Waterways adaptive planning – a key planning mechanism to meet obligations and objectives over a 10-year+ timeframe

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Key points

- Melbourne Water is piloting the development of Adaptive Service Plans (ASPs) for waterway planning. ASP's are anticipated to be a key waterway planning mechanism to identify the significant shifts required to adapt and help meet obligations and objectives over a 10+ year timeframe.
- A key component of an ASP is the identification of multiple future pathways that can be implemented under different conditions. This gives decision-makers flexibility to respond to uncertainty over time, supported by clear trigger points that indicate when a change in pathway may be required.
- The process to develop ASPs has traditionally been applied to constructed assets and the management of coastal environments, and to date there has been little guidance on how to apply the process to natural waterway assets.
- A pilot ASP is currently being developed for the Maribyrnong River catchment, one of the five major catchments in the Port Phillip and Western Port catchment management region.
- Adaptive pathways were developed to address the four priority issues with the greatest impact on waterway values and therefore health in the Maribyrnong catchment. This paper outlines the process to develop the pathway for the 'flow regime' issue and objective.
- Early insights have shown high levels of engagement with the project working group and good alignment to the Healthy Waterways Strategy (HWS) and Monitoring Evaluation Reporting and Improvement (MERI) framework. The process has clarified a need to better understand the triggers and decisions that need to made, with an opportunity to streamline waterway objectives and measures.

Abstract

Melbourne Water is developing Adaptive Service Plans (ASPs) to help respond to uncertainty and change over the long term, while continuing to meet regulatory, environmental and community expectations. For waterways, this approach is relatively new. ASPs are designed to explore a plausible range of futures (10 years or more) scenarios and uncertain conditions, such as climate change and population growth and map out flexible pathways for action. These pathways require the setting of clear objectives, performance measures and trigger points that signal when a change in direction is needed.

This paper presents the process and interim findings of a pilot Waterways Adaptive Service Plan (WASP) currently being developed for the Maribyrnong River catchment, one of five major catchments in the Port Phillip and Western Port catchment management region. As there is limited guidance on applying adaptive planning to natural waterway assets at Melbourne Water, the pilot has adopted a "learn by doing" approach. As much as possible, adaptive planning concepts have been aligned with existing data, monitoring programs and planning frameworks—particularly the Healthy Waterways Strategy 2018–2028 (HWS) and Monitoring, Evaluation, Reporting and Improvement (MERI) framework (2019) and Asset Management Plans. This reduces the need for new systems, embeds adaptive decision-making into business as usual activities, avoids duplication, and improves organisational ownership, clarity, and uptake across Melbourne Water.

Findings from the pilot show strong engagement and cross collaboration across Melbourne Water teams and good alignment between current waterway objectives, monitoring programs and adaptive planning requirements. The draft pathways highlight the complexity of achieving the objectives, including the number of interventions required, the relative current and future effectiveness of each intervention, the reliance on interventions managed by others, and uncertainty around the timing of triggers, including external drivers. The process has identified opportunities to further align and streamline objectives, outcomes and performance measures across strategy, investment decision-making and regulatory processes, supporting efficient, consistent and transparent prioritisation of investment. An evaluation undertaken at the completion of the pilot project will determine how well adaptive planning can support more transparent, risk-aware and flexible decision making for waterway practitioners under increasing uncertainty.

Keywords

Adaptive Service Plans (ASPs), adaptive planning, decision-making, Healthy Waterways Strategy 2018-2028, price submission, objectives, pathways

Introduction

Melbourne Water (MW) is the waterway and catchment manager for the Port Phillip and Westernport Region, with obligations set out in the *Water Act* (1989) and *Catchment and Land Protection Act 1994* (*CALP Act*) respectively. Together, these Acts enable MW to take an integrated approach to managing waterways and catchments across the five major catchments: Werribee, Maribyrnong, Yarra, Dandenong and Western Port (Figure 1). The funding available to deliver these obligations (excluding catchments) is set every five years through Melbourne Water's Price Submission process, subject to review and approval by the Essential Services Commission (ESC).

Figure 1 The five major catchments of the Port Phillip and Western Port region (Melbourne Water, 2018a)

The core responsibilities of this role include developing and facilitating the delivery of external facing ‘sector strategies’ such as the Healthy Waterways Strategy 2018–2028 (HWS) (Melbourne Water, 2018a) and the Regional Catchment Strategy (RCS) (Melbourne Water, 2021). Delivery of the HWS is supported through co-designed programs for each of the region’s five catchments.

To plan for uncertainty, adapt to changes in the external environment e.g. climate change and urbanisation and continue to meet obligations over the long-term, MW has identified the need to develop Adaptive Service Plans (ASPs). These plans support the “conversion to action” phase of

planning by clearly translating strategic directions into practical, deliverable programs for Melbourne Water. ASPs are intended to complement the development of external-facing implementation plans for future Regional Waterways Strategies (RWS).

Melbourne Water's ASPs will adopt a long-term planning horizon spanning at least two regulatory price periods (10 years or more). Outputs from ASPs will inform the development of internal-facing Asset Management Plans (AMPs), Melbourne Water's price submission process (Melbourne Water, 2026) and the Waterways and Drainage Investment Plan (Melbourne Water, 2020a). Accordingly, there is a need for ASPs to align in both process and language across MW.

The key components to the development of an ASP are:

- clearly defined objectives that provide a consistent basis for monitoring progress, e.g. water flows provide for healthy river and wetland ecosystems and diverse populations of native plants and animals.
- an understanding of the risks (and opportunities) in being able to meet these objectives under different future scenarios, e.g. pace and scale of climate change impacts and urban development
- identification of alternative interventions or management actions that can be implemented over time to meet objectives e.g. stormwater harvesting or revegetation
- defined pathways showing trigger and decision points that signal when changes are needed

There are relatively few documented examples of adaptive planning being applied to the management of natural waterways. Existing applications are predominately focused on coastal hazard adaptation, land use planning and disaster preparedness e.g. Christchurch City Council, 2025, DELWP, 2021 and EPICCA, 2014.

Therefore, the approach to developing the first ASP for waterways, or WASP, is to learn by doing, and undertake a pilot to:

- test the approach before scaling up,
- learn what works with the application of real data
- build organisational capability and alignment across teams (from strategy development to on-ground delivery) and services (water and sewerage).

Adaptive management and adaptive plans

Adaptive management and adaptive plans are closely related but are often confused. Adaptive plans outline the long-term direction under uncertainty, including decision points and potential responses to future change. Adaptive management, by contrast, is the ongoing cycle of implementation, monitoring, learning and adjustment that puts the plan into practice and refines it over time (Aurecon, 2022).

The HWS MERI framework supports an adaptive management approach by providing a structured process for continuous learning and improvement (Melbourne Water, 2019). The framework enables changes in environmental conditions—such as climate variability—as well as policy and technological developments to be identified and responded to through updated management actions (Melbourne Water, 2019). It includes high-level Key Evaluation Questions (KEQs) to guide data collection, evaluation and reporting, along with detailed Monitoring and Evaluation Plans (MEPs). These MEPs document how performance of the HWS will be tracked and evaluated across the three ecosystem types: rivers, wetlands and estuaries. The rivers MEP is relevant to this project (Melbourne Water, 2020b).

Together, these documents were central to the HWS mid-term review (Melbourne Water, 2024), which as part of the adaptive management cycle aimed to strengthen strategy implementation and improve readiness for the end-of-strategy evaluation. The review also identified improvements in monitoring and reporting programs, and highlighted the need for ongoing enhancement of data collection and management systems, as well as updates to specific targets (Melbourne Water, 2024).

The development of the WASP provides an opportunity to address these gaps, strengthen the application of adaptive management within the current HWS, organisational decision making and support planning for the 2028 RWS.

Pilot WASP

Jacobs Group (Australia) were engaged by MW to develop the pilot WASP in collaboration with key MW personnel across strategy, asset management and operation teams through five interactive online workshops.

Pilot project scope

The Maribyrnong River catchment was selected as the pilot catchment as it presents a diverse range of environmental challenges and complex problems, including achieving environmental flow objectives in the absence of an environmental water reserve and under significant urban development (Melbourne Water, 2026). In addition, deep Traditional Owner, community and agency interest in this catchment provides a strong foundation for future stakeholder engagement and progressing solutions that rely on multi-stakeholder partnerships.

Project method

The project delivers on the first four phases of Jacobs' adaptive planning approach (adapted from Ministry for the Environment, 2017), which are outlined below.

Phase 1 What is happening?

The purpose of this phase was to establish a shared understanding of the context for the Maribyrnong WASP, including its current condition and key waterway features.

Key management issues, opportunities, future change drivers and stakeholder interests were identified. The primary output of this phase was a list of problem (and where relevant, opportunity) statements for the key issues within the catchment.

Phase 2 What matters most?

The purpose of this phase was to identify the top 4 priority issues that were identified in Phase 1 and develop corresponding strategic and service objectives. The strategic objectives set the WASP's aspirations and long-term direction, and the service objectives define the measurable, time-bound outcomes. The future RWS will guide the development of these objectives.

Credible risk events were defined for each strategic objective, which is a plausible event aligned with the service objectives not being achieved. These risks were examined using a risk bow tie framework with the assessment process examining initiating causes, existing controls and potential consequences. The risk assessment was aligned with Melbourne Water's risk management framework. The assessment considered the risk of not achieving each service objective under current conditions (2026) and future conditions (2040 and 2070), across two scenarios, high climate change and urban development pressures.

Phase 3 What can we do about it?

The purpose of this phase was to identify that interventions that will drive progress towards achieving each of the service objectives and mitigate the risks identified in Phase 2.

Each intervention was assessed and described in terms of its purpose, the risks and initiating causes it addressed, its effectiveness under current and future scenarios and indicative cost. Knowledge, Values and Rules (KVR) were also identified to highlight the information and/or actions required to support the successful implementation of each intervention e.g. research, investigations and trials.

Phase 4 How do we implement?

Adaptive pathways were developed for the service objectives, illustrating the potential sequencing of interventions over time. Pathways were informed by the identification of triggers, such as changes in

environmental condition or the achievement of key KVR, and include decision points at which additional actions may be implemented. These decision points are designed to ensure interventions are introduced before a system limit is reached — that is, the point at which the waterway system can no longer maintain its desired level of service or ecological condition despite existing management interventions.

Maribyrnong catchment pilot interim findings

At the time of writing, the project is nearing completion of Phase 4, with the development of draft adaptive pathways. While the pathways are yet to be combined, a number of early insights have emerged and are discussed below under each of the project phases.

Phase 1 What is happening?

A workshop with key MW personnel developed a shared understanding of the Maribyrnong catchment, noting the major waterways, diverse landscapes, environmental and cultural values that it supports (Figure 2). Problem statements were also collected and later cross-checked against those described in the HWS and HWS mid-term review (Melbourne Water, 2024).

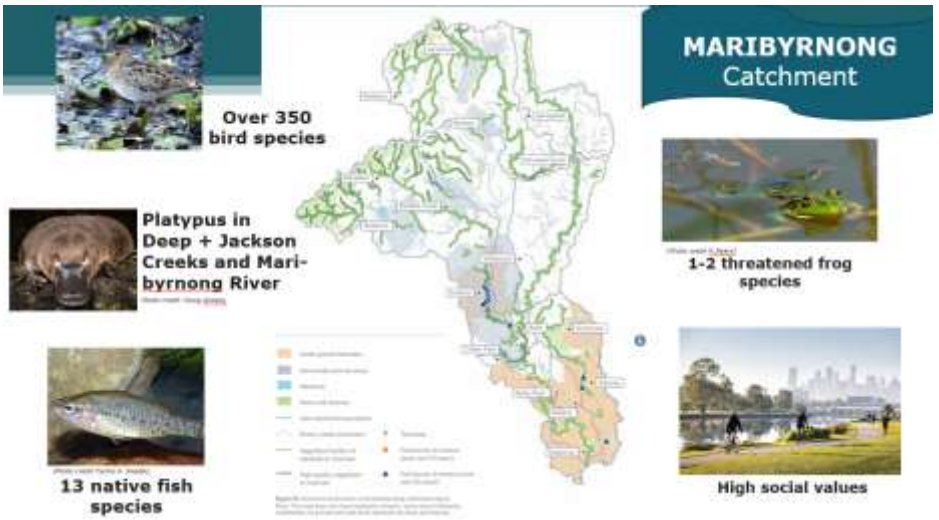

Figure 2 Maribyrnong River Catchment features

Phase 2 What matters most?

Top 4 priority issues

In order to reduce the scope and complexity of the pilot, workshop participants voted on the top 4 priority issues to be used as the basis for the pilot WASP (Table 1). Participants discussed the relationship and hierarchy between the issues, for example, insufficient water and urban development both contributing to the one issue, 'flow regime'. Some of the issues were noted as being aligned to the waterway conditions described in the HWS conceptual models for the environmental values and key findings from the HWS mid-term review i.e. water regime and water quality (Melbourne Water, 2021). Future WASPs will consider a longer list of problems/issues.

Table 1 Top 4 priority issues to be used in the pilot WASP

	Issue
1	Flow regimes are under pressure from reduced water availability, flashier flows and declining base flow due to climate change and urban development.
2	Water quality risks are being exacerbated by climate change and large-scale changes in catchment conditions due to urbanisation
3	Headwater streams, wetlands and their functions are being lost with increased urban development
4	The condition and extent of riparian vegetation corridors is declining, under pressure from climate change, pest plants and animals and fire

Strategic and service objectives and credible risk events

A second workshop was held with key MW personnel to develop strategic and service objectives, and credible risk events for each of the top 4 issues (Table 2). The objectives and credible risk events were informed by the HWS and MERI, particularly the 2028 targets and 2050 vision. Where possible, they were also aligned with the customer outcomes, Key Performance Indicators (KPIs) and targets established through MW's price submission process.

For simplicity, the interim findings presented for the remainder of this paper focus on the 'flow regime' issue, demonstrating the application of the adaptive pathways approach (Table 2).

Table 2 Flow regime issue, corresponding service objectives and credible risk event

	Top 4 priority issue	Strategic objective	Service objective	Credible risk event
1	Flow regimes are under pressure from reduced water availability, flashier flows and declining base flow due to climate change and urban development.	Water flows provide for healthy river and wetland ecosystems and diverse populations of native plants and animals.	1.1 Deliver recommended flow regime to the Maribyrnong River, its tributary streams and key wetlands each year to 2050. 1.2 Harvest 15 GL/y and infiltrate 3.9 GL/y of stormwater by 2050. 1.3 Directly connected imperviousness in each sub-catchment does not increase beyond its current rating to 2050.	Failure to provide a flow regime in the Maribyrnong River and its tributaries that provides for a healthy river ecosystem.

Assessment of risk

A third workshop with Subject Matters Experts (SMEs) completed a risk assessment for the 'flow regime' issue, through the development of risk bow ties (Figure 3) and qualitative risk assessments (Figure 4).

For the risk bow tie, SMEs identified the likely causes of the credible risk, such as reduced rainfall, more frequent drought and urbanisation. They also identified the potential consequences, including impacts on habitat, biodiversity, and community values. Existing controls and potential future interventions were assessed. Consistent with findings from the HWS mid-term review, these included measures such as enhanced flow management, updated planning and administrative guidelines, and other interventions to improve the resilience of the river system under future climate and development scenarios.

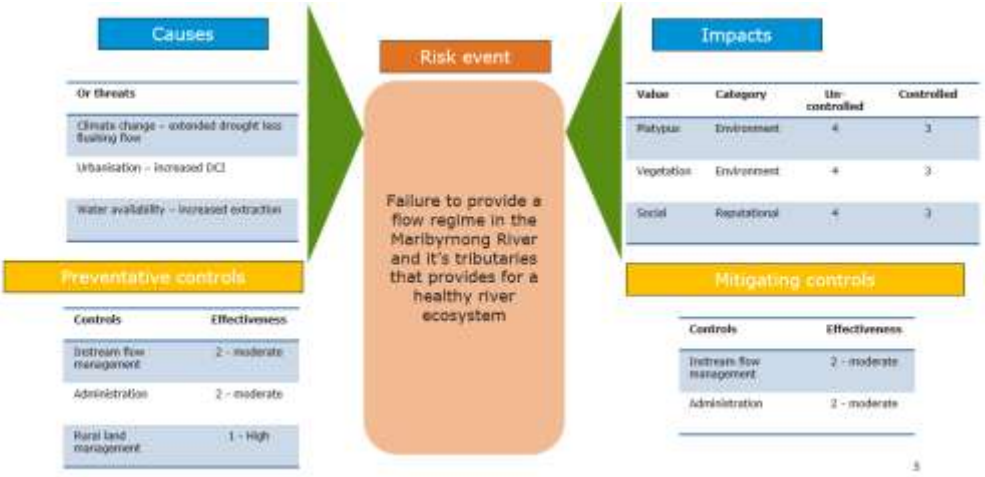

Figure 3 Flow regime risk bow tie

Subject Matter Experts then considered how the likelihood and consequences of the risk may change under future climate and development scenarios. The assessment was undertaken for current conditions (2026) and future time horizons (2040 and 2070). Two risk pathways were considered, 1. Uncontrolled, if no additional interventions are introduced, and 2. Controlled, what happens if current and future interventions are implemented as conditions change.

The scenario results show that climate change and urban development are expected to place increasing pressure on river flows over time and that current management may be sufficient today, but under future climate change and urban growth the risk increases significantly (Figure 4). Without additional intervention, the risk of failing to provide a healthy flow regime in the Maribyrnong River is expected to increase significantly over time.

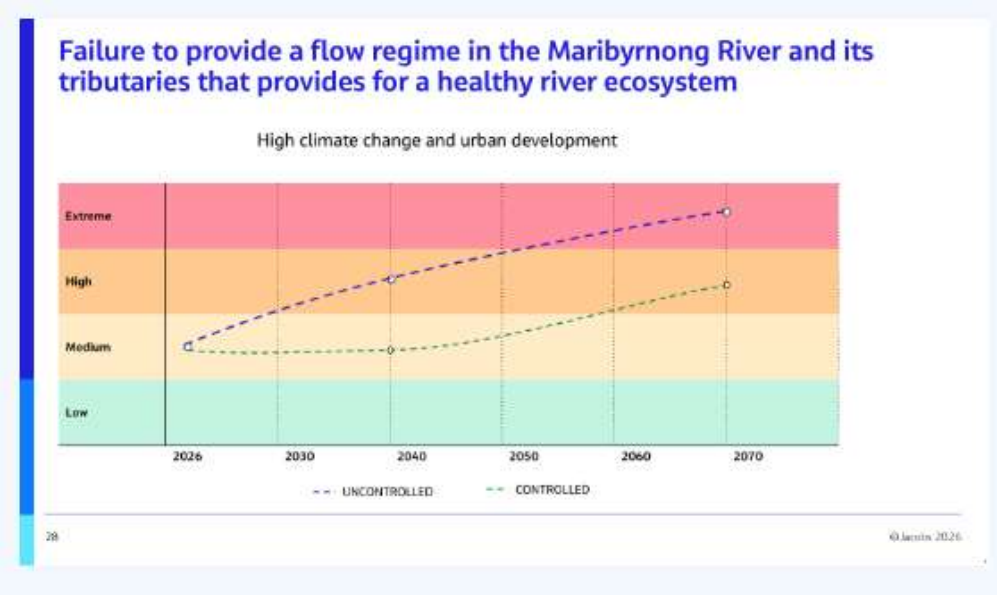

Figure 4 Flow regime combined scenario results

Phase 3 What can we do about it?

Interventions

A fourth workshop focused on identifying the interventions required to achieve the service objective (Table 2) and mitigate the risks identified in Phase 2. Proposed interventions included instream flow

management (including alternative water sources such as recycled water), administration (planning scheme, water entitlements), stormwater infiltration and stormwater harvesting.

Participants noted that interventions identified to address the 'flow regime' issue would also contribute to mitigating credible risks associated with other priority issues identified in Phase 1. It was further recognised that these interventions are generally well understood and established; however, their implementation is largely constrained by existing regulatory and policy settings, requiring reform rather than the development of new approaches.

Indicators, triggers and decision points

Indicators, triggers and decision points were then identified to guide adaptive management over time. These included monitoring the delivery of the recommended flow regime for the Maribyrnong River and changes in the percentage of Directly Connected Imperviousness (DCI).

The group also discussed how to represent decision points that sit outside Melbourne Water's direct control, particularly the uncertainty associated with the timing and likelihood of future policy, regulatory and funding changes. Recognising these external dependencies is important for understanding when pathway transitions may become feasible.

Knowledge, values and rules

Knowledge, Values and Rules were also identified to highlight the information, enabling actions and governance arrangements required to support the successful implementation of each intervention. These included research, investigations, monitoring, pilot projects and trials, as well as policy, planning and stakeholder engagement activities.

Phase 4 How do we implement?

Adaptive pathway

The fifth and final workshop involved presenting and refining the draft pathway for the flow regime issue (Figure 5). The pathway illustrates the sequencing of the many interventions over time and how management actions may evolve in response to changing conditions. It is informed by the monitoring of indicators and triggers, such as changes in environmental condition, the delivery of the recommended flow regime and the achievement of key KVR actions. In this case, the trigger has already occurred and KVR actions are to be undertaken prior to a number of decision points in 2035.

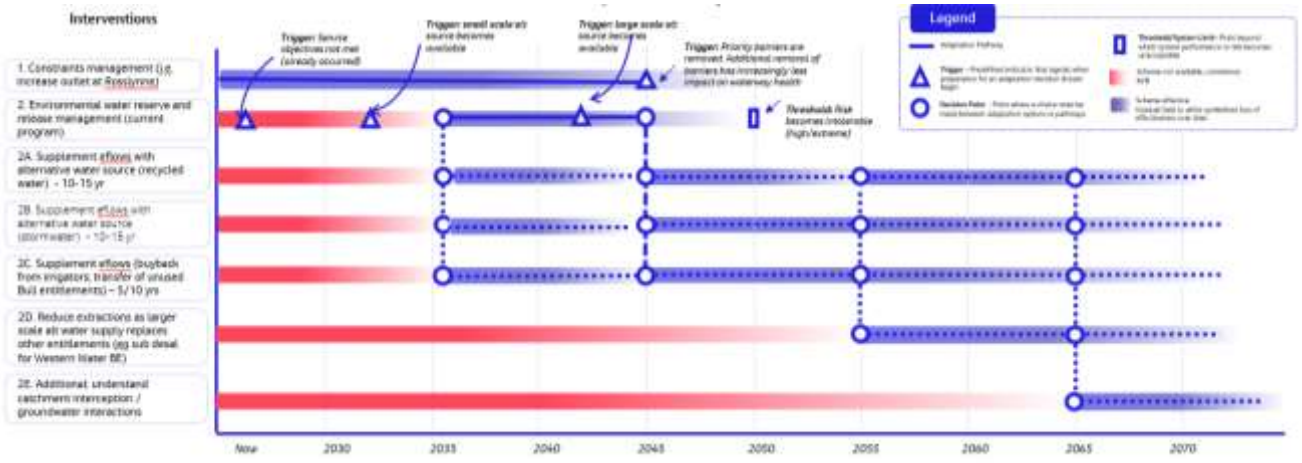

Figure 5 Draft pathways diagram for the 'flow regime' issue

Next steps

The last step in the development of the pilot WASP will involve analysing the pathways for each of the top 4 priority issues to identify commonalities and opportunities for integration. The output will be one

pathway with a full set of interventions and KVR actions to be delivered over the next decade. Key lessons will be identified in addition to elements of the process that should be retained, modified or deleted to more widely apply adaptive service planning to waterways.

Conclusions

ASPs are a new artefact for waterway planning at MW that aim to help turn long-term strategies into practical action by supporting decision-making under uncertainty. ASPs consider multiple possible future conditions and outline flexible pathways for action, with clear trigger points that signal when a change in direction is needed.

There is currently limited guidance on how to apply ASPs to waterways, which are natural and dynamic systems. To address this gap, MW has adopted a 'learning by doing' approach through developing a pilot WASP for the Maribyrnong catchment, one of five major river catchments in the Port Phillip and Western Port region.

While ASPs are not a single solution or a 'silver bullet', early insights from the pilot show strong engagement and collaboration across teams and good alignment with data, objectives and language used in the HWS and MERI. An opportunity to better align outcome language and performance measures across MW has also been identified. The next steps in the process will be to combine the pathways for each top priority issue and identify where there is overlap in the interventions, trigger points and timing.

By organising complex information into clearer decision pathways, WASPs have the potential to build preparedness and strengthen long-term planning, management and investment. Lessons from the Maribyrnong pilot will help refine the approach and support the broader rollout of ASPs across other catchments.

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