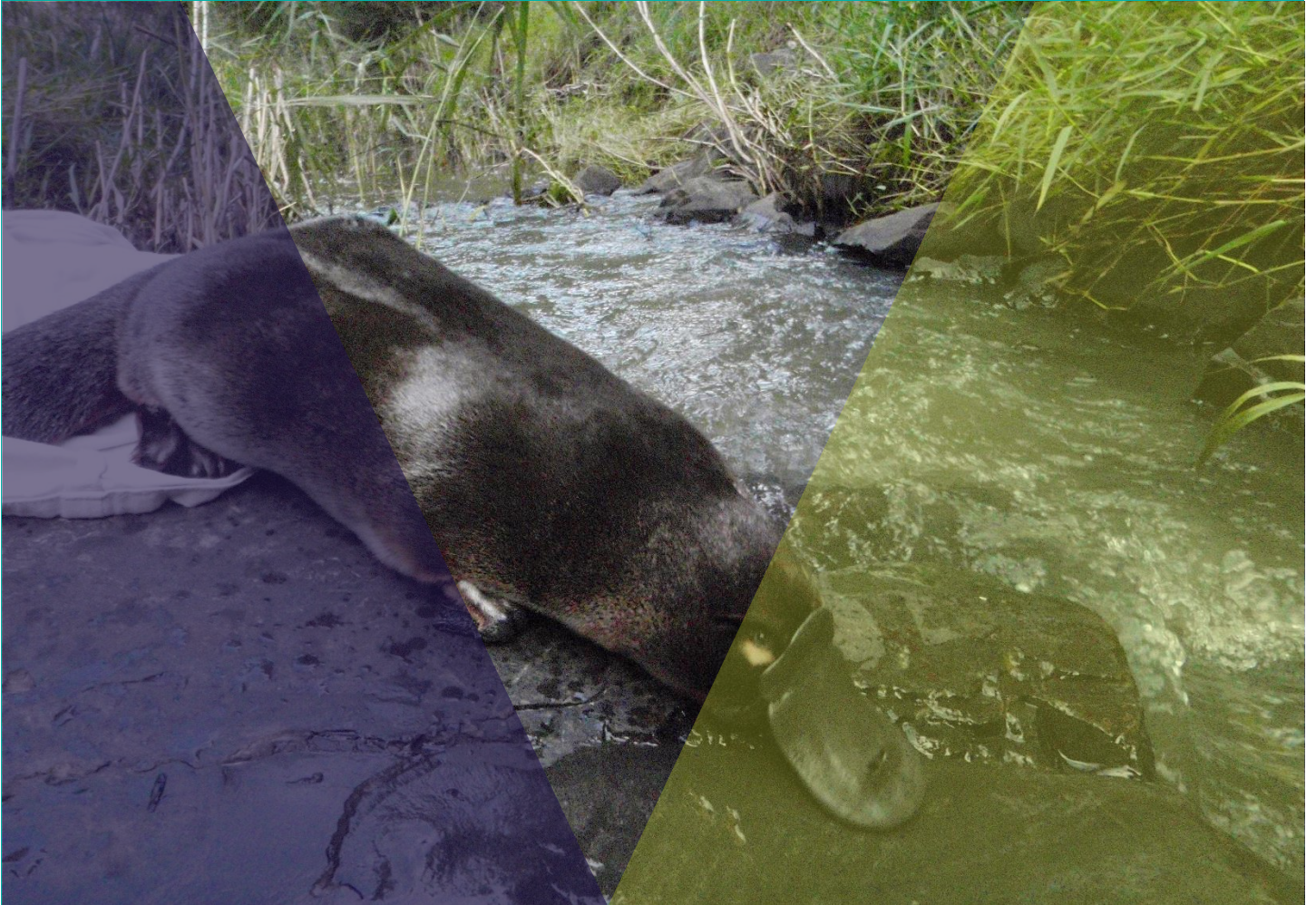


Threatened Species and Communities Risk Assessment

Platypus Risk Assessment



July 2021

Photo credit

Tom Kelly - Platypus released back into a Melbourne waterway following a survey as part of a population monitoring program.

Acknowledgment

We acknowledge and respect Victorian Traditional Owners as the original custodians of Victoria's land and waters, their unique ability to care for Country and deep spiritual connection to it. We honour Elders past and present whose knowledge and wisdom has ensured the continuation of culture and traditional practices.

We are committed to genuinely partner, and meaningfully engage, with Victoria's Traditional Owners and Aboriginal communities to support the protection of Country, the maintenance of spiritual and cultural practices and their broader aspirations in the 21st century and beyond.



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1. Summary

The Platypus was listed as vulnerable under the *Flora and Fauna Guarantee Act 1988* (FFG Act) in January 2021. This Risk Assessment Report considers risks to this species in the short and long term and whether interim or permanent protections are required.

Under Victoria's modernised Regional Forest Agreements (RFA), the Department of Environment, Land, Water and Planning (DELWP) must, within six months of a species or ecological community being listed as threatened under the Victorian FFG Act or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), undertake a risk assessment where the species or community is or has the potential to be at risk from forestry operations, determine whether additional interim or permanent protections and management actions are necessary, and implement interim protections and actions where relevant.

This risk assessment is built upon the input of species experts combined with information sources including published literature and spatial analysis. The consequence and likelihood of each risk was determined to assess the overall level of risk posed to the Platypus by hazards over the next 20 years as they variously apply across the five Victorian RFA regions (Central Highlands, Gippsland, East Gippsland, North East and West), including consideration of the effectiveness of existing controls. It considers whether any of the identified risks (those ranked significant or high) represent an immediate risk of serious or irreversible harm in the short term (next 18 months). Finally, it states whether permanent protections may be required to mitigate the identified significant or high risks in the longer-term.

The following key hazards were considered to impact the Platypus in all RFA regions:

- Bushfire events were assessed as a 'significant' risk to the Platypus, as they can cause direct mortality or injury, loss of aquatic and terrestrial habitat, debris-flow and siltation, fragmentation, and increased predation. These effects are compounded by climate change.
- Decline in streamflow and water quality was assessed as 'significant' in all RFA regions except the West RFA, which was assessed as 'high'. This is based on the impacts of altered streamflow, river regulation, rainfall run-off interception, turbidity, toxicants and pollution. These impacts reduce the habitat quality, connectivity, and food resources of the Platypus.
- Entanglement and fishing by-catch was assessed as a 'significant' risk to the Platypus, which are highly susceptible to drowning in nets and traps or being entangled in litter and discarded fishing line.
- Extreme weather events and climate change was assessed as a 'high' risk to the Platypus. Climate change will result in more severe bushfires, lower and more patchy rainfall, and increased drought frequency and severity. Extended drought periods can reduce Platypus habitat, decrease their foraging ability, and increase competition. Large flood events and overbank flood events have been associated with lower recruitment in Platypus, and may displace individuals, reduce food resources, and drown juveniles.
- Forestry operations, including timber harvesting and associated roading and forest regeneration activities, was assessed as a 'medium' risk to the Platypus. This is due to the potential for sediment input to waterways which reduces water quality and the abundance of Platypus food resources.
- Genetic decline was assessed as a 'medium' risk to all RFA regions except the West RFA, which was assessed as 'significant' due to highly fragmented isolated populations. Genetic drift and inbreeding in small isolated populations reduce adaptive capacity and fitness.
- Habitat fragmentation due to in-stream barriers was assessed as a 'medium' risk to the Platypus. Habitat fragmentation can result in reduced maintenance of metapopulation processes, restricted movement, reduced genetic diversity, and reduced recolonisation capacity.
- Habitat loss and degradation was assessed as a 'significant' risk to the Platypus. Vegetation removal, particularly near waterways, can result in habitat degradation, fragmentation and loss, altered flow regimes, and reduced water quality.
- Pest plants and animals were assessed as a 'significant' risk to the Platypus. Platypus can move over land when dispersing as juveniles, or during dry periods when searching for water, which leaves

them vulnerable to predation by foxes, dogs and cats. Introduced plants and animals impact Platypus habitat through bank erosion and increased sedimentation and introduced fish species compete for food resources.

Table 1 below lists the hazards together with their level of risk across the RFA regions as determined by this assessment. It is noteworthy that there is only minor variation in the level of risk posed by the hazards across the five regions, which suggests that risks to platypus are widespread. However, it is acknowledged this would have local variations.

Table 1: List of hazards and risk ratings over the next 20 years

Hazard	Central Highlands	East Gippsland	Gippsland	North East	West
Bushfire events	Significant	Significant	Significant	Significant	Significant
Decline in streamflow and water quality	Significant	Significant	Significant	Significant	High
Entanglement and fishing by-catch	Significant	Significant	Significant	Significant	Significant
Extreme weather events and climate change	High	High	High	High	High
Forestry operations	Medium	Medium	Medium	Medium	Medium
Genetic decline	Medium	Medium	Medium	Medium	Significant
Habitat fragmentation due to in-stream barriers	Medium	Medium	Medium	Medium	Medium
Habitat loss and degradation	Significant	Significant	Significant	Significant	Significant
Pest plants and animals	Significant	Significant	Significant	Significant	Significant

Assessing risk

The risks posed by the various hazards were assessed on the basis of the likelihood of the hazard impacting on Platypus populations over the next 20 years combined with the consequence of any such impacts. A brief description of the risk assessment method is provided in Appendix 2.

Cumulative impacts and interactions between hazards

There are significant interactions between the identified hazards that may limit or exacerbate their individual impacts. Examples of this include changes in water regimes and water quality that can exacerbate the impacts of predation, considerable portions of normally flowing waterways predictably ceasing flowing in drought, and climate change increasing the risk of these hazards.

Fragmentation cumulates with most hazards that degrade habitat, reduce connectivity, and cause loss of genetic diversity. For example, in-stream barriers such as large dams restrict movements along rivers, while land clearing, land use change and invasive species can restrict overland movements of the Platypus. Lowered population sizes and fragmentation of populations will increase the likelihood of local extinctions and loss of genetic viability of many populations.

Although each hazard has been assessed individually, the cumulative impacts of these hazards are likely to pose more significant threats when considered together. Hazards, such as entanglement or habitat fragmentation, may not individually cause significant or irreversible damage to the Platypus in the short term,

but they may contribute to its overall decline. However, given the relative complex operation of each hazard, it is difficult to quantify the cumulative impacts of the hazards considered in this risk assessment.

Requirement for interim or permanent protections

Based on the findings of this assessment, there is no requirement for additional interim protections to manage risk to the Platypus. However, noting the reasons for the listing of this species, permanent protections and active management will be required to mitigate the impact of any hazard identified at a significant or high risk, and all hazards rated a medium risk or higher will be considered in future management. In many cases, this will involve the maintenance of existing controls; in some cases, further augmentation or adjustment may be required, subject to appropriate evaluation. In a few cases, new protection measures and/or programs of active management may be required.

The next steps

This risk assessment will be followed by the preparation of a draft management plan under the *Flora and Fauna Guarantee Act 1988*. The draft management plan will be based on a detailed assessment of the management actions necessary for the conservation of the Platypus. All relevant social and economic factors will be considered in the preparation of the draft management plan and further consultation with relevant government agencies will be undertaken prior to its completion to ensure that the intended management actions are feasible and proportionate to the level of risk posed by the various hazards identified in this document. The draft management plan will be released for public comment prior to approval.

2. Overview

2.1 Introduction

Under Victoria's modernised RFAs, DELWP must, within six months of a species or ecological community being listed as threatened under the Victorian FFG Act or the Commonwealth EPBC Act, undertake a risk assessment where the species or community is or has the potential to be at risk from forestry operations, determine whether additional interim or permanent protections and management actions are necessary, and implement interim protections and actions where relevant. The Platypus was listed as threatened under the FFG Act in January 2021.

The Platypus is considered to have the potential to be at risk from forestry operations due to a) the extensive overlap of the Platypus's likely habitat with areas available for timber harvesting and b) the existence of a plausible mechanism of impact – sedimentation of streams as a result of timber harvesting and associated roading potentially affecting water quality and food availability.

Four experts were asked to assess the level of risk posed to the Platypus by hazards over the next 20 years as they variously apply across the five Victorian RFA regions (Central Highlands, Gippsland, East Gippsland, North East and West), by determining the consequence and likelihood of each hazard, as well as considering the effectiveness of existing controls. They were also asked to assess whether any of the identified risks (those ranked significant or high) represent an immediate risk of serious or irreversible harm in the short term (next 18 months). Finally, they were asked to propose feasible, realistic measures (including regulatory controls, active management and/or further knowledge acquisition) that should be considered to mitigate the identified significant or high risks over the longer term.

The experts who contributed to this assessment all have extensive experience and specific knowledge of the Platypus; they included a university-based researcher, an environmental consultant, a community-based scientist and a staff member from DELWP.

2.2 Species information

The Platypus has a streamlined, dorso-ventrally flattened body with a broad, flat tail all covered in dense waterproof fur, and short limbs with webbed feet and a rubbery bill (SAC 2020). Platypus are seasonal breeders, and in Victoria the mating season is from August to November, with young emerging from their nests and weaning in late summer. Females lay 1-3 eggs (generally 2) after an estimated gestation of ~16 days, which hatch after ~10 days incubation, and females will suckle the young for 3-4 months prior to their emergence from the burrow (Thomas *et al.* 2018).

The usual longevity for wild Platypus is around 15 years (SAC 2020), however wild females have been known to live up to 21 years (Grant 2004a; Bino *et al.* 2015). In captivity, males breed from 2-11 years old, and females from 2-mid teens, however in the wild it is thought they do not breed until they are 4 years old (SAC 2020). The generation length of the Platypus has been variously estimated to be ~10 years (Furlan *et al.* 2012), 9-12 years (Woinarski *et al.* 2014), and 6.5 years in Melbourne creeks (Serena *et al.* 2014).

The Platypus appears to have been widely distributed in waterways throughout Victoria (apart from the northwest region, Mornington Peninsula and Wilson's Promontory (Grant 1992)), which has not seemed to have changed significantly since European settlement (except for the lower Murray River downstream of Echuca, where it no longer exists (Menkhorst 1995)). However, this broad distribution fails to depict localised declines, localised extinctions, and reduced abundance. Preliminary surveys after the 2019/20 bushfires indicate an impact to the Platypus, with relatively low capture rates on the fire affected rivers and a sex bias towards males (SAC 2020).

The Platypus is semiaquatic and entirely dependent on aquatic ecosystems. The species occurs in a variety of water bodies including rivers, creeks, lakes and man-made dams and reservoirs, and occupies diverse habitats with reliable surface water (SAC 2020). Habitat variables demonstrated to be associated with Platypus occurrence or foraging activity include reliable surface flow, undercut banks, steep banks >0.5m high, cobble substrate, riparian vegetation overhanging the water, and pool depth between 1m and 3m

(Ellem *et al.* 1998; Grant & Bishop 1998; Serena *et al.* 1998; Serena *et al.* 2001; Bethge *et al.* 2003; Grant 2004b; SAC 2020).

2.3 Listing under the Flora and Fauna Guarantee Act

The taxon was assessed as eligible under IUCN Criterion A: The taxon has undergone, is suspected to have undergone, or is likely to undergo in the immediate future a substantial reduction in population size.

This is due to the mounting evidence that populations have reduced in abundance and distribution in the past 30 years due to multiple stressors that directly impact the species or degrade aquatic ecosystems. The taxon has been threatened by a range of human activities primarily due to changes in land use and alteration of waterways (SAC 2020).

The taxon was assessed as eligible under IUCN Criterion B: The taxon's geographic distribution is restricted and the distribution of the population or habitat of the taxon is severely fragmented or restricted to a limited number of threat-based locations; and there is a continuing decline or reduction in extent of occurrence, area of occupancy, area, extent or quality of habitat, and number of locations or subpopulations.

Evidence provided showed that there are many threats impacting on Platypus habitats resulting in habitat degradation, fragmentation and loss, most of which are currently operating and are expected to continue. These threats include drought/water lack, bushfires, floods, erosion, habitat degradation, climate change and human activity (SAC 2020).

2.4 Habitat distribution model and VBA observations

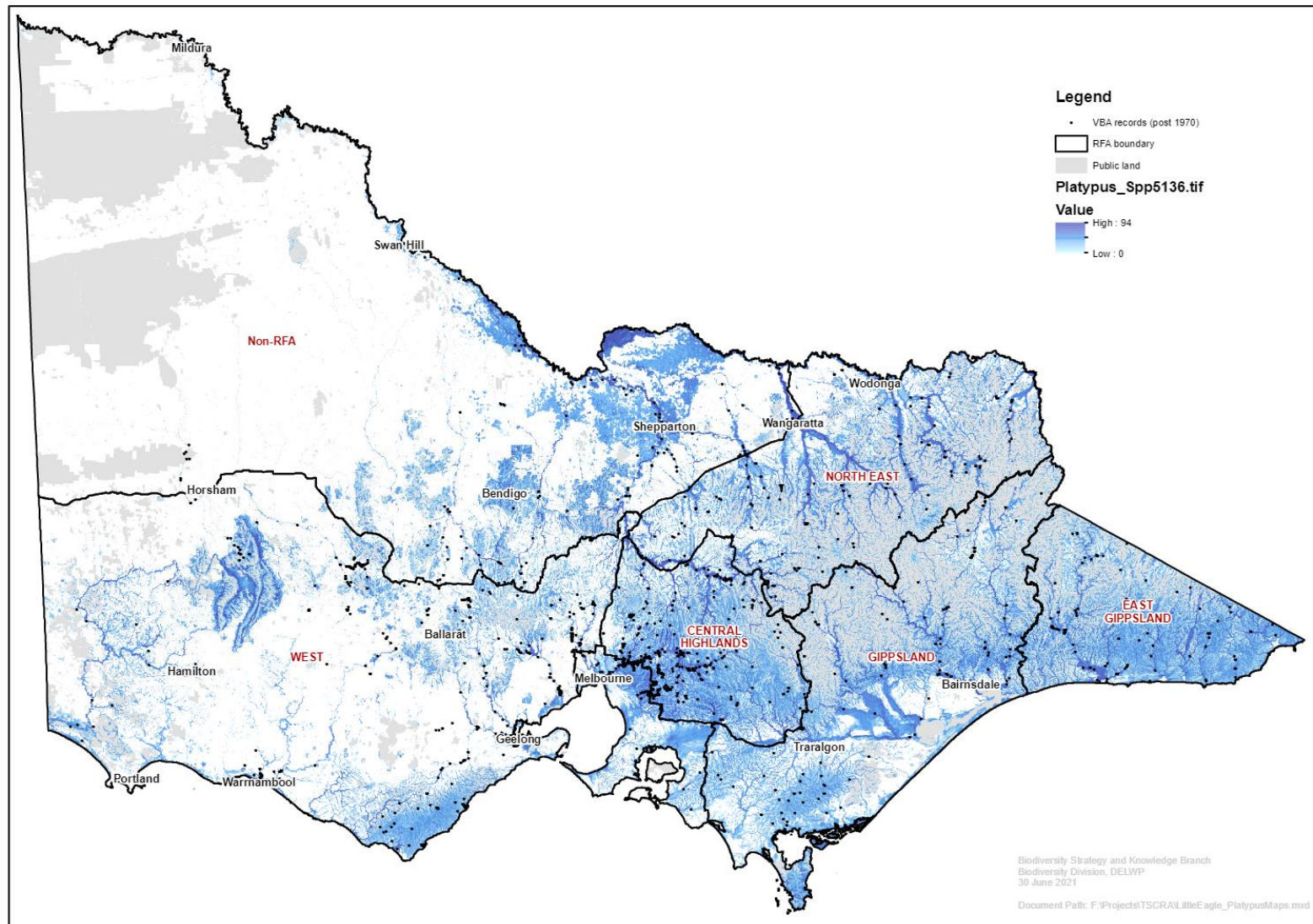


Figure 1. Victorian Platypus Habitat Distribution Model with Victorian Biodiversity Atlas (VBA) records. See Appendix 1 for table of data.

3. Key hazards identified in this risk assessment

3.1 Bushfire events

3.1.1 Hazard description

Effects of bushfire on aquatic ecosystems are most often caused by ash and sediment being carried by run-off from the surrounding landscape, with impacts such as poor water quality and reduced numbers of aquatic invertebrates (Rugenski & Minshall 2014; Dahm *et al.* 2015; Verkaik *et al.* 2015). Bushfires can cause direct mortality or injury, loss of aquatic and terrestrial habitat, debris-flow and siltation, fragmentation, and increased predation. These impacts are all compounded by climate change. Post-fire population recovery for aquatic species depends on water availability, habitat connectivity, riparian vegetation condition and water quality.

Some prior work indicates that bushfires in Gippsland (Serena & Williams 2008), western Victoria (Griffiths *et al.* 2015; Williams & Serena 2006), and near Melbourne (Bloink 2020; Armistead & Weeks 2009), had no impact on local Platypus populations. However, sedimentation triggered by severe post-fire flooding in steep terrain potentially reduced habitat quality in the upper Thomson River catchment in Gippsland (Serena & Williams 2008). The impact of bushfire also depends on previous conditions relating to water availability. Almost 14% of available Platypus habitat was impacted during the 2019-20 bushfires (van Eeden *et al.* 2020), which were preceded by a severe drought in many parts of the Platypus' range and followed by extreme floods.

Using eDNA, Griffiths *et al.* (2020) found that Platypus site occupancy declined by 14% across 48 sites within the 2019/20 bushfire area in Victoria and New South Wales. However, post-fire microbial decomposition rates increased significantly in response to the higher water temperature caused by reduced stream shading (Rodríguez Lozano *et al.* 2015). Given that eDNA in water is degraded both by microbial digestion and UV radiation (which increases due to reduced shading), it is possible that detection of Platypus eDNA in the post-fire study area declined at least partly as an outcome of fire-induced tree defoliation.

3.1.2 RFA regions affected

This hazard can affect all RFA Regions. It is typically localised within each region, with widespread events like the 2019/20 bushfires currently possible but rare and forecast to become more frequent with climate change.

3.1.3 Evaluation of existing controls

Existing control measures for this hazard include:

- the Victorian Government's Safer Together approach, including fuel management, to reduce the severity of bushfires in Victoria;
- bushfire suppression – coordinated action to limit the extent and severity of bushfires;
- Natural Values and Wildlife Officer roles in most Level 3 Incident Management Teams;
- Biodiversity risk assessment role deployed in every Rapid Risk Assessment Team; and
- environmental considerations in Readiness and Response Plans.

Bushfires cannot be prevented in all cases or effectively controlled when weather conditions are unfavourable. Bushfire response is an overriding priority for agencies such as the Country Fire Authority, DELWP and Parks Victoria, but the impacts of bushfires on species such as the Platypus cannot always be avoided. Post-fire, rapid biodiversity risk assessment is a valuable recent development, while noting that resource constraints and safety factors may limit and/or delay recovery action.

3.1.4 Risk assessment

The consequence of bushfire events was assessed as moderate and likely to occur over the next 20 years. Therefore, this hazard has a significant overall risk to the Platypus (Table 2). Severe events are more likely in the more densely forested areas of the Central Highlands, East Gippsland, Gippsland, and North East RFA regions, however populations in the West RFA region a) often occur in streams associated with forested

areas, b) tend to be smaller and c) are more likely to be exposed to low flow or cease to flow events; therefore bushfire impacts could still be significant.

Table 2: Risk assessment for bushfire events over the next 20 years

Hazard	Central Highlands	East Gippsland	Gippsland	North East	West
Bushfire events	Significant	Significant	Significant	Significant	Significant

3.1.5 Urgency

The likelihood of serious or irreversible environmental damage by bushfire in the short-term has been assessed as moderate to likely, depending on climatic conditions. The hazard could cause serious environmental damage, particularly for small isolated populations in areas of high fire risk, and areas of previous fire impact could be at risk of short-term impacts and need to be considered in contemporary management, such as protection of refugia, and appropriate flow management. However, the unpredictability of bushfire events over such short timeframes means that, apart from active consideration of the needs of the Platypus in the immediate post-bushfire risk assessments, there is little that can be done specifically. Therefore, no interim enforceable protections or priority management actions are required in the short-term.

3.1.6 Potential mitigations

Based on the expert input to this assessment, the following potential mitigations for bushfire events may be considered in the further development of permanent protections:

- greater focus on mitigating sedimentation through bank stabilisation post-fire;
- careful assessment of the conduct and scale of planning burning during periods of low water levels when Platypus may be more susceptible to fire impacts;
- greater consideration of Platypus in bushfire management strategies; and
- additional monitoring of Platypus after bushfire events.

3.2 Decline in streamflow and water quality

3.2.1 Hazard description

The hazard of streamflow and water quality includes:

- altered streamflows due to the extraction of water;
- river regulation;
- rainfall run-off interception (e.g. stock and domestic dams); and
- decreased water quality (e.g. turbidity) and toxicants (e.g. contamination of water and sediment by heavy metals).

Changes in water regimes and water quality have resulted in a reduction in Platypus habitat area and quality (Martin *et al.* 2014), loss of connectivity (Furlan *et al.* 2013), and a reduction in food resources (Growthns & Growthns 2001). The distribution of the Platypus overlaps significantly with Australia's most regulated rivers, with dams being present in 40.8% of sub-catchments in which Platypus have been recorded (Hawke *et al.* 2020). Large dams also fragment populations along and between rivers (Hawke *et al.* 2021a) and alter flow regimes, including the timing and temperature of flows, which can impact Platypus abundances downstream of regulatory structures (Hawke *et al.* 2021b). Climate change is also likely to have an impact on streamflow, causing an increase in drought frequency and severity, and lower and more patchy rainfall leading to reduced water flows (CSIRO & Bureau of Meteorology 2020).

Reduction of flow volumes through extraction of water can lead to increased frequencies of cease to flow events and the drying of critical freshwater refugia (Woinarski & Burbridge 2016). Long-term mean reduction in stream/river surface discharge is predicted to adversely affect both the size of Platypus populations due to

reduced food resources and extent of foraging areas, and their resilience, due to increased mortality risk and reduced breeding success. Victoria has the highest density of stock and domestic dams in Australia, with farm dams built since 2015 being on average 50% larger in surface area and hold 66% more water compared to those built in 1989 (Malerba *et al.* 2021).

Platypus are sensitive to water quality hazards such as turbidity and toxicants. For example, more Platypus were recorded in streams with lower concentrations of phosphorus, nitrogen, suspended solids, and heavy metals (Serena & Pettigrove 2005). Urban stormwater runoff (which can alter the volume, pattern and quality of water flow (Walsh *et al.* 2012)), rather than catchment urban density per se, is one likely mechanism for this pattern (Martin *et al.* 2014). Furthermore, Platypus diet consists largely of disturbance-sensitive invertebrates (McLachlan-Troup *et al.* 2010) that are potentially more prone to localised extinctions in streams receiving urban stormwater runoff (Walsh 2004). Outside of catchments with high levels of urban stormwater, processes related to forestry operations and agricultural land use may also contribute to water quality hazards (Grant & Temple-Smith 2003; Bino *et al.* 2019).

3.2.2 RFA regions affected

This hazard is widespread throughout the Platypus' range and extends across all populations in each RFA region, with the West RFA region particularly susceptible to altered flow regimes.

3.2.3 Evaluation of existing controls

Existing controls for this hazard include:

- Streamflow Management Plans (SFMP) as required under the *Water Act 1989*, which define the total amount of water in a catchment and describes how it will be shared between the environment and water users;
- Sustainable Water Strategies, which are used to manage threats to the supply and quality of water resources to protect environmental, economic, cultural and recreational values;
- the Victorian Waterway Management Strategy (VWMS), which provides the framework to maintain or improve the condition of rivers, estuaries and wetlands so that they can continue to provide environmental, social, cultural and economic values to Victorians;
- the regional waterway strategies (RWSs), which are a single planning document for river, estuary and wetland management in each region and drive implementation of the management approach outlined in the VWMS;
- FFG Act Action Statement No. 177 – Alteration to the natural flow regimes of rivers and streams; action statements describe the nature of the potentially threatening process and set out what has been done and what will be done to manage its impacts on native flora and fauna;
- the *Environment Protection Act 2017*, which provides for policies and regulation to minimise harm to public health and the environment from pollution and waste;
- the Murray-Darling Basin Plan, which aims to bring the Basin back to a healthier and sustainable level, while continuing to support farming and other industries for the benefit of the Australian community;
- Environmental Entitlements under the *Water Act 1989*, which enable water to be taken and used to maintain an Environmental Water Reserve, or to improve the environmental values and health of water ecosystems; and
- Environmental Water Management Plans produced by Catchment Management Authorities, where environmental watering goals, ecological objectives, and required water regimes are identified. The Victorian Environmental Water Holder then considers these proposals and prioritises annual watering actions.

The experts consulted for this assessment generally considered the current controls for decline in streamflow and water quality insufficient in mitigating the impacts of this hazard on the Platypus over the long term.

They cited the following factors as supporting this conclusion:

- SFMPs have only recently considered the Platypus and targets are frequently not met;
- many smaller streams do not have SFMPs;
- water diversions may be poorly regulated and there is the potential for illegal extraction;
- there is currently a poor understanding of the impacts of groundwater extraction on surface water flows; and
- extraction of water for domestic and stock purposes can have a major impact on water availability, particularly during dry periods when refuge pools are critical, which is likely to be exacerbated under climate change and human population growth.

Although the construction of large off-stream impoundments to support commercial developments such as orchards is regulated by regional water authorities, there are currently limited controls on the location, size or cumulative catchment-wide impact of their small stock and domestic dam counterparts.

3.2.4 Risk assessment

The overall risk level of the decline in stream flow and water quality was assessed as significant (Table 3) in the Central Highlands, East Gippsland, Gippsland and North East RFA regions. In these regions, the consequence of the hazard was assessed as moderate, with it likely to occur over the next 20 years. The hazard was assessed as high risk in the West RFA region, based on a consequence rating of major due to the smaller, more isolated Platypus populations, and a likelihood rating of likely to occur over the next 20 years, exacerbated by less reliable rainfall under climate change and relatively greater demands on the available water.

Table 3: Risk assessment for decline in stream flow and water quality over the next 20 years

Hazard	Central Highlands	East Gippsland	Gippsland	North East	West
Decline in stream flow and water quality	Significant	Significant	Significant	Significant	High

3.2.5 Urgency

The likelihood of serious or irreversible environmental damage by decline in streamflow and water quality in the short-term is assessed as low. The effects of this hazard are chronic, continuous and are exacerbated during dry periods. Pollution is presumed to have a long-term impact unless there is significant local event such as a chemical spill. Therefore, no interim enforceable protections or priority management actions are required in the short-term.

3.2.6 Potential mitigations

Based on the expert input to this assessment, the following potential mitigations for the decline in streamflow and water quality may be considered in the further development of permanent protections:

- identifying where environmental watering programs can contribute to supporting Platypus, in particular the maintenance of summer baseflows and minimising cease to flow events;
- setting sustainable water use targets through Sustainable Water Strategies which consider future water availability and consumption; supporting water efficiency by using alternative water sources where appropriate to meet water requirements e.g. recycled water; and limitations of extraction and diversions (surface and ground water);
- avoidance of bankfull water releases for irrigation during summer;
- enhancing the understanding of impacts of streamflow and water quality on Platypus populations;
- identifying priority areas where declines in streamflow and water quality are most likely to impact on the Platypus;
- enhanced consideration of streamflow management and implications for species such as the Platypus when new dams are constructed, especially for stock and domestic purposes;

- identification and protection of drought refuge pools to ensure they remain viable habitat;
- targeted measures to reduce the impact of domestic stock access in riparian zones; and
- improved controls for unregulated systems.

3.3 Entanglement (including by litter) and fishing by-catch

3.3.1 Hazard description

Entanglement and fishing by-catch of Platypus can result in injury or death. Enclosed traps, which are used to capture fish and crustaceans, frequently drown Platypus which become trapped inside and cannot escape. In Victoria, 56% of 186 Platypus mortalities (1980–2009) were caused by drowning in illegal nets or enclosed traps (Serena & Williams 2010a). The Victorian Fisheries Authority (VFA) announced a state-wide ban on enclosed traps in 2019.

The Platypus is highly susceptible to drowning in submerged eel nets (Serena & Williams 2010a). A Platypus is unable to eat or sleep while confined in a net and food passes through a Platypus's digestive tract and is excreted in just 5 hours (Booth & Connolly 2008). Assessments of plasma concentrations of stress hormones (adrenaline and noradrenaline) show Platypus are subject to a high degree of stress when confined in nets (McDonald *et al.* 1992). A large proportion of the trappable Platypus population in summer and early autumn consists of lactating females, recently emerged juveniles, or post-lactating females that are often in very poor condition.

Entanglement in fishing lines and litter is an ongoing hazard. In one study, some 10% of 133 captured animals had one or more pieces of rubbish encircling the body (Serena & Williams 1998), and entanglement in discarded fishing line and other manufactured materials was responsible for 8% of all Victorian Platypus mortality records from the 1980s to 2009 (Serena & Williams 2010a). There was an eightfold increase in the risk of entanglement with litter in the greater Melbourne area compared to regional Victoria (Serena & Williams 2021).

3.3.2 RFA regions affected

This hazard is widespread across all RFA regions but is more severe near population centres, and by-catch from eel management is likely to be more significant in the East Gippsland, Gippsland, and West RFA regions.

3.3.3 Evaluation of existing controls

Existing controls for this hazard include:

- a ban on opera house nets in all Victorian public and private waters;
- the Victorian Eel Fishery Management Plan 2017, which sets out strategies and management arrangements to achieve the objectives including an implementation plan and an evaluation and review process;
- monitoring and regulation by the VFA; and
- litter reduction programs and action plans.

The ban on opera house nets in 2019 has been evaluated as good. This is due to an extensive education and information campaign and net replacement programs, and because to date there have been no recorded drownings of Platypus since the ban was implemented. However, while this ban applies to Victoria, opera house nets are still available to purchase for use in other states and may legally be carried through Victoria. The ban could also be supported with a widespread behaviour change program.

General litter reduction programs and litter action plans and management have been evaluated as poor. Litter still accumulates in urban waterways, although some councils and land managers have strategies and complete actions for this litter. These programs can be successful however are not extensive across the state and do not prevent all risk from the hazard. This could also be supported by recreational fishing education programs to minimise impacts of fishing lines.

The Victorian Eel Fishery Management Plan 2017 was rated as satisfactory. Fyke net regulations have been a successful measure. However, the restrictions on placement of eel nets and how frequently they are checked has been rated as poor. Experts identified a need for increased compliance on permit and licence conditions.

3.3.4 Risk assessment

The overall risk level of entanglement and fishing by-catch was assessed as significant (Table 4), with a major consequence and possible likelihood of occurring over the next 20 years. It should be noted that, while the rating for this risk across the five RFA regions is uniform, the causal factors vary, with litter and angling by-catch more prominent close to population centres, while commercial fishing by-catch associated with eel fishery is more prominent in some other areas.

Table 4: Risk assessment for entanglement and fishing by-catch over the next 20 years

Hazard	Central Highlands	East Gippsland	Gippsland	North East	West
Entanglement and fishing by-catch	Significant	Significant	Significant	Significant	Significant

3.3.5 Urgency

The likelihood of serious or irreversible environmental damage by entanglement and fishing by-catch in the short-term has been assessed as low to possible. This is an ongoing hazard that has a minor impact on the entire population, and the state-wide ban of opera house nets has limited the urgency of action to address this hazard. Therefore, no interim enforceable protections or priority management actions are required in the short-term.

3.3.6 Potential mitigations

Based on the expert input to this assessment, the following potential mitigations for the entanglement and fishing by-catch may be considered in the further development of permanent protections:

- support for a national ban on opera house nets to prevent use within Victoria;
- compliance and behaviour change program targeting illegal use of opera house nets;
- further support of public education programs to reduce litter in waterways;
- greater focus on impacts on the Platypus of litter in state-wide, municipal, and waste management plans;
- further support for river health programs and community programs to clean up waterways;
- support for programs to inform anglers fishing on the appropriate response to Platypus entanglement; and
- review of the impact of commercial eel fisheries in areas that overlap extensively with known Platypus habitats.

3.4 Extreme weather events and climate change

3.4.1 Hazard description

The State of the Climate 2020 report (CSIRO & Bureau of Meteorology 2020) indicates an increase in the severity of bushfires, lower and more patchy rainfall leading to reduced water flows, and an increase in both drought frequency and severity, which will continue to put pressure on Platypus populations. Extended periods of drought can dry up rivers and creeks, reducing suitable habitat available for Platypus, while decreasing their foraging ability and increasing competition (Bino *et al.* 2019). This could lead to localised absences as Platypus may be forced to disperse over land to refuge pools, where they become particularly vulnerable to predation by foxes and dogs (Grant & Fanning 2007). Cease to flow duration has been shown to be significantly related to Platypus abundance in the Melbourne Region (Mitrovski 2008; Griffiths *et al.* 2019), with river cease to flow days increasing in 85% of sub-catchments that have available data (Hawke *et*

al. 2021b). The increase in air temperatures and drying of streams and refuge pools risks elevating water temperatures above the Platypus's upper thermal tolerance of ~ 30°C (Robinson 1954).

Populations may be slow to recover with consecutive droughts compounding the impact of this hazard. During the Millennium Drought (2001-2009), reductions in abundance and distribution were observed across the species' range, and the recent (2017-2019) extreme drought across much of eastern Australia had many instances of Platypus distress and mortality (Bino *et al.* 2021). Reductions to river flows due to increased dry periods and increases in temperature are predicted to have a significant impact on the future survival of the species in its northern extent (Klamt *et al.* 2011; Bino *et al.* 2020; Hawke *et al.* 2020), and increases in drought frequency and severity are predicted to reduce the total population abundance of the Platypus by up to 73% within the next 50 years (Bino *et al.* 2020). Increasing human water demands during drought conditions will increase stress on water sources with regulation of rivers with dams likely exacerbating these impacts (Klamt *et al.* 2011).

By 2055, the suitable climatic niche for the Platypus is predicted to contract, mostly in the northern and western regions of its range (Hawke *et al.* 2020). Although significant uncertainties regarding future climate exist, models based on a species' climatic niche are likely to underestimate the impacts of climate change, which would increase drought frequencies and intensity (CSIRO & Bureau of Meteorology 2020) as well as impacting metapopulation dynamics (Bino *et al.* 2020).

Flooding can also be hazardous to the Platypus. Overbank flood events, particularly during summer, may cause displacement of individuals (Bino *et al.* 2015), reduction in food resources (Marchant & Grant 2015), and drowning of juveniles (Bino *et al.* 2015). Large flood events have been associated with lower recruitment in Platypus (Grant *et al.* 2004; Serena *et al.* 2014; Serena & Grant 2017).

3.4.2 RFA regions affected

All populations across all RFA regions are affected by this hazard.

3.4.3 Evaluation of existing controls

Existing controls for this hazard include:

- the *Climate Change Act 2017*, which provides Victoria with legislation to manage climate change risks, maximise the opportunities that arise from decisive action, and drives transition to a climate-resilient community and economy with net-zero emissions by 2050;
- Victoria's Climate Change Adaptation Action Plan for the Natural Environment System, which is a system-level adaptation action plan developed to respond to the priorities outlined in the *Climate Change Act 2017*, including an assessment of the extent to which existing policy addresses these priorities, and identifying actions to address key gaps;
- Streamflow Management Plans, developed under the *Water Act 1989*, define the total amount of water in a catchment and describes how it will be shared between the environment and water users; and
- the Victorian Floodplain Management Strategy 2016 which sets the direction for floodplain management in Victoria and evaluates Victoria's flood risks.

Despite the valuable contribution made by the existing controls, extreme weather events cannot be prevented and our ability to manage their impacts is limited, given their scale and unpredictability. Climate change mitigation cannot be effectively achieved at the scale of this assessment but State-based climate adaptation strategies will play a role. Overall, this risk is poorly controlled.

3.4.4 Risk assessment

The overall risk level of extreme weather events and climate change was assessed as uniformly high (Table 5), with a moderate consequence and an almost certain likelihood of occurring over the next 20 years.

Table 5: Risk assessment for extreme weather events and climate change over the next 20 years

Hazard	Central Highlands	East Gippsland	Gippsland	North East	West
Extreme weather events and climate change	High	High	High	High	High

3.4.5 Urgency

The likelihood of serious or irreversible environmental damage by extreme weather events and climate change in the short-term has been assessed as possible. The effects of drought are chronic and continuous, however there is some opportunity that drought could occur in the short-term, with the impact dependent on severity and scale of drying. While Platypus can generally cope with these short-term effects, it does depend on climatic conditions. Measures could be implemented early to mitigate possible future impacts of drought for identified priority populations. Large flood events during summer will reduce Platypus recruitment for the season but will not significantly impact overall populations unless there are regular events each year. However, this again depends on climatic conditions. Climate change impacts will be gradual and ongoing and cannot be easily managed for this species at the state level. Therefore, no interim enforceable protections or priority management actions are required in the short-term to avoid serious and irreversible harm. These impacts must be considered over a longer period.

3.4.6 Potential mitigations

Based on the expert input to this assessment, the following potential mitigations for extreme weather events and climate change may be considered in the further development of permanent protections:

- identifying where environmental watering programs can contribute to supporting Platypus, in particular the maintenance of summer baseflows and minimising cease to flow events;
- enhanced regulation of extraction or diversion of surface and groundwater and stormwater harvesting;
- continuing to focus on key threats to the Platypus in all relevant water management plans (e.g. Streamflow Management Plans) and drought mitigation frameworks to minimise impacts on freshwater ecosystems and to maintain freshwater refugia using environmental flows;
- consideration of Platypus in climate change adaptation programs such as regional adaptation plans;
- identification of refugia and research into which active management actions could better support Platypus populations in these areas; and
- pest animal control and monitoring, targeting riparian areas during periods of drought to reduce predation.

3.5 Forestry operations

3.5.1 Hazard description

Forestry operations include timber harvesting and associated roading and forest regeneration activities, including native forests and plantations on public and private land. The potential impacts of forestry operations on the Platypus in native forests are loss or degradation of riparian habitat, and sediment input to waterways that reduces water quality and the abundance and diversity of benthic macroinvertebrate species in streams (Grant & Temple-Smith 2003). Work in Tasmania found that Platypus were more likely to occur in streams in previously unharvested areas, and that streams in harvested areas tended to be more incised (when a stream cuts its channel through the process of degradation or erosion), had less organic material and more sand, less stable banks, and more log barriers (Koch *et al.* 2006). Differences in the benthic macroinvertebrate communities (key Platypus diet items such as water bugs and their larvae) were also recorded between Tasmanian streams in harvested and unharvested areas (Davies *et al.* 2005).

Plantations (both hardwood and softwood) occur throughout the Victorian RFA regions, especially in the North East, Central Highlands and West. The potential impacts of plantation harvesting are similar to those for native forest. The establishment of new plantations on previously cleared land has the potential to have

local impacts on surface runoff due to elevated water use by rapidly growing trees. The use of chemical treatments such as pesticides can also be transported into waterways in various ways, including aerial drift and groundwater movement (Mossop *et al.* 2013). While there are controls in place, such as mandatory no-spray zones, and buffer zones around waterways for specific chemicals, there still remains a risk to waterways (Mossop *et al.* 2013).

3.5.2 RFA Regions affected

There are localised impacts across all RFA regions where timber harvesting occurs, however, they are more extensive in the Central Highlands and East Gippsland RFA regions based on the overlap of Platypus' distribution and areas available for forestry operations (See Appendix 1).

3.5.3 Evaluation of existing controls

Existing controls for this hazard include:

- The *Code of Practice for Timber Production 2014* (the Code) which provides the framework for the regulation of commercial timber harvesting operations on both public and private land; and
- The Comprehensive, Adequate and Representative (CAR) Reserve System which provides a level of protection from forestry operations for forest ecosystems.

While the Code does not have a specific, detection-based prescription for the Platypus, it includes general protection measures for waterways through the requirement to apply buffers and filter strips and restrictions on harvesting on steep slopes. The Code also includes requirements to manage the impacts of road construction including stream crossings on waterways. These measures are rated overall as satisfactory for the Platypus, although contention remains regarding the effectiveness of filter strips on drainage lines in preventing soil erosion and waterway sedimentation. The CAR reserve system is noted as providing protections for substantial areas of Platypus habitat.

3.5.4 Risk assessment

Forestry operations were assessed as a medium overall risk to the Platypus (Table 6), with a moderate consequence and a possible likelihood of occurring over the next 20 years. While the ratings across the five RFA regions are uniform, there is variation in terms of the relative contributions of native forest timber harvesting and plantations; native forest harvesting is more prominent in East Gippsland and the Central Highlands, while plantations feature more strongly in the remaining regions.

Table 6: Risk assessment for forestry operations over the next 20 years

Hazard	Central Highlands	East Gippsland	Gippsland	North East	West
Forestry Operations	Medium	Medium	Medium	Medium	Medium

3.5.5 Urgency

The likelihood of serious or irreversible environmental damage by forestry operations in the short-term has been assessed as low. Any short-term impacts on the Platypus are likely to be low and localised to recently harvested areas. Therefore, no interim enforceable protections or priority management actions are required in the short-term. Any additional mitigations will be considered as part of permanent protections.

3.5.6 Potential mitigations

As the risk of forestry operations is considered medium at most over a 20 year period and the existing controls are generally considered satisfactory, it is proposed only to monitor the effectiveness of the existing controls to ensure that forestry operations do not have an adverse impact on the Platypus between now and the phase out of public land native forest timber harvesting in 2030.

3.6 Genetic decline

3.6.1 Hazard description

Genetic drift and inbreeding in small isolated populations can cause a reduction in genetic diversity, which can result in a potential reduction in adaptive capacity and fitness. Gene flow via dispersal of animals is a critical mechanism for increasing the viability of natural populations and facilitating ecological and evolutionary processes (Baguette *et al.* 2013; Tigano & Friesen 2016). Platypus are capable of terrestrial and aquatic dispersal (Furlan *et al.* 2013). However, some Platypus populations contain high levels of inbreeding and small effective population sizes (Furlan *et al.* 2012; Martin *et al.* 2018). In Victoria, this is more pronounced presumably due to the characteristically high degree of overlap among Platypus home ranges in linear systems, along with the species' longevity (Martin *et al.* 2018).

3.6.2 RFA regions affected

This hazard is likely throughout all RFA regions where small, isolated populations exist.

3.6.3 Evaluation of existing controls

There are no direct control measures in place to support genetic viability of the species. Indirect measures, such as improving connectivity of freshwater ecosystems, may provide a benefit.

3.6.4 Risk assessment

The overall risk level of genetic decline was assessed as medium (Table 7) in the Central Highlands, East Gippsland, Gippsland and North East RFA regions, with a moderate consequence but unlikely to occur over the next 20 years. In the West RFA region, the hazard was assessed as significant due to more fragmented isolated populations, with a moderate consequence but more likely to occur over the next 20 years. It should be noted that while the hazard has been assessed as medium across many of the RFA regions, there can be locally significant impacts within those regions.

Table 7: Risk assessment for genetic decline over the next 20 years

Hazard	Central Highlands	East Gippsland	Gippsland	North East	West
Genetic decline	Medium	Medium	Medium	Medium	Significant

3.6.5 Urgency

The likelihood of serious or irreversible environmental damage by genetic decline in the short-term has been assessed as low. Therefore, no interim enforceable protections or priority management actions are required in the short-term.

3.6.6 Potential mitigations

Based on the expert input to this assessment, the following potential mitigations for genetic decline may be considered in the further development of permanent protections:

- evaluating genetic diversity and viability of Platypus populations across Victoria;
- identifying at risk populations and increasing genetic diversity through reconnection of populations and/or translocations; and
- incorporating genetic diversity considerations into planning for refuge sites.

3.7 Habitat fragmentation due to in-stream barriers

3.7.1 Hazard description

Many aquatic species are subject to habitat fragmentation effects of in-stream barriers. Such fragmentation can lead to reduced capacity to maintain metapopulation processes, restricted movement, reduced genetic

diversity and viability, and reduced recolonisation capacity following local extinctions (which small isolated populations are at have a higher risk of from following stochastic events).

Studies have shown that Platypus have been observed to navigate natural barriers (e.g. McKenzie Falls in Gariwerd (Grampians) (Griffiths & Weeks 2010)), as well as evidence of Platypus passing infrastructure (e.g. 8 m weirs). Moving outside of aquatic environments exposes Platypus to greater predation hazard, particularly in highly urbanised or cleared environments where the risk is expected to be greater as there is limited protection from predators. Similarly, it is these same in-stream structures that control and regulate flows, with low flows exacerbating fragmentation, increasing the distance between pools. Culverts can also function as a barrier.

In addition, genetic studies have confirmed successful overland travel by Platypus at a much larger spatial scale. Some 11% of 120 Platypus occupying neighbouring but spatially independent river systems in New South Wales were first-generation migrants that had moved across land between the two systems (Kolomyjec *et al.* 2009). Gene flow has also been documented between Platypus populations in rivers systems on different sides of the Great Dividing Range (Furlan *et al.* 2013). However, overland travel is costly, as it increases predation risk from terrestrial predators (Serena & Williams 2010a), requires more energy than swimming (Fish *et al.* 2001), and exposes animals to heat stress (Grant & Dawson 1978).

3.7.2 RFA regions affected

This hazard is widespread throughout the Platypus' range across all RFA regions. This requires further assessment, but it is likely to extend to the entire distribution in Victoria with varying intensities.

3.7.3 Evaluation of existing controls

Existing controls for this hazard include:

- the VWMS, which provides the framework to maintain or improve the condition of rivers, estuaries and wetlands so that they can continue to provide environmental, social, cultural and economic values to Victorians;
- the RWSs, which are a single planning document for river, estuary and wetland management in each region and drive implementation of the management approach outlined in the VWMS; and
- FFG Act Action Statement No. 139 – Prevention of passage of aquatic biota by instream structures; action statements describe the nature of the potentially threatening process and set out what has been done and what will be done to manage its impacts on native flora and fauna.

This control has been rated as poor, as there are high number of dams, weirs and culverts throughout the Platypus' range; while there has been some adoption of 'fishways' to assist fish to bypass barriers, these are generally not suitable for the Platypus.

3.7.4 Risk assessment

The overall risk of habitat fragmentation due to in-stream barriers was assessed as medium (Table 8), with a moderate consequence, and a possible likelihood of occurring over the next 20 years. It should be noted that the impacts of the barriers will vary based on size, type and position of barrier, as well as the size of the habitat patch that is fragmented.

Table 8: Risk assessment for habitat fragmentation due to in-stream barriers over the next 20 years

Hazard	Central Highlands	East Gippsland	Gippsland	North East	West
Habitat fragmentation due to in-stream barriers	Medium	Medium	Medium	Medium	Medium

3.7.5 Urgency

The likelihood of serious or irreversible environmental damage by habitat fragmentation due to in-stream barriers in the short term is considered negligible. The effects of fragmentation are long-term and cumulative on the entire population. It is an ongoing impact which is heavily exacerbated during extreme droughts which

force Platypus to seek refugia, and afterwards to facilitate recolonisation. Therefore, no interim enforceable protections or priority management actions are required in the short-term.

3.7.6 Potential mitigations

Based on the expert input to this assessment, the following potential mitigations for habitat fragmentation due to in-stream barriers may be considered in the further development of permanent protections:

- the removal of decommissioned weirs and other structures where applicable, subject to environmental assessment processes;
- identifying priority barriers and creating platypus friendly passages which provide protection from predation;
- translocation plans to support migration and gene flow between populations;
- incorporate Platypus into existing barrier removal programs which focus on native fish; and
- appropriate consideration of Platypus in waterway strategies.

3.8 Habitat loss and degradation

3.8.1 Hazard description

This hazard is described as the clearing of vegetation in catchments, particularly adjacent to waterways, and vegetation removal resulting in habitat degradation, fragmentation and loss, altered flow regimes and reduced water quality. It also includes riparian frontage management on Crown land. Much of the habitat loss and degradation is historical rather than current. Additional habitat loss maybe occurring at a low level, but ongoing degradation continues.

Riparian vegetation is a key determinant of water quality and riverine ecosystem health (Bunn *et al.* 1999; Allan 2004). Physical degradation of Platypus habitat occurs by clearing both riparian and catchment-scale vegetation which increases bank erosion, destroys shelters and burrows for breeding, creates sedimentation which fills pools (including deep pools that serve as drought refuges), and reduces food availability (Bino *et al.* 2019), while increasing predation risk. Riparian vegetation is also important for organic inputs into streams which supports the entire food chain such as macroinvertebrates, the prey of Platypus (Marchant & Grant 2015), and the shade of trees provides thermal dampening (Klamt *et al.* 2011).

Extensive land clearing occurred across south-eastern Australia during the 20th century (Bradshaw 2012; Evans 2016). By the 1980s, almost 40% of Australia's forests had been severely modified by clearing (Wells *et al.* 1984). Although most land clearing occurred in south-eastern Australia prior to the mid-20th century (Bradshaw 2012), other processes impacting freshwater habitat, such as sedimentation, are ongoing (Bartley *et al.* 2014; Reside *et al.* 2017). While Platypus occur in waterways in cleared agricultural land (Lunney *et al.* 1998), land clearing is a significant threat to their habitat (Bino *et al.* 2019). Unrestricted livestock access to rivers has caused further degradation of riverbanks through trampling. Bank erosion can significantly increase without riparian vegetation for stability, increasing sedimentation and turbidity, further degrading Platypus habitat (Lunney *et al.* 2004).

There are approximately 170,000 kilometres of river and creek frontage in Victoria. Inadequately restricted use of riparian frontage by livestock, particularly cattle, commonly degrades Platypus habitat by reducing protective vegetation cover, causing banks to become compacted and damaging Platypus burrows, promoting soil erosion and channel sedimentation, and contributing to water pollution and eutrophication (Burger *et al.* 2010). Less frequently, bank habitats may be significantly degraded by firewood collection, rubbish dumping, being used as storage depots for farm machinery, and recreation such as fishing, prospecting and long-term camping (e.g. Hardiman & Burgin 2011).

3.8.2 RFA Regions affected

This hazard impacts across the species' range on both public and private land, in all five RFA regions. Riparian frontage management particularly affects the North East, Gippsland and West RFA regions.

3.8.3 Evaluation of existing controls

Existing control measures for this hazard include:

- the VWMS, which provides the framework to maintain or improve the condition of rivers, estuaries and wetlands so that they can continue to provide environmental, social, cultural and economic values to Victorians;
- the RWSs, which are a single planning document for river, estuary and wetland management in each region and drive implementation of the management approach outlined in the VWMS.
- the regulation of the removal of native vegetation under the Victorian Planning Provisions and all planning schemes in Victoria; and
- support for landholders to undertake fencing for revegetation and protection of riparian zones.

Overall, these controls are considered to be satisfactory, noting the scale of the challenge to address historic loss and degradation. Expert input reflects concerns about the degree of permitted clearing and the slow progress towards achieving a net increase in catchment vegetation cover.

Incentives for landholders to fence waterways has been evaluated as good. These programs incentivising landholders to protect riparian habitat, including fencing off stock and restoration and revegetation, have been successful in protecting and enhancing habitat features. However, this is not an enforceable undertaking.

Extensive funding is already being directed by DELWP, typically through catchment management authorities, to defray costs of fencing freehold agricultural land and adjoining Crown frontages, replanting the fenced frontage with appropriate native vegetation, and establishing alternative livestock watering points when necessary. In return, a landholder is required to sign a riparian management licence that requires the frontage to be managed in an environmentally sustainable manner, e.g. by limiting livestock access and controlling weeds. This has been evaluated as satisfactory, as compliance of riparian management licensees is likely to be high in normal-to-wet years. However, it is worthwhile noting that compliance is likely to be lower in dry years when grass growth is reduced in paddocks and the cost of purchased feed tends to rise.

3.8.4 Risk assessment

Based on information available for previous documented declines in species distribution and abundance, this hazard poses a significant risk to the Platypus. Most documented declines and local extinctions of Platypus populations are in agricultural or urban areas where clearing of vegetation is extensive, suggesting this is a significant risk, although there are many other confounding factors. It has been assessed to have a moderate consequence and is likely to occur over the next 20 years.

Table 9: Risk assessment for habitat loss and degradation over the next 20 years

Hazard	Central Highlands	East Gippsland	Gippsland	North East	West
Habitat loss and degradation	Significant	Significant	Significant	Significant	Significant

3.8.5 Urgency

The likelihood of serious or irreversible environmental damage by habitat degradation or loss in the short-term has been assessed as low. Much of the loss is historic, however degradation continues in various forms in combination with other hazards addressed in this assessment. Impacts are long term and ongoing, therefore no interim enforceable protections or priority management actions are required in the short-term.

3.8.6 Potential mitigations

Based on the expert input to this assessment, the following potential mitigations for the habitat loss and degradation may be considered in the further development of permanent protections:

- review of the effectiveness of native vegetation retention measures in riparian zones and strengthening if required;
- enforcement activities by Crown land managers to control impacts to riparian areas, such as for recreational activities;
- review of the effectiveness of Crown frontage licence conditions in managing the impact of stock on the condition of riparian zones and water quality; and
- maintenance and expansion of incentives and investment programs to protect, enhance and restore riparian and in-stream zones.

It should be noted that initial funding has been allocated to implement management activities to benefit the Platypus following its listing. These funds are proposed to support projects focusing on riparian zone protection and restoration in key river reaches. The longer-term objective would be that these river reaches would act as “demonstration reaches”, illustrating what can be achieved for the Platypus and its habitat with appropriate management and community engagement.

3.9 Pest plants and animals

3.9.1 Hazard description

This hazard includes multiple distinct mechanisms of impact:

- predation by pest animals (e.g. wild dogs, foxes and cats);
- impact of introduced plants on riparian habitat and in-stream (e.g. willows);
- pest animals causing bank erosion (e.g. deer); and
- introduced animals such as carp causing sedimentation.

Platypus are known to undertake movements over land, such as dispersing juveniles or during dry periods in search of water. During these times, they are vulnerable to predation by invasive terrestrial carnivores such as red foxes (*Vulpes vulpes*), both feral and domestic dogs (*Canis familiaris*), and feral house cats (*Felis catus*) (Grant & Fanning 2007). In Tasmania, as many as 40% of Platypus deaths were due to attacks by domestic dogs (Connolly *et al.* 1998). In Victoria, predation by raptors, dogs, or foxes accounted for 13% (n = 24) of documented Platypus deaths (Serena & Williams 2010a).

Introduced plants such as willows (*Salix* spp.), can cause increased flooding, reduced flows, loss of habitat for aquatic macroinvertebrates, and low dissolved oxygen levels (Grant & Temple-Smith 2003). It is likely that carp increase habitat sedimentation (Serena & Williams 2010b), and a range of introduced fish species including carp, salmonids such as trout (*Salmo trutta* and *Oncorhynchus mykiss*), and redfin perch (*Perca fluviatilis*) occur throughout most of the Platypus’ range, and compete with Platypus for benthic invertebrates (Grant & Temple-Smith 2003).

3.9.2 RFA regions affected

This hazard is widespread across all RFA Regions.

3.9.3 Evaluation of existing controls

Existing control measures for this hazard include:

- the Weeds and Pests on Public Land (WPPL) program, which funds landscape-scale weed and pest projects, focusing on protecting Victoria’s biodiversity; and
- the Victorian Deer Control Strategy, which outlines a process for a strategic and coordinated approach to deer control.

The WPPL program has been evaluated to be of moderate benefit for the Platypus. There is some effective control of foxes and willows in certain areas, however there are significant deficiencies in the management of others, such as carp and trout. Overall, the effectiveness of pest plant and animal controls for the Platypus is

poor on the basis that effective control measures are not necessarily implemented consistently, despite the success of programs for some species in some areas.

3.9.4 Risk assessment

The overall risk of pest plants and animals was assessed as significant, with a minor consequence and an almost certain likelihood of occurring over the next 20 years. It should be noted that the impacts of this hazard could be locally high, especially where populations are already stressed such as urbanised and highly disturbed landscapes.

Table 10: Risk assessment for pest plants and animals over the next 20 years

Hazard	Central Highlands	East Gippsland	Gippsland	North East	West
Pest plants and animals	Significant	Significant	Significant	Significant	Significant

3.9.5 Urgency

The likelihood of serious or irreversible environmental damage by pest plants and animals in the short-term has been assessed as low, as impacts are incremental over the longer-term. Therefore, no interim enforceable protections or priority management actions are required in the short-term.

3.9.6 Potential mitigations

Based on the expert input to this assessment, the following potential mitigations for pest plants and animals may be considered in the further development of permanent protections:

- increasing riparian restoration programs including willow removal;
- improved control measures for feral species such as cats, feral dogs, and carp;
- empirical data gathering on the effectiveness of pest plants and animals control programs for Platypus, to increase uptake by landholders;
- behaviour change and education of domestic pet owners, such as a campaign encouraging dogs to be kept on leashes near waterways; and
- suitable design of Platypus ladders to enable safe passage from predation around barriers.

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Appendix 1

Spatial information

Table 11: Platypus Distribution Statistics

Full Habitat Distribution Model ¹													
Modelled habitat	Victoria	Central Highlands		East Gippsland		Gippsland		North East		West		Non-RFA	
habitat distribution model total (ha; %)	6,794,999	850,191	13%	921,831	14%	1,405,892	21%	1,055,693	16%	1,237,305	18%	1,324,087	20%
habitat distribution model available for forestry operation (ha; %)	320,517	101,422	12%	175,978	19%	20,817	1%	9,533	1%	12,768	1%		
habitat distribution model affected by bushfires since 2000 (ha; %)	2,190,518	268,353	32%	753,381	82%	587,478	42%	381,945	36%	187,859	15%	11,502	1%
habitat distribution model within CAR reserve system (ha; %) w/ prescription	2,196,269	281,642	33%	507,394	55%	536,149	38%	325,134	31%	368,307	30%	177,643	13%
Private land	3,336,724	363,239	43%	127,008	14%	669,364	48%	539,688	51%	716,197	58%	921,228	70%
Important Populations ²													
Important populations total (ha; %)	87,179	29,707	34%	9,799	11%	9,935	11%	14,334	16%	9,485	11%	13,919	16%
Important populations available for	559	225	1%	271	3%	21	0%	23	0%	20	0%		

¹ DELWP currently has HDMs for over 4000 taxa that predict the distribution and relative likelihood of suitable habitat for each species across Victoria. This covers all terrestrial vertebrate fauna and most vascular plants. HDMs are built using species occurrence records from the VBA and relating that data to environmental variables, such as soil, prevailing climate and topography to make predictions about the likely distribution of habitat for individual species across Victoria.

² Spatial data to determine where important species locations exist so that appropriate management actions can be undertaken to minimise the impacts to these populations during an emergency event. Unpublished.

forestry operation (ha; %)													
Important populations affected by bushfires since 2000 (ha; %)	18,036	3,858	13%	6,510	66%	3,798	38%	2,924	20%	874	9%	72	1%
Important populations within CAR reserve system (ha; %)	17,843	4,877	16%	4,798	49%	3,173	32%	1,831	13%	1,302	14%	1,862	13%
Private land	54,355	21,074	71%	3,747	38%	4,917	49%	9,403	66%	6,618	70%	8,596	62%
Post 1970 VBA Records (200m buffer)³													
Post 1970 VBA records total (#; %)	14,273	3,969	28%	1,088	8%	1,535	11%	1,718	12%	3,720	26%	2,243	16%
Post 1970 VBA records available for forestry operation (#; %)	154	73	2%	65	6%	2	0%	9	1%	4	0%		
Post 1970 VBA records affected by bushfires since 2000 (#; %)	2,990	703	18%	790	73%	672	44%	620	36%	190	5%	15	1%
Post 1970 VBA records within CAR reserve system (#; %)	3,244	1,069	27%	598	55%	577	38%	448	26%	402	11%	149	7%
Private land	8,332	2,228	56%	316	29%	660	43%	836	49%	2,748	74%	1,543	69%

³ The VBA species observations are a foundation dataset that feeds into some of the many biodiversity tools used in DELWP's everyday decision making - showing where wildlife is now and how this has changed over time. This makes it a core input to the majority of the governments processes and programs that impact native species

Appendix 2

Summary of methods

These methods are broadly based on the DELWP risk management guidelines but they have been modified for application to an environmental context.

Step 1: Establish the context

For each species some key information is provided (pre-filled) to set the context for the species or community. This information includes listing status, information on the spatial distribution, fire history and tenure of modelled habitat. A stocktake of relevant literature is also provided.

Experts were asked to:

- provide information about their knowledge of the species;
- provide any recommended further sources of information on the species; and
- provide an overall comment on the accuracy of the species Habitat Distribution Model, Important Populations Data Set and VBA records

Step 2: Conduct the hazard assessment per RFA region

In this step experts were asked to describe the major hazards operating on the species or community within each RFA region that it occurs. A hazard can apply equally in each region or may vary between regions. Experts were asked to complete one page per hazard per region (or multiple regions if risk and control ratings are equivalent).

Experts were asked to refer to the information provided in Step 1 in making their assessment.

Experts were asked to:

- identify the hazard (see Table 12 below) or describe any additional hazards;
- provide hazard details (i.e. Any additional information on the hazard, if required such as 'only impacts near the Snowy River');
- describe the mechanism of impact of the hazard on the species; and
- provide a statement on the interaction with other hazards.

Step 3: Evaluation of existing controls

A risk assessment should be performed to establish a realistic view of risks requiring consideration and/or treatment within the context of the risk assessment. Therefore, when performing a risk assessment and discussing hazards, the current controls or policy settings should be considered.

For each hazard experts were asked to:

- List the controls currently operating to mitigate the hazard, drawing on the general controls list provided to populate this field with any relevant mechanism;
- Assess the effectiveness of the controls (see Table 13 below); and
- Provide an explanation for the rating of the effectiveness of the existing control.

Step 4: Risk assessment

Current risk assessment is an assessment of the risk rating as it stands today, with consideration of all existing controls currently in place. Experts were asked to assess the consequence on the species if the hazard occurs, given the vulnerability of the species or community to the hazard and the effectiveness of the current controls. Experts were then asked to make a judgement on the likelihood of the hazard having the expected consequence and determine the overall risk level according to the likelihood and consequence scales.

In this step experts were asked to provide the following for each risk listed for each RFA region per species or community:

- Consequence (see Table 14 below);
- Likelihood (see Table 15 below);
- Overall risk level (see Table 16 below); and
- Confidence in assessment (see Table 17 below).

Step 5: Urgency

Experts were asked to assess the likelihood of serious or irreversible environmental damage prior to January 2023 (18-months from the risk assessment) to determine if any interim protections are needed in the short term. Experts are asked to provide:

- Likelihood rating of serious or irreversible damage prior to January 2023 – judgement based on risk in the next 18-months; and
- An explanation of their rating.

Step 6: Potential measures

Risk management is fundamentally about identifying risks and then treating the risks to ensure that the risk profile is kept within a tolerable level. While it is unlikely that the risks will be eliminated entirely, the purpose of treating risks is to achieve an acceptable risk exposure in the most effective and efficient manner.

This step requires experts to identify possible mitigations for the hazards identified in Step 2 where those hazards have been assessed as significant or high overall. We acknowledge that some risks/threats are more manageable than others – if, in the opinion of the assessor, there is no feasible and effective mitigation, this should be stated.

Experts were asked to propose feasible, realistic measures (including regulatory controls, active management and/or further knowledge acquisition) that should be considered to mitigate the identified significant or high risks. Proposed measures could include modifications to existing measures.

Repeat Step 2 – 6 for all relevant hazard/region combinations.

Moderation of risk assessments

A subsequent moderation process was conducted to review all risk assessments to ensure consistency in application of the ratings system. The moderation process involved experienced policy and planning staff to ensure ratings for control effectiveness, consequence and likelihood had been consistently applied, in consultation with expert assessors where relevant.

Reference tables

Table 12: Hazards

The examples of hazards below are drawn from the recommendation reports prepared for the Platypus and Little Eagle prior to their listing under the *Flora and Fauna Guarantee Act 1988*. Other hazards may be relevant.

Hazard
Altered fire regimes
Altered flow regimes
Bushfire events
Climate change (requires explanation of relevant parameter)
Collision with vehicles, fences and powerlines
Competition by native species
Decline in streamflows
Decline in water quality
Entanglement in nets, traps, and litter
Extreme weather events (droughts, floods, storms, extreme temperatures)
Fishing by-catch
Forestry operations
Fragmentation of populations due to in-stream barriers
Habitat loss and degradation (need to specific mechanism)
Loss of genetic diversity
Pest plants and animals – predation, competition, herbivory, trampling, etc.
Pollution (e.g. contamination of sediment by heavy metals)
River regulation
Secondary poisoning by pesticides
Sedimentation
Shooting and trapping
Strategic fuelbreaks and road construction and maintenance
Water extraction

Table 13: Control effectiveness rating

Control Rating	Description
Good	Controls are consistently applied through time and space where the hazard exists and have been demonstrated to be effective.
Satisfactory	Controls are consistently applied through time and space where the hazard exists and appear to be effective but this has not been demonstrated.
Poor	Controls are consistently applied through time and space where the hazard exists but appear not to be effective or have been demonstrated not to be effective. or Controls are not consistently applied through time and space where the hazard exists.
Uncontrolled	No controls are applied where the hazard exists.

Table 14: Consequence descriptions

Category	Descriptors
Extreme	Extent: Impacts on almost all (> 80%) of the extent of the species/community range OR a majority of particularly high value sites. Severity: Very serious effect on the species' persistence, significant reduction in population size and/or associated habitat: species/community likely to go extinct across the range in the <u>RFA region</u> or any of the discrete sub-populations within a region within the timeframe due to the hazard Duration: Impacts expected to endure over a long time period (e.g. 20 + years) or populations are not expected to recover
Major	Extent: Impacts on a large proportion (60-80%) of the extent of the species /community range or a major amount of high value sites Severity: major effect on the species or community persistence, major reduction in population size and/or associated habitat, species/community may be threatened with extinction across the range in the RFA region or any of the discrete sub populations within the region. Duration: Impacts expected to endure over a major time period 10-20 years
Moderate	Extent: Impacts on moderate proportion (30-60%) of the extent of the species /community range or a moderate amount of high value sites Severity: Moderate effect on the species or community persistence, may be a reduction in population size, unlikely to be threatened with extinction from this hazard Duration: Impacts expected to endure over a moderate time period 5-10 years
Minor	Extent: Limited impacted on the extent of the species/community range (10-30%) or high value sites Severity: minor effect on the species or community persistence, unlikely to lead to population reduction Duration: Impacts expected to endure over a short time period 1-4 years
Negligible	Extent: Negligible effect on the extent of the species/community range, Contained locally within a single site/area Severity: Negligible effect on the species or community persistence: Duration: Impacts expected to endure for a negligible time period and/or under 1 year.

Table 15: Likelihood descriptors

Rating	Description
Almost Certain	The hazard is expected to occur constantly or frequently within a species' habitat or community extent over 20 years at a scale that will cause the expected consequence. In the case of an isolated event, the probability of occurrence is >80% over 20 years at a scale that will cause the expected consequence.
Likely	The hazard is likely to occur in most circumstances within a species' habitat or community extent over 20 years at a scale that will cause the expected consequence. In the case of an isolated event, the probability of occurrence is 50-80% over 20 years at a scale that will cause the expected consequence.
Possible	The hazard might occur within a species' habitat or community extent over 20 years at a scale that will cause the expected consequence. In the case of an isolated event, the probability of occurrence is 20-49% over 20 years at a scale that will cause the expected consequence.
Unlikely	The hazard is unlikely to occur within a species' habitat or community extent over 20 years at a scale that will cause the expected consequence. In the case of an isolated event, the probability of occurrence is 5-19% over 20 years at a scale that will cause the expected consequence.
Rare	The hazard may only occur in exceptional circumstances. In the case of an isolated event, the probability of occurrence is <5% over 20 years at a scale that will cause the expected consequence.

Table 16: Risk matrix

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

Table 17: Confidence in risk assessment⁴

Confidence level	Descriptor	Supporting evidence
Highest	Assessed likelihood, consequence or risk is easily assessed to one level, with almost no uncertainty	Recent historical event of similar magnitude to that being assessed in the community of interest or Quantitative modelling and analysis of highest quality and length of data relating directly to the affected community, used to derive results of direct relevance to the scenario being assessed
High	Assessed likelihood, consequence or risk has only one level, but with some uncertainty in the assessment	Recent historical event of similar magnitude to that being assessed in a directly comparable community of interest or Quantitative modelling and analysis use sufficient quality and length of data to derive results of direct relevance to the event being assessed
Moderate	Assessed likelihood, consequence or risk could be one of two levels, with significant uncertainty	Historical event of similar magnitude to that being assessed in a comparable community of interest or Quantitative modelling and analysis with reasonable extrapolation of data required to derive results of direct relevance to the event being assessed
Low	Assessed likelihood, consequence or risk could be one of three or more levels, with major uncertainty	Some comparable historical events through anecdotal information or Quantitative modelling and analysis with extensive extrapolation of data required to derive results of relevance to the event being assessed
Lowest	Assessed likelihood, consequence or risk could be one of four or more levels, with fundamental uncertainty	No historical events or quantitative modelled results to support the levels

4. National Emergency Risk Assessment Guidelines Handbook “: Confidence level descriptions” (page 42), Australian Institute for Disaster Resilience