

Attachment 3: Risk Assessment

Significant Impact Criteria <i>Will the action...</i>	Nature and Extent of Likely Impact	Actions to Mitigate Risk
<p>Lead to a long-term decrease in the size of a population</p>	<p>Estimation of skate and ray numbers is inherently challenging because of limited sampling methods available, and that challenge is exacerbated in Macquarie and Bathurst Harbours by virtue of their remoteness, scale and the prevailing environmental conditions (especially in the former which has naturally low light penetration).</p> <p>In the listing advice it was estimated that the population of skate in both known locations was likely to be small, in the order of 1,000 individuals, an estimate developed by Last and Gledhill, 2007.</p> <p>In Bathurst Harbour, only four skate have ever been captured (Last and Gledhill, 2007). Two other skate/skate markings have been observed up until 2003. There has been significant survey efforts in this area over the past two decades without result. Maugean skate DNA was detected at very low levels in a recent environmental DNA (eDNA) survey in 2022 (Moreno et al. 2022).</p> <p>Bell <i>et al.</i> (2016) estimated the population of skate in Macquarie Harbour to be around 3,177 individuals (with a 95% confidence limit of 1827-6247), although they did note that this was likely an underestimate due to sampling issues and thus considered that the Macquarie Harbour skate population is “a feasible minimum population size”.</p> <p>Recent studies by Moreno and</p>	<p>There are four main actions that have been implemented or are underway that address and mitigate this risk, all of which are being undertaken within the comprehensive and multi-level AMF:</p> <ol style="list-style-type: none"> 1. Population monitoring – the Tasmanian Government in partnership with IMAS has funded surveys of Skate abundance and distribution annually since 2012. These surveys have provided the best available information on population changes and also provided insights into specific measures needed to protect skates in key locations (e.g. leading to targeted recreational and commercial fishing regulations). They have also provided opportunities to (a) improve survey protocols (e.g. to reduce the risk of accidental mortality of skate via tagging or gill net surveys as occurred in 2014 when at least 10 of 270 tagged skates died within 2 weeks of being tagged; Bell et al 2016) and (b) trial new survey methods (e.g. use of a side-scan (multi beam hydro acoustics) AUV. With support from the FRDC, e-DNA surveys have also been conducted in Bathurst Harbour and Macquarie Harbour to assess presence/absence of skate and inform other survey methods. These have been inconclusive in determining whether skate are extirpated in Bathurst Harbour and so further surveys of these areas

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	<p>Semmens (2023) have suggested that there has been a decline of up to 47% in the relative abundance of skate.</p> <p>The action could lead to a long-term decrease in the size of the Maugean skate population if it directly increased mortality rates of adults or juveniles or indirectly impacted habitat availability to a level that meant a viable population was no longer able to survive within Macquarie Harbour</p>	<p>and other potential habitats are planned.</p> <ol style="list-style-type: none"> 2. Biomass limits and more recently a nitrogen input limit (TPDNO) have been reduced to a level that the monitoring program is indicating that (despite seasonal and annual variability), the total tonnage of oxygen below 15 m has increased from 2014 to 2023. 3. New conditions introduced in Environmental Licences relating to additional Water Quality Monitoring and DO Mitigation Plans. The AMF that has operated since the 2012 decision, described in this submission, will continue to inform management decisions and licence conditions to minimise any potential impacts to Macquarie Harbour and the Maugean skate. 4. A proactive, industry and FRDC funded Macquarie Harbour Oxygenation Pilot Project has recently been developed which seeks to assess the feasibility of a controlled increase in DO levels in Macquarie Harbour. That project will inform the feasibility of any longer-term initiatives of this type. <p>In addition, the CAP includes numerous initiatives underway that both reduce loss of individual skates (e.g. new fishing measures introduced in 2022 and strengthened in 2023) and establish a new population and habitat enhancement measures. If</p>

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		<p>successful, these will enhance the population via a captive breeding program which has just commenced. These new measures complement and reinforce the related and substantial ongoing further controls on salmon production that will also ensure that habitat quality is protected. It is notable that production levels are now below levels prior to the expansion action being granted.</p> <p>While there is no evidence to indicate a current direct causal linkage between salmon farming and the population decline of the species, the AMF has adopted a proactive and precautionary approach. The AMF will ensure the action will not lead to a significant decrease in the size of the population of the Maugean skate.</p>
<p>Reduce the area of occupancy of the species</p>	<p>The preferred habitat for the species are shallow channels of around 5 m to 15 m in depth with the key water quality variables being temperatures (12–15 °C) and salinity (18–27 ppt), with naturally low-moderate dissolved oxygen concentrations (30–80% dissolved oxygen).</p> <p>The verified habitat for the species in Macquarie Harbour is currently identified as 3,455 ha (current Conservation Advice) with all potential habitat (5 m to 15 m shallow channels) mapped to a total of 6,975 ha (Bell <i>et al</i> 2016).</p> <p>Skate exhibit a high level of site fidelity but do seasonally extend their range which is estimated to be <10 km². They are also adaptable in</p>	<p>The action moved farming lease areas away from potential habitat and the environmental standards outline that all pens must not be placed on the seabed. Consequently, the action will not directly reduce the area of occupancy for the Maugean skate within Macquarie Harbour.</p> <p>Marine farming and environmental licence controls on marine farming operations on the Harbour mitigate indirect impacts to water quality and benthic conditions through monitoring and management responses.</p> <p>NRE Tas and the EPA Tas have progressively reduced the maximum biomass levels in response to environmental</p>

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	<p>how they use vertical and horizontal dimensions of habitat, particularly during periods of rapid environmental change. For example, Moreno <i>et al</i> (2020) note that a large storm surge and subsequent oxygen recharge in March/April 2019 resulted in all tracked individuals expanding their extended activity areas considerably, including movement into deeper waters, while still maintaining a strong attachment to their core home range areas.</p> <p>The action could lead to a reduction in the area of occupancy of the species within Macquarie Harbour if the area of occupancy was directly modified or indirect impacts lead to water quality or benthic condition declining to a point that the species could no longer occupy its preferred habitat. The action could directly impact the habitat for the species if the salmon farm pen bays were placed on the seabed within preferred habitat for the species. Indirect impacts to water quality or benthic habitat could occur if the marine farming operations were such that the number of fish within pens removed a level of oxygen from the water reducing it to a level that natural recharge events could not return dissolved oxygen to suitable levels within the Macquarie skate’s preferred habitat.</p> <p>Moreno <i>et al</i> (2020) note that it can be hard to distinguish between the relative significance of stresses on Harbour condition. They also note that skate are subject to wide ranging fluctuations in water chemistry. For instance, oxygen</p>	<p>monitoring across Macquarie Harbour as follows:</p> <ol style="list-style-type: none"> 1. October 2015 – 20,500 tonnes 2. February 2017 – 14,000 tonnes 3. June 2017 – 12,000 tonnes 4. June 2018 – 9,500 tonnes <p>From September 2022, a TPDNO cap of 500.1 tonnes per annum was determined, representing a 50% reduction compared to 2014-15 feed inputs.</p> <p>These management responses have led to improved water quality and benthic conditions within the Harbour.</p> <p>The annual Harbour oxygen budget is 64 000 tonnes and the current annual marine farming respiration has been calculated at 40 tonnes of oxygen or less than 1% loss from the Harbour oxygen budget (<i>pers comm</i> Jeff Ross). Draw down of oxygen from respiration from marine farming will not have a significant impact on DO levels in the Harbour or on Maugean skate.</p> <p>Benthic surveys indicate overall improved sediment conditions, including an increase in the diversity and abundance of benthic species across the Harbour. Notably, at the majority of both lease and external sites faunal abundance and the number of species have returned to or are closely approaching the range observed prior to the decline in spring 2016-early 2017 (Ross <i>et al</i> 2024). Through the implementation of the AMF</p>

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	<p>levels experienced ranged from normoxic (50-100%), hypoxic (20-50%) and to near anoxic (~0-20%), with individuals often experiencing substantial variation (as high as > 90%) in the range of DO levels within the same day.</p> <p>Marine farming in Macquarie Harbour could also indirectly reduce the area of occupancy for the species if the action changed the hydrology in the Harbour to the point that changed the frequency or process for ocean and freshwater mixing in the water column. Marine farming in Macquarie Harbour does not influence exchanges with the ocean or inflows of freshwater from the Gordon and King Rivers which are the dominant influences on the hydrodynamics of the estuary. As such the action will not have an impact on the hydrology of the Harbour.</p>	<p>marine farming will not have a significant impact on the condition of the benthic environment within the Harbour so will not impact benthic habit utilised by the Maugean skate.</p> <p>Between 2018 and 2021, nutrient concentrations across the harbour declined somewhat from previous elevated levels. Monitoring of various forms of nitrogen, including the observed trends in TKN in bottom waters, suggests that there had been an increase in the organic nitrogen pool within the system that is now beginning to decline (Ross <i>et al</i> 2020). The TPDNO cap of 500.1 tonnes per annum is ensuring that marine farming will not contribute additional nutrients to the estuarine environment</p> <p>Monitoring of DO in the Harbour demonstrates that marine farming in Macquarie Harbour has not had a direct impact on DO levels within the skates preferred habitat of shallow channels of 5 m to 15 m.</p> <p>Since 2014, DO monitoring of bottom water has shown a slow upwards trend due to periodic recharges, particularly in summer, and periods of decline through winter and spring (Ross <i>et al</i> 202) indicating that the management controls in place are ensuring that the action is being managed in manner to allow DO levels within the Harbour to improve.</p> <p>The introduction of Environmental Licence conditions and the deoxygenation trial being</p>

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		<p>implemented by industry to further address DO levels in Macquarie Harbour to ensure that the recent gains in improved DO levels will be maintained and will potentially minimise impacts from environmental events.</p> <p>The action will not reduce the area of occupancy of the Maugean skate within Macquarie Harbour.</p>
<p>Fragment an existing population into two or more populations</p>	<p>The action could fragment an existing population of the species within Macquarie Harbour if barriers or structures were put in place or if operations were conducted in such a way that there was a specific impact on parts of the overall skate population.</p>	<p>No structures or barriers are proposed by the action and operations are regulated in such a way that there is no potential for fragmentation of the population directly.</p> <p>The action will not fragment an existing population into two or more populations of the Maugean skate within Macquarie Harbour.</p>
<p>Adversely affect habitat critical to the survival of a species</p>	<p>Conservation advice for the species identifies habitat critical to the survival of the Maugean skate as all of both Macquarie and Bathurst Harbours, which includes the area occupied (verified habitat) by the known subpopulation in Macquarie Harbour and provides for potential range extension (through recovery or translocation). The area identified as verified habitat is considered to be irreplaceable and necessary for the persistence and recovery of the species. This habitat covers an area of 3,455 ha (Bell <i>et al</i> 2016) of shallow channels between 5 m and 15m in depth.</p> <p>The area of potential habitat for skate in Bathurst Harbour is not mapped in detail but estimated at <40km².</p>	<p>There is increasing understanding of the structure and functioning of habitat and the use of that habitat by skates in Macquarie Harbour. There is very little understanding of habitat functioning and relationship(s) with skate behaviour in Bathurst Harbour.</p> <p>Threats to habitat in Macquarie are increasingly well understood and accounted for in the CAP and Conservation Advice.</p> <p>As noted above, key threats to habitat from the action have actively been addressed through a range of regulatory measures under the AMF and industry practices. Current data and research indicate that salmon farming in Macquarie Harbour is</p>

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	<p>The EPBC Listing statement noted that both habitats are under increasing pressure from vessel based tourism, fishing and pollution. While the World Heritage status of Port Davey provides some form of habitat protection to the species, increasing activity and growing tourism in the area has the potential to impact on this species. Potential impacts include a change in nutrient status caused by vessel discharge; habitat disturbance and incidental capture in fishing nets. Similar threats to the species occur in Macquarie Harbour, combined with pollution from mining activities.</p> <p>The critical habitat for the species could be adversely affected if it was directly destroyed or indirect impacts (both natural and anthropogenic) lead to water quality or benthic condition declining to a point that the species could not use the critical habitat.</p>	<p>not adversely affecting habitat critical for the species survival.</p> <p>Climate change is the one common potential threat to both known and potential habitats in both Harbours. As Ross <i>et al</i> (2020) note, the waters of Macquarie Harbour have warmed over the past 30 years and this acts synergistically with other climate and influences on habitat functioning. Climate related threats are subject to a range of response measures at local¹, National² and International³ levels. The Tasmanian government is in the process of developing a specific Marine Heatwave Response Plan⁴ that will also identify measures that may enhance adaptation capacity.</p> <p>The action will not adversely affect habitat critical to the survival of the Maugean skate.</p>
<p>Disrupt the breeding cycle of a population</p>	<p>Maugean Skate are oviparous, with an asynchronous discontinuous reproductive cycle in which a proportion of the adult females are reproductively active at any given time (Bell <i>et al</i>, 2016). Triggers to initiate breeding for the species are not known. While no skate laying egg capsules have been observed to date, the only documented living skate egg capsule was found entangled in a gillnet set in ~30 m</p>	<p>The trigger to initiate breeding within the population is not known. However, as outlined above, the action will not have an impact on the benthic or water quality conditions within the preferred habitat for the species hence it is highly unlikely that the action would lead to changes within the environment that reduce triggers to initiate breeding or impact juvenile survival rates.</p>

¹ [Climate Change Action Plan | Renewables, Climate and Future Industries Tasmania \(recfit.tas.gov.au\)](https://recfit.tas.gov.au)

² [Australia's climate change strategies - DCCEEW](#)

³ [COP 28 Global Stocktake](#)

⁴ [Marine Heatwaves | Fishing Tasmania](#)

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	<p>(Treloar <i>et al</i>, 2017). This observation and the incidental capture of empty egg capsules in depths of > 20 m (Bell <i>et al</i>, 2016) led to suggestions that Maugean Skate lay eggs at depths outside of their preferred depth range. However, Moreno <i>et al.</i>, 2020 note that egg cases are most abundant at depths of <10 metres.</p> <p>The action could impact on the breeding cycle of the Maugean skate if changes to environmental conditions occurred that inhibited migration pathways or triggers to initiate breeding. Evidence indicates that the Maugean skate have home ranges of less than <10km hence it is unlikely that the species would exhibit migration behaviour.</p> <p>If impacts of water quality on the species changes juvenile survival rates, then cohorts in the population will be smaller and given the 12 year life span of the species this may lead to reduced capacity for the species to breed.</p> <p>The action could increase the current egg predation rate of 20% (Moreno <i>et al</i> 2020) for the species if it facilitated the introduction of a pest species that predated on the eggs for the species.</p>	<p>The action has been ongoing for a period of 12 years and during this time no pest species have been introduced to Macquarie Harbour that are attributed to marine farming. Salmon biosecurity controls overseen by NRE Tas and related EPA Tas permit restrictions limit the movement of equipment between marine farming leases and requires monitoring and regulations regarding the discharge of bilge water; these will continue to apply to the action.</p> <p>Through the implementation of the AMF the action will not disrupt the breeding cycle of a population of the Maugean skate.</p>
<p>Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to</p>	<p>The action will not destroy, remove or isolate habitat for the species but may modify the functional availability or quality of habitat if indirect impacts lead to water quality or benthic condition declining.</p>	<p>With the reduction in both stocking density and introduction of the TPDNO cap, and comprehensive EPA Tas and Marine Farming licence conditions that have been updated over recent years (and described earlier), the action will not further</p>

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<p>decline</p>		<p>impact the availability or quality of habitat to the extent that the species is likely to decline.</p> <p>With initiatives underway to improve water quality under the Macquarie Harbour Oxygenation Project and related initiatives under the CAP to better understand habitat requirements and expand monitoring initiatives, it is possible that some habitat areas may be enhanced.</p> <p>The action will not decrease the availability or quality of habitat within Macquarie Harbour for the Maugean skate to the extent that the species is likely to decline.</p>
<p>Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat</p>	<p>Brown Trout are already present in the Gordon River and Henty River, and there is potential for Atlantic Salmon and Rainbow Trout to escape from the action. However, for the latter two species to become established as wild populations it would require the survival of escaped fish, appropriate environmental conditions for fish to breed, and suitable habitat for recruitment of juvenile fish. Studies by the then Tasmanian Aquaculture and Fisheries Institute (TAFI) and analyses of recent escapes elsewhere in Tasmania by (Lyle, 2021) suggest that escaped Atlantic Salmon do not thrive in the wild, and there is no evidence of salmon establishing self-sustaining populations in Tasmania. The TAFI research demonstrated that escaped</p>	<p>Salmonid farming has been undertaken in Macquarie Harbour since 1986.</p> <p>The action has been ongoing for a period of twelve years (though the expansion proposed has not eventuated) and during this time no pest species attributed to marine farming have been introduced to Macquarie Harbour. Permit conditions that apply to this action specifically seek to reduce the risk of introducing invasive species and are considered appropriate to mitigate any risk.</p> <p>The Tasmanian Salmonid Industry Biosecurity Program (January 2023), has further strengthened the regulatory framework to mitigate the introduction of invasive marine pests statewide.</p>

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	<p>Rainbow Trout fed on native fauna but has not reported populations becoming established through a full life cycle. There has been no evidence over the last twelve years that links escaped salmon or trout to impacts on the Maugean skate.</p> <p>The increase in the movement of vessels and equipment into Macquarie Harbour as a result of the ongoing action has potential to increase the level of risk that marine pests will establish in the area. The greatest risk could come from the movement of commercial vessels, including harvest barges, and aquaculture equipment from areas with high numbers of marine pests to Macquarie Harbour. These pests could be translocated via ballast water discharge or hull fouling. Pests that are not known to occur in the area that could potentially establish as a result of increased boat traffic between the south-east and Macquarie Harbour include the Northern Pacific Seastar (<i>Asterias amurensis</i>), the Japanese seaweed (<i>Undaria pinnatifida</i>), and toxic dinoflagellates such as <i>Gymnodinium catenatum</i> and <i>Alexandrium catenella</i>. Although most of the environment in Macquarie Harbour may not be suitable for some pests because of the strong light attenuation, it may be suitable for the toxic dinoflagellates because they vertically migrate.</p>	<p>The action will not result in the introduction of an invasive species that will be harmful to a Maugean skate.</p>

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<p>Introduce disease that may cause the species to decline</p>	<p>Currently, there are no serious disease issues in Macquarie Harbour. Previously, a number of diseases have been identified in Macquarie Harbour; these have included yersiniosis, marine aeromonad disease of salmonoids (MAS) and vibriosis. In 2006, <i>Ichthyophonus</i> caused mortality in rainbow trout. In addition, Aquabirnavirus, Reovirus and a rickettsia-like organism (RLO) have also been detected.</p> <p>The key component in the preventative disease program for Macquarie Harbour is vaccination against Marine Aeromonad Disease and vibriosis. Since the introduction of the vaccination process, there have been no outbreaks of these diseases. Additionally, there is mandatory health surveillance carried out NRE Tas personnel within the framework of the Tasmanian Salmonid Health Surveillance Program (Tas SHSP) which is a joint Industry and Government Program.</p> <p>Further, the current operators within the plan area are implementing a Fish Health Management Plan (FHMP) which will provide a specific detailed strategy for the ongoing management of fish health in Macquarie Harbour. The operators have signed off on the strategies outlined in the FHMP which consists of a combination of compliance, best practice and regulation through management</p>	<p>Salmonids have been in the Harbour since 1986.</p> <p>The action has been ongoing for a period of 12 years and during this time no disease that may cause a decline to the Maugean skate population has been detected in Macquarie Harbour.</p> <p>The action will not result in the introduction of a disease that may cause Maugean skate to decline.</p>

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	<p>controls and marine farming licence conditions. The FHMP addresses detailed, standard operating practices to prevent disease from entering the harbour, to prevent spread and impact of disease in the harbour and to respond to emergency disease situations. The FHMP is reviewed annually or more frequently if needed.</p>	
<p>Interfere with the recovery of the species.</p>	<p>There are two parallel and co-joined processes underway that seek to ensure skate recovery. Both the Commonwealth Conservation Advice and the Tasmanian Government’s CAP outline a series of initiatives designed to protect habitat and support captive breeding of the skate.</p> <p>Both plans have received near term funding support which is further complemented by ongoing industry and research initiatives such as the MHOP project and FRDC investments.</p>	<p>All actions being undertaken by government, industry, research and community partners are coordinated and have been designed to ensure persistence of the species. All conservation actions underway and planned in the near term are informed by ongoing research and monitoring activities which are also continuously informing and shaping the adaptive management approach applied by NRE Tas and the EPA Tas.</p> <p>Through the AMF and CAP measures, this action will not interfere with recovery of the Maugean skate. The CAP introduces measures to maximise the probability of recovery.</p>