



# Snowy 2.0 Threatened Fish Management Plan



Revision: A

Date: 19/09/2023

## Certificate of Approval

**Title:** Snowy 2.0 Threatened Fish Management Plan

**Revision:** A

**Date of issue:** 19/09/2023

### Approval Record

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	Trevor Daly	Senior Fisheries Manager (NSW DPI)
<b>Approved By:</b>	Scott Hansen (NSW DPI)	Director-General of NSW DPI

### Document Revision Table

Rev.	Date	Description of modifications
		N/A

**Ms Kiersten Fishburn**  
**Secretary**  
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**4 Parramatta Square**  
**Parramatta NSW 2150**

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Re: Snowy Hydro 2.0 project – DPI endorsement of Recreational Fishing and Threatened Fish Management Plans in line with conditions of consent

Dear Ms Fishburn,

As you are aware, Snowy Hydro 2.0 is a large-scale pumped hydro project that seeks to link the existing Talbingo and Tantangara storages within the Snowy Hydro scheme.

The development has been classified as Critical State Significant Infrastructure (CSSI) and was granted planning approval in October 2021 subject to various conditions of consent.

Conditions 22, 24 and 26 of the Snowy 2.0 Infrastructure Approval (CSSI: 9687) provided by the NSW Department of Planning requires Snowy Hydro Limited (SHL) to submit a series of Management Plans to mitigate the potential impacts of the development.

SHL have submitted the Recreational Fishing and Threatened Fish Management Plans to the Department for consideration. These plans have been reviewed and advice has been sought from our Advisory Bodies, namely Recreational Fishing NSW and the NSW Fisheries Scientific Committee.

Based on these reviews, and in accordance with the planning approval and in my capacity as Director General Primary Industries, I am pleased to advise the Management Plans have been developed to the Department's satisfaction, and provide endorsement of both the Recreational Fishing Management Plan and the Threatened Fish Management Plan.

If you have any enquiries, please contact Mr Anthony Townsend, A/Director Freshwater Environment at [anthony.townsend@dpi.nsw.gov.au](mailto:anthony.townsend@dpi.nsw.gov.au) or 0427 782 701.

Yours sincerely,



**Scott Hansen**  
Director General  
Department of Primary Industries

## Acronyms and Definitions

AEA	Aquatic Ecology Assessment, Appendix M.2 of the Snowy 2.0 Main Works EIS
AP	Annual Program
Approval	Infrastructure Approval for Snowy 2.0 Main Works issued under Section 5.19 of the <i>Environmental Planning and Assessment Act 1979</i> (Dated: 20th May 2020) (SSI 9687)
AqHMP	Aquatic Habitat Management Plan
Biosecurity Act	<i>Biosecurity Act 2015</i> (NSW)
Biosecurity Regulation	<i>Biosecurity Regulation 2017</i> (NSW)
BRMP	Biosecurity Risk Management Plan
DAWE	Commonwealth Department of Agriculture Water and the Environment (formerly Department of Environment and Energy, now the Department of Climate Change, Energy, the Environment and Water)
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water (listed as DAWE in the Project Consent)
DPI	NSW Department of Primary Industries, formerly part of the Department of Planning, Industry and Environment, now part of Regional NSW.
DPIE	Department of Planning, Industry and Environment, now known as the Department of Planning and Environment
EAC	Expert Advisory Committee. Required under Condition 24(b) of the Infrastructure Approval for Snowy 2.0 Main Works
EIS	Snowy Hydro 's Environmental Impact Statement for Snowy 2.0 Main Works
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
FGJV	Future Generation Joint Venture
FSC	NSW Fisheries Scientific Committee
FM Act	Fisheries Management Act 1994
M-E Tunnel	Murrumbidgee-Eucumbene Tunnel. A one way tunnel linking Tantangara Reservoir with the Eucumbene Reservoir
NPWS	National Parks and Wildlife Service
NSW	New South Wales
PHES	Pumped Hydroelectric Station
RTS	Response to Submissions for the Snowy 2.0 Main Works EIS
RFMP	Recreational Fishing Management Plan
TARP	Trigger, Action and Response Plan
TFMP	Threatened Fish Management Plan

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# 1. Introduction

This document is known as the Threatened Fish Management Plan (TFMP) for Snowy 2.0 Main Works.

It has been prepared to meet the requirements of Schedule 3 conditions 20(b), 24 and 25 of the Infrastructure Approval for Snowy 2.0 Main Works issued under Section 5.19 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) (Dated: 20<sup>th</sup> May 2020) (CSSI 9687) (the NSW Approval) and the relevant requirements of Annexure A, Part A, Conditions 12-16 issued under sections 130(1) and 133(1) of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). (Dated: 29<sup>th</sup> June 2020) (EPBC 2018/8322) (the EPBC Approval).

## 1.1. Project Overview

Snowy Hydro Limited (Snowy Hydro) owns, manages, and maintains the Snowy Mountains Hydroelectric Scheme (the Scheme). The Scheme currently includes 16 major dams, nine power stations, one pumped power station, 145 km of interconnected tunnels and pipelines, and 80 km of aqueducts. The Scheme, principally located within the Kosciuszko National Park (KNP), is one of the largest and most complex hydro-electric schemes in the world.

The pumped hydro-electric expansion of the Scheme (Snowy 2.0) will link the existing Tantangara and Talbingo Reservoirs via a new underground tunnel and a pumped hydro-electric power station (PHES). Snowy 2.0 will provide an additional 2,000 MW of dispatchable generating capacity, along with approximately 350,000 MWh of large-scale energy storage that will be available on demand as quick-start electricity generation at critical times of peak demand.

For almost 70 years Snowy Hydro has responsibly operated the Snowy Scheme within KNP. Snowy Hydro is committed to avoiding and minimising potential impacts from Snowy 2.0, as they do for the existing business.

## 1.2. Project Approval

This project was designated Critical State Significant Infrastructure (CSSI 9687) and assessed under Part 5 of the EP&A Act. Under sections 5.23 and 5.24 of the EP&A Act, certain separate approvals and licences are not required. The project was approved by the NSW Minister for Planning and Public Spaces under Section 5.19 of the EP&A Act on the 20<sup>th</sup> of May 2020.

A referral (EPBC 2018/8322) was also prepared and lodged with the Commonwealth Minister for the Environment (DAWE, now DCCEEW) under the EPBC Act and the proposal was subsequently determined to be a controlled action under that Act. The project was approved under sections 130(1) and 133(1) of the EPBC Act on the 29<sup>th</sup> June 2020.

Transferring water through the PHES between Talbingo and Tantangara Reservoirs requires authorisation under the *NSW Biosecurity Act 2015* and *NSW Fisheries Management Act 1994* (FM Act). Appropriate authorisation instruments will be issued to Snowy Hydro by the NSW Department of Primary Industries (DPI) once three aquatic management plans have been approved by the NSW Director General of DPI. These plans are:

- Threatened Fish Management Plan (TFMP) (this plan)
- Recreational Fishing Management Plan (RFMP)
- Biosecurity Risk Management Plan (BRMP).

Conditions that relate to aquatic species and recreational fisheries were included within the Main Works Infrastructure Approval in Schedule 3, Conditions 20-27 (SSI 9687) (Table 1) and in the EPBC Approval in Annexure A, Part A, Conditions 12-16 (Table 2). The requirement to prepare this plan is contained in Condition 24 of the NSW Approval.

Full details of the Conditions of Approval and supporting information can be found at:

<https://www.planningportal.nsw.gov.au/major-projects/project/12891>

**Table 1: Relevant Conditions of Approval for Snowy 2.0 Main Works**

Condition	Requirement	Where addressed
Schedule 3, Condition 20	<p>The Proponent must:</p> <p>(a) minimise the biosecurity risks associated the development, including the movement and/or spread of weeds, pests and pathogens;</p>	<p>Snowy 2.0 Aquatic Biodiversity Management Plan, Appendix F - Weed, Pest and Pathogen Management Plan Snowy 2.0 Biosecurity Risk Management Plan</p>
	<p>(b) minimise the impact of the development on threatened fish species and their habitat, particularly the Macquarie Perch, Stocky Galaxias and Murray Crayfish; and</p>	<p>Snowy 2.0 Aquatic Habitat Management Plan. This Plan, Sections 3.2, 3.3, 4.2, 4.3 and 6.2</p>
	<p>(c) minimise the impact of the development on recreational fishing in Tantangara Reservoir and Lake Eucumbene.</p>	<p>Snowy 2.0 Recreational Fishing Management Plan</p>
Schedule 3, Condition 21	<p>Prior to the commencement of commissioning, the Proponent must install:</p> <p>(a) a fish barrier on Tantangara Creek to prevent so far as is reasonably practicable Climbing Galaxias reaching the existing population of Stocky Galaxias in the upper reaches of the creek; and</p> <p>(b) fish screens at the southern end of the Tantangara Reservoir to prevent so far as is reasonably practicable the movement of pest fish (in all its forms: eggs, larvae, juveniles and adults) and spread of disease to the mid-Murrumbidgee River and Lake Eucumbene.</p>	<p>Incorporated into project design. Snowy 2.0 Biosecurity Risk Management Plan</p>
Schedule 3, Condition 22	<p><b>Biosecurity Risk Management Plan</b></p> <p>Within 2 years of the commencement of construction, the Proponent must prepare a Biosecurity Risk Management Plan for the development to the satisfaction of the Director-General of NSW DPI. This plan must:</p> <p>(a) be prepared by a suitably qualified and experienced person in consultation with DPIE, NPWS and DAWE;</p> <p>(b) include a detailed biosecurity risk management framework for minimising the ongoing biosecurity risks of the development required in condition 20(a) above, including:</p> <ul style="list-style-type: none"> <li>• developing systems to prevent spills from the Tantangara Reservoir so far as is reasonably practicable; and</li> <li>• pest fish and disease surveillance and eradication/management measures to protect the Macquarie Perch and Stocky Galaxias in the Mid to Upper Murrumbidgee catchment and the salmonid fishery in Lake Eucumbene;</li> </ul> <p>(c) include detailed plans for the installation and use of the fish screens and barriers required in condition 21 above, including:</p> <ul style="list-style-type: none"> <li>• minimising the environmental impacts associated with installing the screens,</li> <li>• testing the effectiveness of the screens before they are used; and</li> <li>• maintaining and improving the effectiveness of the screens and barriers over time;</li> </ul>	<p>Snowy 2.0 Biosecurity Risk Management Plan</p>

Condition	Requirement	Where addressed
	(d) include a program to monitor, evaluate and publicly report on these plans, including: <ul style="list-style-type: none"> <li>• carrying out monitoring using epidemiologically designed surveys; and</li> <li>• conducting fish, disease and eDNA surveys.</li> </ul>	
Schedule 3, Condition 23	The Proponent must implement the approved Biosecurity Risk Management Plan for the development.	Snowy 2.0 Biosecurity Risk Management Plan
Schedule 3, Condition 24	<b>Threatened Fish Management Plan</b> Within 12 months of the commencement of construction, the Proponent must prepare a Threatened Fish Management Plan for the development to the satisfaction of the Director-General of NSW DPI.	This Plan, Certificate of Approval and Section 1.5
	This plan must: (a) be prepared by a suitably qualified and experienced person in consultation with DPIE and DAWE;	This Plan, Certificate of Approval and Section 1.5
	(b) include the establishment and use of an expert advisory committee to provide advice to the proponent on the implementation of the plan;	This Plan, Section 2.2
	(c) describe the detailed measures that would be implemented to comply with condition 20(b) above;	This Plan, Sections 3.2, 3.3, 4.2, 4.3 and 6.2
	(d) include a detailed captive breeding program for the Macquarie Perch and Stocky Galaxias involving the spending of \$5 million over 5 years from the commencement of the program that provides for: <ul style="list-style-type: none"> <li>• population monitoring, surveillance and research on the Macquarie Perch and Stocky Galaxias in the Mid to Upper Murrumbidgee catchment;</li> <li>• habitat surveys to identify suitable receiving sites for stocking insurance populations of Stocky Galaxias and Macquarie Perch;</li> <li>• captive breeding, stocking and monitoring of Macquarie Perch and Stocky Galaxias with the aim of achieving self-sustaining populations of these species;</li> <li>• habitat enhancement for the Macquarie Perch in the mid-Murrumbidgee catchment in accordance with the National Recovery Plan to increase the existing population's resilience to the potential biosecurity risks from the development</li> </ul>	Stocky Galaxias This Plan, Section 3.3  Macquarie Perch This Plan, Section 4.3
	(e) include a review after 5 years of the commencement of the captive breeding program in (d) above and detail the trigger, action and response plan for the extension of the program;	This Plan, Section 5
	(f) include a program to minimise the impacts of the development on the Murray Crayfish in Talbingo Reservoir, including: <ul style="list-style-type: none"> <li>• population monitoring and surveillance for Murray Crayfish;</li> <li>• relocating any Murray Crayfish from the disturbance area of the development prior to disturbing the relevant area; and</li> <li>• habitat enhancement for the Murray Crayfish habitat in the vicinity of the disturbance area at the Talbingo</li> </ul>	This Plan, Section 6.3.1  Snowy 2.0 Aquatic Habitat Management Plan; This Plan, Section 6.3.2



Condition	Requirement	Where addressed
	Reservoir, including the use of woody debris salvaged during construction; and	Snowy 2.0 Aquatic Habitat Management Plan; This Plan, Section 6.3.3
	(g) include a program to monitor and publicly report on the progress of each program/plan and the effectiveness of these measures.	This Plan, Section 2.4
Schedule 3, Condition 25	The Proponent must implement the approved Threatened Fish Management Plan for the development.	This Plan, Section 0
Schedule 3, Condition 26	<p>Within 12 months of the commencement of construction, the Proponent must prepare a Recreational Fishing Management Plan for the development to the satisfaction of the Director-General of NSW DPI.</p> <p>This plan must:</p> <p>(a) be prepared by a suitably qualified and experienced person in consultation with DPIE, NPWS and relevant recreational fishing groups;</p> <p>(b) describe the detailed measures that would be implemented to comply with condition 20(c) above, including:</p> <ul style="list-style-type: none"> <li>• a program involving the spending of \$5 million over 5 years from the commencement of the program to develop the capability to restock, and to restock, the Tantangara Reservoir and Lake Eucumbene with salmonid fish;</li> <li>• a program to monitor the impacts of the development on recreational fishing in Tantangara Reservoir and Lake Eucumbene;</li> <li>• a review after 5 years of the commencement of the restocking program and detail the trigger, action, and response plan for the continuation of the restocking of Tantangara Reservoir and/or Lake Eucumbene salmonid fish;</li> </ul> <p>(c) include a program to monitor and publicly report on the effectiveness of these measures.</p>	Snowy 2.0 Recreational Fishing Management Plan
Schedule 3, Condition 27	The Proponent must implement the approved Recreational Fishing Management Plan for the development.	Snowy 2.0 Recreational Fishing Management Plan
Schedule 4, Condition 4	<p>Within 3 months of the following, unless the Planning Secretary agrees otherwise, the Proponent must review and (if necessary) update the approved strategies, plans and programs for the development to the satisfaction of the Planning Secretary:</p> <p>(a) the submission of an incident report under condition 6 below;</p> <p>(b) the submission of an independent environmental audit report under condition 10 below; and</p> <p>(c) any modification to the conditions of this approval; or</p> <p>(d) a direction of the Planning Secretary under condition 4 of schedule 2.</p> <p>Note: This is to ensure the strategies, plans and programs are updated on a regular basis, and incorporate any recommended measures to improve the environmental performance of the development.</p>	Section 7
Schedule 4, Condition 6	The Proponent must notify the Department and NPWS via the Major Projects Portal immediately after it becomes	Section 1.7

Condition	Requirement	Where addressed
	aware of an incident on site. This notice must set out the location and nature of the incident	
Schedule 4, Condition 7	Within 7 days of becoming aware of any non-compliance with the conditions of this approval, the Proponent must notify the Department via the Major Projects portal of the non-compliance. This notice must set out the non-compliance, the reasons for the non-compliance (if known) and what actions have been taken, or will be taken, to address the non-compliance.	Section 1.7
Schedule 4, Condition 8	The Proponent must provide regular reporting on the environmental performance of the development on its website in accordance with the requirements in any approved strategies, plans or programs.	Section 2.4
Schedule 4, Condition 12	From the commencement of the development of the Main Works until the completion of the ecological rehabilitation of the areas used for operations, the Proponent must: (a) make copies of the following information publicly available on its website: <ul style="list-style-type: none"> <li>• the documents referred to in the definition of the Exploratory Works and Main Works;</li> <li>• current statutory approvals for the development;</li> <li>• approved strategies, plans or programs;</li> <li>• a comprehensive summary of the monitoring results of the development, reported in accordance with the requirements in the conditions of this approval, or any approved strategies, plans and programs;</li> <li>• a monthly summary of complaints;</li> <li>• a record of all incidents and non-compliances;</li> <li>• any independent environmental audit, and the Proponent's response to the recommendations in any audit;</li> <li>• any approved audit action plan;</li> <li>• any other matter required by the Planning Secretary;</li> </ul> (b) keep this information up to date.	Section 1.5; Section 2.4

**Table 2: Snowy 2.0 Main Works, NSW (EPBC 2018/8322) Conditions of Approval for Aquatic Ecology and Biodiversity**

Condition	Requirement	Where addressed
Annexure A, Part A, Condition 12	To minimise impacts to the aquatic environment, the approval holder must comply with conditions 20-25 of the NSW approval relating to biosecurity and fish management.	Snowy 2.0 Biosecurity Risk Management Plan; Snowy 2.0 Threatened Fish Management Plan; Snowy 2.0 Recreational Fishing Management Plan
Annexure A, Part A, Condition 13	To minimise potential impacts of pest fish movement on protected matters, the approval holder must, in addition to conditions 22c and 24d of the NSW approval: <ul style="list-style-type: none"> <li>a. investigate reasonable measures, including the installation of secondary fish barriers, to protect tributaries identified as priority receiving sites for the establishment of stocking insurance populations of the Macquarie Perch and Stocky Galaxias;</li> </ul>	Snowy 2.0 Biosecurity Risk Management Plan; This Plan, Section 3.3.3 and 4.3.3

Condition	Requirement	Where addressed
	<p>b. include the findings of the investigation in the Biosecurity Risk Management Plan required by condition 22 of the NSW approval, and the Threatened Fish Management Plan required by condition 24 of the NSW approval; and</p> <p>c. before undertaking any stocking of insurance populations required by condition 24d of the NSW approval, implement those measures determined under condition 13a to protect tributaries identified as priority receiving sites for the establishment of stocking insurance populations of the Macquarie Perch and Stocky Galaxias.</p>	
Annexure A, Part A, Condition 14	<p>The Biosecurity Risk Management Plan required by condition 22 of the NSW approval, and the Threatened Fish Management Plan required by condition 24 of the NSW approval, must be peer reviewed by an independent, suitably-qualified expert/s approved by the Department.</p> <p>a. The peer review must be made publicly available on the approval holder's website within 10 business days of finalisation; and</p> <p>b. The peer review must be undertaken prior to approval of the Biosecurity Risk Management Plan and Threatened Fish Management Plan by the Director-General of the NSW Department of Primary Industries.</p>	<p>Snowy 2.0 Biosecurity Risk Management Plan; This Plan, Section 0</p>
Annexure A, Part A, Condition 15	<p>The Biosecurity Risk Management Plan and the Threatened Fish Management Plan must include provisions to make monitoring data (excluding sensitive ecological data) available as part of the monitoring, evaluation and reporting programs required by condition 22d and 24g of the NSW approval.</p>	<p>Snowy 2.0 Biosecurity Risk Management Plan; This Plan, Section 2.4</p>
Annexure A, Part A, Condition 16	<p>The approval holder must implement the Biosecurity Risk Management Plan and Threatened Fish Management Plan approved by the Director-General of the NSW Department of Primary Industries until the end date of this approval, unless otherwise agreed by the Minister in writing.</p>	<p>Snowy 2.0 Biosecurity Risk Management Plan; This Plan, Section 0 and 7</p>

### 1.3. Management Plan Scope

The overarching objective of the TFMP is to meet the conditions of approval (CoA) for Snowy 2.0 Main Works.

The TFMP describes the detailed measures that will be implemented to minimise the impact of the Snowy 2.0 development on threatened fish species and their habitat, particularly the Macquarie Perch (*Macquaria australasica*), Stocky Galaxias (*Galaxias tantangara*) and Murray Crayfish (*Euastacus armatus*).

The consent conditions of the Snowy 2.0 Main Works approval require the TFMP to include a detailed captive breeding program for the Macquarie Perch and Stocky Galaxias involving the spending of \$5 million over 5 years from the commencement of the program (Condition 24(d); Table 1). The Plan also includes monitoring and management measures associated with minimising the impact of Snowy 2.0 on Murray Crayfish in Talbingo Reservoir (Condition 24(f); Table 1).

The content of the TFMP is based around the requirements of the CoA provided in Table 1 and Table 2.

### 1.4. Environmental Management Measures

Environmental safeguards and management measures for the Snowy 2.0 project were included in Appendix C of the Snowy 2.0 Main Works Response to Submissions (RtS) (Table 3).

**Table 3: Main Works environmental management measures relevant to Aquatic Threatened Species in included in the RTS and AEA**

ID	Measure	Where addressed
AE01	<p>An Aquatic Habitat Management Plan will be prepared and implemented to guide management of impacts to aquatic habitat. The plan will:</p> <ul style="list-style-type: none"> <li>• be prepared in consultation with NPWS and DPI-Fisheries;</li> <li>• include a description of measures that would be implemented to: <ul style="list-style-type: none"> <li>– minimise impacts to aquatic habitat outside the approved disturbance areas;</li> <li>– minimise the loss of key aquatic habitat;</li> <li>– minimise the impacts of the development on threatened fauna species;</li> <li>– minimise the impact of the development on fish habitat;</li> <li>– relocate Murray crayfish from the shallower parts of the approved disturbance area in Talbingo Reservoir prior to disturbing these areas</li> <li>– notify DPI-Fisheries of any fish kills;</li> </ul> </li> <li>• include a trigger action and response plan for the Murray crayfish, which would be implemented if monitoring shows the development is adversely affecting the species;</li> <li>• include a program to restore and enhance the aquatic habitat of the approved disturbance area except for the intakes and their approach areas as soon as practicable following the completion of development in these areas;</li> <li>• include a program to monitor and report on the effectiveness of these measures.</li> </ul>	Snowy 2.0 Aquatic Habitat Management Plan; Snowy 2.0 Biosecurity Risk Management Plan; Snowy 2.0 Threatened Fish Management Plan
AE02	Bridges or culverts would be designed and constructed in accordance with NSW DPI fish passage requirements for waterway crossings (Fairfull & Witheridge 2003) where practicable.	Snowy 2.0 Aquatic Habitat Management Plan
AE03	Construction works within the channel of a permanent waterway with type 1 or 2 key fish habitat would allow some flow to maintain fish passage at all times and be staged to minimise the total disturbance at any given time.	Snowy 2.0 Aquatic Habitat Management Plan
AE04	<p>A Weed, Pest and Pathogen Management Plan will be prepared and implemented to minimise and manage the spread of weeds, pest fish and pathogens. The plan will:</p> <ul style="list-style-type: none"> <li>• be prepared in consultation with NPWS and DPI-Fisheries;</li> <li>• include a description of measures that would be implemented to: <ul style="list-style-type: none"> <li>– minimise the spread of weeds and pest via vehicle and plant movements;</li> <li>– remove aquatic macrophytes appropriately where required to do so to enable construction activities;</li> </ul> </li> <li>• include a program to monitor and report distribution of pest fish within the project area;</li> <li>• include a surveillance plan for EHNV in key locations within the project area.</li> </ul>	Snowy 2.0 Biodiversity Management Plan, Appendix F - Weed, Pest and Pathogen Management Plan; Snowy 2.0 Biosecurity Risk Management Plan
AE05	Designated blast limits and other management measures to minimise impacts to aquatic ecology will be outlined in the Blast Management Plan.	Snowy 2.0 Blast Management Plan
AE06	<p>Install the following:</p> <ul style="list-style-type: none"> <li>• fish barrier on Tantangara Creek designed to prevent upstream migration of Climbing galaxias; and</li> <li>• fine mesh screens to prevent transfer of key species through releases from the Tantangara Dam River Outlet Works and the Murrumbidgee– Eucumbene tunnel.</li> </ul>	Incorporated into project design; Snowy 2.0 Biosecurity Risk Management Plan

Key management measures for Snowy 2.0 associated with minimising the impact of the development on Macquarie Perch (*Macquaria australasica*), Stocky Galaxias (*Galaxias tantangara*) and Murray Crayfish (*Euastacus armatus*) in the TFMP are presented in Section 3, 4 and 6 respectively.

Potential construction impacts from Snowy 2.0 on aquatic habitats and fish are managed through the implementation of a series of management plans implemented by the Future Generation Joint Venture (FGJV), available on Snowy Hydro's website: <https://www.snowyhydro.com.au/snowy-20/documents/> .

Biosecurity risks associated with the operation of Snowy 2.0 will be monitored and managed through the implementation of the BRMP, that is to be approved by the Director-General of NSW DPI.

## **1.5. Plan Preparation, Consultation and Approval**

This TFMP has been prepared by suitably qualified and experienced persons in consultation with NSW DPI (formerly part of DPIE), the Department of Planning (DPE), the National Parks and Wildlife Service (NPWS) and the Department of Climate Change, Energy, the Environment and Water (DCCEEW) (formerly DAWE).

Representatives from DPI-Fisheries and DPI-Biosecurity and Food Safety have been regularly updated regarding the preparation of this plan, and the BRMP and RFMP, via the establishment of a Working Group and Steering Committee. The working group has met generally monthly since July 2020 with the Steering Committee typically meeting quarterly. An overview of the consultation that was undertaken to develop the TFMP is provided in Appendix A; Table 9.

This plan has been issued to DPI, DPE and DCCEEW and other relevant stakeholder agencies for review and comment, with comments incorporated where required. Once approved, the current version of the TFMP will be made available on Snowy Hydro's website ([www.snowyhydro.com.au](http://www.snowyhydro.com.au)).

The TFMP has been prepared by Elizabeth (Lizzie) Pope (BSc(Hons)) and Dr Lachlan Barnes (PhD). In developing this management plan, Lizzie and Lachlan sought and incorporated the advice of key experts in each aspect of the Plan as well as the NSW DPI Technical Working Group (listed in Appendix A). Experts, in addition to the DPI Working Group, who have provided advice for this plan include Dr Tarmo Raadik, Associate Professor Mark Lintermans, Daniel Stoessel, Dr Jared Lyon, Dr Zeb Tonkin, Dr Dean Gilligan, Dr Sylvia Zukowski and Dr Nick Whiterod.

Lizzie is a Senior Environmental Scientist at Snowy Hydro with almost 20 years' experience in the environment sector. She has been closely involved in the aquatic impact assessment and development of controls for Snowy 2.0 since the beginning of the project. She has written numerous management plans and impact assessments in her employment at Snowy Hydro and in her previous role in consulting. She has presented at many conferences and forums, co-authored scientific papers and currently sits on an advisory reference panel for a fish passage project in south-east Asia for Charles Sturt University.

Lachlan works at SLR Consulting and has over 19 years' experience as a researcher and consultant. Lachlan has completed detailed impact assessments on threatened and listed species throughout Australia on a variety of projects including those associated with dredging, critical infrastructure, and renewable energy developments. Lachlan was a co-author of the aquatic ecology impact assessment for the Snowy 2.0 project. Lachlan has extensive experience in seamlessly integrating specialist insights into impact assessments and management plans, ensuring a comprehensive and effective approach to conservation and environmental outcomes.

## **1.6. Peer Review**

In accordance with Condition 14 of the EPBC Approval (Table 2) prior to submission of the TFMP to the Director-General of the NSW Department of Primary Industries for approval, this TFMP has been peer reviewed by an independent, suitably-qualified expert approved by DCCEEW.

Details of the review are provided in Appendix B and are also publicly available on Snowy Hydro's website.

## **1.7. Reporting incidents and non-compliance**

As per Schedule 4, Condition 6, Snowy Hydro will notify DPE and NPWS via the Major Projects Portal immediately after it becomes aware of an incident on site. This notice must set out the location and nature of the incident.

As per Schedule 4, Condition 7, within 7 days of becoming aware of any non-compliance with the conditions of approval related to the BRMP, Snowy Hydro will notify the Department of Planning via the Major Projects portal of the non-compliance. This notice will set out the non-compliance, the reasons for the non-compliance (if known) and what actions have been taken, or will be taken, to address the non-compliance.



## 2. Plan Implementation and Reporting

### 2.1. Responsibility for Implementation

To ensure the best possible outcome from breeding and restocking activities for Macquarie Perch and Stocky Galaxias under the captive breeding program required in Condition 24(d) (Table 1; Section 3.3 and 4.3), and as the lead agency for managing threatened fish species in NSW, these activities, including planning and reporting, will be managed and undertaken by, or under the direction of, DPI Fisheries. NSW DPI has established, and will maintain, collaborative arrangements with a range of tertiary institutions and external parties to enhance husbandry and release techniques to further ensure best practice is implemented and maximise the likelihood of successful outcomes. All other activities required within this Plan will be the responsibility of Snowy Hydro.

Implementation of all activities undertaken as part of the TFMP will be reviewed and endorsed by an Expert Advisory Committee (EAC) (Section 2.2). The EAC will ensure activities undertaken as part of the TFMP are effective, efficient, adaptive and incorporate outcomes of previous activities and contemporary advances in science and research on the focal populations.

Each year an Annual Program or programs (AP) will be developed that will guide the implementation of the TFMP (Section 2.3). The AP will be reviewed and endorsed by the EAC prior to being implemented. The AP will identify and describe the activities to be undertaken in the subsequent 12-month period.

The results of works undertaken as part of the TRMP that informs the development of the AP will be outlined in an Annual Report (AR) (Section 2.4).

### 2.2. Expert Advisory Committee

As per Condition 24(b), an EAC will be established to provide advice to the proponent on the implementation of the TFMP. Each year, in accordance with the EAC Terms of Reference (ToR), members of the EAC will assess, review and endorse the implementation of activities identified in the AP to meet the requirements of the TFMP.

The EAC will be governed by a Terms of Reference (ToR) that will outline but not necessarily be limited to including the following:

- Background of the purpose and context of the document
- Role of the EAC
- EAC membership and period of appointment
- EAC member roles and responsibilities
- Governance and decision-making arrangements for how TFMP implementation results and activities will be reviewed, assessed and endorsed
- Budget management/reporting
- Meeting schedule and indicative timeframe for input and involvement in the EAC
- Dispute resolutions arrangements
- Record keeping requirements
- Intellectual property rights
- Details of mechanisms of how the ToR may be reviewed or extended
- Reporting arrangements.

It is anticipated that the individuals will retain tenure for at least 5 years. However, if required, members may be replaced in consultation with NSW DPI with an individual of similar expertise (as detailed in the ToR). Any updates to committee membership would be notified within the relevant Annual Program (see Section 2.3).

NSW DPI have nominated that the DPI Chief Scientist and at least one member of the Fisheries Scientific Committee is to be made a member of this committee. The EAC will include at least two scientists with demonstrable species-specific expertise.

### 2.3. Annual Program

Each year when activities are to occur as part of the TFMP, an Annual Program or programs (AP) will be prepared by 31 October in each year (or other such date as agreed by Snowy Hydro and NSW DPI) and submitted to the EAC for review and endorsement or otherwise. Following review by the EAC, the AP will be updated where appropriate and finalised for publication.

Aspects of the AP (or a separate AP) relating to the Captive Breeding Program required by Condition 24(d) (Table 1; Section 3.3 and 4.3), will be prepared by NSW DPI. The AP will outline activities to be undertaken in the subsequent 12-month period and provide details of progress against program expenditure and expenditure estimated for the following 12 months.

The AP will be informed by results of activities undertaken during the previous 12 months (Section 2.4) outlined for Stocky Galaxias (Section 3), Macquarie Perch (Section 4) and Murray Crayfish (Section 6) to address the objectives of the TFMP.

Existing knowledge of aspects of Stocky Galaxias and Macquarie Perch is currently limited (see Section 3 and Section 4). Consequently, the activities described in each AP for the captive breeding program will be developed iteratively based on current knowledge and best practises for each species and the results of activities completed as part of the TFMP (Section 2.4). For all aspects of the AP, the nature of future activities will be highly contingent on prior expenditure on the program and outcomes from earlier activities. Activities outlined in the TFMP therefore provide a broad framework on which specific actions will be developed and refined through the process of EAC review and endorsement of the AP.

It is anticipated that all proposed activities will be planned and undertaken in consideration of existing and planned NSW DPI activities with a view to optimising value and outcomes of the TFMP for the relevant species. Collaboration with other agencies to improve outcomes and maximise value will be sought where appropriate. Activities identified in the AP will be consistent with relevant EPBC Act Conservation Advice, Federal Recovery Plans and State Priority Conservation Actions for the species.

All funding arrangements required to implement tasks identified in the AP will be made in accordance with Snowy Hydro's internal procurement processes following endorsement from the EAC.

## **2.4. Annual Reporting**

In any year when activities have occurred as part of the TFMP, by 31 August in each year (or such later date as agreed by Snowy Hydro and NSW DPI), an Annual Report or reports (AR) will be produced and submitted to the EAC detailing the results of activities undertaken for the TFMP during the period of 12 months ending in 30 June. Following review by the EAC, the AR will be updated where appropriate and finalised for publication.

The Annual Report associated with activities relating to the Captive Breeding Program required by Condition 24(d) (Table 1; Section 3.3 and 4.3), will be prepared by NSW DPI.

The report/s will be used to inform the development of the AP (Section 2.3) and will be made publicly available on the Snowy Hydro website.

The Threatened Fish Management Plan Annual Report will include, but not be limited to:

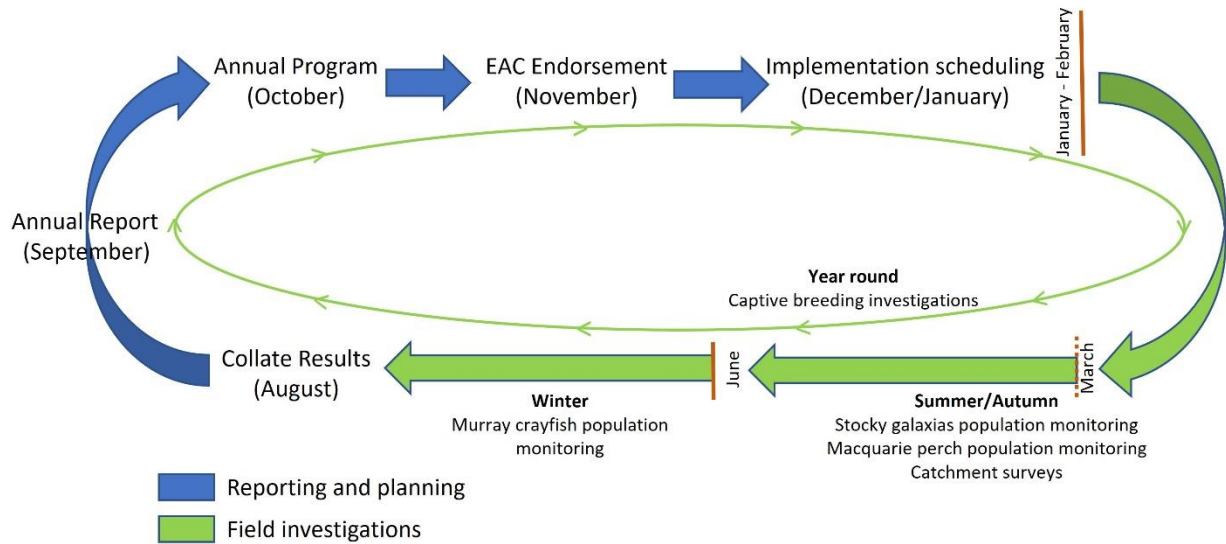
- An overview of activities undertaken and interpretation of their effectiveness
- Summary of outcomes of monitoring programs and other activities
- Details of compliance with the approved TFMP.

Any reports and data produced as part of activities undertaken for the TFMP will be shared between Snowy Hydro and NSW DPI once final.

## **2.5. Implementation schedule**

An indicative diagrammatic depiction of how the implementation of TFMP activities and the subsequent development of the AR and AP as well as EAC endorsement would be achieved is presented in Figure 1.

Activities that are ongoing will be reported on as part of the AR and updates to the AP will be made that year if required otherwise those activities will continue until completion as stated in the AP by which they have been initiated.



**Figure 1 Indicative depiction of the implementation of TFMP activities**

## 2.6. Memorandum of Understanding

A Memorandum of Understanding (MoU) will be developed with NSW DPI that outlines how the two parties will work together implement activities specified in the TFMP. The MoU would outline but not necessarily be limited to including the following:

- Stating the purpose and duration of the agreement
- Governance arrangements for how expenditure to undertake activities will be managed
- Roles and responsibilities of the signatories or other named parties
- Dispute resolutions arrangements
- Record keeping requirements
- Intellectual property rights
- Terms of termination provisions for breaches of arrangement
- Details of mechanisms of how the MoU may be extended
- Reporting arrangements.

### 3. Stocky Galaxias

The following sections provide an overview of the Stocky Galaxias species, the potential impact to this species from the project and a framework of activities to inform the development of the AP and address the CoA. Content within this section has been guided by the Snowy 2.0 Main Works Environmental Impact Statement (EIS), the conditions of consent, consultation with NSW DPI and expert advice provided by some of Australia's foremost experts on Stocky Galaxias and other small bodied native galaxiids managed through an engagement with the Arthur Rylah Institute (ARI).

In order to understand the current state of knowledge of Stocky Galaxias and inform how best to plan and implement the captive breeding program activities for Stocky Galaxias, Snowy Hydro commissioned the Arthur Rylah Institute (ARI) to prepare a series of reports correlating with each of the activities for the species specified to be undertaken as part of the detailed captive breeding program described in Condition 24(d). The documents inform the description of proposed activities below and are expected to be heavily relied on in the development of Annual Plans. As noted within these documents, the scope and scale of activities described provide a roadmap for the achievement of many of the Conservation Priority Actions for this species (NSW DPI, 2017). As such, the value and relevance of these documents extend beyond their use in the implementation of the captive breeding program for the TFMP.

Table 4 provides details of the documents prepared as part of the engagement with the ARI used to inform the framework of activities proposed to address the objectives of the TFMP. Activities in each AP will be drawn from these documents with decisions regarding the adoption, timing and scale of activities to be based on current knowledge, outcomes of previous activities and available resources and budgets. The prioritisation and adoption of individual activities will be centred on the degree to which the task will further the aim of achieving self sustaining populations of these species within the target catchments.

As noted in Section 2.2, each AP is to be reviewed and endorsed by the EAC prior to finalisation and implementation.

**Table 4: List of documents prepared for Snowy Hydro Limited to inform the preparation and implementation of the captive breeding program for the TFMP.**

Topic	Contributing Authors	Citation
Review of existing information	Raadik, T.A. and Lintermans, M.	Raadik, T.A. and Lintermans, M. (2022). Stocky Galaxias – review of existing information, Snowy 2.0. Published client report for Snowy Hydro Ltd, Cooma. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Victoria.
Species Monitoring	Raadik, T.A. and Lintermans, M.	Raadik, T.A. and Lintermans, M. (2022). Stocky Galaxias - monitoring plan, Snowy 2.0. Published client report for Snowy Hydro Ltd, Cooma. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Victoria.
Habitat Surveys	Raadik, T.A. and Lintermans, M.	Raadik, T.A. and Lintermans, M. (2022). Stocky Galaxias - catchment survey, Snowy 2.0. Published client report for Snowy Hydro Ltd, Cooma. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Victoria.
Translocation	Raadik, T.A., Stoessel, D. and Lintermans, M.	Raadik, T.A., Stoessel, D. and Lintermans, M. (2022). Stocky Galaxias - translocation strategy, Snowy 2.0. Published client report for Snowy Hydro Ltd, Cooma. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Victoria.
Captive Breeding	Stoessel, D.J. and Raadik, T.A.	Stoessel, D.J. and Raadik, T.A. (2022). Stocky Galaxias – captive breeding strategy, Snowy 2.0. Published client report for Snowy Hydro Ltd, Cooma. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Victoria.

### 3.1. Species Summary

Stocky Galaxias is a small scale-less non migratory native fish listed as Critically Endangered under the FM Act and EPBC Act (Figure 2; Raadik 2014; NSW FSC 2019; TSSC 2021). Its distribution is currently limited to a 3 km section of Tantangara Creek, a small creek in the upper Murrumbidgee catchment above Tantangara Reservoir (Raadik, 2014) and the upper section of Sallys Flat Creek, a tributary of the Goodradigbee River (Lintermans et al, 2021a). Very little is known or published on the biology and ecology of Stocky Galaxias, although evidence suggests it is expected to be like other higher-elevation species in the Mountain Galaxias complex (Raadik 2014; Allan et al. 2021).

The species is considered as one of Australia's most threatened freshwater fishes (Lintermans et al. 2020) and is at an extremely high risk of extinction from stochastic events such as drought, fire or predator invasion as well as habitat degradation given its extremely small global range (Driscoll et al. 2019; Lintermans and Allan 2019). Currently the primary threat to the persistence of the species, and the likely reason for its restricted distribution, is predation by introduced Trout. A natural waterfall on Tantangara Creek and Sallys Flat Creek currently prevents Trout access to the existing stocky galaxiid populations, thereby reducing the likelihood of predator-based extinction from occurring (Raadik 2014, Lintermans and Allan 2019, Lintermans et al. 2020).



**Figure 2: Stocky Galaxias (*Galaxias tantangara*), November 2016 (Image: Tarmo A. Raadik).**

With respect to the species and developing population resilience, the following four key knowledge gaps have been identified by Raadik and Lintermans (2022a):

- *Distribution.* Whilst Stocky Galaxias is only known from two small populations in the headwaters of Tantangara Creek and Sallys Flat Creek, its former distribution is considered to have been much larger and other isolated populations may still exist (Raadik 2014, NSW FSC 2019, Lintermans et al. 2021a).
- *Captive breeding.* Whilst some aspects of the wild breeding biology of Stocky Galaxias are known (Allan et al. 2021), and a collection of fish are currently being maintained in captivity, the knowledge and ability to maintain a population and produce viable offspring from captive breeding, remains largely unknown.
- *Demographics.* The age at sexual maturity, or longevity of Stocky Galaxias is unknown.
- *Genetic diversity.* The genetic diversity of the species is unknown.

### 3.2. Project Impacts, Risks and Mitigation

There are no direct impacts anticipated to Stocky Galaxias arising from the construction of Snowy 2.0 Main Works because the only known habitat and population of the species is outside of the direct construction area for the project (Cardno 2019).

A potential indirect impact to Stocky Galaxias identified during the impact assessment for the project included the potential transfer and subsequent establishment of pest fish species, in particular the Climbing Galaxias (*Galaxias brevipinnis*), following hydrologic connection between Talbingo and Tantangara Reservoirs to facilitate PHES operation (Cardno 2019).



Climbing Galaxias is a small bodied native fish, considered indigenous to coastal drainages in southeastern Australia including the Snowy River and Eucumbene River catchments but it is considered introduced in the Murray and Murrumbidgee River systems (Lintermans, 2019). It has been detected in a tributary of Talbingo Reservoir but has not been detected in the Murrumbidgee catchment upstream of Tantangara Reservoir (Cardno 2019). The potential for this species to be entrained during pumping, survive transfer through the power station and subsequently establish within Tantangara is uncertain, but in the absence of controls, the possibility cannot be excluded.

If Climbing Galaxias establish in Tantangara Creek, impacts could include predation and/or competition with Stocky Galaxias resulting in impacts to the population. This could include a reduction in population size or in the worst case, population loss. Any impact to the population would likely be associated with greater susceptibility to the effects of existing and cumulative threats (including habitat impacts from pest species and bushfire impacts) (Cardno 2019).

To address this potential outcome, Snowy Hydro committed to designing and constructing a 'Galaxiid barrier' at the downstream extent of the Stocky Galaxias habitat (Table 3) and this commitment was subsequently imposed as Condition 21(a) of the Infrastructure Approval (Table 1).

Detailed plans for the installation and operation of the barrier will be included within BRMP as required by Condition 22(c) of the NSW Approval. The BRMP will also include a program of pest fish and disease surveillance and eradication/management measures to protect the Stocky Galaxias in upper Tantangara Creek. These commitments are the key measures that will minimise the impact of the development on Stocky Galaxias.

Once these controls are in place, the likelihood of Climbing Galaxias being transferred to Tantangara Reservoir from Talbingo Reservoir, establishing in the upper Murrumbidgee catchment then migrating upstream of the planned barrier and establishing in upper Tantangara Creek leading to competition with and extinction of Stocky Galaxias was assessed as rare (Cardno 2019).

The captive breeding program described in Section 3.3 of this Plan is intended to further assist NSW DPI Fisheries and DCCEEW in protecting this critically endangered fish species and will address several Priority Actions identified by NSW DPI (2017) and the NSW Fisheries Scientific Committee (FSC) (2019) for the Stocky Galaxias. Such measures will be aimed at achieving self-sustaining populations and may improve the resilience of the species to withstand competition from Climbing Galaxias, should the controls fail at some point in the future.

### **3.3. Captive Breeding Program**

A key focus for the TFMP is a detailed captive breeding program for the Macquarie Perch and Stocky Galaxias involving the spending of \$5 million over 5 years from the commencement of the program as described in Condition 24(d) (Table 1).

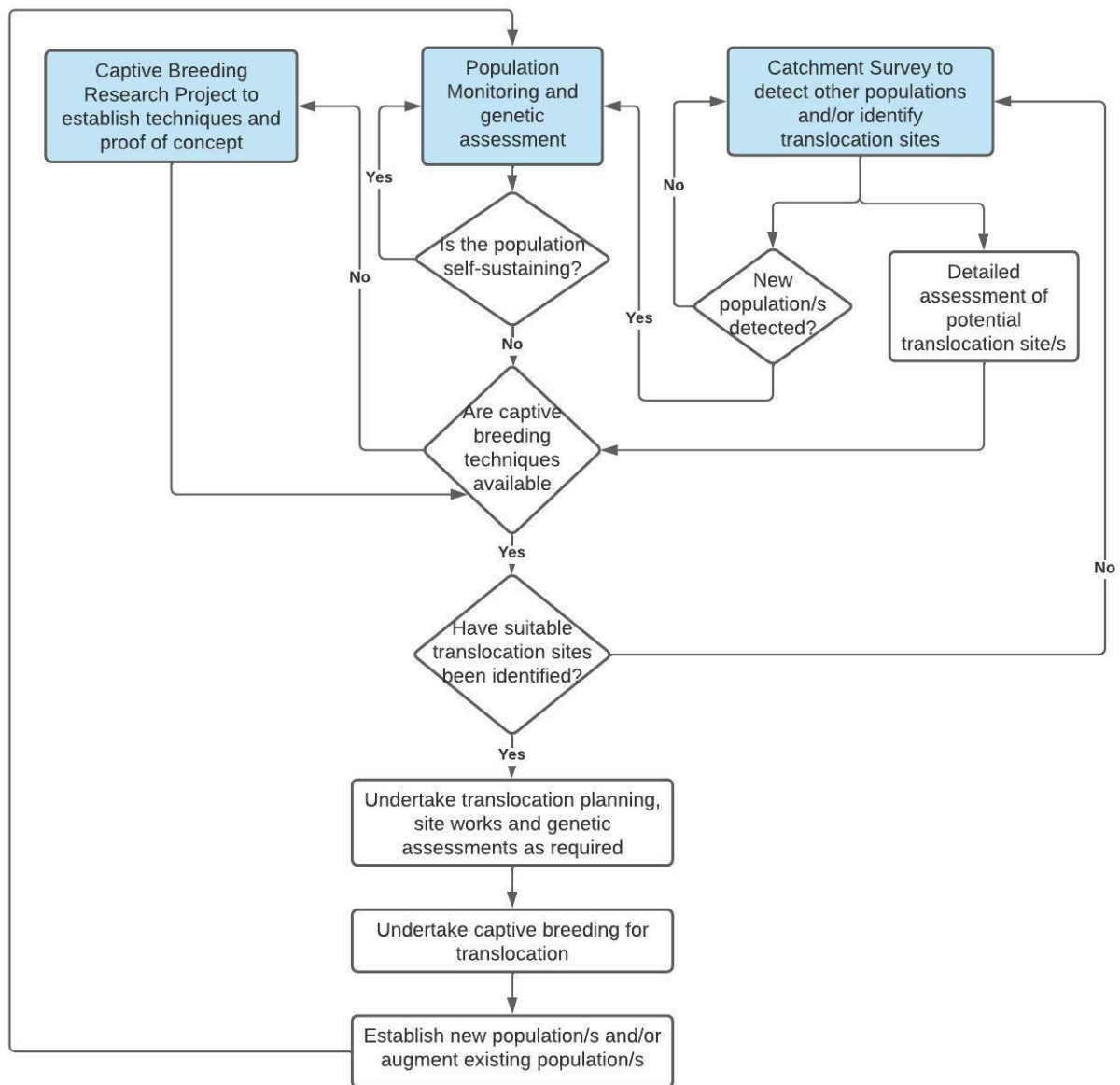
In the case of Stocky Galaxias, the program provides for:

- Population monitoring, surveillance and research on the Stocky Galaxias in the Upper Murrumbidgee catchment
- Habitat surveys to identify suitable receiving sites for stocking insurance populations of Stocky Galaxias
- Captive breeding, stocking and monitoring of Stocky Galaxias with the aim of achieving self-sustaining populations of these species.

As described in Section 3.1, Stocky Galaxias are at high risk of extinction from several threatening processes unrelated to Snowy 2.0, that are exacerbated by the species' small spatial range and single small global population (Lintermans & Allan 2019). A key task for the captive breeding program will be to collect data and undertake activities aimed at addressing the key knowledge gaps described in Section 3.1.

The indicative process flow for captive breeding program activities for Stocky Galaxias is detailed in Figure 3. The identification, prioritisation and implementation of all activities associated with the program will be based on recommendations provided in the reports listed in Table 4 and other contemporary research as well as input from the EAC.

The specific details and how these activities will be implemented each year will be provided in the AP (see Section 2.3). Activities will extend to full scale captive breeding and stocking only if suitable stocking sites are located, captive breeding trials are successful, and the program budget and timeline allows. All decisions regarding progress and priorities will be made or endorsed by the EAC.



**Figure 3: Indicative process flow activities for Stocky Galaxias.**

*Note: Not all activities may be achieved as part of the captive breeding program within this TFMP.*

*\* A self-sustaining population is defined as one that is able to remain stable or increase over time without human assistance for reproduction or dispersal*

### 3.3.1. Population Monitoring, Surveillance and Research

Population monitoring, surveillance and research of Stocky Galaxias in the upper Murrumbidgee catchment will be an activity completed as part of the captive breeding program. The overall objective of these activities is to:

*To provide baseline, comparable data on the species, to inform decisions on management intervention for the long-term survival of the species.*

There is currently no existing population level data or active monitoring program for the only confirmed population of Stocky Galaxias being undertaken.

Population monitoring of Stocky Galaxias to be completed as part of the TFMP aligns with the following priority actions identified by NSW DPI (2017) and the NSW FSC (2019) for the species:

- Monitor the population at Tantangara Creek over time to assess trends in abundance and distribution and to identify emerging threatening processes (Medium priority)
- Investigate distribution, habitat and movements (Medium priority)
- Identify and map important habitat (creeks/locations), particularly for recruitment and as potential drought refuge habitat (High priority)
- Population genetic analysis of current and new populations, to inform translocation plan and specific population management.

Routine surveillance monitoring of Stocky Galaxias is anticipated to occur annually with genetic analysis of caudal fin tissue samples anticipated to occur every three years. Further monitoring may occur in response to adverse observations made during routine surveillance activities<sup>1</sup> (see: Raadik & Lintermans 2022b). To achieve the overall objective of the population monitoring surveillance and research of Stocky Galaxias in the upper Murrumbidgee monitoring activities will focus on the following population attributes identified in **Table 5**.

**Table 5. Life history parameters to be monitored for Stocky Galaxias in the upper Murrumbidgee catchment**

Criterion	Explanation	Life-history parameters
Persistence	Continued presence over space and time	- Presence of individuals across the sample range - Relative abundance of individuals
Trajectory	Direction of change over time	- Individual condition (length / weight condition indices, parasites, disease)
Variability	Fluctuation over time	- Size structure of population (young of year, juveniles, sub-adults, adults)
Status	Overall level of extinction risk	- Successful recruitment (abundance and proportion of population; abundance of individuals) - Level of genetic diversity and effective population size (will be used to assist design captive breeding and translocation activities)

All life history parameters are relevant to each criterion. (Source: Raadik & Lintermans 2022b)

Appropriate routine monitoring locations will be established within the upper Murrumbidgee catchment where Stocky Galaxias are known to occur. Should additional populations of Stocky Galaxias be identified these may also be incorporated into the monitoring activities. Appropriate locations and the level of effort applied to monitoring activities will be determined by NSW DPI in consultation with the EAC and specified within each AP (see Section 2.3).

Appropriate methods and techniques including but not limited to the following may be used to monitor the life-history parameters of Stocky Galaxias:

- Backpack electrofishing
- Dip netting
- Caudal fin clipping – for genetic assessment
- Visual assessment and measurement of individuals
- eDNA analysis (to assess potential presence of predators – see the BRMP for additional details associated with pest fish monitoring activities).

Stocky Galaxias monitoring and surveillance activities are anticipated to occur annually during autumn<sup>2</sup>. Additional monitoring or adaptive/opportunistic activities may be undertaken in response to adverse observations or findings. Data collected as part of the Stocky Galaxias monitoring and surveillance activities will be stored electronically and made publicly available as appropriate. Outcomes of the monitoring, surveillance and research activities undertaken

<sup>1</sup> Depending on the level of urgency and suspected cause, any additional monitoring would be included in the following year’s Annual Program, or undertaken in consultation with the EAC via an amendment to the current year’s Annual Program.

<sup>2</sup> Genetic assessment of the population is likely to occur less frequently i.e. every three years unless it is determined to be required to be undertaken more frequently as a result of monitoring program activities (Raadik & Lintermans 2022b)

each year will be reported in the AR (Section 2.4) and will be used in the development of subsequent APs (Section 2.3).

By undertaking a multi-year monitoring program for the duration of the TFMP captive breeding program, key baseline data on population and genetic statistics will be collected for Stocky Galaxias that will enable NSW DPI and other parties to continue population management at the conclusion of the program.

### 3.3.2. Habitat Surveys

Stocky Galaxias are currently known from a two confirmed populations (Raadik 2014; Lintermans et al. 2021a), and few targeted surveys for their presence have been undertaken across the broader landscape (NSW FSC 2019). The recent discovery of the new population at Sallys Flat Creek suggests that there is a reasonable potential that other populations exist in the area but have not yet been discovered (Raadik and Lintermans, 2022c; Lintermans et al. 2021a). Consequently, a key early action for the captive breeding program involves searching for additional, extant populations. Habitat surveys will also be used to locate and assess potential translocation sites for the establishment of new additional populations, if required. Results of these activities will be used to inform the scale, scope and relative importance of captive breeding and stocking.

The overall aim of a habitat survey is twofold:

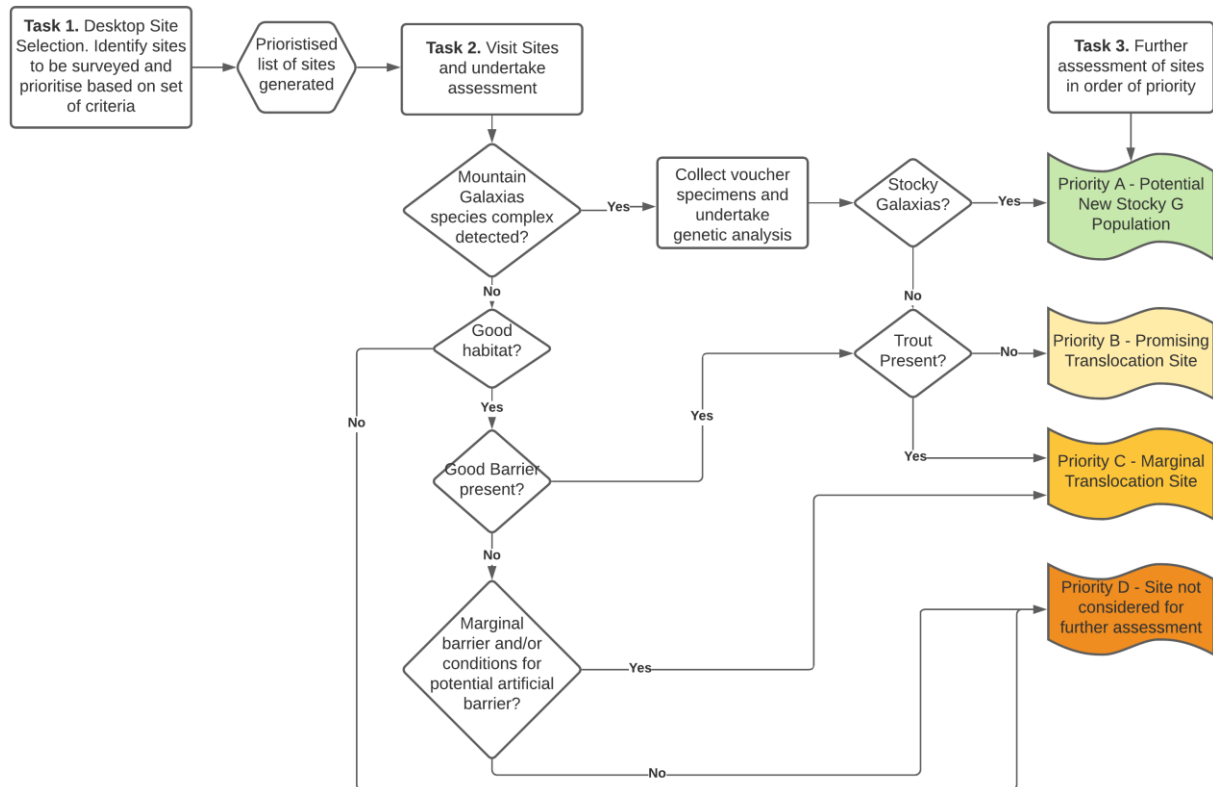
*To improve knowledge on the distribution (presence/absence) and potentially suitable habitat of Stocky Galaxias, to inform decisions on management intervention for the long-term survival of the species.*

A habitat survey for Stocky Galaxias aligns with the following priority actions identified by NSW DPI (2017) and the NSW FSC (2019):

- Survey similar habitat areas to Tantangara Creek to determine if other populations of Stocky Galaxias occur (High priority)
- Identify potential candidate sites for possible future translocation of Stocky Galaxias (Medium priority)
- Investigate distribution, habitat and movements (Medium priority)
- Further survey work to locate potential Trout-free sites for future translocation
- Broad-scale fish survey work in upper Murrumbidgee catchment to locate additional populations
- Identification of streams suitable for Trout barrier installation (or augmentation).

The habitat survey will comprise three main tasks (Figure 4):

1. Desktop identification and prioritisation of potentially suitable sites
  - a. Criteria to identify potentially suitable habitats will include but may not be limited to:
    - i. Stream elevation of 1000 m or above
    - ii. Exclude streams with known presence of predators
    - iii. Exclude areas cleared for agriculture
    - iv. Prioritise streams containing instream barriers that may or are known to exclude Trout
    - v. Exclude 1<sup>st</sup> and > 5<sup>th</sup> order stream (at 1:25,000 scale)
2. Initial 'rapid' field survey of identified potential sites to determine if Stocky Galaxiids (or galaxias species complex) and/or suitable habitats are present
3. Detailed field survey of identified galaxiid or potential translocation sites (Raadik & Lintermans 2022c).



**Figure 4. Flow chart of Stocky Galaxias catchment survey tasks and summarised activities (Raadik & Lintermans 2022c).**

Habitat survey activities are envisaged to be a one-off assessment, although tasks may occur over multiple years.

Habitat survey activities to be undertaken in any particular year will be detailed in the AP with the outcomes of any works reported in the AR and used to inform and prioritise subsequent activities in future APs (see Section 2.3).

Methods used to undertake rapid and detailed field surveys of new or potential Stocky Galaxias habitats will be appropriate to determine the presence of existing populations and/or assess the value or applicability of the site for translocation and may include:

- Electrofishing
- eDNA collections
- Dip netting
- Measurement of water quality parameters
- Collection and processing of voucher specimens.

### 3.3.3. Captive breeding and stocking

Stocky Galaxias are considered to have a high risk of extinction as only two small genetically isolated populations exist (Raadik, 2014; Lintermans et al, 2021a). A key activity to decrease the risk of extinction is to increase the size of the population and/or the number of populations. Given the limited geographic range Stocky Galaxias inhabit, it is unlikely that the number of individuals within the existing population can substantially increase or that individuals from the population can be sustainably and regularly removed to facilitate wild-to-wild transfer of individuals to establish additional populations (should appropriate translocation habitats be identified (see Section 3.3.2)) without potentially having detrimental impacts on the remaining population.

An appropriate action for the species is therefore to establish techniques for captive management, breeding and subsequent enhancement of existing populations or the establishment of new self-sustaining populations by translocation into suitable habitats (Stoessel and Raadik 2022).

Captive breeding could be used to produce enough viable individuals to increase the resilience of the existing population as well as provide individuals within identified translocation habitats. Success of a captive breeding



program for Stocky Galaxias is however far from certain as this species has not previously been bred in captivity and it has only been recently that adults and juveniles have been maintained in captivity at facilities at the Gaden Trout Hatchery in Jindabyne and at the Charles Sturt University campus in Albury (Raadik and Lintermans, 2022a).

The objective of captive breeding activities for Stocky Galaxias as part of the TFMP is to:

*Improve the resilience of the species by increasing the number of individuals and aiming at achieving self-sustaining populations through the captive production and release of viable offspring with evolutionary potential.*

Captive breeding does not specifically align with any of the previous recommended management/research actions for Stocky Galaxias (NSW DPI 2017; NSW FSC 2019) however, it is an important component to the success of the following recommended priority actions:

- Formulation of a detailed translocation plan and undertake translocations to establish additional, viable populations to spread extinction risk
- Undertake emergency rescue of Stocky Galaxias in response to drought, oil spills/ pollution, detection of biosecurity threats (e.g. disease or pests), or to avoid other detrimental impacts.

Whilst the species general ecological requirements for captive survival have been somewhat established (though not published), the potential requirements for reproduction and egg and larval survival can only be inferred from observations in the wild (Allan et al. 2021; Raadik and Lintermans 2022a), and from captive breeding of similar species in the Mountain Galaxias complex (Stoessel et al. 2015; Stoessel et al. 2020). Furthermore, the following key knowledge gaps need to be resolved and may influence the success of captive breeding for Stocky Galaxias:

- Population genetic information (see Section 3.3.1)
- Requirements for successfully maintaining broodstock in captivity
- Undertaking captive breeding
- Care and growth of larvae
- Care and growth of juveniles before release.

Captive breeding activities undertaken as part of the TFMP would be undertaken in the following stages<sup>3</sup>:

1. Research and development
2. Proof of concept of husbandry and production techniques
3. Full scale production and maintenance of captive fish to facilitate the translocation of individuals into the wild to supplement existing populations or establish new populations in suitable habitats.

#### *Research and development*

As part of the captive breeding program for the TFMP, research and development activities would be commissioned to address the existing key knowledge gaps in the ability to breed Stocky Galaxias in captivity and undertake captive breeding of Stocky Galaxias suitable for release into the wild.

The activities and scheduling of the research and development activities will be detailed in the AP. Activities undertaken during the research and development stage may require an extended period to complete. Progress of activities undertaken will be incorporated into the AR.

#### *Proof of concept of husbandry and production*

Following the initial research and development stage of the captive breeding program a proof of concept of husbandry and production techniques stage will be initiated. This stage will incorporate the learnings from the research and development stage and scale up all activities to enable the testing of techniques at a proof of concept size to provide confidence in the ability to maintain and produce individuals in captivity.

The activities and scheduling of the proof of concept of husbandry and production techniques activities will be detailed in the AP with the progress of activities undertaken to be incorporated into the AR.

#### *Full scale production*

Full scale production of captive bred stocky galaxias for stocking into the wild would be the final stage in the development of the captive breeding program and is dependent on the successful completion of the first two stages. Once stocky galaxias can be regularly and routinely produced in captivity, individuals will be released into the wild to supplement existing populations or establish new populations in suitable habitats.

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<sup>3</sup> Succession between stages will be dependent on the success of activities undertaken in the previous stage.

Following the release of individuals into the wild at new suitable habitats, population monitoring and surveillance activities (see Section 3.3.1) would be initiated at these locations to provide insight relating to the life history parameters of the population (Table 5). These monitoring and surveillance activities would be used to determine if these populations are self-sustaining and able to meet the definition of a 'wild population' from the IUCN Guidelines (IUCN, 2022).

The commencement of full-scale captive breeding with the intent to establish new populations is also dependent on the identification of suitable translocation sites where new populations could be established and/or an identified need to increase the population of fish in Tantangara Creek or Sallys Flat Creek. The habitat survey (see Section 3.3.1) may lead to the discovery of other Stocky Galaxias populations that may have implications for the implementation of the captive breeding program.

The aim of the captive breeding program is to achieve self-sustaining populations of this species, however, given the existing status and threats to Stocky Galaxias, the high degree of uncertainty regarding the potential success of captive breeding, the lack of knowledge associated with suitable receiving sites and the long-term nature of species recovery and population establishment, it is conceivable that this goal will not be achieved within the timeframe of this program. Notwithstanding, decisions regarding the implementation and prioritisation of all activities for the program will be focused towards achieving this goal and setting up NSW DPI to continue the species conservation and recovery beyond the timeframe of this plan.

#### *Instream barriers*

Prior to any stocking at potential receiving sites, an investigation would occur into reasonable measures, including the installation of secondary fish barriers, to protect the receiving sites for the establishment of stocking insurance populations of the Stocky Galaxias. Such an investigation would occur once priority locations are identified during the habitat survey (Section 3.3.2) with findings reported in the AR and any plans for implementation detailed in subsequent APs.

As set out by Raadik et al. (2022), if a barrier, or barriers, are present, but are found to be only partially or totally ineffective, they should be assessed to see if they can be modified to improve their ability to prevent fish passage. Solutions may involve increasing the height or vertical angle of an existing barrier, removing control points to remove or decrease downstream pool level, removal of obstructions to increase water flow and drainage during flood events and infilling of low-flow channels to eliminate potential fish passage pathways.

Where barriers do not exist, an alternative consideration would be given to construction of one or more artificial instream barriers. As artificial barriers can be expensive, and difficult to construct in remote areas, optimal site characteristics, which also achieve the necessary barrier characteristics required to be effective in preventing upstream fish passage are needed to make them feasible. These can include:

- A narrow, steep valley – reduces barrier width
- Relatively steep stream gradient – reduces barrier height required
- Stable substrate such as bedrock
- Ease of access for construction (Raadik et al., 2022).

## 4. Macquarie Perch

The following sections provide an overview of the Macquarie Perch species, the potential impact to this species from the project and detail planned activities covered by the TFMP. Content within these sections have been guided by the Snowy 2.0 Main Works EIS, the conditions of consent, consultation with NSW DPI and expert advice provided by some of Australia's foremost experts on Macquarie Perch managed through an engagement with the Arthur Rylah Institute (ARI).

In order to understand the current state of knowledge of Macquarie Perch in the mid-Murrumbidgee catchment, Snowy Hydro commissioned the Arthur Rylah Institute (ARI) to prepare a series of reports correlating with each of the activities for the species specified to be undertaken as part of the detailed captive breeding program described in Condition 24(d). The documents inform the description of proposed activities below and are expected to be heavily relied on in the development of APs. As noted within these documents, the scope and scale of activities described provide a roadmap for the achievement of many of the Conservation Priority Actions for this species (NSW DPI, 2015). As such, the value and relevance of these documents extend beyond their use in the implementation of the captive breeding program for the TFMP.

Table 6 provides details of the documents prepared as part of the engagement of the ARI used to inform the framework of activities proposed to address the objectives of the TFMP. Activities in each AP will be drawn from these documents with decisions regarding the adoption, timing and scale of activities to be based on current knowledge, outcomes of previous activities and available resources and budgets. The prioritisation and adoption of individual activities will be centred on the degree to which the task will further the aim of achieving self sustaining populations of these species within the target catchments.

As noted in Section 2.2, each AP is to be reviewed and endorsed by the EAC prior to implementation.

**Table 6: List of documents prepared for Snowy Hydro Limited to inform the preparation and implementation of the captive breeding program for the TFMP.**

Topic	Contributing Authors	Citation
Review of existing information	Tonkin, Z., Lintermans, M. and Lyon, J.	Tonkin, Z., Lintermans, M. and Lyon, J. (2022). Macquarie Perch – review of existing information, Snowy 2.0. Published client report for Snowy Hydro Ltd, Cooma. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Victoria.
Species Monitoring	Lintermans, M., Tonkin, Z., Lyon, J. and Gilligan, D.	Lintermans, M., Tonkin, Z., Lyon, J. and Gilligan, D. (2022). Macquarie Perch – monitoring plan, Snowy 2.0. Published client report for Snowy Hydro Ltd, Cooma. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Victoria.
Habitat Surveys	Lintermans, M., Lyon, J. and Tonkin, Z.	Lintermans, M., Lyon, J. and Tonkin, Z. (2022). Macquarie Perch – catchment survey, Snowy 2.0. Published client report for Snowy Hydro Ltd, Cooma. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Victoria.
Translocation	Tonkin, Z., Lintermans, M., Gilligan, D. and Lyon, J.	Tonkin, Z., Lintermans, M., Gilligan, D. and Lyon, J. (2022). Macquarie Perch - translocation strategy, Snowy 2.0. Published client report for Snowy Hydro Ltd, Cooma. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Victoria.
Captive Breeding	Lyon, J. Ho, H., Ingram, B, Gilligan, D., Pavlova, A., Moyles, A. and Tonkin, Z.	Lyon, J. Ho, H., Ingram, B, Gilligan, D., Pavlova, A., Moyles, A. and Tonkin, Z. (2022). Macquarie Perch – captive breeding strategy, Snowy 2.0. Published client report for Snowy Hydro Ltd, Cooma. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Victoria.

#### 4.1. Species Summary

Macquarie Perch is a medium-sized, long-lived percichthyid fish endemic to the south-eastern reaches of the Murray–Darling Basin (MDB) and several rivers of the eastern seaboard (Figure 5; NSW DPI, 2016; Tonkin et al. 2018). It is listed as endangered under the EPBC Act and the FM Act. Preferred habitat includes clear water and deep, rocky holes with extensive cover (Ebner et al. 2011; NSW DPI 2016). Females reach full maturation at 3 years of age and males at 2 years. Reproductive maturity is considered to be age- rather than size- dependent (Appleford et al. 1998; Commonwealth of Australia 2018). Fish spawn over gravel and stones in riffles when water temperatures exceed 16 °C during spring and early summer (October–December) (Cadwallader and Rogan 1977; Appleford et al. 1998; Douglas 2002; Tonkin et al. 2010; Tonkin et al. 2018).



**Figure 5: Adult Macquarie Perch (*Macquaria australasica*) (Image: Jarod Lyon).**

The species has undergone major declines in abundance and distribution from 1920 – 1960s and in the MDB has been reduced to a series of fragmented, small, and often isolated populations (Lintermans 2007; Trueman 2011; DELWP unpublished data). There are approximately 12–18 known populations (Lintermans et al. 2019). Recovery actions for Macquarie Perch in response to the threats listed below are detailed in existing recovery plans (NSW DPI 2015; Commonwealth of Australia 2018).

Within the mid Murrumbidgee catchment, Macquarie Perch were historically widespread but suffered abrupt declines since the mid-1980s (Lintermans 2002). Current knowledge of the population suggests it exists as a series of scattered self-sustaining sub-populations occurring from ~30.5 km downstream of Tantangara Dam to Murrells Crossing, ~15 km south of Cooma (Lintermans 2016; M. Lintermans, unpublished data). Macquarie Perch has been functionally extinct in the Murrumbidgee River in the ACT since the mid-1980s (Lintermans 2002). There is no long-term ecological monitoring being undertaken on Macquarie Perch in the mid Murrumbidgee River, with the exception of a project by Local Land Services gathering data at two sentinel sites which has funding secured until 2023 (M. Lintermans, pers comm.).

Captive breeding and stocking of Macquarie Perch in NSW has been undertaken episodically at the Narrandera Fisheries Centre since the 1970s in NSW. New hormone technology is currently being developed to improve hatchery production of fingerlings to reduce the reliance on capturing ripe brood stock from the wild to provide stock for restocking activities (Tonkin et al., 2022a). Stocking has not previously occurred within the Murrumbidgee River catchment anywhere upstream of the ACT with the recent exception of a genetic rescue translocation of 40 fish in and around Cooma by NSW DPI in November 2020 as part of the 'Reaching For Recovery' project in partnership with the Southeast Local Land Services (LLS).

Threats to the species include:

- In-stream sedimentation, de-snagging and riparian degradation
- Overfishing
- Competition, predation and disease transmission by introduced species
- Barriers to movements (e.g. dams)
- Modification to river flows and temperatures
- Poor genetic diversity (Pavlova et al. 2017)

- Climate change induced episodic events such as extreme drought and fire (Tonkin et al. 2022a).

Four key knowledge gaps specifically associated with the mid-Murrumbidgee population of Macquarie Perch include:

- Current distribution and trend of recruiting sub-populations
- Population dynamics
- Genetic diversity and the need for and efficacy of genetic rescue
- Identification of translocation opportunities (Tonkin et al. 2022a).

## 4.2. Project Impacts, Risks and Mitigation

There are no direct impacts anticipated to Macquarie Perch arising from the construction of Snowy 2.0 Main Works because the habitat of the mid-Murrumbidgee population is outside of the direct construction area for the project (Cardno 2019).

A potential indirect impact identified during the impact assessment for Snowy 2.0 included the potential transfer and subsequent establishment of pest fish species, in particular Redfin perch (*Perca fluviatilis*) (Redfin), following completion of construction and hydrologic connection of Talbingo and Tantangara Reservoirs to facilitate power station operation (Cardno 2019).

Redfin are known to occur in Talbingo Reservoir but have not to date been detected in Tantangara Reservoir or the mid-Murrumbidgee River downstream of Tantangara Reservoir down to the ACT border where a population of Macquarie Perch is known to occur. Redfin are known to occur in the Murrumbidgee River within the ACT (Cardno, 2019). The potential for Redfin to be entrained from Talbingo during pumping, survive transfer through the power station and subsequently establish within Tantangara Reservoir and spread to the mid-Murrumbidgee River is uncertain, but in the absence of controls, the possibility cannot be excluded.

Should Redfin establish in the mid-Murrumbidgee River, impacts could include predation and/or competition with Macquarie Perch resulting in impacts to the population. This could include reduction in population size or in the worst case, population loss. Any impact would likely be associated with a greater susceptibility to the effects of existing and cumulative threats (including the presence of other existing predatory species, such as stocked Rainbow Trout and Brown Trout, and river regulation and its potential influence on spawning cues and sedimentation) (Cardno 2020).

Redfin (and, to a lesser extent Rainbow Trout) are known hosts of the fish disease Epizootic Haematopoietic Necrosis Virus (EHNK). The EHNK status of Redfin in Talbingo Reservoir is unknown and an outbreak has never been detected in either reservoir. There is potential that, if present in Talbingo Reservoir, water transfer through Snowy 2.0 could increase the range of EHNK. Several native species, including Macquarie perch, are susceptible to EHNK under laboratory conditions, although natural disease events caused by EHNK have never been detected in species other than Redfin and Rainbow Trout (Hick et al. 2019; Cardno, 2019).

To address this potential outcome, Snowy Hydro committed to designing and constructing fish screens at Tantangara Dam and the inlet to the Murrumbidgee to Eucumbene tunnel to prevent the transfer of all life stages of fish so far as is reasonably practicable from Tantangara Reservoir through the Dam to the mid-Murrumbidgee River and to Lake Eucumbene (Table 3) and this commitment was subsequently imposed as Condition 21(a) of the Infrastructure Approval (Table 1).

Detailed plans for installation and use of the screens will be included within the BRMP, including:

- Minimising the environmental impacts associated with installing the screens
- Testing the effectiveness of the screens before they are used
- Maintaining and improving the effectiveness of the screens over time.

The likelihood of a reservoir spill or a failure of the proposed screens leading to transfer of Redfin to the mid-Murrumbidgee River downstream of Tantangara Reservoir, if Redfin successfully transfer to Tantangara Reservoir during the operation of Snowy 2.0, was assessed as rare (Cardno, 2019). The BRMP will document the systems Snowy Hydro will have in place to prevent spills over Tantangara Dam wall so far as is reasonably practical, maximising the likelihood that all releases to the mid Murrumbidgee River pass through the planned screens. The BRMP will also include a program of pest fish and disease surveillance and eradication/management measures to protect the Macquarie Perch in the mid-Murrumbidgee River.

The captive breeding program described in Section 4.3 is intended to assist NSW DPI Fisheries and DCCEEW in protecting this endangered fish and will go some way in addressing the management priorities identified in the



*National Recovery Plan for the Macquarie Perch* (Commonwealth of Australia 2018) and the Priority Actions identified by NSW DPI for the Macquarie Perch (NSW DPI, 2015). Such measures may improve the resilience of the species to withstand competition from Redfin, should the controls fail at some point in the future.

### 4.3. Captive Breeding Program

A key focus for the TFMP is a detailed captive breeding program for the Macquarie Perch and Stocky Galaxias involving the spending of \$5 million over 5 years from the commencement of the program as described in Condition 24(d).

In the case of Macquarie Perch, the program provides for:

- Population monitoring, surveillance and research on the Macquarie Perch in the Mid Murrumbidgee catchment
- Habitat surveys to identify suitable receiving sites for stocking insurance populations of Macquarie Perch
- Captive breeding, stocking and monitoring of Macquarie Perch with the aim of achieving self-sustaining populations of these species
- Habitat enhancement for the Macquarie Perch in the mid-Murrumbidgee catchment in accordance with the National Recovery Plan to increase the existing population's resilience to the potential biosecurity risks from the development.

The objective for all activities associated with the captive breeding program for Macquarie Perch in the TFMP is to address the following CoA (Condition 26(d)) requirements:

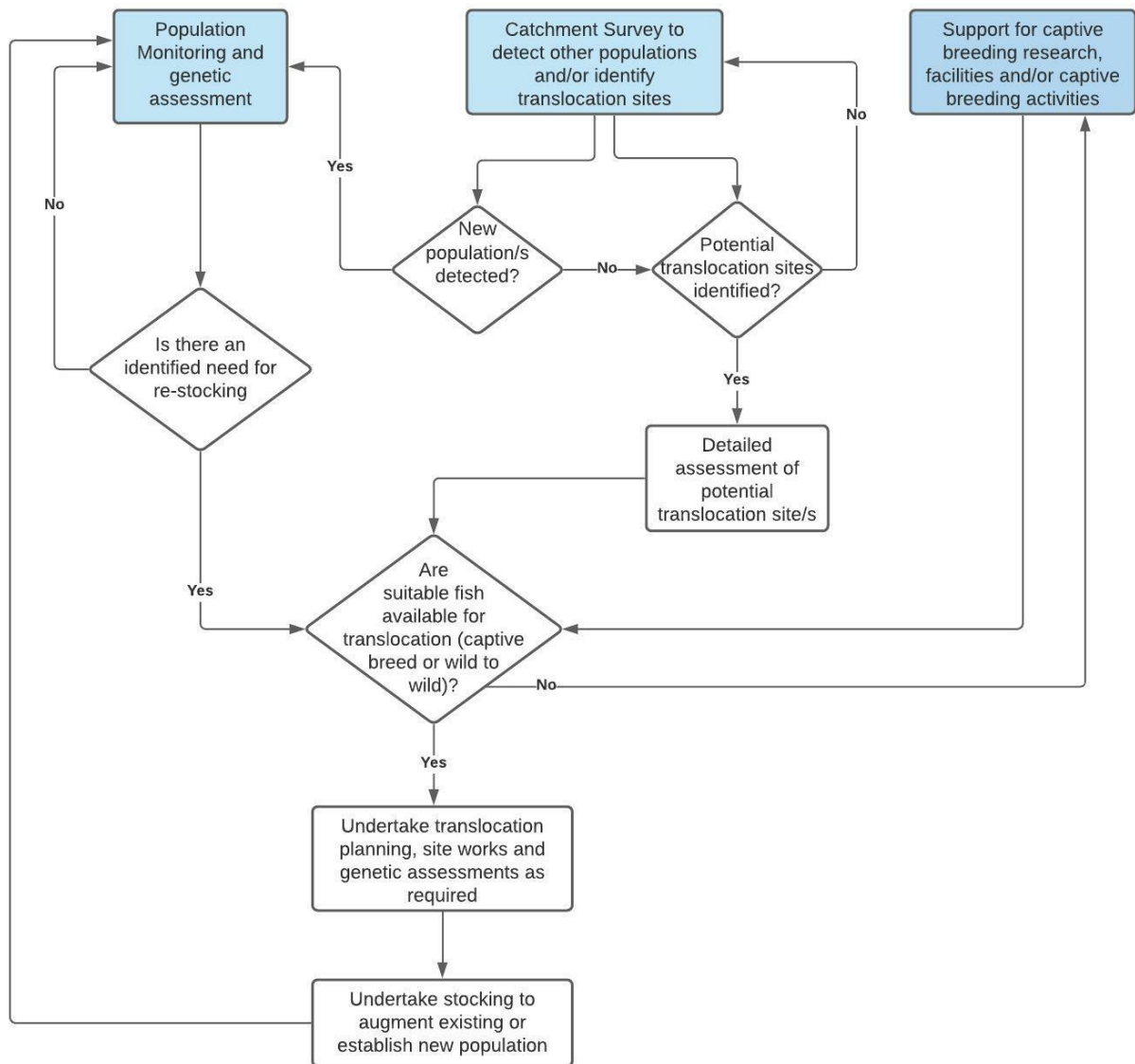
- Population monitoring, surveillance and research of Macquarie Perch in the mid Murrumbidgee catchment
- Habitat surveys to identify suitable receiving sites for stocking insurance populations of Macquarie Perch
- Captive breeding, stocking and monitoring of Macquarie Perch with the aim of achieving self-sustaining populations of the species
- Habitat enhancement for the Macquarie Perch in the mid-Murrumbidgee catchment.

Although periodic monitoring of the mid-Murrumbidgee Macquarie Perch population has historically occurred including a current surveillance project by Local Land Services, knowledge regarding the status and detailed distribution of the population throughout the catchment is lacking. The species has been successfully held and bred in captivity, although the process remains difficult with ongoing research occurring to enable improvements to the efficiency of captivity breeding (Section 4.1).

The aim of the program is to achieve self-sustaining populations of this species, however, given the existing status and threats to Macquarie Perch, the difficulties associated with captive breeding, the lack of knowledge associated with suitable receiving sites and the long-term nature of species recovery and population establishment, it is not anticipated that this goal will be achieved within the timeframe of this program. Notwithstanding, decisions regarding the implementation and prioritisation of all activities for the program will be focused towards achieving this goal and setting up NSW DPI to continue the species conservation and recovery beyond the timeframe of this plan.

The indicative process flow for captive breeding program activities for Macquarie Perch are detailed in Figure 6. The specific details and how these activities will be implemented each year will be provided in the AP (see Section 2.3). The scope and scale of stocking activities will be highly dependent on outcomes of population monitoring, habitat surveys, genetic assessment and captive breeding activities. All decisions regarding progress and priorities will be made or endorsed by the EAC.





Note: Not all activities may be achieved as part of the captive breeding program within this TFMP.

**Figure 6: Indicative process flow activities for Macquarie Perch**

#### 4.3.1. Population Monitoring

Population monitoring, surveillance and research of Macquarie Perch in the mid Murrumbidgee catchment will be an activity completed as part of the TFMP. The overall objective of these activities is to:

*To provide baseline, comparable data on the Mid Murrumbidgee population, to inform decisions on management intervention for the long-term survival of the population.*

Monitoring for the TFMP will aim to complement and build on existing monitoring occurring in this catchment (Lintermans et al. 2022a).

Population monitoring of Macquarie Perch to be completed as part of the TFMP aligns with the following priority action for Macquarie Perch identified by NSW DPI (2015) that are relevant to this document include:

- Monitor Macquarie Perch populations over time to assess trends in abundance and distribution and to identify emerging threatening processes (High priority).

Routine surveillance monitoring of Macquarie Perch is anticipated to occur annually with genetic analysis of caudal fin tissue samples anticipated to occur every three years. Further monitoring may occur in response to adverse

observations made during routine surveillance activities<sup>4</sup> (see: Lintermans et al. 2022a). To achieve the overall objective of the population monitoring surveillance and research of Macquarie Perch in the mid Murrumbidgee monitoring activities will focus on the following population attributes identified in Table 7.

**Table 7. Life history parameters to be monitored for Macquarie Perch in the mid Murrumbidgee catchment**

Criterion	Explanation	Life-history parameters
Persistence	Continued presence over space and time	- Presence of individuals across the sample range - relative abundance of individuals
Trajectory	Direction of change over time	- Individual condition (length / weight condition indices, parasites, disease)
Variability	Fluctuation over time	- Size structure of population (young of year, juveniles, sub-adults, adults)
Status	Overall level of extinction risk	- Successful recruitment (abundance and proportion of population; abundance of individuals) - Level of genetic diversity and effective population size (will be used to assist design captive breeding and translocation activities).

All life history parameters are relevant to each criterion. (Source: Lintermans et al. 2022a)

Appropriate routine monitoring locations will be established within the mid Murrumbidgee catchment where Macquarie Perch are known to occur and where monitoring has previously detected the species. Should additional populations of Macquarie Perch be identified these may also be monitored. Appropriate locations and the level of effort applied to monitoring activities will be determined by NSW DPI in consultation with the EAC and specified within each AP (see **Section 2.3**).

Appropriate methods and techniques including but not limited to the following may be used to monitor the life-history parameters:

- Electrofishing – backpack and/or boat
- Fyke nets
- Gill nets
- Caudal fin clipping – for genetic assessment
- Visual assessment and measurement of individuals
- eDNA analysis (to assess potential presence of predators – see the BRMP for additional details associated with pest fish monitoring activities).

Macquarie Perch monitoring and surveillance activities are anticipated to occur annually during autumn. Additional monitoring or adaptive/opportunistic activities may be undertaken in response to adverse observations or findings. Data collected as part of the Macquarie Perch monitoring and surveillance activities will be stored electronically and made publicly available to as appropriate. Outcomes of the monitoring, surveillance and research activities undertaken each year will be reported in the AR (Section 2.4) and will be used in the development of subsequent APs (Section 2.3).

By undertaking a multi-year monitoring program for the duration of the TFMP captive breeding program, key baseline data on population and genetic statistics will be collected for Macquarie Perch that will enable NSW DPI and other parties to continue population management at the conclusion of the program.

#### 4.3.2. Habitat Surveys

The distribution and occupancy of Macquarie Perch in major tributaries of the Mid-Murrumbidgee River and in selected gorge habitat of the main stem remains a key knowledge gap (Lintermans et al., 2022b). Undertaking habitat surveys to identify any previously unknown extant populations and confirming the distribution and abundance of the existing populations is therefore a key activity that will lead to a greater understanding of

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<sup>4</sup> Depending on the level of urgency and suspected cause, any additional monitoring would be included in the following year’s Annual Program, or undertaken in consultation with the EAC via an amendment to the current year’s Annual Program.

Macquarie Perch in this catchment. Results of habitat surveys will be a key input to inform the scale, scope and relative importance of captive breeding and stocking of Macquarie Perch in this catchment.

The overarching aim of a habitat survey for Macquarie Perch within the Mid-Murrumbidgee catchment is to:

*Establish the geographic extent of the existing population/s of Macquarie Perch in both the Murrumbidgee River mainstem and major tributaries.*

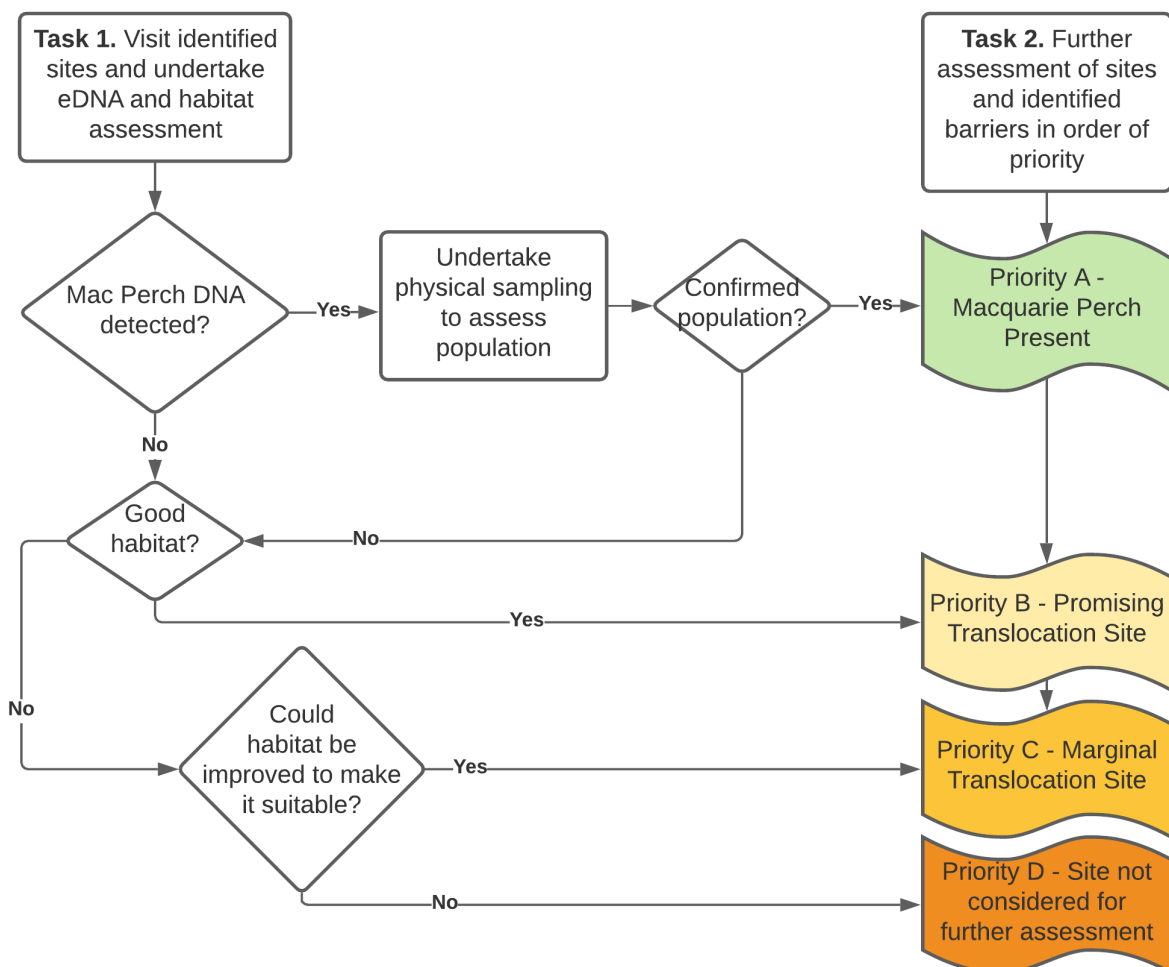
Such a survey would also assist in:

- Identifying potential translocation sites for the species
- Identifying opportunities for habitat enhancement
- Verifying the presence and distribution of target pest fish within the catchment (i.e. primarily Redfin).

Habitat survey for Macquarie Perch in the mid-Murrumbidgee catchment aligns with the National Recovery Plan Strategy 5 – Improve understanding of the biology and ecology of the Macquarie perch, and its distribution and abundance (Commonwealth of Australia 2018) and the following priority actions identified by NSW DPI (2015):

- Conduct targeted surveys to determine the current distribution and abundance of Macquarie Perch (Medium priority)
- Monitor Macquarie Perch populations over time to assess trends in abundance and distribution and to identify emerging threatening processes (High priority)
- Identify potential candidate sites for possible future translocation of Macquarie Perch (Low priority).

An outline of the habitat survey activities is described in Figure 7. The design of a habitat survey will be based on the recommendations by Lintermans et al. (2022b) and will be planned and prioritised in consultation with the EAC.



**Figure 7** Flow chart of Macquarie Perch catchment survey tasks and summarised activities (Sourced from: Lintermans et al., 2022b).

#### 4.3.3. Captive breeding and Stocking

The distribution of Macquarie Perch in the mid-Murrumbidgee catchment is thought to have contracted substantially from its historical distribution in the area and there are concerns about its genetic viability (Lintermans et al., 2022b; Pavlova et al. 2017).

The specific objectives of the captive breeding and stocking program are to:

- Develop a captive breeding and genetic management plan for the mid-Murrumbidgee population to improve the resilience of the existing population by increasing the number of individuals, distribution, and genetic diversity and/or establish additional sub-populations within the catchment
- Establish a facility to enable the captive production of Macquarie Perch
- Utilise information from the habitat surveys to prioritise stocking and reintroduction sites.

All activities associated with the captive breeding and genetic management plan undertaken as part of the TFMP would be reviewed and endorsed by the EAC prior to commencement of any activities. Key activities to be included in the captive breeding and genetic management plan include but are not limited to:

- Detail the proposed approach for captive breeding of Macquarie Perch (where, how, who)
- Set out the steps to procure and stock Macquarie Perch in the mid-Murrumbidgee River
- Establish a catchment specific translocation procedure to enable the harvesting, transport and release/return of Macquarie Perch for translocation, stock for a captive breeding program, and for emergency extraction if needed (post-fire, predator / disease incursion, etc.)
- Genetic assessment of the current population and details regarding future genetic management of brood fish for captive program and genetic rescue options
- Implementation of captive breeding and stocking.

##### *Instream barriers*

Prior to any stocking at potential receiving sites on tributaries of the Murrumbidgee River, an investigation would occur into reasonable measures, including the installation of secondary fish barriers, to protect the receiving sites for the establishment of stocking insurance populations of the Macquarie Perch. Such an investigation would occur once priority locations are identified during the habitat survey (Section 4.3.2) with findings reported in the AR and any plans for implementation detailed in subsequent APs.

#### 4.3.4. Habitat Enhancement

Habitat degradation and loss has been identified as a major contributor to the decline of Macquarie Perch populations. The aim of habitat enhancement works in the mid-Murrumbidgee catchment is to:

- Improve and increase available habitat for Macquarie Perch to enable increases in abundance and distribution resulting in increased population resilience.

Habitat enhancement options and opportunities will be developed as part of the habitat surveys. This information will be utilised to target and prioritise where and what habitat enhancement works are undertaken. Any proposed habitat enhancement works would be required to be endorsed by the EAC.

Key activities to be undertaken as part of the habitat enhancement works would include but not be limited to:

- Habitat surveys to identify opportunities for habitat enhancement works
- Scope and consultation with existing and potential groups active in habitat enhancement activities in and adjacent to the mid-Murrumbidgee catchment.
- Prioritise and schedule proposed activities and determine who will implement
- Scope and identify opportunities for co-investment and value adding

## 5. Program Extension

The captive breeding program for Stocky Galaxias and Macquarie Perch described in Section 3.3 and 4.3 is to be reviewed after 5 years from the commencement of the Program. Table 8 outlines the TARP for the potential extension of the program.

Firm commitments for additional potential expenditure and extension of the captive breeding program are exclusively linked to potential impacts to these species from Snowy 2.0. Snowy Hydro may, at its discretion, continue funding for selected activities following a request from NSW DPI (Table 8).

Pest fish surveillance to determine potential pest fish incursion as a result of Snowy 2.0, will be undertaken as part of the BRMP. As per the consent conditions for Snowy 2.0 Main Works, the BRMP is to include a detailed biosecurity risk management framework for minimising the ongoing biosecurity risks of the development, including the movement and/or spread of weeds, pests and pathogens. Of relevance to this Plan, the BRMP will include pest fish and disease surveillance and eradication/management measures to protect the Macquarie Perch and Stocky Galaxias in the Mid to Upper Murrumbidgee catchment (Table 1). This surveillance program, or a verified positive detection of pest fish from an alternative source, will be used to determine whether a trigger has been met within the TARP for the TFMP.

The commencement date of the captive breeding program will be detailed in the first AP for the TFMP.

Irrespective of the outcomes of the TARP, Snowy Hydro may, at its discretion, continue support for targeted monitoring at selected locations of one or both species in the event of program suspension to maintain confidence in the condition of the population/s to enable an accurate assessment of impact, should one occur, at some point in the future.

**Table 8: Trigger, Action Response Plan for the extension of the captive breeding program for Stocky Galaxias and Macquarie Perch**

Performance theme	Trigger	Action Response
Pest fish incursion	Detection of Redfin incursion in mid-Murrumbidgee River below Tantangara Dam	Undertake activities specified in the BRMP to determine the causality of the incursion.  If incursion of Redfin is deemed to be due to a failure of the screens or a dam spill, initiate pest fish incursion activities detailed in the Biosecurity Risk Management Plan (BRMP) including potential extension/ reactivation of captive breeding program funding
Pest fish incursion	Detection of Climbing Galaxias incursion in upper Tantangara Creek above the fish barrier	Undertake activities specified in the BRMP to determine the causality of the incursion.  If incursion of Climbing Galaxias is deemed to be due to a failure of the Tantangara Weir, initiate pest fish incursion activities detailed in the BRMP including potential extension/ reactivation of captive breeding program funding
Pest fish incursion	Detection of Climbing Galaxias incursion into other known populations of Stocky galaxias in the Upper Murrumbidgee catchment	Undertake activities specified in the BRMP to determine the causality of the incursion.  If appropriate, initiate pest fish incursion activities detailed in the BRMP including potential extension/ reactivation of captive breeding program funding
Disease incursion	Detection of EHNV in Stocky Galaxias in Upper Tantangara Creek above the fish barrier or Macquarie Perch in the mid-Murrumbidgee River or within the water at these locations.	Initiate disease response activities detailed in the BRMP including potential extension/ reactivation of captive breeding program funding.
Captive breeding	Despite best endeavours, captive breeding activities unsuccessful at producing Stocky Galaxias at conclusion of TFMP \$5 million commitment	1. NSW DPI to develop proposed strategy, timeline and budget for progressing with measures for further captive breeding program activities  2. Snowy Hydro and NSW DPI to discuss potential funding models for further captive breeding program activities  3. Proposal to be reviewed and advice provided by the EAC
Captive breeding	Despite best endeavours, stocking of Macquarie Perch in the mid-Murrumbidgee and/or Stocky Galaxias in the upper Murrumbidgee (or other agreed locations) has been unsuccessful or unable to occur prior to conclusion of TFMP \$5 million commitment	1. NSW DPI to develop proposed strategy, timeline and budget for progressing with measures to source fish and undertake stocking  2. Snowy Hydro and NSW DPI to discuss potential funding models for further activities  3. Proposal to be reviewed and advice provided by the EAC
Governance and funding	Unallocated funding from \$5 million commitment available at the end of the 5 year program	1. NSW DPI to develop proposed strategy and timeline for additional measures for captive breeding program activities  2. Proposal to be reviewed and approved by Snowy Hydro and EAC



## 6. Murray Crayfish

The following sections provide an overview of the Murray Crayfish species, the potential impact to this species in Talbingo Reservoir from Snowy 2.0 and detail planned activities included in the TFMP to minimise the impacts of the development. Content within these sections have been guided by the Snowy 2.0 Main Works EIS, the conditions of consent, consultation with NSW DPI and from expert input provided by Aquasave (Nature Glenelg Trust).

### 6.1. Species summary

Murray Crayfish is the second largest freshwater crayfish in the world (Riek 1969). It is a long-lived, slow-growing, late maturing species which spawns annually with a winter-spring brooder strategy (Gilligan et al. 2007; Morison 1988). The species has experienced substantial declines in range and abundance (Furse and Coughran 2011; Gilligan et al. 2007). Murray Crayfish is listed as Vulnerable under the FM Act and is under threatened listing assessment under the EPBC Act.

Murray Crayfish were historically abundant in the region of the Tumut River impounded by Talbingo Reservoir (Gilligan et al. 2007) and has persisted following the construction of the reservoir. Targeted surveys within Talbingo and Blowering Reservoirs during the period 2008–2010 demonstrated a healthy population with a 1:1 sex ratio, and a good population structure (including regular recruitment and long-term survival) (Zukowski et al. 2013). Sampling of a single site in 2013 in Talbingo Reservoir (NSW DPI, unpublished data) demonstrated a similar abundance however a considerable reduction in catch was observed in 2018, 2019 and 2020 surveys (Cardno, 2019; Zukowski and Whiterod 2019; Zukowski and Whiterod 2020).

### 6.2. Project Impacts, Risks and Mitigation

Murray Crayfish have the potential to be impacted during construction of Snowy 2.0 both directly as a result of works within the Talbingo Reservoir disturbance areas or indirectly as a result of changes to water quality or from blasting. These risks were comprehensively described and assessed within the AEA for the Main Works EIS (Cardno, 2019).

It is assumed that conditions will not be favourable for Murray Crayfish within the Snowy 2.0 disturbance areas of Talbingo Reservoir. As such, the AEA proposed to relocate any crayfish prior to disturbance and this was incorporated into Condition 24 of the Project Consent. The process for relocation prior to disturbance is detailed within the FG Construction Aquatic Habitat Management Plan (AqHMP).

The AqHMP has been prepared in consultation with NPWS and DPI-Fisheries and includes a description of measures intended to minimise project related impacts to Murray Crayfish in Talbingo Reservoir. It also includes a trigger action and response plan (TARP) for the Murray Crayfish, which would be implemented if monitoring shows the development is adversely affecting the species.

### 6.3. TFMP Commitments

The objective for all activities associated with Murray Crayfish is to:

*Minimise the impacts of the development on Murray Crayfish in Talbingo Reservoir*

#### 6.3.1. Population Monitoring

Population monitoring of Murray Crayfish in Talbingo Reservoir aims to observe the population to confirm its ongoing presence prior to and during works associated with Snowy 2.0. Following declines over the past decade, a relatively small population of Murray Crayfish now persists in the reservoir (Zukowski and Whiterod 2019; Zukowski and Whiterod 2020) compared to historical observations (Zukowski et al. 2013). The presence of such a small population means that statistical analysis of observed changes will not be meaningful and the development of a Before, After, Control, Intervention (BACI) monitoring program is not practical (Zukowski and Whiterod, 2021).

The small size of the crayfish population will make it difficult to robustly attribute any impacts to the population directly to Snowy Hydro 2.0 proposed works. However, an ongoing monitoring program will enable confirmation of a continuous presence of crayfish in the reservoir. Data may also be used to inform an assessment of impact, should changes to water quality or other important habitat variables, monitored as part of the Snowy 2.0 Main Works Surface Water Management Plan, be observed as a result of the Snowy 2.0 project (Zukowski and Whiterod, 2021).

An annual monitoring program designed by some of Australia's foremost experts in Murray Crayfish using a repeat spatial and temporal design will provide a framework to monitor Murray Crayfish population metrics over time (see

Zukowski and Whiterod, 2021). Sampling locations will be broadly distributed across the reservoir, including locations distant and proximate to the Snowy 2.0 works. Sampling across all sites will allow evaluation of the spatial patterns and temporal trends in population metrics (relative abundance, length structure, presence of females carrying eggs, evidence of recruitment). Sampling will also occur within Wallaces Creek and the Yarrangobilly River if these locations can be safely accessed during the reservoir sampling event.

Each year, sampling will be undertaken in accordance with the Monitoring Plan developed by Zukowski and Whiterod (2021). Details within the AP (Section 2.3) will set out the planned:

- Sampling timeframes
- Survey location/s
- Methods and level of effort
- Specific parameters to be measured
- Details to be reported.

Monitoring is anticipated to occur annually for the duration of Snowy 2.0 construction and for 3 years following the commencement of commissioning of the PHES. Any change to this schedule would be made in consultation with NSW DPI and advice from the EAC and be set out in the relevant AP.

### 6.3.2. Relocation

Murray Crayfish will be relocated from any disturbance areas within Talbingo Reservoir, prior to disturbance in accordance with the procedures set out in the AqHMP.

### 6.3.3. Habitat Enhancement

Following the completion of construction, habitat enhancement will occur in the vicinity of the disturbance area in Talbingo Reservoir in accordance with the procedures set out in the AqHMP.

## 7. Review and Conclusion of the TFMP

The TFMP will remain in place until the end date of the approval unless otherwise agreed by the Minister<sup>5</sup>. This Plan may be reviewed at any time by agreement between Snowy Hydro, DPI and DCCEE.

Major changes to the TFMP or a review of the Plan, will be submitted for approval as required to the Director-General of NSW DPI. Amendments and variations to activities set out in the TFMP that remain consistent with the broad principles of the Plan may be submitted as part of an AP and may occur by agreement between Snowy Hydro and DPI outside of a formal review process and with advice from the EAC.

As per Schedule 4, Condition 4, within 3 months of the following, unless the Planning Secretary agrees otherwise, Snowy Hydro will review and (if necessary) update the BRMP for Snowy 2.0:

- a) the submission of an incident report related to activities associated with this BRMP;
- b) the submission of an independent environmental audit report related to activities associated with the BRMP;
- c) any modification to the relevant conditions of approval; or
- d) a direction of the Planning Secretary under condition 4 of schedule 2 of the Infrastructure approval.

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<sup>5</sup> Minister means the Australian Government Minister administering the EPBC Act including any delegate thereof. The EPBC Approval has effect until December 2140.

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## Appendix A – Details of Consultation

**Table 9: Details of Consultation with NSW DPI and DCCEEW during TFMP preparation**

Working Group Meetings	Steering Committee Meetings	Other Correspondence/Meetings
11/08/2020; 24/09/2020; 10/11/2020; 04/12/2020; 10/02/2021; 10/03/2021; 05/05/2021; 09/06/2021; 14/07/2021; 17/08/2021; 08/09/2021; 13/10/2021; 10/11/2021; 14/12/2021; 22/02/2022; 17/03/2022; 04/05/2022; 29/07/2022; 01/09/2022; 31/10/2022; 01/12/2022; 16/02/2023; 16/03/2023; 26/04/2023; 18/05/2023; 15/06/2023	14/12/2020; 12/04/2021; 13/09/2021; 03/02/2022 (Including Fieldtrip to Snowy 2.0); 25/10/2022; 16/12/2022	31/08/2021 – Letter from Snowy Hydro to NSW DPI to endorse delay of TFMP 15/09/2021 – Letter from NSW DPI to Snowy Hydro endorsing proposal to extend the submission date of the TFMP 05/10/2021 – Notification provided to DPIE from Snowy Hydro regarding delay in submission of TFMP 26/05/2022; 22/07/2022; 24/11/2022 – Workshops between DPI and Snowy Hydro to progress TFMP 31/01/2023 – Meeting with DCCEEW to provide an overview of the TFMP and discuss the Peer Review Process

**Table 10: Steering Committee and Working Group participants**

Person	Title	Organisation Represented	Steering Committee	Working Group
Kieran Cusack	Project Director – Snowy 2.0	Snowy Hydro Limited	✓	
Dave Evans	Director of Engineering – Snowy 2.0	Snowy Hydro Limited	✓	
Andrew Nolan	Manager Water and Environment	Snowy Hydro Limited	✓	✓
Charlie Litchfield	Head of Environment and Lands	Snowy Hydro Limited	✓	✓
Elizabeth Pope	Senior Environmental Scientist	Snowy Hydro Limited		✓
Lachlan Barnes	Principal Consultant	Snowy Hydro Limited (SLR Consulting)		✓
Jonathan Carroll	Project Engineer – Snowy 2.0	Snowy Hydro Limited (SMEC)		✓
Sean Sloane	Deputy Director General Fisheries	NSW DPI	✓	
John Tracey	Deputy Director General Biosecurity & Food Safety	NSW DPI	✓	
Andrew Sanger	Director Biosecurity Projects	NSW DPI	✓	✓
Cameron Lay	Director Freshwater Environment	NSW DPI	✓	✓
Sarah Fairfull	Director Aquatic Environment	NSW DPI	✓	✓
Marcel Green	Program Leader Shark Strategy & Threatened Species	NSW DPI		✓
Peter Turnell	Director Recreational and Aboriginal Fisheries	NSW DPI		✓
Luke Pearce	Senior Fisheries Manager	NSW DPI		✓
Trevor Daly	Senior Fisheries Manager	NSW DPI		✓
Melissa Walker	Manager Aquatic Biosecurity	NSW DPI		✓
Cameron Westaway	Senior Fisheries Manager Inland	NSW DPI		✓



<b>Person</b>	<b>Title</b>	<b>Organisation Represented</b>	<b>Steering Committee</b>	<b>Working Group</b>
Jim Harnwell	Program Leader Fish Stocking & Enhancement Operations	NSW DPI		✓
Christina Bos	Policy and Projects Officer	NSW DPI		✓
Matthew McLellan	Senior Fisheries Manager Inland	NSW DPI		✓

NB. Listed participants did not necessarily attend each meeting

## **Appendix B – Peer Review**

# INDEPENDENT PEER REVIEW REPORT

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SNOWY 2.0 THREATENED FISH MANAGEMENT PLAN

OCTOBER 2023

## Authorisation

<b>Author Name:</b>	Steve Fermio	<b>Reviewer / Approver:</b>	Will Steggall
<b>Position:</b>	Principal Environmental and Earth Scientist	<b>Position:</b>	Practice Lead Biodiversity
<b>Signature:</b>		<b>Signature:</b>	
<b>Date:</b>	31/10/2023	<b>Date:</b>	31/10/2023

## Document Revision History

Revision	Date	Details
0.1	21/6/2023	Draft peer review report
1.0	31/10/23	Final peer review report updated in response to DPE approved TFMP

**Report Name:** Snowy 2.0 Threatened Fish Management Plan Peer Review

**Project No.:** 883

**Prepared for:**  
Snowy Hydro Limited

**Prepared by:**  
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# 1. INTRODUCTION

## 1.1 Project background

The Snowy 2.0 Project was designated Critical State Significant Infrastructure (CSSI 9687) and assessed under Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The project was approved by the NSW Minister for Planning and Public Spaces under Section 5.19 of the EP&A Act on the 20th of May 2020.

A referral (EPBC 2018/8322) was also prepared and lodged with the Commonwealth Minister for the Environment (DAWE, now DCCEEW) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the proposal was subsequently determined to be a controlled action under that Act.

The project was approved under section 130(1) and 133(1) of the EPBC Act on the 29th of June 2020.

Conditions that relate to aquatic biosecurity and fish were included within the NSW Main Works Infrastructure Approval in Schedule 3, Conditions 20-27 and in the EPBC Approval in Annexure A, Part A, Conditions 12-16.

A key requirement of the NSW Approval from an aquatic perspective is the preparation of a Threatened Fish Management Plan (TFMP) (Condition 24). Prior to approval of the TFMP by the Director-General of the NSW Department of Primary Industries, Condition 14 of the EPBC Approval, requires that the TFMP be peer reviewed by an independent, suitably qualified expert/s approved by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW).

On 9 May 2023, the DCCEEW approved Steve Fermio, Will Steggall and Leonie Stevenson from WolfPeak to undertake the peer review of the TFMP as required under Condition 14 of the EPBC Approval (Appendix A).

Section 2 of this report details our assessment as to whether or not the TFMP (Revision A dated 18 September 2023) satisfies the specific requirements of Condition 24 (a)-(g).

Other comments and conclusions relevant to our review are provided in Section 3.

## 1.2 About the review team

WolfPeak is a specialist environmental and sustainability consultancy based in NSW with its main offices in Sydney and Port Macquarie. We provide specialist and high quality environmental, ecological, sustainability, compliance assurance, auditing and strategic advisory services to government and communities, proponents and design and construction contractors in the private and public infrastructure sectors, including but not limited to:

- Inland Rail Project (Australian Rail Track Corporation)
- Central Land Council (Northern Territory)
- Sydney Metro (NSW Transport)
- NSW Department of Education



- NSW Department of Health
- Coffs Harbour Bypass (Gamuda Ferrovia Joint Venture)
- NSW Northern Rivers Reconstruction Corporation
- Port Authority of NSW
- Local councils in the Mid North Coast region of NSW
- NSW National Parks and Wildlife Service

We are regularly appointed as independent Environmental Representatives and Auditors by the NSW Department of Planning and Environment (DPE) (formerly the Department of Planning Industry and Environment or DPIE) on major development (SSD) and infrastructure (CSSI/SSI) projects including Sydney Metro, Inland Rail, NSW National Parks and Wildlife Service, NSW Department of Education school infrastructure projects, NSW Health infrastructure projects and Port Botany operations to name a few.

In these roles we are trusted to act and advise in an independent capacity and our reports are made publicly available and relied on for assurance purposes by government agencies, proponents and the community.

Steve Fermio (Peer Review Lead Author) is an independent environmental expert appointed by the NSW DPE to the Wollongong City and Lane Cove Council's Independent Local Planning Panels. These Panels determine development applications within those two local government areas that are of a contentious nature or where significant departures from planning controls are proposed.

The TFMP was also reviewed by our experienced ecologists Will Steggall (Practice Lead, Biodiversity) and Leonie Stevenson (Senior Aquatic Ecologist).

WolfPeak has not previously been engaged directly by Snowy Hydro Limited (SHL) for work on the Snowy 2.0 Project and has had no involvement whatsoever in the preparation of the TFMP.

## 2. PEER REVIEW

Our assessment as to whether the TFMP (Revision A dated 18 September 2023) satisfies the requirements of Condition 24 (a) – (g) is detailed in Table 1 below.

The TFMP is a comprehensive document prepared by SHL and a suitably qualified expert (Dr Lachlan Barnes), informed by close consultation with NSW DPI fisheries scientists and input from several other nationally recognised fisheries scientists including Mark Lintermans, Zeb Tonkin, Sylvia Zukowski and Tarmo Raadik. The TFMP references a significant suite of published scientific literature in the field of aquatic ecology.

It is evident that the plan has been prepared in consultation with the relevant government agency scientific specialists and includes a comprehensive implementation schedule and reporting framework.

The TFMP includes oversight by an Expert Advisory Committee and Annual Reporting provisions with a commitment to make these reports publicly available.

A Memorandum of Understanding will be developed between SHL and NSW DPI that will detail how these parties will co-operate to implement the TFMP.

The TFMP also includes appropriate review provisions and a commitment to remain in place for the life of the EPBC Approval (December 2040) unless otherwise agreed by the Australian Government Minister administering the EPBC Act.

Table 1 – Compliance with Condition 24

Condition	Requirement	Where addressed	Requirement satisfied (Yes/No)	Comment / recommendation
Schedule 3, Condition 24	<p><b>Threatened Fish Management Plan</b></p> <p>Within 12 months of the commencement of construction, the Proponent must prepare a Threatened Fish Management Plan for the development to the satisfaction of the Director-General of NSW DPI.</p>	The TFMP, Certificate of Approval and Section 1.5	No	<p>This requirement cannot be satisfied until the TFMP is approved by the Director-General of NSW DPI. Notwithstanding, its pre-requisites have been satisfied as set out in this table and via the completion of this Peer Review Report.</p> <p>We note that several extensions to the timeframe for the approval of the TFMP were advised in correspondence between SHL, NSW DPI and DPE (TFMP, Appendix A, Table 9).</p>

Condition	Requirement	Where addressed	Requirement satisfied (Yes/No)	Comment / recommendation
	<p>This plan must:</p> <p>(a) be prepared by a suitably qualified and experienced person in consultation with DPIE and DAWE;</p>	<p>The TFMP, Certificate of Approval and Section 1.5</p>	<p>Yes</p>	<p>The TFMP has been prepared by Dr Lachlan Barnes, Principal Marine Science Lead, SLR Consulting. Dr Barnes has extensive experience in this field with a Bachelor degree in Science Marine Biology and a PhD in Fish Ecology.</p> <p>A Working Group overseeing the development of the TFMP - comprising representatives of SHL and NSW DPI (formerly part of DPIE) - have met on a monthly basis since July 2020. The Working Group reports to a Steering Committee that met on an approximately quarterly basis from December 2020.</p> <p>On 31 January 2023 a meeting was held with DCCEEW (formerly DAWE) to provide an overview of the TFMP and consult with them on the plan. On 7 March 2023 SHL provided a response to DCCEEW's comments on the draft TFMP including details of the changes made to the plan as a result of their comments.</p>

Condition	Requirement	Where addressed	Requirement satisfied (Yes/No)	Comment / recommendation
	(b) include the establishment and use of an expert advisory committee to provide advice to the proponent on the implementation of the plan;	TFMP, Sections 2.1, 2.2	Yes	The TFMP includes details regarding the establishment, terms of reference and role of the Expert Advisory Committee. NSW DPI have nominated members to be included on the committee.

Condition	Requirement	Where addressed	Requirement satisfied (Yes/No)	Comment / recommendation
	(c) describe the detailed measures that would be implemented to comply with condition 20(b) above;	TFMP, Sections 3.2, 3.3, 4.2, 4.3 and 6.2	Yes	<p>The TFMP includes details of the following key measures, among others:</p> <ul style="list-style-type: none"> <li>• Construction of a fish barrier at the downstream extent of the Stocky Galaxias habitat and fish screens at the southern end of the Tantangara Reservoir (details of the barrier and fish screens are included in Part 2 of the draft Biosecurity Risk Management Plan (Version 0.2))</li> <li>• Captive breeding program (including population monitoring, surveillance and research, habitat surveys and captive breeding and stocking) for the Macquarie Perch and Stocky Galaxias</li> <li>• Habitat enhancement for the Macquarie Perch</li> <li>• Population monitoring, relocation and habitat enhancement for the Murray Crayfish (details of relocation and habitat enhancement measures are provided in the Aquatic Habitat Management Plan, Rev F) (AqHMP)</li> </ul>

Condition	Requirement	Where addressed	Requirement satisfied (Yes/No)	Comment / recommendation
	<p>(d) include a detailed captive breeding program for the Macquarie Perch and Stocky Galaxias involving the spending of \$5 million over 5 years from the commencement of the program that provides for:</p> <ul style="list-style-type: none"> <li>• population monitoring, surveillance and research on the Macquarie Perch and Stocky Galaxias in the Mid to Upper Murrumbidgee catchment;</li> <li>• habitat surveys to identify suitable receiving sites for stocking insurance populations of Stocky Galaxias and Macquarie Perch;</li> <li>• captive breeding, stocking and monitoring of Macquarie Perch and Stocky Galaxias with the aim of achieving self-sustaining populations of these species;</li> <li>• habitat enhancement for the Macquarie Perch in the mid-Murrumbidgee catchment in accordance with the National Recovery Plan to increase the existing population's resilience to the potential biosecurity risks from the development</li> </ul>	<p>Stocky Galaxias TFMP, Section 3.3</p> <p>Macquarie Perch TFMP, Section 4.3</p>	Yes	As per above
	<p>(e) include a review after 5 years of the commencement of the captive breeding program in (d) above and detail the trigger, action and response plan for the extension of the program;</p>	TFMP, Section 5	Yes	Provision for review of the captive breeding program is set out in section 5 of the TFMP and the TARP in Table 8 of the Plan.



Condition	Requirement	Where addressed	Requirement satisfied (Yes/No)	Comment / recommendation
	<p>(f) include a program to minimise the impacts of the development on the Murray Crayfish in Talbingo Reservoir, including:</p> <ul style="list-style-type: none"> <li>• population monitoring and surveillance for Murray Crayfish;</li> <li>• relocating any Murray Crayfish from the disturbance area of the development prior to disturbing the relevant area; and</li> <li>• habitat enhancement for the Murray Crayfish habitat in the vicinity of the disturbance area at the Talbingo Reservoir, including the use of woody debris salvaged during construction; and</li> </ul>	<p>TFMP, Section 6.3 Snowy 2.0 Aquatic Habitat Management Plan; TFMP, Section 6.3.2</p> <p>Snowy 2.0 Aquatic Habitat Management Plan; TFMP, Section 6.3.3</p>	Yes	<p>The program to minimise impacts to the Murray Crayfish is detailed in section 6.3 of the TFMP.</p> <p>The TFMP includes measures for population monitoring. Detailed measures for relocation and habitat enhancement consistent with the requirements of this condition are included in the AqHMP (RtS AE01 and Main Works Aquatic Ecology Assessment, Appendix M.2 of EIS).</p> <p><b>Recommendation:</b></p> <p><b><i>It is recommended for transparency that either the AqHMP (or relevant sections) be made publicly available, or alternatively the TFMP include the relevant details from Appendix A and C of the AqHMP regarding the relocation and habitat enhancement measures for the Murray Crayfish.</i></b></p>
	<p>(g) include a program to monitor and publicly report on the progress of each program/plan and the effectiveness of these measures.</p>	TFMP, Section 2.4	Yes	<p>An Annual Report (prepared by NSW DPI) on the results of the implementation of the TFMP is proposed to be submitted to the Expert Advisory Committee established under Condition 24(b). The Report is to be made publicly available on SHL's website.</p>

### 3. CONCLUSIONS

We consider that the TFMP (Revision A dated 18 September 2023) is fit for purpose and satisfies the requirements of NSW Approval Condition 24<sup>1</sup> (a) – (g), as detailed in Table 1 above.

We therefore endorse the Plan for approval by the Director-General of the NSW DPI.

Without affecting our endorsement, we make the following comment on the TFMP for consideration in its finalisation and approval:

- It is recommended for transparency that either the AqHMP (or relevant sections) be made publicly available, or alternatively the approved TFMP include the relevant details from Appendix A and C of the AqHMP regarding the relocation and habitat enhancement measures for the Murray Crayfish.

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<sup>1</sup> Noting that the approval of the TFMP by the Director-General of NSW DPI is required to fully satisfy Condition 24

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## APPENDIX A – APPROVAL OF PEER REVIEW TEAM



EPBC ref: 2018/8322

Elizabeth Pope  
Senior Environmental Scientist  
Snowy Hydro Limited  
Elizabeth.Pope@snowyhydro.com.au

**Approval of qualified experts for Snowy Hydro 2.0 Main Works, NSW (EPBC 2018/8322).**

Dear Elizabeth

Thank you for your correspondence dated 17 February 2023 to the department, requesting approval of suitably qualified experts to undertake a peer review of the Threatened Fish Management Plan under condition 14 of *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval 2018/8322.

I have noted the information provided, including the qualifications and experience of the nominated experts and the requirements specified in the conditions attached to the EPBC Act approval for the above project.

I have approved:

- Steve Fermio for undertaking a peer review of the Threatened Fish Management Plan, under condition 14 of EPBC 2018/8322
- Will Staggall for undertaking a peer review of the Threatened Fish Management Plan, under condition 14 of EPBC 2018/8322
- Leonie Stevenson for undertaking a peer review of the Threatened Fish Management Plan, under condition 14 of EPBC 2018/8322

Should you require any further information please contact Karina Richards on 0476 564 933 or by email to [PostApproval@dcceew.gov.au](mailto:PostApproval@dcceew.gov.au).

Yours sincerely

A handwritten signature in black ink, appearing to read 'Brendan Linton-Smith'.

Brendan Linton-Smith  
A/g Branch Head  
Environment Assessments (Vic, Tas) and Post Approvals Branch  
Department of Climate Change, Energy, the Environment and Water  
9 May 2023