Overview of Risk Assessment

Water Resource Risks in the Maribyrnong and Moorabool Catchments

September 2025

alluvium

Alluvium recognises and acknowledges the unique relationship and deep connection to Country shared by Aboriginal and Torres Strait Islander people, as First Peoples and Traditional Owners of Australia. We pay our respects to their Cultures, Country and Elders past and present.

Artwork by Melissa Barton. This piece was commissioned by Alluvium and tells our story of caring for Country, through different forms of waterbodies, from creeklines to coastlines. The artwork depicts people linked by journey lines, sharing stories, understanding and learning to care for Country and the waterways within.

This report has been prepared by Alluvium Consulting Australia Pty Ltd for Southern Rural Water under the contract titled Water Resource Risks in the Maribyrnong and Moorabool Catchments.

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Contents

1 Introduction

Following the completion of the hydrologic modelling (see Attachment A), a risk assessment has been conducted on the values identified earlier in the project. The risk assessment has been performed using existing water management targets that relate to values across environmental, social, economic and cultural themes for both the Maribyrnong and Moorabool catchments.

The briefing paper describes the process undertaken to inform key takeaways from the risks to the catchments. This information is intended to inform key questions we hope to discuss with the SRG.

2 Role of risk assessment in the project

The purpose of this risk assessment is to identify risks that the modelled changes to the Moorabool and Maribyrnong River systems pose on values within the catchments. In this assessment, the modelled changes in question are the differing impacts of farm dam interception of runoff under historic and current levels of development, as well as an assessment of what current development conditions would look like under a future climate.

Hydrologic model outputs were assessed against current working targets for river management, such as environmental flow recommendations, urban water system level of service targets, restriction targets and licenced water entitlement volumes to determine how well each respective value was supported or limited by the modelled hydrologic regime in question. The determination of risk rating allows for the interpretation of cause and effect between each model scenario and opens up opportunities to identify and address the stressors that are contributing to these risks.

Ultimately the risk assessment is intended to be used to inform the development of mitigation options that can be discussed at the next SRG meeting.

3 SRG role in risk assessment

The Stakeholder Reference Group (SRG) meeting on the 9th of September 2025 is designed to be a discussion on the risk assessment work conducted, the challenges and limitations of the approach and to help guide the next stages of the project. The key discussion points of the meeting will be:

- Overview of the risk assessment approach for contextual framing of the findings
- Open discussion about the key prevailing messages of the assessment, and limitations
- Implications of the results and identification of potential areas for further investigation or the refinement of the approach.

4 Risk Assessment Process

The initial risk assessment conducted for both the Moorabool and Maribyrnong catchments is based on the modelling results and the changes in flows across the different scenarios. The process that was used and the values that are tested are shown below.

For this assessment, risks are defined as *the potential for negative impacts on the values identified*. In this application, the risk is identified as the risk of detrimental effects under each modelled scenario to the environmental, economic, social and cultural values.

Using a standard approach to risk assessment, the project focussed on the combination of the likelihood of an event occurring, and the consequence rating of that event. The two ratings can then be applied to a risk matrix to determine the risk to the value (see Figure 1 and Table 1).

Figure 1 – Risk assessment framework showing relationship between modelled factors and the likelihood and consequences that make up a risk

This process has been applied across the value themes environmental, economic, social and cultural values. As each of these themes are informed by different information sources, the approaches have been tailored to the specific theme to determine the likelihood and consequence rating.

In some instances (particularly in the social and cultural themes), the use of a quantitative assessment was not considered appropriate as there are no specific flow thresholds that can be used for quantitative analysis. In these instances, as qualitative discussion on the potential impacts of the modelled results has been used to inform risk rating.

Table 1 – Likelihood and consequence table for assignment of risk used in this assessment

		Consequence			
		Minor	Moderate	Major	Extreme
Likelihood	Rare	Low	Low	Medium	Significant
	Unlikely	Low	Medium	Medium	Significant
	Possible	Medium	Medium	Significant	Significant
	Likely	Medium	Significant	Significant	High
	Almost certain	Significant	Significant	High	High

5 Value based risk assessment approaches

5.1 Environmental approach

The environmental assessments for both the Moorabool and Maribyrnong catchments have been informed by the most recent FLOWS studies for each f the rivers. These FLOWS studies have been able to inform the identification of values in each of the catchments (as discussed in a previous meeting), as well as the specific flow regime that is expected to support values identified.

Using the information available on those studies, the approach has been developed to best identify the likelihood and consequence to each value under each of the flow components.

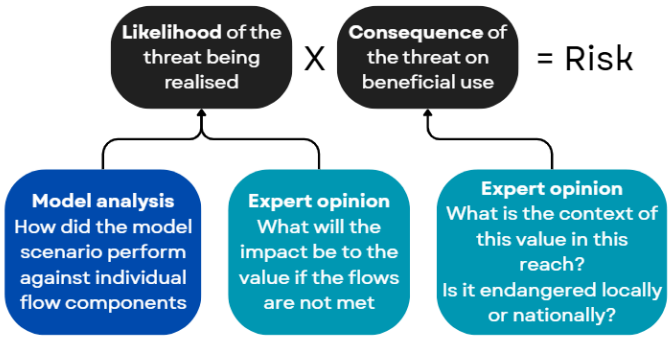


Figure 2 – Risk assessment framework and assessment methodology of environmental values

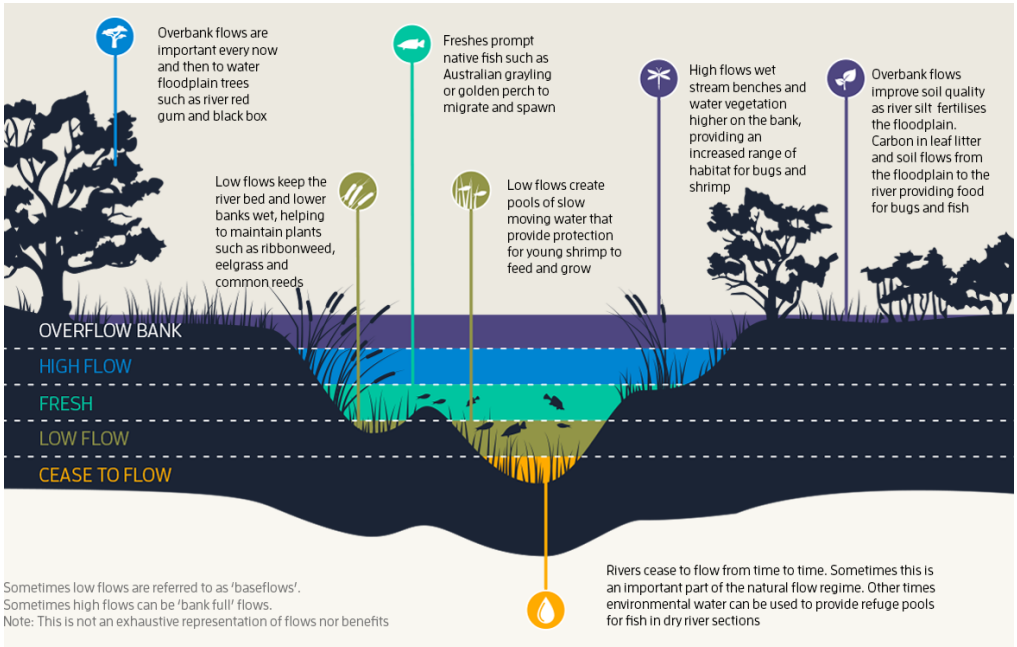
As the figure shows, the identification of likelihood is built on assessment of how well the flows meet the individual flow recommendations, combined with an expert assessment on how reliant the value is on the particular flow component. The meeting of flow recommendations is a quantitative analysis based on the modelling results, and the regional significance is based on the expert opinion of the project team aquatic ecologist.

Additionally, the consequence is based on the expert opinion of the regional significance of the value, to determine if the impacts will be felt locally or at a wider scale should the flows not be met.

The environmental assessment uses the elements of the flow regime that has been recommended in the FLOWS study, which incorporates low flow, fresh and high flow events into the flow recommendations.

Note that the environmental assessment measures the likelihood of impact to each value in each flow component. As there are multiple values in each catchment and a list of flow components in the FLOWS studies, a long list of value-flow combinations is created for assessment (103 combinations in the Maribyrnong, 194 in the Moorabool). This approach allows the performance of each model scenario (being the percentage of days over the model period that flow targets are met) to be combined with the reliance the values have on the flows and create a long list of likelihood for assessment.

Table 2 Types of flows (VEWH, 2025)



5.2 Economic approach

The economic assessments for the Moorabool and Maribyrnong catchments were conducted using the measure of access to water under existing water licence conditions. Run of river irrigation access and D&S water use under Section 8 are values attributed to water demands that are explicitly measured in the Source models.

For the risk assessment of values of Section 51 licences, the risk is defined as the reduction in reliability of water access limiting the ability to pump water to support irrigation. Measures of demand reliability determine how much of the absolute demand from licenced water holders is able to be met under each scenario. The assessment of reliability is an annual or seasonal measure of ability to access 100% of the water demand as per licence rules. The measurement of magnitude and duration of water demand shortfall identifies the significance of the impact to the value of licenced water access.

For D&S Section 8 water use, the risk being assessed is the risk of reduced access to on farm water (available in farm dam storage) for the purposes of domestic and household use and stock watering. The ability to access water through D&S (Section 8) licences is measured through the modelled levels of storage of the farm dams in the STEDI models. At the end of the dry and wet seasons, the average storage levels indicate the volume of water available for D&S users. Limiting access to this water use is considered to have greater consequence in summer due to the greater need for stored water and lower inflow volumes for recharge.

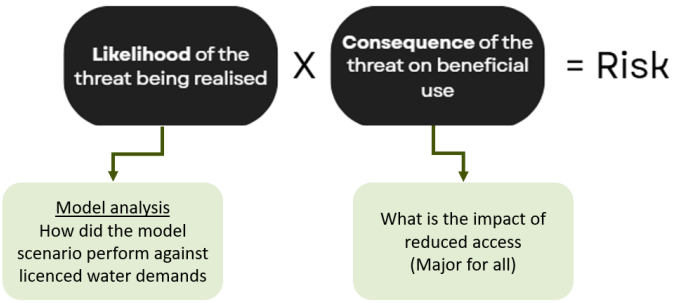


Figure 3 – Risk assessment framework and assessment methodology of economic values

5.3 Social approach

The social assessments for the Moorabool and Maribyrnong catchments were assessed in this risk assessment relate to the level of service of water supply to meet urban and rural access. This was conducted using the measure of river management targets set out by water corporations in Urban Water Strategies and Local Management Plans.

In rural areas, the level of service metric that is used to determine a risk to social values is the number of years that a ban is enforced, which is explicitly modelled in Source. For urban areas, the measure is restriction level.

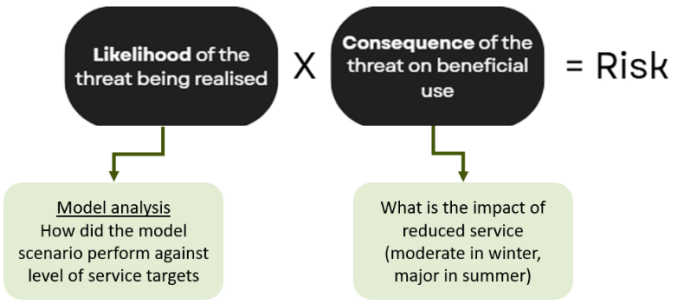


Figure 4 – Risk assessment framework and assessment methodology of social values

Note that this approach is only relevant for the quantitative results. See Section 7 for detail on the further qualitative assessment that was conducted to capture risks to social values.

5.4 Cultural approach

The cultural assessment has been assessed using a qualitative approach. See section 7 for the qualitative assessment.

6 Key messages from the assessment

Following the completion of the risk assessment, some messages became clear. The interpretation of the results identified some limitations in the approach. The assessment used a standardised approach of using model outputs and measured against existing management targets (such as level of service, environmental flow recommendations) to attribute a risk rating, the whole of catchment results smooth some of the noise that is evident in the catchment by catchment or sub-annual trends.

It was noted that the incremental risk created by farm dam in the catchment is not prominent when evaluated along with to the total risks that the catchments are facing when assessing the management targets. The incremental change in risk is currently not captured in the tables as the definition for the low, med, significant and high-risk rating are ranges and the change in risks may not result in a change of risk range.

When further assessment was done into what the incremental risks are, the main drivers causing impact are similar to what is described in the modelling reporting, whereby:

- As per the hydrological analysis, under drier conditions (i.e. during summer periods and drought years), farm dams are typically less full, so they capture a larger proportion of the available runoff
- For the projected climate change scenario (to 2065), average inflow and rainfall are projected to decrease and evaporation is projected to increase. Under these projected drier conditions with climate change, the impact of farm dams as a proportion of runoff will increase but the absolute volumes of water captured and taken by most farm dams are lower, due to an overall reduction in volumes of water flowing into the farm dams
- Increased number and volume of farm dams across catchments results in less water available to support:
    - Economic values – lower stream water availability reduces access to irrigation and entitlement take
    - Social values – Level of service targets are able to be met under all scenarios for urban areas, but rural level of service sees increases in number of times bans are enforced
- Farm dams have the greatest impact at the low flow range. This means that for:
    - Environmental values – Individual flow recommendations that relate to low flows and freshers are less supported under a more developed catchment.

        This assessment is based on impact on a species level, with consideration for how localised that species is, and the results are aggregated to show an overall ranking of severity.

The current set of results describe the total risk that catchments are facing, but the metrics we have defined are too coarse to drill into the detail of incremental risk and are likely to need refinement.

7 Assessment of results

A summary of the quantitative assessments is included below, along with further discussion on the limitations already identified. The full tables of results are included as attachments at the end of this document.

7.1 Summary of quantitative results

Using the method described, an initial risk assessment was undertaken on all of the scenarios. It is clear that the absolute risk under each scenario is higher than the incremental risk shown in the difference between scenarios. This could indicate that the impacts that are directly attributable to farm dams are not evident in the results due to:

- The risk assessment being presented on a whole of catchment level, smoothing some of the variation across the catchment
- The risk assessment presents annual results of metrics, that have been designated a high/medium/low rating based on set criteria, and only the worst case (maximum) risk rating for each value is shown
- The level of detail in understanding the *range* of impacts is not shown here and limits judgement on the impacts that are attributable to farm dams. This is because each value is sensitive to hydrological impacts on different flow components and requires further investigation to determine the magnitude of risk and range to each value.

The undeveloped scenario created a starting point where large numbers of values started at either significant (8 values) or high (10 values), making the changes between scenarios less obvious and therefore harder to assess. Regardless, the results show an increase in risk rating in the 2025 and climate change scenario, that is consistent with the trend in hydrological impacts.

Based on this assessment, an additional risk assessment approach was undertaken, focussed on the incremental impact of farm dams (removing the background stressors).

7.2 Summary of incremental assessment

As has been described in earlier sections, the approach used was not able to clearly show the additional risk caused by farm dams due to the range of other risks that exist in the catchment and the limitations created by the risk ranges.

In order to further test the results, the values were reassessed but rather than using the performance as described in Section 5.1, a change in performance was used This was intended to isolate the changes in risk created by farm dams in the modelled results by restarting the assessment with the new approach to likelihood development.

These results are also included at the end of this paper, and with the risks again presented according to the maximum risks to values across the whole catchment, a new set of limitations, namely,

- The whole of catchment approach does still reduce the sensitivity of the results, and
- The use of the maximum risk rating limits the detail of the results. If one of the tests conducted remains a high risk, then the nuance of the other changes is lost (for example 1 high risk results across 194 tests in the Moorabool catchment will appear the same as 150 high risk results).

The primary takeaways from the risk assessment are that risks to values are mainly associated with low flow and freshes in the catchments. Low Flows and freshes are the flow components that occupy the significant and high-risk ratings in the 2009 development scenario, and this becomes more prominent in the 2025 development scenario. Risks to values at high flows are generally classified in the low to medium risk ratings under both scenarios.

The addition of climate change variables into the 2025 development scenario increases the flow stress and the risk. All flow components under this scenario move towards higher risks ratings, with a noticeable shift in the fresh and high flow component risks.

The ratings of likelihood used in the risk assessments have been modified to reflect the *change* in the performance against flow targets.

8 Discussion

8.1 Environmental

Potential impacts on bird populations (Maribyrnong and Moorabool)

The risk to birds in the area is likely to be impacted under all scenarios. Bird populations that would utilise these catchments for food and habitat are noted to have other catchments in the region that may be able to support

the populations (such as in the nearby Ramsar sites). The significant and high risks identified to the vegetation and invertebrate values are likely to have impacts on the capacity to support bird populations.

Potential impacts on water quality (Maribyrnong and Moorabool)

Water quality risk in both catchments is likely to be impacted by the changes in flow regime. While the modelling does not model water quality or take into account the quality of runoff into the rivers, there are elements of the flow that may play a roll in water quality outcomes.

As lower flows are the components that show the greatest impact in each of the scenarios, it may be inferred that the rivers have a reduced capacity to flush the system out when required. Additionally, pooling and slower flows resulting from the lower volumes passing through the catchment could result in warmer waters creating algal bloom issues.

8.2 Economic

Potential impacts on tourism (Maribyrnong and Moorabool)

With tourism values in riverine areas dependant on a healthy river, the significant and high risks identified for vegetation, fish and the inferred impacts on birds have the potential to impact the draw of tourism to the region. (this is linked to social values, with additional comments there).

8.3 Social

Potential impacts on human wellbeing outcomes (Maribyrnong and Moorabool)

As noted in the values paper, a review conducted in 2024 for Melbourne Water by Mosaic Insights investigated the relationship between the flow dependant values of a catchment and the human wellbeing outcomes they support. The primary influences were quality of vegetation (noted as significant and high risk), biodiversity (significant and high risk for invertebrates, fish, frogs and the inferred impacts on birds) and water quality/flow regime (see above). Based on those assessments it could be assumed that human wellbeing outcomes would be impacted.

8.4 Cultural

Potential impacts on traditional owner values

Cultural values have been considered as they relate to the values across the environmental, economic and social themes. The assessment does not intend to capture the full range of Traditional Owner values or encapsulate the Traditional Owner definition of values.

9 Outcomes

The key items that have been identified in the risk assessment are that:

- The approach used has identified limitations in the way risks are currently assessed, linked to;
    - The whole of catchment approach and the use of the maximum risk rating covers over much of the change that is occurring
    - Impacts of farm dams are not always visible as the incremental change may not change the risk range used
- The change in risks for each of the flow components shows that the highest risk element of the flow regime are the low flow and freshes, supporting the findings of the modelling review.
- Climate change exacerbates the risks posed to low and fresh flows, and will increase the risk to high flow events

Ultimately the risk assessment has shown that farm dams create risks to environmental, economic, social and cultural values, and these risks are primarily in the lower flow ranges.

With those finding in mind, the project is posing 3 discussion points to the SRG:

Discussion Point 1
Do you have any clarification questions?

Discussion Point 2
How do you think the results inform the need for management change?

Discussion Point 3
Does the assessment cover the appropriate level of detail to determine mitigation opportunities? How would you like this reflected in the final reporting?

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Appendix B1 – Initial Risk assessment results

Note that these are the maximum ratings of risk across the whole catchment. This represents the worst case scenario within the catchment

Maribyrnong		Maximum risk and reach(es)			
Theme	Value	Undeveloped	LOD 2009	LOD 2025	Future Climate
Environmental	Vegetation	High	High	High	High
Environmental	Fish	Significant	Significant	High	High
Environmental	Frogs	Significant	Significant	Significant	Significant
Environmental	Invertebrates	High	High	High	High
Economic	Access for Irrigation	High (Lower end of the catchment only)	High (Lower end of the catchment only)	High (Lower end of the catchment only)	High (Lower end of the catchment only)
Economic	Access for D&S (summer)	N/A	High	High	High
Economic	Access for D&S (winter)	N/A	Significant	Significant	Significant
Social	Reliability of urban water access	Low	Low	Low	Low
Social	Reliability of rural water access	High	High	High	High
Social	Access to water downstream	Low	Low	Low	Low
Social	Delivery of low flow events past downstream gauge (summer)	Significant	Significant	Significant	Significant
Social	Delivery of fresher flow events past downstream gauge (winter)	Significant	Significant	Significant	Significant

Moorabool		Maximum risk and reach(s)			
Theme	Value	Undeveloped	LOD 2009	LOD 2025	Future Climate
Environmental	Vegetation	Significant	Significant	Significant	Significant
Environmental	Fish	High	High	High	High
Environmental	Invertebrates	Significant	Significant	Significant	Significant
Environmental	Turtles	High	High	High	High
Environmental	Frogs	Significant	Significant	Significant	Significant
Economic	Access for Irrigation	High	High	High	High
Economic	Access for D&S (summer)	N/A	High	High	High
Economic	Access for D&S (winter)	N/A	Medium	Medium	Medium
Social	Reliability of urban water access	Low	Low	Low	Low
Social	Reliability of rural water access	High	High	High	High
Social	Access to water downstream	High	High	High	High
Social	Delivery of low flow events past downstream gauge (summer)	High	High	High	High
Social	Delivery of fresher flow events past downstream gauge (winter)	Significant	High	High	High

Appendix B2 - Results of the incremental assessment

Note: This table assesses the incremental risk created by farm dams. Only the environmental values risks will have changed as they were the only once that underwent the test as they have the clear, standardised performance thresholds.

The ratings of likelihood used in the risk assessment have been modified to reflect the *change* in the performance against flow targets (i.e. instead of 60% of days resulting in a low likelihood, less than 5% worse than the no farm dam scenario is considered low likelihood).

Maribyrnong				
Theme	Value	LOD 2009	LOD 2025	Future Climate
Environmental	Vegetation	Significant	Significant	High
Environmental	Fish	Significant	Significant	Significant
Environmental	Frogs	Medium	Medium	Significant
Environmental	Invertebrates	High	High	High
Economic	Access for Irrigation	High (Lower end of the catchment only)	High (Lower end of the catchment only)	High (Lower end of the catchment only)
Economic	Access for D&S (summer)	High	High	High
Economic	Access for D&S (winter)	Significant	Significant	Significant
Social	Reliability of urban water access	Low	Low	Low
Social	Reliability of rural water access	High	High	High
Social	Access to water downstream	Low	Low	Low
Social	Delivery of low flow events past downstream gauge (summer)	Significant	Significant	Significant
Social	Delivery of fresher flow events past downstream gauge (summer)	Significant	Significant	Significant

Moorabool				
Theme	Value	LOD 2009	LOD 2025	Future Climate
Environmental	Vegetation	Significant	Significant	Significant
Environmental	Fish	High	High	High
Environmental	Invertebrates	Significant	Significant	Significant
Environmental	Turtles	High	High	High
Environmental	Frogs	Significant	Significant	Significant
Economic	Access for Irrigation	High	High	High
Economic	Access for D&S (summer)	High	High	High
Economic	Access for D&S (winter)	Medium	Medium	Medium
Social	Reliability of urban water access	Low	Low	Low
Social	Reliability of rural water access	High	High	High
Social	Access to water downstream	High	High	High
Social	Delivery of low flow events past downstream gauge (summer)	High	High	High
Social	Delivery of fresher flow events past downstream gauge (summer)	High	High	High