

Chapter 5. Challenges for water planning, management and use (the risk assessment)



5. Challenges for water planning, management and use (the risk assessment)

Water resource plans must take into account current and future risks to the condition and continued availability of water in Victoria's share of the Murray-Darling Basin.

The plans must identify these risks and describe how those assessed as medium or high will be managed.

This chapter outlines the current and future risks to the availability and condition of water resources in Victoria's North and Murray water resource plan area. These were identified through the risk assessment that was completed to meet the requirements of Part 9 of Chapter 10 of the Basin Plan.

5.1 Victoria's approach to the risk assessment

The Basin Plan describes the requirements for determining risk. Under the provisions of the Basin Plan the risk assessment must consider risks relating to:

- water availability and condition for economic, social, cultural, Indigenous and other public benefit values
- water not being of a suitable quality for use including salinity
- environmental water requirements for priority environmental assets and ecosystem functions (identified in Victoria's long-term watering plans) and the health of water-dependent ecosystems
- groundwater systems (including structural damage and groundwater / surface water connections)
- interception activities
- water quality degradation

Under the Basin Plan a water resource plan must describe how the water resources of the water resource plan area will be managed during extreme events. These events include extreme dry periods (drought), extreme water quality events and other events that compromise the ability to meet critical human needs. These types of events were included in the risk assessment. See [Chapter 10](#) for more information on how extreme events are managed.

The Basin Plan also requires a water resource plan to identify the objectives and outcomes sought by Aboriginal people in relation to the management of water resources in the water resource plan area. There must be regard to the social, spiritual and cultural values of Aboriginal



people and the uses of water resources for these purposes. The risks to these values and uses have been assessed in this risk assessment. See [Chapter 8](#) for more information on Aboriginal water values and uses.

5.1.1 Conducting the risk assessment

Victoria carried out a comprehensive risk assessment to assess current and future risks over the life of the water resource plan. The assessment took place over a 12-month period and was overseen by an expert advisory panel of key stakeholders, including water corporations, catchment management authorities and technical experts.

The assessment examined risks in a consistent, structured and transparent way across each Victorian water resource plan area. It used the same method for all areas while recognising regional differences.

Risks were assessed taking into account Victoria's comprehensive water management arrangements and influencing factors like environmental management, land use planning and emergency management to determine the residual risks. The assessment has also been based on the assumption that the Basin Plan is in place and that the Basin Plan does not in itself represent or impose a threat to the continued availability and condition of the water resources.

The approach for the risk assessment aligns with international and national standards, assessing risk as the product of the likelihood and consequence of a threat impacting on an asset. The flexible method used for the assessment means it can be updated as new risks emerges and conditions change.

In addressing the risks, water resource plans must describe the risk and the factors that contribute to those risks. Adequate information must be, and has been, captured in the data gathering process to enable the development of a description of the risk and the factors contributing to the risks. The risks and the factors that have contributed to these risks and the assumptions underlying the risk assessment have been set out in [Appendix B](#).

5.1.1.1 Assessing risks – causes, threats and uses of water

Risks were assessed based on the requirements of International Organisation for Standardisation -ISO 31000:2009 as required by the Basin Plan. Combining a number of factors such as causes, threats and beneficial uses and testing these across different future scenarios allowed risk levels to be determined. Developed scenarios cover a range of possible future situations and are not 'forecasts' of a most likely future. Instead they are useful for contingency planning and system stress testing.

Risk levels - ranging from very low to very high - were determined as a product of likelihood and the consequence of a risk occurring. When considering the consequence of the risk occurring, it was done on a water resource plan scale rather than on a local scale.

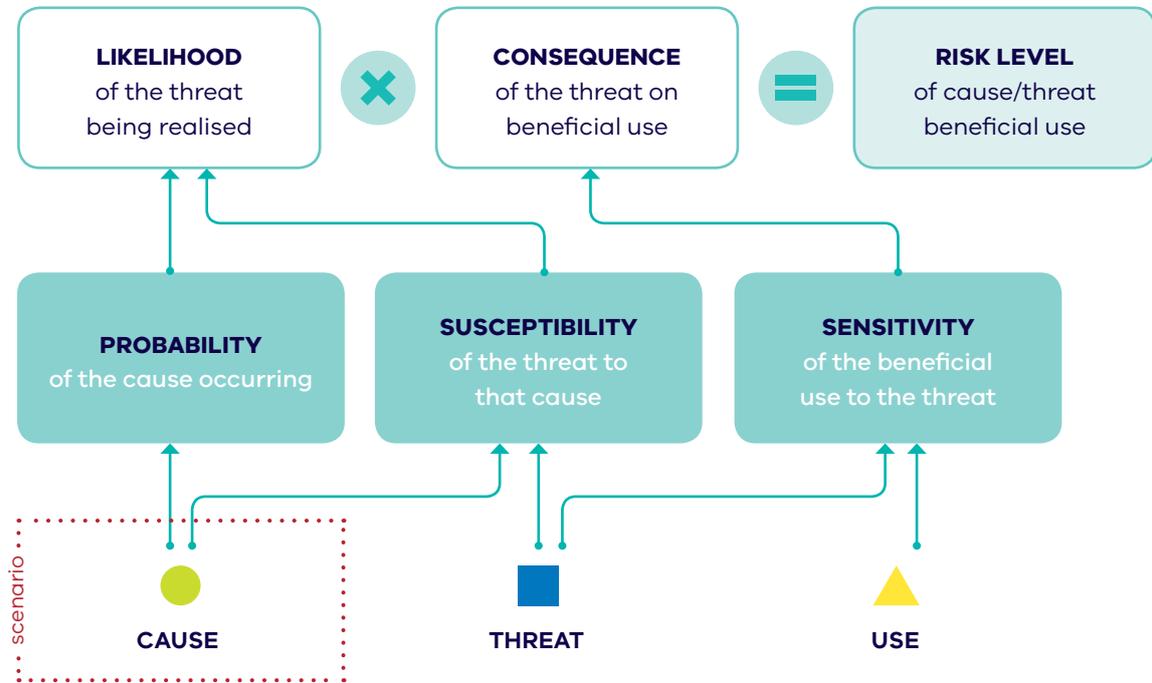


Figure 5-1: The risk assessment process

Worked example

A cause (e.g. extreme drought) may result in a threat (e.g. decline in water availability) that impacts on a use (e.g. consumptive use) of water.

A summary of the identified causes, threats and beneficial uses considered in the risk assessment is set out in **Table 5-1**.

The risk assessment included:

- 16 separate causes and scenarios
- 13 threats
- 37 beneficial water use categories

Table 5-1: Summary of the identified causes, threats and beneficial uses considered in the risk assessment

● CAUSE	■ THREAT	▲ USE
An event or events that can lead to a threat.	A deviation from an agreed starting point that may affect beneficial uses.	The water resource plans protect the 'condition and continued availability' of Basin water resources for beneficial uses.



 CAUSE	 THREAT	 USE
<p>Causes considered in this assessment:</p> <ul style="list-style-type: none"> • climate change • extreme drought • extreme wet periods • flooding • land use change (affecting availability) • land use change (affecting condition) • farm dams • bushfires • increased utilisation of water access rights • increase in the number of rights and volume of entitlements • non-compliance with the <i>Water Act 1989</i> • changes to timing and location of demands • earth resource extraction • failure to continue to invest in best practice land use initiatives • point source discharges • major asset failures • pest animals and weeds 	<p>Threats are:</p> <ul style="list-style-type: none"> • adverse changes in the volume or pattern of water • continuation or changes in water quality that renders it not fit for purpose 	<p>Beneficial uses have been assessed in terms of:</p> <ul style="list-style-type: none"> • consumptive uses • environmental uses • social/recreational uses, and • indigenous/Aboriginal uses
	<p>Threats considered in this assessment to:</p> <p>Availability</p> <p>Surface water:</p> <ul style="list-style-type: none"> • reduction in volume • changes to seasonal pattern • changes to the interannual pattern <p>Groundwater:</p> <ul style="list-style-type: none"> • decline in inflow to the aquifer • adverse change to the seasonal pattern of inflow to the aquifer • condition of the (water) resource <p>Water quality:</p> <ul style="list-style-type: none"> • elevated levels of salinity • elevated levels of suspended sediment and/or nutrients • elevated levels of toxicants (pesticides, herbicides, heavy metals, hydrocarbons) • pathogens (giardia, cyanobacteria) • other (water temperature, pH and/or dissolved oxygen) <p>Structural form of priority environmental assets - wetlands and rivers:</p> <ul style="list-style-type: none"> • longitudinal connectivity • lateral connectivity • instream physical habitat <p>Structural form of aquifers</p>	<p>These beneficial uses have been assessed based on assessment of risk to:</p> <ul style="list-style-type: none"> • surface water availability based on categories that define the legal entitlement or right to water • groundwater availability based on categories that reflect the physical attributes of the aquifer from which water is derived • water quality condition based on the State Environment Protection Policy beneficial use categories

5.2 Risks identified in the water resource plan areas

Risk assessment results summary

More than 95 per cent of the high and medium risks identified by the risk assessment were found to be associated with:

- causes such as climate change, extreme drought, and land use practices if there is a failure to proceed with existing strategies and improved management programs
- threats such as suspended sediment and nutrients, salinity, other water quality issues and a reduction in the volume of water available
- lack of information about the availability (or absence) of water for Aboriginal use, either for cultural flows or for Aboriginal environmental outcomes as proposed by the Murray-Darling Basin Authority.

These causes and threats usually have a negative impact on all water uses. However lack of information about the availability or absence of water for Aboriginal cultural uses was assessed as having significantly more risks than any other beneficial use. This arises because there is limited information to determine how Aboriginal cultural uses of water might be affected by changes in water resources. For example, Aboriginal cultural uses of water may be affected by salinity but there is no information available on which to base this relationship. As a consequence, Aboriginal uses of water were assumed to have a very high sensitivity to any changes to surface water or groundwater.

A description of causes and threats which generate the majority of risks is provided in **Table 5-2**.

Table 5-2: Summary description of causes and threats which generate the majority of risks across all water resource plan areas

 <p>CAUSE</p>	<p>Climate change</p>	<p>Climate change was found to be a common cause of risk across all water resource plan areas. The high level of risk was associated with its very high probability of occurring, and when climate change occurs, it typically impacts over wide spatial areas and for periods that extended over the life of the water resource plan and beyond.</p> <p>Climate change was identified as a risk to both the availability and condition of water resources.</p>
	<p>Extreme drought</p>	<p>Extreme drought was found to be a common cause of risk. Although extreme drought has a lower likelihood than climate change of occurring within the life of the water resource plans, the risk typically had higher magnitudes of impact on water availability and condition, with a similar span and extent to climate change.</p>
	<p>Failure to continue to invest in best practice land use initiatives</p>	<p>Existing land use practices were found to be a common cause of risk. These risks are associated with the end of support for existing programs to improve catchment and waterway management. Stopping support for programs of waterway and catchment management would result in failure of significant past investment in soil conservation works and failure to address existing barriers to fish passage and other land and waterway management issues.</p>
	<p>Land use – future changes</p>	<p>Potential changes to land use could impact on the condition of the water resource which generates a number of medium to very high risks in both surface water and groundwater water resource plan areas. These land use changes include increased dairy production and increased cropping. These have the potential to increase sediment and nutrient loads in waterways and toxicant impacts on groundwater.</p>
	<p>Earth resource development</p>	<p>Earth resource development was found to be a cause of risk in the Northern Victoria surface water resource plan area. This risk was associated with sand and gravel extractions from the floodplain of the mid-Goulburn River (groundwater).</p> <p>Cessation of mining and associated groundwater pumping (e.g. in the Bendigo area) was found to be a significant localised risk in the Goulburn-Murray water resource plan area.</p>
	<p>Changes to the timing and location of demands</p>	<p>Changes to the timing and location of water demands were found to have very high risks in the water resource plan areas that cover surface water. These risks are associated with changing demands associated with agricultural and environmental water deliveries and the potential impact of these deliveries on rivers and wetlands.</p>

 THREAT	Water availability - reduction in volume of water	<p>The risk assessment showed that a decline in surface water volumes is a significant and common threat across the surface water areas.</p> <p>A decline in inflow to aquifers or an adverse increase in inflow were also identified as a significant threat to groundwater resources.</p>
	Water condition - salinity	<p>Salinity was found to be a common threat across water resource plan areas. Salinity is an issue linked to both extreme wet periods (rising salinity) and extreme dry periods (saline pools in river systems).</p>
	Water condition - suspended sediment and nutrients	<p>Suspended sediments and nutrients were identified as a common threat to the water resources of the surface water resource plan areas. The threat arises from many causes including climate change, extreme wet periods, extreme drought, bushfire and change in land use.</p>
	Water condition - toxicants	<p>Increasing toxicant levels have been identified as a potential risk to the groundwater resources. The risks could arise from earth resource development, point source discharges and changes to land use.</p>
	Water condition - adverse change in the seasonal pattern of inflow to aquifers	<p>As a result of climate change and extreme drought, adverse changes to the inflow of water to aquifers was identified as a common threat to the beneficial use of groundwater. Higher temperatures and extended periods of low rainfall can result in increased evapotranspiration and reduced infiltration, resulting in a decline in inflow to aquifers.</p>

5.2.1 Description of risks

The Basin Plan requires all the identified risks to be listed in the water resource plan. A list has been provided in table form in [Appendix B, Section 2.1](#) of Appendix B refers to the northern Victoria surface water area, [section 2.2](#) refers to the Goulburn-Murray groundwater area and [section 2.3](#) to the Victorian Murray surface water area. Supporting tables also assess the quantified uncertainty of each risk.

Almost 900 of potential risks are included in these tables. A hierarchical structure has been adopted to manage the analysis and management of these risks. Importantly, this hierarchal structure did not result in the arbitrary exclusion of risks. The approach adopted has enabled detailed analysis of specific risks and grouping of risks into themes that allows broad analysis of issues.

The water resource plans must either describe a strategy to address medium, high and very high risks or explain why any such risk cannot be addressed in a water resource plan. All medium and higher level risks have a number of identified strategies stipulated to manage the risk and there is a description of the strategies in [Table 4.2.1](#) of [Appendix B](#).

5.3 Summary – Northern Victorian water resource plan area (surface water)

A total of 130 consolidated risks were identified for the Northern Victoria water resource plan area. Of these, 87 were identified as medium to very high risk.

Causes associated with the highest occurrence of medium to very high risk were:

- climate change
- extreme drought
- failure to continue to invest in best practice land use initiatives
- pests and weeds
- farm dams
- changes to the timing and location of demands
- earth resource development
- major asset failure

5.3.1 Water availability

Water availability was assessed in terms of the form of legal entitlement to the surface water (see [Table 5-3](#)).

Climate change was the only cause of risk that generated **very high risks** to water availability for environmental and consumptive uses. Extreme drought caused **high risk** to environmental and consumptive uses.

The risk assessment found that climate change could trigger a reduction in volume of water and a change to seasonal pattern (threats) which would have a **very high risk** for the environment's low reliability and uncontrolled (above cap) water. A reduction in volume (threat) would also be a **high risk** to the environment's high reliability water.

The risk assessment found extreme drought could trigger a reduction in volume of water would be a **high risk** for the environment's low reliability and uncontrolled (above cap) water, and could trigger a change to interannual patterns and would have a **high risk** for the environment's uncontrolled (above cap) water.

The risk assessment found that climate change could trigger a reduction in volume of water (threat) and a change to seasonal pattern (threat) which would have a **very high risk** for the consumptive use of low reliability water and section 51 licences. A reduction in volume would also have a **high risk** to consumptive uses of high reliability water, section 51 licences and section 8 stock and domestic rights. A change to seasonal pattern would also have a **high risk** to consumptive uses of section 8 stock and domestic rights.

The risk assessment found extreme drought could trigger a reduction in volume of water which would be a **high risk** for consumptive uses of low reliability water, and could trigger a change to interannual patterns and would have a **high risk** for consumptive uses for section 51 licence and section 8 stock and domestic rights.

Table 5-3: Northern Victoria water resource plan area summary of risks to availability of surface water

Cause	Threat	Use									
		Environmental					Consumptive				
		High reliability	Low reliability	Controlled water – passing flows	Uncontrolled water – above cap water	Very high reliability	High reliability	Low reliability	System operating water	S51 licences	S8 stock and domestic
Climate change	Reduction in volume										
	Change to seasonal pattern										
	Change to interannual pattern										
Extreme drought	Reduction in volume										
	Change to seasonal pattern										
	Change to interannual pattern										
Bushfires	Reduction in volume										
	Reduction in volume										
Land use change: availability	Reduction in volume										
	Reduction in volume										

Cause	Threat	Use									
		Environmental					Consumptive				
		High reliability	Low reliability	Controlled water – passing flows	Uncontrolled water – above cap water	Very high reliability	High reliability	Low reliability	System operating water	S51 licences	S8 stock and domestic
Farm dams	Reduction in volume										
Timing and location of demands	Change to seasonal pattern										
Major asset failure	Change to seasonal pattern										

Legend	5	4	3
	Very high risk	High risk	Medium risk

5.3.2 Water quality (condition)

Water quality assessments were based on the beneficial uses and users of water established in Victoria's State Environment Protection Policy (Waters) (DELWP, 2018).

The risk assessment (see [Table 5-4](#)) found that climate change could trigger pathogens (threat) and other impacts on water quality (threat), and earth resource development could trigger toxicants (threat) and these would have a **very high risk** for environmental uses.

The risk assessment found climate change could trigger salinity and suspended solids and nutrients (threats), extreme drought could trigger toxicants and pathogens (threats) and earth resource development could trigger salinity (threats), and failure to continue to invest in best practice land use initiatives could trigger salinity, suspended solid and nutrients and pathogens (threats) and pest and weeds could trigger suspended solids and nutrients (threat) all which would have a **high risk** for environmental uses.

The risk assessment found that climate change could trigger pathogens (threat) and would be a **very high risk** for consumptive users including the use of water for human drinking, agriculture and irrigation, aquaculture and fish and crustacean consumption. Climate change could also trigger other water quality impacts (threat) and would be a very high risk for consumptive users including the use of water for agriculture and irrigation, aquaculture and human consumption of fish and crustaceans.

The risks assessment found that earth resource development could trigger toxicants (threat) and would have a **very high risk** for consumptive users including the use of water for human drinking, agriculture and irrigation, aquaculture and fish and crustacean consumption.

The risk assessment found that climate change could trigger salinity and suspended solids and nutrients (threats) and would be a **high risk** for consumptive users including the use of water for agriculture and irrigation, and fish and crustacean consumption.

The risk assessment found that extreme drought could trigger toxicants and pathogens (threats) and would be a **high risk** for consumptive users including the use of water for agriculture and irrigation, aquaculture.

The risk assessment found that extreme wet could trigger suspended solids and nutrients (threats) and would be a **high risk** for consumptive users including the use of water for human drinking, agriculture and irrigation, aquaculture, industry and commercial, and fish and crustacean consumption.

The risk assessment found that failure to continue to invest in best practice and use initiatives could trigger salinity, suspended solids and nutrients and pathogens (threats) and would be a **high risk** for consumptive users including the use of water for human drinking, agriculture and irrigation, aquaculture, and fish and crustacean consumption.

The risk assessment found pests and weeds could trigger suspended solids and nutrients (threat) and would have a **high risk** for consumptive users including water for human drinking, agriculture and irrigation, aquaculture, and fish and crustacean consumption.

The risk assessment found that earth resource development could trigger salinity and toxicants (threat) and would be a **high risk** for consumptive users including the use of water for agriculture and irrigation, industry and commercial, and fish and crustacean consumption.

Social uses were categorised as primary contact recreation (for example swimming) secondary contact recreation (for example fishing) and aesthetics. The risk assessment found that climate change could trigger pathogens (threat) and other impacts on water quality (threat), and earth resource development could trigger toxicants (threat) and these would have a **high to very high risk** for primary and secondary contact recreation, and pathogens (threat) is a **very high risk** for aesthetics.

The risk assessment found that failure to continue to invest in best practice and use initiatives could trigger pathogens (threat) and would be a **high risk** for primary contact recreation.

Table 5-4: Northern Victoria water resource plan area summary of risks to water quality (condition) of surface water

Cause	Threat	Use												
		Environment	Consumptive	Agriculture and irrigation	Aquaculture	Industry and commercial	Fish, crustaceans consumption	Social	Primary contact recreation	Secondary contact recreation	Aesthetics			
Climate change	Salinity													
	Suspended solids and nutrients													
	Toxicants													
	Pathogens													
	Other water quality impacts													
Extreme drought	Suspended solids and nutrients													
	Toxicants													
	Pathogens													
	Other water quality impacts													
	Salinity													
Extreme wet	Suspended solids and nutrients													

Cause	Threat	Use												
		Environment	Human drinking	Agriculture and irrigation	Aquaculture	Industry and commercial	Fish, crustaceans consumption	Primary contact recreation	Secondary contact recreation	Aesthetics				
Bushfires	Suspended solids and nutrients													
	Other water quality impacts													
Land use change: condition	Salinity													
	Suspended solids and nutrients													
Failure to continue to invest in best practice land use initiatives	Salinity													
	Suspended solids and nutrients													
	Pathogens													
	Other water quality impacts													
Farm dams	Salinity													
	Suspended solids and nutrients													
	Other water quality impacts													

Cause	Threat	Use											
		Environment	Consumptive	Agriculture and irrigation	Aquaculture	Industry and commercial	Fish, crustaceans consumption	Primary contact recreation	Secondary contact recreation	Aesthetics			
Increased utilisation of water access rights	Salinity												
	Suspended solids and nutrients												
Non-compliance with the Water Act 1989	Salinity												
	Suspended solids and nutrients												
	Other water quality impacts												
Timing and location of demands	Other water quality impacts												
	Other water quality impacts												
Earth resource development	Salinity												
	Suspended solids and nutrients												
	Toxicants												
Major asset failure	Salinity												
	Other water quality impacts												

Cause	Threat	Use																		
		Environment	Consumptive	Agriculture and irrigation	Aquaculture	Industry and commercial	Fish, crustaceans consumption	Social	Primary contact recreation	Secondary contact recreation	Aesthetics									
Pests and weeds	Suspended solids and nutrients																			
	Other water quality impacts																			

Legend	5	4	3
	Very high risk	High risk	Medium risk

5.3.3 Social (recreational and amenity) and Aboriginal uses

Risks to recreational and amenity and Aboriginal cultural values were assessed in terms of the risks associated with both the condition/quality of water available for these purposes and the availability of water for these functions.

The social, environmental, and consumptive uses of water are relatively well understood as water resource planning concepts. However, Aboriginal uses of water are not as well understood which is why a large number of risks have been generated at this stage in the risk assessment.

Climate change and extreme drought were identified as having medium or high-level risks to recreational uses of water.

Climate change generated very high risks associated with impact to Aboriginal cultural uses of water with regard to:

- reduction in volume
- changes to seasonal patterns
- salinity
- suspended solids and nutrients
- pathogens
- other water quality impacts
- loss or decline in longitudinal connectivity
- loss or decline in lateral connectivity
- loss or decline in instream physical habitat.

Earth resource development also generated very **high risks** to Aboriginal cultural values with regard to salinity, toxicants and a loss or decline in instream physical habitat.

Climate change and extreme drought also posed **medium or high risks** to recreational and amenity uses because of threats associated with declines in water availability. Changes to seasonal patterns of inflows posed these risks only with regard to climate change.

5.3.4 Priority environmental assets

The risk assessment found that climate change generated **high and very high risks** with regard to the environmental health of rivers and wetlands including, loss or decline in longitudinal connectivity, loss or decline in lateral connectivity and loss or decline in instream physical habitat for rivers and wetlands.

The risk assessment found that earth resource development causing a loss or decline in instream physical habitat is **very high risk**, and the changes to the timing and location of demands causing a loss or decline in instream physical habitat is also **very high risk** for rivers and wetlands (see [Table 5-5](#)).

The risk assessment found that extreme drought causing a loss or decline in longitudinal connectivity is **high risk** for rivers, and extreme drought causing a loss of decline in lateral connectivity is **high risk** for wetlands.

The risk assessment found that changes to the timing and location of demands causing a loss or decline in instream physical habitat is **very high risk** for rivers and wetlands.

Table 5-5: Northern Victoria water resource plan area summary of risks to priority environmental assets

Cause	Threat	Rivers	Wetlands
Climate change	Loss or decline in longitudinal connectivity	5	4
	Loss or decline in lateral connectivity	4	5
	Loss or decline in instream physical habitat	5	5
Extreme drought	Loss or decline in longitudinal connectivity	4	3
	Loss or decline in lateral connectivity	3	4
	Loss or decline in instream physical habitat	3	3
Failure to continue to invest in best practice land use initiatives	Loss or decline in longitudinal connectivity	3	3
	Loss or decline in lateral connectivity	3	3
	Loss or decline in instream physical habitat	3	3
Earth resource development	Loss or decline in longitudinal connectivity	3	3
	Loss or decline in instream physical habitat	5	5
Pests and weeds	Loss or decline in longitudinal connectivity	3	3
	Loss or decline in instream physical habitat	3	3
Changes to the timing and location of demands	Loss or decline in instream physical habitat	5	5

Legend	5	4	3
	Very high risk	High risk	Medium risk

5.4 Summary - Victorian Murray water resource plan area (surface water)

A total of 124 consolidated risks were identified in the Victorian Murray water resource plan area. Of these, 78 were identified as medium to very high risk.

Causes associated with the occurrence of medium to very high risk were:

- climate change
- extreme drought
- failure to continue to invest in best practice land use initiatives
- farm dams
- major asset failure
- pests and weeds.

5.4.1 Water availability

Water availability was assessed in terms of the form of legal entitlement to the surface water (see [Table 5-6](#)).

Climate change was the only cause of risk that generated **very high risks** to water availability for environmental and consumptive uses. Extreme drought caused **high risk** to environmental and consumptive uses.

The risk assessment found that climate change could trigger a reduction in volume of water and a change to seasonal pattern (threats) which would have a **very high risk** for the environment's low reliability and uncontrolled (above cap) water. A reduction in volume (threat) would also be a **high risk** to the environment's high reliability water.

The risk assessment found extreme drought could trigger a reduction in volume of water which would be a **high risk** for the environment's low reliability and uncontrolled (above cap) water, and could trigger a change to interannual patterns and would have a **high risk** for the environment's uncontrolled (above cap) water.

The risk assessment found that climate change could trigger a reduction in volume of water (threat) and a change to seasonal patterns (threat) which would have a **very high risk** for the consumptive use of low reliability water and section 51 licences. A reduction in volume would also have a **high risk** to consumptive uses of high reliability water, section 51 licences and section 8 stock and domestic rights. A change to seasonal pattern would also have a **high risk** to consumptive uses of section 8 stock and domestic rights.

The risk assessment found extreme drought could trigger a reduction in volume of water and would be a **high risk** for consumptive uses of low reliability water, and could trigger a change to interannual patterns and would have a **high risk** for consumptive uses for section 51 licence and section 8 stock and domestic rights.

Table 5-6: Victorian Murray water resource plan area summary of risks to availability of surface water

Cause	Threat	Use									
		Environment					Consumptive				
		High reliability	Low reliability	Controlled water – passing flows	Uncontrolled water – above cap water	Very high reliability	High reliability	Low reliability	System operating water	S51 licences	S8 stock and domestic
Climate change	Reduction in volume	Orange	Red	Yellow	Red	Yellow	Orange	Red	Yellow	Orange	Orange
	Change to seasonal pattern	Yellow	Yellow	Yellow	Red	Yellow	Yellow	Yellow	Yellow	Red	Orange
	Change to interannual pattern	White	Yellow	White	Yellow	White	White	Yellow	White	Yellow	Yellow
Extreme drought	Reduction in volume	Yellow	Orange	Yellow	Orange	White	Yellow	Orange	White	Yellow	Yellow
	Change to seasonal pattern	White	White	White	Yellow	White	White	White	White	Yellow	Yellow
	Change to interannual pattern	White	Yellow	White	Orange	White	White	Yellow	White	Orange	Orange
Bushfires	Reduction in volume	White	Yellow	White	Yellow	White	White	Yellow	White	White	White
	Reduction in volume	White	Yellow	White	Yellow	White	White	Yellow	White	White	White
Land use change: availability	Reduction in volume	White	Yellow	White	Yellow	White	White	Yellow	White	White	White
	Reduction in volume	White	Yellow	White	Yellow	White	White	Yellow	White	White	White

Cause	Threat	Use									
		Environment					Consumptive				
		High reliability	Low reliability	Controlled water – passing flows	Uncontrolled water – above cap water	Very high reliability	High reliability	Low reliability	System operating water	S51 licences	S8 stock and domestic
Farm dams	Reduction in volume										
	Change to seasonal pattern										
	Change to interannual pattern										

Legend	5	4	3
	Very high risk	High risk	Medium risk

5.4.2 Water quality (condition)

Water quality assessments were based on the beneficial uses and users of water established in Victoria's State Environment Protection Policy (Waters) (DELWP, 2018).

The risk assessment (see [Table 5-7](#)) found that climate change could trigger pathogens and other impacts on water quality (threats), and these would have a **very high risk** for environmental uses.

The risk assessment found extreme drought could trigger pathogens (threat) and failure to continue to invest in best practice land use initiatives could trigger salinity, suspended solid and nutrients and pathogens (threats), and pests and weeds could trigger suspended solids and nutrients (threat) all which would have a **high risk** for environmental uses.

The risk assessment found that climate change could trigger pathogens (threat) and would be a **very high risk** for consumptive users including the use of water for human drinking, agriculture and irrigation, aquaculture, and fish and crustacean consumption. Climate change could also trigger other water quality impacts (threat) and would be a **very high risk** for consumptive users including the use of water for agriculture and irrigation, aquaculture and human consumption of fish and crustaceans.

The risk assessment found that climate change could trigger other water quality impacts (threats) and would be a **high risk** for consumptive users including the use of water for drinking.

The risk assessment found that extreme drought could trigger pathogens (threat) and would be a **high risk** for consumptive users including the use of water for human drinking and aquaculture.

The risk assessment found that failure to continue to invest in best practice and use initiatives could trigger salinity, suspended solids and nutrients and pathogens (threats) and would be a **high risk** for consumptive users including the use of water for human drinking, agriculture and irrigation, aquaculture, and fish and crustacean consumption.

The risk assessment found pests and weeds could trigger suspended solids and nutrients (threat) and would have a **high risk** for consumptive users including water for human drinking, agriculture and irrigation, aquaculture, and fish and crustacean consumption.

Social uses were categorised as primary contact recreation (for example swimming) secondary contact recreation (for example fishing) and aesthetics. The risk assessment found that climate change could trigger pathogens (threat) and other impacts on water quality (threat), and these would have a **high to very high risk** for primary and secondary contact recreation, and pathogens (threat) is a **very high risk** for aesthetics.

The risk assessment found extreme drought and a failure to continue to invest in best practice land use initiatives could cause pathogens (threat) which would be a **high risk** for primary contact recreation.

Table 5-7: Victorian Murray water resource plan area summary of risks to condition of surface water

Cause	Threat	Murray Water Resource Plan Area									
		Environment	Consumptive			Social			Other		
		Environmental	Human drinking	Agriculture and irrigation	Aquaculture	Industry and commercial	Fish, crustaceans consumption	Primary contact recreation	Secondary contact recreation	Aesthetics	
Climate change	Salinity	Yellow		Yellow			Yellow				
	Suspended solids and nutrients										
	Toxicants		Yellow	Yellow				Yellow			
	Pathogens	Dark Red	Dark Red	Dark Red	Dark Red	Yellow	Dark Red	Dark Red	Dark Red	Dark Red	Dark Red
	Other water quality impacts	Dark Red	Orange	Dark Red	Dark Red	Yellow	Dark Red	Orange	Orange	Yellow	Yellow
	Pathogens	Orange	Orange	Orange	Orange		Orange	Orange	Orange	Yellow	Yellow
Extreme drought	Other water quality impacts	Yellow	Yellow	Yellow	Yellow		Yellow	Yellow	Yellow	Yellow	
	Salinity	Yellow		Yellow							
Extreme wet	Suspended solids and nutrients	Yellow					Yellow				
	Suspended solids and nutrients	Yellow	Yellow	Yellow	Yellow		Yellow	Yellow	Yellow	Yellow	
Bushfires	Suspended solids and nutrients	Yellow	Yellow	Yellow	Yellow		Yellow	Yellow	Yellow	Yellow	
	Other water quality impacts	Yellow		Yellow	Yellow		Yellow	Yellow	Yellow	Yellow	

Cause	Threat	Threat									
		Environment	Consumptive			Social			Aesthetics		
		Environmental	Human drinking	Agriculture and irrigation	Aquaculture	Industry and commercial	Fish, crustaceans consumption	Primary contact recreation	Secondary contact recreation	Aesthetics	
Failure to continue to invest in best practice land use initiatives	Salinity										
	Suspended solids and nutrients										
	Pathogens										
	Other water quality impacts										
Farm dams	Salinity										
	Suspended solids and nutrients										
Non-compliance with the Water Act 1989	Suspended solids and nutrients										
Timing and location of demands	Salinity										
Earth resource development	Salinity										
	Toxicants										
Major asset failure	Other water quality impacts										

Cause	Threat	Risk Level									
		Environment			Consumptive			Social			
		Environmental	Human drinking	Agriculture and irrigation	Aquaculture	Industry and commercial	Fish, crustaceans consumption	Primary contact recreation	Secondary contact recreation	Aesthetics	
Pests and weeds	Suspended solids and nutrients	5	4	3	4	3	4	3	4	3	
	Other water quality impacts	3	3	3	3	3	3	3	3	3	

Legend	5	4	3
	Very high risk	High risk	Medium risk

5.4.3 Social (recreational and amenity) and Aboriginal uses

Risks to recreational and amenity and Aboriginal cultural values were assessed in terms of the risks associated to both the condition/quality of water available for these purposes and the availability of water for these functions.

The social, environmental, and consumptive uses of water are relatively well understood as water resource planning concepts. However, Aboriginal uses of water are not as well understood which is why a large number of risks have been generated at this stage in the risk assessment.

Climate change generated **very high risks** associated with impact to Aboriginal cultural uses of water with regard to:

- reduction in volume
- change to seasonal pattern
- salinity
- pathogens
- other water quality impacts.

Climate change and extreme drought also posed **medium or high risks** to recreational and amenity uses because of threats associated with declines in water availability. Changes to seasonal patterns of inflows posed these risks only with regard to climate change.

5.4.4 Priority environmental assets

The risk assessment found that changes to the timing and location of demands causing a loss or decline in instream physical habitat is **very high risk** for rivers and wetlands (see [Table 5-8](#)).

Climate change, extreme drought, failure to continue to invest in best practice land use initiatives and pests and weeds generated **medium risks** to the health of rivers and wetlands in the Victorian Murray water resource plan area.

Table 5-8: Victorian Murray water resource plan area risks to priority environmental assets

Cause	Threat	Rivers	Wetlands
Climate change	Loss or decline in longitudinal connectivity		
	Loss or decline in lateral connectivity		
	Loss or decline in instream physical habitat		
Extreme drought	Loss or decline in longitudinal connectivity		
	Loss or decline in lateral connectivity		
Failure to continue to invest in best practice land use initiatives	Loss or decline in longitudinal connectivity		
	Loss or decline in lateral connectivity		
	Loss or decline in instream physical habitat		

Cause	Threat	Rivers	Wetlands
Pests and weeds	Loss or decline in longitudinal connectivity		
	Loss or decline in instream physical habitat		
Changes to the timing and location of demands	Loss or decline in instream physical habitat		

Legend	5	4	3
	Very high risk	High risk	Medium risk

5.5 Summary – Goulburn-Murray water resource plan area (groundwater)

A total of 68 consolidated risks were identified in the Goulburn-Murray groundwater water resource plan area. Of these, 34 were identified as **medium to very high risk**.

Causes associated with the high occurrence of moderate to **very high risk** were:

- climate change
- point source discharges
- major asset failure.
- extreme drought
- land use change: availability
- land use change: condition
- earth resource development

5.5.1 Water availability

Groundwater availability was assessed in terms of the biophysical attributes of the aquifer (see [Table 5-9](#)).

Climate change was the only cause of risk that generated **very high risks** to water availability for environmental and consumptive uses.

The risk assessment found that climate change could trigger a decline in inflow to, or increase in extraction from, aquifers in the upland layered valley and uplands which would have **very high risks** for environment and consumptive uses, and would have **high risks** for basin margin shallow for environment and consumptive uses and **high risk** for basin margin deep for consumptive use.

The risk assessment found that climate change could trigger an adverse change to the seasonal pattern of inflow to, or extraction from, aquifers in the basin margin shallow, upland layered valley and uplands which would have **very high risks** for environment and consumptive uses, and would have **high risks** for basin margin deep for consumptive uses.

Table 5-9: Goulburn-Murray groundwater water resource plan area summary of risks to availability

Cause	Threat	Use							
		Environment			Consumptive				
		Basin margin deep	Basin margin shallow	Upland layered valley	Uplands	Basin margin deep	Basin margin shallow	Upland layered valley	Uplands
Climate change	Decline in inflow to, or increase in extraction from, aquifer	Yellow	Yellow	Red	Red	Yellow	Yellow	Red	Red
	Adverse change to the seasonal pattern of inflow to, or extraction from, aquifer	Yellow	Red	Red	Red	Yellow	Red	Red	Red
	Salinity								Yellow
Extreme drought	Decline in inflow to, or increase in extraction from, aquifer								Yellow

Legend	5	4	3
		Very high risk	High risk

5.5.2 Water quality (condition)

Groundwater quality (condition) assessments were based on the beneficial uses and users of water established in Victoria’s State Environment Protection Policy (Waters).

The risk assessment found that climate change could trigger threats related to increased salinity which poses a **high risk** to the consumptive use of water for agricultural and irrigation and consumption of fish and crustaceans (see [Table 5-10](#)).

Table 5-10: Goulburn-Murray groundwater water resource plan area summary of risks to condition

Cause	Threat	Consumptive				
		Human drinking	Agriculture and irrigation	Aquaculture	Industry/commercial	Fish, crustaceans consumption
Climate change	Salinity	3	4	3	3	4
Land use change: condition	Salinity	3	3	3	3	3
	Toxicants	3	3	3	3	3
Earth resource development	Salinity	3	3	3	3	3
	Toxicants	3	3	3	3	3
Point source discharges	Salinity	3	3	3	3	3
	Toxicants	3	3	3	3	3

Legend	5	4	3
	Very high risk	High risk	Medium risk

5.5.3 Social (recreational and amenity) and Aboriginal uses

Risks to recreational and amenity and Aboriginal cultural values were assessed in terms of the risks associated to both the condition and quality of water available for these purposes and the availability of water for these functions.

The social, environmental, and consumptive uses of water are relatively well understood as water resource planning concepts. However, Aboriginal uses of water are not as well understood which is why a large number of risks have been generated at this stage in the risk assessment.

Climate change generated **very high risks** associated with impact to Aboriginal cultural uses of water with regard to:

- decline in inflow to, or increase in extraction of water from, aquifers
- adverse change to the seasonal pattern of inflow to, or extraction of water from, aquifers
- salinity

These were followed by **high risk** of extreme drought, land use changes affecting water condition, earth resource development, point source discharges and major asset failure which generated high risks to Aboriginal cultural values of water across a variety of threats.

Climate change also posed **medium risks** with regard to recreational and amenity uses, because of threats associated with declines in water availability and changes to seasonal patterns of inflows to or extraction from aquifers.

5.6 Strategies for addressing medium and higher-level risks

Under the provisions of the Basin Plan, water resource plans are required to address medium or higher-level risks.

In addressing the risks, water resource plans must describe the risks and the factors contributing to those risks. Adequate information must be captured in the data gathering process to develop a description of the risk and the factors contributing to risks for the risk register and the risk assessment.

The tables provided in [Appendix B section 3.2](#), [section 3.3](#) and [section 3.4](#) provide a description of risks for the water resource plan area defined in accordance with section 10.41(6) of the Basin Plan as having:

- a medium or higher level of risk
- the factors that contribute to those risks
- the quantified uncertainties in the level of risk attributed to each risk by way of sensitivity analysis.

In addressing the risks, the water resource plans must describe the risks and the factors contributing to those risks. The tables in the Risk Assessment Report at [Appendix B section 3.2](#), [section 3.3](#) and [section 3.4](#) describe clearly the causes, activated threats and impact on users/ use types.

Adequate information has been captured in the data gathering process to develop a description of the risks and the factors contributing to the risks. The risks and factors contributing to these risks and the assumptions underlying the risk assessment were set out in the Risk Assessment Report and an accompanying risk register.

Under Victorian legislation there is no one 'water resource plan'. Rather, risk-based water resource planning is carried out through a range of processes, plans and strategies, many of which embed risk management practices.

Based on the themes identified in the risk assessment, the medium to high-level risks identified will be addressed through continuing development and implementation of existing broad-scale policies and improvement programs identified through *Water for Victoria* (DELWP, 2016) and existing policies and programs.

Addressing risks will be achieved through a combination of state-based policy and program development, collaboration with regional water managers and engagement with regional stakeholders and interstate water planning agencies.

Examples of such planning and policy development include:

- review and enhancement of climate change adaptation policy and practice
- review and enhancement of drought management policy and practice
- implementation of updated state-wide water quality policy
- reaffirmation of continued commitment to support existing management programs, including waterway management, soil conservation, forestry management, and dairy, grazing and irrigation management.

35 strategies were identified as part of Victoria's water and catchment management framework. Continued implementation of these strategies will address the risks identified for the availability and condition of water resources.

These strategies combine the policy directions contained and reinforced through *Water for Victoria* (DELWP, 2016) and existing regulations and guidelines, and are identified in **Table 4.2.1** of **Appendix B**. Each medium or high-level risk has been linked to the strategies where they contribute to the management of that risk.

5.6.1 Surface water risks

Appendix B section 3.2 identifies the medium or higher-level risks and confidence level and identifies the strategies to address the risk for the Northern Victoria water resource plan area for surface water as follows:

- **Table 3.2.1** to **Table 3.2.9** are related to consumptive uses
- **Table 3.2.10** to **Table 3.2.18** are related to environmental uses
- **Table 3.2.19** to **Table 3.2.28** are related to Aboriginal uses
- **Table 3.2.29** to **Table 3.2.33** are related to recreational uses
- **Table 3.2.34** to **Table 3.2.35** are related to critical human water needs
- **Table 3.2.36** to **Table 3.2.39** are related to priority environmental assets
- **Table 3.2.41** to **Table 3.2.42** are related to interception activities
- **Table 3.2.43** to **Table 3.2.44** are related to non-compliance.

Appendix B section 3.4 identifies the medium or higher-level risks and confidence level and identifies the strategies to address the risk for the Victorian Murray water resource plan area for surface water as follows:

- **Table 3.4.1** to **Table 3.4.8** are related to consumptive uses
- **Table 3.4.9** to **Table 3.4.16** are related to environmental uses
- **Table 3.4.17** to **Table 3.4.26** are related to Aboriginal uses
- **Table 3.4.27** to **Table 3.4.30** are related to recreational uses
- **Table 3.4.31** to **Table 3.4.32** are related to critical human water needs
- **Table 3.4.33** to **Table 3.4.36** are related to priority environmental assets

- **Table 3.4.38** to **Table 3.4.39** are related to interception activities
- **Table 3.4.40** to **Table 3.4.41** are related to non-compliance.

5.6.2 Groundwater risks

Appendix B section 3.3 identifies the medium or higher-level risks, confidence level and strategies to address the risk for the Goulburn-Murray water resource plan area (groundwater) as follows:

- **Table 3.3.1** to **Table 3.3.3**: are related to consumptive uses
- **Table 3.3.4**: is related to environmental uses
- **Table 3.3.5**: to **Table 3.3.14** are related to Aboriginal uses
- **Table 3.3.15** is related to recreational uses
- **Table 3.3.16** to **Table 3.3.17** is related to critical human water needs
- **Table 3.3.18** is related to priority environmental assets dependent on groundwater and surface water connections and environmental outcomes relating to groundwater from climate change
- **Table 3.3.19** is related to risks to the productive base of groundwater
- **Table 3.3.21** to **Table 3.3.22** are related to interception
- **Table 3.3.23** to **Table 3.3.24** is related to non-compliance.

5.7 Managing compliance risks - the Basin Compliance Compact

Victoria's water resource compliance and enforcement framework is designed to protect the environment and existing entitlement holders from illegal take and use of water. Non-compliance with the Victorian Water Act includes the unauthorised take and/or use of water or the constructing or altering of works without consent.

The Water Compliance Report 2017–18 (DELWP, 2018) reported 1,625 cases of alleged compliance breaches of the Victorian Water Act in non-urban systems across Victoria. Among others, this included 786 advisory letters and 740 warning notices. Fourteen prosecutions for breaches of the Victorian Water Act were initiated in 2017-18 and 10 prosecutions were finalised during this period.

While Victoria has low levels of water theft, risks to compliance can increase during drought when there is more competition for the available water or where there are constraints on delivering water during peak demand. Demand for water is increasing and we can expect increased competition in the water market. The risk assessment reviewed the risk of non-compliance with the Victorian Water Act, including the unauthorised take and/or use of water or the constructing or altering of works without consent.

The assessment found that there were limited **medium-level risks** associated with non-compliance related to impacts on water condition affecting consumptive, environmental and Aboriginal uses in the Northern Victoria and Victorian Murray water resource plan areas. In the Goulburn-Murray water resource plan area condition risks were limited to Aboriginal uses due to lack of information about these uses.

Risks of non-compliance with the Victorian Water Act to water availability were limited to Aboriginal uses in the Northern Victorian and Victorian Murray water resource plan areas and Goulburn-Murray water resource plan area, again due to the lack of information about these uses. In short, compliance issues are not associated with high levels of risk to other users or the environment at the scale of the water resource plan areas.

However as noted by the Independent Reviewer of the Basin Compliance Compact:

'Public confidence in the management of water in the Murray-Darling Basin has been seriously undermined by a series of reports dating from a Four Corners report in July 2017 of governments failing to adequately enforce compliance and demonstrate integrity in the management of water in the Basin, particularly the northern Basin.'

These incidents highlighted the importance of having effective compliance and enforcement systems across the entire Murray-Darling Basin. Effective compliance helps maintain community confidence in entitlements and water markets as people know that everybody is held to account to the same rules.

Water corporations in Victoria are responsible for administering entitlements, including metering water use and managing compliance. *Water for Victoria* (DELWP, 2016) noted that the compliance and enforcement regime in the Victorian Water Act requires updating and committed the government to modernise the enforcement regime to align with best practice regulation. It noted that water corporations will adopt a consistent risk-based approach to manage compliance and enforcement, with improved oversight and reporting.

On 8 June 2018 the Murray-Darling Basin Ministerial Council signed an interim Basin Compliance Compact. The Basin Compliance Compact commits all Basin states and the Australian Government to improve the transparency and accountability of water management and put more consistent compliance and enforcement into action across the Basin states.

Compliance and enforcement is discussed in more detail at [section 6.7](#). A number of actions and complementary strategies identified in the Risk Assessment Report ([Appendix B](#)) also address compliance and enforcement. Implementation of the Basin Compliance Compact is reflected in strategy 32 on 'strengthening and modernising compliance arrangements'.