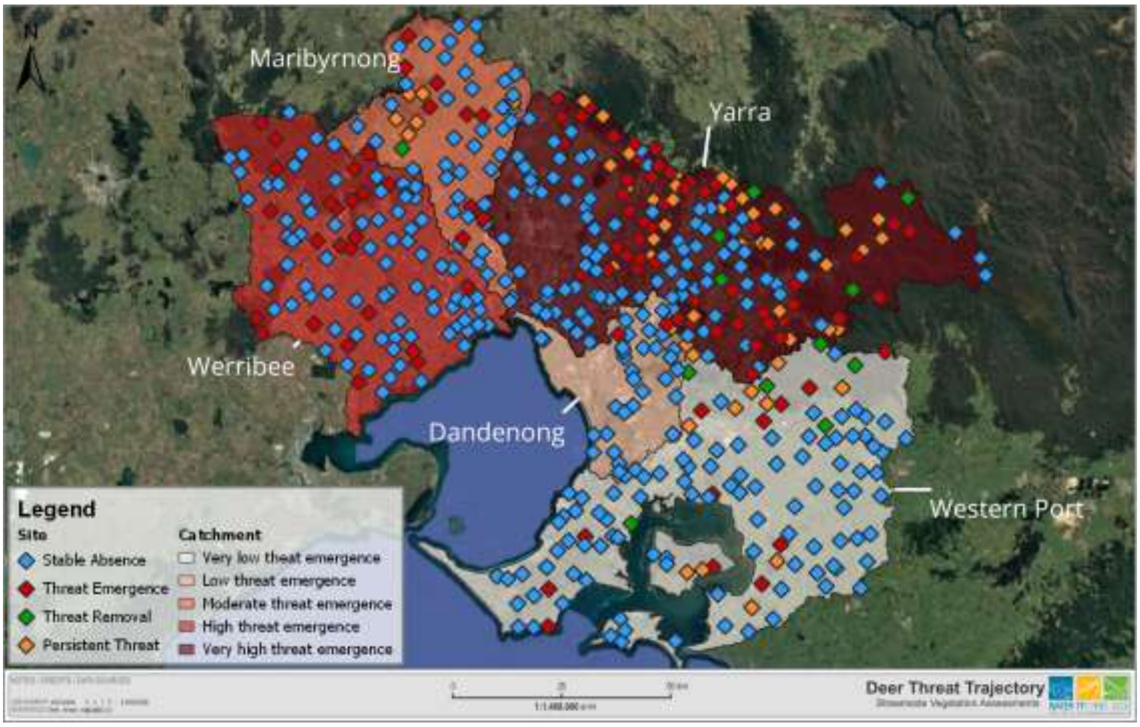

Figure 5 Deer-related changes in threat between 2021 to 2025 across all sites. Point colour represents stable absence (blue), threat emergence (red), threat removal (green) or persistent deer-related impacts (orange) between survey periods. The colour of catchment indicates the relative increase in deer-related impacts between survey periods

Discussion

The combined results suggest that despite vegetation condition remaining relatively stable between 2021 and 2025, there are important spatial differences that are noteworthy. Catchments exhibited distinct condition trajectories, with Werribee exhibiting the greatest degree of change with a slight net average decline overall and increase in deer threat between the two monitoring periods. In contrast the neighboring Maribyrnong catchment sites show evidence of significant improvement. Average Yarra site condition remained comparatively stable overall, despite deer impacts significantly increasing in 2025.

The substantial increase in the detection of deer in riparian zones between the two-time frames, particularly in the Werribee and Yarra catchments, is concerning. Even though the program was established primarily to detect long-term changes over time these findings highlight the value of examining the data after each round of monitoring so that changes such as these can be flagged and integrated into improved planning and management strategies.

The Healthy Waterways Strategy has reported across multiple annual reports and concluded through the strategy midterm evaluation process (Melbourne Water, 2024) that deer are increasingly a threat to asset condition and the long-term investment strategy to protect and improve riparian condition in the region. This data is supportive of how significant this issue is and that control measures are not yet sufficient, despite the efforts of multiple agencies including Melbourne Water and coordinated plans such as the Peri-urban Deer Management Program (DEECA, 2021)

The establishment of this long-term monitoring program and the data it collects will be crucial for the end of strategy evaluation process, the development of the next waterway and catchment management strategy, (currently underway) and for informing future adaptive management processes and practices. It may also be used for communication and collaboration with stakeholders regarding priority locations for riparian works and informing control programs for emerging threats detected across the catchment.

Beyond Melbourne Water's use of the data for strategy and management purposes, it is also proved valuable for research efforts. For example, results from the rapid condition assessments were combined with satellite data (Sentinel-2 imagery) to model riparian vegetation condition across the Port Phillip and Westernport Catchment (Hislop *et al*. 2025). Modifications to the monitoring method in 2025 enable the data to be used to explore the development of habitat suitability models for in-stream species. While adaptation of the method is required so that the program responds to opportunities for additional value to be explored, care should be taken to ensure the long term aims of the program are maintained.

Capacity building

A monitoring program as large as this required the deployment of multiple teams of botanists over several months in order to deliver within the designated time frames. Water Tech botanists teamed with independent contractors who have many years of experience working with landholders across the Melbourne region as well as staff from of the Arthur Rylah Institute. Pairing junior and senior botanists together wherever possible maximised the development of skills for the less experienced staff and contributed to building the network of botanists across the state. This clear and immediate benefit was a highlight of the project overall. A genuine feeling of camaraderie was built across the program which invariably will not only be an ongoing legacy of the 2025 deployment but potentially future iterations.

Figure 6 The significance of the networking and capacity building benefits of a large program like the SVA cannot be underestimated

Conclusions

The SVA program has demonstrated both its value and its resilience through two monitoring rounds. Although riparian vegetation condition across the Port Phillip and Westernport region remained broadly stable between 2021 and 2025, the significant and rapid expansion of deer into riparian zones — particularly in the Werribee and Yarra catchments — is a clear signal that requires management response. The data supports calls for stronger, better-coordinated deer control efforts across multiple agencies, and confirms that current control measures are not keeping pace with the spread of this threat.

The SVA design — stratified, spatially representative, and repeated on a five-year cycle — is proving fit for purpose as a long-term evidence base for strategy development and adaptive management. Its value will grow with each additional monitoring round. The program's expanding utility, from remote sensing model training to in-stream habitat suitability research, highlights the importance of thoughtful method evolution that does not compromise long-term comparability. Future program managers should continue to balance innovation with consistency.

Finally, the intentional pairing of junior and senior practitioners across this program has delivered an immediate and lasting investment in the botanical workforce of Victoria. This model — building skills and professional networks through program delivery rather than as a separate activity — is a transferable lesson for waterway managers running large, field-based monitoring programs anywhere in Australia.

Acknowledgements

The authors would like to acknowledge Ruby Carr for her assistance in drafting the manuscript for this paper.

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