



BIODIVERSITY MANAGEMENT PLAN SNOWY 2.0 – EXPLORATORY WORKS

Stage 1 - Exploratory Works Access Roads

December 2019



leed

Biodiversity Management Plan

Rev 1

Report Snowy 2.0 - Exploratory Works - Biodiversity Management Plan | Prepared for Snowy Hydro
16 December 2019

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Abbreviations and Glossary

AHD	Australian Height Datum
BAM	Biodiversity Assessment Method
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
BCD	Biodiversity and Conservation Division
BMP	Biodiversity Management Plan
BoM	Bureau of Meteorology
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offset Scheme
EMS	Environmental Management Strategy
DEC	NSW Department of Environment and Conservation (now Office of Environment and Heritage)
DECC	Department of Environment and Climate Change (now Office of Environment and Heritage)
DNA	Deoxyribonucleic acid
DoI Water	NSW Department of Industry – Lands & Water
DoEE	Department of Energy and Environment
DPIE	NSW Department of Planning, Industry and Environment Formerly NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries
DSM	Digital surface model
EIS	<i>Environmental Impact Statement Exploratory Works for Snowy 2.0</i>
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPA	NSW Environment Protection Authority
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
EWMS	Environmental Work Method Statement
GDEs	Groundwater dependent ecosystems
KFH	Key Fish Habitat
KNP	Kosciuszko National Park
MNES	Matters of national environmental significance
NCC	Nature Conservation Council

NPA	National Parks Association
NPW Act	<i>NSW National Parks and Wildlife Act 1995</i>
NPW Regulation	<i>NSW National Parks and Wildlife Regulation 2009</i>
NPWS	NSW National Parks and Wildlife Service
OEH	NSW Office of Environment and Heritage
PCTs	Plant community types
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
REMM	Revised environment management measures
Submissions Report or RTS	Response to Submissions Exploratory Works for Snowy 2.0
TECs	Threatened ecological community

1 Introduction

1.1 Context

This Biodiversity Management Plan (BMP or Plan) forms part of the Environmental Management System (EMS) for Exploratory Works for Snowy 2.0 (the Project). The Exploratory Works is the first stage of Snowy 2.0, a pumped hydro-electric storage and generation project which will increase the hydro-electric capacity within the existing Snowy Mountains Hydro-electric Scheme. The second stage, or main project, will be subject to a separate Environmental Impact Statement in 2019.

This BMP has been prepared to address the requirements of the *EP&A Act CSSI 9208 approval: 8 January 2019*, the *Environmental Impact Statement Exploratory Works for Snowy Hydro 2.0 (EIS)*, and the revised environmental management measures (REMM) within the *Response to Submissions Exploratory Works for Snowy 2.0 (RTS)*.

This revision of the BMP has been prepared to address the requirements of the Exploratory Works for Snowy 2.0 Modification 1 Assessment Report (MOD1) and the REMMs within the Exploratory Works Modification 1 Response to Submissions Report which were approved by Department of Planning, Industry and Environment (DPIE) on 2 December 2019.

The original EIS Exploratory Works scope includes:

- an exploratory tunnel about 3.1 km long to the site of the underground power station;
- horizontal and other test drilling, investigations and analysis in situ at the proposed cavern location and associated areas, and around the portal construction pad, access roads and excavated rock management areas all within the disturbance footprint;
- a portal construction pad for the exploratory tunnel. This will provide the entrance structure to the tunnel and an area for infrastructure and equipment needed to support tunnelling activities;
- an accommodation camp for the Exploratory Works construction workforce;
- road works and upgrades to enable access and haulage routes during Exploratory Works. This includes upgrades to 26 km of existing roads and creating about 2 km of new roads;
- barge access infrastructure to enable access and transport by barge on Talbingo Reservoir. This includes one new barge ramp at Talbingo Spillway in the northern part of Talbingo Reservoir and one new barge ramp at Middle Bay near Lobs Hole at the southern part of Talbingo Reservoir;
- excavated rock management, including subaqueous placement within Talbingo Reservoir. Up to 750,000 m³ of excavated rock will need to be tested for its geochemical properties (ie whether the rock is reactive or non-reactive) before being managed by a combination of the following options:
 - re-use - suitable material can be used as construction materials for roads or similar. Some materials will be provided to NPWS for use in road maintenance and upgrades in other areas of KNP;
 - on land placement - material will be temporarily placed in one of two on land emplacement areas.

- subaqueous placement within Talbingo Reservoir – suitable material will be placed at a suitable location within Talbingo Reservoir, subject to a number of water quality controls and monitoring; and
- services infrastructure such as diesel-generated power, water and communication;
- post-construction revegetation and rehabilitation, management and monitoring.

Having regard to the design changes identified in Modification 1, the scope now comprises the following listed in Table 1.1 below:

Table 1.1 New scope items for EW (Stage 1 & 2) as a result of MOD1

Stage 1	
Lobbs Hole Substation	<p>Additional disturbance area required for the construction power connection to an existing transmission line (Line 2) at Lobs Hole for power supply to the Exploratory Works accommodation camp and construction areas. This will provide a reliable and long-term source of construction power and will reduce the reliance on diesel generation and associated on-site storage requirements and emissions. Works in this area will include establishing a substation, connection infrastructure, access roads and ancillary construction areas;</p> <p>This will include:</p> <ul style="list-style-type: none"> • construction of a 330/33 kV substation within Kosciuszko National Park and adjacent to Line 2, which forms a 330-kV connection between Upper Tumut Switching Station and Yass Substation; • geotechnical investigation works to inform the detailed design of the construction power substation; • replacement of one transmission support structure (Structure 54) within the existing transmission easement. This will involve removal of the existing structure and establishment of one new steel lattice tower, approximately 50 m in height; • short overhead 330 kV transmission line connections (approximately 100 m in length) between the substation and the new Structure 54; • 33 kV feeder connection between the substation and the Exploratory Works construction power network. This will be either overhead lines or underground cables; • establishment and upgrade of access tracks and roads to the new substation and transmission line structures; • installation of a fibre optic communication link into the new substation from the approved communication network; and • ancillary activities, including brake and winch sites, crane pads, site compounds and equipment laydown areas. <p>(Illustrated Appendix G Figure 1i)</p>
Camps Bridge and Wallaces Creek	<ul style="list-style-type: none"> • additional disturbance area around Camp Bridge and Wallaces Creek Bridge required for improved constructability of the crossings. Works within these areas will include vegetation clearing, levelling earthwork, erection of falsework, sediment controls, laydown, parking and movement of equipment;

	(Illustrated in Appendix G Figures 1h and 1i of this plan and Modification 1 Assessment Report Figure 3.9)
Lobs Hill Ravine Road and Construction Boundary Changes	<ul style="list-style-type: none"> • minor changes to the project boundary identified through detailed design including: <ul style="list-style-type: none"> – revised road upgrade for Lobs Hole/Ravine Road to improve access, drainage and safety; – minor additions to construction areas for design optimisation. • removal of dangerous trees on Lobs Hole Ravine Road. This will involve either complete or partial removal of up to 91 trees that have been identified to pose a safety risk to road users on Lobs Hole Ravine Road and Mine Trail Road; <p>(Illustrated in Appendix G, Figures 1d, 1e, 1f and 1i)</p>
Operating Hours	<ul style="list-style-type: none"> • modify operating hours from existing 7 am to 6pm to sunrise to sunset
Miscellaneous	<ul style="list-style-type: none"> • continued use of existing communications towers within KNP that were previously approved by the NPWS under a separate review of environmental factors (REF R – Wallaces Creek Geotechnical drilling) environmental impact assessment carried out under the NSW National Parks and Wildlife Act 1974 (NPW Act) and its regulation for the geotechnical investigation program; and • increase in peak traffic volumes. Additional vehicles will be required to access the site to facilitate construction of Exploratory Works, however no change in impacts to the road network are expected. <p>(location of communications towers illustrated in Appendix G Figures 1a, 1f, 1l)</p>
Stage 2	
Borehole drilling and geophysical surveys	<ul style="list-style-type: none"> • Borehole drilling and geophysical surveys for further geotechnical investigation of the Snowy 2.0 power station and power waterway at Marica, Talbingo and Tantangara; • clearing of up to 2.79 hectares (ha) of additional vegetation for access tracks and drilling pads. • About 1.33 ha within Smokey Mouse potential habitat; • trimming of overhanging dangerous branches on adjacent trees (these trees will not require removal); • mulching of trees and vegetation; • establishment of an additional 1 km of access tracks (4 m wide), including minor earthworks, • placement of geofabric (as required) and import of stabilised material; • establishment of eight drilling pads and boreholes at top of the cavern area, with an area of 900 m2 per pad, including minor earthworks, placement of geofabric (as required) and import of stabilised material (as required); • undertaking geophysical surveys near Talbingo and Tantangara reservoirs; • establishment of two drilling pads and boreholes at both Tantangara and Talbingo with an area of • 900 m2 per pad, including approximately 400 m of additional access tracks and minor earthworks (as required);

	<ul style="list-style-type: none"> • establishment of in-reservoir boreholes including one in Talbingo Reservoir and two in Tantangara Reservoir; • drilling of additional nested vertical boreholes at each of the drilling pads up to a depth of 1,100 m; • conversion of the investigation boreholes into monitoring bores; • undertaking geophysical surveys; and • rehabilitation of the drilling pads and access tracks following completion of works • ongoing maintenance of existing access tracks required for geotechnical investigations within KNP <p>(Illustrated in (Illustrated in Appendix G Figure 1j, 1k, 1l, 1m and 1n)</p>
Talbingo Laydown	<p>Outside of KNP, SHL is proposing to add four laydown locations to facilitate the construction of the communications cable linking Lobs Hole with the Tumut 3 Power Station.</p> <p>These are proposed on existing hardstand areas along Talbingo Reservoir within Snowy Hydro owned land.</p> <p>(Illustrated in Appendix G, Figure 1o)</p>
Tantangara Access	<p>Two additional geotechnical boreholes are required to facilitate the detailed design of cuttings, bridge foundations, retaining wall foundations, and drainage structures near Nungar Creek</p> <p>(Illustrated in Appendix G, Figure 1m and 1n)</p>

The Exploratory Works is estimated to take around 30 to 34 months to complete.

As with most of the existing Snowy Scheme, the majority of Snowy 2.0 is within Kosciuszko National Park. Snowy Hydro has been working with NSW National Parks and Wildlife Service (NPWS) since the announcement of Snowy 2.0 to ensure long term management objectives for Kosciuszko National Park are considered in project development.

The Project has been designed in a way that avoids and minimises impacts to Kosciuszko National Park where possible. This has included the planning of access roads and construction areas to avoid impacting the heritage listed Washington Hotel ruins at Lobs Hole, and Smoky Mouse habitat along Upper Lobs Hole Ravine Road. It also includes designing road upgrades to minimise impacts to geodiversity features including a block stream and a fossil outcrop along Lower Lobs Hole Ravine Road. The former copper mine at Lobs Hole is also considered a geoheritage site, however it is also a source of known contamination and has therefore been avoided as much as possible to prevent disturbance.

While there are some unavoidable impacts during construction, the Exploratory Works will allow for a number of longer-term benefits and contributions to Kosciuszko National Park through a biodiversity offset program, improved access roads and recreational facility upgrades. The completion of Exploratory Works will also allow for the greater benefits of Snowy 2.0 to be realised.

1.2 Construction activities and sequencing

Exploratory Works will be delivered in three stages:

- **Stage 1a – Pre-construction Minor Works** - pending the approval process, works may commence in the first quarter of 2019. The scope of pre-construction minor works includes dilapidation studies, survey work, borehole installation, site office establishment, minor access roads, installation of monitoring equipment, installation of erosion and sediment controls, archaeological salvage and minor clearing;
- **Stage 1b – Exploratory Works Access Roads (EWAR)** - pending the approval process, works may commence in the first quarter of 2019. The scope includes roadworks and upgrades to enable access and haulage routes during Exploratory Works;
- **Stage 2 – Exploratory Works** - pending progress with Stage 1, works may commence in quarter three of 2019. The scope for Stage 2 will be the remainder of the Exploratory Works, including the exploratory tunnel, portal construction pad, accommodation camp and excavated rock management. Stage 2 also includes subaqueous emplacement within Talbingo Reservoir.

To present the staging of plans a separate Staging Report has been prepared and was submitted to Department of Planning and Environment. Timing of the Exploratory Work stages is presented below.

Exploratory Works	2019				2020				2021			
Stage 1 – Access Roads												
Stage 2 – Exploratory Works												

Figure 1.1 Timing of Exploratory Works stages

1.2.1 Exploratory Works Access Roads

The Exploratory Works Access Roads (EWAR) will provide early access to the tunnel portal located to the east of the Talbingo Reservoir, and to Talbingo Reservoir itself. The works include upgrades to and/or construction of the following internal roads:

- Ravine Road;
- Mine Trail Road;
- Lobs Hole Road;
- Wharf Road.

The EWAR scope includes but is not limited to the following:

- setting out the works including delineation of site boundaries;

- establishment of all site facilities required and removal upon completion, including all temporary safety and security measures required;
- locating and protecting all public and private utility services;
- maintenance of the existing roadway and associated infrastructure;
- clearing and grubbing of vegetation including creation of mulch and compost;
- establishment of short term and long-term (eg: detention and sedimentation basins) erosion and sedimentation control systems and devices;
- removal and disposal of existing infrastructure including pipes, culverts, drainage channels and other minor structures;
- excavation and stockpiling of topsoil;
- earthworks including excavation of cuttings, construction of fills including selected zone material, and placement of excess spoil in stockpile;
- progressive opening to traffic;
- treatment of cut and fill slope batter surfaces including slope retention systems where shown;
- construction of clean and dirty water drainage systems including culverts, open and subsoil drainage systems;
- construction of pavements including subgrades and pavements and road surfacing;
- design, supply, construction of temporary structures / bridges over Wallace Creek and the Yarrangobilly River and removal of completion;
- construction of permanent bridges over Wallace Creek and the Yarrangobilly River;
- installation of road furniture including but not limited to barriers, line marking, guide posts and road signs;
- placement / replacement of topsoil and revegetation and other surface treatments to disturbed earth surfaces including lining of open drains;
- clean up and restoration of work areas and areas disturbed by the contractor.

The additional EWAR scope as a result of MOD1 will include:

- construction of a 330/33 kV substation within Kosciuszko National Park and adjacent to Line 2, which forms a 330-kV connection between Upper Tumut Switching Station and Yass Substation;
- geotechnical investigation works to inform the detailed design of the construction power substation;
- replacement of one transmission support structure (Structure 54) within the existing transmission easement. This will involve removal of the existing structure and establishment of one new steel lattice tower, approximately 50 m in height;

- short overhead 330 kV transmission line connections (approximately 100 m in length) between the substation and the new Structure 54;
- 33 kV feeder connection between the substation and the Exploratory Works construction power network. This will be either overhead lines or underground cables;
- establishment and upgrade of access tracks and roads to the new substation and transmission line structures;
- installation of a fibre optic communication link into the new substation from the approved communication network; and
- ancillary activities, including brake and winch sites, crane pads, site compounds and equipment laydown areas.
- minor changes to the project boundary identified through detailed design including:
 - additional disturbance area around Camp Bridge and Wallaces Creek Bridge required for improved constructability of the crossings. Works within these areas will include vegetation clearing, levelling earthwork, erection of falsework, sediment controls, laydown, parking and movement of equipment;
 - additional disturbance area required for the construction power connection to an existing transmission line at Lobs Hole. Works in this area will include establishing a substation, connection infrastructure, access roads and ancillary construction areas;
 - revised road upgrade for Lobs Hole/Ravine Road to improve access, drainage and safety; and
 - minor additions to construction areas for design optimisation.
- removal of dangerous trees on Lobs Hole Ravine Road. This will involve either complete or partial removal of up to 91 trees that have been identified to pose a safety risk to road users on Lobs Hole Ravine Road and Mine Trail Road;
- continued use of existing communications towers within KNP that were previously approved by the NPWS under a separate review of environmental factors (REF R – Wallaces Creek Geotechnical drilling) environmental impact assessment carried out under the NSW National Parks and Wildlife Act 1974 (NPW Act) and its regulation for the geotechnical investigation program; and
- increase in peak traffic volumes. Additional vehicles will be required to access the site to facilitate construction of Exploratory Works, however no change in impacts to the road network are expected.

The works are proposed to commence in the first quarter of 2019

This Plan identifies the project's environmental management measures in relation to biodiversity management. It has been developed for Stage 1 of the Exploratory Works project and will be revised prior to commencement of Stage 2 works.

This plan will remain active for the duration of the Stage 1 scope for the purposes of Leed Engineering's compliance. At some time in the future, Stage 1 will cease to be active or Leed will cease to be the principal contractor, in which case the Stage 2 management plans will supercede these plans and be the only active management plans for the Snowy 2.0 Project.

The timing of the preparation, consultation and submission of this plan is shown within Figure 4.3 of the EMS. Ongoing revisions to the BMP will occur in accordance with Section 1.6.1 of the EMS.

1.3 Background

Snowy Hydro Limited (Snowy Hydro) is the proponent of the Snowy 2.0 project which is a pumped hydro-electric storage and generation project proposed to address increasing demands for renewable energy supplies. Snowy 2.0 involves linking Talbingo and Tantangara reservoirs within the existing Snowy Mountains Hydro-electric Scheme (Snowy Scheme) and building an underground power station between the two reservoirs.

Snowy Hydro proposes to carry out Exploratory Works prior to the main construction works for the Snowy 2.0 project, to inform the detailed design and to reduce project risk. Exploratory Works are required to obtain detailed geological data for the proposed location of the underground power station. An exploratory tunnel is to be constructed to gain this information. The Exploratory Works will predominantly be located in the Lobs Hole area of Kosciuszko National Park. If the Exploratory Works are not undertaken, risks to the design and construct elements of the power station cavern are significantly increased.

The *Environmental Impact Statement Exploratory Works for Snowy 2.0* (EIS) was prepared to assess the impact of these works on the environment, and included an assessment of biodiversity impacts within Chapter 5.1 and Appendices F and G. MOD1 also identified biodiversity values relevant to the modification area, assessed any impacts, and proposed any required mitigation measures within Chapter 6.1, 7.1 and Appendix A. The EIS and MOD1 identified that the main biodiversity issue for the Exploratory Works were the impacts to several threatened species and their habitat. These species include the Smoky Mouse, Booroolong Frog and Murray Crayfish which were confirmed to be present in the study area and the Macquarie Perch. The Macquarie Perch was not detected but potential key fish habitat exists in Yarrangobilly River, warranting consideration in design and construction.

A significant effort was undertaken to understand the biodiversity values within the project area and to design the project to avoid and minimise impacts to the identified values. Significant controls will be implemented to minimise and mitigate direct and indirect impacts during construction. The construction of the project will result in the clearing of 95.2ha of native vegetation and the residual impacts will be offset through the Biodiversity Offset Strategy.

A referral was prepared and lodged with the Commonwealth Department of Energy and Environment (DoEE) under the EPBC Act. The Commonwealth Minister's delegate determined on 10 July 2018 that Exploratory Works is not a controlled action, meaning that it does not require further assessment and approval under the EPBC Act before it can proceed.

The *Response to Submissions Exploratory Works for Snowy 2.0* (Submissions Report or RTS) included revised environmental management measures within Chapter 8. The management measures from that report have been addressed within this BMP.

1.4 Environmental management system

The overall environmental management system for the Project is described in the Environmental Management Strategy (EMS). This BMP forms part of Snowy Hydro Limited's environmental management framework for the Project, as identified in Figure 1.1 and as described in Section 4.1 of the EMS.

This Plan identifies and describes general biodiversity aspects and appropriate management measures. It is applicable to Stage 1 of the Exploratory Works project. The timing of the preparation, consultation, submission and approval of this and other plans is shown within Figure 4.3 of the EMS. Ongoing revisions to the BMP will occur in accordance with Section 1.6.1 and 8 of the EMS.

Some work activities require greater detail and warrant a separate plan. The activities which are also related to biodiversity management which are detailed within other management plans, as shown within Table 1.1 below.

Table 1.2 Relationship to other plans

Activities	Relevant plan	Timing of the plan*	
		Stage 1	Stage 2
Road construction	This plan	P	R
Other construction including site facilities	This plan	P	R
Clearing for heritage salvage and excavations	Aboriginal Heritage Management Plan	P	R
	Historic and Natural Heritage Management Plan	P	R
Monitoring for impacts on Murray crayfish in Talbingo Reservoir	Aquatic Habitat Management Plan	P	R

* P – prepare, R - revise

The Biodiversity Offset Strategy, which is to be prepared for the project, does not form part of this Plan. It has been developed separately by Snowy Hydro and is required to ensure any offsets achieve best value for the management of biodiversity values in the Kosciuszko National Park (KNP).

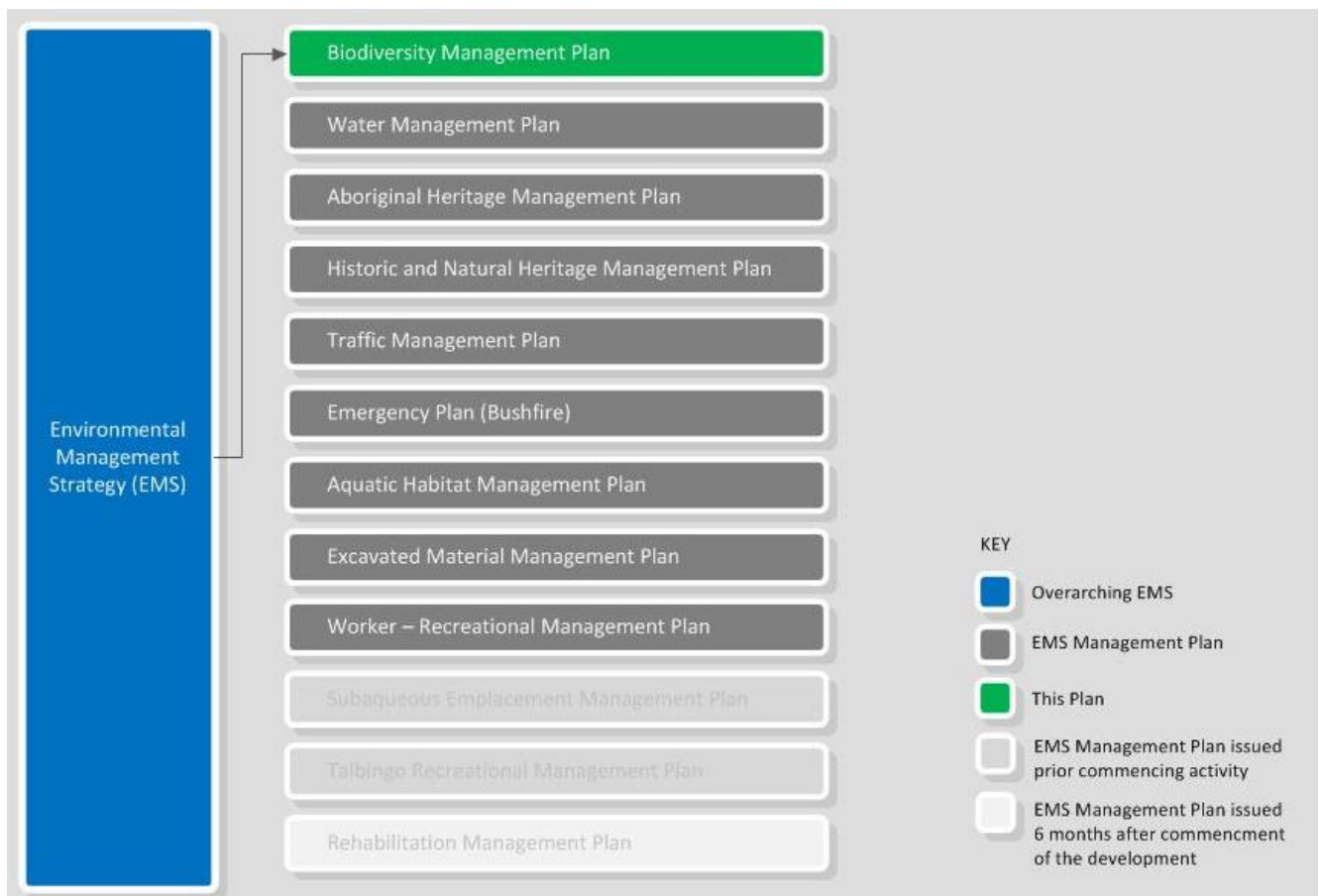


Figure 1.2 EMS structure

Management measures identified in this Plan will be incorporated into site specific documents which are to be prepared by the Contractor. These site-specific documents will be prepared for construction activities and will detail the management measures which are to be implemented on the ground. Construction personnel will be required to undertake works in accordance with the mitigation measures identified in the site-specific documents.

1.5 Purpose and objectives

The purpose of this Plan is to describe how the Project proposes to minimise and manage construction impacts on biodiversity during construction of Stage 1 of the Project.

The key objective of the Biodiversity Management Plan is to describe the management measures that are to be implemented to ensure that impacts to biodiversity are minimised and within the scope permitted by the Project conditions of consent. To achieve this, Snowy Hydro and the Contractor will:

- ensure appropriate measures are implemented to address the relevant conditions of consent and the revised environmental management measures listed within the Submissions Report, as detailed within Table 2.1 and Table 2.2 of this Plan;
- detail the existing biodiversity identified within the project footprint during the EIS including threatened and endangered flora and fauna;

- ensure reasonable and feasible measures are implemented during construction to avoid or minimise biodiversity impacts;
- detail the specific monitoring programs for the Smoky Mouse, Booroolong Frog and Murray Crayfish populations present in, and adjacent to, the project area; and
- establish a pre-disturbance procedure and permit system.

1.6 Consultation

The BMP is to be prepared in consultation with the National Parks and Wildlife Service (NPWS) and Office of Environment and Heritage (OEH). The Office of Environment and Heritage (OEH) includes various divisions involved in the Snowy2.0 projects:

- National Parks and Wildlife Service (NPWS);
- Conservation and Regional Delivery Division (CRDD) - planning, floodplains, biodiversity and Aboriginal cultural heritage (ACH) regulation and threatened species functions; and
- Office of Environment and Heritage (OEH) Science Division.

Preliminary consultation for the Biodiversity Management Plan, Biodiversity Monitoring Program and Weed and Feral Animals Management Plan began in November 2018.

The MOD1 Assessment Report and associated technical studies were submitted by Snowy Hydro to DPIE in June 2019 and publicly exhibited in accordance with the EP&A Act between 26 June and 9 July 2019. Nine submissions were received during the public exhibition period, including one from a special interest group and two individual community submissions.

Table 1.2 Preliminary BMP consultations with stakeholder agencies

Date	Consultation	Outcomes
13 th November 2018	Issued BMP to OEH and NPWS	Sent as information to these Agencies for their review.
16 th November 2018	Meeting with OEH	Presented the structure and contents of the BMP to OEH and discussed clearing management, threatened species protection, monitoring methods and periods and weed control.
22 nd November 2018	Issued revised BMP to NPWS	

7 th December 2018	Received consolidated comments from OEH	Comments accepted and plans revised to address comments.
12 th December 2018	Initial consultation meeting with NPWS	Outlined the Project approval process and management plan development
16 th January 2019	Re-issued draft plans to NPWS	Latest revision to reflect revised comments and draft SSI 9208 conditions of consent
22 nd January 2019	Initial consultation meeting with NPWS	Discussed revisions to management plans and consultation and approval program
31 st January 2019	Received BMP comments from NPWS	Comments accepted and plans revised to address comments.
5 th February 2019	Initial consultation meeting with NPWS	Discussion with NPWS about current plans, latest comments and the ongoing consultation process.
12 th February 2019	BMP issued to NPWS and OEH	This Rev A incorporates previous comments and conditions of consent from Development consent 9208 issued on 7 th February 2019.
1 st March 2019	Receipt of OEH Review comments.	Comments addressed and this plan reissued for DPE satisfaction.
25 th October 2019	Revision 1 sent to DPIE BCD for comment	Revision as a result of MOD1 changes
25 th October 2019	DPIE BCD responded stating that they require plans to include revisions but were happy with changes and previous opportunities for comment.	Plan updated with NPWS, DPIE and DPIE BCD comments

2 Environmental requirements

2.1 Legislation

Legislation relevant to biodiversity includes:

- *Environmental Planning and Assessment Act 1979* (EP&A Act);
- *National Parks and Wildlife Act 1974* (NPW Act);
- *Biodiversity Conservation Act 2016* (BC Act);
- *Fisheries Management Act 1994* (FM Act);
- *Biosecurity Act 2015*; and
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

2.2 Project Consent Conditions

Project approval was granted by DPE on 11 February 2019 with the following Biodiversity management conditions specified under Schedule 3 Specific Environmental Conditions of the Development consent. MOD1 was granted approval by DPIE on 2 December 2019. The relevant conditions are presented in Table 2.1.

Table 2.1 Project Consent conditions relevant to biodiversity management

Condition	Requirement	Where addressed
	Biodiversity Management Plan	
Schedule 3 6	Prior to carrying out any construction, unless the Planning Secretary agrees otherwise, the Proponent must prepare a Biodiversity Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:	Section 1 This plan
	(a) be prepared in consultation with the NPWS and BCD	Section 1.5

	<p>(b) include a description of the measures that would be implemented to:</p> <ul style="list-style-type: none"> • protect vegetation and fauna habitat outside the approved disturbance area; • minimise native vegetation clearing in the approved disturbance area; • minimise the loss of key fauna habitat; • undertake pre-clearance surveys of fauna; • minimise the impacts of the development on threatened flora and fauna species, including the: <ul style="list-style-type: none"> ○ - Smoky Mouse (<i>Pseudomys fumeus</i>); ○ - Boorolong Frog (<i>Litoria booroolongensis</i>); ○ Eastern Pygmy-possum (<i>Cercartetus nanus</i>) • maximise the salvage of resources within the approved disturbance area - including native vegetative material and top soil containing vegetative matter and native seed bank – for beneficial reuse in the rehabilitation of the site; • collect and propagate seed for use in rehabilitation; • control the spread of weeds and pathogens, including <i>Phytophthora cinnamomi</i> (<i>P. cinnamomi</i>); • control the spread of feral pests; • minimise the potential for erosion; and • minimise bushfire risk; 	<p>Section 5 of this plan</p> <p>Weed management Section 5 of this plan</p> <p>Rehabilitation Weed management Surface water management plan Emergency Plan</p>
	<p>(c) include a program to monitor and report on the effectiveness of these measures.</p>	Biodiversity Monitoring Program
7	The Proponent must implement the approved Biodiversity Management Plan for the development.	
Condition 3 Schedule 4	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, the Proponent may submit revised strategies, plans or programs required under this approval at any time. With the agreement of the Planning Secretary, the Proponent may also submit any strategy, plan or program required by this approval on a staged basis. The Planning Secretary may approve a revised strategy, plan or program required under this approval, or the staged submission of any of these documents, at any time. With the agreement of the Planning Secretary, the Proponent may prepare the revised or staged strategy, plan or program without undertaking consultation with all parties nominated under the applicable condition in this approval.	
Condition 4 Schedule 4	<p>Within 3 months, unless otherwise agreed with the Planning Secretary, of:</p> <p>(a) the submission of an incident report under condition 5 below;</p> <p>(b) the submission of an audit report under condition 7 below; and</p> <p>(c) the approval of 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>the Proponent must review, and if necessary revise, the strategies, plans, and programs required under this approval to the satisfaction of the Planning Secretary.</p> <p>Where this review leads to revisions in any such document, then within 4 weeks of the review the revised document must be submitted to the Planning Secretary for approval, unless otherwise agreed with the Planning Secretary.</p>	

2.3 Revised environmental management measures

Environmental safeguards and management measures are included in the EIS in Section 6.3. During preparation of the Submissions Report, revised environmental management measures were developed and are included in Section 8 of the Submissions Report.

The environmental management measures relevant to this Plan are listed in Table 2.2 below. If additional measures are cross-referenced from another section of the EIS or Submissions Report, these measures are also included.

Table 2.2 Management measures from the EIS relevant to biodiversity

Impact	Reference #	Environmental management measure	Where addressed
Impacts to biodiversity	ECO01	The Biodiversity Management Plan (BMP) will include the following:	
		<ul style="list-style-type: none"> identification of guidelines relevant to construction, the matters they apply to and what is required to ensure compliance; pre-disturbance inspection requirements to identify features of conservation significance and select appropriate management measures and environmental controls which will include: <ul style="list-style-type: none"> exclusion fencing around all areas of retained significant vegetation and fauna habitat adjacent to construction compounds and the camp (to avoid damage from camp activities); where works are to be undertaken within the 50 m buffer zone, all vegetation, rocks, logs and other shelter are to be carefully inspected for frog species; and vegetation clearing is to follow a two-staged process based on non-habitat and habitat vegetation. standard precautions and mitigation measures in Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update) (Fisheries NSW 2013); tree assessment and management protocols consistent with AS 4970-2009 Protection of trees on development sites; and terrestrial and aquatic weed, pest and pathogen prevention and management protocols which will include: <ul style="list-style-type: none"> construction of wash-down stations or the use of alternate hygiene protocols at suitable locations where practicable; wash-down or alternate hygiene protocols will be applied to all vehicles prior to movement from Link Road to Lobs Hole Ravine and vice versa where practicable; implementation of a weed and pathogen monitoring program; implementation of a weed control program if weeds are identified within the site; no food waste will be left outside in open areas accessible to feral animals and waste will be stored appropriately in lidded, inaccessible bins and disposed off-site; remote camera monitoring for feral animals at the accommodation camp; a predator control program will be implemented, in conjunction with OEH and NPWS, to control feral animals; all equipment and vessel components, such as propellers, hulls, anchors and any other equipment used should be inspected for pest aquatic plants (particularly fragments of Canadian pondweed (<i>Elodea canadensis</i>) known to be present in Talbingo Reservoir) and pest fish; vessels and vehicles should be washed down and cleaned prior to arriving at the boat ramp to be launched onto the reservoir and before travelling off-site from the reservoir; and all personnel working within the waters should be instructed on how to identify potential pests. pre-clearance procedures; and 	<p>Section 2.5</p> <p>Appendix C</p> <p>Section 5</p> <p>Appendix F</p> <p>Appendix C</p> <p>Appendix D</p>

Impact	Reference #	Environmental management measure	Where addressed
		<ul style="list-style-type: none"> an unexpected threatened species finds procedure. 	
Impacts to biodiversity	ECO02	Other than for Yarrangobilly River Bridge, Wallaces Creek Bridge and sections of Mine Trail Road and Lobs Hole Road required for permanent infrastructure ground disturbance within the avoidance footprint (Yarrangobilly River and Smoky Mouse habitat) will be prohibited, and marked with environmental controls as an exclusion area.	Section 5
Impacts to biodiversity	ECO03	The accommodation camp will be sited in areas of lower quality vegetation where practicable.	Section 5 (Stage 2)
Impacts on threatened species	ECO04	<p>Potential impacts to Threatened Species will be managed and measured through the Biodiversity Management Plan during construction. The Biodiversity Management Plan will include:</p> <ul style="list-style-type: none"> Smoky Mouse monitoring program; and Boorolong Frog monitoring program. 	<p>This plan</p> <p>Appendix B</p> <p>Appendix B</p>
Impacts on threatened species	ECO05	<p>Vehicle traffic movements along Upper Lobs Hole Ravine Road will be:</p> <ul style="list-style-type: none"> limited to day time between sunrise and sunset (except for emergencies); limited to 40km/h; and where practicable, reduced through the use of Talbingo Reservoir to barge heavy machinery, construction equipment and materials. 	Section 5
Impacts on threatened species	ECO06	During Exploratory Works frog exclusion fencing will be installed in key areas where infrastructure is located in close proximity to Booroolong Frog primary habitats such as the bridge crossings. The fencing will be designed to minimise frogs from being able to access the road crossing.	Section 5
Impacts on threatened species	ECO07	Fauna spotters will check areas adjacent to Yarrangobilly River prior to clearing for Booroolong Frog and translocate them to adjacent habitats away from impacts.	Section 5 Appendix E
Impacts on threatened species	ECO08	During construction the Yarrangobilly River buffer zone will be revegetated and weed species removed, where practicable. This will be limited to the areas where work is planned in Stage 1 specifically the Wallace Creek and Yarrangobilly River bridge locations. Specific rehabilitation plans will be developed as part of this work and this work will be carried out prior to the final completion of these structures.	Section 5 Appendix F
Impacts on threatened species	ECO09	Where works are to be undertaken within the 50 m buffer zone of Yarrangobilly River, all vegetation, rocks, logs and other shelter are to be carefully inspected for frog species.	Section 5
Impacts on fish eggs and larvae due to extraction of water from Talbingo Reservoir sedimentation	ECO10	<p>The water pipeline intake will be designed to:</p> <ul style="list-style-type: none"> prevent adult fish from entering the intake and discourage adult fish from approaching the intake which may include: incorporation of an enclosed, dark and long passage approach to the intake; if feasible, screening of the intake with at least 5 mm 3 mm mesh screen; if feasible, installation of a coarse mesh (e.g. cm aperture) screen / cage a few metres around the intake and removal and control of any aquatic vegetation and wood debris within and immediately adjacent to the intake location; and if feasible, limiting the approach water velocity at the headwall during normal operation ideally to 0.1 m/s. locate the intake pump in deeper water where possible; and allow for pump start up procedures involving initial slow water 	<p>Section 5</p> <p>Aquatic Habitat Management Plan</p>

Impact	Reference #	Environmental management measure	Where addressed
		velocity to reduce likelihood of aquatic biota being drawn into the pump.	
Impacts to fish passage	ECO11	The permanent bridges at Yarrangobilly River and at Wallaces Creek will be designed with consideration of Policy and Guidelines for Fish Habitat Conservation Update 2013 (DPI 2013) and Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (NSW Fisheries 2003).	Section 5 Aquatic Habitat Management Plan
Impacts to fish passage	ECO12	<p>The temporary bridges at Yarrangobilly River and at Wallaces Creek will be designed, constructed and removed to</p> <ul style="list-style-type: none"> where practicable implement measures in line with the guidelines for temporary structures in Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update) (DPI 2013) and recommended crossing design considerations in Fairfull and Witheridge (2003) which includes: <ul style="list-style-type: none"> temporary in-stream structures will avoid spanning the full width of the waterway channel to ensure base flow conditions are maintained down the waterway where practicable; maintaining some unmodified channel so that a weir effect or flow through rock interstices only is not created where practicable; and temporary in-stream structures will be inserted during low-flow periods where practicable ensure any build-up of debris which potentially obstructs fish passage will be removed; and the temporary structures will be removed and the river channel rehabilitated following construction of the permanent bridges. 	Section 5 Aquatic Habitat Management Plan
Impacts to fish passage	ECO13	Construction and removal of the temporary bridge at Yarrangobilly River will avoid or minimise in stream works during the migration time of Macquarie Perch (October to January) where possible.	Section 5 Aquatic Habitat Management Plan
Impact to aquatic ecology from erosion and sedimentation	ECO14	The water quality controls described in in WAT01 to WAT05 and WM1.1 to WM 8.8 will be implemented. These controls range from worker training / awareness, engaging specialist Soil Conservationist, site specific controls etc.	Section 5 Surface Water Management Plan
Dangerous tree removal	M1.1	<p>The following controls will be implemented during dangerous tree removal:</p> <ul style="list-style-type: none"> Wherever feasible, trees will be delimbed to reduce safety risks, reduced in height by at least 50% and retained in-situ as habitat trees. This will be determined on a case-by-case basis, with the priority being safety of construction workers and road users Where this is not feasible, due to safety risks etc. complete removal will be required. Trees will be removed in a manner which avoids and minimises impacts to adjacent vegetation. Wherever feasible, trees will be removed using sectional dismantling of the tree, with upper limbs removed using tree climbers and elevated work platforms, and gently lowered to the ground or felled onto the road. The trunk will be removed using a tree harvester. This removal method will minimise impacts to adjacent vegetation and threatened species habitat. The removal of any hollow bearing limbs will be undertaken in accordance with the pre-clearance and clearing procedures outlined in the Exploratory Works Biodiversity Management Plan, as updated, including staged clearing. <p>All hollow-bearing limbs and sections of trunk will be retained adjacent to the works area (but outside the disturbance boundary wherever possible) as habitat. These limbs and trunk sections should be gently</p>	

Impact	Reference #	Environmental management measure	Where addressed
		placed into these areas, minimising vegetation disturbance.	
Impacts to aquatic habitat and biota during dredging and subaqueous placement	ECO15	<p>The subaqueous placement monitoring program for Talbingo Reservoir will be developed and implemented.</p> <p>Measures relevant to aquatic ecology will be implemented as described below including:</p> <ul style="list-style-type: none"> • monitoring of water quality indicators including turbidity, pH and dissolved oxygen within and downstream of the construction area and, if a decline in water quality is detected as a result of the works, investigate potential causes and develop and implement an appropriate response; • the extent of the placement area will be minimised as far as practicable; • the extent of the dredge footprint will be minimised as far as practicable; • subaqueous placement would not occur shallower than 3 m below minimum operating level (i.e. where aquatic habitat, such as aquatic plants are less likely to occur); • placement of large rocks within the placement area will occur and is expected to enhance the value of this habitat for fish and mobile invertebrates by providing hard surface and refuges; • un-necessary noise and vibration disturbances should be kept to a minimum where practicable to avoid impacts to fish and other aquatic species; • removing wood debris from within the dredge footprint and subaqueous placement location and spreading it back into the reservoir in relatively shallow water (0-10 m) where fish are more likely to occur; • where feasible, mapping/identification of aquatic habitats within and adjacent to the subaqueous placement areas and other reference areas to characterise the habitat and place this in context of that present throughout the entire reservoir; and • mapping of aquatic habitats would include searches for crayfish burrows along the shoreline, as these could indicate the presence of Murray crayfish and would inform the final placement area extent. Deployment of crayfish traps along the shorelines adjacent to the placement area and within the placement area could be used to re-locate any large mobile invertebrates (including any Murray crayfish) from these areas to nearby sections of the reservoir that would not be affected by placement; • prior to commencement of seismic surveys, smaller releases of compressed air will be undertaken just below the surface; • during seismic surveys, operators will be vigilant to potential harm to fish and invertebrates. If any harmed or dead biota are observed during works then this would result in the scaling back of works or review and adjustment of methodology (e.g. magnitude, frequency and/or duration of releases); • minimising suspension of sediment and turbidity by implementing WAT14 and WAT15. 	Subaqueous Rock Trial Management Plan and Dredge Environmental Management Plan (Stage 2)

2.4 Permits and licences

As this project has been designated Critical State Significant Infrastructure and assessed under Part 5 of the EP&A Act, permits relating to fish passage or dredging or reclamation works are not required.

An Environment Protection Licence (EPL) will be obtained by Snowy Hydro for the scheduled activity of extractive activities. The EPL details the conditions which must be complied with when undertaking the extractive activities works.

Ecologists will hold Scientific Licence under Part 2 of the Biodiversity Conservation Act (including Animal Ethics Approval under the Animal Research Act 1985) for fauna handling / rescue and survey work. Where rescued fauna require rehabilitation and care only wildlife rehabilitation organisations authorised under Part 2 of the Biodiversity Conservation Act 2016 may be used

2.5 Guidelines

The guidelines considered in the development and implementation of this management plan include:

- NSW DPI *Policy and Guidelines for Fish Habitat Conservation and Management* (Update 2013) (NSW DPI, 2013). This replaces the *Policy and Guidelines for Aquatic Habitat Management and Fish Conservation* (NSW DPI, 1999) and the former *Policy and Guidelines for Fish Friendly Waterway Crossings* (NSW DPI 2003);
- NSW Fisheries, January 2003, *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*, Fairfull and Witheridge, 2003;
- NSW National Parks & Wildlife Service. 2001. *Policy for the Translocation of Threatened Fauna in NSW: Policy and Procedure Statement No. 9* Threatened Species Unit, Hurstville NSW;
- DECCW, 2008, *Hygiene protocol for the control of disease in frogs*;
- NSW Fisheries, 1999, DPI *Policy and Guidelines: Aquatic Habitat Management and Fish Conservation*;
- SOS Conservation Strategy
- relevant recovery plans, priority action statements and best practice guidelines.

3 Existing environment

The following section summarises existing terrestrial and aquatic flora and fauna within and adjacent to the project including species, communities and habitats based on the information contained in Section 5.1 and Appendix F of the EIS. Appendix F includes the Biodiversity Development Assessment.

The Exploratory Works are predominantly located within Kosciusko National Park (KNP) which is largely vegetated across its 673,543 ha extent. The extent of vegetation across the KNP provides a high degree of connectivity.

3.1 Native vegetation

Native vegetation across the project area is described based on three key areas:

- **Lobs Hole Ravine Road** - vegetation along the upper (southern) extent of Lobs Hole Ravine Road is largely intact, with minimal disturbance evident. Vegetation comprises tall montane forests with large trees and a shrubby understorey. Weed invasion is minimal and limited to road edges. The lower reaches of Lobs Hole Ravine Road, generally below 1,200 m, comprise dry sclerophyll forests with a shrubby to grassy understorey;
- **Lobs Hole** - first used in the early 1800s for the movement of stock, Lobs Hole has since been the site of prospecting, mining, grazing, settlement, refuge from the winters of Kiandra, gardening and agriculture. From the 1860s to approximately 1917, it was the site of a copper mine. Lobs Hole is now a public camping area with a boat ramp which is used to access the southern reaches of Talbingo Reservoir. These activities and past land uses have resulted in significant amounts of clearing and disturbance of vegetation in the area, and have modified native vegetation and fauna habitats;
- **northern end of Talbingo Reservoir** - the area around the proposed barge access infrastructure at the northern end of Talbingo Reservoir has been subject to clearing and disturbance associated with the construction of the dam wall and Tumut 3 power station. Large areas have been cleared and are largely devoid of native vegetation. However, some areas of moderate quality vegetation are in the project area.

The EIS found that the native vegetation is largely intact, with 90% native vegetation cover within a 1,500 m buffer of the survey area, providing a high degree of connectivity to large and contiguous patches of vegetation.

3.1.1 Plant community types

Plant community types (PCTs) are a NSW classification used to identify plant communities. The EIS included a review of regional vegetation mapping which identified twenty-four plant community types (PCTs) within the Exploratory Works survey area.

Site investigations identified the presence of **nine** PCTs within the Exploratory Works disturbance footprint. These nine PCTs include 28 vegetation zones. Of these zones, 17 show significant levels of existing disturbance, four show some degree of impact, and seven are considered representative of relatively intact vegetation of high quality.

Table 3.1 below describes the nine PCTs and the area they cover within the project footprint. Vegetation mapping of the plant community types is provided in Appendix A.

Table 3.1 Plant community types within the Exploratory Works disturbance footprint

Plant community type	Vegetation formation	Vegetation class	Area (ha)
PCT 285 – Broad-leaved Sally grass – sedge woodland on valley flats and swamps in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Upper Riverina Dry Sclerophyll Forests	5.41
PCT 296 - Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	Dry Sclerophyll Forest (Shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests	47.40 0.11
PCT 300 – Ribbon Gum – Narrow-leaved (Robertsons) Peppermint montane fern – grass tall open forest on deep clay loam soils in the upper NSW South Western Slopes Bioregion and Kosciuszko escarpment	Wet Sclerophyll Forests (Grassy sub-formation)	Southern Tableland Wet Sclerophyll Forests	8.13 1.67
PCT 302 – Riparian Blakely's Red Gum - Broad-leaved Sally woodland - tea-tree - bottlebrush - wattle shrubland wetland of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Upper Riverina Dry Sclerophyll Forests	10.39 1.61
PCT 303 – Black Sally grassy low woodland in valleys in the upper slopes sub-region of the NSW South Western Slopes Bioregion and western South Eastern Highlands Bioregion	Grassy Woodlands		0.31
PCT 311 – Red Stringybark - Broad-leaved Peppermint - Nortons Box heath open forest of the upper slopes subregion in the NSW South Western Slopes Bioregion and adjoining South Eastern Highlands Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Upper Riverina Dry Sclerophyll Forests	2.78 0.09
PCT 643 – Alpine shrubland on scree , blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion	Alpine Complex	Alpine Heaths	0.12 0.01
PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests	17.34 6.62
PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)		1.09
PCT 999 – Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests	0.64 0.64
PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	Grassy Woodlands		0.47
PCT 1196 – Snow Gum – Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	Grassy Woodlands	Subalpine Woodlands	2.98
PCT 1224 – Sub alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	Grasslands		0.15
PCT 1225 – Sub-alpine grasslands of valley floors, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	Grasslands		>0.01

3.1.2 Threatened ecological communities

Three threatened ecological communities (TECs) were identified as having potential to occur within the project area. These communities were;

- White box yellow box Blakely's red gum woodland - endangered ecological community (EEC)
- Tablelands Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions EEC
- Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and South Western Slopes Bioregions EEC

Following detailed desk and field studies undertaken during the EIS, it was determined that none of these TECs occur in the project area.





3.1.3 Threatened flora species

No threatened flora species as listed under the *Biodiversity Conservation Act 2016* or *Environment Protection and Biodiversity Conservation Act 1999* were recorded in the study area during field surveys for the EIS.

Based on previous records, three threatened flora species were identified as having potential to occur within the project area.

Threatened and endangered flora species with the potential to occur within the study area, and their conservation status, are listed in Table 3.2.

Table 3.2 Threatened plant species

Common name	Scientific name	BC Act	EPBC Act	Occurrence likelihood	Image
Curtis' Colonbath	<i>Colobanthus curtisiae</i>	No	Yes - Vulnerable	Low	 1
Blue-tongued Greenhood	<i>Pterostylis oreophila</i>	Yes – Critically endangered	Yes – Critically endangered	Low	 2
Cotoneaster Pomaderris	<i>Pomaderris cotoneaster</i>	Yes –Endangered	Yes – Endangered	Low	 3
Austral Toadflax	<i>Thesium australe</i>	Yes - Vulnerable	Yes - Vulnerable	Low	 4

¹ Image reference - Tasmanian government.

² NSW Office of Environment and Heritage (Richard Hartland image).

³ NSW Office of Environment and Heritage (Jackie Miles image).

⁴ NSW Office of Environment and Heritage.

3.2 Fauna habitats

3.2.1 Terrestrial

The upper section of Lobs Hole Ravine Road consist of tall wet sclerophyll forests to 40 m. In these areas, hollows are abundant with good numbers of large, old trees. Large logs, coarse woody debris and leaf litter are also abundant on the ground, providing shelter for a high number of fauna species.

Below approximately 1,200 m, vegetation transitions to drier sclerophyll forests. In these areas, hollows are limited to old, mature trees which tend to be rare. Large logs, coarse woody debris and leaf litter are also less common, providing more limited habitat for fauna species.

Along the intermittent and permanent watercourses in Lobs Hole a number of riparian communities occur. Where these communities are intact, large trees are moderately common and support large hollows. In many sections of the Exploratory Works survey area, the midstorey and understorey are heavily disturbed, with significant weed invasion particularly thickets of Blackberry (*Rubus fruticosus* species aggregate). Coarse woody debris, logs and leaf litter varies from absent to moderately sparse, depending on past disturbance. There are limited areas considered to be of good quality for fauna species.

3.3 Threatened fauna

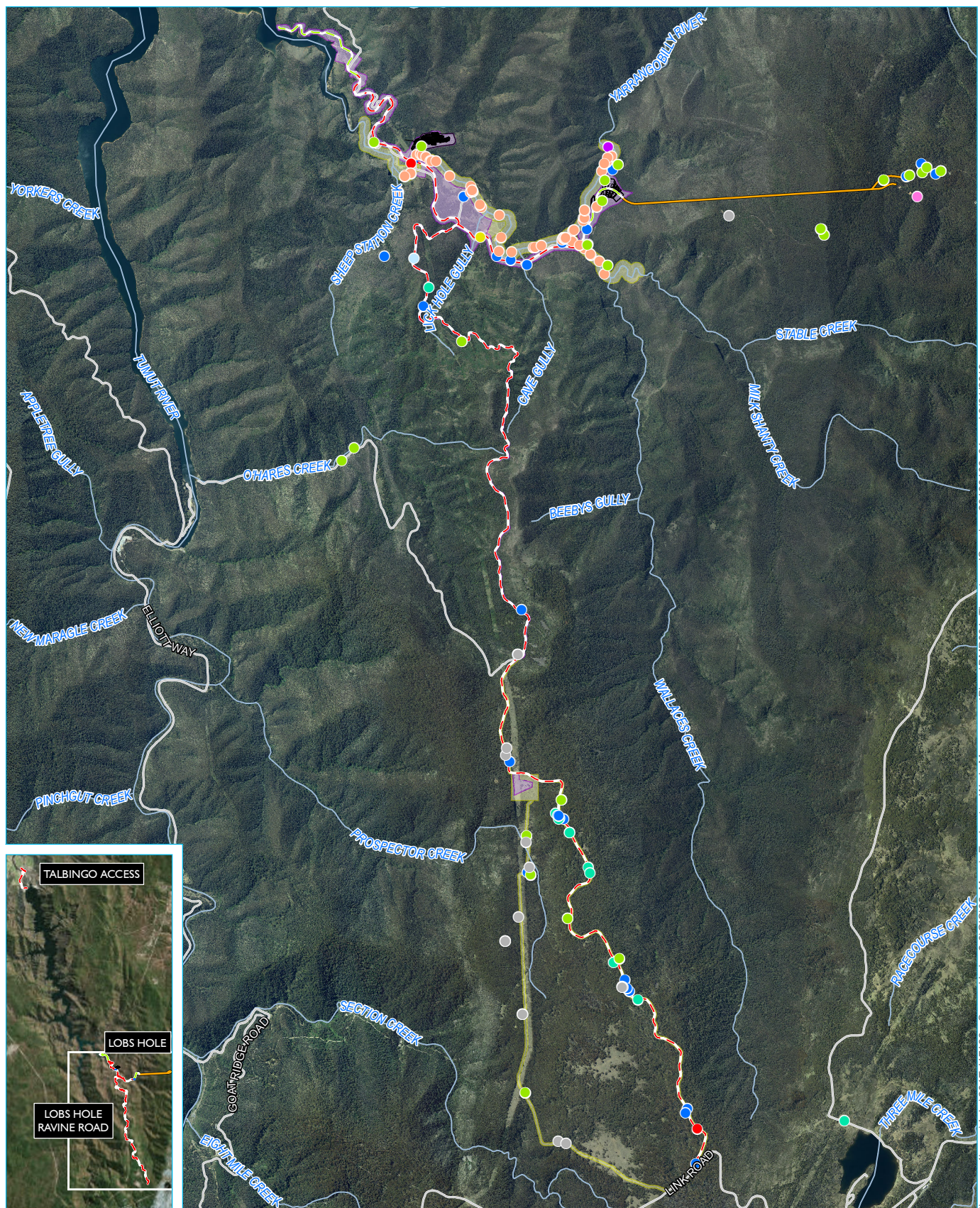
Nineteen species of threatened fauna were identified as having potential to occur within the project area based on background research. The EIS confirmed ten threatened fauna species within or adjacent to the Exploratory Works disturbance footprint. This included seven threatened bird species, two threatened mammal species and one threatened amphibian. In terms of threatened aquatic fauna, the Murray Crayfish was also identified.

A summary of the species confirmed to be present within the study area during EIS surveys is provided in Table 3.2. The locations that these were observed is shown in Figure 3.1.

Table 3.3 Threatened fauna

Common name	Scientific name	BC Act	EPBC Act
Threatened bird species			
Diamond Firetail	<i>Stagonopleura guttata</i>	Vulnerable	Not listed
Dusky Woodswallow	<i>Artamus cyanopterus</i>	Vulnerable	Not listed
Flame Robin	<i>Petroica phoenicea</i>	Vulnerable	Not listed
Scarlet Robin	<i>Petroica boodang</i>	Vulnerable	Not listed
Varied Sittella	<i>Daphoenositta chrysoptera</i>	Vulnerable	Not listed
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	Vulnerable	Not listed
Masked Owl	<i>Tyto novaehollandiae</i>	Vulnerable	Not listed
Threatened mammal species			

Common name	Scientific name	BC Act	EPBC Act
Eastern Pygmy possum	<i>Cercartetus nanus</i>	Vulnerable	Not listed
Smoky Mouse	<i>Pseudomys fumeus</i>	Critically Endangered	Endangered
Threatened amphibian species			
Booroolong Frog	<i>Litoria booroolongensi</i>	Endangered	Endangered
Threatened fish species			
Murray Crayfish	<i>Euastacus armatus</i>	Vulnerable	Not listed
Macquarie Perch	<i>Macquaria australasica</i>	-	Endangered



Source: EMM (2018); Snowy Hydro (2018); SMEC (2018); Robert Bird (2018); DFSI (2017)

KEY

- - - Access road upgrade
- - - Access road extension
- Exploratory tunnel
- Permanent bridge
- Portal construction pad and accommodation camp conceptual layout
- Local road or track
- Watercourse

- Disturbance footprint
- Avoidance footprint
- Threatened fauna species
- Booroolong Frog (59)
- Diamond Firetail (1)
- Eastern Pygmy-possum (47)
- Flame Robin (11)
- Gang-gang Cockatoo (26)
- Masked Owl (2)

- Murray Crayfish (1)
- Satin Flycatcher (1)
- Scarlet Robin (1)
- Smoky Mouse (14)
- Varied Sittella (1)

Threatened species identified during EIS targeted surveys

Snowy 2.0
Biodiversity Management Plan
Exploratory Works
Figure 3.1



3.3.1 Smoky Mouse

The Smoky Mouse local population is unknown. The species was recorded at 13 locations along the upper section of Lobs Hole Ravine Road to around 1,100 m elevation. It is likely to occupy this entire ridge, given the extent of suitable habitat in this area. The Eastern Pygmy-possum was recorded at numerous locations within or adjacent to the Exploratory Works disturbance footprint, within the upper reaches of Lobs Hole Ravine Road to Lobs Hole.



Figure 3.2 Smoky Mouse (EMM EIS)

3.3.2 Booroolong Frog

The Booroolong Frog was recorded within the survey area along the Yarrangobilly River, from the full supply level of Talbingo Reservoir to the upper reaches of the Yarrangobilly River, as well as along Wallaces Creek.

The Yarrangobilly River provides optimal breeding habitat for this species, with a series of cobble banks and bedrock structures along stream margins, with slowflowing water. These areas are connected by larger, slow-flowing pools.

It is likely that this population extends upstream to at least Blue Creek Firetrail (Dave Hunter OEH, pers. comm.).



Figure 3.3 Booroolong Frog (EMM EIS, Robert Bird 2017)

3.3.3 Bird species

The Diamond Firetail, Dusky Woodswallow, Scarlet Robin and Varied Sitella were recorded at disparate locations throughout the project area, with limited records. The Flame Robin and Gang-gang Cockatoo were found to be abundant and dispersed throughout the project area, with records from the top of Lobs Hole Ravine Road to Lobs Hole. Breeding habitat for the Gang-gang Cockatoo is limited to the tops of Lobs Hole Ravine Road and along the Yarrangobilly River. The Masked Owl was recorded at two locations within and adjacent to the

Exploratory Works disturbance footprint during targeted surveys; on the Yarrangobilly River in Lobs Hole and in the upper sections of Lobs Hole Ravine Road, near the intersection with Link Road. Although the species may forage throughout the local area, breeding habitat is limited to these two locations.

3.4 Groundwater dependent ecosystems

Three PCTs were identified as groundwater dependent ecosystems (GDEs) during the EIS studies:

- Broad-leaved Sally grass-sedge woodland (PCT 285);
- Brittle Gum - Peppermint open forest (PCT 296); and
- Riparian Blakeley's Red Gum – Broadleaved Sally woodland (PCT 302).

These PCTs are associated with the alluvial/colluvial areas along the Yarrangobilly River or associated tributaries. The groundwater study completed for the Exploratory Works concluded that alluvial/colluvial aquifers along the Yarrangobilly River are expected to experience some reductions in baseflow however, the level predicted is considered negligible and highly unlikely to affect GDEs.

Yarrangobilly Caves is a High Priority Groundwater Dependant Ecosystem (GDE) listed within the *Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011*. Yarrangobilly Caves is located within the groundwater model domain for the whole project, approximately 8 km north of the current Project area. Yarrangobilly Caves has been studied, and monitored, as part of the EIS groundwater assessment, and there are no impacts predicted to occur at Yarrangobilly Caves as a result of the Exploratory Works (EMM 2018a).

3.5 Pest species

There are a number of wild animals in the Kosciusko National Park region, including feral cats, foxes, brumby horses, dogs and deer. Within the Exploratory Works footprint, the main pest species of concern of growth in population and activity is the feral Cat (*Felis catus*) and Red Fox (*Vulpes vulpes*) and their consequent impacts on native animals. Predation by feral Cats and Red Foxes are listed as key threatening processes under the BC Act and EPBC Act (NPWS 2001, DEWHA 2008, DoE 2015) with impacts from feral Cats also listed as a key threat to the Smoky Mouse (Menkhorst and Broome 2008a, 2008b). Introduced predators are also considered a threat to Eastern Pygmy-possums (NSWSC 2001).

3.6 Weeds

Areas which have experienced considerable disturbance within the Exploratory Works footprint exhibit evidence of weeds. There are three identified weeds of significance in gullies and along Yarrangobilly Creek and Talbingo Reservoir. These weeds are:

- Blackberry (*Rubus spp.*);
- St. Johns Wort;
- Sweet Briar (*Rosa rubiginosa*).

Both watercourses (Wallaces Creek and Yarrangobilly River) are subject to significant weed infestation and in particular with Blackberry. Blackberry, a weed of national significance, has established itself to the point of infestation within the area, particularly in gullies and along the Yarrangobilly River.


4 Environmental aspects and impacts

4.1 Impact summary

An environmental aspect is an element of an organisation's activities, products, or services that has, or may have, an impact on the environment (ISO 14001 Environmental management systems). The relationship of aspects and impacts is one of cause and effect.

Key aspects of the Project that could result in biodiversity impacts are identified in Table 4.1. The extent of these impacts will depend on the nature, extent and magnitude of construction activities and their interaction with the natural environment (Column 2).

Table 4.1 Biodiversity aspects, impacts and environmental factors

	Environmental Aspects (Construction activities that may impact biodiversity)	Environmental Impacts	Environment Factors (Conditions)
	Clearing native vegetation Topsoil stripping Bulk earthworks Soil movement and transfer Material stockpiles and emplacement areas Bridge construction and waterway crossings Operation of compounds Movement of vehicles Use of artificial lights	Loss of 95.2 ha of native vegetation Loss of 70.64 ha of potential habitat for threatened species including: <ul style="list-style-type: none"> Gang-gang cockatoo (0.9ha); Eastern pygmy possum (66.6ha); Booroolong frog (2.04ha); Masked owl (0.9ha); Smoky mouse (0.2ha). Loss of riparian vegetation Potential for fauna mortality Potential for increase in weeds and pathogens Potential for increase in feral animals (feral cat and red fox) Disturbance of river/creek beds and banks Potential for impact on frogs and aquatic ecology Fauna species movement, reproduction and gene flow due to impacts on connectivity Fragmentation of habitats and associated impacts to connectivity and fauna movement Mobilisation of sediments during periods of wet weather	Site conditions and prior site disturbance Water quality Weed and pest animal presence and abundance Soil types and the mobilisation of sediments

The impacts on Smoky Mouse habitat (a critically endangered species in NSW) is potentially the most serious. No road widening works will be carried out during Exploratory Works in the area of identified habitat, which is primarily limited to the upper section of Lobs Hole Ravine Road.

The Booroolong Frog may be indirectly impacted by changes to water quality through the introduction of sediments from construction site runoff. On the basis of the assessment of the existing aquatic environment and the scope of the Exploratory works the aquatic ecology assessment concluded that impacts would not significantly compromise the functionality, long-term connectivity, viability of habitats, or ecological processes within assemblages of biota beyond the small affected areas.

Mobilisation of fine sediments into the watercourses located in the survey area is unlikely to result in long-term impacts to aquatic environments; these events will be pulse events and will be rapidly flushed out of the system resulting in negligible impacts to threatened species (Dave Hunter OEH pers. comm.). Likewise, short term reductions in water quality are unlikely to result in impacts to aquatic environments, as they will be rapidly flushed out of the system. The key mechanism for impacting on aquatic environments will be mobilisation of large amounts of coarse sediment, which clog interstitial spaces providing key breeding habitat for the Booroolong Frog, or long term negative changes to water quality.

A 50m buffer zone is proposed on either side of Yarrangobilly River and Wallaces Creek. The Mine Trail Road upgrade will disturb the proposed 50 m Yarrangobilly River and Wallaces Creek buffer zone at three discrete locations: the bridge over the Yarrangobilly River; the bridge over Wallaces Creek; and along Mine Trail Road in the eastern section of Lobs Hole Ravine. The bridge design for both locations will include a single span bridge. This has been recommended to minimise structures within the river or creek, to maintain fish passage and to avoid impacts to Macquarie Perch, if they are present.

Residual impacts following implementation of all controls include:

- clearing of 95.2 ha of native vegetation; and
- impacts to 70.64 ha of threatened species habitat for five species credit species.

Residual impacts will be offset in accordance with the objective and principles outlined in the biodiversity offset strategy which has been developed as a separate document to the Biodiversity Management Plan.

Impacts to Murray Crayfish from Stage 1 activities within the Yarrangobilly River and Talbingo Reservoir from activities associated with temporary and permanent crossings are discussed within the associated management plans.

5 Environmental management measures

5.1 Management measures

A range of environmental requirements and control measures are identified in the EIS, Submissions Report and the draft baseline conditions. Safeguards and management measures will be implemented to avoid, minimise or manage impacts to biodiversity.

Specific safeguards and management measures to address biodiversity impacts of the Project are identified in Table 5.1

Table 5.1 Biodiversity management measures

ID	Measure / Requirement	Application	When to implement	Responsibility	Source document
General					
BM01	Training will be provided to all project personnel, including relevant sub-contractors on biodiversity management practices and the requirements from this plan through inductions, toolboxes and targeted training.	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager QHSE	Tender guideline
BM02	Relevant biodiversity management measures from this plan will be included in site environmental documents including for example, Environmental Work Method Statements (EWMS) and/or Site Environmental Plans (SEPs) and/or Construction Management Plans (CMP).	Stage 1 Stage 2	Construction	Contractor Enviro Manager QHSE	Good practice
BM03	Where changes to design require consideration of works outside the approved construction footprint, the design will be referred to Snowy Hydro for approval and advice regarding further assessment and approval requirements in accordance with the EMS. This will outline the relevant pathways to assess and manage this change in accordance with relevant process and legislation.	Stage 1 Stage 2	Design / Construction	Contractor Site PM, Enviro Manager	Good practice
BM04	In the event that threatened species or endangered ecological communities are unexpectedly identified during construction the Unexpected (UXF) Threatened Species Procedure included in Appendix D will be followed.	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager, QHSE	REMM ECO01
BM05	A project ecologist will be appointed prior to the commencement of construction.	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager	Tender guideline
BM06	Where practicable, the accommodation camp will be sited in areas of lower quality vegetation.	Stage 2	Design / Construction	Main Contractor Site PM, Enviro Manager	REMM ECO03

ID	Measure / Requirement	Application	When to implement	Responsibility	Source document
BM07	<p>Where practicable the site layout will be arranged so that adequate bushfire APZs can be established without impacting the 50 m Yarrangobilly River buffer.</p> <p>The APZ and other fire prevention measures are outlined in the Emergency Bushfire Plan.</p> <p>This plan addresses key elements around bushfire management including</p> <ul style="list-style-type: none"> • hazard assessments, • bushfire awareness requirements • bushfire mitigation measures • fire preparedness and • fire response 	<p>Stage 1</p> <p>Stage 2</p>	Construction	<p>Main Contractor</p> <p>Site PM</p>	REMM PUS02
BM08	<p>Vehicle traffic movements along Upper Lobs Hole Ravine Road will be:</p> <ul style="list-style-type: none"> • limited to between sunrise and sunset (except for emergencies),; • limited to 40km/h; and • reduced through the use of a barge to transport heavy machinery, construction equipment and materials. 	<p>Stage 1</p> <p>Stage 2</p>	Construction	<p>Contractor</p> <p>Site PM, Enviro Manager, QHSE</p>	REMM ECO05
BM09	Construction lighting and resulting glare will be minimised where it can be shown that to do so would not compromise safety. All lighting should incorporate cut-off shields and be directed downward toward work activities, away from the night sky and away from known locations of light-sensitive habitat.	<p>Stage 1</p> <p>Stage 2</p>	Construction	Tunnel Contractor	Tender guideline
Vegetation clearing, protection and management					
Pre-clearing					
BM10	<p>The Contractor must not clear more than:</p> <p>a) 0.04 ha of known breeding habitat for the Booroolong Frog;</p>	<p>Stage 1</p> <p>Stage 2</p>	Pre-construction / Construction	<p>SHL</p> <p>Site PM, Enviro Manager</p>	EIS

ID	Measure / Requirement	Application	When to implement	Responsibility	Source document
	b) 2 ha of dispersal and refuge habitat for the Booroolong Frog.			QHSE Survey	
BM11	<p>The contractor is to apply a “No-go” zone through appropriate means (eg fencing, flagging etc) to the following areas:</p> <ul style="list-style-type: none"> provide a 50 m setback from the Yarrangobilly River and Wallace Creek to prevent disturbance of vegetation within sensitive riparian areas and Booroolong frog habitat, and limit clearing and disturbance to that approved through the EIS for the section along Upper Lobs Hole Ravine Road to avoid clearing identified Smoky Mouse (threatened species) habitat. <p>The avoidance footprint will be appropriately fenced and designated as a “No-go” zone prior to commencement of works.</p>	<p>Stage 1</p> <p>Stage 2</p>	Construction	<p>Contractor/SHL Design</p> <p>Site PM, Enviro Manager</p> <p>QHSE</p>	REMM ECO01
BM12	During Exploratory Works frog “No-go” zone fencing will be installed in key areas where infrastructure is located in close proximity to Booroolong Frog primary habitats such as the bridge crossings. The fencing will be designed to minimise frogs from being able to access the road crossing.	<p>Stage 1</p> <p>Stage 2</p>	Construction	<p>Contractor</p> <p>Site PM, Enviro Manager</p> <p>QHSE</p>	REMM ECO06
BM13	So as to minimise disturbance, where reasonable and feasible, remnant native vegetation shall be retained between the disturbance footprint and the approved development footprint boundary.	<p>Stage 1</p> <p>Stage 2</p>	Construction	<p>Contractor</p> <p>Site PM, Enviro Manager</p>	Tender guideline
BM14	The clearing of native vegetation shall be minimised with the objective of reducing impacts to any threatened species or EECs where feasible and reasonable.	<p>Stage 1</p> <p>Stage 2</p>	Construction	<p>Contractor</p> <p>Site PM, Enviro Manager</p> <p>QHSE</p>	Tender guideline
BM15	“No-go” zones will be established around all areas of retained vegetation and fauna habitat. These areas will be fenced using appropriate fencing materials	<p>Stage 1</p> <p>Stage 2</p>	Construction	<p>Contractor</p> <p>Site PM, Enviro</p>	REMM ECO01

ID	Measure / Requirement	Application	When to implement	Responsibility	Source document
	and designated and signed as “No-go” Zones.			Manager QHSE	
BM16	Existing trees, plants and other vegetation that are to remain within or adjacent to the Site will be maintained to prevent damage or injury to them. Operations will be planned or carried out to ensure that there is no damage to any trees or vegetation outside the disturbance footprint.	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager	REMM ECO01 Tender guideline
BM17	“No-go” Zones will be set up around all trees retained within and adjacent to the disturbance footprint. Tree assessment and management protocols consistent with <i>AS 4970-2009 Protection of trees on development sites</i> will be implemented prior to clearing.	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager QHSE	REMM ECO01
BM18	A collection of indigenous native seed and alpine sods shall be collected from areas identified to be disturbed, for propagation and use in the final landscaping works. The objective for seed picking in Stage 1 is to collect seed colonising shrubs, forbs and grasses from the Lobs Hole area. Due to the staging of work it has been determined that it would be prudent to propagate these seeds when rehabilitation scope and timing is clearer. This will be carried out by ecologists and the scope will be limited by the available seed stock at the time of collection.	Stage 1 Stage 2	Pre-construction / Construction	SHL	Rehabilitation Strategy
BM19	A Clearing and Grubbing Construction Method Statement (CMS) will be prepared prior to clearing activities.	Stage 1 Stage 2	Construction	Contractor Enviro Manager QHSE	Tender guideline
BM20	The pre-clearing procedure provided in Appendix C will be implemented during construction.	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager QHSE	REMM ECO01

ID	Measure / Requirement	Application	When to implement	Responsibility	Source document
BM21	<p>The limits of clearing will be clearly delineated on site at least ten working days prior to the proposed commencement of clearing.</p> <p>An ecologist will be engaged to undertake a pre-clearing walk along the entire site with Snowy Hydro at least ten working days prior to the proposed commencement of clearing. The ecologist will:</p> <ul style="list-style-type: none"> check for the evidence of presence of flora and fauna species; flag key habitat features, including (but not limited to) nests, hollow bearing trees or large logs, caves, mineshafts and rock outcrops and overhangs; identify nearby habitat suitable for the release of any that may be encountered during clearing works; careful inspection of habitat for frog species within the 50m buffer zone; and where works are to be undertaken within the 50 m buffer zone of Yarrangobilly River, all vegetation, rocks, logs and other shelter are to be carefully inspected for frog species. <p>The supervisor, operator and environmental advisor are to walk the clearing footprint prior to commencing clearing.</p>	Stage 1	Construction	Project Ecologist	
		Stage 2		Contractor Site PM, Enviro Manager QHSE Project Ecologist	REMM ECO01 Tender guideline Good practice
BM22	<p>Clearing limits/disturbance footprint will be delineated using highly visible, durable, continuous barrier such as safety flagging, or other similarly robust and durable material.</p> <p>Delineation will be installed consistently through the project to reduce the risk of error or misinterpretation of boundaries. Where a continuous rope is impractical due to terrain and vegetation density, highly visible flagging will be</p>	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager QHSE	REMM ECO01 Good practice Tender guideline

ID	Measure / Requirement	Application	When to implement	Responsibility	Source document
	placed on vegetation to maintain line of sight of the clearing boundary. “No-go Zone” signs will be placed in prominent positions along each section of exclusion fencing as shown on the Drawings, sensitive areas or directed by the Principal.				
BM23	Habitat trees within areas to be cleared will be marked during the pre-clearing inspection by the Ecologist. Where-ever possible these will be marked using highly visible, durable, continuous barrier such as safety flagging, or other similarly robust and durable material. GPS coordinates for all habitat trees identified will be recorded during the pre-clearing survey.	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager QHSE Project Ecologist	REMM ECO01 Tender guideline
BM24	Prior to undertaking vegetation clearing , pre-clearance inspections will be undertaken by appropriately qualified ecologists in line with the Pre-clearing and clearing procedure (Appendix C). The pre-clearing inspections will: <ul style="list-style-type: none"> • check for the evidence of presence of flora and fauna species; • flag key habitat features, including (but not limited to) nests, hollow bearing trees or large logs using highly visible, durable, continuous barrier such as safety flagging, or other similarly robust and durable material. This will be carried out where-ever possible within the site access and safety constraints. • GPS coordinates for all habitat trees identified will be recorded during the pre-clearing survey ; and • identify nearby habitat suitable for the release of any that may be encountered during clearing works. 	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager Project Ecologist	REMM ECO01 Good practice Tender guideline
BM25	Hollow bearing trees marked for removal as well as	Stage 1	Construction and	Contractor	REMM ECO01

ID	Measure / Requirement	Application	When to implement	Responsibility	Source document
	<p>caves, mineshafts and rock outcrops and overhangs will be checked by the Ecologist prior to felling/ disturbance and any animals found will be relocated to adjacent habitat.</p> <p>Two stage felling methodology will be adopted for any hollow bearing trees. This has been outlined in detail in Appendix C.</p> <p>Other resources such as vegetation, topsoil, mulch etc will be re-used through the stabilisation works through resspreading across disturbed areas. This will maximise the utilisation of existing seedbank and resources in disturbed areas. Specific procedures for these activities have been provided in Excavated Material Management Plan.</p> <p>Ecologists should capture and/or remove fauna that have the potential to be disturbed as a result of clearing activities.</p> <p>Where practicable, where a hollow bearing tree is felled, the tree hollows will be salvaged, and the salvaged sections reused as hollow replacements. The ecologists will monitor these periodically over the life of the EW project.</p> <p>To prevent injury and mortality of fauna, an ecologist will be present at the time of felling hollow bearing trees. Further details will be developed in the Fauna Handling and Rescue Procedure (FHRP) which is to be developed by the Contractor included in Appendix E.</p> <p>Fauna handling must be carried out by ecologists and they must liaise with licensed wildlife carers for availability of carers when works are occurring.</p> <p>Local veterinarians and wildlife carers must be identified and contacted before clearing commences, to ensure they are available during works.</p>	Stage 2	operation	Site PM, Enviro Manager QHSE Project Ecologist	Tender guideline
BM26	Prior to any disturbance of waterway banks, a	Stage 1	Construction	Contractor	Tender guideline

ID	Measure / Requirement	Application	When to implement	Responsibility	Source document
	thorough inspection by a qualified ecologist will be undertaken for aquatic fauna and frogs.	Stage 2		Site PM, Enviro Manager QHSE Project Ecologist	
BM27	Ecologists will check areas adjacent to Yarrangobilly River prior to clearing for Booroolong Frog and move them to adjacent habitats away from impacts, within the Yarrangobilly River.	Stage 1	Pre-construction / Construction	Contractor	REMM ECO07
BM28	Prior to site disturbance the site shall be inspected by the Ecologist and areas of weed infestation identified and clearly delineated to avoid weed spread using signage and highly visible barrier or tape such as flagging, bunting, nightline or other similarly robust and durable material with reflective strips periodically along its length. Weed hygiene protocols, eradication and removal will be managed in accordance with the Weed and Feral Animal Management Plan included in Appendix F.	Stage 1 Stage 2	Pre-construction / Construction	Contractor	REMM ECO01
BM29	The following controls will be implemented during dangerous tree removal: <ul style="list-style-type: none"> • Wherever feasible, trees will be delimbed to reduce safety risks, reduced in height by at least 50% and retained in-situ as habitat trees. This will be determined on a case-by-case basis, with the priority being safety of construction workers and road users. Where this is not feasible, due to safety risks etc. complete removal will be required. • Trees will be removed in a manner which avoids and minimises impacts to adjacent vegetation. Wherever feasible, trees will be removed using sectional dismantling of the tree, with upper limbs removed using tree climbers and elevated work platforms, and gently lowered to the ground or felled onto the road. The trunk will be removed using a tree harvester. This removal method will minimise impacts to adjacent vegetation and threatened species habitat. The removal of any 	Stage 1 Stage 2	Pre-construction / Construction	Contractor	REMM ECO01

ID	Measure / Requirement	Application	When to implement	Responsibility	Source document
	<p>hollow bearing limbs will be undertaken in accordance with the pre-clearance and clearing procedures outlined in the Exploratory Works Biodiversity Management Plan, as updated, including staged clearing.</p> <p>All hollow-bearing limbs and sections of trunk will be retained adjacent to the works area (but outside the disturbance boundary wherever possible) as habitat. These limbs and trunk sections should be gently placed into these areas, minimising vegetation disturbance.</p> <p>As per the Project clearing procedure, a fully qualified ecologist will need to be on site to inform the 2 stage clearing process.</p>				
Clearing					
BM30	<p>Vegetation clearing works are to follow the Pre-clearing and clearing procedure (Appendix C), as outlined below:</p> <ul style="list-style-type: none"> Stage 1 will include the removal of all non-habitat vegetation (eg shrubs, regrowth, ground cover and non-habitat trees). 24-48 hours will be allowed between Stage 1 and Stage 2. Stage 2 will include the removal of all habitat vegetation: <ul style="list-style-type: none"> nests and on-ground logs will be carefully inspected by an ecologist. Logs should be carefully rolled and inspection beneath the log undertaken; habitat trees (trees with hollows or nests) will be carefully lowered to the ground with minimal impact and nests and hollows inspected by the ecologist; any fauna species are to be relocated to habitat identified during the pre-clearing process or, if injured, 	<p>Stage 1</p> <p>Stage 2</p>	Construction	<p>Contractor</p> <p>Site PM, Enviro Manager</p> <p>QHSE</p> <p>Project Ecologist</p>	<p>REMM ECO01</p> <p>Tender guideline</p>

ID	Measure / Requirement	Application	When to implement	Responsibility	Source document
	<p>transported to a veterinarian or wildlife carer;</p> <ul style="list-style-type: none"> – where works are undertaken during the active period for the Booroolong Frog (October to March) the frog should be relocated to the nearest area of retained riparian habitat; • Records are to be kept of all fauna rescue events including locations to where fauna have been relocated. Provide GPS coordinates for such events. • Clearing data will be recorded and will be included in Project monthly reporting requirements. 				
Aquatic habitat					
BM31	<p>The water pipeline intake will be designed to prevent adult fish from entering the intake and discourage adult fish from approaching the intake which may include:</p> <ul style="list-style-type: none"> • incorporation of an enclosed, dark and long passage approach to the intake; • if feasible, screening of the intake with at least 5 mm to 3 mm mesh screen. if feasible, installation of a coarse mesh (e.g. cm aperture) screen / cage a few metres around the intake and removal and control of any aquatic vegetation within and immediately adjacent to the intake location; and • if feasible, limiting the approach water velocity at the headwall during normal operation ideally to 0.1 m/s. • locate the intake pump in deeper water where possible away from fish habitat such as woody debris and aquatic plants; and • allow for pump start up procedures involving 	<p>Stage 1</p> <p>Stage 2</p>	Construction	Drilling Contractor	REMM ECO10

ID	Measure / Requirement	Application	When to implement	Responsibility	Source document
	initial slow water velocity to reduce likelihood of aquatic biota being drawn into the pump.				
BM32	The permanent bridges at Yarrangobilly River and at Wallaces Creek will be designed with consideration of <i>Policy and Guidelines for Fish Habitat Conservation Update 2013</i> (DPI 2013) and <i>Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings</i> (NSW Fisheries 2003).	Stage 1	Construction	SHL Designer Site PM Design Team Enviro Manager	REMM ECO11
BM33	<p>The temporary bridges at Yarrangobilly River and at Wallaces Creek will be designed, constructed and removed to:</p> <ul style="list-style-type: none"> • adhere where practicable to implement measures in line with the guidelines for temporary structures in Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update) (DPI 2013) and recommended crossing design considerations in Fairfull and Witheridge (2003) which including; and • temporary in-stream structures will avoid spanning the full width of the waterway channel to ensure base flow conditions are maintained down the waterway where practicable; • maintaining some unmodified channel remains so that a weir effect or flow through rock interstices only is not created where practicable; • guidelines on the type of suitable fill material will be applied; and. • temporary in-stream structures will be inserted during low-flow periods where possible, with management plans being submitted to NSW DPI detailing how high flow events will be managed to limit erosion of the structures and 	Stage 1	Construction	Contractor Site PM, Enviro Manager	REMM ECO12

ID	Measure / Requirement	Application	When to implement	Responsibility	Source document
	<p>associated sedimentation of downstream waterways.</p> <ul style="list-style-type: none"> • ensure any build-up of debris which is potentially obstructing to fish passage will be removed; and • the temporary structures will be removed and the river channel rehabilitated following construction of the permanent bridges. • Work around waterways will be carried out in accordance with both Water Management Plan and Aquatic Habitat Management Plan. 				
BM34	Construction and removal of the temporary bridge at Yarrangobilly River will avoid or minimise in-stream works likely to affect fish passage during the migration time of Macquarie Perch (October to January) where possible.	Stage 1	Construction	Contractor Site PM, Enviro Manager	REMM ECO13
BM35	Streams to be crossed perpendicular to flow and where possible crossing sites selected to avoid unstable banks, bends in the channel, deep pools and confluences with other channels.	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager	Tender guideline
BM36	The bed and banks are to be reinstated to a condition similar to or better than the original condition ensuring that there are no adverse impacts on the aquatic values (different measures may be required for each crossing) and where feasible and reasonable, avoid impacts on geomorphic processes.	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager QHSE	Tender guideline
BM37	All construction materials used for watercourse crossings (rocks and gravel) are to be free of fine particles to minimise turbidity.	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager QHSE	Tender guideline
BM38	Instream and riparian disturbance will be minimised and sediment, woody snags or debris removed from	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro	Tender guideline

ID	Measure / Requirement	Application	When to implement	Responsibility	Source document
	a stream or stream channel will be minimised. Trimming or 'lopping' of branches and logs will be considered as a first option before moving.			Manager QHSE	
BM39	Any instream woody debris removed during construction will be replaced at the completion of the works within the same waterways from which it was removed.	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager QHSE	Tender guideline
BM40	Fish that become stranded due to temporary access crossings or construction of temporary or permanent creek diversions must be captured and translocated following the DPI Fisheries Guidelines – A Guide to Acceptable Procedures and Practices for Aquaculture and Fisheries Research.	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager QHSE	Tender guideline
BM41	Where possible, existing crossings would be used. Where this is not feasible or reasonable, the temporary crossings would be designed to minimise impacts on the existing aquatic ecology and water quality.	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager	Tender guideline
BM42	General temporary waterway access track mitigation measures would be undertaken: <ul style="list-style-type: none"> temporary crossings would be constructed from clean fill using pipe or box culvert cells to carry flows; all temporary works (eg crossings, flow diversion barriers) would be removed as soon as practicable and in a way that does not promote future channel erosion; the preferred temporary structure for crossing waterways would be consistent with Witheridge (2002) where the use of bridges is the preferred structure for Class 1 (major fish habitat waterways); scour protection works would be established at temporary crossings as required. 	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager QHSE	REMM ECO12

ID	Measure / Requirement	Application	When to implement	Responsibility	Source document
	<ul style="list-style-type: none"> At the completion of construction, the temporary crossings would be removed and rehabilitated. All work around waterways will be carried out in accordance with requirements outlined in Water Management Plan and Aquatic Habitat Management Plans. 				
BM43					
BM43	Measures to prevent the introduction and/or spread of pests and disease causing agents such as bacteria and fungi (inc. chytrid) will be implemented in accordance with the Weed and Feral Animal Management Plan within Appendix F.	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager QHSE	REMM ECO01
BM44	Pathogen measures as detailed within the Weed and Feral Animal Management Plan will be implemented to minimise the introduction and spread of weeds and pathogens including <i>P cinnamomi</i> .	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager QHSE	REMM ECO01
BM45	<p>If pathogens are identified on site, the measures detailed within the Weed and Feral Animal Management Plan will be implemented, including:</p> <ul style="list-style-type: none"> testing may be required to confirm the presence of pathogens; advice from government departments will be sought on practical hygiene management measures; fenced exclusion zones will be identified to restrict access into contaminated areas. 	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager QHSE	REMM ECO01
BM46	Blackberry will be disposed of in accordance with NPWS policy which can include burning, done in accordance with NSW RFS burning guidelines and under the supervision of a licenced fire control person	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager QHSE	Best Practice/ NPWS guidelines RFS standards for pile burning NSW RFS Bushfire Environmental Assessment Code
BM47	Feral animals will be managed in accordance with	Stage 1	Construction	Contractor	Best Practice/ NPWS guidelines

ID	Measure / Requirement	Application	When to implement	Responsibility	Source document
	NPWS practices. Sightings are to be reported immediately to contractor environment representative and SHL so swift management actions can be introduced	Stage 2		Site PM, Enviro Manager QHSE	Weed and feral animal management plan
Rehabilitation					
BM48	Woody debris including felled trees and bushrock will be re-used on site for habitat improvement where possible as detailed in the Landscape/Rehabilitation Management Plan.	Stage 1 Stage 2	Construction	Contractor Site PM, Enviro Manager QHSE	Tender guideline
BM49	<p>EIS Commitment ECO008 provides the following commitment</p> <ul style="list-style-type: none"> During construction the Yarrangobilly River buffer zone will be revegetated and weed species removed, where practicable. <p>It has been determined to not be practicable to undertake a complete revegetation and weed mitigation program within the entire 50m buffer zone as part of the Stage 1 work activities. However this work will be carried out at the Wallace Creek and Yarrangobilly River permanent bridge locations. Specific rehabilitation plans will be developed as part of this work and this work will be carried out prior to the final completion of these structures.</p>	Stage 1	Construction	Contractor Site PM, Enviro Manager	REMM ECO008

5.2 Pre-clearing

The Pre-Clearing Procedure in Appendix C will be followed

5.3 Vegetation clearing

Pre-clearing procedure has been provided in Appendix C.

5.4 Unexpected threatened species finds procedure

If any threatened species or threatened ecological community is unexpectedly encountered during construction activities, the *Unexpected Threatened Species Finds Procedure* provided in Appendix D will be followed.

6 Compliance management

6.1 Monitoring and inspection

A number of monitoring programs will occur to assess the impacts on and survival of three key species within the Project footprint. These are for the Smoky Mouse and the Booroolong frog. These monitoring programs are presented within the Appendix B.

Monitoring will also occur to monitor water quality within Yarrangobilly River, Wallaces Creek and Talbingo Reservoir. The Water Quality Monitoring Program is included within Appendix A of the Surface Water Management Plan. Monitoring of Aquatic habitat is presented in the Aquatic Habitat Management Plan (EMS – Appendix B7)

Details of the weed, pathogen and feral animals monitoring to be undertaken during construction are provided in the following sections.

Weekly environmental inspections of the project will occur in accordance with Section 7.1 of the EMS.

6.1.1 Weed and pathogen monitoring

The Weed and Feral Animal Management Plan (Appendix F) outlines the activities to ensure the project will not have a significant negative impact on key fauna habitats through spread of weeds and pathogens in the project area.

The monitoring program will include:

- construction of wash-down stations or the use of alternate hygiene protocols at suitable locations where practicable. In the short-term wash-down stations will not be implemented due to the limited space and infrastructure available.
- heavy vehicles and plant entering Ravine Road from Link Road will be inspected prior to entry for pathogens and weed hygiene. Vehicles determined not to be clean will need to be cleaned at nearby licenced wash facility. The record of heavy vehicle and plant weed hygiene inspections will be readily available where required ;
- alternate hygiene protocols will be applied to all vehicles prior to movement from Link Road to Lobs Hole Ravine and vice versa where practicable.
- implementation of a weed and pathogen monitoring program;
- implementation of a weed control program if weeds are identified within the site;
- soil testing, including baseline and ongoing testing, for pathogens such as *P.cinnamomi*;
- baseline surveys, prior to works, to document weed species present, as well as cover and abundance, in key habitats such as at the top of Lobs Hole Ravine Road, adjacent to the tunnel portal and construction pad, and adjacent to the accommodation camp; and

- the monitoring program will include a repeatable and objective measure of weed cover at varying distances from key infrastructure. It is suggested that a modified version of the biometric assessment method (OEH 2014) is applied.

The weed and pathogen monitoring program has been developed in conjunction with NPWS, OEH and Snowy Hydro. The monitoring program outlines triggers and adaptive management measures for the monitoring program.

6.1.2 Feral species monitoring

The Weed and Feral Animal Management Plan (Appendix F) outlines the activities to ensure the project does not have a significant negative impact on key feral species throughout the project area. To document changes in the abundance of feral species arising from increased human activity, and inform location and extent of controls, a feral species monitoring program will be implemented. Monitoring will include:

- remote camera surveys along trails and adjacent to key infrastructure; and
- a predator control program will be implemented, in conjunction with OEH and NPWS, to control feral animals.

The feral species monitoring program has been developed in conjunction with NPWS, OEH and Snowy Hydro. The monitoring plan outlines triggers and adaptive management measures for the monitoring program.

6.2 Training

All site personnel will undergo site induction training relating to biodiversity including threatened species and habitat protection management issues.

The induction training will address elements related to biodiversity management including:

- existence and requirements of this BMP;
- relevant legislation;
- roles and responsibilities for biodiversity management;
- biodiversity mitigation and management measures.

Targeted training in the form of toolbox talks or specific training will also be provided to personnel with a key role in contaminated land management. Examples of training topics include:

- clearing procedures;
- identification of weed species and feral animals
- no-go zones;
- threatened species within the project area;
- the unexpected finds procedure for threatened species (Appendix D);

- the procedures regarding management of weeds or pathogens.

Further details regarding the staff induction and training are outlined in Section 4.4 of the EMS.

6.3 Auditing

Audits will be undertaken to assess the effectiveness of the management measures, compliance with this BMP, the Project approval conditions, EIS, REMMs and other relevant approvals, licences and guidelines.

Audit requirements are detailed in Section 7 of the EMS and will be scheduled and delivered by independent experts and specialists in accordance with the Independent Audit requirements (DPE 2018) and as outlined in Schedule 4, Condition 9. More details can be found in the EMS.

6.4 Reporting

Reporting will include regular compliance reporting to DPIE and NPWS via the Major Projects portal as required by Schedule 4, condition 7 of the Project approval conditions. The regular compliance reports will track compliance against the Project approval conditions and the revised environmental management measures and will be reported in accordance with, the relevant Compliance Reporting requirements (DPE 2018) as per, Schedule 4, Conditions 7 and 8. Likewise, any reporting of an incident will be in writing via the Major Projects portal immediately after the Project becomes aware of an incident on site. The notification will identify the development, including the application number, and set out the location and nature of the incident.

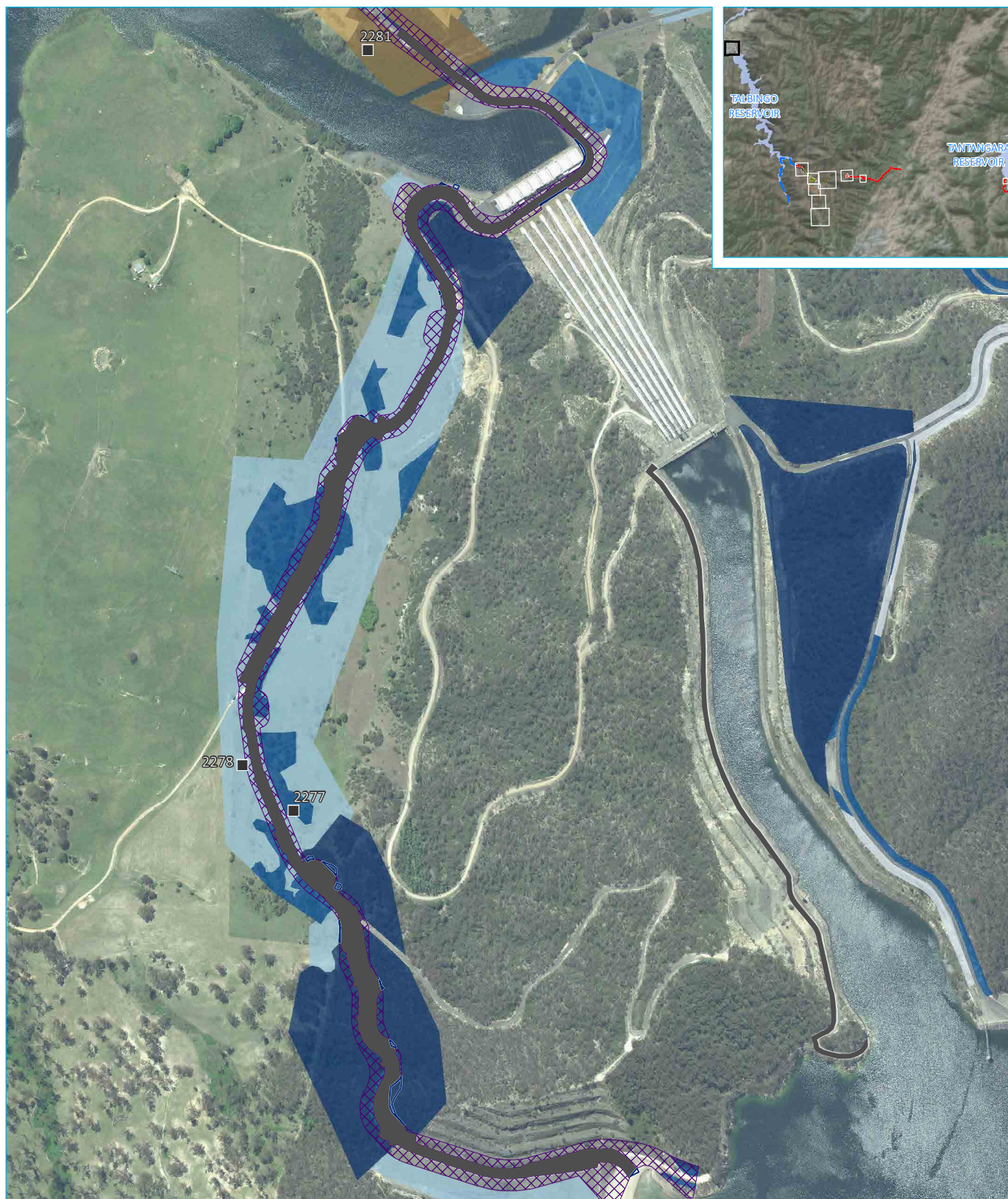
Reporting requirements and responsibilities are documented in Section 6 and 7 of the EMS.

Snowy Hydro are required to provide updated reports on the outcomes of clearing processes as well as digital spatial data to NPWS.

Biodiversity Management Plan

Appendix A

Plant community types and vegetation zone mapping (EIS)



Source: EMM (2019); Snowy Hydro (2019); SMEC (2018); DFSI (2017); GA (2015); LPMA (2011); OEH (2014)

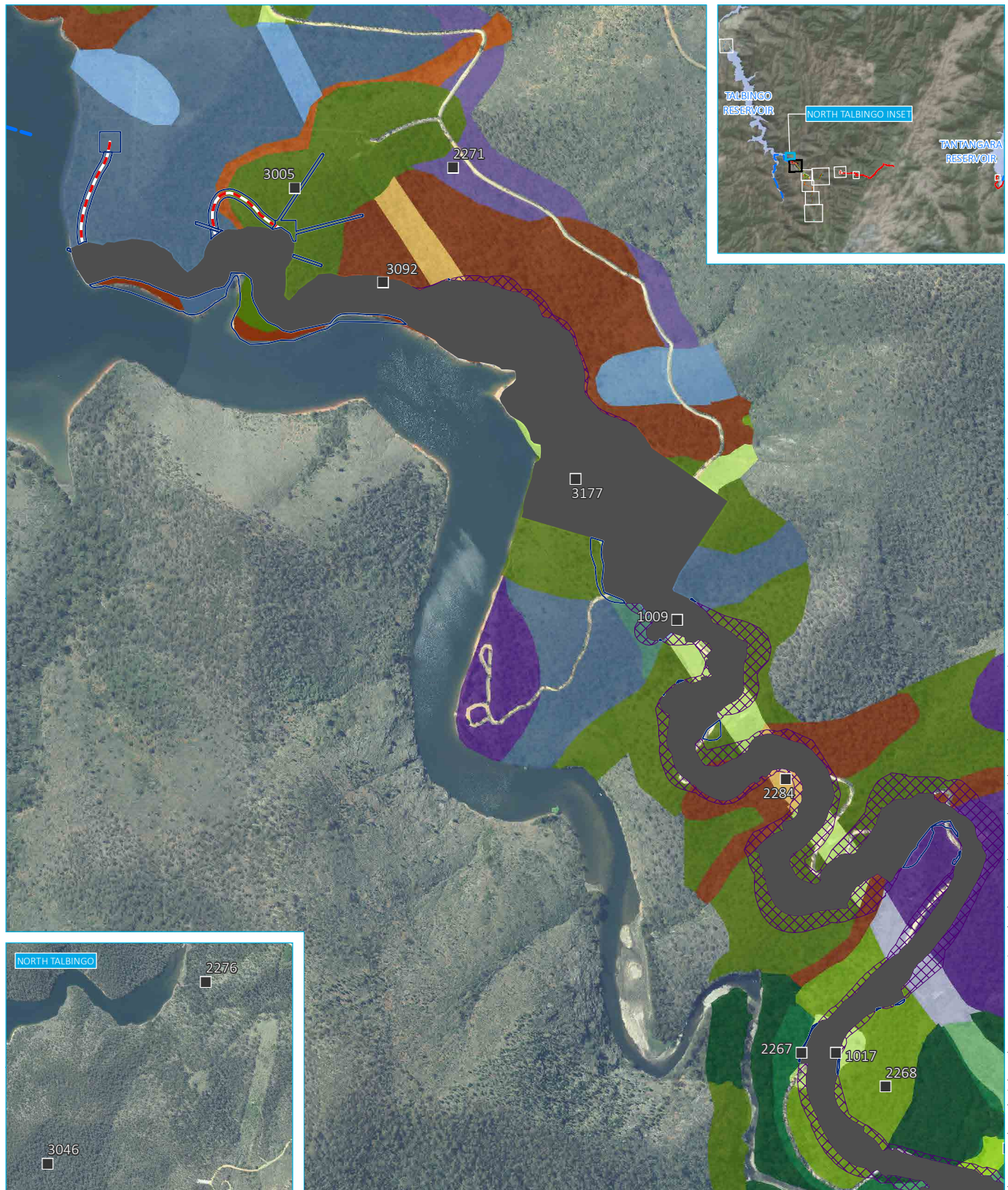
KEY

- Plot location
- EW approved construction footprint (additional)
- EW approved construction footprint
- ▨ EW approved construction footprint reduced
- PCT 311
 - Moderate/good - High
 - Moderate/good - Medium
 - Moderate/good - Poor
 - Moderate/good - Other
 - Moderate/good - Derived grassland
 - Low
- PCT 650
 - Moderate/good - Medium
 - Moderate/good - Derived grassland

Plant community type and vegetation zone mapping within the Modification 1 project area, including plot locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure A1





Source: EMM (2019); Snowy Hydro (2019); SMEC (2018); DFSI (2017); GA (2015); LPMA (2011); OEH (2014)

KEY

- Plot location
- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced
- Proposed access track
- Approved EW access
- Boat access
- PCT 296
 - Moderate/good - High
 - Moderate/good - Medium
 - Moderate/good - Derived grassland

- PCT 300
 - Moderate/good - High
 - Moderate/good - Medium
 - Moderate/good - Derived grassland
- PCT 302
 - Moderate/good - High
 - Moderate/good - Medium
 - Moderate/good - Other
- PCT 729
 - Moderate/good - High
 - Moderate/good - Medium
 - Moderate/good - Poor

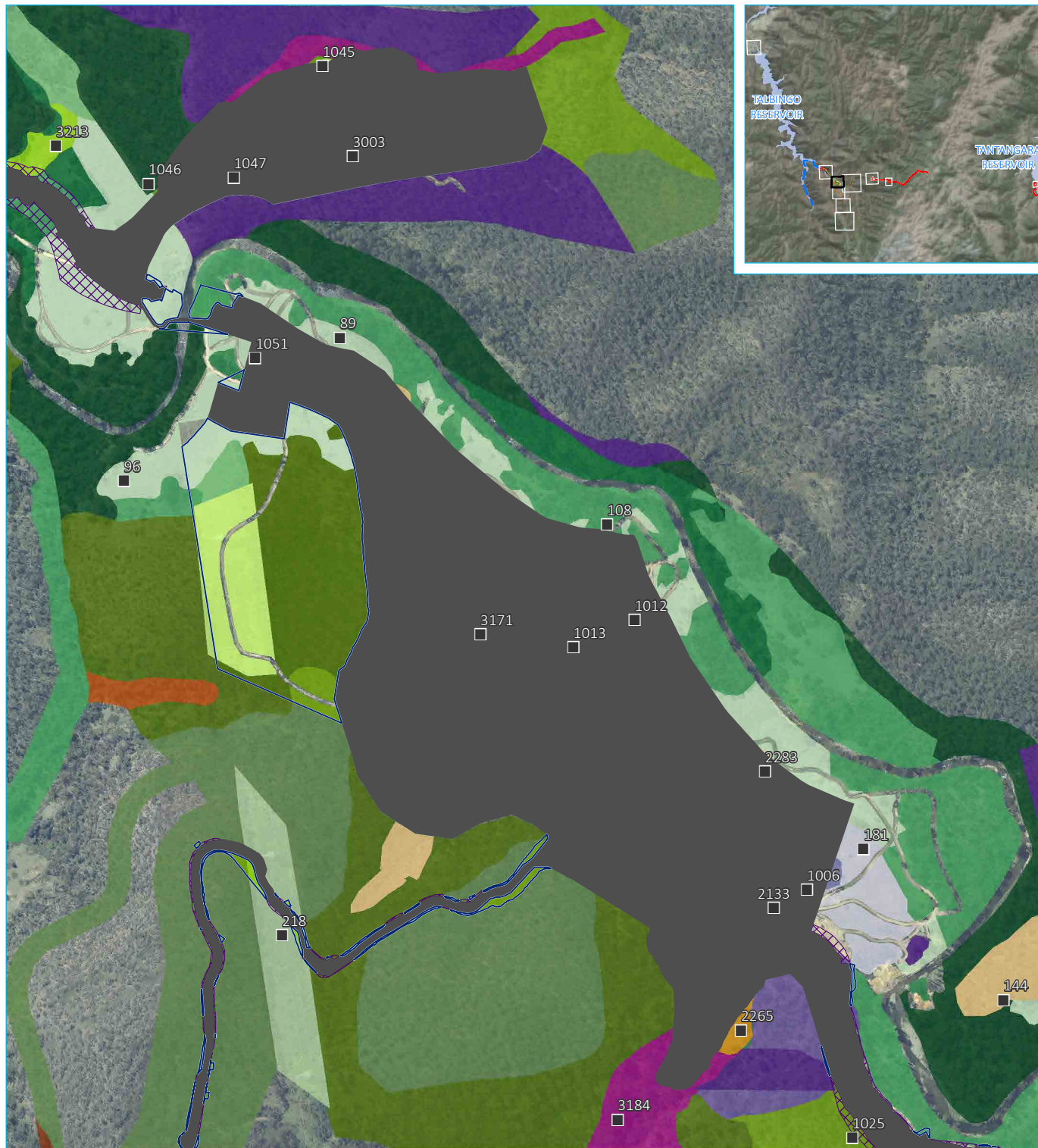
- Moderate/good - Derived grassland
- PCT 1191
 - Moderate/good - High
 - Moderate/good - Derived grassland
- PCT 1196
 - Moderate/good - High

Plant community type and
vegetation zone mapping within the
Modification 1 project area,
including plot locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure A2



\\EMMSVR1\emmm\jobs\2017\17188 - Snowy Hydro 2.0\GIS\02_Maps\EIS_EW_Mod1\BDAR\B006c_PCTandVegZones_20190603_02.mxd 4/06/2019



Source: EMM (2019); Snowy Hydro (2019); SMEC (2018); DFSI (2017); GA (2015); LPMA (2011); OEH (2014)

KEY

- Plot location
- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced
- PCT 285
 - Moderate/good - High
 - Moderate/good - Poor
 - Low
- PCT 296
 - Moderate/good - High
 - Moderate/good - Medium
 - Moderate/good - Poor
 - Moderate/good - Other
 - Moderate/good - Derived grassland

- Low
- PCT 299
 - Moderate/good - Medium
- PCT 300
 - Moderate/good - High
 - Moderate/good - Medium
- PCT 302
 - Moderate/good - High
 - Moderate/good - Medium
 - Moderate/good - Poor
 - Moderate/good - Other
 - Moderate/good - Derived grassland
 - Low

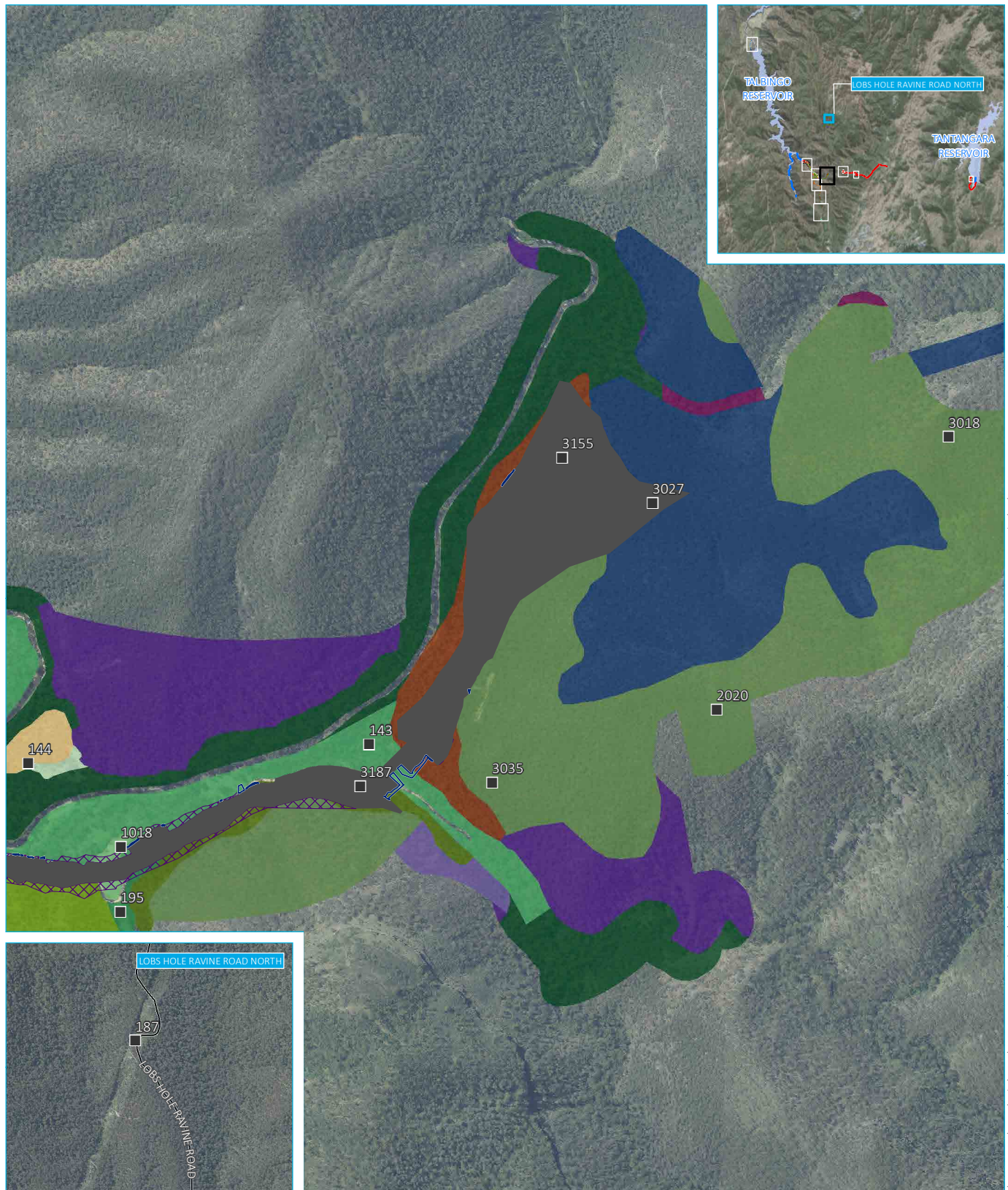
- PCT 729
 - Moderate/good - High
 - Moderate/good - Medium
 - Moderate/good - Poor
 - Moderate/good - Derived grassland
- PCT 999
 - Moderate/good - High
 - Moderate/good - Derived grassland

Plant community type and vegetation zone mapping within the Modification 1 project area, including plot locations

0 100 200 m
GDA 1994 MGA Zone 55

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure A3





Source: EMM (2019); Snowy Hydro (2019); SMEC (2018); DFSI (2017); GA (2015); LPMA (2011); OEH (2014)

KEY

- Plot location
- EW approved construction footprint (additional)
- EW approved construction footprint
- ▨ EW approved construction footprint reduced
- PCT 285
 - Moderate/good - Poor
- PCT 296
 - Moderate/good - High
 - Moderate/good - Medium
- PCT 299
 - Moderate/good - High

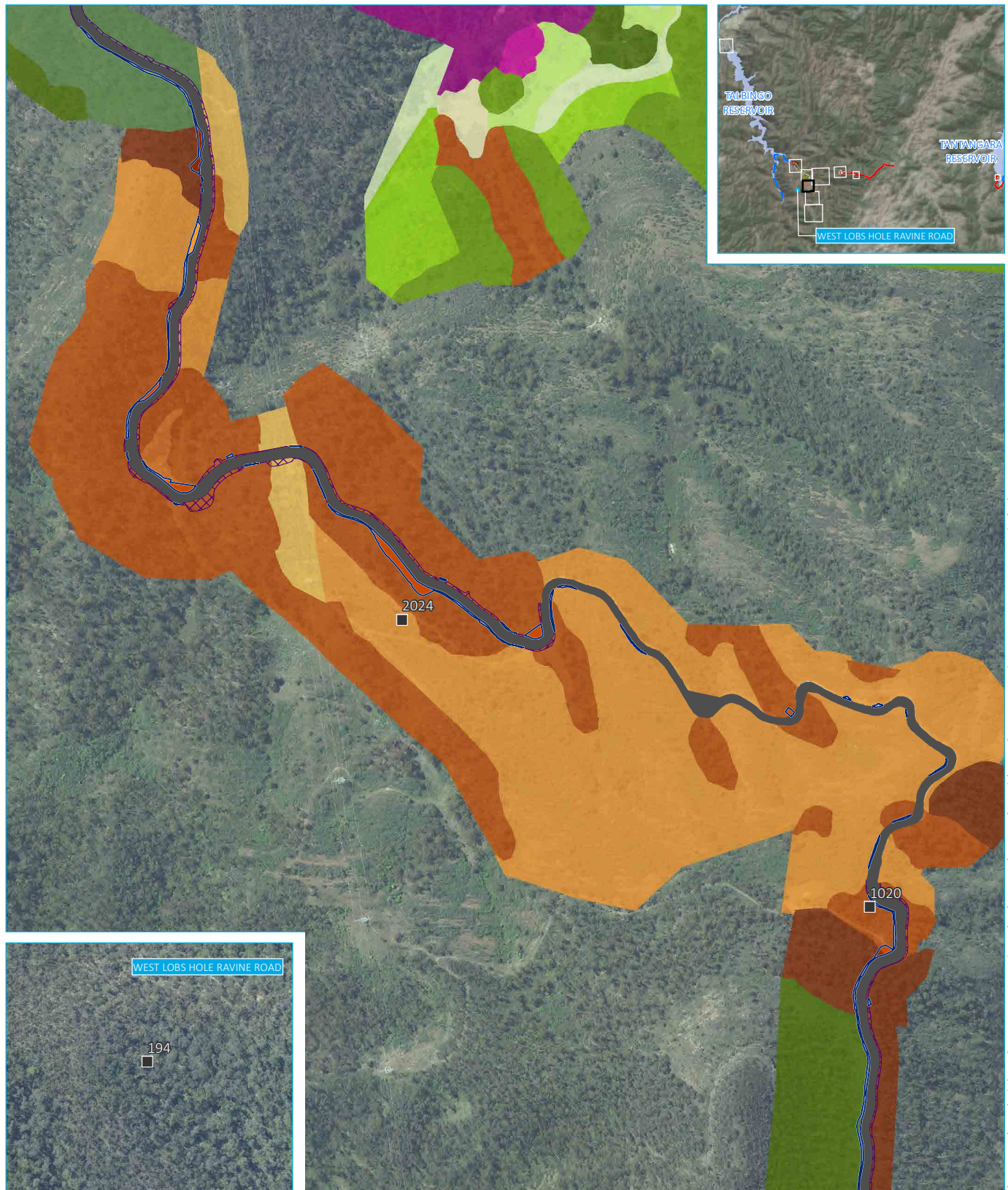
- PCT 300
 - Moderate/good - High
- PCT 302
 - Moderate/good - High
 - Moderate/good - Poor
 - Moderate/good - Other
 - Moderate/good - Derived grassland
 - Low
- PCT 311
 - Moderate/good - High
- PCT 729
 - Moderate/good - High

- Moderate/good - Medium
- PCT 999
 - Moderate/good - High

Plant community type and vegetation zone mapping within the Modification 1 project area, including plot locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure A4





Source: EMM (2019); Snowy Hydro (2019); SMEC (2018); DFSI (2017); GA (2015); LPMA (2011); OEH (2014)

KEY

- Plot location
- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced
- PCT 299
 - Moderate/good - Medium
 - Low
- PCT 300
 - Moderate/good - High
 - Moderate/good - Medium
 - Moderate/good - Poor
 - Moderate/good - Other

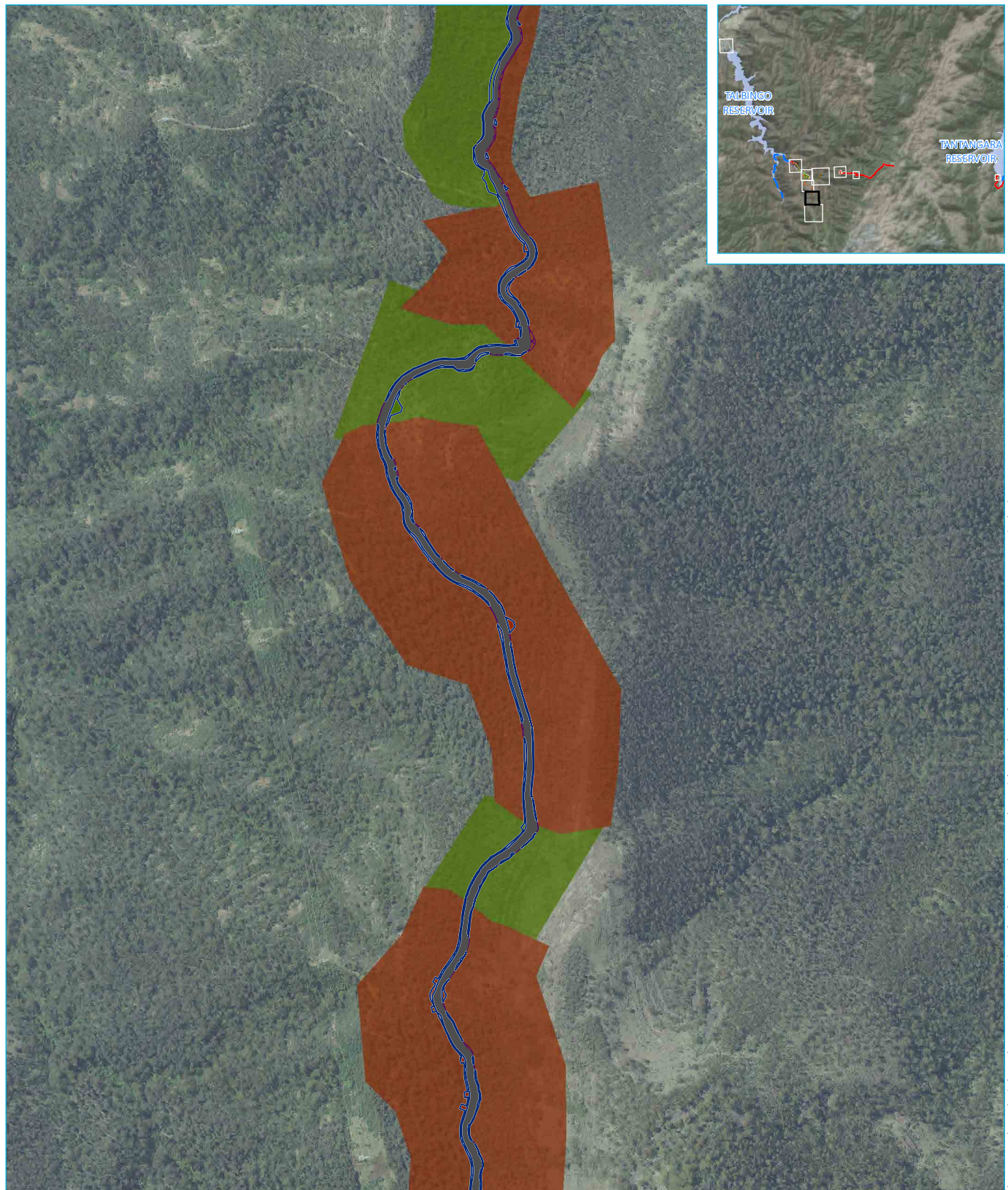
- Moderate/good - Derived grassland
- Low
- PCT 302
 - Moderate/good - Poor
 - Moderate/good - Derived grassland
- PCT 729
 - Moderate/good - High
 - Moderate/good - Medium
 - Moderate/good - Poor
 - Moderate/good - Derived grassland
 - Low

- PCT 999
 - Moderate/good - High

Plant community type and vegetation zone mapping within the Modification 1 project area, including plot locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure A5





Source: EMM (2019); Snowy Hydro (2019); SMEC (2018); DFSI (2017); GA (2015); LPMA (2011); OEH (2014)

KEY

- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced

PCT 300

 Moderate/good - High

PCT 729

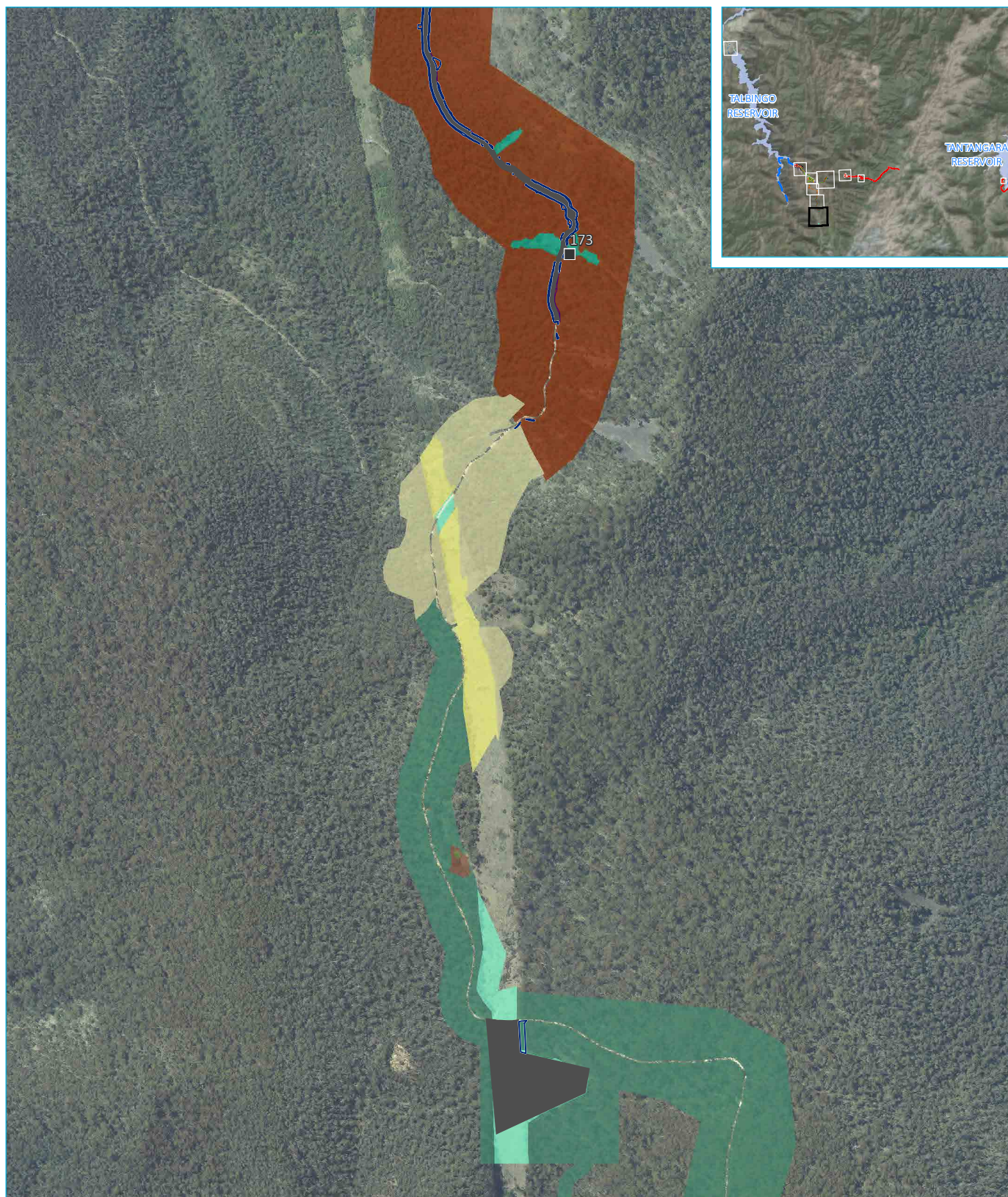
 Moderate/good - High

Plant Community Type and vegetation
zone mapping within the Modification 1
project area, including plot locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure A6



\\EMMSVR1\enmm\Jobs\2017\117188 - Snowy Hydro 2.0\GIS\02_Maps\EIS_EW_Mod1\BDAR\B006f_PCTandVegZones_20190603_02.mxd 4/06/2019



Source: EMM (2019); Snowy Hydro (2019); SMEC (2018); DFSI (2017); GA (2015); LPMA (2011); OEH (2014)

0 100 200
m
GDA 1994 MGA Zone 55

KEY

- Plot location
- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced
- PCTsEMM1500mBuffer_20190508
- PCT 300
- Moderate/good - High
- PCT 303
- Moderate/good - High
- PCT 637
- Moderate/good - High

- PCT 643
- Moderate/good - High
- PCT 953
- Moderate/good - High
- Moderate/good - Derived grassland
- PCT 1196
- Moderate/good - High
- Moderate/good - Derived grassland

Plant Community Type and vegetation
zone mapping within the Modification 1
project area, including plot locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure A7



Biodiversity Management Plan

Appendix B

Biodiversity Monitoring Program

Appendix B - Biodiversity Monitoring Program

Snowy 2.0 - Exploratory Works – Stage 1

Prepared for Snowy Hydro | 19 November 2019

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Biodiversity Monitoring Program

Report J17188RP1 | Prepared for Snowy Hydro | 19 November 2019

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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1 Introduction

1.1 Context

This Biodiversity Monitoring Program (program) forms an appendix to the Biodiversity Management Plan (BMP) which is an appendix of the Construction Environmental Management Plan (CEMP).for Snowy 2.0 - Exploratory Works (the project). The purpose of the program is to detail the biodiversity monitoring requirements which are to be implemented during construction of the Snowy 2.0 – Exploratory Works project (the project).

The project is the first phase of Snowy 2.0, a pumped hydro-electric storage and generation project which will increase the hydro-electric capacity within the existing Snowy Mountains Hydro-electric Scheme.

The *Environmental Impact Statement Exploratory Works for Snowy 2.0* (EIS) was prepared to assess the impact of the of the project on the environment, and included an assessment of biodiversity impacts within Chapter 5.1 and Appendix F. The EIS identified that the main biodiversity issue for the project were the impacts to several threatened species and their habitat, including the Smoky Mouse (*Pseudomys fumeus*) and Booroolong Frog (*Litoria booroolongensis*), which were confirmed to be present within and adjacent to the project area.

The EIS also identified other potential indirect impacts to biodiversity as a result of the project including threatened species as a result of the project, including the potential for such as the introduction and/or exacerbation of weeds and pathogens, feral herbivores and feral predators. This monitoring program has been prepared to address the requirements of *the* Project consent conditions and the revised environmental management measures within the Response to Submissions Exploratory Works for Snowy 2.0 (Submissions Report or RTS).

1.2 Program structure

This introductory chapter provides the context of this monitoring program as well as an overview and schedule of the monitoring program. Subsequent chapters are arranged into one subject entity per chapter. Each chapter will:

- detail the existing conditions, impact predictions and monitoring objectives;

and

- outline monitoring parameters, methods, locations, frequencies, data analysis and triggers for adaptive management.

The subject entities are:

- Smoky Mouse (Chapter 2);
- Booroolong Frog (Chapter 3);
- weeds and pathogens (Chapter 4);
- feral herbivores (Chapter 5); and

- feral predators (Chapter 6).

1.3 Objectives

The key objective of this program is to ensure that impacts arising from the project are in line with impacts predicted to occur, as outlined in the EIS. The primary objectives of the program are to:

- detail existing conditions;
- detail the monitoring parameters, method of data collection including frequency and location, method of data analysis and reporting requirements;
- enable the identification and quantification of any impacts;
- provide threshold triggers for implementation of adaptive management procedures; and
- demonstrate compliance with relevant consent conditions and other monitoring requirements.

1.4 Schedule

The monitoring schedule is summarised in Table 1.1, with further detail provided in each chapter.

Table 1.1 **Monitoring schedule**

Task	Timing		
	Pre-construction (baseline)	During construction	Post-construction
Smoky Mouse habitat characteristics monitoring	Biannually (Spring and autumn)	Biannually (Spring and autumn)	Biannually (Spring and autumn)
Smoky Mouse occupancy monitoring	Three monitoring events per year, with each monitoring event defined as one month deployment of cameras – during January to March 2019	Three monitoring events per year, with each monitoring event defined as one month deployment of cameras	Three monitoring events per year, with each monitoring event defined as one month deployment of cameras
Smoky Mouse population monitoring	Three monitoring events per year (quarterly), with each monitoring event defined as four nights of trapping	Three monitoring events per year (quarterly), with each monitoring event defined as four nights of trapping	Three monitoring events per year (quarterly), with each monitoring event defined as four nights of trapping
Booroolong Frog population monitoring	Two separate nocturnal monitoring events during the breeding season (November to mid-December) per year	Two separate nocturnal monitoring events during the breeding season (November to mid-December) per year	Two separate nocturnal monitoring events during the breeding season (November to mid-December) per year
Booroolong Frog habitat characteristics monitoring	Annually, and after any surface water incidents during January to March 2019	Annually, and after any surface water incidents	Annually, and after any surface water incidents
Booroolong Frog surface water quality monitoring	Refer to the Surface water monitoring program (SWMoP)	Refer to the Surface water monitoring program (SWMoP)	Refer to the Surface water monitoring program (SWMoP)
Weeds presence/absence monitoring	One monitoring event during January 2019	Annual event (Spring)	Bi-annually (seasonally based)
Weed cover monitoring	One monitoring event during January 2019	Annual event (Spring)	Bi-annually (spring and autumn)
<i>Phytophthora</i> presence/absence monitoring	Four monitoring events per year (quarterly)	Annual event (Spring)	Four monitoring events per year (quarterly)
Other monitoring (dieback)	To be determined pending outcome of weed monitoring program	To be determined pending outcome of weed monitoring program	To be determined pending outcome of weed monitoring program
Feral herbivores presence/absence monitoring	One monitoring event during January 2019	One monitoring event per year (spring or autumn), lasting 10 days	Four monitoring events per year (quarterly), with each monitoring event lasting 30 days
Feral herbivores abundance monitoring	One monitoring event during January 2019	One monitoring event per year (spring or autumn), lasting 10 days	Four monitoring events per year (quarterly), with one monitoring event defined as four nights
Feral predators presence/absence monitoring	One monitoring event during January 2019	One monitoring event per year (spring or autumn), lasting 10 days	Four monitoring events per year (quarterly), with each monitoring event lasting 30 days
Feral predators abundance monitoring	One monitoring event during January 2019	One monitoring event per year (spring or autumn), lasting 10 days	Four monitoring events per year (quarterly), with one monitoring event defined as four nights

2 Smoky Mouse monitoring program

2.1 Baseline conditions

During development of the EIS, surveys for the Smoky Mouse were completed and reported in the *Snowy 2.0 Exploratory Works, Biodiversity Development Assessment Report* (EMM 2018). Smoky Mouse was recorded at 13 locations within and adjacent to the project disturbance footprint between December 2017 and May 2018 (Photograph 2.1 and Figure 2.1). Smoky Mouse was recorded via terrestrial trapping (one record) and by remote camera (12 records). A mark-recapture study was not conducted during these investigations (aimed only to determine presence/absence) and therefore the number of individuals occupying the survey area is currently unknown.

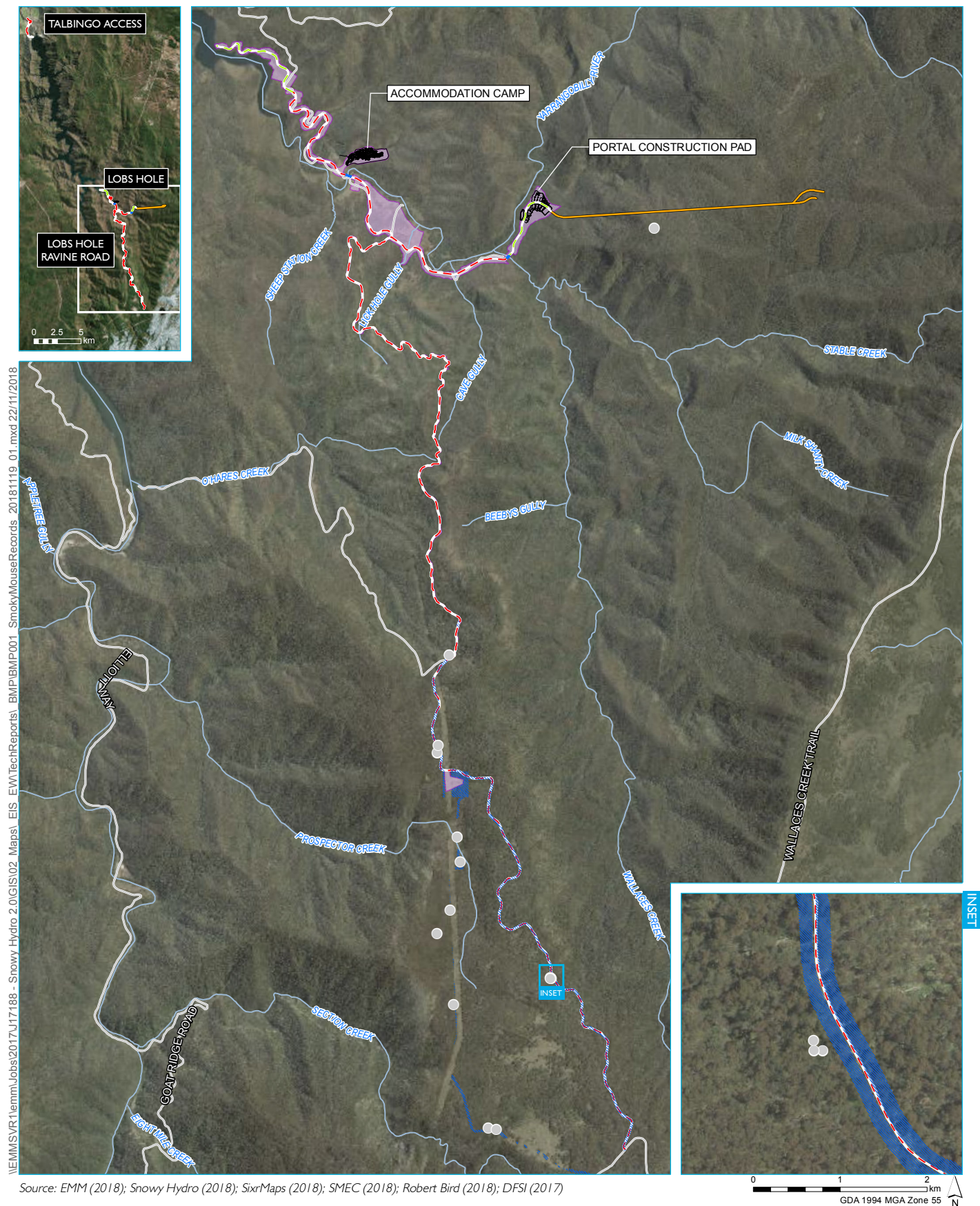
The species distribution recorded by EMM (2018) within the survey area is predominantly associated with a single vegetation community (PCT 1196 - *Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion*) along the upper reaches of Lobs Hole Ravine Road, above 1,100 m. In this area vegetation consists of tall forests dominated by Mountain Gum (*Eucalyptus dalrympleana*) and Snow Gum (*Eucalyptus pauciflora*), with a moderate to dense shrubby midstorey dominated by shrubs from the plant family *Fabaceae* (with some *Epacridaceae* and *Mimosaceae*) and dense groundcover with abundant sub-shrubs, logs and leaf litter. Around and below 1,100 m, vegetation transitions to drier communities dominated by Peppermint (*Eucalyptus dives* and *Eucalyptus robertsonii* subsp. *robertsonii*), Brittle Gum (*Eucalyptus mannifera* subsp. *mannifera*) and Candlebark (*Eucalyptus rubida*) with a moderate to sparse midstorey and sparse grassy groundcover. Here, soils become much rockier and may be less suitable for burrowing. There is a single record from boulder streams aligned with PCT 643 - *Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion*.

A conservative assessment of Smoky Mouse habitat has been undertaken by EMM (2018), with all vegetation not in 'Low' or 'Derived Grassland' conditions classes from the top of Lobs Hole Ravine Road (at the intersection with the Link Road) down to around 1,100 m identified as potential habitat (Figure 2.1). This includes:

- PCT 1196 - *Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion*, excluding areas in 'Low' or 'Derived Grassland' condition classes;
- PCT 639 - *Alpine Ash - Snow Gum shrubby tall open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion*, excluding areas in 'Low' or 'Derived Grassland' condition classes;
- PCT 643 - *Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion*;
- PCT 644 - *Alpine Snow Gum - Snow Gum shrubby woodland at intermediate altitudes in northern Kosciuszko NP South Eastern Highlands Bioregion and Australian Alps Bioregion*; and
- PCT 953 - *Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion*.



Photograph 2.1 Smoky Mouse captured via trapping near the project area



KEY

- Access road upgrade
- Access road extension
- Exploratory tunnel
- Permanent bridge
- Portal construction pad and accommodation camp conceptual layout
- Local road or track
- Watercourse
- Disturbance footprint
- Smoky Mouse potential habitat
- Smokey Mouse survey results
- Smoky Mouse record (14)

Smoky Mouse records and habitat

Snowy 2.0
Biodiversity monitoring program
Exploratory Works
Figure 2.1

2.2 Mitigation measures

In recognition of the location of the project in the Kosciuszko National Park (KNP), and associated biodiversity and other values of the KNP, the project has undergone significant steps to avoid, minimise and mitigate impacts. The main mitigation measure to avoid impacts on Smoky Mouse has been through avoidance of direct impact (clearance) on Smoky Mouse habitat, with only 0.2 ha of known and potential habitat to be cleared for the project.

After substantial efforts to avoid Smoky Mouse habitat, residual indirect impacts that could occur because of the project include:

- vehicle strike during the night time along the upper sections of Lobs Hole Ravine Road when the Smoky Mouse is active. Rare or low density populations, such as the Smoky Mouse, may be at risk of significant impacts and local extinction if this impact is not managed appropriately (Hoskin & Goosem 2010);
- through the introduction of weeds or pathogens such as *Phytophthora* (via increased vehicular movement in the project area) that may impact upon the species' habitat; and
- through increase in feral predator numbers (resulting from increased human activity in the project area) that may prey upon the Smoky Mouse.

To prevent these indirect impacts from occurring, the following mitigation measures are being implemented for the project:

- vehicle movement will be limited to daytime hours only (except for emergencies). Day time hours are to be taken as the time between first light and last light;
- a 40 km/h speed limit will be imposed on Lobs Hole Ravine Road, with night time movements (if required) limited to 20 km/h;
- a weed and pathogen monitoring program and implementation of weed and/or pathogen control programs if weeds and/or pathogens are identified (see Section 4);
- feral species (herbivore and predator) monitoring programs and the implementation of feral species control programs (see Sections 5 and 6);
- wash-down or alternate hygiene protocols will be applied to all vehicles prior to movement from Link Road to Lobs Hole Ravine and vice versa where practicable ;and
- a Smoky Mouse monitoring program, to monitor any changes in habitat, occupancy and population of the species and in proximity to the project, arising from the project (this Section).

As a result of the avoidance and mitigation measures outlined above, direct impacts to Smoky Mouse habitat resulting from the project have been constrained to 0.2 ha. EMM (2018) concluded that additional controls to minimise and mitigate the risk of indirect impacts to the Smoky Mouse would largely avoid these impacts.

2.3 Monitoring objectives

The overarching monitoring objective for the Smoky Mouse is to determine whether controls put in place to avoid and minimise project impacts to the species have avoided impacts to the population, specifically:

- to determine habitat characteristics of occupied habitat, within proximity to the project, and document any changes arising from the project;
- to determine occupancy at previous sites within proximity to the project and document any changes arising from the project; and
- to understand population size within proximity to the project, and document any changes arising from the project.

2.4 Monitoring parameters

To determine if the mitigation measures put into place effectively mitigate indirect impacts to Smoky Mouse as a result of the project, the following parameters will be monitored:

- habitat characteristics;
- occupancy at previous sites; and
- population size.

2.5 Habitat characteristics monitoring

The monitoring of Smoky Mouse habitat characteristics will be undertaken by a suitably qualified ecologist (s) and will be undertaken as detailed in Table 2.1.

Table 2.1 Smoky Mouse habitat characteristics monitoring

Objective
To determine the habitat characteristics of occupied Smoky Mouse habitat, within proximity to the project, and document any changes to the habitat arising from the project.
Sampling units
Habitat complexity at ground level (0.5 m and below).
Method
<p><i>Photopoints</i></p> <p>Photopoints are undertaken along the upper reaches of Lobs Hole Ravine Road to monitors changes in Smoky Mouse habitat characteristics and encompasses the following:</p> <ul style="list-style-type: none"> • A pair of photopoints will be placed at 500 m intervals along the upper sections of Lobs Hole Ravine Road; • For each pair, one photopoint will be placed adjacent to Lobs Hole Ravine Road at 20 m and one photopoint will be placed distant to Lobs Hole Ravine Road at 120 m. Each set of photopoints will be placed perpendicular to the road, as shown in Figure 2.2; • During the first monitoring event (baseline) <ul style="list-style-type: none"> ○ each photopoint location will be micrositied to capture suitable Smoky Mouse habitat (eg logs, coarse woody debris, leaf litter, dense understorey cover and key feed species); ○ photopoints will be south oriented to avoid direct sunlight in the shot and associated glare; ○ permanent markers (eg star picket marked/flagged with monitoring location name) will be installed, along with the coordinates of each monitoring location, in order to relocate for subsequent monitoring events. This will include a larger stake (to relocate the site) and a smaller stake located at 0.5 m above ground level. The second stake will be used to place the camera on top to take the photo. This will ensure subsequent monitoring photos are taken from the same location and aspect; • When taking the photo, take a first photo with the monitoring location written on a board within the photo to enable later identification and a second photo that is the monitoring photo; • Each photograph (taken with the same GPS enabled camera on the same settings each time) will record the habitat complexity at ground level (0.5 m) at each monitoring location; • If photographs won't be curated immediately, include a record board in a bottom corner of each frame, or ensure location marker shows the location number (eg written on with a paint marker); • Ensure not to trample vegetation when first locating then subsequently accessing monitoring locations; and • Data will be collected via the proforma included as Appendix A. This includes the date, weather conditions, recorders, photograph number and other notable features (for example visible disturbance of Smoky Mouse habitat features). <p><i>Transects</i></p> <p>Transects are undertaken along the upper reaches of Lobs Hole Ravine Road to monitors changes in habitat characteristics and encompasses the following:</p> <ul style="list-style-type: none"> • A pair of transects to be placed at 500 m intervals along Lobs Hole Ravine Road; • Each transect to be 50 m and will be placed parallel to Lobs Hole Ravine Road at a distance of 20 m and 120 m from the road verge (Figure 2.3); • The line-point intercept method will be used at 1 m intervals along each 50 m transect; • At each 1 m interval (starting from 1 m) the following data will be recorded: <ul style="list-style-type: none"> ○ any species below 50 cm, to gain an estimate of habitat complexity below 0.5 m; ○ the cover of Smoky Mouse key feed species (listed in Appendix B) below 0.5 m above the ground, using a straight rod. Any intercepts or "hits" of a key feed species (for native shrubs, native grasses and native ground cover) on the rod at and below the 0.5 m mark will be recorded as present (eg if <i>Epacris</i> sp. intercepts the rod at 0.2 m, 0.3 m and 0.5 m, a three would be recorded for this species at this interval. No intercepts of key feed species at each stratum below 0.5 m records a zero; • As data is collected for a total of 50 intervals along each transect, the cover (%) of key feed species for each stratum (native shrubs, native grasses and native ground cover) is calculated by dividing the number of hits by 50, then

Table 2.1 Smoky Mouse habitat characteristics monitoring

<p>multiplying it by 100; and</p> <ul style="list-style-type: none"> • Data will be collected via the proforma included as Appendix A.
<p>Location</p> <p>Upper reaches of Lobs Hole Ravine Road, above 1,100 m, as per the design shown in Figures 2.2 and 2.3 and in identified potential habitat with indicative locations shown on Figure 2.4.</p>
<p>Timing, effort and frequency</p> <p>Frequency for both photo points and transects will comprise two monitoring events per year (biannually – Spring and Autumn) during each project phase (pre-construction, construction and post-construction), commencing in January 2019.</p>
<p>Data analysis</p> <ul style="list-style-type: none"> • Photographs taken at each photopoint location will be downloaded and stored in a suitable folder structure in order to visually compare with the previous monitoring event photograph; • The use of photo boards or cover analysis software will be trialled in order to attempt to streamline the data analysis process; • A photolog should be produced for each monitoring event, that compares the current photograph at each monitoring location with the photograph from the previous monitoring event at the same location; and • Transect data to be kept in a spreadsheet to determine any changes in the cover (%) of key feed species at each transect location between monitoring periods.
<p>Triggers for adaptive management</p> <ul style="list-style-type: none"> • Observed degradation (degradation in structure, loss of key feed species) of habitat characteristics of occupied habitat; and • The observed degradation is combined with an observed increase or new occurrence of a primary impact (weeds, pathogens or feral herbivores as identified within Sections 4, 5 and 6 of this program).

Figure 2.2 Smoky Mouse habitat characteristics monitoring - photopoint set up

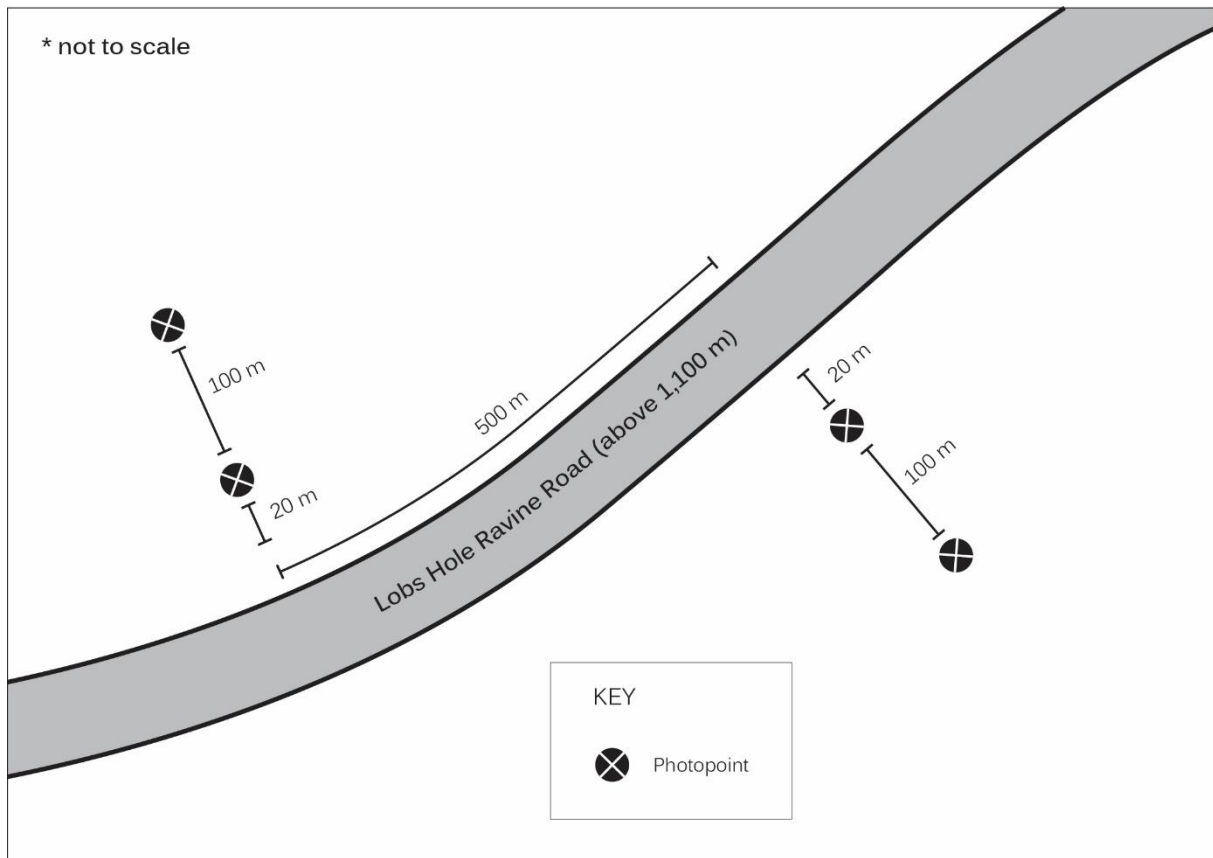
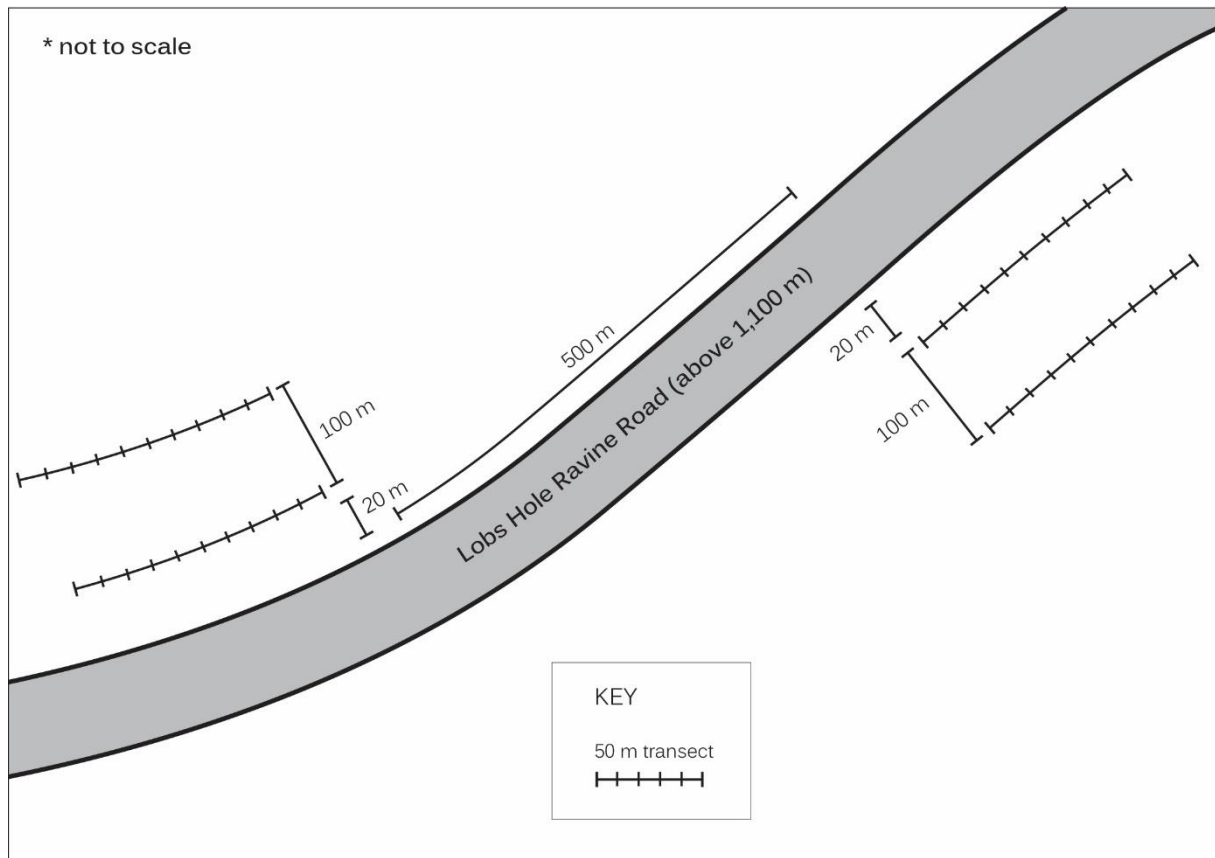
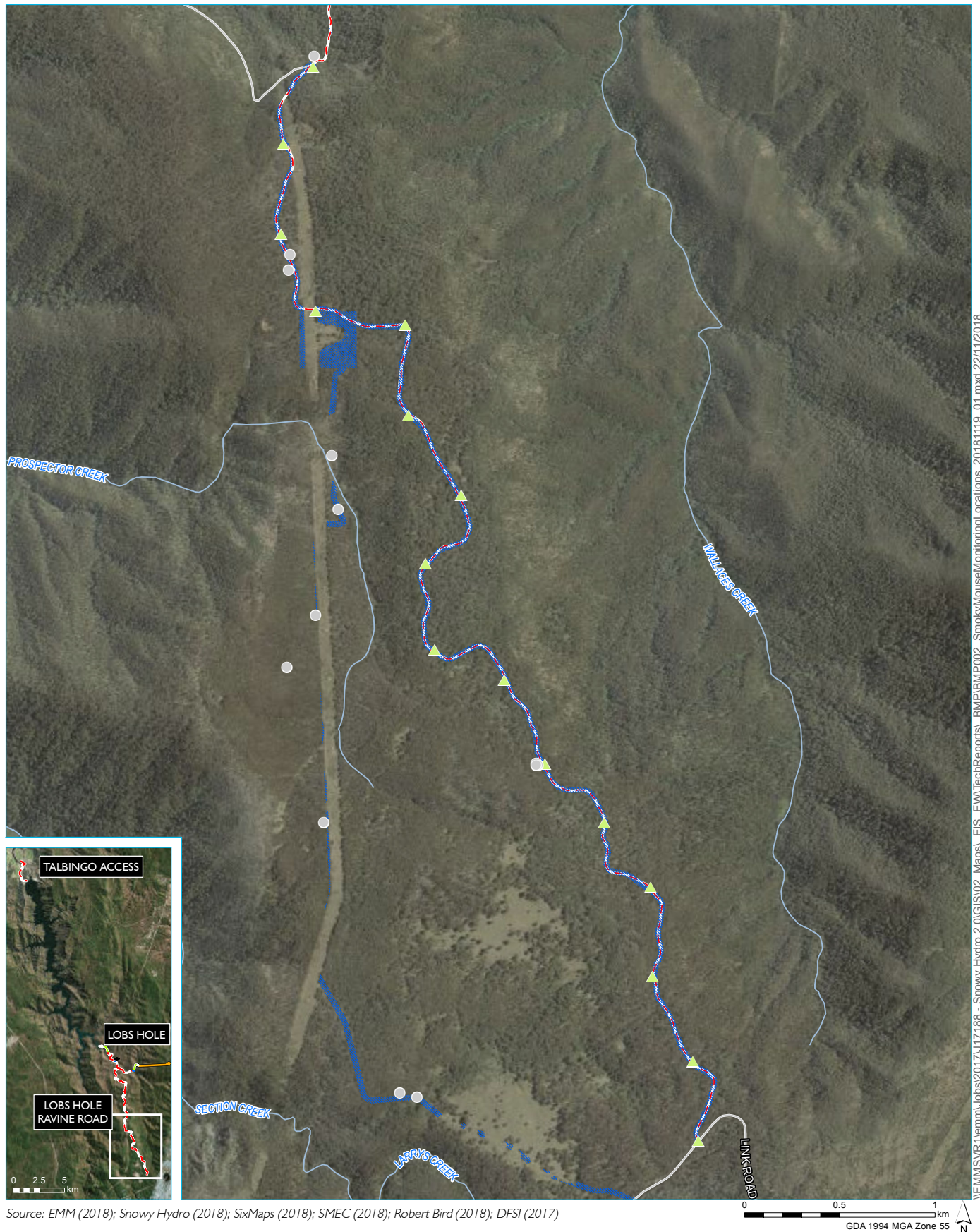


Figure 2.3 Smoky Mouse habitat characteristics monitoring - transect set up





Source: EMM (2018); Snowy Hydro (2018); SixMaps (2018); SMEC (2018); Robert Bird (2018); DFSI (2017)

KEY

- Access road upgrade
- Access road extension
- Exploratory tunnel
- Local road or track
- Watercourse
- Smoky Mouse potential habitat
- ▲ Smoky Mouse monitoring location
- Smoky Mouse record (13)

Smoky Mouse habitat characteristics monitoring - indicative locations

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Biodiversity monitoring program
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Figure 2.4



2.6 Occupancy monitoring

The monitoring of Smoky Mouse occupancy will be undertaken by a suitably qualified ecologist (s) and as detailed in Table 2.2.

Table 2.2 Smoky Mouse occupation monitoring

Objective
To determine Smoky Mouse occupancy (presence/absence) at previous sites within proximity to the project and document any changes as a result of the project.
Sampling units
Remote camera monitoring along Lobs Hole Ravine Road.
Method
<i>Remote camera monitoring</i>
<ul style="list-style-type: none">• Remote cameras will be placed at known (previously surveyed) locations along Lobs Hole Ravine Road (three sites), as well as at 500 m intervals along Lobs Hole Ravine Road;• At each site, a pair of cameras will be placed out, with one camera placed adjacent to Lobs Hole Ravine Road at 20 m and one placed distant to Lobs Hole Ravine Road at 120 m, as shown in Figure 2.5;• Cameras to be attached to a tree or stake and positioned approximately 25 cm above ground with bait stations placed 1.5 m away;• Bait station to be baited with walnuts;• Microsite cameras to face suitable Smoky Mouse habitat (eg logs, coarse woody debris, leaf litter, dense understorey cover and key feed species) (see Photograph 2.2);• Trimming of vegetation with hand held shearers directly between the camera and bait station may be required to avoid vegetation from obscuring the view of an animal investigating the bait or that might cause the camera to false trigger;• Cameras are placed out for a minimum of one month per survey (Nelson et al. 2009) detected Smoky Mouse on baited cameras on or before the tenth night of a survey); and• Coordinates to be recorded at each camera location, in order to repeat the method during each subsequent monitoring event.
Location
Upper reaches of Lobs Hole Ravine Road, above 1,100 m, as per the design shown in Figure 2.5 and in identified potential habitat with indicative locations shown on Figure 2.6.
Timing, effort and frequency
<ul style="list-style-type: none">• A monitoring event is defined as minimum one month deployment of all camera traps as per the layout explained in methods; and• Frequency will comprise three monitoring events per year (or every four months) during each project phase (pre-construction, construction and post-construction), commencing in January 2019.
Data analysis
<ul style="list-style-type: none">• Animals captured on digital images are to be identified with reference to appropriate field guides and by consultation with Smoky Mouse experts, if required;• Data to be kept in a spreadsheet to determine presence/absence between monitoring periods; and• Data trends to be analysed by a suitably qualified person, in order to detect absence or decline.
Triggers for adaptive management

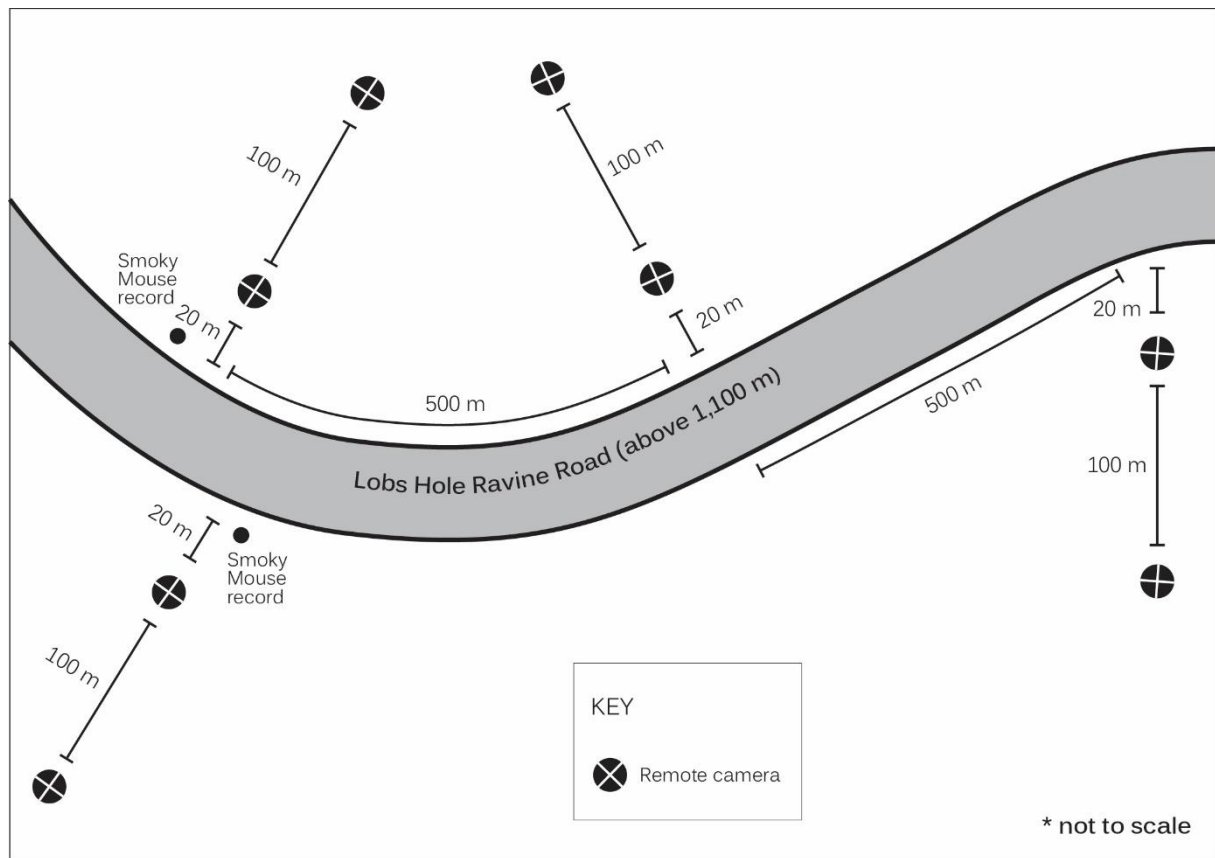
Table 2.2 **Smoky Mouse occupation monitoring**

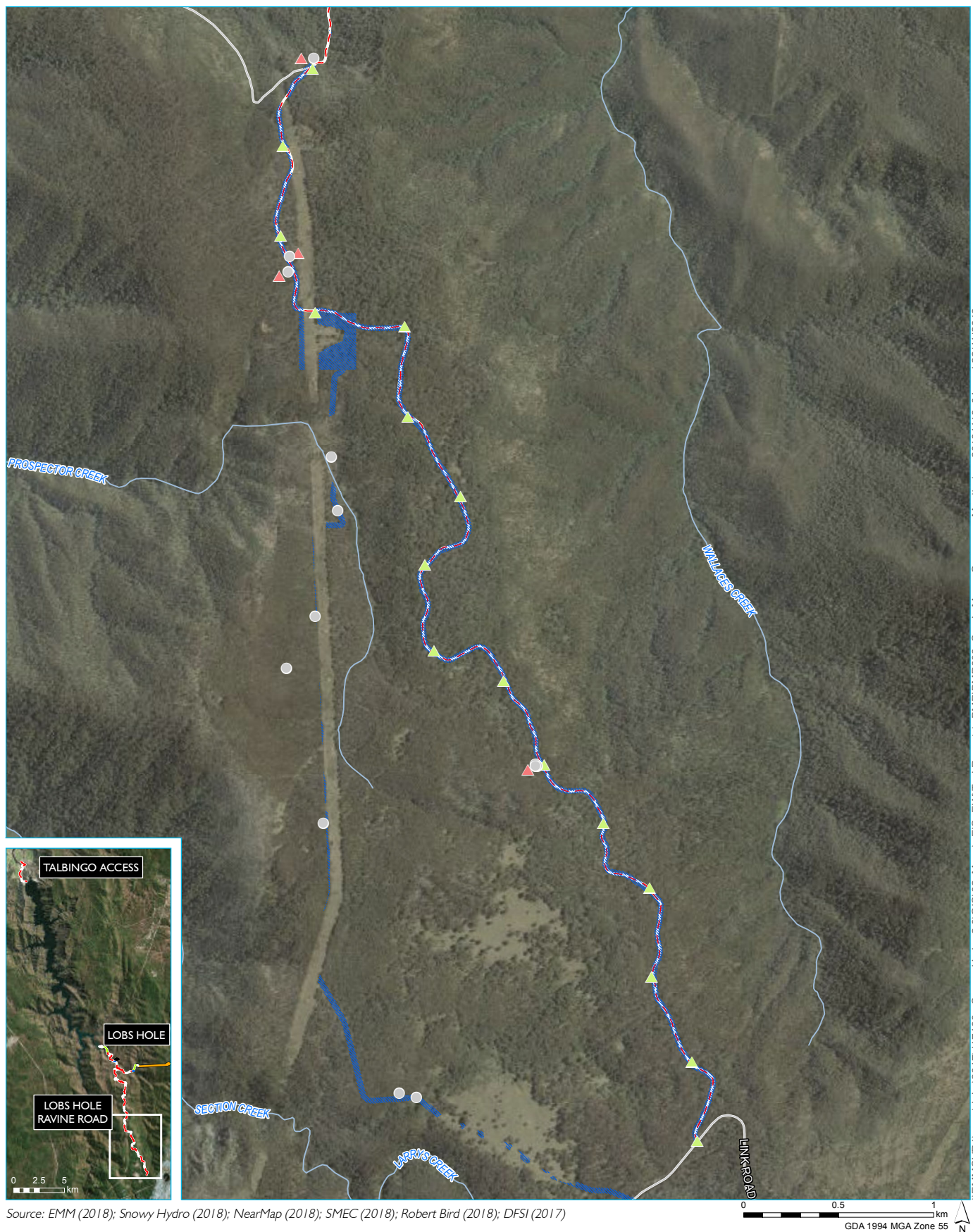
-
- Absence of Smoky Mouse from >50% of sites where the species was recorded during baseline surveys, as monitored during construction; and
 - Absence recorded for greater than one year; and
 - The absence is combined with an observed increase or new occurrence of a primary impact (weeds, pathogens, or feral herbivores/predators as identified within Sections 4, 5 and 6 of this program).
-



Photograph 2.2 **Smoky Mouse captured on remote camera near the project area, showing suitable habitat features**

Figure 2.5 Smoky Mouse occupancy monitoring - remote camera set up





KEY

- - Access road upgrade
- - Access road extension
- - Exploratory tunnel
- - Local road or track
- - Watercourse
- ▨ Smoky Mouse potential habitat
- ▲ Smoky Mouse monitoring location
- ▲ Monitoring location of Smokey Mouse survey records
- Smoky Mouse record (13)

Smoky Mouse occupancy monitoring - indicative locations

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Figure 2.6

2.7 Population monitoring

The monitoring of Smoky Mouse population will be undertaken by a suitably qualified ecologist (s) and as detailed in Table 2.3.

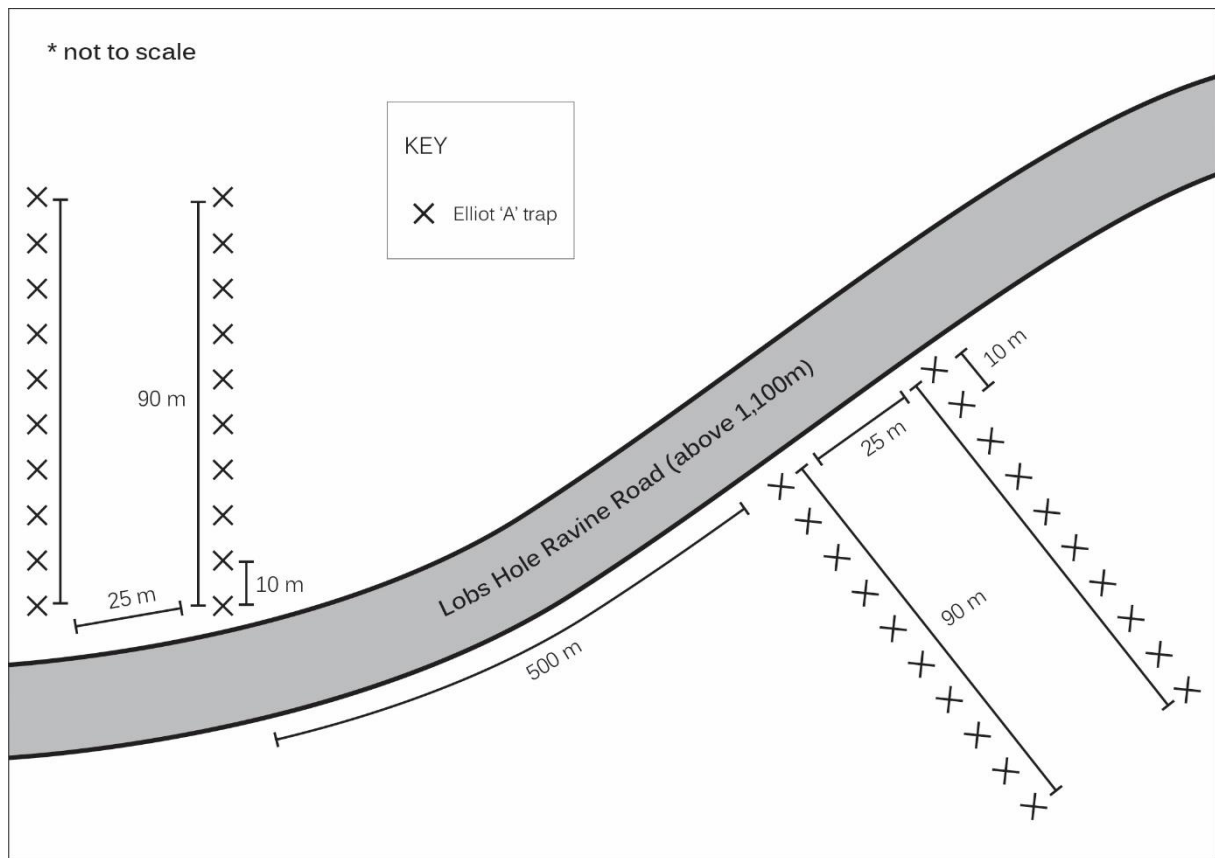
Table 2.3 Smoky Mouse population monitoring

Objective
To understand Smoky Mouse population size within proximity to the project and document any changes as a result of the project.
Sampling units
Trapping and pit tagging within identified habitat in proximity to the project area.
Method
<p><i>Trapping and pit tagging</i></p> <ul style="list-style-type: none"> • Elliot A traps will be placed at known (previously surveyed) locations along Lobs Hole Ravine Road; • Traps will be placed in parallel transects, at 500 m intervals along Lobs Hole Ravine Road; • At each monitoring location, 20 Elliot A traps will be placed 10 m apart in two parallel lines (each line being 90 m) separated by 25 m and perpendicular to the road (Figure 2.7); • Coordinates to be recorded at each trap transect location, in order to successfully find the traps during each monitoring event and well as repeat the method during each subsequent monitoring event; • Traps to be placed out for 4 nights per monitoring period; • Traps to be baited with walnuts; • Traps checked early in the morning and closed for the day; • Traps opened and rebaited in the late afternoon; • Smoky Mouse captured to be pit tagged to allow mark-recapture data; and • Trapping and pit tagging to be undertaken as per best practice methods and under appropriate scientific and animal ethics licences.
Location
Upper reaches of Lobs Hole Ravine Road, above 1,100 m, as per the design shown in Figure 2.7 and in identified known habitat (previously recorded) and potential habitat as per the locations for occupancy monitoring and as shown in Figure 2.6.
Timing, effort and frequency
<ul style="list-style-type: none"> • A monitoring event is defined as 4 nights deployment of the traps as per the layout explained in methods and shown in Figure 2.7; • Frequency will comprise three monitoring events per year (one event approximately every four months) during each project phase (pre-construction, construction and post-construction), commencing in January 2019; and • It is noted that frequency of trapping for monitoring studies and repeated capture of pregnant or lactating females should be kept to a minimum (Nelson et al 2009). This will be mitigated by closing traps if lactating females are captured.
Data analysis
<ul style="list-style-type: none"> • Animals captured are to be identified and pit-tagged by a suitably qualified ecologist with reference to appropriate field guides and in consultation with Smoky Mouse experts; • Data to be kept in a spreadsheet to determine population trends between monitoring periods; and • Data trends to be analysed by a suitably qualified person, in order to detect any decline in population.
Triggers for adaptive management
<ul style="list-style-type: none"> • A statistically significant population decline (that upon review by species experts, is also considered as biologically significant) occurs during construction and/or post-construction when compared with pre-construction surveys. Given the variability of natural systems, a statistically significant population decline is here defined as an alpha value of 0.1;

Table 2.3 **Smoky Mouse population monitoring**

and
<ul style="list-style-type: none">• The decline is combined with an observed increase or new occurrence of a primary impact (weeds, pathogens, or feral herbivores/predators as identified within Sections 4, 5 and 6 of this program).

Figure 2.7 Smoky Mouse population monitoring - trapping set up



3 Booroolong Frog monitoring program

3.1 Baseline conditions

Surveys for the Booroolong Frog were completed for the *Snowy 2.0 Exploratory Works, Biodiversity Development Assessment Report* (EMM 2018). The Booroolong Frog was recorded at 59 locations within the survey area along the Yarrangobilly River, from the full supply level (FSL) of Talbingo Reservoir to the upper reaches of the Yarrangobilly River, as well as along Wallaces Creek (Figure 3.1). It is likely that this population extends upstream to at least Blue Creek Fire Trail (Dave Hunter OEH, pers. comm.).

Water quality sampling has been undertaken by EMM (2018) at four locations in the Yarrangobilly River and at three locations in Wallaces Creek, with samples obtained on three occasions between February to April 2018. All sampling was undertaken during base flow conditions. A summary of the water quality results is presented in Appendix C. Key results from water quality sampling are summarised as follows:

- pH ranged between 7.5 to 8.4, within the ANZECC (2000) guideline range of 6.8 to 8.5;
- electrical conductivity (an indicator of salinity) ranged between 32 to 185 $\mu\text{S}/\text{cm}$, within the guideline range of 30 to 350 $\mu\text{S}/\text{cm}$;
- suspended solids and turbidity were consistently either below detection limits or within the lower end of the guideline range. This is in line with expectations given the clear appearance of the water;
- phosphorus and nitrogen concentrations were below guideline values in all samples except for a single sample from the Yarrangobilly River that recorded a Nitrate concentration of 1.9 mg/L; and
- all dissolved metal concentrations were below guideline values following hardness adjustments except for:
 - a single sample of Aluminium that was marginally elevated relative to the guideline value;
 - all samples of Barium were elevated relative to the low reliability trigger value; and
 - a single sample of Fluoride that was elevated relative to a low reliability trigger value.

These results indicate the Yarrangobilly River is in good condition, reflecting the predominantly undisturbed catchment contained within a national park.

The Yarrangobilly River provides optimal breeding habitat for Booroolong Frog, with a series of cobble banks and bedrock structures along stream margins, with slow-flowing water. These areas are connected by larger, slow-flowing pools. Breeding habitat in Wallaces Creek is much more limited, with only small sections providing suitable breeding habitat. It is likely this area provides sub-optimal breeding habitat as well as connective and dispersal habitat.

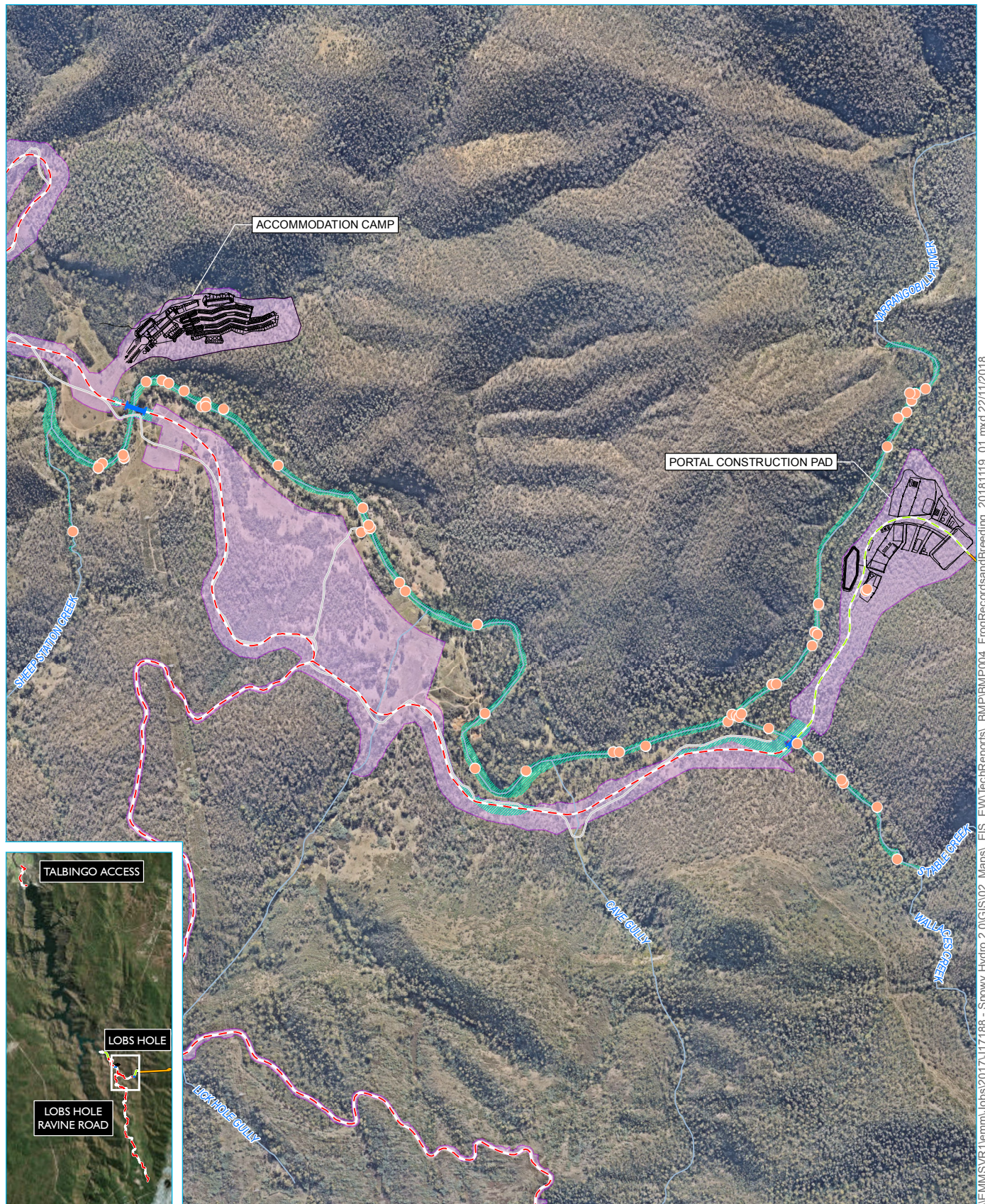
During the breeding season the species shelters under rocks or amongst vegetation near the ground on the stream edge (Anstis 2002, Robinson 1993). In winter, the frogs have been observed under rocks within the riparian zone (Anstis et al. 1998, OEH 2012). The Booroolong Frog is not known to move very far along the stream from where they are recorded (less than 50 m within a season) with maximum movements recorded being 300 m (Hunter 2001). During targeted surveys, the Booroolong Frog was observed up to 130 m from the Yarrangobilly River during a high rainfall event that saw key breeding

habitat flooded. During this period the majority of frogs were observed within the riparian zone (ie within 50 m of the Yarrangobilly River, see Figure 3.1).

Based on the above information, the Yarrangobilly River and Wallaces Creek have been identified as breeding habitat, while areas within 50 m of this breeding habitat has been identified as potential dispersal and refuge habitat (Figure 3.1).



Photograph 3.1 **Booroolong Frog captured within the project area**



Source: EMM (2018); Snowy Hydro (2018); NearMap (2018); SMEC (2018); Robert Bird (2018); DFSI (2017)

KEY

- - Access road upgrade
- - Access road extension
- - Exploratory tunnel
- - Permanent bridge
- - Portal construction pad and accommodation camp conceptual layout
- - Local road or track
- - Watercourse
- - Disturbance footprint
- - Amphibian survey results
- - Booroolong Frog
- - Booroolong Frog - breeding habitat

Booroolong Frog records and breeding habitat

Snowy 2.0
Biodiversity monitoring program
Exploratory Works
Figure 3.1

3.2 Mitigation measures

In recognition of the location of the project in the Kosciusko National Park (KNP), and associated biodiversity and other values of the KNP, the project has undergone significant steps to avoid, minimise and mitigate impacts. The main mitigation measure to avoid impacts on Booroolong Frog has been through avoidance of direct impact (clearance) on Booroolong Frog habitat. Early in the design phase of the project, a key measure to avoid impacts to Booroolong Frog has been the development of a buffer along the Yarrangobilly River of 50 m, and avoidance of works within this buffer area to protect the species' habitat. In consultation with species experts from OEH, it was determined that if works can be avoided within this 50 m buffer direct impacts to Booroolong Frog can be avoided, along with most indirect impacts.

After substantial efforts to avoid Booroolong Frog habitat, residual direct impacts that will occur as a result of the project include:

- the proposed road upgrade will impact on the 50 m buffer at three locations:
 - the bridge over the Yarrangobilly River;
 - the bridge over Wallaces Creek; and
 - along Mine Trail Road in the eastern section of Lobs Hole.

Residual potential indirect impacts that could occur as a result of the project include:

- the mobilisation of large amounts of coarse sediments into Booroolong Frog habitat, with the key period for mobilisation being during initial earthworks for the road upgrades; and
- the potential for contamination of receiving waters due to accidental leaks and spills or surface water discharge.

To prevent these indirect impacts from occurring, the following mitigation measures are being implemented for the project:

- a sedimentation and erosion control plan will be prepared for each construction zone for the project with a range of sediment controls being put into place within the disturbance footprint and to mitigate any impacts to the Yarrangobilly River (see Sedimentation and Erosion Control Plan);
- during construction and operations frog exclusion fencing will be installed in key areas where infrastructure is near Booroolong Frog primary habitats such as the bridge crossings. The fencing will be designed to minimise frogs from being able to access the road crossing;
- fauna spotters will check areas prior to clearing for Booroolong Frog and translocate them to adjacent habitats away from impacts;
- a surface water management plan will be prepared for the project with a range of surface water controls being put into place within the disturbance footprint and to mitigate any impacts to the Yarrangobilly River (see Surface Water Management plan).
- no water will be extracted from the Yarrangobilly River for the project, all water will be sourced from the Talbingo Reservoir;

- a surface water monitoring program will be implemented to ensure run-off does not result in changes in water quality within the Yarrangobilly River (see this Section and the Surface Water Monitoring Program – Appendix B.3 of the CEMP); and
- it is intended that the exploratory tunnel, portal and construction portal will be decommissioned and rehabilitated following completion of the project.

Following measures to avoid impacts to Booroolong Frog and its habitat outlined in EMM (2018) the project will result in direct impacts to 2.04 ha of habitat for the Booroolong Frog. The implementation of a 50 m buffer will also avoid the majority of indirect impacts. To determine the effectiveness of this control measure EMM (2018) recommended a monitoring program will be implemented, and include the following:

- water quality monitoring;
- population monitoring; and
- habitat monitoring.

3.3 Monitoring objectives

The overarching monitoring objective for Booroolong Frog is to determine whether controls put in place to avoid and minimise project impacts to the species have avoided impacts to the population, specifically:

- to determine ongoing population trajectory of the Yarrangobilly Booroolong Frog population;
- to compare shifts in distribution and abundance of Booroolong Frog rocky breeding habitat between treatment (Yarrangobilly River and Wallaces River within Lobs Hole in the project area) and control (upstream of the project area) sections of the Yarrangobilly River;
- to compare changes in the depth of pools between treatment and control sections of stream; and
- to identify and quantify any water quality impacts (within the Yarrangobilly River and Wallaces Creek) arising from the project that may impact upon the Booroolong Frog.

3.4 Monitoring parameters

To determine if the mitigation measures put into place effectively mitigate indirect impacts to Booroolong Frog as a result of the project, the following parameters will be monitored:

- population;
- habitat characteristics; and
- surface water quality.

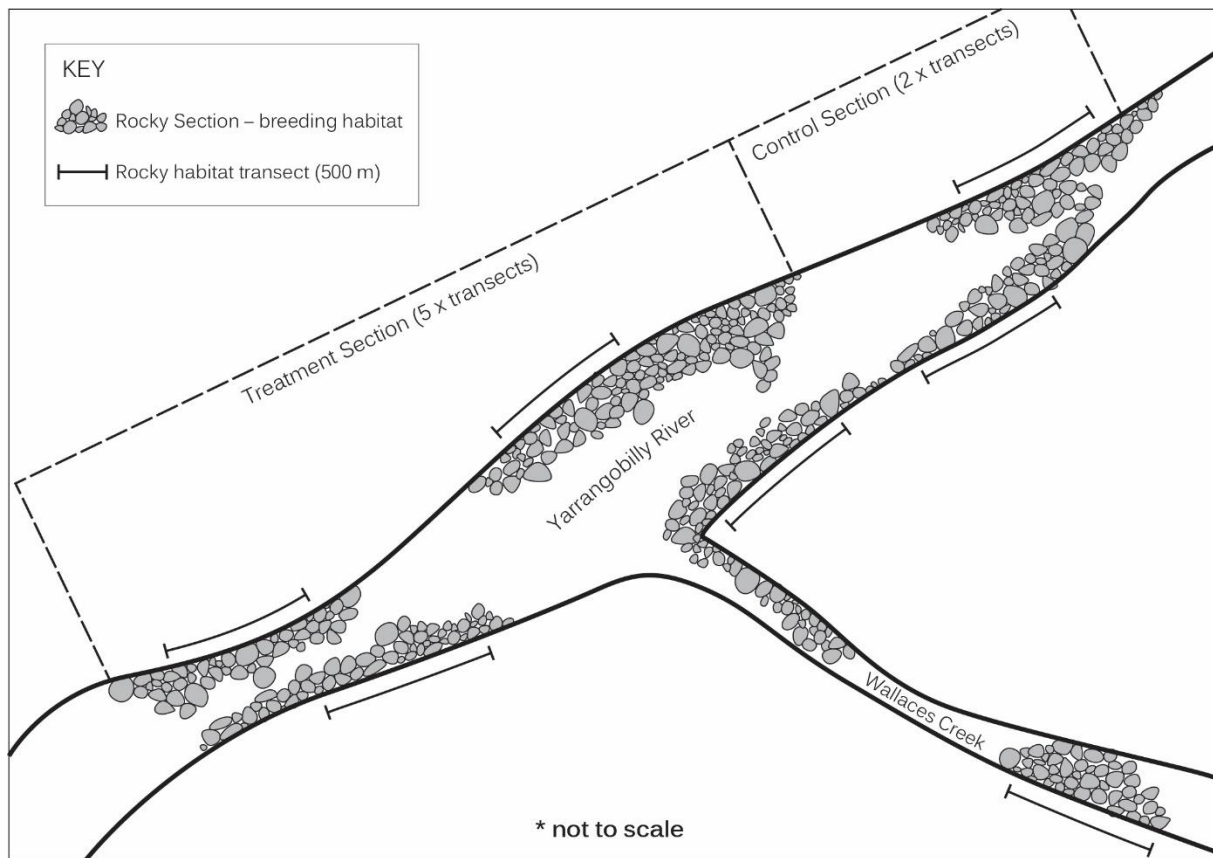
3.5 Population monitoring

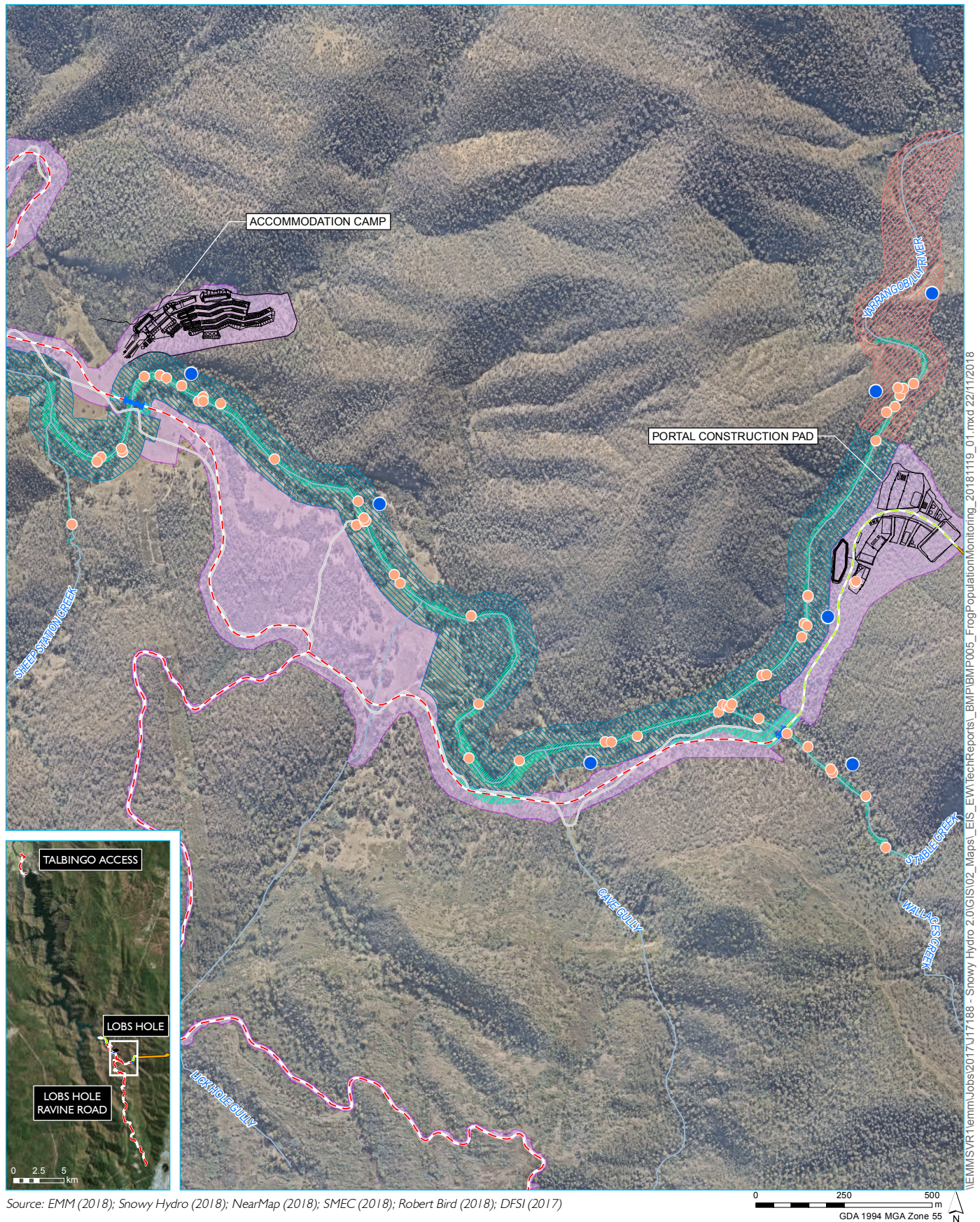
The monitoring of Booroolong Frog population will be undertaken by a suitably qualified ecologist(s) and will be undertaken as detailed in Table 3.1.

Table 3.1 Booroolong Frog population monitoring

Objective
To determine ongoing population trajectory of the Yarrangobilly Booroolong Frog population, and document any changes arising from the project.
Sampling units
Occupancy (presence/absence) and relative abundance of male frogs along rocky sections of stream bank (breeding habitat) along the Yarrangobilly River and Wallaces Creek.
Method
<p><i>Stream transects</i></p> <p>Stream transects are undertaken along rocky sections (breeding habitat) of the Yarrangobilly River and Wallaces Creek. This method is particularly focused on determining the occupancy of breeding habitat by mature male frogs and will encompass the following:</p> <ul style="list-style-type: none"> • Spotlighting within the riparian zone for eye-shine; • Spotlighting to occur in representative transects along the Yarrangobilly River and Wallaces Creek of 500 m in length; • Two observers to walk each 500 m transect using a spotlight and headtorches; • Hygiene protocols to be followed to prevent the spread of chytrid fungus; • The location, sex, and total number of frogs observed during each census to be recorded; and • Data will be collected via the proforma included as Appendix B. This includes recording, as a minimum, the date, weather conditions, count, sex, location (easting and northing as well as descriptive attributes), accuracy of location recorded and recorders.
Location
A total of five transects will be located within the sections of streams subject to the project works (treatment section, four in Yarrangobilly River, one in Wallaces Creek), as well as two transects within the control section upstream of the works, along the Yarrangobilly River. Each transect is to be located along rocky sections of stream bank (breeding habitat). See Figure 3.2 for an indicative layout of the transect set up and Figure 3.3 for indicative locations within the treatment and control sections.
Timing, effort and frequency
<ul style="list-style-type: none"> • Surveys will be undertaken at night during the breeding season (November to mid-December); • Surveys will be undertaken during suitable conditions (no rain, low stream flows, relatively light wind and air temperature above 10 degrees); • Each 500 m transect will be surveyed for frog abundance each year on two separate occasions between the start of November and mid-December; and • More than four nights and two observers may be required to survey all indicated transects four times within each of the two events.
Data analysis
<ul style="list-style-type: none"> • Breeding habitat is defined as an area of rocky habitat occupied by one or more mature male Booroolong Frog during the breeding season; • The collected data should be entered into a database for comparison of occupancy of Booroolong Frog in identified breeding habitat between each breeding season; and • The monitoring of control sections upstream of the project area will help to determine if any identified changes in occupancy in breeding areas within the treatment section are a result of the project or otherwise other abiotic factors (if the same changes are also observed in the control section upstream of the project).
Triggers for adaptive management
<ul style="list-style-type: none"> • A decline in relative abundance (that upon review by species experts, is also considered as biologically significant) occurs during construction and/or operation at impact sites and that does not also occur at the control sites; • Decline in relative abundance is accompanied by a decline in other monitoring parameters (see Section 3.6 and 3.7 below).

Figure 3.2 **Booroolong Frog population monitoring - transect set up**





KEY

- - - Access road upgrade
- - - Access road extension
- - - Exploratory tunnel
- - - Permanent bridge
- - - Portal construction pad and accommodation camp conceptual layout
- - - Local road or track
- - - Watercourse

- Indicative monitoring location
- Disturbance footprint
- Control section
- Treatment section
- Amphibian survey results
- Booroolong Frog
- Booroolong Frog - breeding habitat

Booroolong Frog population monitoring - indicative locations

Snowy 2.0
Biodiversity monitoring program
Exploratory Works
Figure 3.3



3.6 Habitat characteristics monitoring

The monitoring of Booroolong Frog habitat characteristics will be undertaken by a suitably qualified ecologist (s) and will be undertaken as detailed in Table 3.2.

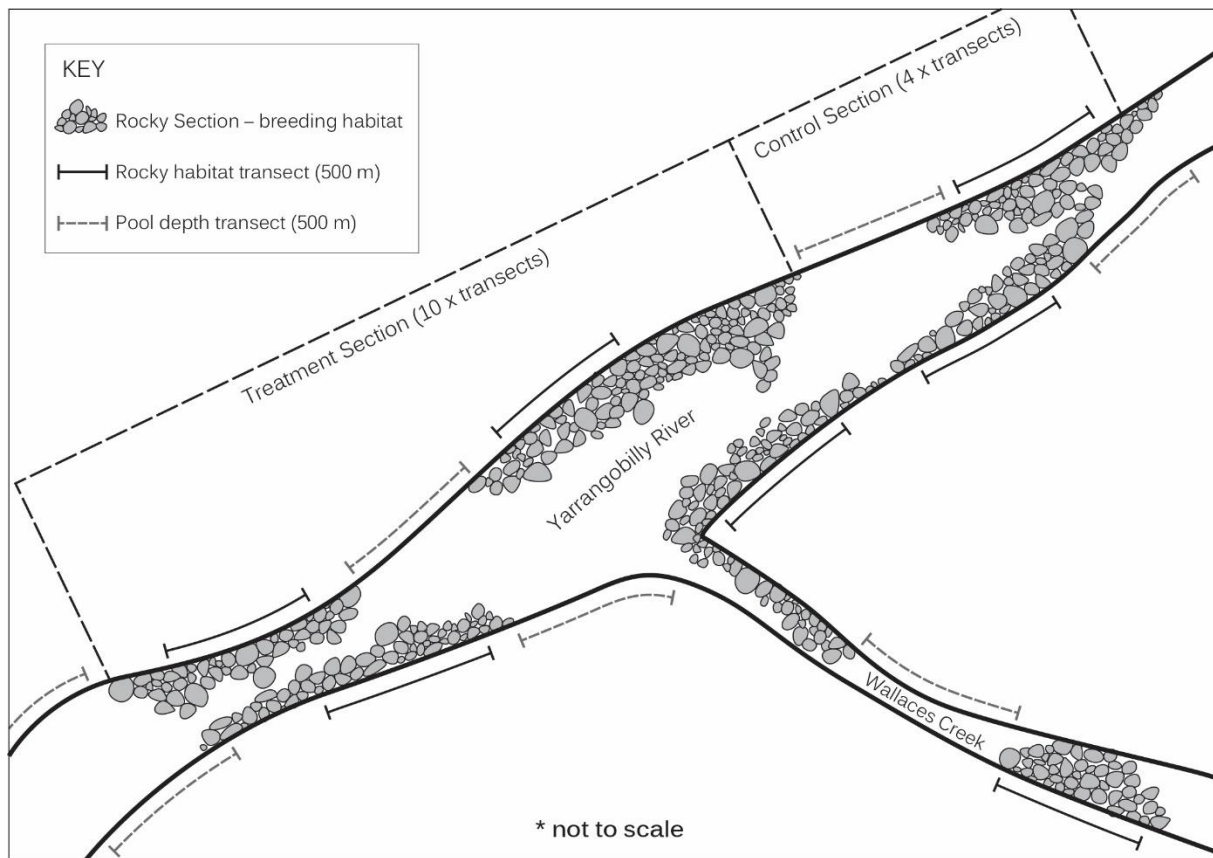
Table 3.2 Booroolong Frog habitat characteristics monitoring

Objective
<p>To monitor rocky breeding habitat and depth of pools within sections of the Yarrangobilly River and Wallaces Creek that occur within the project area, and document any changes arising from the project. Specific objectives are:</p> <ul style="list-style-type: none">• to compare shifts in distribution and abundance of rocky breeding habitat between treatment (Yarrangobilly River and Wallaces Creek in the project area) and control sections of the Yarrangobilly River (upstream of the project area); and• to compare changes in the depth of pools between treatment and control sections of stream.
Sampling units
<ul style="list-style-type: none">• Rocky sections of stream bank (breeding habitat) in treatment and control sections; and• Depth of pools in treatment and control sections.
Method
<p><i>Rocky breeding habitat monitoring</i></p> <ul style="list-style-type: none">• Measures the distribution, type, and length of rocky habitats along the stream banks of the Yarrangobilly River and Wallaces Creek within the treatment sections (five representative transects measuring 500 m in length, four in Yarrangobilly River and one in Wallaces Creek) and also along the stream banks of the control section of the Yarrangobilly River (two representative transects measuring 500 m in length). The location of these transects could be replicated from the population monitoring transects. Rock type is divided into two broad categories:<ul style="list-style-type: none">- cobble banks - a section of stream bank greater than 2 m in length with a continuous cover of loose rock; and- bedrock banks - defined as a section of stream bank greater than 2 m in length with a continuous cover of solid rock that is embedded in the ground.• Sections of habitat are recorded separately where they are separated by more than 1 m of unsuitable habitat;• A GPS waypoint is taken to record the location of the start of each section of breeding (rocky) habitat, with the position of the habitat also recorded as left bank, right bank, or middle (when facing upstream);• The length of each rocky section is measured in metres, relative to the approximate centre-line of the stream. <p><i>Pool depth monitoring</i></p> <ul style="list-style-type: none">• A pool is defined as a discrete deeper section of stream with relatively slow flow;• Pool depth monitoring is recorded when a GPS waypoint is taken to record the location of the centre of each pool;• The location and approximate maximum depth of each pool is recorded in centimetres, as well as the pool length in metres, to the nearest 10 cm;• Pool depth monitoring is to occur within the treatment sections of the Yarrangobilly River and Wallaces Creek (five representative transects measuring 500 m in length, four in Yarrangobilly River and one in Wallaces Creek) and also along the control section of the Yarrangobilly River (two representative transects measuring 500 m in length). These transects cannot be replicated from the rocky breeding habitat monitoring and population monitoring as they are measuring pool depth;• Data will be collected via the proformas included as Appendix A. This includes recording the information explained above for both rocky breeding habitat monitoring and pool depth monitoring, as well as the date, weather conditions, accuracy of locations mapped, photos of each area of habitat recorded (with GPS enabled camera), any other notable features (for example visible disturbance) and recorders;• Data will be imported into a Geographic Information System (GIS) database in order to digitally map the identified habitat;• The GPS enabled photographs and notes on the identified habitat will be attached to each mapped area within the GIS mapping. This will allow comparison of data and habitat mapping between each monitoring period.

Table 3.2 Booroolong Frog habitat characteristics monitoring

Location
<p><i>Rocky breeding habitat monitoring</i></p> <p>A total of five representative transects will be located within the sections of streams subject to the project works (treatment section, four in Yarrangobilly River, one in Wallaces Creek), as well as a total of two transects within the control section upstream of the works, along the Yarrangobilly River. Each transect is to be located along rocky sections of stream bank (breeding habitat).</p> <p><i>Pool depth monitoring</i></p> <p>A total of five representative transects will be located within the sections of streams subject to the project works (treatment section, four in Yarrangobilly River, one in Wallaces Creek), as well as a total of two transects within the control section upstream of the works, along the Yarrangobilly River. Each transect is to be located along representative areas with pools.</p> <p>See Figure 3.4 for an indicative layout of the transects set up. Indicative monitoring locations within the treatment and control sections are not shown, as suitable locations will need to be determined during the first monitoring event.</p>
Timing, effort and frequency
<p>The entire treatment section and control section will be mapped on a yearly basis, and after any surface water incidents that have the ability to mobilise large amounts of coarse sediments into Booroolong Frog habitat, with the key period for mobilisation being during initial earthworks for the road upgrades.</p>
Data analysis
<ul style="list-style-type: none"> • Data and habitat mapping from each monitoring event will be compared to that collected and mapped for the previous monitoring event; • This will allow detection of any changes in rocky breeding habitat and pool depth along the treatment sections; and • The monitoring of control sections upstream of the project area will help to determine if any identified changes within the treatment streams are a result of the project or otherwise other abiotic factors (if the same changes are also observed in the control section upstream of the project).
Triggers for adaptive management
<ul style="list-style-type: none"> • Observed degradation, change or loss of rocky (breeding) habitat or pools within the Yarrangobilly River and Wallaces Creek that occur within the treatment section, that is not also observed in the control section of the Yarrangobilly River (upstream of the project area).

Figure 3.4 Booroolong Frog habitat characteristics monitoring – transect set up



3.7 Surface water quality monitoring

Appendix B3 of the CEMP contains the Surface Water Management Plan (SWMP) and related Surface Water Monitoring Program (Appendix B of the SWMP) for the project.

An Environment Protection Licence (EPL) EPL 21266 has been obtained for the project. The EPL prescribes water quality parameters to be measured and associated discharge criteria for licenced stormwater basins and construction sediment basins. It also details the monitoring and analytical requirements by reference to authority publications eg *Approved Methods for Sampling and Analysis of Water Pollutants in NSW*, 2004.

Mobilisation of fine sediments into the watercourses located in the project area is unlikely to result in long-term impacts to habitat for the Booroolong Frog; these events will be pulse events and will be rapidly flushed out of the system resulting in negligible impacts to this species (Dave Hunter OEH pers. comm.). Likewise, short term reductions in water quality are unlikely to result in impacts to habitat for the Booroolong Frog, as they will be rapidly flushed out of the system. The key mechanism for impacting on habitat for the Booroolong Frog will be mobilisation of large amounts of sediment, which clog interstitial spaces providing key breeding habitat for the Booroolong Frog, or long term negative changes to water quality.

The data collected during regular monitoring for the Surface Water Monitoring Program will be used to monitor surface water quality for the Booroolong Frog. The surface water quality monitoring will be undertaken by a suitably qualified person(s) with those parameters of importance to the Booroolong Frog, its habitat and monitoring within the project area detailed in Table 3.3.

Table 3.3 Booroolong Frog surface water quality monitoring

Objective
To identify and quantify any surface water quality impacts (within the Yarrangobilly River and Wallaces River) arising from the project, that may impact upon the Booroolong Frog.
Sampling units
<ul style="list-style-type: none">• Weather;• Volumetric discharge;• Stormwater; and• Full suite of water quality parameters.
Method
The following monitoring will be undertaken for the Surface Water Monitoring Program: <i>Weather station</i> <ul style="list-style-type: none">• An automated weather station will be installed within Lobs Hole to accurately account for rainfall across the site during rain periods (Figure 3.5). <i>Stream gauges</i> <ul style="list-style-type: none">• Stream gauges are located or will be installed within the project area to record volumetric discharge (Figure 3.5). <i>Flow meters</i> <ul style="list-style-type: none">• Flow meters will be installed at all process water monitoring locations to determine water usage and the net extraction or discharge to Talbingo Reservoir during construction. <i>Stormwater monitoring</i> <ul style="list-style-type: none">• Stormwater monitoring will occur at the ponds that receive runoff from the construction pad and accommodation camp (SW_1, SW_2, SW_3, as shown in Figure 3.5).

Table 3.3 Booroolong Frog surface water quality monitoring

Water quality monitoring

The Surface Water Monitoring Program will monitor a suite of physiochemical properties, nutrients, metals (dissolved) and oxygen demand parameters as well as include visual inspection of erosion and sediment controls and downstream drainage within the treatment sections and the control section, upstream of the project in the Yarrangobilly River. These parameters will be measured at locations LH_SW_1 and LH_SW_2 (controls) through LH_SW_9 (Figure 3.5) and will include:

- Physiochemical properties to be measured via a portable water quality meter in the field including pH, electrical conductivity (EC), turbidity, dissolved oxygen, temperature and oxidising and reducing potential (ORP);
- Physiochemical properties to be measured via analysis undertaken by a NATA certified laboratory including major cations (Na, K, Mg, Ca), major anions (Cl, SO₄, HCO₃ and CO₃), total suspended solids, total dissolved solids, total hardness, and total recoverable hydrocarbons;
- Nutrients to be measured via analysis undertaken by a NATA certified laboratory include total nitrogen, ammonia, nitrate, nitrite, and total kjeldahl nitrogen;
- Metals (dissolved) to be measured via analysis undertaken by a NATA certified laboratory include Al, As, Ag, B, Ba, Cr (total), Co, Cd, Cu, Fe, Hg, Mn, Ni, Pb, Se, V and Zn; and
- Oxygen demand properties to be measured via analysis undertaken by a NATA certified laboratory include Chemical oxygen demand and Biological oxygen demand.

Large amounts of coarse sediments, as a result of surface water runoff within the project area, have been identified as being the key potential impact to Booroolong Frog habitat within the treatment sections and therefore monitoring of TSS will be useful. The other parameters have not been identified as having a potential significant impact to the Booroolong Frog or its habitat within the treatment sections (Dave Hunter OEH pers. comm. 11 October 2018). However, these parameters will be useful to review when attempting to identify any potential causes or correlations with impacts to the species habitat or population.

Location

The above parameters will be monitored at each of the monitoring locations as shown on Figure 3.5.

Timing, effort and frequency

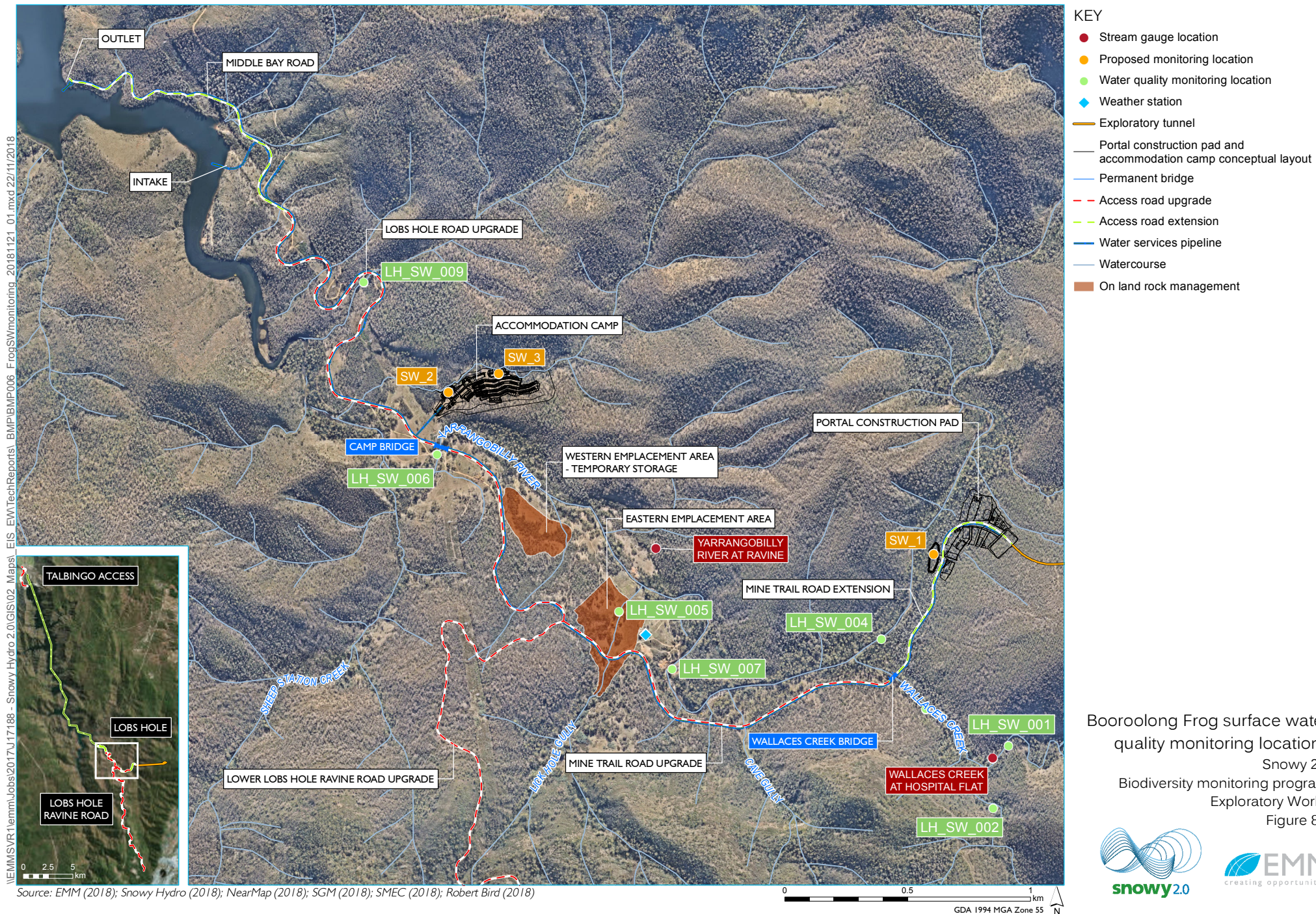
- *Weather station*: continuous;
- *Stream gauges*: continuous;
- *Flow meters*: continuous;
- *Stormwater monitoring*: quarterly;
- *Water quality monitoring*: monthly and after any surface water incidents that have the potential for contamination of receiving waters due to accidental leaks and spills or surface water discharge (especially discharge with high sediment loads) (event based); and
- Liaison between the site environmental representative, the project scientist in charge of surface water monitoring and the project Ecologist in charge of Booroolong Frog monitoring is essential to share collected water quality data and to respond effectively to event based monitoring, if required.

Data analysis

- Data from each monitoring event and parameter to be suitable stored (eg excel datasheet) to allow water quality data to be reviewed to identify any potential causes or correlations, to inform adaptive management.

Triggers for adaptive management

- Decline in water quality for three consecutive monitoring periods, coupled with declines in other Booroolong Frog monitoring criteria (see above sections).



4 Weed and pathogen monitoring program

4.1 Baseline conditions

Vegetation surveys were completed for the *Snowy 2.0 Exploratory Works, Biodiversity Development Assessment Report* (EMM 2018). Vegetation along the upper (southern) extent of Lobs Hole Ravine Road is largely intact, with minimal disturbance evident. Vegetation comprises tall montane forests with large trees and a shrubby understorey. Weed invasion is minimal, limited to road edges. The lower section of Lobs Hole Ravine Road, generally below 1,200 m, consists of dry sclerophyll forests with a shrubby to grassy understorey. In some areas disturbance due to past land use is evident and significant, while in other areas there is minimal disturbance. Weediness varies, depending on past land use, and is heavy in some areas.

Lobs Hole has a long history of occupation, first used in the early 1800s for the movement of stock. Since this time Lobs Hole has been the site of prospecting, grazing, settlement, refuge from the winters of Kiandra, gardening and agriculture. From the 1860s to approximately 1917, Lobs Hole was the site of copper mining. During the construction of the Snowy Scheme, Lobs Hole was well used during surveying work. A major surveying camp was set up by Major Clews at Lobs Hole (believed to be at the junction of the Yarrangobilly and Tumut rivers and now under water, but this is not confirmed) and the Wallaces Creek camp was apparently located near to the junction of Wallaces Creek and Yarrangobilly River (exact location unknown). Lobs Hole is now a public camping area (Ravine Campground) with a boat ramp which is used to access the southern reaches of Talbingo Reservoir.

These activities and past land uses have resulted in significant amounts of clearing and disturbance of vegetation in the area. Native vegetation, which includes fauna habitats have been modified by past disturbances associated with land clearing, livestock grazing and weed invasion. Native vegetation has re-established itself throughout Lobs Hole; however, Blackberry (*Rubus fruticosus* species aggregate), a weed of national significance, has established itself to the point of infestation within the area. The riparian zones of both Wallaces Creek and the Yarrangobilly River within the project area are reasonably well vegetated, except for the lower section of the Yarrangobilly River which has been subject to clearing in Lobs Hole. In this area some banks are unvegetated. Both watercourses are subject to significant weed infestation, in particular with Blackberry.

Key weed species identified in *Rehabilitation Guidelines for the Resort Areas of Kosciuszko National Park*. (DECC 2007) and recorded during flora surveys for the broader Snowy 2.0 project include:

- Sheep Sorrel (*Acetosella vulgaris*);
- Yarrow (*Achillea millefolium*);
- Browntop Bent (*Agrostis capillaries*);
- Sweet Vernal Grass (*Anthoxanthum odoratum*);
- Spear Thistle (*Cirsium vulgare*);
- Hawthorn (*Crataegus monogyna*);
- Cocksfoot (*Dactylis glomerata*);
- Patterson's Curse (*Echium plantagineum*);

- Yorkshire Fog Grass (*Holcus lanatus*);
- St John's Wort (*Hypericum perforatum*);
- Cat's Ear/Flatweed (*Hypochaeris* spp.);
- Bird's-foot Trefoil (*Lotus* spp.);
- Musk Monkey Flower (*Mimulus moschatus*);
- Sweet Briar (*Rosa rubiginosa*);
- Blackberry (*Rubus* spp.);
- Dandelion (*Taraxacum officinale*); and
- Mullein/Aarons Rod (*Verbascum thapsus* and *V. virgatum*).

Areas which have already experienced considerable disturbance within the Exploratory Works footprint exhibit evidence of weeds. There are three identified weeds of significance in gullies and along Yarrangobilly Creek and Talbingo Reservoir. These weeds are:

- Blackberry (*Rubus* spp.);
- St John's Wort (*Hypericum perforatum*);
- Sweet Briar (*Rosa rubiginosa*).

Other weed species of concern, with potential to be transported into or within KNP during construction activities associated with the project and subject to current control programs include:

- African Lovegrass (*Eragrostis curvula*);
- Ox-eye Daisy (*Leucanthemum vulgare*);
- Serrated Tussock (*Nasella trichotoma*);
- English Broom (*Cytisus scoparius*);
- Cape Broom (*Genista monspessulana*);
- Lupins (*Lupinus polyphyllus*);
- Yarrow (*Achillea millefolium*);
- Large-flowered Mountain Trumpet (*Collomia grandiflora*);
- Cinquefoil (*Potentilla*)
- Phalaris;
- Willows;

- *Myosotis laxa subsp caespitose*;
- Mouse-eared Hawkweed; and
- Orange hawkweed (*Hieracium aurantiacum*).

Recently, there has been growing concern about the introduction of Orange Hawkweed to additional areas of the KNP. Currently there are seven infestations, totalling approximately 10 ha, currently confined to an area of some 8165 ha in the Jagungal wilderness area, which is situated over 50km south of the Project area. Orange hawkweed (*Hieracium aurantiacum*) presents a major threat to primary production and biodiversity across south-eastern Australia. It is on the National Alert List of Environmental Weeds. In addition, orange hawkweed is recognised as an agricultural sleeper weed in Australia. Under the Noxious Weeds Act 1993, all hawkweeds (*Heiracium* spp.) are listed as Class 1 noxious weeds.

Infection of native plants by *Phytophthora cinnamomi* is listed as a key threatening process under the BC Act and EPBC Act. *P.cinnamomi* can lead to death of trees and shrubs, resulting in devastation of native ecosystems (DECC 2008). Infection of susceptible communities with *P.cinnamomi* leads to

- changes in the structure and composition of the native plant communities;
- a significant reduction in primary productivity and functionality; and
- habitat loss and degradation for dependent flora and fauna (DoE 2014b).

Impacts from *P.cinnamomi* has been identified as a key threat to the Smoky Mouse (DECC 2008, Menkhorst and Broome 2008a, 2008b).

P.cinnamomi has not been confirmed as surviving in KNP, although it has potential to affect some species within the project area if it were to establish. However, it remains to be established if *P.cinnamomi* could be pathogenic under the conditions in the KNP (Keith McDougall OEH pers. comm. 12 September 2018). The main *Phytophthora* species of concern in the KNP is *Phytophthora gregata*, which is resulting in mortality of *Pimelea bracteata* en masse (Keith McDougall OEH pers. comm. 12 September 2018). *Pimelea bracteata* was not recorded within the project area.

4.2 Mitigation measures

In recognition of the location of the project in the KNP, and associated biodiversity and other values of the KNP, the project has undergone significant steps to avoid, minimise and mitigate impacts. The main measure to minimise impacts associated with possible weed and pathogen introduction or exacerbation, has been to place project roads and infrastructure, where possible, in areas of existing roads and disturbed areas from past land use. However, indirect impacts that could occur because of the project include:

- increased movement of vehicle has the potential to transport weeds and pathogens (such as *Phytophthora*) into the disturbance footprint and adjacent vegetation, resulting in degradation of vegetation and fauna habitat (including Smoky Mouse habitat).

To prevent these indirect impacts from occurring, the following mitigation measures are being implemented for the project:

- wash-down stations will be constructed at suitable locations, with wash down for weeds as well as *Phytophthora*. Wash-down of all vehicles will be completed prior to movement from Link Road to Lobs Hole Ravine and vice versa; and
- a weed and pathogen monitoring program and implementation of weed and/or pathogen control programs if weeds and/or pathogens are identified (this Section).

4.3 Monitoring objectives

The overarching monitoring objective for weeds and pathogens is to determine whether controls put in place to ensure weed cover does not increase across the project area and to ensure pathogens do not enter the project area, particularly in key fauna habitat, are successful. The objective is to also inform the location and extent of controls, specifically:

- to determine weed presence/absence within proximity to project roads and key project infrastructure;
- to determine changes in weed cover within proximity to project roads and key project infrastructure; and
- to undertake soil sampling in order to monitor pathogens within proximity to project roads and key project infrastructure.

4.4 Monitoring parameters

To determine if the mitigation measures put into place effectively mitigate potential weed and pathogen impacts, particularly in key fauna habitat, the following parameters will be monitored:

- weed presence/absence;
- weed cover; and
- soil pathogen presence/absence.

4.5 Weed presence/absence monitoring

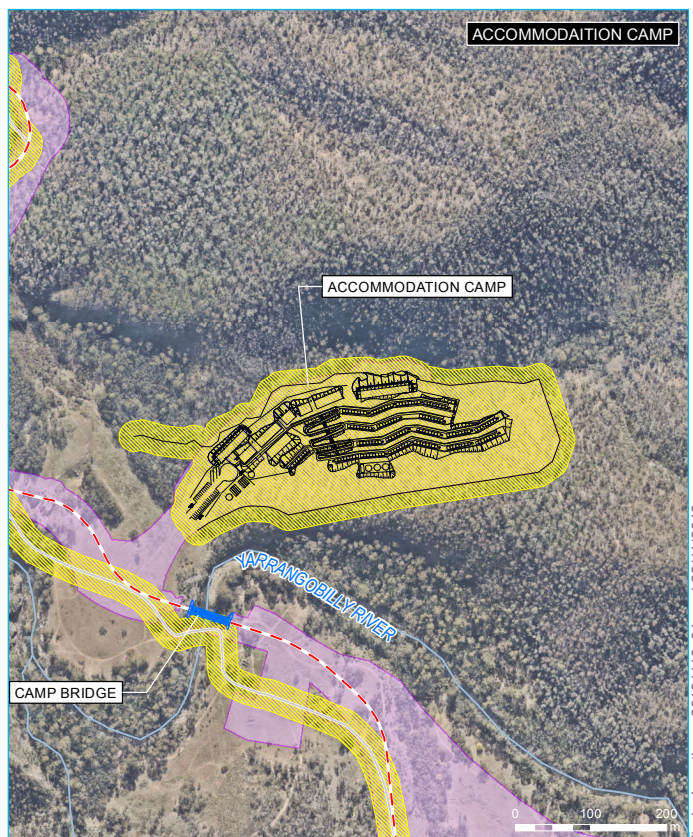
The monitoring of weed presence/absence will be undertaken by a suitably qualified ecologist (s) and will be undertaken as detailed in Table 4.1.

Table 4.1 Weed presence/absence monitoring

Objective
To determine weed presence/absence within proximity to project roads and key project infrastructure, to inform the location and extent of controls.
Sampling units
Weed mapping
Method
<i>Weed mapping</i>
<ul style="list-style-type: none"> • Surveys will be undertaken adjacent to project roads and around key infrastructure areas (within a 20 m buffer of

Table 4.1 Weed presence/absence monitoring

these areas) and will record:
<ul style="list-style-type: none"> ○ weed species identified as a priority for control as per weed species of concern in Chapter 4.1 above and listed in Appendix D of the WFAMP ○ location using a GPS (easting and northing); ○ number of individuals, the estimated size of infestation (eg m² for large infestations) and estimated cover (Trace<1%; Light 1-10%, Medium 11-50%, Dense >50%); ○ age class for woody weeds (seedlings, juveniles, mature, resprout); ○ comments on any other features; and ○ photograph of each weed area recorded. ○ Groups of individuals will be marked out with a waypoint and large infestations will be mapped out as a polygon;
<ul style="list-style-type: none"> • Mapping will be produced that shows the areas, associated weed species and number estimates, to allow comparison between monitoring periods; • Data will be collected via the proforma included as Appendix A; and • Mapping will be updated each monitoring period (new areas and revisit mapped areas to record growth and/or effectiveness of management applied).
Location
<ul style="list-style-type: none"> • Adjacent to project roads (Lobs Hole Ravine Road and Mine Trail Road), and within a 20 m buffer; • Adjacent to accommodation camp and within a 20 m buffer; • Adjacent to construction compounds and within a 20 m buffer; and • Figure 4.1 shows indicative locations.
Timing, effort and frequency
Weed mapping will occur Annually (in Spring) during each project phase (pre-construction, construction and post-construction), commencing prior to construction (January 2019).
Data analysis
Weed mapping and associated data to be kept in a GIS and accompanying spreadsheet to determine any changes in the presence of weeds between monitoring periods.
Triggers for adaptive management
New occurrence of weeds within proximity to project roads and key project infrastructure, where previously not recorded.
Weed species that trigger immediate control are included within Appendix D.



Source: EMM (2018); Snowy Hydro (2018); NearMap (2018); SMEC (2018); Robert Bird (2018); DFSI (2017)

GDA 1994 MGA Zone 55

KEY

- Access road upgrade
- Access road extension
- Permanent bridge
- Portal construction pad and accommodation camp conceptual layout
- Local road or track
- Watercourse
- Disturbance footprint
- Indicative weed monitoring area

Weed presence / absence monitoring -
indicative locations

Snowy 2.0
Biodiversity monitoring program
Exploratory Works
Figure 4.1

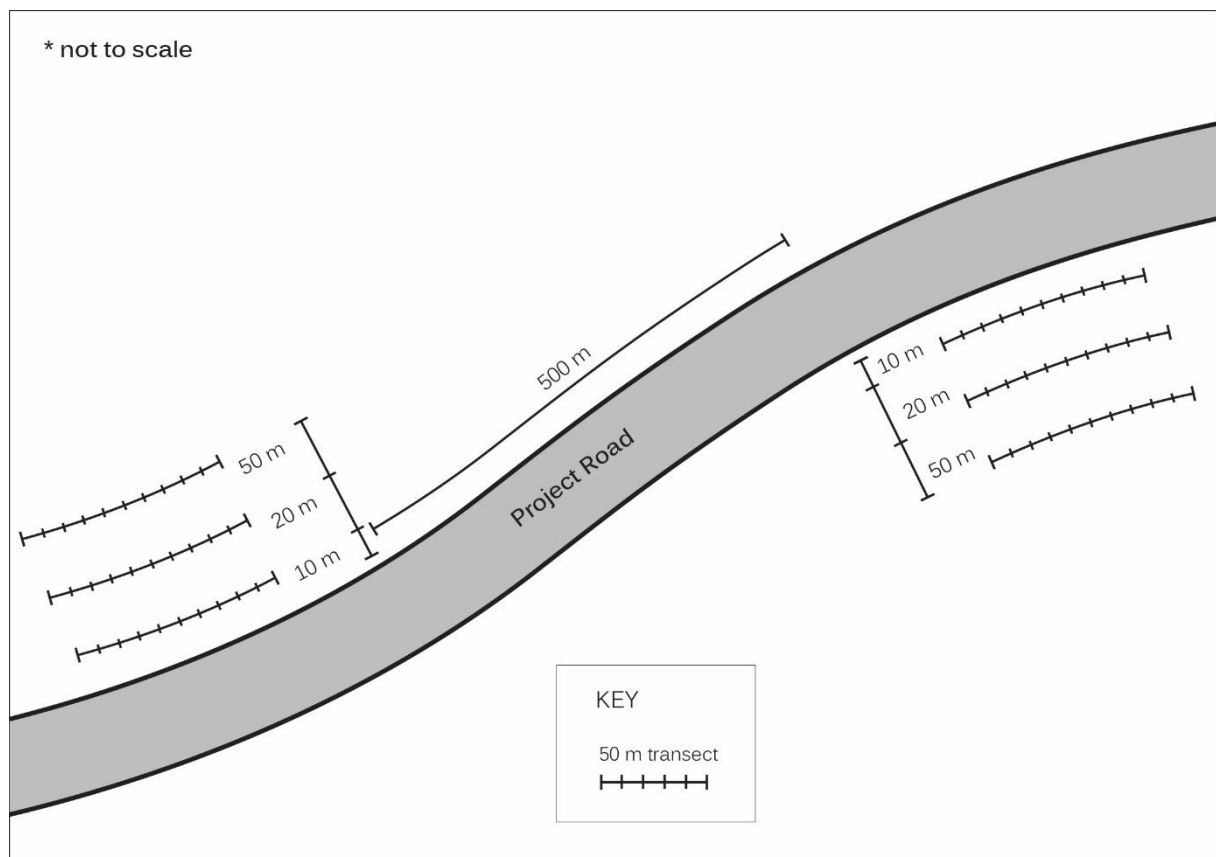
4.6 Weed cover monitoring

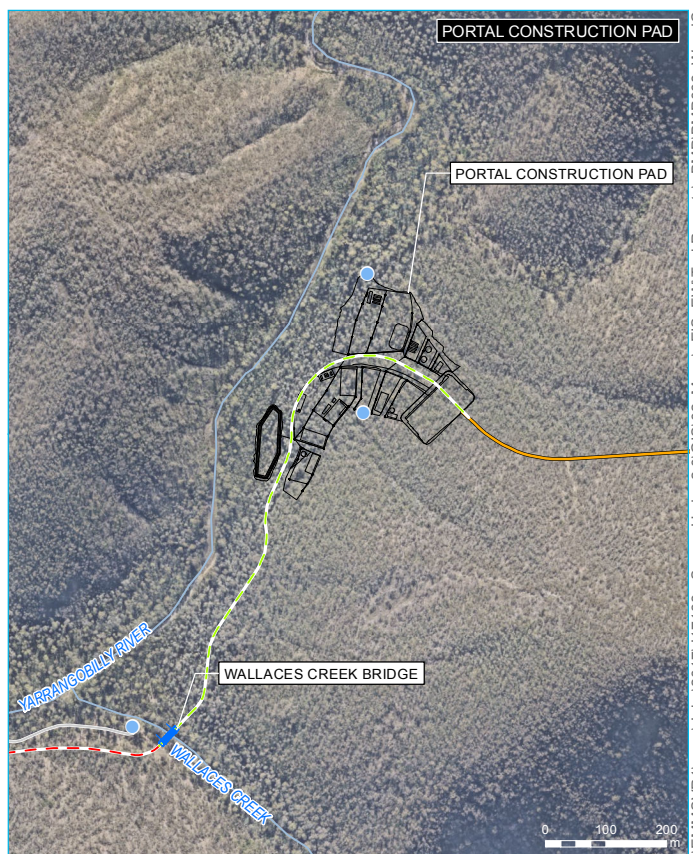
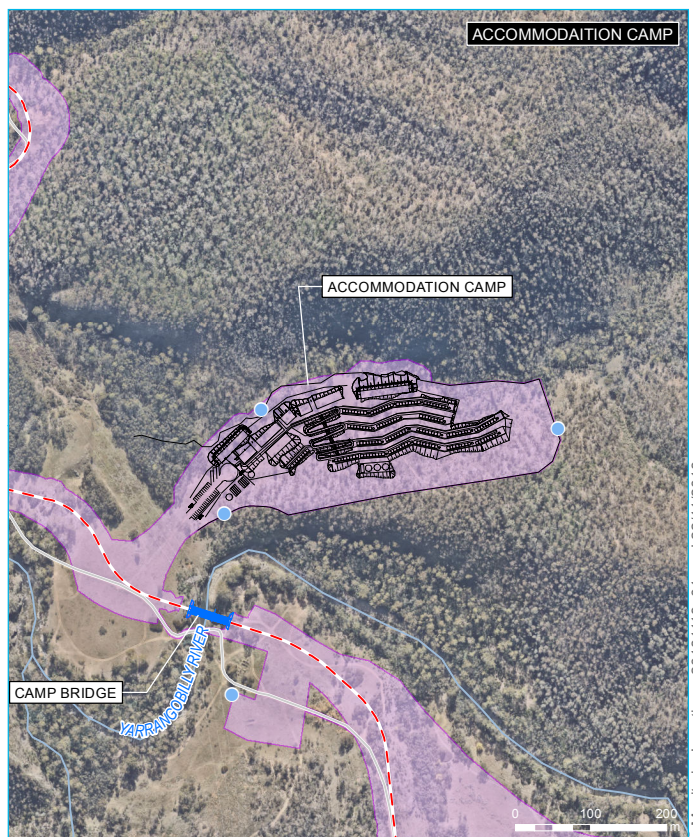
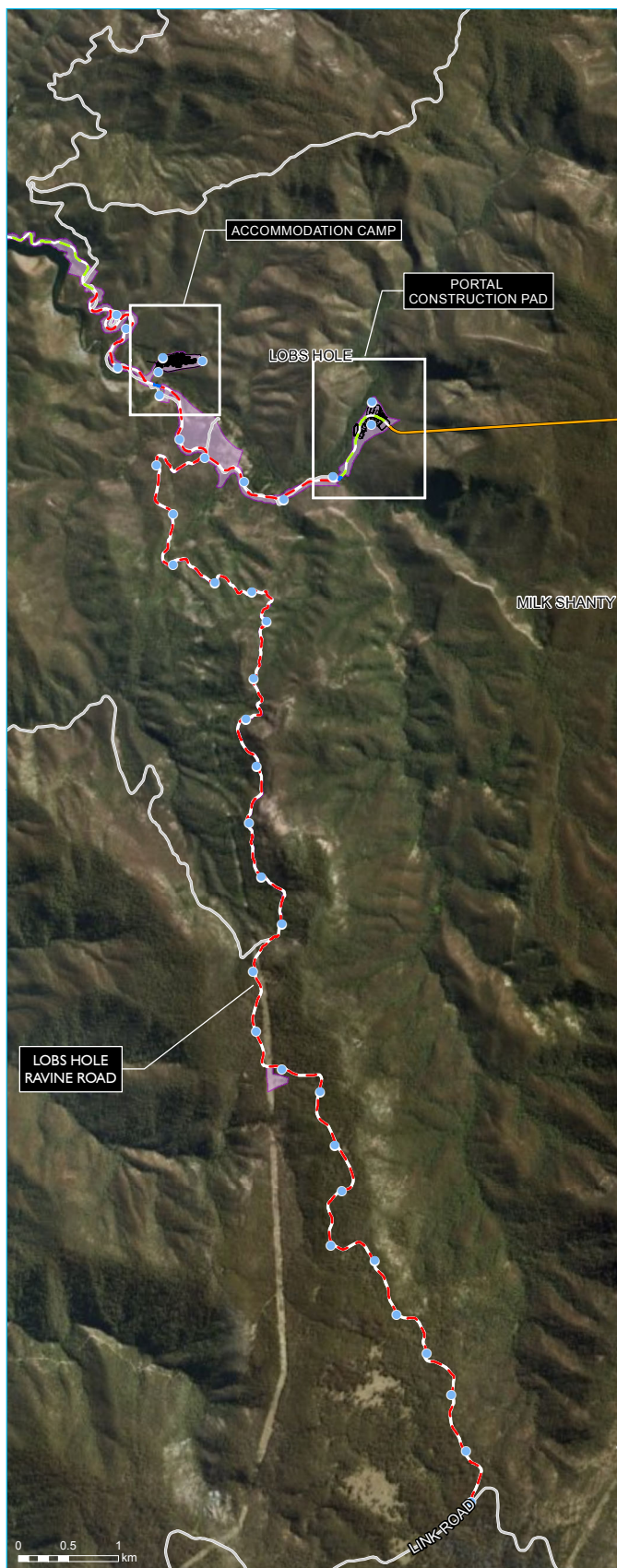
The monitoring of weed cover will be undertaken by a suitably qualified ecologist (s) and will be undertaken as detailed in Table 4.2

Table 4.2 Weed cover monitoring

Objective
To determine changes in weed cover within proximity to project roads and key project infrastructure, to inform the location and extent of controls.
Sampling units
Weed cover
Method
<i>Transects</i>
<ul style="list-style-type: none"> • A series of transects are undertaken adjacent to project roads and around key infrastructure areas; • Each set of transects to be placed at 500 m intervals along project roads and around key infrastructure areas; • Transects will be 50 m long and will be placed parallel to project roads and key infrastructure, with the first transect placed 10 m from the road/infrastructure area edge, the second placed 20 m from the edge and the third placed 50 m from the edge (Figure 4.2); • The line-point intercept method will be used at 1 m intervals along each 50 m transect; • At each 1 m interval (starting from 1 m), the cover of weed species will be measured, using a straight rod. Any intercepts or “hits” of a weed species on the rod will be recorded as present (with one being the upper limit for each stratum at each point). No intercepts of weed species at each stratum records a zero; • As data is collected for a total of 50 intervals along each transect, the cover (%) of weeds for each ground stratum (exotic shrubs <1 m, exotic grasses and exotic ground cover) is calculated by dividing the number of hits by 50, then multiplying it by 100; • An estimate of weed cover (% see Specht) for exotic canopy species and exotic mid storey species is to be calculated every 5 m along each 50 m transect; • As data is collected for a total of 10 intervals along each transect, the cover (%) of mid storey and canopy weeds is calculated by determining the average of cover at each interval; • For the baseline monitoring event, it is necessary to install permanent markers (eg star picket marked/flagged with monitoring location name) and to also record the coordinates of each monitoring location, in order to relocate for subsequent monitoring events; and • Data will be collected via the proforma included as Appendix A.
Location
<ul style="list-style-type: none"> • Adjacent to project roads (Lobs Hole Ravine Road and Mine Trail Road, as indicated in Figure 4.3); • Adjacent to accommodation camp; and • Adjacent to construction compounds.
Timing, effort and frequency
Frequency will comprise one monitoring events per year (spring) during each project phase (pre-construction, construction and post-construction), commencing in November 2018.
Data analysis
Transect data to be kept in a spreadsheet to determine any changes in the cover (%) of weeds at each transect location between monitoring periods.
Triggers for adaptive management
A significant increase in weed cover, being greater than 10%.

Figure 4.2 Weed cover monitoring - transect set up





Source: EMM (2018); Snowy Hydro (2018); NearMap (2018); SMEC (2018); Robert Bird (2018); DFSI (2017)

GDA 1994 MGA Zone 55

KEY

- Access road upgrade
- Access road extension
- Permanent bridge
- Portal construction pad and accommodation camp conceptual layout
- Local road or track
- Watercourse
- Disturbance footprint
- Indicative weed cover monitoring location

Weed cover monitoring -
indicative locations

Snowy 2.0
Biodiversity monitoring program
Exploratory Works
Figure 4.3

4.7 *Phytophthora* presence/absence monitoring

Soil monitoring, to test for presence/absence of *Phytophthora*, will be undertaken by a suitably qualified person (s) and will be undertaken as detailed in Table 4.3.

Table 4.3 Presence/absence of *Phytophthora* monitoring

Objective
To undertake soil sampling in order to monitor pathogens within proximity to project roads and key project infrastructure, , to inform the location and extent of controls.
Sampling units
Soil sampling
Method
<p><i>Soil sampling</i></p> <p>Soil sampling will occur in key areas such as at vehicle washdown (to ensure that hygiene measures are effective) and around key infrastructure areas and roads where there is movement of vehicles and machinery and will include, at each monitoring location:</p> <ul style="list-style-type: none"> • use a sterile garden trowel to scrape away surface leaf litter; • dig a small hole, collect a small amount of soil and living plant roots; • place them into a new, thick zip-lock plastic bag; • the hole does not need to be any deeper than 10 cm and you only need 100-250 grams of soils; • label the bag with date, monitoring site code and sample number eg 19/12/18, Washdown01, North; • place into a second bag to prevent cross contamination and as a safeguard against breakage; • store soil samples in a cool, dark place and dispatch for analysis as practicable after sampling; • after each sample, scrub your hands and the trowel thoroughly with methylated spirits to disinfect them and prevent cross-contamination of samples; and • send samples to a suitable laboratory to analyse for <i>Phytophthora</i>.
Location
<ul style="list-style-type: none"> • Vehicle washdown stations; • Around key infrastructure areas; • Project roadsides; and • Locations to be established during first monitoring event.
Timing, effort and frequency
Frequency will comprise four monitoring events per year (quarterly) during pre-construction and one per year (construction and post-construction), commencing in January 2019.
Data analysis
Monitoring data (laboratory results) for each monitoring location to be kept in a spreadsheet with additional results added after each monitoring program.
Triggers for adaptive management
A soil sample returns a positive result for <i>Phytophthora</i> .

4.8 Other monitoring

4.8.1 Dieback

Monitoring for signs of dieback associated with *Phytophthora* can be difficult and misleading as most dieback is not related to *Phytophthora*. It may be more useful to monitor the health of indicator species such as *Xanthorrhoea glauca*, *Pimelea bracteata* and *Phebalium squamulosum* – where they occur in or adjacent to the project area (Keith McDougall OEH pers. comm. 12 September 2018).

Armillaria luteobubalina, commonly known as the Australian honey fungus, is a species of mushroom in the family Physalacriaceae. Widely distributed in southern Australia, the fungus is responsible for a disease known as Armillaria root rot, a primary cause of Eucalyptus tree death and forest dieback. *Armillaria luteobubalina* is currently only known from the Round Mountain area south of Cabramurra and on the Yarrangobilly River near the Snowy Mountains Highway (Keith McDougall OEH pers. comm. 12 September 2018). There may need to be monitoring of *Armillaria luteobubalina* if that is detected in the project area.

If dieback is noted within the weed presence/absence monitoring or the weed cover monitoring (the proformas in Appendix A include prompts to record any dieback noted) this monitoring program will be reviewed to include monitoring for dieback (mapping, soil testing, using indicator species) and adaptive management measure implemented if required.

5 Feral herbivore monitoring program

5.1 Baseline conditions

Remote camera surveys, spotlighting and opportunistic sightings undertaken for the *Snowy 2.0 Exploratory Works, Biodiversity Development Assessment Report* (EMM 2018) recorded the following feral herbivores within the project area:

- Horse (*Equus caballus*);
- Deer (*Damas spp.*, *Cervus spp.*, *Axis spp*); and
- Rabbit (*Oryctolagus cuniculus*) (Photograph 6.1).

The feral herbivore records were not limited to any one habitat type within the project area and it is possible that they occur across the project area.



Photograph 5.1 Rabbit captured via remote camera within the project area

5.2 Mitigation measures

To minimise the risk of increased feral herbivore activity, the following controls will be implemented for the project:

- a monitoring program will be implemented using remote cameras to monitor feral herbivore activity (this program); and
- remote cameras will be placed along Lobs Hole Ravine Road (north and south) and Mines Trail to monitor feral herbivore movements (this program).

5.3 Monitoring objectives

The overarching monitoring objective for feral herbivores is to document changes in occupation (presence/absence) and abundance within proximity to the project, arising from increased human activity associated with the project and to inform the location and extent of controls, specifically:

- to determine occupancy and abundance along project roads and adjacent to key project infrastructure; and
- to determine occupancy and abundance on the upper sections of Lobs Hole Ravine Road (in Smoky Mouse habitat).

5.4 Monitoring parameters

To determine if the mitigation measures put into place effectively mitigate indirect impacts associated with feral herbivores, the following parameters will be monitored:

- presence/absence; and
- abundance.

5.5 Presence/absence monitoring

The monitoring of feral herbivore presence/absence will be undertaken by a suitably qualified ecologist (s) and will be undertaken as detailed in Table 5.1

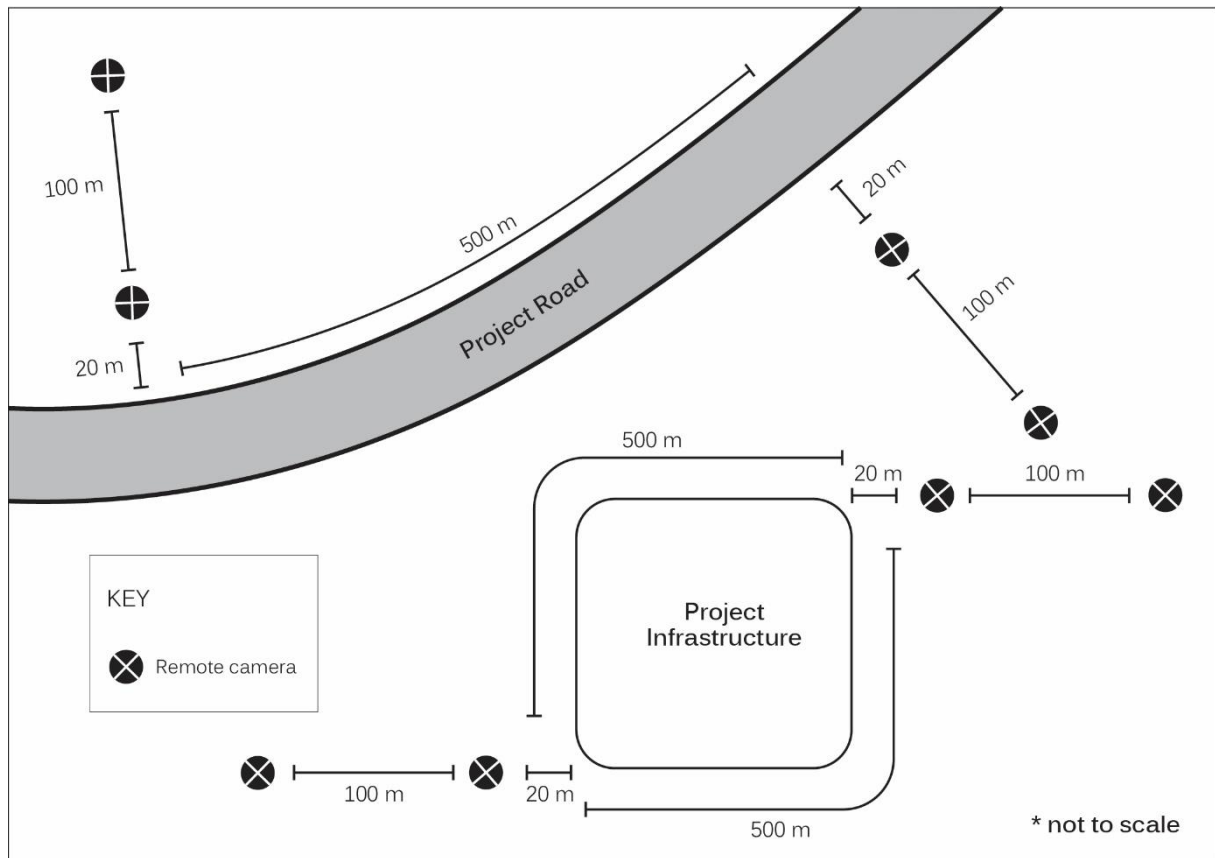
Table 5.1 Feral herbivore presence/absence monitoring

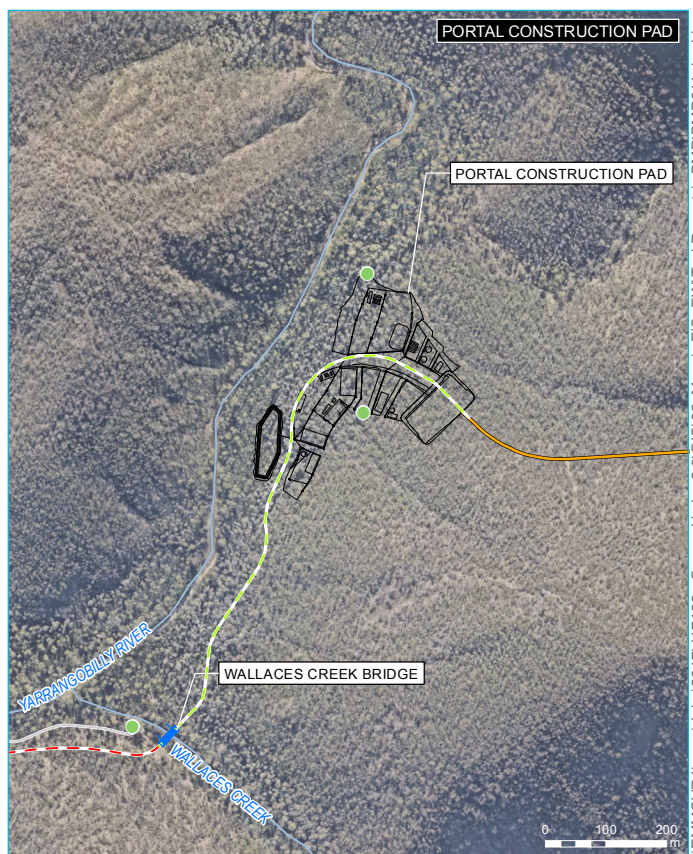
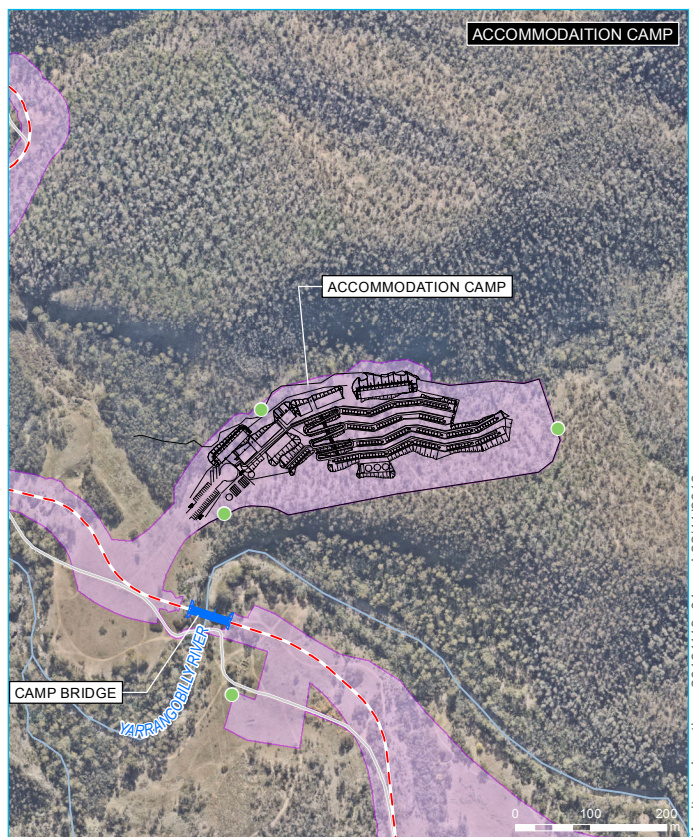
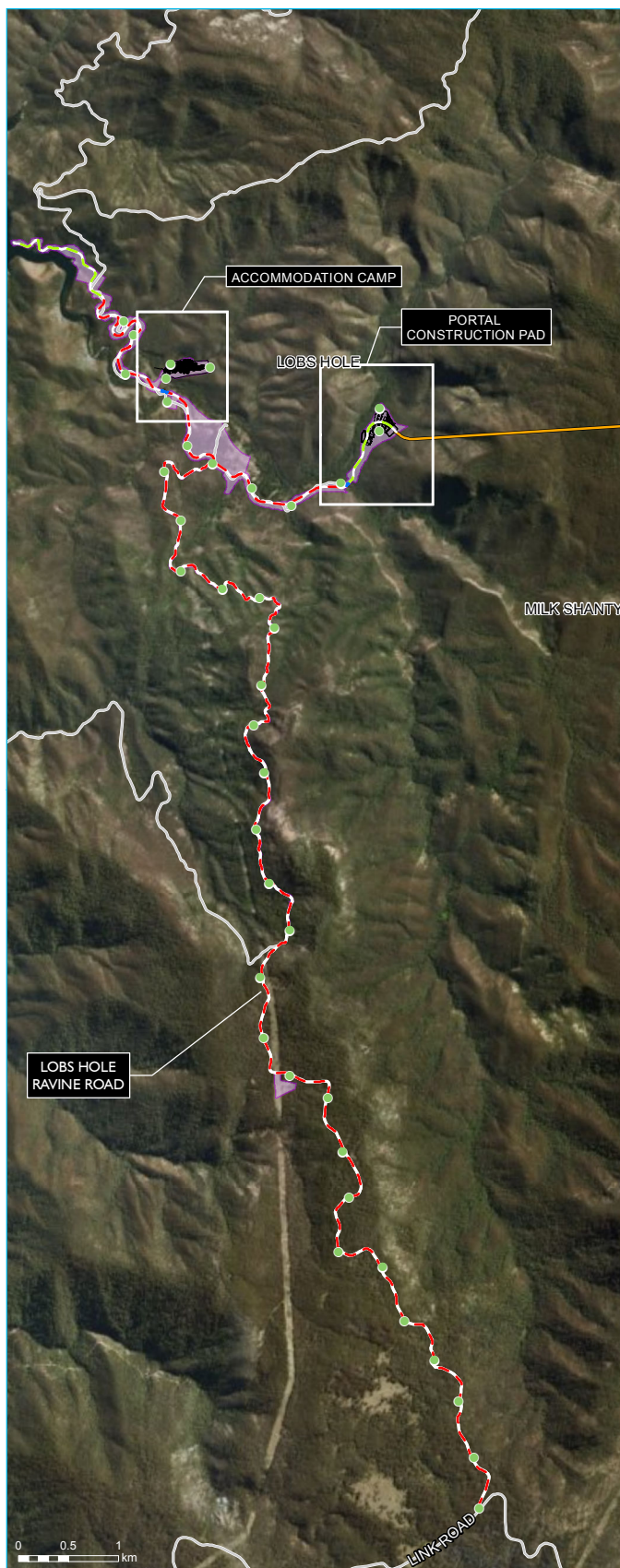
Objective
To determine feral herbivore (rabbit) presence/absence within proximity to the project and document any changes arising from increased human activity as a result of the project and to inform location and extent of controls.
Sampling units
Remote camera monitoring along project roads and adjacent to key infrastructure.
Method
<i>Remote camera monitoring</i>
<ul style="list-style-type: none"> • Remote cameras will be placed at locations adjacent to project roads and around key infrastructure areas; • A pair of cameras will be placed at 500 m intervals along the project roads (perpendicular to the roads with each pair of cameras placed on alternate sides of the road) as well as at project infrastructure; • For each pair, one camera will be placed adjacent to the road or infrastructure at 20 m and one will be placed distant to the road or infrastructure at 120 m, as shown in Figure 5.1; • Cameras to be attached to a tree or stake and positioned approximately 1 m above ground; • The cameras are to be unbaited, as this is more suitable for long term monitoring; • Micro siting or otherwise trimming of vegetation with hand-held shearers directly between the camera and bait

Table 5.1 Feral herbivore presence/absence monitoring

<p>station may be required to avoid vegetation from obscuring the view of an animal investigating the bait or that might cause the camera to false trigger;</p> <ul style="list-style-type: none"> • Cameras are placed out for one month (30 days) per monitoring period; and • Coordinates to be recorded at each camera location, in order to repeat the method during each subsequent monitoring event.
Location
<ul style="list-style-type: none"> • Adjacent to project roads (Lobs Hole Ravine Road and Mine Trail Road, as indicated in Figure 5.2); • Adjacent to accommodation camp; and • Adjacent to construction compounds.
Timing, effort and frequency
<ul style="list-style-type: none"> • A monitoring event is defined as 10 days (10 days) deployment of all camera traps as per the layout explained in methods; and • Frequency will comprise one monitoring event per year, during each project phase (pre-construction, construction and post-construction), commencing in January 2019.
Data analysis
<ul style="list-style-type: none"> • Data to be kept in a spreadsheet to determine presence/absence at monitoring locations between monitoring periods; • Occupancy is commonly used as a metric for estimating species' occurrence and is a function of abundance (MacKenzie et al 2003; O'Connell and Bailey 2011) as it concerns the probability of a particular animal being in a given site or patch. This method can be misused by only reporting on detection sites and ignoring non-detection sites, thereby failing to calculate the detection probability (O'Connell and Bailey 2011), therefore • Data trends are to be analysed by a suitably qualified person (eg biometrician), in order to determine occupancy. Software programs can also be used for calculating occupancy.
Triggers for adaptive management
<p>A statistically significant increase in the number of sites at which feral herbivores recorded over consecutive monitoring periods or years.</p>

Figure 5.1 Feral herbivore presence/absence monitoring - remote camera set up





Source: EMM (2018); Snowy Hydro (2018); NearMap (2018); SMEC (2018); Robert Bird (2018); DFSI (2017)

GDA 1994 MGA Zone 55

KEY

- Access road upgrade
- Access road extension
- Permanent bridge
- Portal construction pad and accommodation camp conceptual layout
- Local road or track
- Watercourse

- Disturbance footprint
- Indicative feral herbivore presence / absence monitoring location

Feral herbivore presence / absence
monitoring - indicative locations

Snowy 2.0
Biodiversity monitoring program
Exploratory Works
Figure 5.2

5.6 Abundance monitoring

The monitoring of feral herbivore abundance will be undertaken by a suitably qualified ecologist (s) and will be undertaken as detailed in Table 5.2

Table 5.2 Feral herbivore abundance monitoring

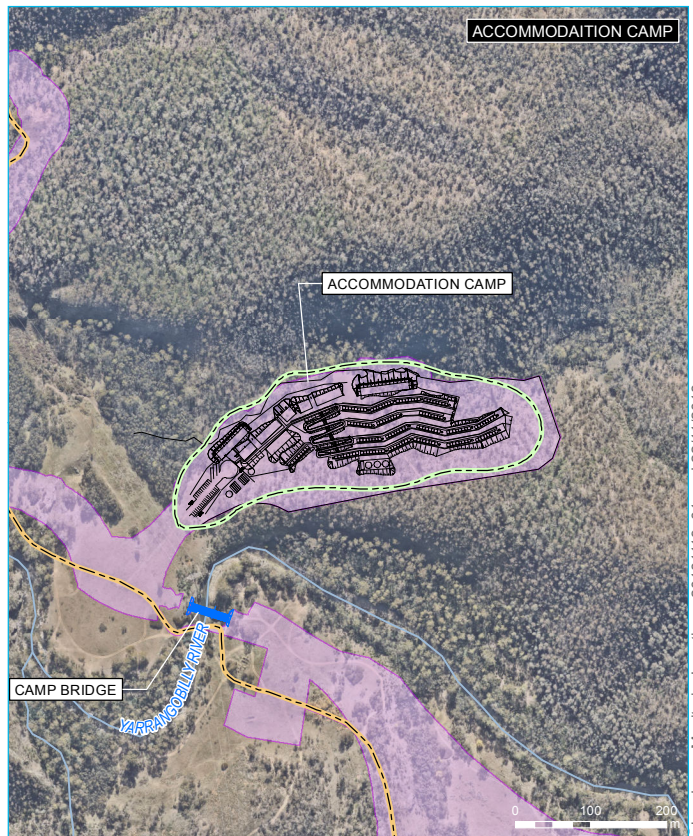
Objective
To determine feral herbivore (Horse and Rabbit) abundance within proximity to the project and document any changes arising from increased human activity as a result of the project and to inform location and extent of controls.
Sampling units
Spotlight counts along project roads and adjacent to key infrastructure (vehicle and walked).
Method
<i>Vehicle spotlight counts</i>
<ul style="list-style-type: none"> • A 4WD vehicle with one driver and an observer using a hand held spotlight (100 W – 12 V narrow beam); • Start approximately half an hour after sunset from an established start point; • One person drives and the other counts animals; • Drive at a constant slow speed (10-15 km/h) along all project roads (Lobs Hole Ravine Road and Mine Trail Road); • Observer scans a 90° arc ahead of the vehicle with a spotlight and count animals seen within 50 m on either side (a hand held tally counter is effective when the rabbit occurs in high numbers); • Every 1 km record the tally on a standardised spotlight count sheet (see proforma in Appendix B); • Repeat the count on three more consecutive nights of similar weather; and • On subsequent counts, start the same time as the first count, use the same route (distance and direction), vehicle, speed, spotlight and people.
<i>Walked spotlight counts</i>
<ul style="list-style-type: none"> • Establish transect paths around key infrastructure; • Start approximately half an hour after sunset from an established start point; • Two people using two hand-held spotlights of the same power, with observers counting only one side each in a 90° arc ahead of them; • Walk at an easy constant walking pace; • Count animals seen within 50 m; • Every 0.5 km record the tally on a standardised spotlight count sheet (see proforma in Appendix B); • Repeat the count on three more consecutive nights of similar weather; • On subsequent counts, start the same time as the first count, use the same route (distance and direction), vehicle, speed, spotlight and people; and • After completion of the survey determine the average of counts and divide them by the length of the transect to get a simple index of abundance (animals/km); and • Use a GPS to help maintain your path.
Location
<ul style="list-style-type: none"> • Vehicle spotlight counts: Lobes Hole Ravine Road and Mine Trail Road (Figure 5.3); and • Walked spotlight counts: around key infrastructure areas (Figure 5.3).
Timing, effort and frequency
<ul style="list-style-type: none"> • A monitoring event is defined as four nights of spotlighting along each project road and around each area of key project infrastructure; and • Frequency will comprise one monitoring event per year, with each event lasting ten nights, during each project phase (pre-construction, construction and post-construction), commencing in January 2019.
Data analysis

Table 5.2 **Feral herbivore abundance monitoring**

After completion of each monitoring event at each location determine the average of counts and divide them by the length of the transect to get a simple index of abundance (animals/km⁻¹) for each road/key infrastructure area during each monitoring event.

Triggers for adaptive management

A statistically significant increase in the number of feral herbivores per km, over multiple consecutive monitoring periods or years.



Source: EMM (2018); Snowy Hydro (2018); NearMap (2018); SMEC (2018); Robert Bird (2018); DFSI (2017)

GDA 1994 MGA Zone 55

KEY

- Permanent bridge
- Portal construction pad and accommodation camp conceptual layout
- Local road or track
- Watercourse
- Disturbance footprint
- Vehicle transect
- Walked transect

Feral herbivore abundance monitoring - indicative locations

Snowy 2.0
Biodiversity monitoring program
Exploratory Works
Figure 5.3

5.6.1 Limitations of abundance monitoring

Night-time counting using spotlights, either on foot or from vehicles, has been used for many years to survey animal species such as the Rabbit (Mitchell & Balogh 2007a). This is mainly because spotlighting is easy to do and can cover large areas in a relatively short time. Spotlighting can sample different vegetation types and compare them under similar conditions within a site (i.e. season, time, weather). Simple indexes of abundance can be produced from these counts. Examples are the number of animals seen per kilometre travelled.

However, indices created from spotlighting counts have bias caused by difference between observers and also in visibility, or 'sightability', which can change with vegetation density and animal behaviour (Mitchell & Balogh 2007a). This monitoring method is also unsuitable in high wind or rain conditions, as these affect rabbit behaviour (Ballinger & Morgan 2002, cited in Mitchell & Balogh 2007a). Other sources of potential variation include the time of night that the survey is done, seasonal variations in animal behaviour and abundance, and the use of roads as transects (vegetation types will not be surveyed evenly) (Mitchell & Balogh 2007a). Despite these shortcomings, spotlighting has been found to be a reliable means of monitoring relative population size in rabbits (Mitchell & Balogh 2007a). For example, in New Zealand, spotlighting along fixed transects has become the standard method used by regional councils and the Ministry of agriculture and Fisheries to assess Rabbit populations (Fletcher et al. 1999, as cited in Mitchell & Balogh 2007a). However, there has been little standardisation of the technique, thus creating difficulties with comparisons between studies.

6 Feral predator monitoring program

6.1 Baseline conditions

Remote camera surveys undertaken for the *Snowy 2.0 Exploratory Works, Biodiversity Development Assessment Report* (EMM 2018) recorded the following feral predators within the project area:

- Cat (*Felis catus*) (Photograph 6.1);
- Dingo/domestic dog (*Canis lupus*); and
- Fox (*Vulpes Vulpes*) (Photograph 6.2).

The feral predator records were not limited to any one habitat type within the project area and it is possible that they occur across the project area.



Photograph 6.1 Cat captured via remote camera within the project area



Photograph 6.2 **Fox captured via remote camera within the project area**

6.2 Mitigation measures

There is potential for increased human activity from the project to result in increased activity of predators, particularly feral Cats and Foxes. Increased activity of feral predators has consequent impacts on native animals. Predation by feral Cats and Red Foxes are listed as key threatening processes under the BC Act and EPBC Act (NPWS 2001, DEWHA 2008, DoE 2015) with impacts from feral Cats also listed as a key threat to the Smoky Mouse (Menkhorst and Broome 2008a, 2008b).

To minimise the risk of increased predator activity, the following controls will be implemented for the project:

- waste will be stored appropriately in inaccessible bins and disposed off-site; no waste will be left outside in open areas accessible to feral animals;
- a monitoring program will be implemented using remote cameras to monitor feral animal activity (this program);
- remote cameras will be placed along Lobs Hole Ravine Road (north and south) and Mine Trail Road to monitor feral animal movements (this program); and
- a predator control program will be implemented, in conjunction with OEH and NPWS, to control feral animals.

6.3 Monitoring objectives

The overarching monitoring objective for feral predators is to document changes in occupation (presence/absence) and abundance within proximity to the project, arising from increased human activity associated with the project and to inform the location and extent of controls, specifically:

- to determine occupancy and abundance along project roads and adjacent to key project infrastructure; and
- to determine occupancy and abundance on the upper sections of Lobs Hole Ravine Road (in Smoky Mouse habitat).

6.4 Monitoring parameters

To determine if the mitigation measures put into place effectively mitigate indirect impacts associated with feral predators, the following parameters will be monitored:

- presence/absence; and
- abundance.

6.5 Presence/absence monitoring

The monitoring of feral predator presence/absence will be undertaken by a suitably qualified ecologist (s) and will be undertaken as detailed in Table 6.1

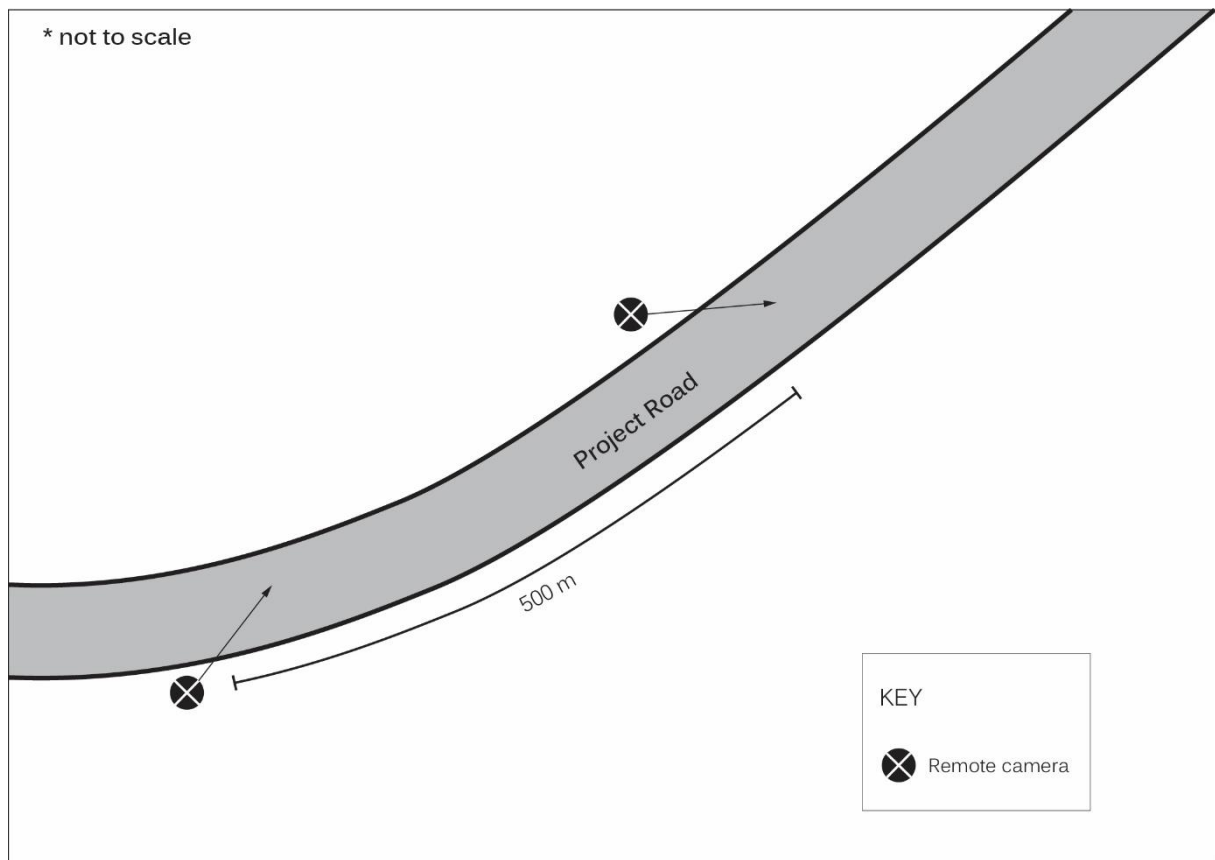
Table 6.1 Feral predator presence/absence monitoring

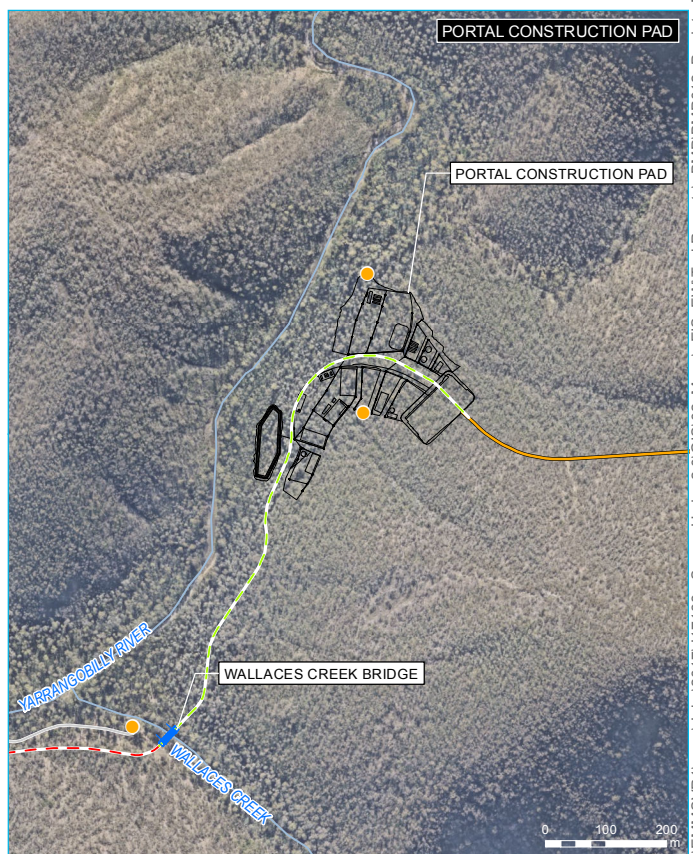
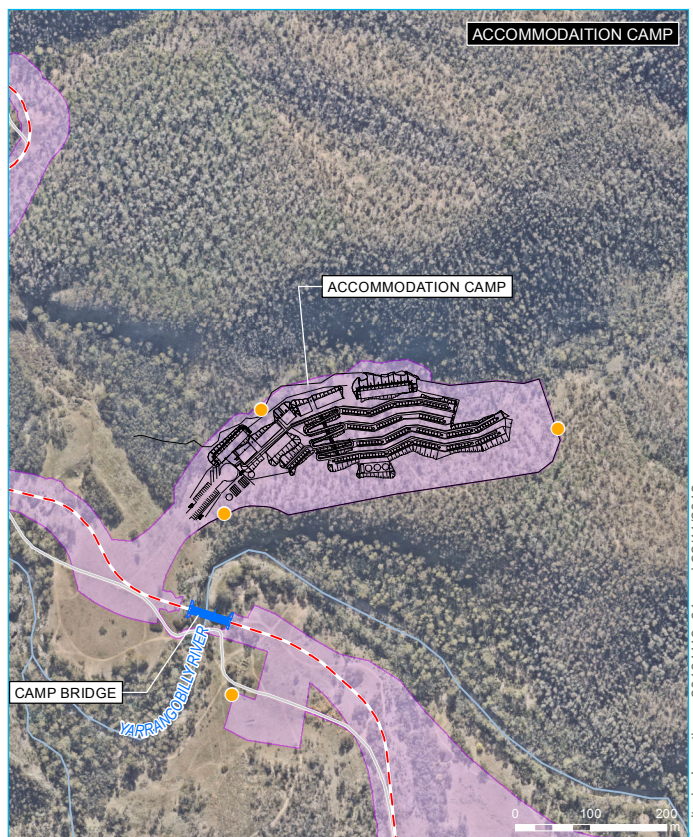
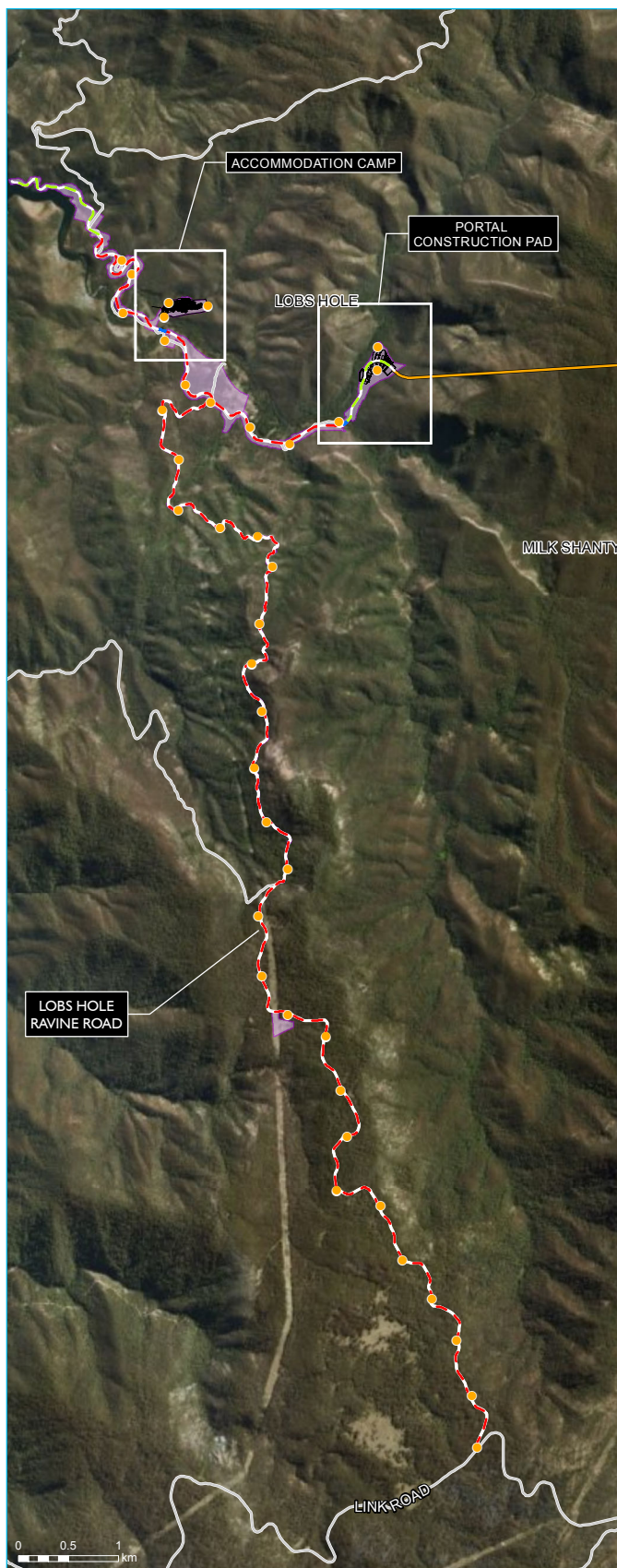
Objective
To determine feral predator presence/absence within proximity to the project and document any changes arising from increased human activity as a result of the project and to inform location and extent of controls.
Sampling units
Remote camera monitoring along project roads and adjacent to key infrastructure.
Method
<i>Remote camera monitoring</i>
<ul style="list-style-type: none">• Remote cameras will be placed at locations adjacent to project roads and around key infrastructure areas;• A camera will be placed at 500 m intervals along the project roads (placed to view across the road) as well as at project infrastructure, as shown in Figure 6.1;• Cameras to be attached to a tree or stake and positioned approximately 1 m above ground. Cameras will be unbaited and left in place for 30 days• Cameras are placed out for one month per monitoring period;• Cameras to be placed at a 45 degree angle to the road; and• Coordinates to be recorded at each camera location, in order to repeat the method during each subsequent monitoring event.
Location
<ul style="list-style-type: none">• Adjacent to project roads;• Adjacent to accommodation camp; and• Adjacent to construction compounds (Figure 6.2).

Table 6.1 Feral predator presence/absence monitoring

Timing, effort and frequency
<ul style="list-style-type: none"> • A monitoring event is defined 30 days deployment of all camera traps as per the layout explained in methods; and • Frequency will comprise four monitoring events per year (or every three months), with each event lasting a month, during each project phase (pre-construction, construction and post-construction), commencing in January 2019. [NOTE: Confirmation sought from Linda Broome so as method aligns with hers]
Data analysis
<ul style="list-style-type: none"> • Animals captured on digital images are to be identified by a suitable Ecologist and with reference to field guides and species experts, if required; • Data to be kept in a spreadsheet to determine presence/absence at monitoring locations between monitoring periods; and • Occupancy is commonly used as a metric for estimating species' occurrence and is a function of abundance (MacKenzie et al 2003; O'Connell and Bailey 2011) as it concerns the probability of a particular animal being in a given site or patch. This method can be misused by only reporting on detection sites and ignoring non-detection sites, thereby failing to calculate the detection probability (O'Connell and Bailey 2011), therefore • Data trends are to be analysed by a suitably qualified person (eg biometrician), in order to determine occupancy. Software programs can also be used for calculating occupancy.
Triggers for adaptive management
Statistically significant increase in the occurrence of feral predators observed across multiple monitoring periods and years.

Figure 6.1 Feral predator presence/absence monitoring - remote camera set up





Source: EMM (2018); Snowy Hydro (2018); NearMap (2018); SMEC (2018); Robert Bird (2018); DFSI (2017)

GDA 1994 MGA Zone 55

KEY

- Access road upgrade
- Access road extension
- Permanent bridge
- Portal construction pad and accommodation camp conceptual layout
- Local road or track
- Watercourse

- Disturbance footprint
- Feral predator presence / absence monitoring location

Feral predator presence / absence
monitoring - indicative locations

Snowy 2.0
Biodiversity monitoring program
Exploratory Works
Figure 6.2

6.6 Abundance monitoring

The monitoring of feral predator abundance will be undertaken by a suitably qualified ecologist (s) and will be undertaken as detailed in Table 6.2.

Table 6.2 Feral predator abundance monitoring

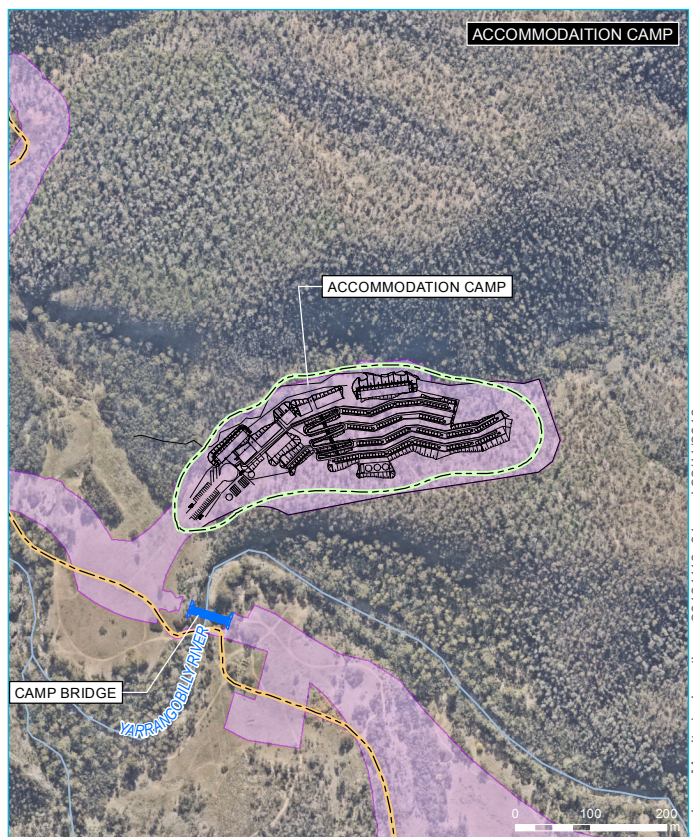
Objective
To determine feral predator (fox and cat) abundance within proximity to the project and document any changes arising from increased human activity as a result of the project and to inform location and extent of controls.
Sampling units
Spotlight counts along project roads and adjacent to key infrastructure (vehicle and walked).
Method
<p><i>Vehicle spotlight counts</i></p> <ul style="list-style-type: none"> • A 4WD vehicle with one driver and an observer using a hand-held spotlight (100 W – 12 V narrow beam); • Start approximately half an hour after sunset from an established start point; • One person drives and the other counts animals; • Drive at a constant slow speed (10-15 km/h) along all project roads (Lobs Hole Ravine Road and Mine Trail Road); • Observer scans a 90° arc ahead of the vehicle with a spotlight and count animals seen within 50 m on either side; • Every 1 km record the tally on a standardised spotlight count sheet (see proforma in Appendix B); • Repeat the count on three more consecutive nights of similar weather; and • On subsequent counts, start the same time as the first count, use the same route (distance and direction), vehicle, speed, spotlight and people. <p><i>Walked spotlight counts</i></p> <ul style="list-style-type: none"> • Establish transect paths around key infrastructure; • Start approximately half an hour after sunset from an established start point; • Two people using two hand-held spotlights of the same power, with observers counting only one side each in a 90° arc ahead of them; • Walk at an easy constant walking pace; • Count animals seen within 50 m; • Every 0.5 km record the tally on a standardised spotlight count sheet (see proforma in Appendix B); • Repeat the count on three more consecutive nights of similar weather; • On subsequent counts, start the same time as the first count, use the same route (distance and direction), vehicle, speed, spotlight and people; and • After completion of the survey determine the average of counts and divide them by the length of the transect to get a simple index of abundance (animals/km); and • Use a GPS to help maintain your path.
Location
<ul style="list-style-type: none"> • Vehicle spotlight counts: Lobes Hole Ravine Road and Mine Trail Road; and • Walked spotlight counts: around key infrastructure areas (Figure 6.3).
Timing, effort and frequency
<ul style="list-style-type: none"> • A monitoring event is defined as four nights of spotlighting along each project road and around each area of key project infrastructure; and • Frequency will comprise one monitoring events per year (spring or autumn), with each event lasting ten nights, during each project phase (pre-construction, construction and post-construction), commencing in January 2019.
Data analysis

Table 6.2 **Feral predator abundance monitoring**

After completion of each monitoring event at each location determine the average of counts (foxes and cats) and divide them by the length of the transect to get a simple index of abundance (animals/km⁻¹) for each road/key infrastructure area during each monitoring event.

Triggers for adaptive management

A statistically significant increase in the number of feral predators per km, over multiple consecutive monitoring periods or years.



Source: EMM (2018); Snowy Hydro (2018); NearMap (2018); SMEC (2018); Robert Bird (2018); DFSI (2017)

GDA 1994 MGA Zone 55

KEY

- Permanent bridge
- Portal construction pad and accommodation camp conceptual layout
- Local road or track
- Watercourse
- Disturbance footprint
- Vehicle transect
- Walked transect

Feral predator abundance
monitoring - indicative locations

Snowy 2.0
Biodiversity monitoring program
Exploratory Works
Figure 6.3

6.6.1 Limitations of abundance monitoring

Night-time counting using spotlights has been used for many years to survey foxes (Mitchell & Balogh 2007b) and simple indexes of abundance can be produced from these counts, such as the number of animals seen per kilometre travelled. However, indexes created from spotlighting counts have bias caused by the use of different observers or changes in visibility or sightability due to vegetation density (Mitchell & Balogh 2007b) other sources of potential variation include the time of night that the survey is undertaken and seasonal variations in animal behaviour and abundance. The use of roads as transects means vegetation types may not be surveyed evenly (Mitchell & Balogh 2007a). Where fox density is low, spotlighting may fail to detect their presence, and as a result, spotlighting tends to underestimate fox numbers (Mitchell & Balogh 2007b).

Despite these shortcomings, spotlighting has been extensively used in Australia, and is considered a practical tool for monitoring the relative size of the fox population, especially where the habitat is open grassland or open woodland where trees are sparse (Mitchell & Balogh 2007b). Sharp et al. (2001) (as cited in Mitchell & Balogh 2007b) suggested that spotlight counts can accurately indicate fluctuations in fox population size but may not be able to detect small changes in abundance.

Similarly, spotlighting has been used for many years to survey feral cats (Mitchell & Balogh 2007c), because it allows large areas to be monitored fairly rapidly. Spotlighting can sample different vegetation types and compare them under similar conditions within a site. Indexes of abundance, such as the number of animals seen per kilometre, can be produced from the spotlight counts; however, indexes created using spotlighting counts should also be corrected for the bias. Where feral cat density is low, spotlighting may fail to detect their presence; therefore, under these conditions, spotlighting may underestimate feral cat numbers (Mitchell & Balogh 2007c). Despite these shortcomings, spotlighting has been used extensively in Australia, and is considered a practical tool for monitoring relative population abundance of feral cats also. Edwards et al. (2000) (as cited in Mitchell & Balogh 2007c) suggested that spotlight counts would improve in precision as the feral cat population size increased, but that they may not be able to detect small changes in abundance at low densities.

7 Reporting and review

7.1 Reporting schedule

An annual report will be prepared that summarises all monitoring undertaken within the year, the results of the monitoring, and any adaptive management undertaken. The annual report is also an opportunity to summarise findings to feed into the annual review of the monitoring program, as explained in the following sections.

7.2 Reporting and review schedule

The reporting and review schedule for this monitoring program is provided in Table 7.1

Table 7.1 Biodiversity monitoring program reporting and review schedule

Review	Schedule
1. Consultation with OEH on draft monitoring program	7 September to 11 October 2018
2. Snowy Hydro review draft monitoring program	15 October 2018
3. OEH and DPE review monitoring program	11 November 2018
4. Short report on monitoring results	After each monitoring event for each entity
5. Annual report	Annually for life of the monitoring program
6. Review of monitoring methods	Annually and on an as needs basis for life of the monitoring program
7. Review of triggers/adaptive management actions	Annually for life of the monitoring program and in the event of any triggers

7.3 Review criteria

Reviews 1 to 3 from OEH, DPE and Snowy Hydro would focus on the practicality of implementing the monitoring program, scientific robustness and compliance with the MCoA.

The review of monitoring methods (review 6) will be annually and on an as needs basis to determine the success of the monitoring methodologies in capturing the required data. This will allow for adjustment (if required) of monitoring methodology and survey design.

The annual review (review 7) would focus on a review of triggers for adaptive management actions. These annual reviews will provide an opportunity for triggers and management that are adaptive to monitoring results.

Task	Timing		
	Pre-construction (baseline)	During construction	Post-construction
Monitoring program	Draft monitoring program October 2018	Methods and adaptive management triggers reviewed annually as part of annual reporting	Methods and adaptive management triggers reviewed annually as part of annual reporting
	Final monitoring program November 2018		

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Biodiversity Monitoring Program

Appendix A

Ecology Proformas

Appendix A

Booroolong Frog Population Monitoring Proforma

Ongoing Population Trajectory of the Yarrangobilly Booroolong Frog population

Rocky breeding habitat monitoring

Date:

Location:

Data collectors:

[illegible]

Appendix A

Booroolong Frog Population Monitoring Proforma

Ongoing Population Trajectory of the Yarrangobilly Booroolong Frog population

Pool depth monitoring

Date:	Location:	Data collectors:
--------------	------------------	-------------------------

[illegible]

Appendix A

Booroolong Frog Population Monitoring Proforma

Ongoing Population Trajectory of the Yarrangobilly Booroolong Frog population

Stream Transects

Date:	Location:	Data collectors:
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[illegible]

Appendix A

Booroolong Frog Surface Water Quality Monitoring

Identify and quantify any surface water quality impacts (within the Yarrangobilly River and Wallaces River)

Weather Station (continuous)

Date:	Location:	Data collectors:
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[illegible]

EXAMPLE

Appendix X: Feral Animal Monitoring Proforma

Abundance

Nocturnal Spotlight Search Monitoring

Date	Location	Vehicle / On Foot?	km Reading	Easting	Northing	Start Time	End Time	Project Phase	Weather Conditions	Staff	Species / Count
Project Phase e.g. pre-construction, construction, post-construction											
Notable Features e.g. observed increase/new occurrence of a primary impact											

Appendix A

Feral herbivore presence/absence monitoring

Remote camera monitoring

Date:

Location:

Data collectors:

[illegible]

Appendix A

Feral herbivore abundance monitoring

Vehicle spotlight counts

Date:

Location:

Data collectors:

[illegible]

Appendix A

Feral herbivore abundance monitoring

Walked spotlight counts

Date:

Location:

Data collectors:

[illegible]

Appendix A

Feral predator presence/absence monitoring

Remote camera monitoring

Date:

Location:

Data collectors:

[illegible]

Appendix A

Feral predator abundance monitoring

Vehicle spotlight counts

Date:

Location:

Data collectors:

[illegible]

Appendix A

Feral predator abundance monitoring

Walked spotlight counts

Date:

Location:

Data collectors:

[illegible]

Appendix A

Phytophthora presence/absence within proximity to project roads and key project infrastructure

Soil Sampling (laboratory: quarterly)

Date:	Location:	Data collectors:
--------------	------------------	-------------------------

[illegible]

Appendix A

Smoky Mouse Population Monitoring Proforma

Population size within proximity to the project

Trapping and pit tagging

Date:

Location:

Data collectors:

[illegible]

Appendix A

Smoky Mouse Occupancy Monitoring Proforma

Presence and Absence

Remote Camera Monitoring

Date:

Location:

Data collectors:

[illegible]

Appendix A

Smoky Mouse Monitoring Proforma

Transects

Date:

Location:

Data collectors:

# Transect Interval	Coordinates	Any species below 50cm	Observations/Comments
1			
2			
3			
5			
6			
7			
8			
9			
10			
11			
12			
13			

14			
15			
16			
17			
18			
19			
20			
21			
22	EXAMPLE		
23			
24			
25			
26			
27			
28			
29			
30			
31			

32			
33			
34			
35			
36			
37			
38			
39			
40	EXAMPLE		
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			

[illegible][illegible]

[illegible][illegible]

Appendix A

Smoky Mouse Monitoring Proforma

Photo points

Date:

Location:

Data collectors:

[illegible]

Appendix A

Booroolong Frog Surface Water Quality Monitoring

Identify and quantify any surface water quality impacts (within the Yarrangobilly River and Wallaces River)

Stream gauges (continuous)

Date:

Location:

Data collectors:

[illegible]

EXAMPLE

Appendix A

Booroolong Frog Surface Water Quality Monitoring

Identify and quantify any surface water quality impacts (within the Yarrangobilly River and Wallaces River)

Flow meters (continuous)

Date:

Location:

Data collectors:

[illegible]

EXAMPLE

Appendix A

Booroolong Frog Surface Water Quality Monitoring

Identify and quantify any surface water quality impacts (within the Yarrangobilly River and Wallaces River)

Stormwater monitoring (quarterly)

[illegible]

EXAMPLE

Appendix A

Booroolong Frog Surface Water Quality Monitoring

Identify and quantify any surface water quality impacts (within the Yarrangobilly River and Wallaces River)

Water quality monitoring (monthly & after any surface water incidents)

Date:

Location:

Data collectors:

[illegible]

EXAMPLE

Appendix A

Weed Species

Weed presence/absence within proximity to project roads and key project infrastructure

Weed mapping (bi-annually)

Date:

Location:

Data collectors:

[illegible]

[illegible]

EXAMPLE

EXAMPLE

Biodiversity Monitoring Program

Appendix B

Smoky Mouse key feed species

Smoky Mouse Key Feed Species/Family Group	Season	Reference
Bogong Moths (<i>Agrostis infusa</i>)	Late Spring/ Early Summer	NSW Office of Environment & Heritage
Hypogeal Fungi (<i>Potorous tridactylus</i>)	Frequent	Broome, L & Menkhorst, P, 2006, <i>Background and Implementation Information for the Smoky Mouse Pseudomys fumeus National Recovery Plan</i> , Department of Sustainability and Environment
Ericaceae (<i>Epacris impressa</i>)	Frequent	Broome. L, Cockburn. A & Ford. F, 2003, <i>Habitat preference, diet and demography of the smoky mouse, in south eastern NSW</i> , CSIRO
Prickly Broom Heath (<i>Monotoca scoparia</i>)	Frequent	Broome. L, Cockburn. A & Ford. F, 2003, <i>Habitat preference, diet and demography of the smoky mouse, in south eastern NSW</i> , CSIRO
Paperbark teatree (<i>Leptospermum trinervium</i>)	Spring on coast, summer on tablelands	Broome. L, Cockburn. A & Ford. F, 2003, <i>Habitat preference, diet and demography of the smoky mouse, in south eastern NSW</i> , CSIRO
Xanthorrhoeoideae (<i>Xanthorrhoea spp.</i>)	Frequent	Broome. L, Cockburn. A & Ford. F, 2003, <i>Habitat preference, diet and demography of the smoky mouse, in south eastern NSW</i> , CSIRO

Biodiversity Monitoring Program

Appendix C

Water quality results summary: Yarrangobilly River (base flow conditions)

	Yarrangobilly River						Wallaces Creek			
	Unit	Guideline value	# Samples	10 th percentile	Median	90 th percentile	# Samples	Min	Median	Max
Field Parameters										
Temperature	°C		11	13	19	22	5	13	15	16
Dissolved Oxygen (DO)	%	90 – 110 ¹	7	29	76	95	5	75	78	92
Electrical Conductivity (EC)	µS/cm	30 – 350 ¹	11	32	171	185	5	65	178	185
pH		6.5 – 8.5 ¹	11	7.5	7.9	8.1	5	7.5	7.6	8.4
Oxidising and Reducing Potential (ORP)		-	11	112	130	143	5	62	133	146
Turbidity	NTU	2 - 25	7	<2	<2	5	3	<2	<2	<2
Analytical Results - General										
Suspended Solids (SS)	mg/l	-	11	<5	<5	<5	5	<5	<5	<5
Total Alkalinity (as CaCO ₃)	mg/l	-	7	15	86	109	3	38	99	104
Total Hardness (as CaCO ₃)	mg/l	-	4	9	89	97	2	87	96	94
Analytical Results - Nutrients										
Ammonia	mg/l	0.013	7	<0.01	<0.01	<0.01	2	<0.01	<0.01	<0.01
Oxidised Nitrogen (NOx)	mg/l	0.015	7	0.01	0.03	1.9	2	0.03	0.035	0.04
Total Kjeldahl Nitrogen (TKN)	mg/l	-	7	<0.1	<0.1	<0.1	2	<0.1	<0.1	<0.1
Total Nitrogen (TN)	mg/l	0.25	7	0.1	0.1	1.9	2	<0.1	<0.1	<0.1
Reactive Phosphorus	mg/l	0.015	4	<0.01	<0.01	<0.01	2	<0.01	<0.01	<0.01
Total Phosphorus (TP)	mg/l	0.020	7	0.01	0.01	0.02	2	<0.01	<0.01	<0.01
Total Organic Carbon	mg/l	-	4	1	11	23	2	8	16.5	25
Dissolved Organic Carbon	mg/l	-	4	<1	<1	<1	2	<1	<1	<1
Analytical Results - Inorganics (Dissolved)										
Fluoride	mg/l	0.115 ³	7	0.1	0.1	0.6	3	0.1	0.1	0.1

	Yarrangobilly River						Wallaces Creek			
	Unit	Guideline value	# Samples	10 th percentile	Median	90 th percentile	# Samples	Min	Median	Max
Analytical Results - Metals (Dissolved)										
Aluminium (Al)	mg/l	0.055	4	0.01	0.01	0.06	2	<0.01	<0.01	<0.01
Arsenic (As)	mg/l	0.013	4	<0.001	<0.001	<0.001	2	<0.001	<0.001	<0.001
Barium (Ba)	mg/l	0.008 ³	4	0.011	0.0285	0.042	2	0.088	0.097	0.106
Boron (Bo)	mg/l	0.370	4	<0.05	<0.05	<0.05	2	<0.05	<0.05	<0.05
Cobalt (Co)	mg/l	0.0014 ³	4	<0.001	<0.001	<0.001	2	<0.001	<0.001	<0.001
Total Chromium (Cr)	mg/l	0.001	7	<0.001	<0.001	<0.001	3	<0.001	<0.001	<0.001
Copper (Cu)	mg/l	0.0014	4	<0.001	<0.001	<0.001	2	0.001	0.002 ⁴	0.003 ⁴
Manganese (Mn)	mg/l	1.9	4	0.001	0.001	0.002	2	0.001	0.0015	0.002
Nickel (Ni)	mg/l	0.011	7	0.001	0.001	0.002	3	0.001	0.002	0.002
Lead (pb)	mg/l	0.0034	4	<0.001	<0.001	<0.001	2	<0.001	<0.001	<0.001
Selenium (Se)	mg/l	0.005	4	<0.01	<0.01	<0.01	2	<0.01	<0.01	<0.01
Silver (Ag)	mg/l	0.0005	4	<0.001	<0.001	<0.001	2	<0.001	<0.001	<0.001
Vanadium (Va)	mg/l	0.006 ³	4	<0.01	<0.01	<0.01	2	<0.01	<0.01	<0.01
Zinc (Zn)	mg/l	0.008	4	<0.005	<0.005	<0.005	3	<0.005	<0.005	<0.005
Mercury (Hg)	mg/l	0.00006	4	<0.0001	<0.0001	<0.0001	2	<0.0001	<0.0001	<0.0001
Iron (Fe)	mg/l	0.3 ³	4	0.05	0.05	0.06	2	<0.05	<0.05	<0.05

Biodiversity Monitoring Program

Appendix D

Priority weeds for control

Appendix D: Weed Species

Priority weeds to target for mapping, monitoring and control

References:

NSW Office of Environment & Heritage (2016);

- Milfoil/Yarrow (*Achillea millefolium*);
- Vipers bugloss (*Echium vulgare*);
- St John's wort (*Hypericum perforatum*);
- Winter cress (*Barbarea verna*);
- Russell lupins (*Lupinus polyphyllus*);
- Large rush (*Juncus effusus*);
- Scotch broom (*Cytisus scoparius*)

ACT Government: Snowy River: Pest Plants (2004)

- African Lovegrass (*Eragrostis curvula*);
- Bathurst Burr (*Xanthium spp*);
- Blackberry (*Rubus fruticosus*);
- Broom (*Cytisus scoparius*);
- Gorse (*Ulex nutans*);
- Horsehound (*Marrubium vulgare*);
- Nodding Thistle (*Carduus nutans*);
- Scotch Thistle (*Onopordum acanthium*);
- Serrated Tussock (*Nassella trichotoma*);
- St John's Wort (*Hypericum perforatum*);
- Sweet Briar (*Rosa rubiginosa*);
- Vipers Bugloss (*Echium vulgare*).

DECC, 2007

- Sheep Sorrel (*Acestosella vulgaris*);

- Yarrow (*Achillea millefolium*);
- Browntop Bent (*Agrostis capillaries*);
- Sweet Vernal Grass (*Anthoxanthum odoratum*);
- Spear Thistle (*Cirsium vulgare*);
- Hawthorn (*Crataegus monogyna*);
- Cocksfoot (*Dactylis glomerate*);
- Patterson's Curse (*Echium plantagineum*);
- Yorkshire Fog Grass (*Holcus lanatus*);
- St John's Wort (*Hypericum perforatum*);
- Cat's Ear/Flatweed (*Hypochaeris spp.*);
- Bird's- foot Trefoil (*Lotus spp.*);
- Musk Monkey Flower (*Mimulus moschatus*);
- Sweet Briar (*Rosa rubignosa*);
- Blackberry (*Rubus spp*);
- Dandelion (*Taraxacum officinale*);
- Mullein/ Aarons Rod (*Verbascum Thapsus/ V.virgatum*);
- African Lovegrass (*Eragrostis curvula*);
- Ox-eye Daisy (*Leucanthemum vulgare*); and
- Serrated Tussock (*Nassella trichotoma*).

Based on these three main reference lists, the following outlines the main priority weeds to be mapped, monitored and controlled during project:

- **African Lovegrass** (*Eragrostis curvula*);
- **St John's wort** (*Hypericum performatum*);
- **Blackberry** (*Rubus spp*);
- **Serrated Tussock** (*Nassella trichotoma*);
- **Ox-eye Daisy** (*Leucanthemum vulgare*)
- **Hawthorn** (*Crataegus monogyna*)
- **Willows** (except Weeping Willow, Pussy Willow and Sterile Pussy Willow); (*Salix spp.*)
- **Broom: English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom** (*Cytisus scoparius*)
- **Flax-leaved Broom, Mediterranean Broom, Flax Broom** (*Genista linifolia*)

- **Gorse, Furze** (*Ulex europaeus*)
- **Bridal Creeper** (Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus) (*Asparagus asparagoides*)
- **Boneseed** (*Chrysanthemoides monilifera subsp.monilifera*)
- **Prickly Pears** (*Opuntia spp.* & *Cylindropuntia spp.*)
- **Fireweed** (Madagascar Ragwort, Madagascar Groundsel) (*Senecio madagascariensis*)
- **Salivina: Giant Salvinia, Aquarium Watermoss, Kariba Weed** (*Salvinia molesta*);
- **Tall perennial Bunchgra** (*Phalaris arundinacea*)

Biodiversity Management Plan

Appendix C

Pre-clearing procedure

Biodiversity Management Plan

Appendix C

Pre-clearing and clearing procedure

1. Purpose and objective

The purpose of this pre-clearing and clearing procedure is to describe how Snowy Hydro and its Contractors propose to manage clearing activities prior to and during construction so as to minimise impacts on biodiversity.

The key objective of this procedure is to describe the management measures that will be implemented during pre-clearing and clearing activities so as to ensure that these activities are conducted with minimum impact to the environment and within the permitted scope of the draft baseline conditions.

2. Training

All personnel taking part in construction activities shall be informed through the site-specific induction, prestart briefing or other targeted training of the importance of clearing limits and the significance of the surrounding environment.

All personnel involved in the clearing activities would be subject to toolbox training on the Clearing and Grubbing EWMS and a prestart meeting which discusses the clearing for the day; limits of clearing; processes to follow; known or potentially occurring threatened species and sensitive areas; and the locations of significant habitat features within and adjacent to the construction areas.

3. Pre-clearing

As detailed further in Table 5-1 of the Biodiversity Management plan the following is to occur prior to clearing:

- An ecologist will be engaged for the project.
- A clearing and grubbing EWMS will be developed.
- The extent of clearing required for construction and permanent infrastructure shall be confirmed on a survey plan and approved with Snowy Hydro. These boundaries are included within the Sensitive Area Plans (SAP) which have been developed from various sources and are a quick spatial reference guide to the significant environmental items on-site.
- **Clearing limits/Exclusion Zones** will be established at least prior to clearing commencing and will include the following:
 - For environmentally sensitive areas: "no-go" zone fencing and signage is to be installed:
 - A 50 metre exclusion zone surrounding the Yarrangobilly River and Wallaces Creek is to be observed at all times, with the exception of approved bridge construction works and section of Mine Trail Road.
 - The existing disturbance footprint along the upper section of Lobs Hole Ravine Road shall be maintained. Disturbance is not permitted outside of existing disturbed areas between chainage 0 and 7750.
 - For Bridge crossing: Frog exclusion fencing will be installed.
 - In other areas the clearing limits will be delineated using signage and highly visible barrier or tape such as flagging, bunting, nightline or other similarly robust and durable material with reflective strips periodically along its length.

Biodiversity Management Plan

Pre-clearing and clearing procedure

- Tree protection zones (TPZs) will be set up around all trees retained within and adjacent to the disturbance footprint using signage and highly visible barrier or tape such as flagging, bunting, nightline or other similarly robust and durable material with reflective strips periodically along its length and designated as "No-go" Zones.
 - Delineation will be installed consistently through the project to mark boundaries and sensitive areas using signage and highly visible barrier or tape such as flagging, bunting, nightline or other similarly robust and durable material with reflective strips periodically along its length and designated as "No-go" Zones to reduce the risk of error or misinterpretation of boundaries. This may not be possible in some circumstances due to safe site access requirements.
- Refer to Weed and Feral Animals Management Plan for the management of weeds prior to clearing.
- Consultation with the ecologist will occur to determine the location of suitable habitat for fauna release.
- An ecologist will undertake a pre-clearing walk along the proposed clearing areas prior to the commencement of clearing. The ecologist will:
 - Check for the evidence of presence of threatened flora and fauna species.
 - Flag key habitat features, including (but not limited to) nests, hollow bearing trees or large logs using signage and highly visible barrier or tape such as flagging, bunting, nightline or other similarly robust and durable material with reflective strips periodically along its length and designated as "No-go" Zones. As noted above in some circumstances this may not be possible due to site safe access requirements. GPS coordinates for all habitat trees identified will be recorded during the pre-clearing survey.
 - Confirm nearby habitat suitable for the release of any that may be encountered during clearing works.
 - Undertake careful inspection of habitat for frog species within the 50m buffer zone.
 - Where works are to be undertaken within the 50 m buffer zone of Yarrangobilly River, all vegetation, rocks, logs and other shelter are to be carefully inspected for frog species.
 - An arborist is to report on any unsound trees that should be removed if required.
- A check to ensure exclusion zones have been delineated and any vegetation to be retained are clearly marked using signage and highly visible barrier or tape such as flagging, bunting, nightline or other similarly robust and durable material with reflective strips periodically along its length and designated as "No-go" Zones
- A check to ensure clearing limits and other delineation required to be installed prior to clearing, is in place.
- The project ecologists should capture and/or remove fauna that have the potential to be disturbed as a result of clearing activities.
- Relocate identified fauna into pre-determined habitat identified for fauna release.
- Inform clearing contractors of any changes to the sequence of clearing if required.
- Contact a wildlife carer or veterinarian to inform them of vegetation clearing works upcoming

Biodiversity Management Plan

Pre-clearing and clearing procedure

- Prior to any disturbance of waterway banks, a thorough inspection by a qualified ecologist will be undertaken for aquatic fauna and frogs.
- Fauna spotters will check areas adjacent to Yarrangobilly River prior to clearing for Booroolong Frog and translocate them to adjacent habitats away from impacts.
- Where possible, existing trees and other vegetation should be retained within 15 metres of waterways and drainage lines until immediately before construction commences in the area.
- The supervisor, operator and environmental advisor are to walk the clearing footprint prior to commencing clearing.
- The **Clearing Permit Hold Point** is to be approved prior to clearing commencing.

4. Vegetation clearing

A two-stage habitat removal process will be implemented and involve the following steps:

Stage 1 – Non-habitat vegetation/ tree removal

Where no areas of habitat have been identified to be cleared, clearing can be undertaken in a single-stage process, and includes the under-scrubbing of non-habitat trees, shrubs and other vegetation.

All boundary and erosion and sediment controls should be in place prior to clearing.

When vegetation, that may provide habitat for native fauna, is proposed to be removed the area will be surveyed by the project ecologist immediately prior to clearing, to:

- Obtain updated information on fauna and fauna habitat resources present:
 - inspection of trees for any new nests constructed since the pre-clearing surveys;
 - inspection of hollow logs and wood debris for the presence of any sheltering fauna.
- Identify any fauna that may have moved into the project area since the initial pre-clearing inspection.
- Capture and relocate non-mobile fauna, such as reptiles and frogs and key habitat features such as active bird nests.
- If not already available, record the details for all Hollow Bearing Trees (HBTs) and trees containing threatened fauna and flora include GPS location, species, type of habitat feature, size of hollow and type of hollow.
- Remove non-habitat vegetation first.

This allows respite between the initial disturbance and the final removal of habitat. The changed environment along with the disturbance should encourage resident fauna to individually relocate without human handling. The timing should allow resident fauna at least 24-48 hours after removal of non-habitat trees to vacate remaining habitat trees.

Stage 2 – Habitat Tree Removal

Biodiversity Management Plan

Pre-clearing and clearing procedure

- Identified habitat (e.g. nests, bush rock, boulder fields, hollow bearing trees and large woody debris) will be left for at least 24-48 hours after removing non-habitat vegetation to allow fauna to escape.
- Nests and on-ground logs will be carefully inspected by an ecologist. Logs should be carefully rolled and inspection beneath the log undertaken.
- The project ecologist will be present during all removal of habitat trees to capture and relocate any encountered fauna.
- Habitat trees (trees with hollows or nests) will be knocked either manually or with machine and then carefully lowered to the ground with minimal impact and nests and hollows inspected by the ecologist.
- Any fauna species are to be relocated to habitat identified during the pre-clearing process or, if injured, transported to a veterinarian or wildlife carer.
- Where works are undertaken during the active period for the Booroolong Frog (October to March) the frog should be relocated to the nearest area of retained riparian habitat.
- Where practical, hollows will be placed in adjacent habitat until the following day for further inspection by a project ecologist to verify no fauna is present. Hollow bearing trees and any other cleared vegetation regarded as valuable for relocation and habitat creation/enrichment are to be retained.
- Records are to be kept of all fauna rescue events including locations to where fauna have been relocated. Provide GPS coordinates for such events
- Stockpiling/storage of cleared timber are to be in designated areas and outside the critical root zone of remaining trees.

5. Unexpected threatened species finds procedure

If any threatened species or threatened ecological community is unexpectedly encountered during construction activities, the Unexpected Threatened Species Finds Procedure provided in Appendix D will be followed.

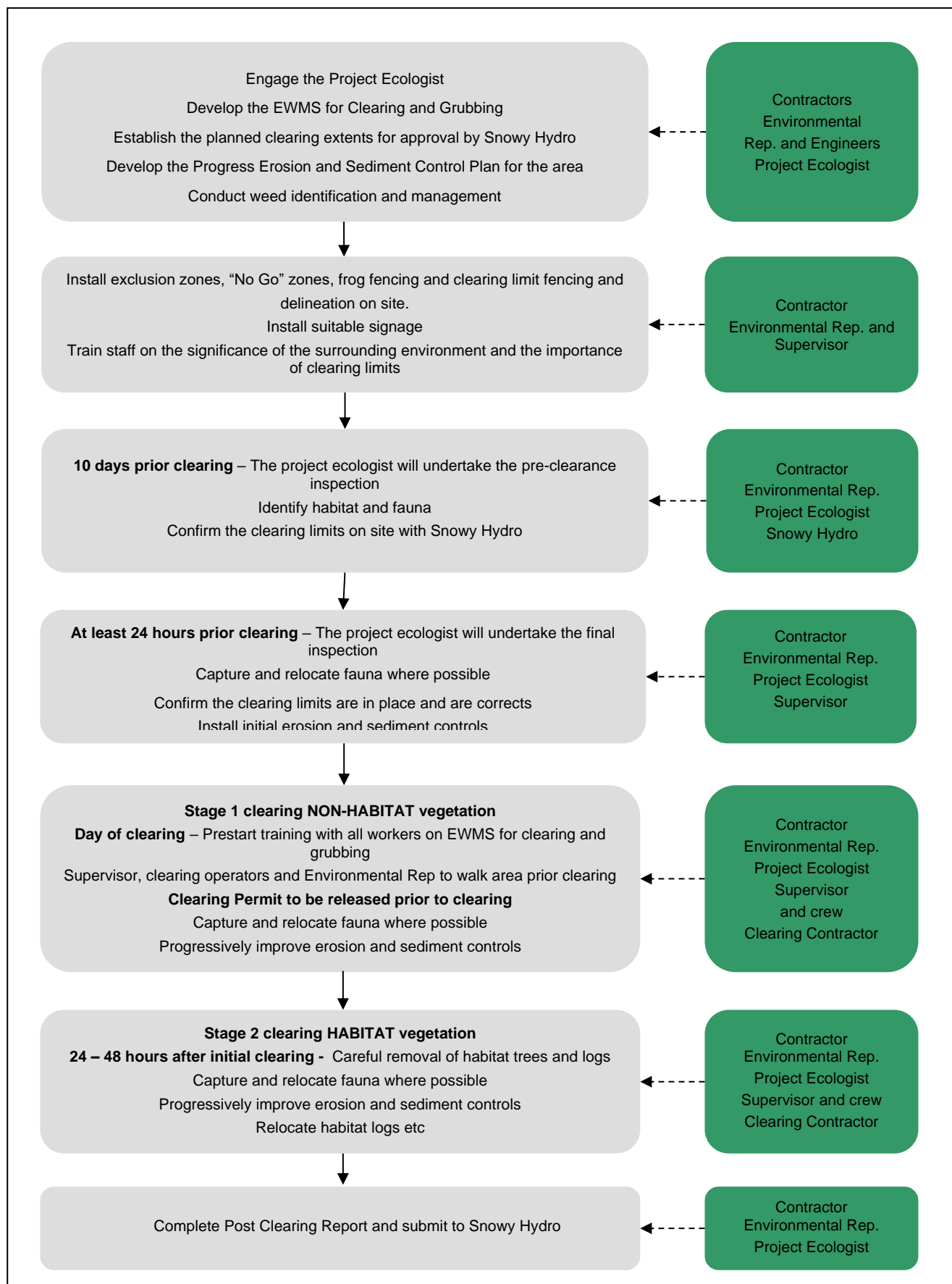
6. Post clearing report

Post clearing reports will be compiled progressively during the clearing phase of the project and submitted to Snowy Hydro. The completed reports will include:

- The name and qualifications of the ecologist or wildlife carer present during clearing.
- An assessment of the habitat and handling of fauna.
- Information on clearing operations, dates, procedures, areas.
- Live animal sightings, captures, any releases or injured/shocked wildlife.
- Any dead animals located.
- Photographs of rescued fauna.

Biodiversity Management Plan

Pre-clearing and clearing procedure



Biodiversity Management Plan

Appendix D

Unexpected threatened species finds procedure

Biodiversity Management Plan

Appendix D

Unexpected threatened species find procedure

1. Purpose

This procedure details the typical actions to be taken when a threatened flora or fauna species is unexpectedly encountered on site. This may be adopted by the Contractor if necessary.

2. Training

Photos and descriptions of threatened species identified as occurring in the project area are detailed within the Biodiversity Management Plan and are included within this Unexpected threatened species find procedure.

All personnel are to be trained through inductions and toolboxes of the biodiversity values of the project, including the potential for the identification of threatened species and this unexpected threatened species finds procedure.

3. Supporting documents

This procedure shall be read and used in conjunction with the Environmental Management Strategy and the Biodiversity Management Plan.

4. Threatened species likely to occur in the area

Threatened species surveys undertaken as part of the EIS did not identify any threatened flora species within or adjacent to the Exploratory Works survey area, however, three threatened flora species have a low likelihood of occurrence:

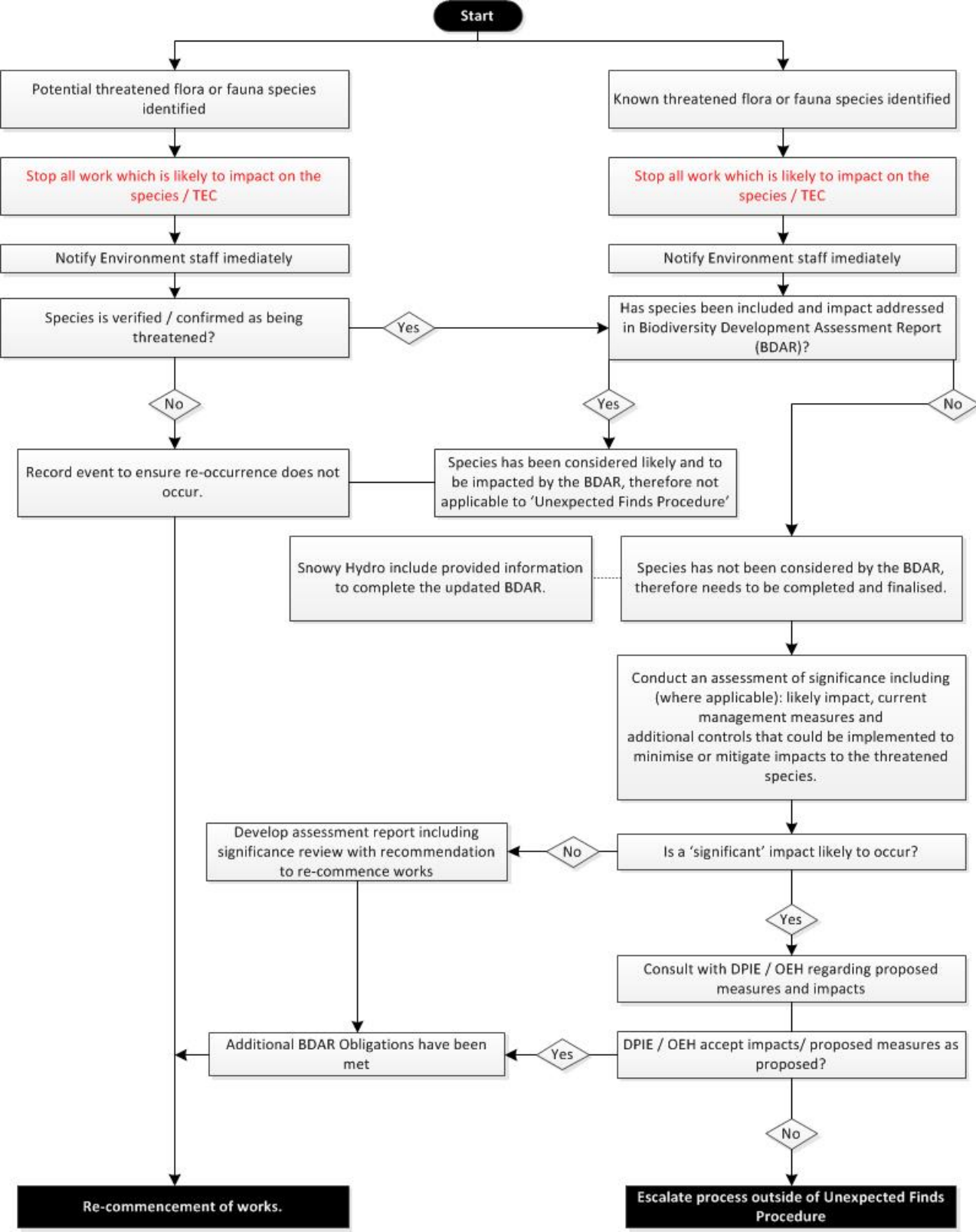
- Curtis' Colobanth (*Colobanthus curtisiae*);
- Blue-tongued Greenhood (*Pterostylis oreophila*);
- Cotoneaster Pomaderris (*Pomaderris cotoneaster*);
- Austral Toadflax (*Thesium australe*).




Ten threatened fauna species have been recorded within or adjacent to the Exploratory Works survey area:




- Smoky Mouse;
- Eastern Pygmy Possum;
- Booroolong Frog;
- Gang Cockatoo;
- Masked Owl;
- Diamond Firetail;
- Dusky Woodswallow;
- Varied Sittella;
- Flame Robin;
- Scarlet Robin.





5. Implementing this procedure




This procedure is applicable to all activities that have the potential impact upon threatened flora and fauna species that have not been assessed and approved. Sensitive Area Plans will clearly identify areas in which impacts on Threatened flora have been approved.





Common name	Scientific name	BC Act	EPBC Act	Image	Appearance	Location
Fauna						
Smoky Mouse	<i>Pseudomys fumeus</i>	Critically endangered	Endangered		<ul style="list-style-type: none"> Fine, soft, pale grey to bluish grey to black fur A grey to white belly and ears and feet that are flesh-coloured with sparse white hair Similar in size to a small rat, the length of individuals, including the tail, is between 180–250mm Primarily nocturnal species 	This species was recorded at 12 locations along the upper section of Lobs Hole Ravine Road to around 1,100 m elevation. The species is likely to occupy this entire ridge, given the extent of suitable habitat in this area. Breeding season is from September to April, and males may be more active and transient during this period as they search for mates.
Eastern Pygmy Possum	<i>Cercartetus nanus</i>	Vulnerable	Not listed		<ul style="list-style-type: none"> Eastern Pygmy-possums are tiny, only weighing 15 to 43 grams Adults have a body length between 70-110mm Almost bare, prehensile (capable of curling and gripping) tail Big, forward-pointing ears Light-brown fur above and white belly below Active climbers 	The Eastern Pygmy Possum was recorded at numerous locations within the Exploratory Works survey area, from the upper reaches of Lobs Hole Ravine to Lobs Hole.
Booroolong Frog	<i>Litoria booroolongensis</i>	Endangered	Endangered		<ul style="list-style-type: none"> Medium sized tree frog, with adults growing to about 5cm Their body-colour may be grey, olive or brown with indistinct black markings The abdomen is white The skin usually has a slightly warty appearance The fingers and toes have well developed discs, and the toes are strongly webbed The call is a soft, purring 'craww' 	A healthy population of the Booroolong Frog was recorded along the entire length of the Yarrangobilly River within and adjacent to the Early Works project area; this population is likely to extend upstream to at least Blue Creek Firetrail.

Common name	Scientific name	BC Act	EPBC Act	Image	Appearance	Location
Murray Crayfish	<i>Euastacus armatus</i>	Vulnerable	Not listed		<ul style="list-style-type: none"> Murray crayfish have large white claws and a dark olive/grey/black carapace, all of which are covered in short robust spikes. Murray Crayfish have been reported to grow to 3 kg and are the second largest freshwater crayfish in the world behind the Tasmanian Freshwater Crayfish. 	Murray Crayfish can be found in the Murray River upstream of Mildura, in the Murrumbidgee River and in some dams, and are the only species in the Euastacus genus that live in both cold and warm water habitats.
Gang Cockatoo	<i>Callocephalon fimbriatum</i>	Vulnerable	Not listed		<ul style="list-style-type: none"> Gang-gang Cockatoos are primarily slate-grey, with the males easily identified by their scarlet head and wispy crest Females have a grey head and crest and feathers edged with salmon pink on the underbelly 	The Gang Gang Cockatoo was found to be common throughout the Exploratory Works survey area, with the species observed at numerous locations foraging. The species was observed to be most common in sub-alpine woodlands (such as at the top of Lobs Hole Ravine Road) and riparian areas at lower elevations (close to the Yarrangobilly River).
Masked Owl	<i>Tyto novaehollandiae</i>	Vulnerable	Not listed		<ul style="list-style-type: none"> A medium-sized owl to 40 - 50 cm long Dark eyes set in a prominent flat, heart-shaped facial disc that is encircled by a dark border The feet are large and powerful, with fully feathered legs down to the toes The owl exists in several colour forms, with wide variation in plumage 	The Masked Owl was recorded at two locations within and adjacent to the Exploratory Works disturbance footprint during targeted surveys; on the Yarrangobilly River in Lobs Hole and in the upper sections of Lobs Hole Ravine Road, near the intersection with Link Road.

Common name	Scientific name	BC Act	EPBC Act	Image	Appearance	Location
Diamond Firetail	<i>Stagonopleura guttata</i>	Vulnerable	Not listed		<ul style="list-style-type: none"> The Diamond Firetail is a large (length 10-12cm, weight 17 grams), striking finch with a bright red bill, and red eyes and rump The white throat and lower breast are separated by a broad black breast-band that extends into the strongly white-spotted, black flanks 	The Diamond Firetail is endemic to south-eastern Australia, extending from central Queensland to the Eyre Peninsula in South Australia.
Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	Vulnerable	Not listed		<ul style="list-style-type: none"> Medium-sized bird (16-19.5cm, 35g), with a longish tail Mostly dark grey-brown, merging to blackish on the tail, with a small black-brown mask Bluish bill with a black tip 	Dusky woodswallows are widespread in eastern, southern and south western Australia.
Varied Sittella	<i>Daphoenositta chrysoptera</i>	Vulnerable	Not listed		<ul style="list-style-type: none"> The Varied Sittella is a small (10cm) songbird with a sharp, slightly upturned bill, short tail, barred undertail, and yellow eyes and feet. In flight the orange wing-bar and white rump are prominent. 	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands.
Flame Robin	<i>Petroica phoenicea</i>	Vulnerable	Not listed		<ul style="list-style-type: none"> The Flame Robin is a small Australian robin that reaches 14cm in length. The male has a dark grey head and upperparts, a small white forehead patch, and white wing stripes and white tail-edges. 	The Flame Robin is endemic to south eastern Australia, and ranges from near the Queensland border to south east South Australia and also in Tasmania.

Common name	Scientific name	BC Act	EPBC Act	Image	Appearance	Location
Scarlet Robin	<i>Petroica boodang</i>	Vulnerable	Not listed		<ul style="list-style-type: none"> The Scarlet Robin is a small Australian robin that reaches 13 cm in length. The male has a black head and upperparts, with a conspicuous white forehead patch, white wing stripes and white tail-edges. The male has a bright scarlet-red chest and a white belly. The female is pale brown, darker above, and has a dull reddish breast and whitish throat. The whitish mark on the female's forehead is smaller than the male's. 	The Scarlet Robin is found from south east Queensland to south east South Australia and also in Tasmania and south west Western Australia.
Flora						
Curtis' Colonbath	<i>Colobanthus curtisiae</i>	No	Yes - Vulnerable		This small perennial herb flowers from November to February with most herbarium specimens collected from November to January. While flowers are necessary to confirm the identity of the species, it can be detected throughout the year	It is a grassland to grassy woodland plant, often found on rocky knolls, and can be found in areas subject to a wide variety of environmental conditions. The species responds to some disturbance.
Blue-tongued Greenhood	<i>Pterostylis oreophila</i>	Yes – Critically endangered	Yes – Critically endangered		The Blue-tongued Greenhood is a terrestrial orchid, with up to five leaves in a basal rosette before flowering. The leaves are later arranged loosely along the 20 cm tall flowering stems. The leaves are oval in shape, to 70 mm long and 20 mm wide. The flower is solitary, erect, predominantly white with narrow green stripes, somewhat bulky (the hood-like structure being about 2.5 cm long). Flowers have a curved lip of a distinctive bluish or blue-green (aqua) colour. It flowers from November to January.	Grows along sub-alpine watercourses under more open thickets of Mountain Tea-tree in muddy ground very close to water.

Common name	Scientific name	BC Act	EPBC Act	Image	Appearance	Location
Cotoneaster Pomaderris	<i>Pomaderris cotoneaster</i>	Yes – Endangered	Yes – Endangered		Cotoneaster Pomaderris is a shrub growing to 4 m tall. Its young stems have a covering of short, white, star-shaped hairs. Its leaves are elliptical, to 30 mm long and 15 mm wide with a tip that is sometimes indented (thus resembling the horticultural Cotoneaster, to which it is not related). The upper surface of the leaf is bristly and the lower surface has a fine white mat of star-shaped hairs. Its petal-less flowers are cream-coloured. Flowering occurs between October and November.	Cotoneaster Pomaderris has been recorded in a range of habitats in predominantly forested country. The habitats include forest with deep, friable soil, amongst rock beside a creek, on rocky forested slopes and in steep gullies between sandstone cliffs.
Austral Toadflax	<i>Thesium australe</i>	Yes - Vulnerable	Yes - Vulnerable		Austral Toadflax is a small, straggling herb to 40 cm tall. Leaves are pale green to yellow-green, somewhat succulent, 1 - 4 cm long and 0.5 - 1.5 mm wide. Flowers are minute and white, emerging where the leaves meet the stems and appearing in spring. The fruit is small and nut-like, developing in summer. This species is often hidden amongst grasses and herbs.	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast.

Biodiversity Management Plan - Appendix E

Fauna handling and rescue procedure

Fauna Handling and Rescue Procedure Snowy 2.0 Exploratory Works (Roads Package)

Appendix E to the Snowy 2.0 – Exploratory Works – Biodiversity Management Plan

E1 Purpose

This procedure explains the actions to be taken in the event that fauna (including injured, shocked, juvenile or other animals) are discovered on the project site that require handling or rescue during vegetation clearance and soil clearance and ongoing construction activities.

E2 Scope

This procedure is applicable to all native and introduced fauna species that are found on the project site. If there is an unexpected threatened species finding, the unexpected threatened species finding procedure outlined in Appendix D of the Snowy 2.0 – Exploratory Works Biodiversity Management Plan must be followed.

Pre-clearing procedure has been provided in Appendix C of this plan. This provides details on the due diligence activities required prior to tree clearing. This includes the two stage clearing methodology.

E3 Induction and Training

All site personnel and subcontractors will be made aware of the actions to be taken in the event that fauna is present on the project. This training will occur on site during the Project induction and as required in toolbox talks.

E4 Rescue Procedure

If wildlife is identified on the project site during clearing or site construction activities that may harm, or has resulted in harm, to the animal or that poses risk to site personnel, the following steps will be taken:

1. Stop all work in the vicinity of the fauna and **immediately notify** the Project Superintendent / Foreman who is to notify the Environmental Manager and/ or Project Ecologist if the latter is present on site.
2. Preferably allow any fauna individuals to leave the area without intervention
3. Use a qualified ecologist or wildlife carer with specific animal handling experience to carry out any fauna handling.
4. Where necessary to minimise stress to native fauna and/or remove the risk of further injury before the Project Ecologist or wildlife handler arrives on site, the Environmental Officer may implement the Handling Procedure detailed in Section 5.
5. If the animal cannot be handled (i.e. venomous reptiles, raptors, bats);
 - a) exclude all personnel from the vicinity with fencing and/or signage; and

- b) record the exact location of the animals to be provided to the Project Ecologist or appropriate wildlife handler.
- 6. Call the Project Ecologist or appropriate rescue agency (refer to contact details provided in below and follow any advice provided. Once the Project Ecologist or wildlife carer arrives at site, they are responsible for the animal and any decisions regarding the care of the animal will be made by that person.
- 7. In the event that wildlife carers, and/or local veterinary Services cannot be contacted, the injured animal shall be delivered to the relevant agency as soon as possible.
- 8. If an animal is injured, it will be kept in a quiet, warm and dark place until it can be transferred to a wildlife carer or vet.
- 9. If any fauna is to be euthanized, it will be undertaken using a suitable technique (e.g. cervical dislocation for small mammals) by a trained and competent personnel (i.e. suitably qualified Project Ecologist or wildlife handler) or will be taken to a veterinarian for euthanasia. The Project Ecologist will consider methods that are humane, painless and rapid.
- 10. If the fauna species is identified as a threatened species that is not a species for the specific work site identified in the **Unexpected Threatened Species Find Procedure** (Appendix D to the Biodiversity Management Plan), workers must follow the protocol specified in that procedure, including:
 - a) immediately cease all work likely to affect the threatened species;
 - b) inform the Environmental Manager and the Project Ecologist;
 - c) following consultation with all relevant stakeholders, the Project Ecologist/Environmental Manager will implement any corrective actions and additional safeguards; and
 - d) following confirmation by the Project Ecologist/Environmental Manager that all appropriate safeguards have been implemented, construction works can recommence.
- 11. Release of fauna captured during construction works, including clearing and associated works, will be undertaken by the Project Ecologist or wildlife handler. If the animal is not injured or stressed, it should be released to an area that is not to be disturbed by the Project construction works, in accordance with the following:
 - a) sites identified as suitable release points by the Project Ecologist or wildlife rescuer;
 - b) release site will contain similar habitat and occur as close to the original capture location as possible;
 - c) if the species is nocturnal, release will be carried out at dusk;
 - d) if the species is arboreal, release will be onto the trunk of a suitable tree;
 - e) release would generally (except in the case of aquatic fauna and amphibians) not be undertaken during periods of heavy rainfall;
 - f) non-native fauna will not be released and will be euthanized; and

- g) if the animal has been placed into care due to injury, age (i.e. young) or stress, upon its rehabilitation it will be released in an area that is not to be disturbed by the Project construction works, at the discretion of the Project Ecologist or wildlife rescuer.

E5 Reporting Requirements

12. Details of captured and relocated fauna will be recorded on the Fauna Rescue Event Record, (**Section E8**) including:
 - a) species;
 - b) location and time captured;
 - c) location and time released;
 - d) behaviour and condition upon capture;
 - e) behaviour and condition upon release; and
 - f) contact details of wildlife carer or vet if the animal was transferred into their care
13. Any fauna injury or death will be recorded and reported on the Fauna Rescue Event Record, (**Section E8**).

E6 Handling Procedure

The Handling Procedure will be implemented only if intervention is necessary (i.e. where fauna is injured or otherwise unable to leave the site without intervention, or to minimise stress to native fauna and/or remove the risk of further injury. The Project Ecologist will implement the following procedures:

1. Cover larger animals (including their head) with a towel or blanket and, if feasible, place in a cardboard box or cloth/hessian bag.
2. Place smaller animals (mammals, birds, reptiles) separately in a cotton bag, tied at the top.
3. Place frogs/tadpoles separately in a single use zip lock plastic bag with a small amount of water and/or the litter /vegetation in which they were found.
4. Fish and other aquatic life (i.e. turtles) place in plastic aquaria or plastic container with sufficient water.
5. For terrestrial fauna keep the animal in a quiet, warm, ventilated and dark place away from noisy construction activities.
6. For aquatic fauna species ensure sufficient amount of water and ensure adequate.
7. Gloves will be worn when handling mammals to protect against scratches and bites.
8. The *Hygiene Protocol for the control of disease in frogs* (DECCW 2009) must be followed for all frog handling to prevent pathogen spread amongst individuals and between catchments:
 - a) single use, non-latex, non-powdered (i.e. nitrile) disposable gloves to be worn when handling individuals if gloves are not available, then avoid touching the frog with bare hands by using implements to transfer to a container;

- b) healthy frogs are to be placed in separate single-use plastic bags which should be partially inflated and include a small amount of leaf litter or clean (i.e. washed in a 0.1% concentration of a benzalkonium chloride based disinfectant solution such as F10SC at 1:250 dilution and not re-used) damp cloth bag containing a small amount of leaf litter;
 - c) sick or injured individuals would be euthanized immediately, unless there is a high probability of recovery, in which case treatment would be as for healthy frogs;
 - d) handling equipment, hands and boots to be cleaned of all soil and sprayed with a 0.1% concentration of a benzalkonium chloride based disinfectant solution (i.e. F10SC at 1:250 dilution) or a Chlorhexidine based product (e.g. Halamid©) and rinsed when moving between waterbodies;
 - e) frogs and tadpoles are not to be moved between catchments; and
 - f) dead frogs would be handled only using single-use gloves and buried in situ to avoid movement of pathogens.
9. Snake handling must be as follows:
- a) handling of snakes must only be undertaken by a qualified ecologist or wildlife carer with experience in snake handling; and
 - b) no contact handling techniques (i.e. use a snake hook and bag in opposed to manually handling the snake) are recommended.
10. All handling of bats must be as follows:
- a) bats must only be handled by a qualified ecologist or wildlife carer experienced in bat handling and vaccinated against the Australian Bat Lyssavirus (ABL);
 - b) gloves must be worn when handling bats; and
 - c) larger bats would be wrapped in a large towel and handled with wearing elbow length puncture proof gloves.

E7 Wildlife carer contact details

1. The ecologist or environmental manager must contact the two local wildlife carer organisations, LAOKO and SONA, must be contacted prior to commencement of each stage to determine availability to assist with caring of injured native wildlife if required and notify of the activities occurring.
2. In the event that local wildlife carers are not available, the national WIRES contact number can be used to identify other local qualified wildlife carers.

Table 2 Wildlife Carer Contact Details

Role	Organisation	Location	Contact Details
Project Ecologist	Umwelt (Australia) Pty Ltd	Canberra / Project Site	The contact details for the Project Ecologist will be kept at a convenient location on the Project site and be available to the Contractor's personnel at all locations where clearing is being undertaken, to enable quick contact and access to the Project Ecologist.
Local Wildlife Carers	Looking After Our Kosciuszko Orphans (LAOKO)	Southern NSW around Jindabyne, to Vic border	6456 1313
Local Wildlife Carers	Saving Our Native Animals (SONA)	Southern NSW, around the areas of Batlow and Tumbarumba	6946 2222
Wildlife Carers	WIRES	National	1300 094 734
Veterinary Clinic	Tumut Veterinary Clinic	78 Adelong Rd, Tumut NSW	6947 3122
Veterinary Clinic	Monaro Veterinary Clinic	3 Massie Street Cooma NSW	6452 2292

E8 Fauna Rescue Recording Sheet

Item	Detail
Date fauna located	
Time fauna located	
Weather (temperature, wind, cloud cover, precipitation)	
Location (Coordinates and description i.e. in tree hollow; under stockpile, open area etc.)	
Fauna type (Mammal, bird, reptile; etc.)	
Species (if known)	
Visual signs of behaviour	
Condition, general health signs, description of injuries, note if a dead specimen	
Is the fauna injured (YES / NO)	
If YES please complete Section A; if NO please complete Section B	
A – Injured Fauna Reporting	
What time was a fauna specialist (qualified ecologist or wildlife handler) called?	
What time did the fauna specialist arrive?	
Fauna specialist name and contact	
What was the outcome? (e.g. animal euthanized; animal in care; animal taken to vet; treated and relocated)	
B – Non-injured Fauna Reporting	
Where was the fauna relocated? (Coordinates and description) <i>n.b. Only a qualified fauna ecologist or wildlife handler is to relocate fauna</i>	
Time the fauna relocated?	
Name and qualification of fauna handler	
Visual signs of behaviour on release	
Condition – general health signs - on release	
General	
Other comments	
Completed by	
Signed	
Date	
<i>n.b. Completed form to be provided to the Environmental Manager and filed in the Environmental Log.</i>	

Biodiversity Management Plan

Appendix F

Weed and Feral Animals Management Plan

Appendix F

Weed and Feral Animal Management Plan

Prepared for Snowy Hydro Pty Ltd
November 2019

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Weed and Feral Animal Management Plan

Report Number

J17188 Snowy 2.0 Exploratory Works Weed and Feral Animal Management Plan

Client

Snowy Hydro Pty Ltd

Date

19 November 2019

Version

Rev 1

Prepared by

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18 November 2019

Approved by

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18 November 2019

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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1 Introduction

1.1 Purpose and Objective

The key objective of the Weed and feral animal Management Plan is to describe the management measures that are to be implemented to ensure that the spread of weeds and pest animals and pathogens are minimised and within the scope permitted by the Project consent conditions.

To achieve this, Snowy Hydro and the Contractor will:

- ensure appropriate measures are implemented to address the relevant conditions of the Project consent conditions and the revised environmental management measures listed within the Submissions Report, as detailed within Table 2.1 and Table 2.2 of this Plan;
- detail the existing weeds, pest animals and pathogens identified within the project footprint during the EIS including any weeds and pests of concern not already within the Project footprint;
- ensure practical measures are implemented prior to and during construction to avoid the introduction of new weeds, pest animals and pathogens and to minimise the spread of existing weeds, pest animals and pathogens;
- detail the specific identification and monitoring programs for known weeds and pest animals and pathogens present in, and adjacent to, the project area; and
- establish procedures to prevent the introduction of new weeds, pest animals and pathogens.

2 Environmental requirements

2.1 Legislation

Legislation relevant to weed management includes:

- *National Parks and Wildlife Act 1974* (NPW Act);
- *Fisheries Management Act 1994* (FM Act); and
- *Biosecurity Act 2015*
- *Pesticides Act, 1999.*

2.2 Permits and Licences

No permits or licences are required.

2.3 Guidelines

- Regional Pest Management Strategy 2012 – 2017: Southern Ranges Region, (OEH; NPWS).
- Rehabilitation Guidelines for the Resort Areas of Kosciuszko National Park. (DECC 2007)
- NSW Agriculture: Noxious and Environmental Weed Control Handbook and website: <http://www.agric.nsw.gov.au/reader/weeds>
- CRC for Weed Management/DEH Introductory Weed Management Manual

3 Existing Environment

The following section summarises existing known weed, pest animal and pathogen species within and adjacent to the project including species, communities and habitats based on the information contained in Section 5.1 and Appendix F of the EIS. Appendix F includes the Biodiversity Development Assessment.

3.1 Weeds

3.1.1 Terrestrial Weeds

The past activities and land uses within the Project area of the KNP and around Talbingo have resulted in significant amounts of clearing and disturbance of vegetation in the area. Native vegetation, which includes fauna habitats have been modified by past disturbances associated with land clearing, livestock grazing and weed invasion.

Native vegetation has re-established itself throughout Lobs Hole; however, Blackberry (*Rubus fruticosus* species aggregate), a weed of national significance, has established itself to the point of infestation within the area. The riparian zones of both Wallaces Creek and the Yarrangobilly River within the project area are reasonably well vegetated, except for the lower section of the Yarrangobilly River which has been subject to clearing in Lobs Hole. In this area some banks are unvegetated. Both watercourses are subject to significant weed infestation, in particular with Blackberry.

Key weed species identified in *Rehabilitation Guidelines for the Resort Areas of Kosciuszko National Park*. (DECC 2007) and recorded during flora surveys for the broader Snowy 2.0 project include:

- Sheep Sorrel (*Acetosella vulgaris*);
- Yarrow (*Achillea millefolium*);
- Browntop Bent (*Agrostis capillaries*);
- Sweet Vernal Grass (*Anthoxanthum odoratum*);
- Spear Thistle (*Cirsium vulgare*);
- Hawthorn (*Crataegus monogyna*);
- Cocksfoot (*Dactylis glomerata*);
- Patterson's Curse (*Echium plantagineum*);
- Yorkshire Fog Grass (*Holcus lanatus*);
- St John's Wort (*Hypericum perforatum*) – High risk Regional Priority Weed Classification
- Cat's Ear/Flatweed (*Hypochaeris* spp.);
- Bird's-foot Trefoil (*Lotus* spp.);
- Musk Monkey Flower (*Mimulus moschatus*);

- Sweet Briar (*Rosa rubiginosa*);
- Blackberry (*Rubus* spp.), classified as a Weed of National Significance, State Priority Weed and Regional Priority Weed
- Dandelion (*Taraxacum officinale*); and
- Mullein/Aarons Rod (*Verbascum thapsus* and *V. virgatum*).

Areas which have already experienced considerable disturbance within the Exploratory Works footprint exhibit evidence of weeds. There are three identified weeds of significance in gullies and along Yarrangobilly Creek and Talbingo Reservoir. These weeds are:

- Blackberry (*Rubus* spp.);
- St John's Wort (*Hypericum perforatum*);
- Sweet Briar (*Rosa rubiginosa*).

3.1.2 Weeds of concern

Other weed species of concern, with potential to be transported into or within KNP during construction activities associated with the project and subject to current control programs include:

- African Lovegrass (*Eragrostis curvula*);
- Ox-eye Daisy (*Leucanthemum vulgare*);
- Serrated Tussock (*Nasella trichotoma*);
- English Broom (*Cytisus scoparius*);
- Cape Broom (*Genista monspessulana*);
- Lupins (*Lupinus polyphyllus*);
- Yarrow (*Achillea millefolium*);
- Large-flowered Mountain Trumpet (*Collomia grandiflora*);
- Cinquefoil (*Potentilla*)
- Phalaris;
- Willows;
- *Myosotis laxa subsp caespitose*;
- Mouse-eared Hawkweed; and
- Orange hawkweed (*Hieracium aurantiacum*).

Recently, there has been growing concern about the introduction of Orange Hawkweed to additional areas of the KNP. Currently there are seven infestations, totalling approximately 10 ha, currently confined to an area of some 8165 ha in the Jagungal wilderness area, which is situated over 50km south of the Project area. Orange hawkweed (*Hieracium aurantiacum*) presents a major threat to primary production and biodiversity across south-eastern Australia. It is on the National Alert List of Environmental Weeds. In addition, orange hawkweed is recognised as an agricultural sleeper weed in Australia. Under the Noxious Weeds Act 1993, all hawkweeds (*Heiracium* spp.) are listed as Class 1 noxious weeds.

3.1.3 Surveyed weeds

A weed survey of the Exploratory Works Project area was conducted in late November and early December 2018. This study identified the following weed species within the Project footprint:

- Bird's-foot Trefoil (*Lotus* spp.)
- Blackberry (*Rubus fruticosus* aggregate)
- Browntop Bent (*Agrostis capillaries*)
- Cat's Ear/Flatweed (*Hypochaeris* spp.)
- Cocksfoot (*Dactylis glomerata*)
- Dandelion (*Taraxacum officinale*)
- Hawthorn (*Crataegus monogyna*)
- Mullein (*Verbascum virgatum*)
- Musk Monkey Flower (*Mimulus moschatus*)
- Sheep Sorrel (*Acetosella vulgaris*)
- Spear Thistle (*Cirsium vulgare*)
- St John's Wort (*Hypericum perforatum*)
- Sweet Briar (*Rosa rubiginosa*)
- Sweet Vernal Grass (*Anthoxanthum odoratum*)
- Willows (*Salix* spp.)
- Yorkshire Fog Grass (*Holcus lanatus*)

3.1.4 Aquatic Weeds

Talbingo Reservoir provides substantial aquatic habitat, in particular extensive areas of wood debris (primarily submerged timber) and the non-native aquatic macrophyte *Elodea Canadensis* (elodea or Canadian pondweed) along shallow edges and embayments. Canadian pondweed is classified as a water weed which is known to potentially:

- Alter dissolved oxygen levels reducing the water quality;
- Restrict navigation and recreational activities on waterways; and
- Pose a drowning hazard for livestock and recreational swimmers.

It spreads via fragments. Elodea does not seed as only male flowers are found in Australia. Stems readily break into pieces which are easily transported in water.

Across NSW, the general biosecurity duty applicable to this weed is to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

3.2 Pathogens of concern (Not currently known in KNP)

Infection of native plants by *Phytophthora cinnamomi* is listed as a key threatening process under the BC Act and EPBC Act. *P.cinnamomi* can lead to death of trees and shrubs, resulting in devastation of native ecosystems (DECC 2008). Infection of susceptible communities with *P.cinnamomi* leads to

- changes in the structure and composition of the native plant communities;
- a significant reduction in primary productivity and functionality; and
- habitat loss and degradation for dependent flora and fauna (DoE 2014b).

Impacts from *P.cinnamomi* has been identified as a key threat to the Smoky Mouse (DECC 2008, Menkhorst and Broome 2008a, 2008b).

P.cinnamomi has not been confirmed as surviving in KNP, although it has potential to affect some species within the project area if it were to establish. However, it remains to be established if *P.cinnamomi* could be pathogenic under the conditions in the KNP (Keith McDougall OEH pers. comm. 12 September 2018). The main *Phytophthora* species of concern in the KNP is *Phytophthora gregata*, which is resulting in mortality of *Pimelea bracteata* en masse (Keith McDougall OEH pers. comm. 12 September 2018). *Pimelea bracteata* was not recorded within the project area.

3.3 Feral animal species

There are a number of wild animals in the Kosciusko National Park region, including feral cats, foxes, brumby horses, pigs, dogs and deer. Within the Exploratory Works footprint, the main pest species of concern of growth in population and activity is the feral Cat (*Felis catus*) and Red Fox (*Vulpes vulpes*) and their consequent impacts on native animals. Predation by feral Cats and Red Foxes are listed as key threatening processes under the BC Act and EPBC Act (NPWS 2001, DEWHA 2008, DoE 2015) with impacts from feral Cats also listed as a key threat to the Smoky Mouse (Menkhorst and Broome 2008a, 2008b). Introduced predators are also considered a threat to Eastern Pygmy-possums (NSWSC 2001).

3.4 Feral Herbivores

Remote camera surveys, spotlighting and opportunistic sightings undertaken for the *Snowy 2.0 Exploratory Works, Biodiversity Development Assessment Report* (EMM 2018) recorded the following feral herbivores within the project area:

- Horse (*Equus caballus*);
- Deer (Damas spp., Cervus spp., Axis spp); and
- Rabbit (*Oryctolagus cuniculus*)

The feral herbivore records were not limited to any one habitat type within the project area and it is possible that they occur across the project area.

3.5 Feral Predators

Remote camera surveys undertaken for the *Snowy 2.0 Exploratory Works, Biodiversity Development Assessment Report* (EMM 2018) recorded the following feral predators within the project area:

- Cat (*Felis catus*) (Photograph 6.1);
- Dingo/domestic dog (*Canis lupus*); and
- Fox (*Vulpes Vulpes*) (Photograph 6.2).

The feral predator records were not limited to any one habitat type within the project area and it is possible that they occur across the project area.


4 Environmental aspects and impacts

4.1 Impact summary

An environmental aspect is an element of an organisation's activities, products, or services that has, or may have, an impact on the environment (ISO 14001 Environmental management systems). The relationship of aspects and impacts is one of cause and effect.

Key aspects of the Project that could result in weed impacts are identified in Table 4.1. The extent of these impacts will depend on the nature, extent and magnitude of construction activities and their interaction with the natural environment (Column 2).

Table 4.1 Weed and feral animal aspects, impacts and environmental factors

	Environmental Aspects (Construction activities that may impact biodiversity)	Environmental Impacts	Environment Factors (Conditions)
	Movement of vehicles Clearing native vegetation Topsoil stripping Bulk earthworks Soil movement and transfer Bridge construction and waterway crossings Operation of compounds Imported materials Movement of vehicles and vessels into and out of site	Introduction of weeds, pest animals and pathogens Spread of weeds, pest animals and pathogens	Presence of existing weeds, feral animals and pathogens within the project area The presence of weeds, feral animals and pathogens adjacent to the project site

5 Environmental Management Measures

A range of environmental requirements and control measures are identified in the EIS, Submissions Report and the draft baseline conditions. Safeguards and management measures will be implemented to avoid, minimise or manage impacts from the introduction and spread of weeds, pathogens and pest animals.

Specific safeguards and management measures to address weed, pest animal and pathogen impacts of the Project are identified in Tables 2.1, 2.2 and 5.1 of the Biodiversity Management Plan.

Management measures for the control of weeds, pathogens and pest animals will take four forms:

- Prevention
- Monitoring
- Control
- Disposal.

5.1 Detailed weed and pathogen mitigation measures

5.1.1 Prevention

i Hygiene Inspections

Snowy Hydro Limited is to establish a weed and pathogen checkpoint at the entry to the site, at the intersection of Links Road and Ravine-Lobs Hole Road as well as at the wharf and northern Link road. This checkpoint will check and document inspection for weeds, vegetative, soil and organic material on and within plant, vehicles and equipment being brought to site.

a. Movement of Sand, Soil, Rocks, Gravel, Fill and other Weed Risk Material

Prior to the movement of any weed risk material to the Project site, the material is to be accompanied with a certificate stating that this material is free from weeds. If a certificate is not available, the Contractor is to conduct and document a weed inspection prior to the first movement of material from the source location and on a regular basis while material is still being delivered and during operation of the source location.

ii Weed washdowns

a. Prior to arrival on site

In order to minimise the risk of any new weeds being introduced to Project work areas, all vehicles, light vehicles and mobile plant shall be inspected prior to Site entry. The Contractor is expected to ensure that all vehicles have been washed down and inspected and that as a minimum, all HV have been washed down off site, inspected prior to entry and accompanied by an vehicle inspection checklist which will include weed hygiene. Due to site and logistical constraints there will be no vehicle wash down bays created at the site entrance during the Stage 1 work program.

In addition to this, all vehicles and equipment will be inspected on site and documented using the Vehicle and Mobile Equipment Weed Inspection Form. The Contractor shall maintain a copy of this form in the

vehicle and in the Project Office at all times for audit and inspection purposes, or an alternative compliance method is to be developed (e.g windscreen stickers).

If a vehicle or equipment arrives unclean and/or without a certificate, at the inspection points at Link Road or Wharf road, they will be refused entry and turned back to travel to the established washdown point at the nearest township.

iii Weed Wash-down Locations

No permanent weed wash-down areas will be located on site. The contractor is to establish a wash down area in a location close to site but in a built-up area. Recommendations are Cooma, Adaminaby, Talbingo, Tumut or Cabramurra. This allows the construction of a washdown area with enough space for the required infrastructure and a ready power and water supply. The recommended method of wash down is using high pressure hoses and cleaning liquids such as Truckwash and Castrol Farmcleanse, or similar products to aid in the removal of soil (especially for pathogens) from the plant, equipment and vehicles. All dirty water is to be treated and is not to be used for dust suppression.

All equipment being brought to site must be washed down prior to arriving on site. As outlined above, when vehicle and plant has been inspected and confirmed as clean, they will be given a form of certification (inspection sheet, windscreen sticker etc.)

Once a vehicle or item of mobile plant or equipment is operating on the Project site and has been demonstrated to be clean on entry then it will be free to move within the Site with the exception of weed risk areas. Once Plant and equipment enters a designated weed area, it is to surrender its weed certificate while being used in a designated weed area. When it has finished working in the area, is to be washed down, reinspected and issued with a new certificate before moving out of that area.

5.1.2 Controls

Where possible topsoil cleared will be stored locally for re-distribution across the same location. Topsoil that cannot be locally stored shall be stockpiled and quarantined. A suitable bund shall be placed around the toe of the stockpile.

Where possible weeds removed as per table 5.2 will be managed in a manner to ensure there is no risk of spread of weeds during transportation and disposal.

Where an area is identified as a significantly weed infested area, signage should be installed to identify the extent of the weed infested area at both ends. Controls should be placed on the entry and exit of vehicles into that area while it is being cleared. For the purpose of this scope of work the only area identified as having significant weeds is around the Yarrangobilly River temporary and permanent bridge sites.

All other non-weed materials excavated within a weed risk area is allowed to be moved within the boundaries of that same weed risk area but cannot be taken to an area with a different weed risk.

i Stockpile management

It is recommended that topsoil, mulch and spoil stockpiles should be monitored between spring and autumn and, where weeds establish on the stock piles, chemical weed control will be undertaken to prevent further stockpile contamination.

ii Chemical Weed Control

There may be some benefit in undertaking chemical weed control in specific situations. In many parts of the project footprint, such as the Ravine Road verges, exotic species co-occur with native species and chemical weed control may be detrimental. If non-target species are impacted the resulting disturbance could potentially allow the establishment of additional weed species. However, there are some situations where selective chemical weed control could be beneficial, these include:

- locations where weed seedlings establish in newly disturbed road verges within forested areas;
- material stockpiles; and
- to prevent seed set in heavily weed infested areas prior to topsoil stripping.

For all weed species there are a numerous alternative herbicide and treatment options available. Broad spectrum non-specific weed treatments are potentially problematic particularly in areas where weed species occur in conjunction with native plants. Where available, herbicide treatments should be selective or at least partially selective. As much as practical herbicide applications that minimise the likely impacts to non-target species should be selected. Weed control methods such as hand removal or the use of wick wipers could be potentially useful in sensitive situations to avoid impacts to non-target species. The NSW WeedWise database provides a range of chemical control options for the treatment of key weed species which will be used to guide chemical control options for the project.

iii Current NPWS practices

NPWS approach has been to target specific weeds that may spread out of Ravine primarily through traffic movement. This has involved annual spraying of all weed species along road verges. NPWS recommend that the project maintains this activity irrespective of weed abundance to ensure continuity of the program. However acknowledging the extent of dynamic nature of the Stage 1 work scope this weed program along Snowy 2.0 works will not continue until the completion of the required work scope.

NPWS has also recently conducted a targeted weed control for St John's Wort, briar, fruit trees and blackberry along the power line easements as well as a program of ongoing monitoring within the Ravine area for any new weeds is also undertaken.

False acacia stands in the Ravine have been subject to a significant control program within the proposed footprint for the exploratory work. Disturbance associated with the works may cause them to re-sprout. Any new plants should be actively suppressed.

Where active weed management occurs, the Exploratory Works Project will continue to follow the methodology currently followed by NPWS as per outlined above and in Table 5.1 below. However work outside of the proposed Exploratory works will not impact on the current programs of NPWS which will continue as required.

iv Blackberry

Blackberry will be disposed of in accordance with NPWS policy which can include burning, done in accordance with NSW RFS burning guidelines and under the supervision of a licenced fire control person. If burning is undertaken it needs to be done in accordance with the NSW RFS standards for pile burning and the NSW RFS Bushfire Environmental Assessment Code.

Table 5.1 Weed control management measures in Snowy region National Parks

Weed	Priority for Control	Current NPWS Control	Exploratory Works Control
Blackberry	Medium to lower Critical (where impact is on threatened species)	Physical removal Biological control, Stem injection/cut Stump/basal bark and spot spraying. Control methods are documented in the WoNS Blackberry Control Manual	Physical removal where the blackberry is within the clearing footprint Removal along the Yerrangobilly River within the project footprint.
St Johns Wort	Medium to lower Critical (where impact is on threatened species)	Physical removal, Biological control Spot or boom spraying.	Control to meet the requirements of the NPWS as applicable to Project weed management
Sweet Briar	Medium to lower Critical (where impact is on threatened species)	Physical removal, Stem injection or cut stump Basal bark Spot spraying.	Control to meet the requirements of the NPWS as applicable to Project weed management
Orange hawkweed	Critical	Physical removal, Biological control Spot or boom spraying	Control to meet the requirements of the NPWS as applicable to Project weed management

5.1.3 Monitoring

i Monitoring Objectives

The overarching monitoring objective for weeds and pathogens is to determine whether controls put in place to ensure weed cover does not increase across the project area and to ensure pathogens do not enter the project area, particularly in key fauna habitat, are successful. The objective is to also inform the location and extent of controls, specifically:

- to determine weed presence/absence within proximity to project roads and key project infrastructure;
- to determine changes in weed cover within proximity to project roads and key project infrastructure; and
- to undertake soil sampling in order to monitor pathogens within proximity to project roads and key project infrastructure.

ii Monitoring parameters

To determine if the mitigation measures put into place effectively mitigate potential weed and pathogen impacts, particularly in key fauna habitat, the following parameters will be monitored:

- weed presence/absence;

- weed cover; and
- soil pathogen presence/absence.

The details of the Snowy 2.0 Exploratory Works Stage 1 monitoring program can be found in the Biodiversity Monitoring Program.

5.2 Detailed feral herbivore and predator mitigation measures

5.2.1 Feral herbivore and predator prevention

To minimise the risk of increased predator activity, the following controls will be implemented for the project:

- waste will be stored appropriately in inaccessible bins and disposed off-site; no waste will be left outside in open areas accessible to feral animals; and
- a predator control program will be implemented, in conjunction with OEH and NPWS, to control feral animals.

5.2.2 Feral herbivore and predator Control

Snowy Hydro will work with NPWS to co-ordinate NPWS control programs so they can continue to be carried out and concurrently work with NPWS to conduct irregular controls which align with current NPWS methodology.

Currently annual control programs that NPWS carries out within the KNP to reduce the environmental impact of some pests is addressed in Table 5.5 below. Snowy Hydro will not actively pursue NPWS weed control programs within the work area.

Table 5.5 Feral herbivore and control management measures in Snowy region National Parks

Animal	Priority for Control	Current NPWS Control	Exploratory Works
Red fox / wild dogs	Fox control and monitoring programs associated with the Fox TAP mountain pygmy possum and broad-toothed rat sites are a critical priority	Integrated control is essential. 1080 baiting, Soft-jaw trapping, M44 ejectors, Opportunistic shooting and cage trapping.	Control to meet the requirements of the NPWS Regional Pest Management strategy 2012 - 2017 Control methods will comply with the NSW DPI Vertebrate Pest Control Manual and the DEH and DPI Model Code of Practice for the Humane Control of Foxes and related standard operating procedures.
Feral cat	Due to the limitations imposed by current techniques, feral cat control is unfeasible over large areas.	Opportunistic shooting Cage trapping or soft-jaw trapping,	Control to meet the requirements of the NPWS Regional Pest Management strategy 2012 - 2017 Comply with the DEH and DPI

	Locations where feral cat control may occur include complementary programs at Fox TAP sites (critical priority) or in recreational areas (such as in Kosciuszko National Park resorts) (medium priority).		Model Code of Practice for the Humane Control of Feral Cats and related standard operating procedures.
Rabbits	<p>Critical priority: Feral rabbit populations that have potential impact on threatened species or communities are of and will be investigated, and control programs implemented where necessary and feasible. New or developing occurrences of a highly invasive species are also of critical priority.</p> <p>Medium priority Feral rabbit populations which occur in the vicinity of a variety of Kosciuszko National Park historic huts and precincts and in the vicinity of Aboriginal artefact scatters. Feral rabbit populations which occur in wilderness areas and the Kosciuszko National Park management units</p>	Cooperative control is essential for effective feral rabbit control. Baiting (1080 or Pindone), warren fumigation (phosphine or CO2), Opportunistic shooting, warren destruction or direct infection of a population with a biological control (such as rabbit calicivirus disease or myxomatosis).	Control to meet the requirements of the NPWS Regional Pest Management strategy 2012 - 2017 Control methods will comply with the NSW DPI Vertebrate Pest Control Manual and the DEH and DPI Model Code of Practice for the Humane Control of Rabbits and related standard operating procedures.
Feral deer (sambar)	Feral deer populations that have potential impact on threatened species or communities are of critical priority and will be investigated, and control programs implemented where necessary and feasible. New or developing occurrences of a highly invasive species are of critical priority. Feral deer populations also occur in wilderness areas and the Kosciuszko National Park management units and are of medium priority.	Cooperative control is essential for effective feral deer control across the landscape. Control methods will include opportunistic shooting or specific shooting operations targeting identified feral deer populations.	Control to meet the requirements of the NPWS Regional Pest Management strategy 2012 - 2017 Control methods will comply with the DEH and DPI Standard Operating Procedures for the Ground Shooting of Feral Deer and the Feral Animal Aerial Shooting Team Guidelines.

5.3 Feral herbivore and predator Monitoring

A biodiversity monitoring Program has been developed for addressing all terrestrial biodiversity monitoring aspects. The Biodiversity monitoring program addresses all monitoring requirements for weeds, feral animal predators and herbivores. The details of the monitoring is shown within Section 6.1 Monitoring and inspection below and within the Biodiversity Monitoring Program.

To minimise the risk of increased predator activity, the following controls will be implemented for the project:

- a monitoring program will be implemented using remote cameras to monitor feral animal activity (this program);
- remote cameras will be placed along Lobs Hole Ravine Road (north and south) and Mines Trail to monitor feral animal movements (this program); and
- a predator control program will be implemented, in conjunction with OEH and NPWS, to control feral animals. Sightings are to be reported immediately to contractor environment representative and SHL so swift management actions can be introduced.

5.3.1 Feral predator monitoring program

i Baseline conditions

Remote camera surveys undertaken for the *Snowy 2.0 Exploratory Works, Biodiversity Development Assessment Report* (EMM 2018) recorded the following feral predators within the project area:

- Cat (*Felis catus*)
- Dingo/domestic dog (*Canis lupus*); and
- Fox (*Vulpes Vulpes*).

The feral predator records were not limited to any one habitat type within the project area and it is possible that they occur across the project area.

5.3.2 Mitigation measures

There is potential for increased human activity from the project to result in increased activity of predators, particularly feral Cats and Foxes. Increased activity of feral predators has consequent impacts on native animals. Predation by feral Cats and Red Foxes are listed as key threatening processes under the BC Act and EPBC Act (NPWS 2001, DEWHA 2008, DoE 2015) with impacts from feral Cats also listed as a key threat to the Smoky Mouse (Menkhorst and Broome 2008a, 2008b).

To minimise the risk of increased predator activity, the following controls will be implemented for the project:

- waste will be stored appropriately in inaccessible bins and disposed off-site; no waste will be left outside in open areas accessible to feral animals;
- a monitoring program will be implemented using remote cameras to monitor feral animal activity (this program);
- remote cameras will be placed along Lobs Hole Ravine Road (north and south) and Mines Trail to monitor feral animal movements (this program); and
- a predator control program will be implemented, in conjunction with OEH and NPWS, to control feral animals.

5.3.3 Monitoring objectives

The overarching monitoring objective for feral predators is to document changes in occupation (presence/absence) and abundance within proximity to the project, arising from increased human activity associated with the project and to inform the location and extent of controls, specifically:

- to determine occupancy and abundance along project roads and adjacent to key project infrastructure; and

- to determine occupancy and abundance on the upper sections of Lobs Hole Ravine Road (in Smoky Mouse habitat).

5.3.4 Monitoring parameters

To determine if the mitigation measures put into place effectively mitigate indirect impacts associated with feral predators, the following parameters will be monitored:

- presence/absence; and
- abundance.

The details of the Snowy 2.0 Exploratory Works Stage 1 monitoring program can be found in the Biodiversity Monitoring Program.

densities.

6 Reporting and review

6.1 Reporting schedule

An annual report will be prepared that summarises all monitoring undertaken within the year, the results of the monitoring, and any adaptive management undertaken. The annual report is also an opportunity to summarise findings to feed into the annual review of the monitoring program, as explained in the following sections.

The detection of any new weed species or the identification of any declared Class 1 or Class 2 pests coming into flower will need to be reported to the site Superintendent as they are identified.

6.2 Compliance

Compliance with this WFMP shall be reported by the Contractor to Snowy Hydro on a monthly basis. Reporting will include monthly internal project reports and six monthly compliance reports as required by condition 14 of the draft conditions of approval. The six-monthly reports will track compliance against the conditions of the draft conditions of approval and the revised environmental management measures. Compliance reporting will be carried out as per Department of Planning and Environment reporting guidelines. Reporting requirements and responsibilities are documented in the Sections 6 and 7 of the EMS.

6.3 Training

All site personnel will undergo site induction training relating to biodiversity including threatened species and habitat protection management issues.

The induction training will address elements related to biodiversity management including:

- existence and requirements of this BMP;
- relevant legislation;
- roles and responsibilities for biodiversity management;
- biodiversity mitigation and management measures.



Targeted training in the form of toolbox talks or specific training will also be provided to personnel with a key role in contaminated land management. Examples of training topics include:

- clearing procedures;
- no-go zones;
- threatened species within the project area;
- the unexpected finds procedure for threatened species;
- the procedures regarding management of weeds or pathogens.

Further details regarding the staff induction and training are outlined in Section 4 of the EMS.

7 Weed and Feral Animal Identification

Most Significant Weed and feral animal identification

	
Blackberry	Boneseed



Gorse

Flax-leaf Broom



Fireweed

Ox-eye daisy



St Johns Wort

Sweet briar



Orange Hawkweed

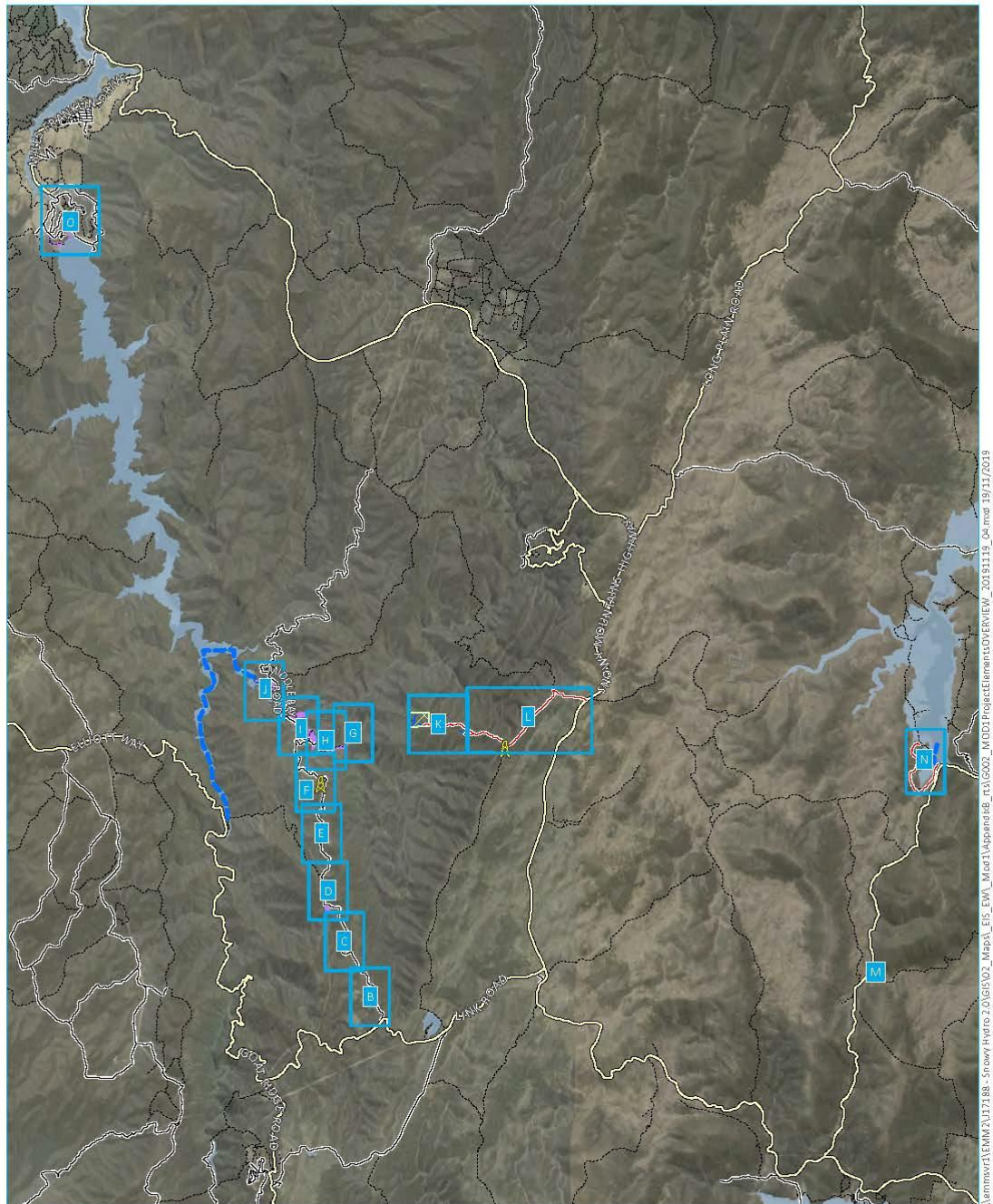
Mouse-eared Hawkweed

	
<p>Rabbit</p>	<p>Feral cat</p>
	
<p>Fox</p>	

Biodiversity Management Plan

Appendix G

Project boundary



Source: EMM (2019); Snowy Hydro (2019); SMEC (2019); DFSI (2017); GA (2015); LPMIA (2011)

KEY

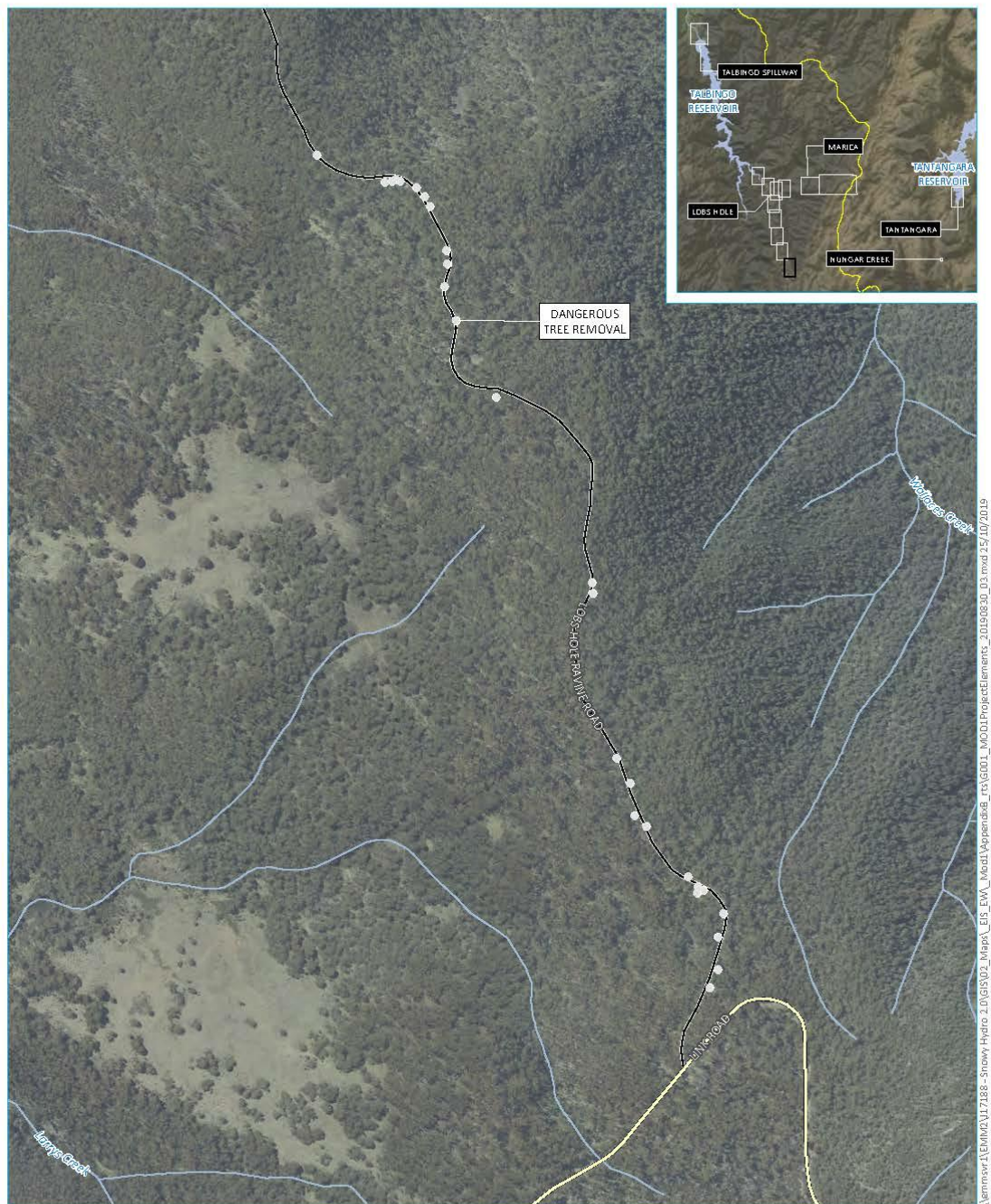
- Proposed temporary communications upgrade location
- Existing access track
- Boat access
- Main road
- Local road
- Vehicular track

- Map index
- EW approved construction footprint
- EW modification construction footprint (additional)
- Boreholes requiring on-site adjustment
- Waterbody

Exploratory Works project boundary
- overview

Snowy 2.0
Exploratory Works EIS
Modification 1
1 a





Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

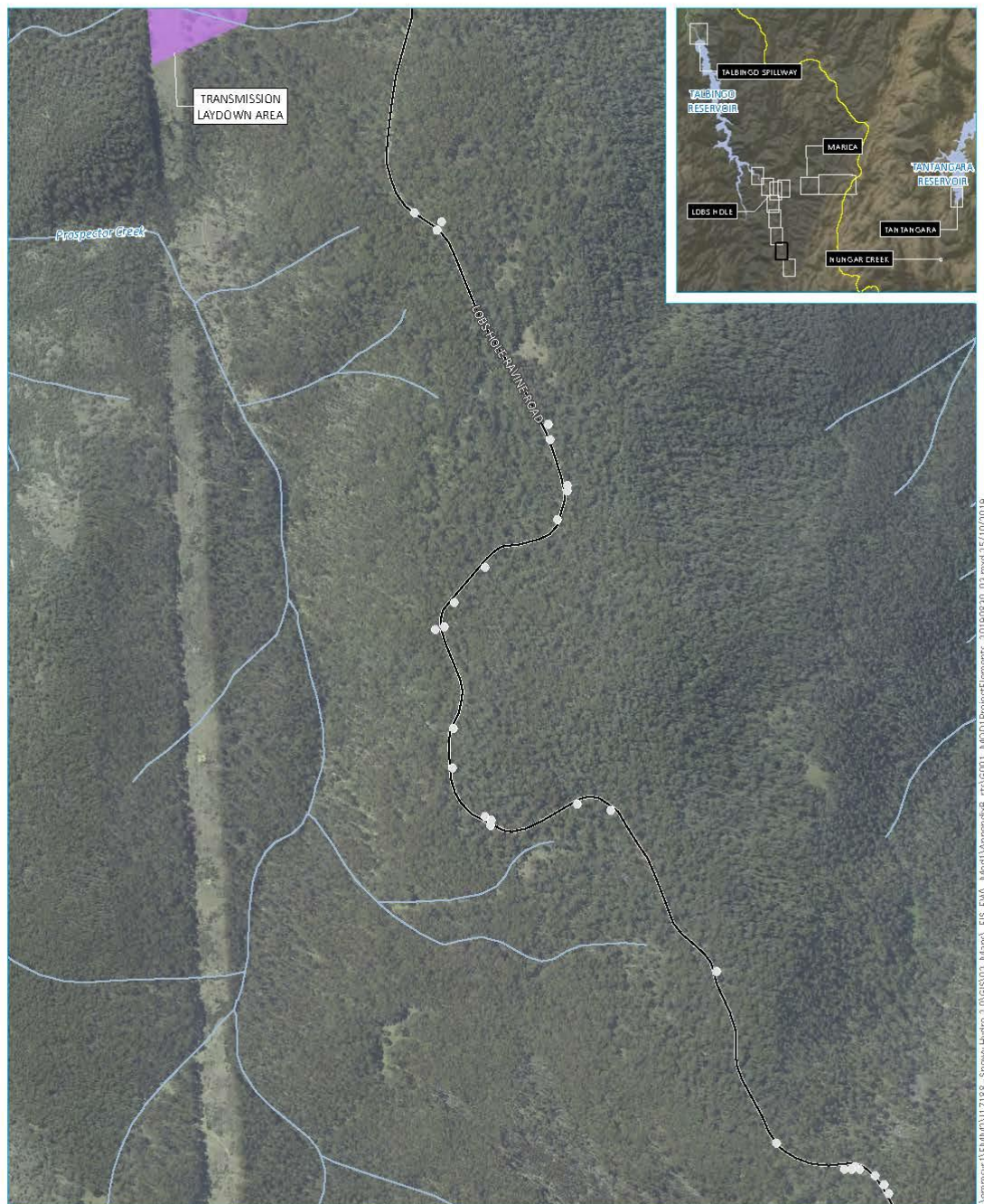
KEY

- Dangerous tree
- Main road
- Local road
- Watercourse/drainage line

Exploratory Works project boundary
- Lobs Hole Ravine Road (Upper) 1

Snowy 2.0
Exploratory Works EIS
Modification 1
1b





Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

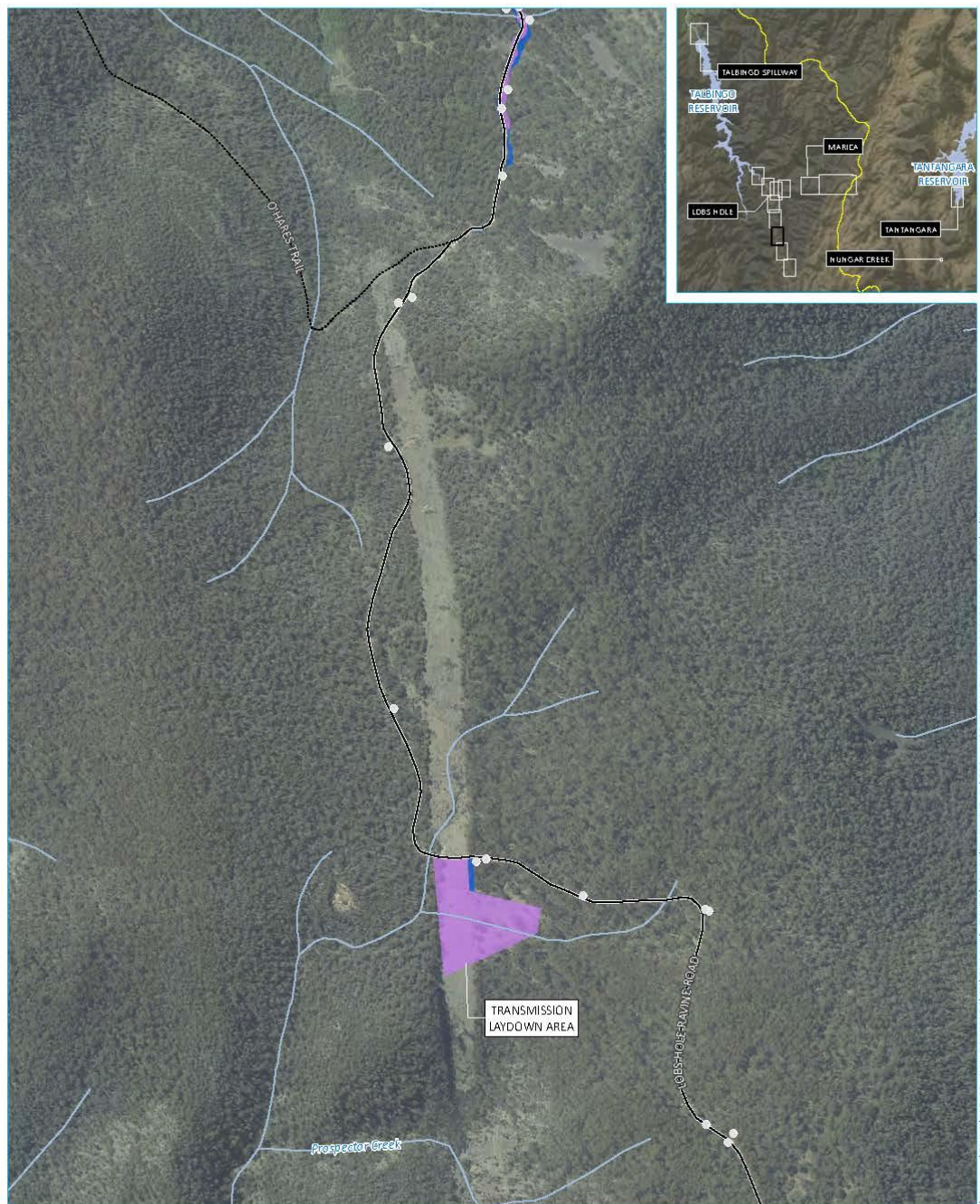
KEY

- Dangerous tree
- Local road
- Watercourse/drainage line
- EW approved construction footprint

Exploratory Works project boundary
- Lobs Hole Ravine Road (Upper) 2

Snowy 2.0
Exploratory Works EIS
Modification 1
1 c





Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

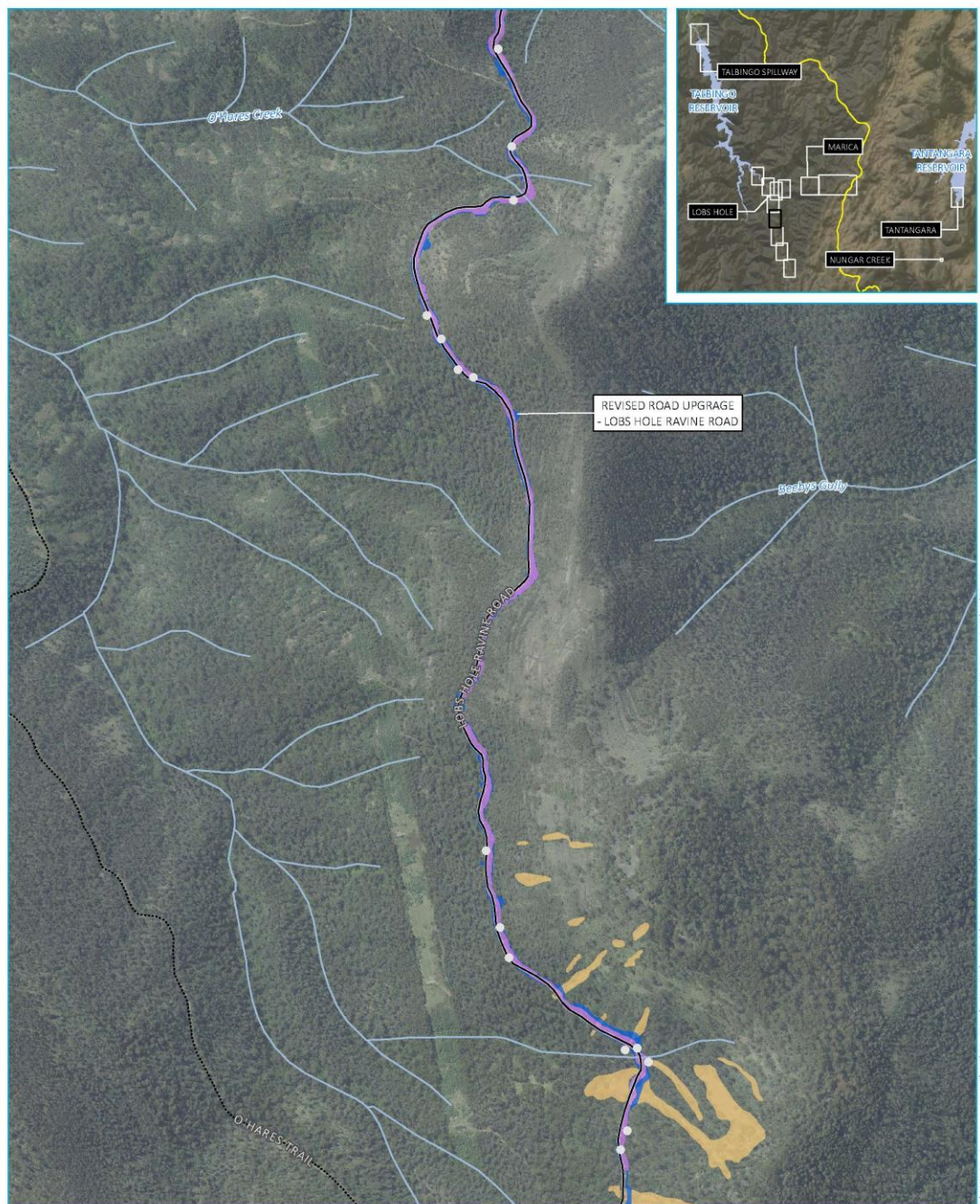
KEY

- Dangerous tree
- Local road
- Vehicular track
- Watercourse/drainage line
- EW approved construction footprint
- EW modification construction footprint (additional)

Exploratory Works project boundary
- Lobs Hole Ravine Road (Upper) 3

Snowy 2.0
Exploratory Works EIS
Modification 1
1 d





Sources: EMM (2019); Snowy Hydro (2019); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

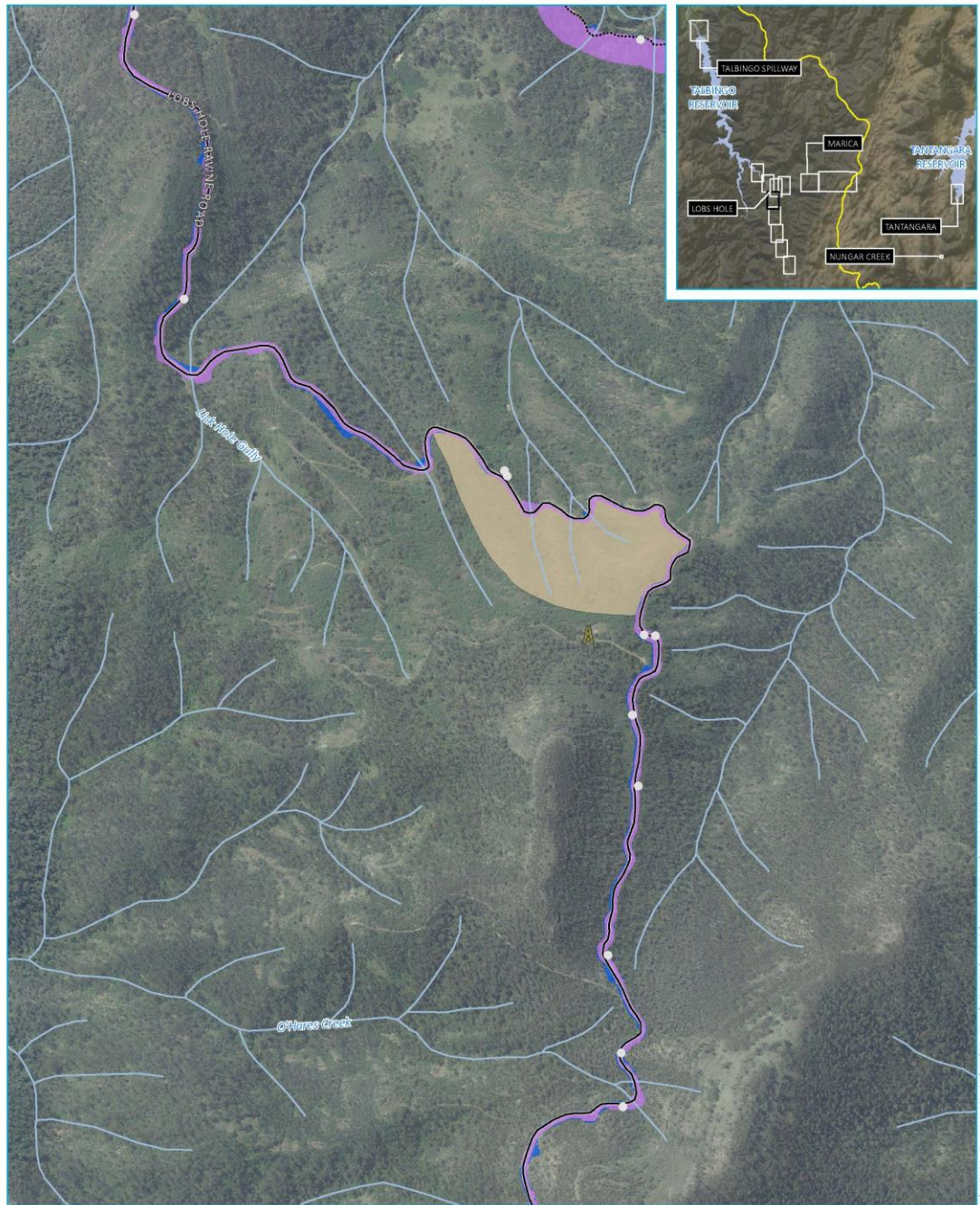
KEY

- Dangerous tree
- Local road
- Vehicular track
- Watercourse/drainage line
- EW approved construction footprint
- EW modification construction footprint (additional)
- Boulder stream

Exploratory Works project boundary
- Lobs Hole Ravine Road (Lower) 1

Snowy 2.0
Exploratory Works EIS
Modification 1
1 e





Sources: EMM (2019); Snowy Hydro (2019); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

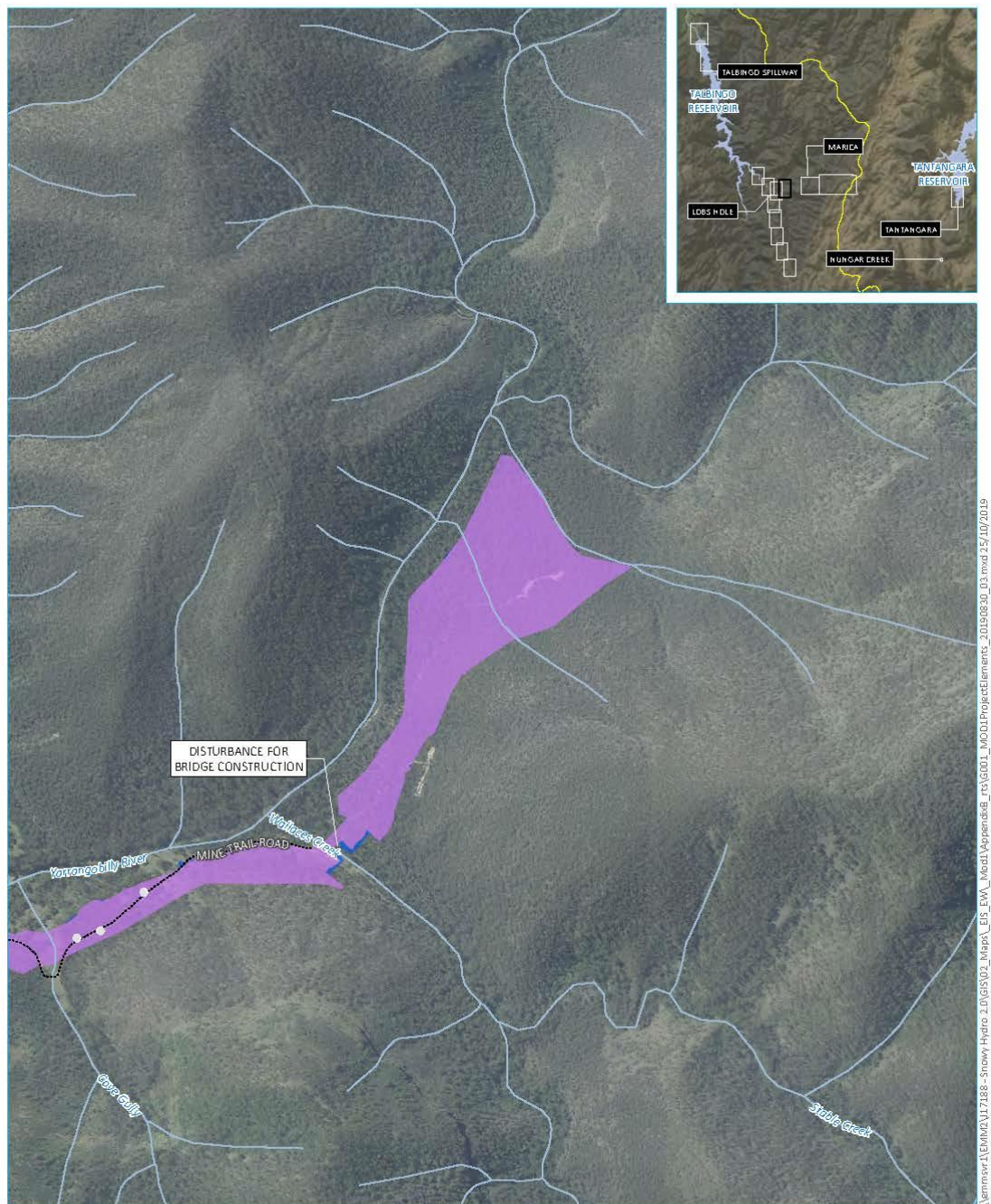
- Dangerous tree
- ▲ Existing temporary communications
- Local road
- Vehicular track
- Watercourse/drainage line
- EW approved construction footprint
- EW modification construction footprint (additional)
- Fossil area

0 50 100 m
GDA 1994 MGA Zone 55

Exploratory Works project boundary - Lobs Hole Ravine Road (Lower) 2

Snowy 2.0
Exploratory Works EIS
Modification 1
1 f





Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

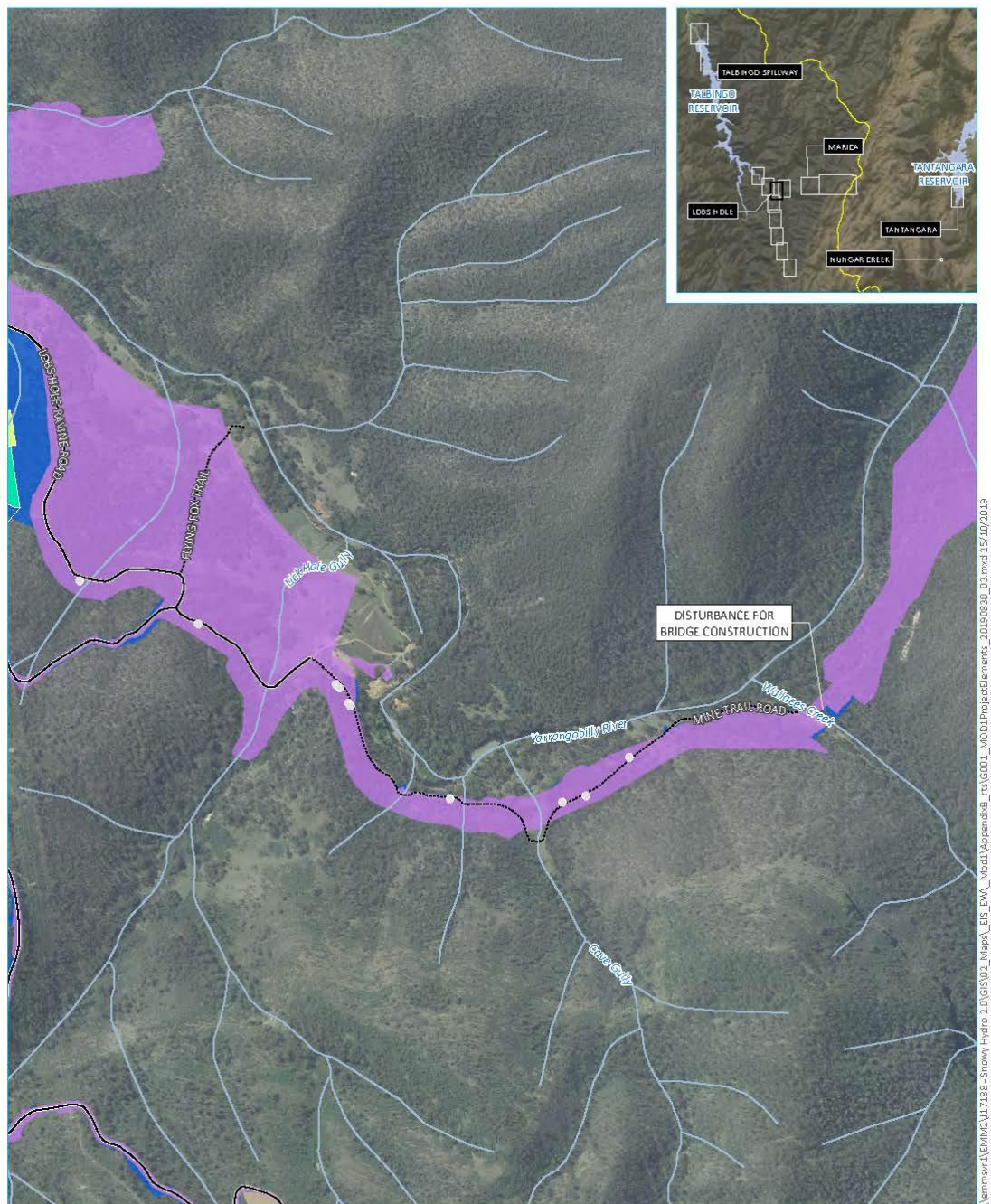
KEY

- Dangerous tree
- Vehicular track
- Watercourse/drainage line
- EW approved construction footprint
- EW modification construction footprint (additional)

Exploratory Works project boundary
- Mine Trail Road 1

Snowy 2.0
Exploratory Works EIS
Modification 1
1 g





Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

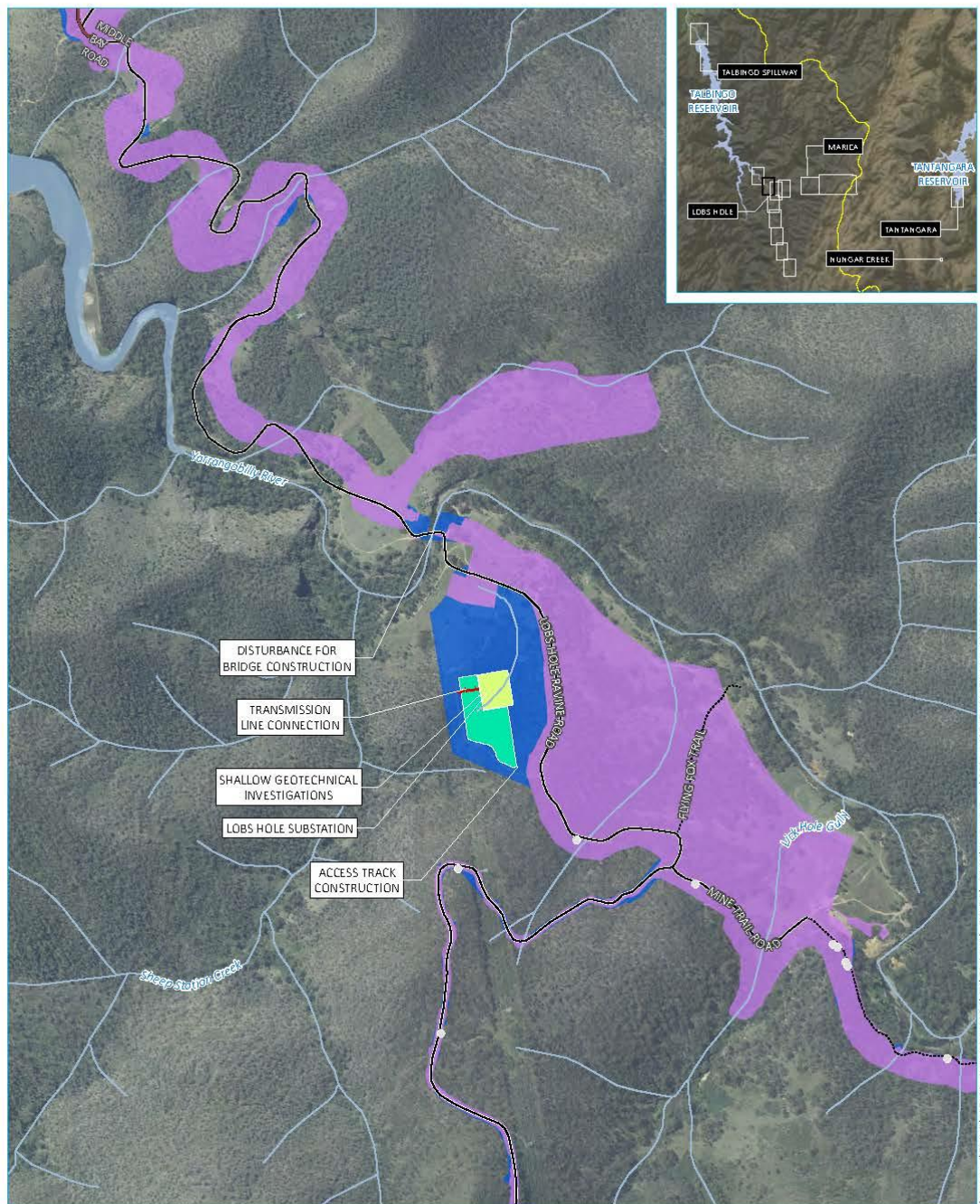
- Dangerous tree
- Local road
- Vehicular track
- Watercourse/drainage line
- EW approved construction footprint
- EW modification construction footprint (additional)
- Indicative laydown area
- Proposed substation
- Fossil area

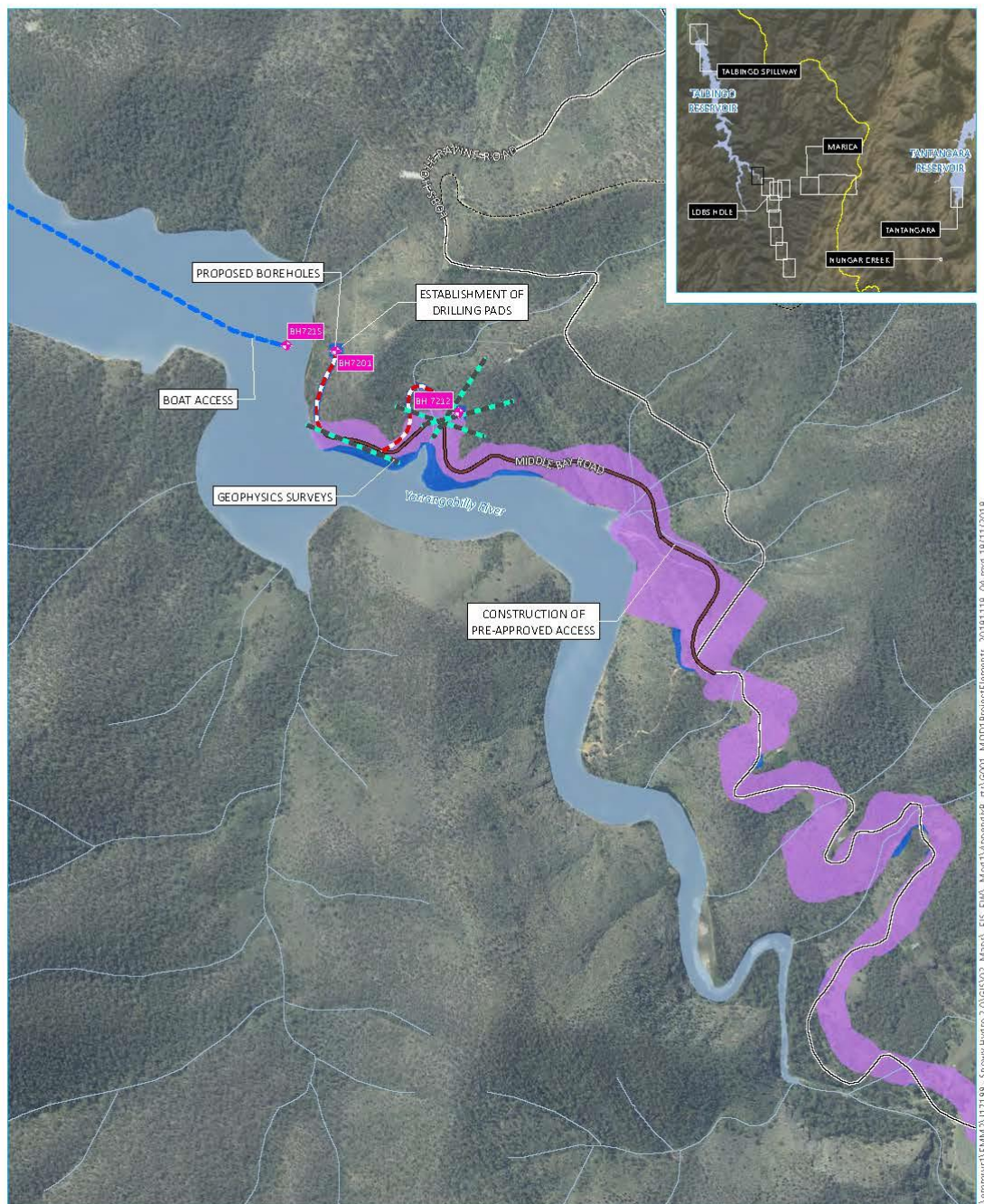
0 250 500 m
GDA 1994 MGA Zone 55

Exploratory Works project boundary
- Mine Trail Road 2

Snowy 2.0
Exploratory Works EIS
Modification 1
1 h







Source: EMM (2019); Snowy Hydro (2019); SMEC (2019); DFSI (2017); GA (2015); LPMIA (2011)

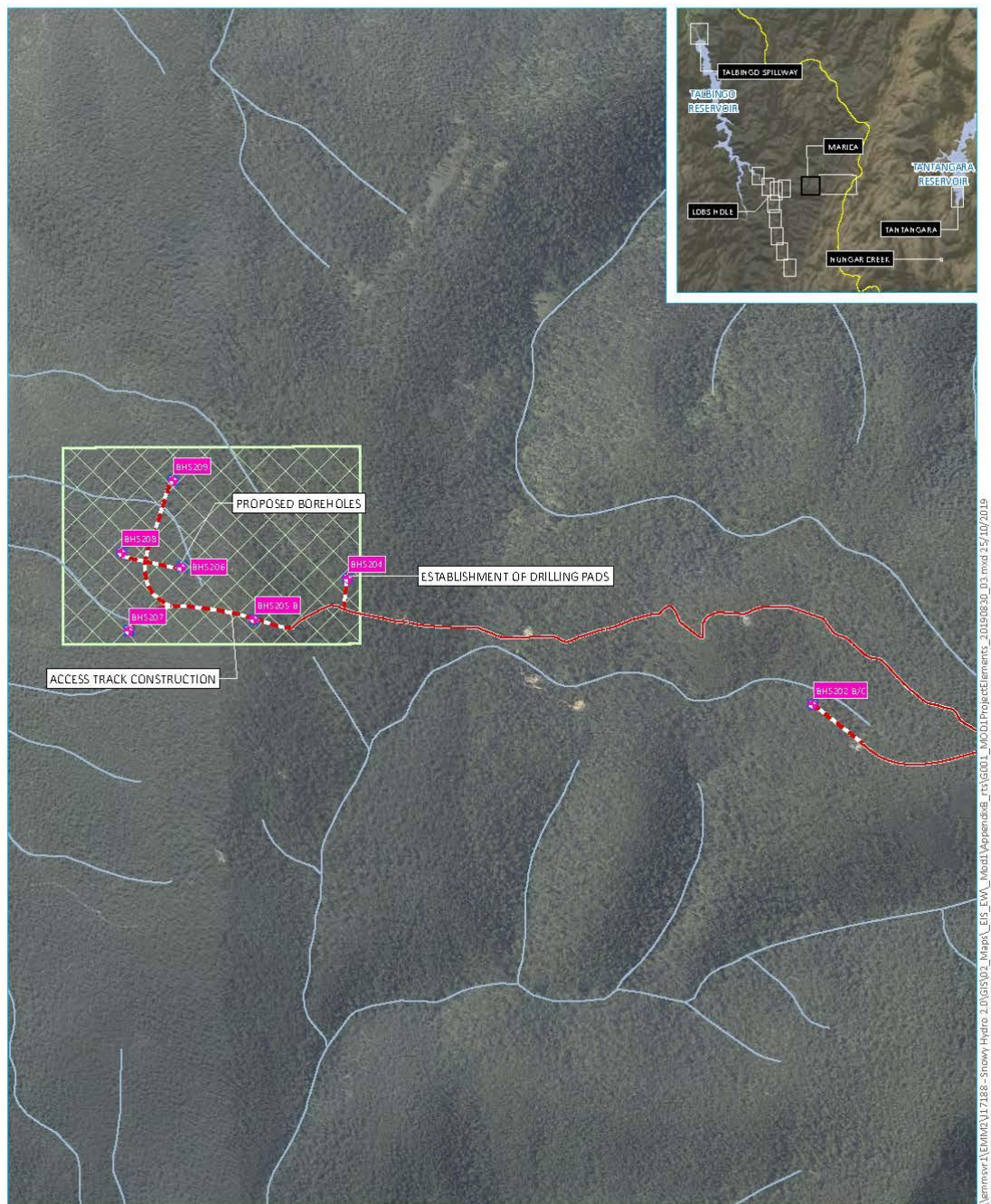
KEY

- ◆ Proposed borehole
- Proposed geophysics
- Proposed access track
- Approved EW access
- Boat access
- Local road
- Vehicular track
- Watercourse/drainage line
- EW approved construction footprint
- EW modification construction footprint (additional)
- Waterbody

Exploratory Works project boundary
- Lobs Hole Ravine Road

Snowy 2.0
Exploratory Works EIS
Modification 1
1 j





Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

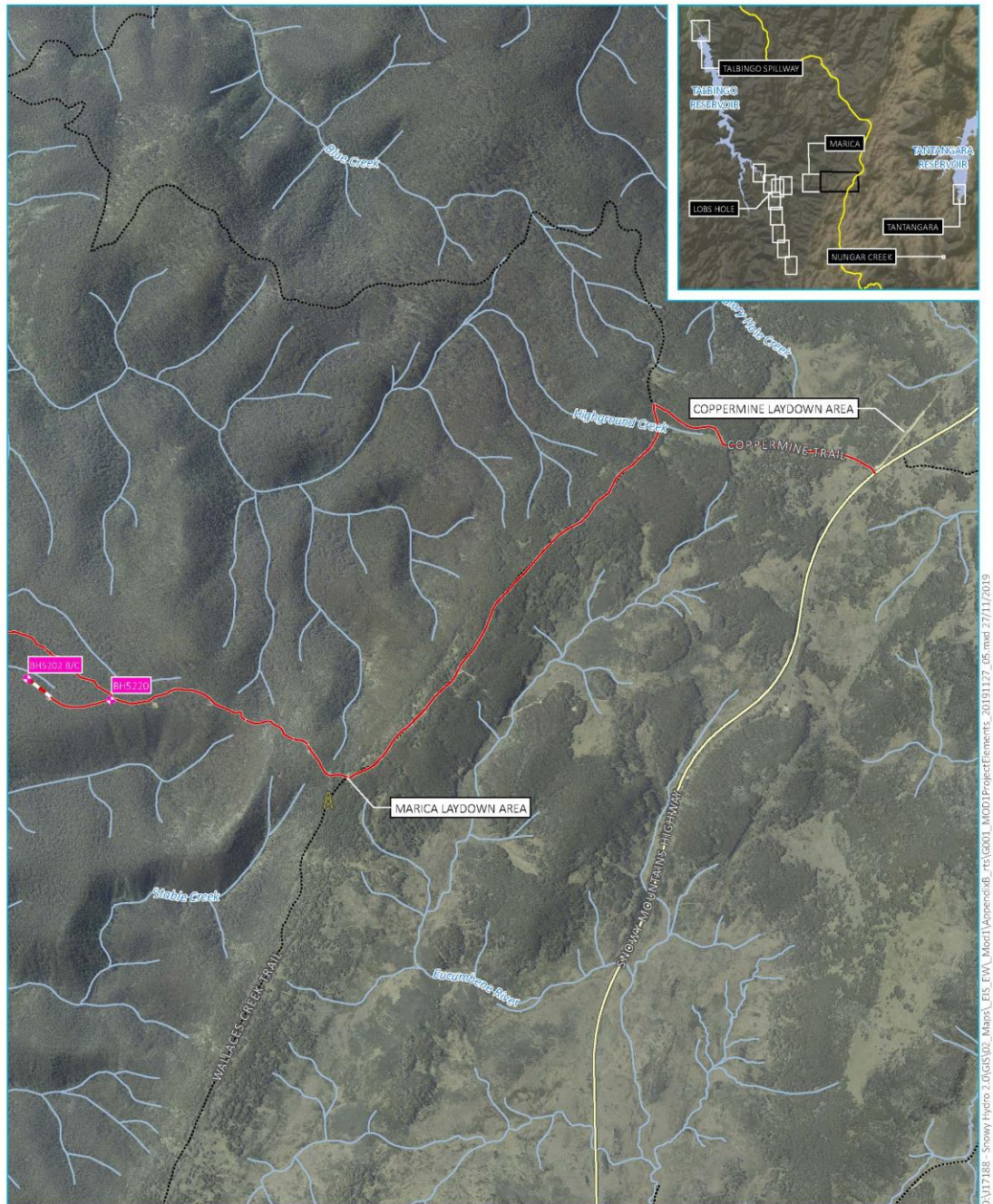
KEY

- ◆ Proposed borehole
- Existing access track
- - - Proposed access track
- Watercourse/drainage line
- EW modification construction footprint (additional)
- Boreholes requiring on-site adjustment

Exploratory Works project boundary
- Marica 1

Snowy 2.0
Exploratory Works EIS
Modification 1
1 k





Sources: EMM (2019); Snowy Hydro (2019); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

- ◆ Proposed borehole
- ▲ Existing temporary communications
- Existing access track
- - - Proposed access track
- Main road
- ⋯ Vehicular track
- Watercourse/drainage line
- EW modification construction footprint (additional)

Exploratory Works project boundary
- Marica 2

Snowy 2.0
Exploratory Works EIS
Modification 1
11





Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

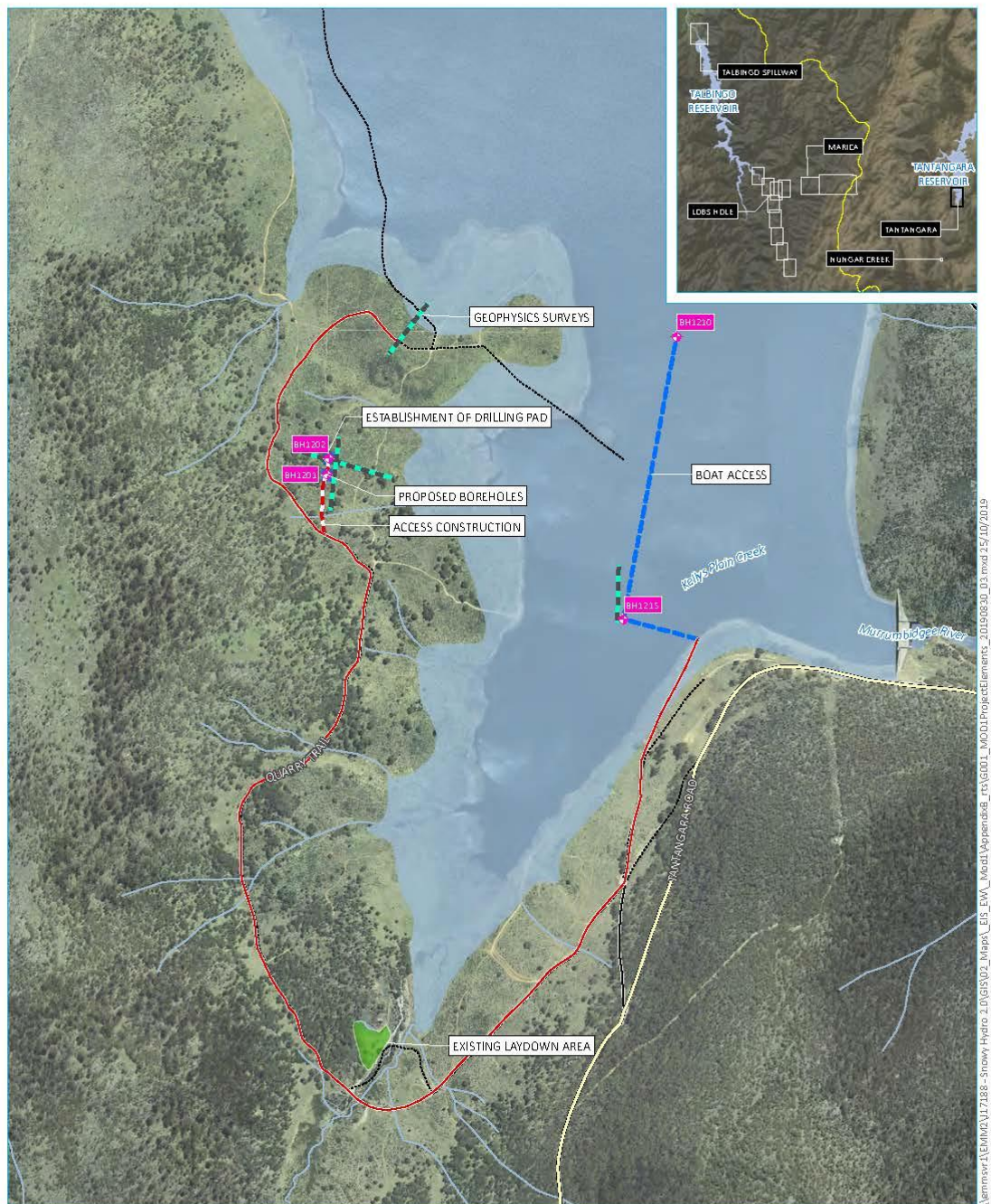
KEY

- ◆ Proposed borehole
- Main road
- Watercourse/drainage line
- Proposed work area

Exploratory Works project boundary
- Nungar Creek

Snowy 2.0
Exploratory Works EIS
Modification 1
1 m





Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

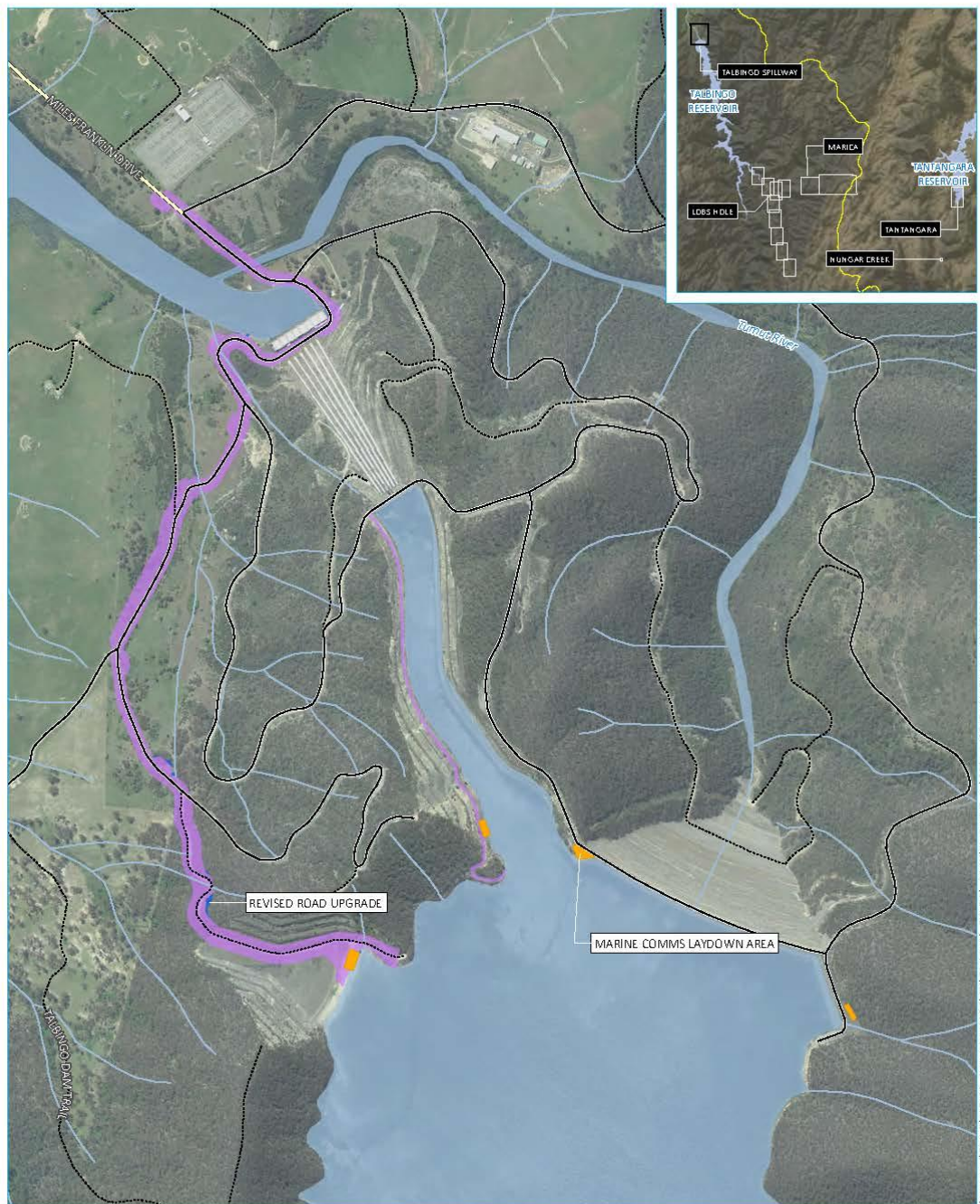
KEY

- ◆ Proposed borehole
- Proposed geophysics
- Existing access track
- - - Proposed access track
- Boat access
- Main road
- Local road
- - - Vehicular track
- Watercourse/drainage line
- EW modification construction footprint (additional)
- Existing laydown area
- Waterbody

Exploratory Works project boundary
- Tantangara Reservoir

Snowy 2.0
Exploratory Works EIS
Modification 1
1 n





Source: EMM (2019); Snowy Hydro (2019); PhotoMapping (2018); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

KEY

- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- EW approved construction footprint
- EW modification construction footprint (additional)
- Marine comms laydown (proposed)
- Waterbody

Exploratory Works project boundary
- Talbingo spillway

Snowy 2.0
Exploratory Works EIS
Modification 1
1.0

