



snowy2.0



VOLUME 2: APPENDICES

MODIFICATION 1 ASSESSMENT REPORT

EXPLORATORY WORKS FOR SNOWY 2.0

June 2019

► **MODIFICATION 1 ASSESSMENT REPORT**

APPENDICES

- A Biodiversity Development Assessment Report
– Snowy 2.0 Exploratory Works Modification 1
- B Assessment of impacts to the Ravine Fossil Beds
- C Heritage Survey Units Summary



CHAPTER

A

**BIODIVERSITY DEVELOPMENT
ASSESSMENT REPORT –
SNOWY 2.0 EXPLORATORY
WORKS MODIFICATION 1**



Exploratory Works Modification 1

Biodiversity Development Assessment Report

Prepared for Snowy Hydro Limited
June 2019

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Exploratory Works Modification 1

Biodiversity Development Assessment Report

Report Number

J17188 RP#63

Client

Snowy Hydro Limited

Date

7 June 2019

Version

v2 Final

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Executive Summary

Snowy Hydro Limited (Snowy Hydro) is pursuing the development of the Snowy 2.0 project, which is a pumped hydro-electric storage and generation project within the Kosciuszko National Park (KNP). 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 sought approval to carry out Exploratory Works prior to the commencement of Snowy 2.0 Main Works. The purpose of the Exploratory Works for Snowy 2.0 is primarily to gain a greater understanding of the conditions at the proposed location of the power station, approximately 850 m below ground level. Exploratory Works was subject to a separate approval to Main Works and an Environmental Impact Statement (EIS, Application SSI 18_9208) was prepared for Exploratory Works and lodged with the Department of Planning and Environment (DPE) in July 2018. Exploratory Works for Snowy 2.0 were approved on 7 February 2019.

Since the Exploratory Works EIS was developed, a construction contractor (Future Generation Joint Venture (FGJV)) has been engaged by Snowy Hydro and a period of design development has led to a shift in the location of the power station approximately one kilometre west along the tunnel alignment. The proposed modification reflects project changes and requirements identified by the construction contractor.

Modification 1 comprises of:

- borehole drilling and geophysical surveys for further geotechnical investigation of the Snowy 2.0 power station and power waterway at the Marica area, Talbingo and Tantangara;
- establishment of a construction power connection to the existing transmission line at Lobs Hole for power to the Exploratory Works accommodation camp and construction areas;
- changes to the project boundary, including additional disturbance areas and a reduction of the disturbance footprint in areas no longer required for construction for Exploratory Works; and
- other ancillary construction activities required to improve the safety, constructability and management of the Exploratory Works.

This report documents the terrestrial biodiversity assessment methods and results, the initiatives built into the Modification 1 project design to avoid and minimise biodiversity impacts, and the additional mitigation and management measures proposed, including offset requirements, to address any residual impacts not able to be avoided.

Modification 1 is located predominately within the South Eastern Highlands Interim Biogeographic Regionalisation of Australia (IBRA) region and Bondo IBRA subregion, and with the Kosciuszko National Park (KNP). Modification 1 project area intersects two major creeks; Wallaces Creek and Yarrangobilly River, along with a number of minor watercourses. Native vegetation is largely intact, with a 90% native vegetation cover within a 1,500 m buffer of the disturbance boundary, providing a high degree of connectivity to large and contiguous patches of vegetation.

Significant field surveys have been undertaken within and adjacent to Modification 1 disturbance area, including initial field assessments, detailed vegetation mapping, vegetation integrity assessments and comprehensive targeted flora and fauna surveys which have exceeded NSW and Commonwealth survey guidelines.

A key focus of project design has been to avoid and minimise impacts to biodiversity values identified during the field surveys, in recognition of the location of the proposed modification in the KNP. This has included an iterative process to the design, including the following steps:

- identification of biodiversity values through comprehensive, rigorous and thorough biodiversity surveys;
- communication of identified values to the project team, including Snowy Hydro and the design team;
- consultation between the design team and project ecologists on various elements to consider both direct and indirect impacts and work through an iterative design process, with multiple iterations of design elements to achieve best practice outcomes;
- consultation with key government stakeholders, including the NSW Office of Environment and Heritage (OEH), NSW National Parks and Wildlife Service (NPWS) and Commonwealth Department of the Environment and Energy (DoEE), including species experts and accountable officers, to seek input and discuss measures proposed to avoid, minimise and mitigate impacts;
- feedback of consultation into the design process; and
- finalisation of measures to avoid, minimise and mitigate impacts.

This has resulted in significant design revisions to avoid impacts, including minimising vegetation clearance at Marica, and the upper sections of Lobs Hole Ravine Road to avoid impacts to Smoky Mouse habitat, and limitation of works within a 50 m buffer around the Yarrangobilly River to avoid and minimise impacts to the Booroolong Frog. In addition, works have been sited, wherever possible, in disturbed parts of the project area to minimise impacts to biodiversity.

Residual impacts following implementation of all controls include:

- clearing of 13.29 ha of native vegetation; and
- impacts to 10.64 ha of threatened species habitat for five species credit species.

A total of 346 ecosystem credits, while a reduction in impacts due to avoidance of areas approved for disturbance in the original Exploratory Works approval has resulted in a reduction of 250 credits. This has resulted in a net increase of 96 credits for Modification 1. A total of 455 species credits are required to offset impacts arising from Modification 1.

In summary, a significant effort has been undertaken to understand the biodiversity values within the project area and design the project to avoid and minimise impacts to identified values. The proposed modification has been sited, where possible, within disturbed areas as a priority. Where this could not be achieved impacts have been minimised and mitigated through implementation of appropriate controls. Residual impacts will be offset in accordance with the objective and principles outlined in the biodiversity offset framework, and before impacts occur.

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Part A

Stage 1: Biodiversity Assessment

1 Introduction

1.1 The project

Snowy Hydro Limited (Snowy Hydro) proposes to develop Snowy 2.0, a large-scale pumped hydro-electric storage and generation project which would increase hydro-electric capacity within the existing Snowy Mountains Hydro-electric Scheme (Snowy Scheme). This would be achieved by establishing a new underground hydro-electric power station that would increase the generation capacity of the Snowy Scheme by almost 50%, providing an additional 2,000 megawatts (MW) generating capacity, and providing approximately 350,000 megawatt hours (MWh) of storage available to the National Electricity Market (NEM) at any one time, which is critical to ensuring system security as Australia transitions to a decarbonised NEM. Snowy 2.0 will link the existing Tantangara and Talbingo reservoirs within the Snowy Scheme through a series of underground tunnels and hydro-electric power station.

Snowy 2.0 has been declared to be State significant infrastructure and critical State significant infrastructure (CSSI) by the NSW Minister for Planning under the provisions of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and is defined in Clause 9 of Schedule 5 of the *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP). Separate applications and environmental impact statements (EIS) for different phases of Snowy 2.0 are being submitted under Part 5, Division 5.2 of the EP&A Act. The Exploratory Works EIS was approved by the Minister on 7th February 2019.

1.2 Purpose of this report

Since the Exploratory Works EIS was developed, a construction contractor (Future Generation Joint Venture (FGJV)) has been engaged by Snowy Hydro and a period of design development has led to a shift in the location of the power station approximately one kilometre west along the tunnel alignment. This shift in the power station location will cause a change in alignment and reduction in length of the exploratory tunnel, which will now also finish approximately one kilometre west of the location detailed in the Exploratory Works EIS. The proposed modification reflects project changes and requirements identified by the construction contractor.

Modification 1 will enhance the outcomes of Exploratory Works. The proposed modification will contribute to the aims of Exploratory Works by providing the following benefits:

- provide additional geotechnical information required for the detailed design of the Snowy 2.0 power station and power waterway;
- improve the efficiency of the Exploratory Works construction power;
- optimise the detailed design of construction areas and access roads; and
- improve worker safety during construction.

The Biodiversity Development Assessment Report (BDAR) supports the Assessment Report for Modification 1. It documents the terrestrial biodiversity assessment methods and results, the initiatives built into the project design to avoid and minimise associated impacts to terrestrial biodiversity, and the mitigation and management measures, including offset requirements, proposed to address any unavoidable residual impacts.

The specific objectives of this assessment are to:

- describe the existing biodiversity values and existing environment;

- identify and assess potential the for presence of biodiversity values including threatened species and communities under relevant legislation including the NSW *Biodiversity Conservation Act 2017* (BC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- identify ecological constraints within and impacts arising from the modification;
- provide mitigation measures to reduce the impacts from the proposal on biodiversity wherever possible; and
- where impacts are unavoidable, consider compensatory measures that are appropriate for the modification.

This BDAR has been prepared in accordance with the Biodiversity Assessment Method (BAM, OEH 2017).

1.3 Location of Modification 1

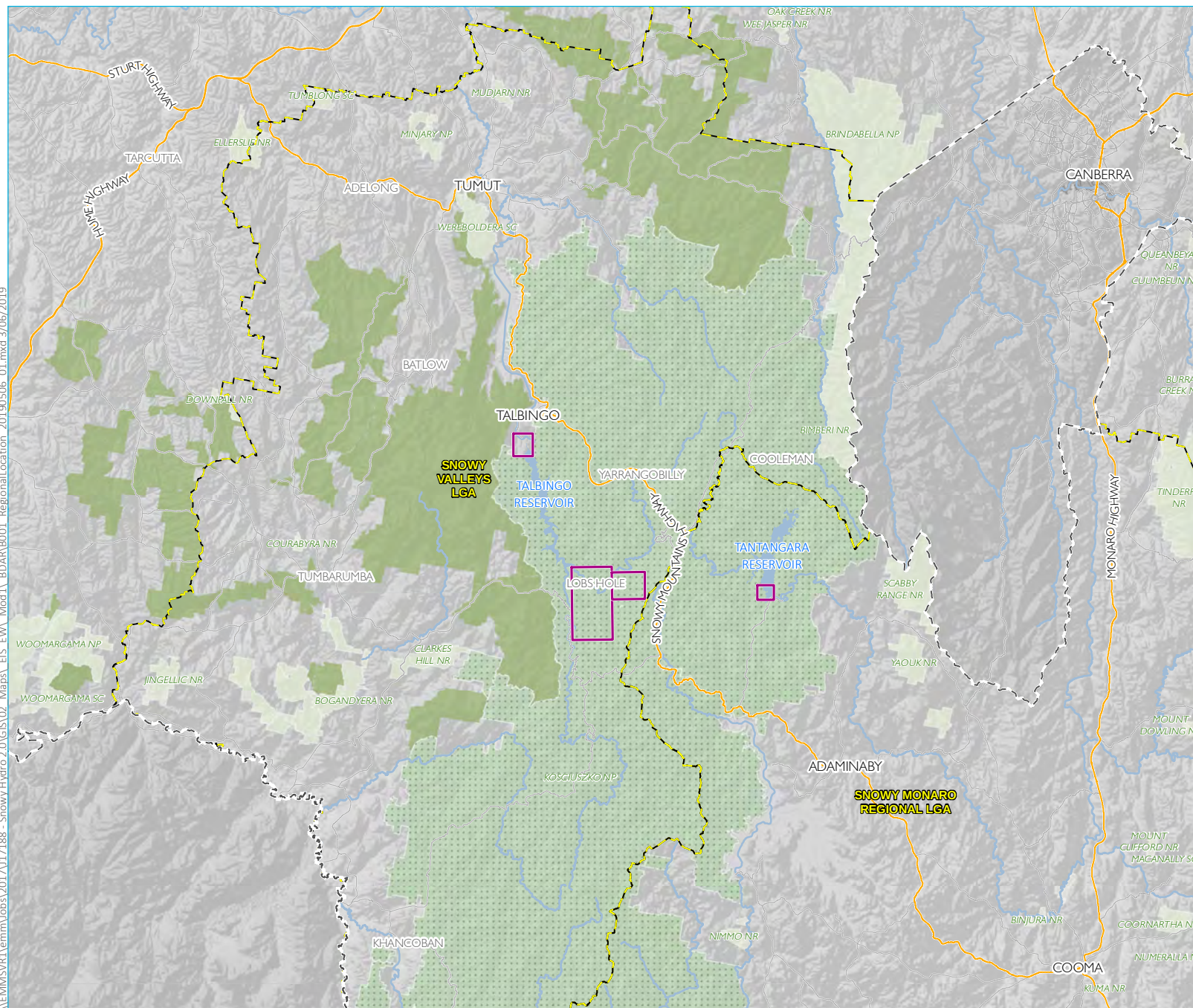
Modification 1 is located within the Australian Alps, in southern NSW. The regional location of Modification 1 is shown on Figure 1.1, within both the Snowy Valleys and Snowy Monaro Regional local government areas (LGAs) and Kosciusko National Park (KNP).

The proposed modifications are near Tantangara Reservoir, Talbingo Reservoir, Lobs Hole and Marica within the Kosciusko National Park (KNP). The regional location of the Modification 1 is shown on Figure 1.1.

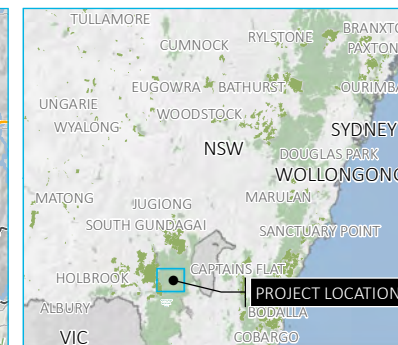
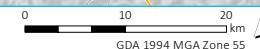
The project area is shown on Figure 1.2 and comprises:

- Areas adjacent to Talbingo and Lobs Hole;
- Marica;
- areas adjacent to Tantangara Reservoir; and
- Talbingo Spillway.

\\EMMSVR1\emm\Jobs\2017\17188 - Snowy Hydro 2.0\GIS\02 Maps\ EIS EWI Mod1\ BDAR\B001 Regional\Location 20190506 01.mxd 3/06/2019



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

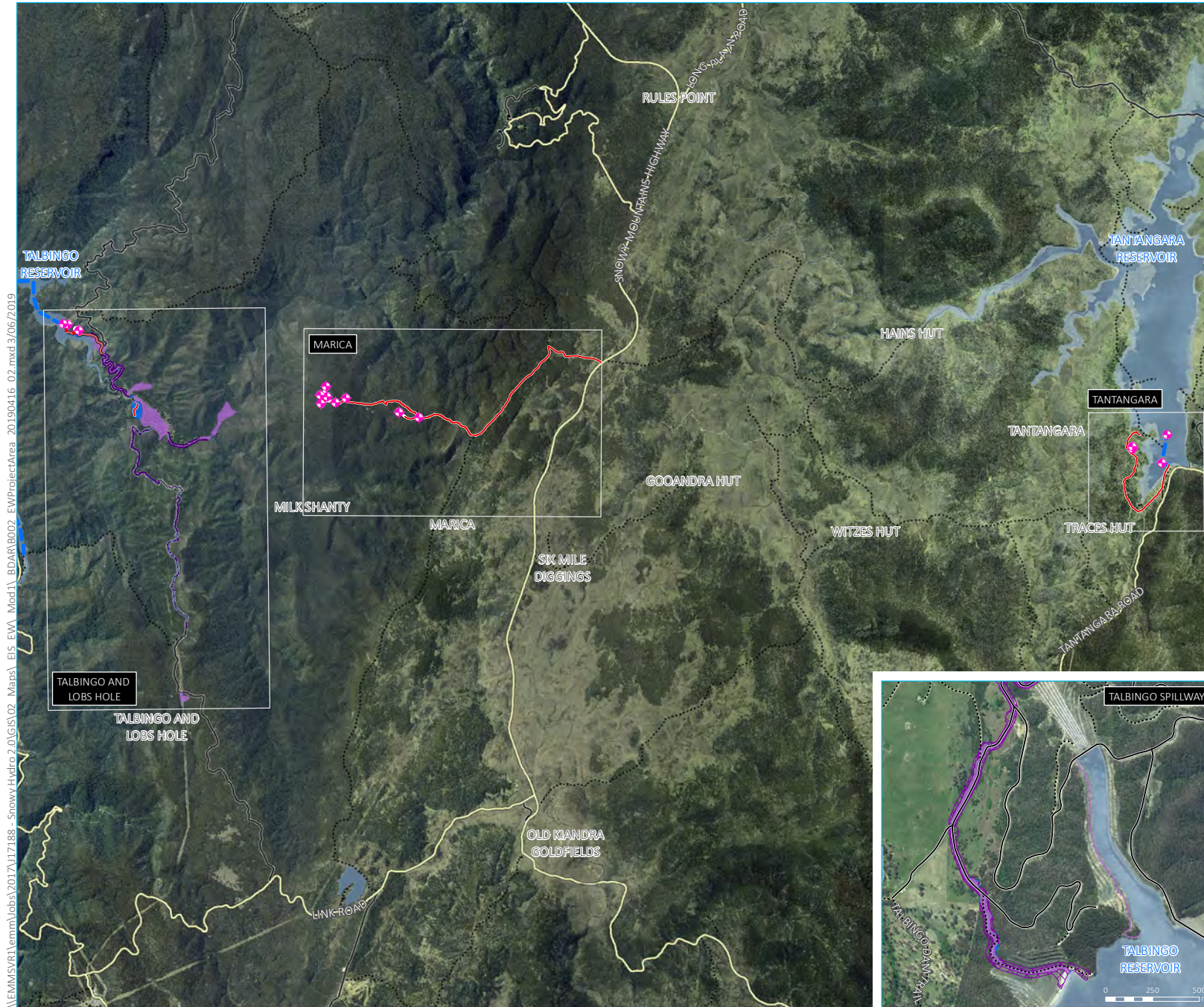


- KEY**
- Exploratory Works MOD 1 project area
 - Main road
 - Local road
 - Watercourse
 - Waterbody
 - Kosciuszko National Park
 - NPWS reserve
 - State forest
 - State boundary
 - Local government area boundary

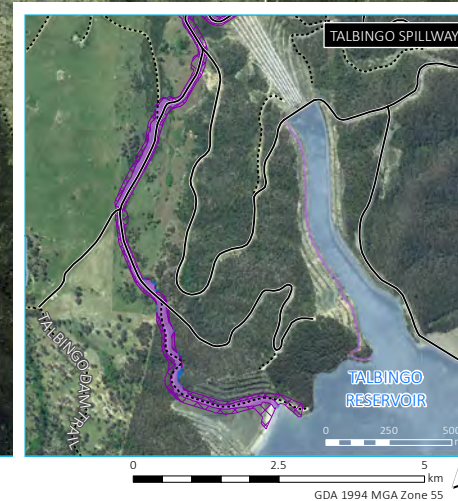
Regional location of Snowy 2.0 and Modification 1

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 1.1





- KEY**
- ◆ Proposed borehole
 - Existing access track
 - - - Proposed access track
 - Approved EW access
 - Boat access
 - Main road
 - Local road
 - ... Vehicular track
 - Waterbody
 - EW EIS approved construction footprint
 - EW EIS modification construction footprint (additional)
 - EW EIS approved construction footprint reduction
 - MOD 1 location reference



Modification 1 project area

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 1.2



1.4 Project area, survey area, disturbance and avoidance footprint definitions

The Exploratory Works modification would be undertaken within the project area shown in Figure 1.1.

The disturbance footprint for Modification 1 includes all areas where land could be directly disturbed by the modification and includes all areas subject to clearing and ground disturbance. The avoidance footprint (referred to as construction footprint reduction in Figure 1.1) shows areas where disturbance to land has been avoided through a reduction in area required for road construction. The development of the disturbance and avoidance footprint was the result of an iterative design process where the biodiversity values within the proposed project area were taken into consideration. This approach allowed for the identification of constraints early in the process, providing flexibility during the design phase of the project to avoid and minimise impact to identified constraints.

Both desktop assessments and field surveys have been undertaken to assess the biodiversity values at a State and Commonwealth level that occur across the survey area. The survey area includes the disturbance and avoidance footprints for Exploratory Works, as shown in Figure 1.2 of EMM (2018), and the disturbance boundary for Modification 1 and adjacent areas, as shown in Figure 1.2 of this assessment.

Surveys have also been undertaken across a broad area as a part of the Main Works project for Snowy 2.0. Where relevant, these surveys are discussed herein.

1.5 Proponent

Snowy Hydro is the proponent for Modification 1. Snowy Hydro is an integrated energy business – generating energy, providing price risk management products for wholesale customers and delivering energy to homes and businesses. Snowy Hydro is the fourth largest energy retailer in the NEM and is Australia's leading provider of peak, renewable energy.

1.6 Assessment guidelines and requirements

This terrestrial biodiversity assessment has been prepared to support the application for Modification 1. Table 1.1 lists the matters relevant to this assessment and where they are addressed in this report.

Table 1.1 Terrestrial biodiversity related elements of the SEARS and how they have been addressed

Requirement	Section addressed
An assessment of the biodiversity values and the likely biodiversity impacts of the project in accordance with the NSW <i>Biodiversity Conservation Act 2016</i> , the Biodiversity Assessment Method (BAM) and documented in a Biodiversity Development Assessment Report (BDAR).	This report.
A strategy to offset any residual impacts of the project focusing on improving the biodiversity and conservation values of the Kosciuszko National Park in the medium to long term.	Section 7.4.
An assessment of the impacts of the project on aquatic ecology, including impacts on key fish habitat and threatened species of fish.	Exploratory Works EIS, Section 6.5.3

1.7 Information sources

1.7.1 Other relevant reports

This terrestrial biodiversity assessment has been prepared with reference to other technical reports that were prepared as part of the EIS for Modification 1. The other relevant reports referenced in this terrestrial biodiversity assessment are listed below.

- EMM 2018a, Environmental Impact Statement: Exploratory Works for Snowy 2.0, Vol 1, prepared for Snowy Hydro Limited.
- EMM 2018b, Response to Submissions: Exploratory Works for Snowy 2.0, prepared for Snowy Hydro Limited.
- EMM 2018c, Geological Sites Report, prepared for Snowy Hydro Limited.
- EMM 2019, Modification 1 to Infrastructure Approval SSI 9208 – Snowy 2.0 Exploratory Works.

1.7.2 Publications and databases

In order to provide context for Modification 1, information about flora and fauna species, populations, communities and habitats from the locality (generally within 10 km of the project area) was obtained from the following databases:

- *BioNet Atlas of NSW Wildlife* (Bionet) for previous threatened species records;
- Commonwealth Department of Environment and Energy (DoEE) *Protected Matters Search Tool* (PMST) for Matters of National Environmental Significance (MNES), including threatened species and communities likely to occur within the Modification 1 project area; and
- the *NSW Plant Community Types* (PCTs), as held within the Vegetation Information System (VIS) Classification 2.1 database.

1.7.3 Spatial data

Spatial data encompassing the Modification 1 project area, including the disturbance and avoidance footprints, was obtained from Snowy Hydro. Base map data was obtained from Department of Finance, Services and Innovation (DFSI) NSW databases, with cadastral data obtained from DFIG digital cadastral database. Mapping for stream orders was obtained from DPI.

The following spatial datasets were utilised during the development of this report:

- *State Vegetation Type Map: Riverina Region Version v1.2 - VIS_ID 4469*;
- *Mitchell Landscapes Version V3.1*;
- *Interim Biogeographic Regionalisation of Australia (IBRA) Version 7*;
- Directory of important wetlands; and
- NSW Wetlands.

Mapping undertaken during the site assessment was conducted using a hand-held GPS units, mobile tablet computers running Collector for ArcGIS™ and Survey123 for ArcGIS™ and aerial photo interpretation. Accuracy is subject to accuracy of GPS devices, generally ± 5 m. Mapping has been produced using a Geographic Information System (GIS; ArcGIS 10.5).

1.8 Legislation requirements

The project has been assessed against the key biodiversity legislation and government policy, including:

- EPBC Act;
- BC Act;
- NSW *Environmental Planning and Assessment Act 1979* (EP&A Act);
- NSW *Biosecurity Act 2015*; and
- NSW *National Parks and Wildlife Act 1974* (NPW Act).

These are discussed further in Section 3.

2 Project description

2.1 Snowy 2.0 Exploratory Works overview

Snowy 2.0 sought approval for Exploratory Works in 2018. An Environmental Impact Statement (EIS, Application SS 18_9208) was lodged with the NSW Department of Planning and Environment (DPE) in July 2018. Exploratory Works for Snowy 2.0 were approved on 7 February 2019.

The Exploratory Works involves the construction associated with geotechnical exploration for the underground power station. This includes:

- an exploratory tunnel to the site of the underground power station;
- horizontal and other test drilling, investigations and analysis;
- a portal construction pad for the exploratory tunnel;
- an accommodation camp for the Exploratory Works construction workforce;
- road works and upgrades providing access and haulage routes during Exploratory Works;
- barge infrastructure to enable access and transport by barge on Talbingo reservoir;
- excavated rock management, including subaqueous placement within Talbingo reservoir;
- services infrastructure such as diesel-generated power, water and communications; and
- revegetation and rehabilitation, management and monitoring post-construction.

2.2 Modification overview

The proposed modification is for additional geotechnical investigation activities which are outside the Exploratory Works approved footprint. The Modification 1 elements are shown in Figure 2.1 and include:

- Borehole drilling and geophysical surveys for further geotechnical investigation to inform the detailed design of the Snowy 2.0 power station and power waterway at Marica, Talbingo and Tantangara. Geotechnical investigations will involve the following activities:
 - clearing of up to 2.75 ha of additional vegetation for access tracks and drilling pads. About 1.33 ha within Smoky 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 and import of stabilised material;
 - establishment of eight drilling pads at top of the cavern area, with an area of 900 m² per pad, works at each pad will include drilling of multiple boreholes, minor earthworks, placement of geofabric and import of stabilised material;

- undertaking geophysical surveys;
 - establishment of two drilling pads at both Tantangara and Talbingo with an area of 900 m² per pad, works at each pad will include drilling of multiple boreholes, minor earthworks, placement of geofabric and import of stabilised material;
 - 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 850 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 groundwater monitoring using existing boreholes and access tracks within KNP.
 - Ongoing maintenance and rehabilitation of existing access tracks required for groundwater monitoring and geotechnical investigations within KNP.
 - Establishment of a construction power connection to the 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. This will include:
 - Construction of a 330/33 kilovolt (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.
 - 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.
 - A short overhead transmission line connection (approximately 60 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.
 - 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 drainage and safety.
- minor additions to construction areas for design optimisation.
- reduction of the project boundary in areas no longer required for construction of Exploratory Works.
- 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 pursuant to clause 23 of the National Parks and Wildlife Regulation 2009 for the geotechnical investigation program.
- 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.

2.2.1 Geotechnical investigations

The geotechnical investigations will involve the following activities:

- establishment of seven drilling pads and boreholes at top of the cavern area, with an area of 900 square metres per pad, including minor earthworks, placement of geofabric and import of stabilised material;
- establishment of two drilling pads and boreholes at both Tantangara and Talbingo with an area of 900 square metres per pad, including access track and minor earthworks;
- 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 850 metres;
- establishment of an additional one kilometre of access tracks (4 metres wide), including minor earthworks, placement of geofabric and import of stabilised material;
- trimming of overhanging dangerous branches on adjacent trees not required to be removed;
- mulching of trees and vegetation;
- undertaking geophysical surveys;
- conversion of the investigation boreholes into monitoring bores;
- undertaking geophysical surveys; and
- rehabilitation of the drilling pads and access tracks following completion of works.

2.2.2 Construction power connection

The construction of a new 330/33kV substation, located within KNP and adjacent to TransGrid's existing Line 2, will form a 330 kV connection between Upper Tumut Switching Station and Yass Substation. The works will include:

- 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 steel lattice tower, approximately 50 metres in height;
- a short overhead transmission line connection (approximately 60m 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 and wholly located within the approved Exploratory Works disturbance footprint;
- establishment and upgrade of access tracks and roads to the new substation and transmission line structures;
- ancillary activities, including brake and winch sites, crane pads, site compounds and equipment laydown areas; and
- establishment and upgrade of access tracks and roads to the new substation and transmission line structures will be required.

2.2.3 Project boundary changes

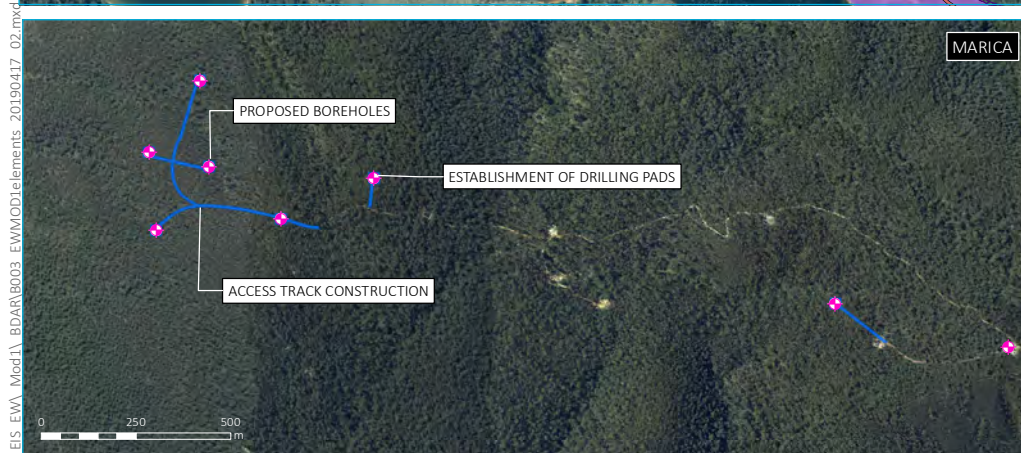
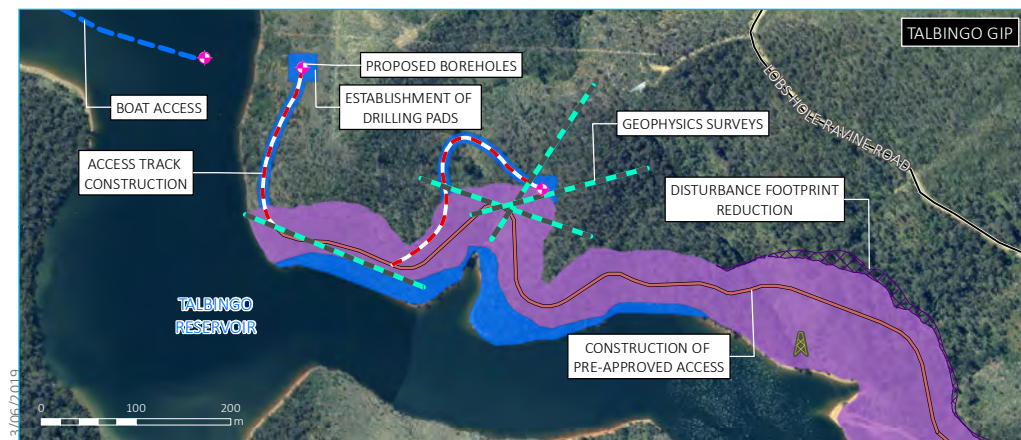
Exploratory Works modification will require additional disturbance to the existing boundary, this will include:

- additional disturbance area around Camp Bridge and Wallaces Creek Bridge required for bridge constructability;
- additional disturbance area due to the construction power substation;
- revised road upgrade boundary for Lobs Hole Ravine Road to accommodate a revised maximum design vehicle; and
- minor additions to infrastructure areas for design optimisation.

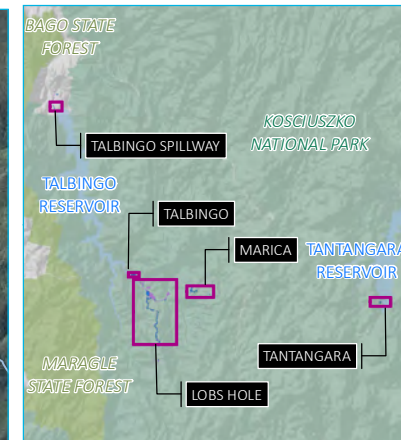
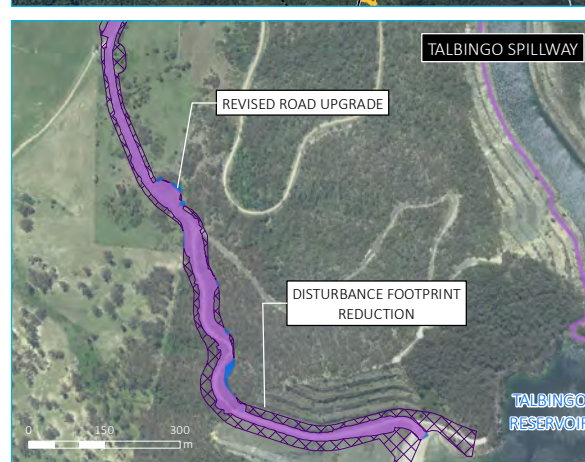
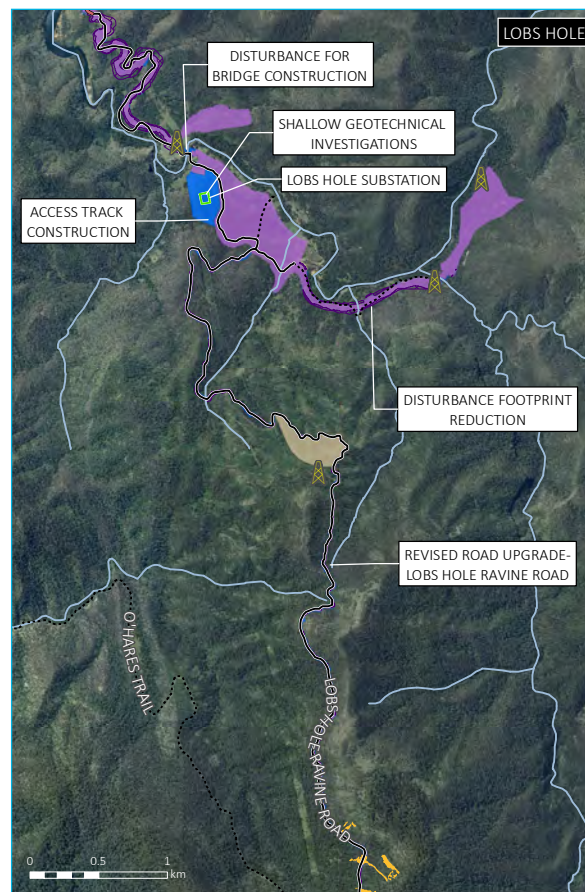
There are areas within the Exploratory Works that are no longer required for construction and therefore will result in a reduction of the disturbance footprint.

2.2.4 Dangerous tree removal

A Tree Risk Assessment (TRA) was completed by Tree Survey Pty Ltd (Tree Survey 2018). The report identified 29 trees as priority 2 for removal and 62 trees as priority 3 for removal. A total of 91 dead trees and trees with dead branches overhanging the access road have been identified as posing a risk to personnel working on the Exploratory Works project, and therefore were recommended for removal.



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



- KEY**
- ◆ Proposed borehole
 - ▲ Proposed temporary communications upgrade location
 - Fossil area
 - Boulder stream
 - EW EIS approved construction footprint
 - EW EIS modification construction footprint (additional)
 - EW EIS approved construction footprint reduction
 - Proposed substation
 - Proposed geophysics
 - Approved EW access
 - Watercourse
 - Local road
 - Vehicular track

Modification 1 elements

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 2.1



GDA 1994 MGA Zone 55



3 Legislative context

This chapter provides a brief outline of the key biodiversity legislation and government policy considered in this assessment.

3.1 Commonwealth

3.1.1 Environmental Protection and Biodiversity Conservation Act 1999

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, heritage places and water resources which are defined as MNES (Matters of National Environmental Significance) under the EPBC Act. These are:

- world heritage properties;
- places listed on the National Heritage Register;
- Ramsar wetlands of international significance;
- threatened flora and fauna species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;
- nuclear actions (including uranium mining); and
- water resources, in relation to coal seam gas or large coal mining development.

Under the EPBC Act, an action that may have a significant impact on a MNES is deemed to be a 'controlled action' and can only proceed with the approval of the Commonwealth Minister for the Environment. An action that may potentially have a significant impact on a MNES is to be referred to DoEE for determination as to whether or not it is a controlled action. If deemed a controlled action the project is assessed under the EPBC Act for approval.

The Exploratory Works project was referred to the Commonwealth Minister for the Environment in June 2018 (EPBC 2018/8217). The project was deemed not a controlled action in July 2018. Impacts associated with this modification do not modify the conclusions drawn in the original referral and will not result in a significant impact to MNES.

3.2 State

3.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act was enacted to encourage the consideration and management of impacts of proposed development or land-use changes on the environment and the community. The EP&A Act is administered by the NSW Department of Planning and Environment (DPE).

The EP&A Act provides the overarching structure for planning in NSW; however, is supported by other statutory environmental planning instruments (EPs) including State environmental planning policies (SEPPs). Snowy Hydro is seeking to modify infrastructure approval SSI 9208 pursuant to section 5.25 of the EP&A Act. EPs relevant to the natural environment are outlined further below.

i State Environmental Planning Policy (State and Regional Development) 2011

Snowy 2.0 has been declared to be Critical State Significant Infrastructure (CSSI) by the NSW Minister for Planning under the provisions of the EP&A Act and is defined in clause 9 of Schedule 5 of the SRD SEPP.

ii State Environmental Planning Policy No 44 – Koala Habitat Protection

State Environmental Planning Policy No 44 – Koala Habitat Protection (SEPP 44) aims to encourage the conservation and management of natural vegetation areas that provide habitat for koalas to ensure permanent free-living populations will be maintained over their present range and to reverse the current trend of koala-population decline. It applies to areas of native vegetation greater than 1 ha and in councils listed in Schedule 1 of SEPP 44. The Modification 1 project area is located in the Snowy Valleys Council LGA and Snowy Monaro Regional Council, which are listed in Schedule 1, therefore Koala habitat has been considered within this assessment.

No Koalas or scats were found in the modification survey area during targeted surveys (see Section 6.3.4iie). The site is therefore not considered core Koala habitat under SEPP 44.

iii Biodiversity Conservation Act 2016

The BC Act commenced operation on 25 August 2017. It repeals and replaces the NSW *Threatened Species Conservation Act 1995* (TSC Act) as the legislation responsible for the conservation of biodiversity in NSW through the protection of threatened flora and fauna species, populations and ecological communities. The BC Act, together with the NSW Biodiversity Conservation Regulation 2017 (BC Regulation), established the Biodiversity Offsets Scheme (BOS).

The BOS includes establishment of the biodiversity assessment method (the BAM, OEH 2017) for use by accredited persons in biodiversity assessment under the scheme. The purpose of the BAM is to assess the impact of actions on threatened species and threatened ecological communities, and their habitats and determine offset requirements. For CSSI, use of the BAM is mandatory.

The BAM sets out the requirements for a repeatable and transparent assessment of terrestrial biodiversity values on land in order to:

- identify the biodiversity values on land subject to proposed development area;
- determine the impacts of a proposed development; and
- quantify and describe the biodiversity credits required to offset the residual impacts of proposed development on biodiversity values.

The biodiversity assessment for Modification 1 has been undertaken in accordance with the requirements of the BAM, as set out in this BDAR.

3.2.2 Biosecurity Act 2015

The NSW *Biosecurity Act 2015* has superseded the *Noxious Weeds Act 1993*, which has now been repealed.

The primary objective of the Biosecurity Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

The Biosecurity Act stipulates management arrangements for weed biosecurity risks in NSW, with the aim to prevent, eliminate and minimise risks. Management arrangements include:

- any land managers and users of land have a responsibility for managing weed biosecurity risks that they know about or could reasonably be expected to know about;
- applies to all land within NSW and all waters within the limits of the State; and
- local strategic weed management plans will provide guidance on the outcomes expected to discharge duty for the weeds in that plan.

The Riverina Regional Strategic Weed Management Plan 2017 - 2022 (RLLS 2017) outlines how government, industry, and the community will share responsibility and work together to identify, minimise, respond to and manage weeds within the Riverina Region, which includes the Modification 1 project area. The plan also supports regional implementation of the Biosecurity Act.

3.2.3 National Parks and Wildlife Act 1979

Under the NPW Act, the Director General of NPWS is responsible for the care, control and management of all national parks and various other categories of protected area. The primary responsibilities of NPWS under this legislation are the protection and maintenance of natural and cultural values, and the fostering of public appreciation, understanding and enjoyment of those values.

The KNP Plan of Management (PoM, DEC 2006) details management objectives for such features within the park such as native plants and animals, soils, karst, rivers, lakes etc. Management objectivities follow those specified within the NPW Act. Relevant management objectives include:

- native plant species and communities are maintained and/or rehabilitated and include a representative range of successional stages and age classes;
- viable populations of all native animal species that currently occur in the park are maintained or restored;
- the diversity of native species found in the park is maximised at a regional scale; and
- research informs the management of the native animals of the park.

The requirements of the NPW Act and the KNP PoM have been considered in this report.

4 Landscape features

The identification of landscape features within the Modification 1 project area was determined using Section 4 of the BAM (OEH 2017), as summarised within this chapter.

4.1 Landscape features

4.1.1 Bioregions and landscapes

The Modification 1 project area occurs across three IBRA regions and subregions (Figure 4.1):

- the barge access infrastructure located at Talbingo, at the northern end of Talbingo Reservoir, is located within the NSW South Western Slopes IBRA region and Inland Slopes IBRA subregion;
- additional boreholes located at Tantangara are in the Australian Alps IBRA region and Snowy Mountains IBRA subregion; and
- the majority of the additional works, including boreholes, access tracks and boundaries in Lobs Hole and Marica, are located within the South Eastern Highlands IBRA region and Bondo IBRA subregion.

As the majority of the Modification 1 project area is located in the South Eastern Highlands IBRA region and Bondo IBRA subregion these were the region and subregion used in this assessment.

The Modification 1 project area occurs across four NSW Landscapes (formerly Mitchell Landscapes, Figure 4.1):

- Pinbeyan - Ravine Ranges;
- Kings Cross Montane;
- Tantangara High Plains and Peaks; and
- Cabramurra – Kiandra Basalt Caps and Sands

Majority of the modification project area is located in the Pinbeyan - Ravine Ranges NSW Landscape, therefore this was the landscape used in this assessment.

4.1.2 Watercourses and wetlands

The Modification 1 project area is located within the Murrumbidgee catchment in the Australian Alps, south-eastern NSW. The Murrumbidgee catchment covers 84,000 square kilometres of southern NSW. It is bordered by the Great Dividing Range to the east, the Lachlan Catchment to the north and the Murray Catchment to the south (NOW 2011).

The western section of the Modification 1 project area intersects two major watercourses; Wallaces Creek and the Yarrangobilly River. Within the project area, Wallaces Creek forms a sixth order stream while the Yarrangobilly River forms a seventh order stream. Yarrangobilly River and Wallaces Creek are perennial streams. Stream substratum consists of unconsolidated boulder, cobble, pebble and gravel substratum with little evidence of siltation. The riparian zone of both watercourses 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 (*Rubus* spp.). This section of the project area is situated adjacent to Talbingo Reservoir. The Reservoir was constructed between 1968 and 1971 as a part of the Snowy Scheme. It has a surface area of 1,940 ha and has a capacity of 921,000 ML when full. The reservoir supplies water to the Tumut 3 power station. The edges of the reservoir are located largely within the KNP, except for the northern section adjacent to the dam wall. The edges are largely vegetated, including intact native vegetation. Numerous stags are located within the reservoir, resulting from the inundation of forests when the dam was completed. Talbingo Reservoir is mapped in the NSW Wetlands spatial dataset.

The eastern section of the Modification 1 project area intersects a first order tributary of the Murrumbidgee River, on the western edge of Tantangara Reservoir. This stream is present as a minor drainage line, and only flows during heavy rain fall. Tantangara Reservoir was constructed between 1958 to 1960 as part of the Snowy Mountains Hydro-Electric Scheme. The reservoir dams the headwaters of the Murrumbidgee River. Before the construction of Tantangara Dam, the flow regime of Murrumbidgee catchment was highly variable. Since 1960 Tantangara Dam has captured and diverted nearly all its inflows to Eucumbene (Snowy Scientific Committee 2010).

No Directory of Important Wetlands in Australia (DIWA) wetlands or Ramsar wetlands are located within or immediately adjacent to the Modification 1 project area.

Wetlands, watercourses and associated buffers are shown in Figure 4.2.

4.1.3 Connectivity

The Modification 1 project area is located within KNP, which is largely vegetated across its 673,543 ha extent, with intact remnant vegetation extending into a further 1.6 M ha across the Australian Alps. The extent of vegetation across the KNP provides a high degree of connectivity.

The various watercourses provide suitable connectivity for aquatic and semi-aquatic species (such as fish and amphibians) and species which use linear features (such as birds and bats) to navigate. The wooded area supports connective feature for terrestrials and arboreal mammals, birds, reptiles etc. The areas within Lobs Hole containing open grassland, paddock trees are considered less suitable for the movement of mammals that require vegetation cover to avoid predation.

4.1.4 Areas of geological significance and soil hazard features

Several areas of geological significance are located within the Modification 1 project area. A summary is provided in EMM (2018c), with further details in the Exploratory Works Geological Sites Report (EMM 2018c)._

4.1.5 Areas of outstanding biodiversity value

There are no areas of outstanding biodiversity value within a 1,500m buffer of the Modification 1 project area.

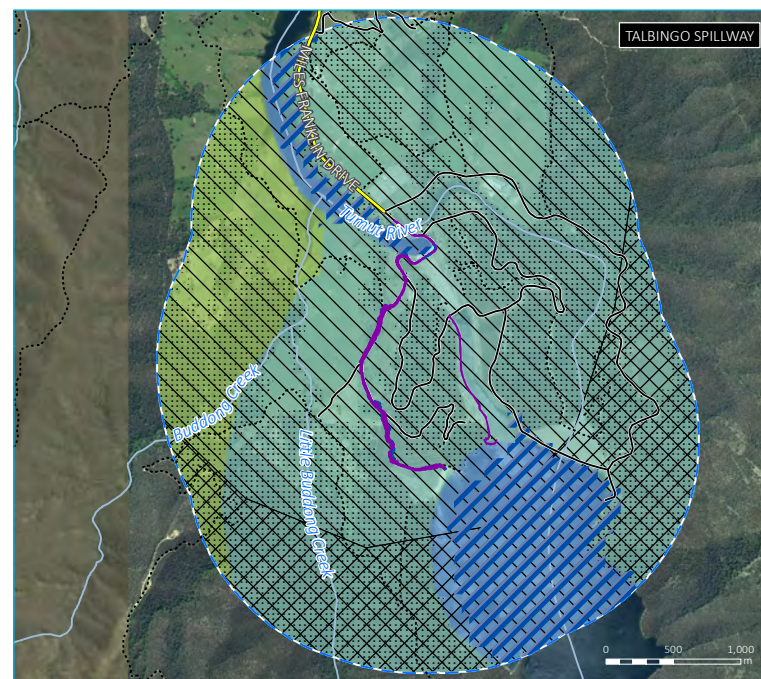
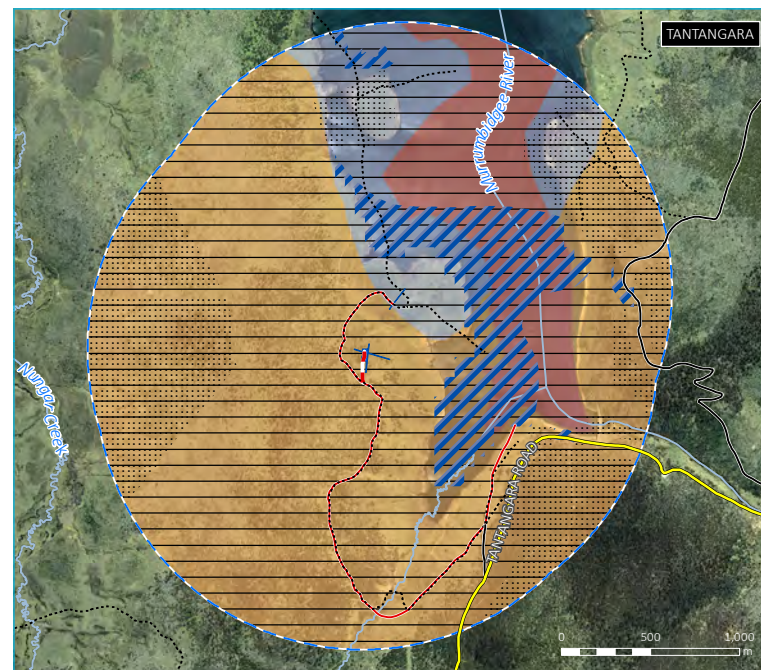
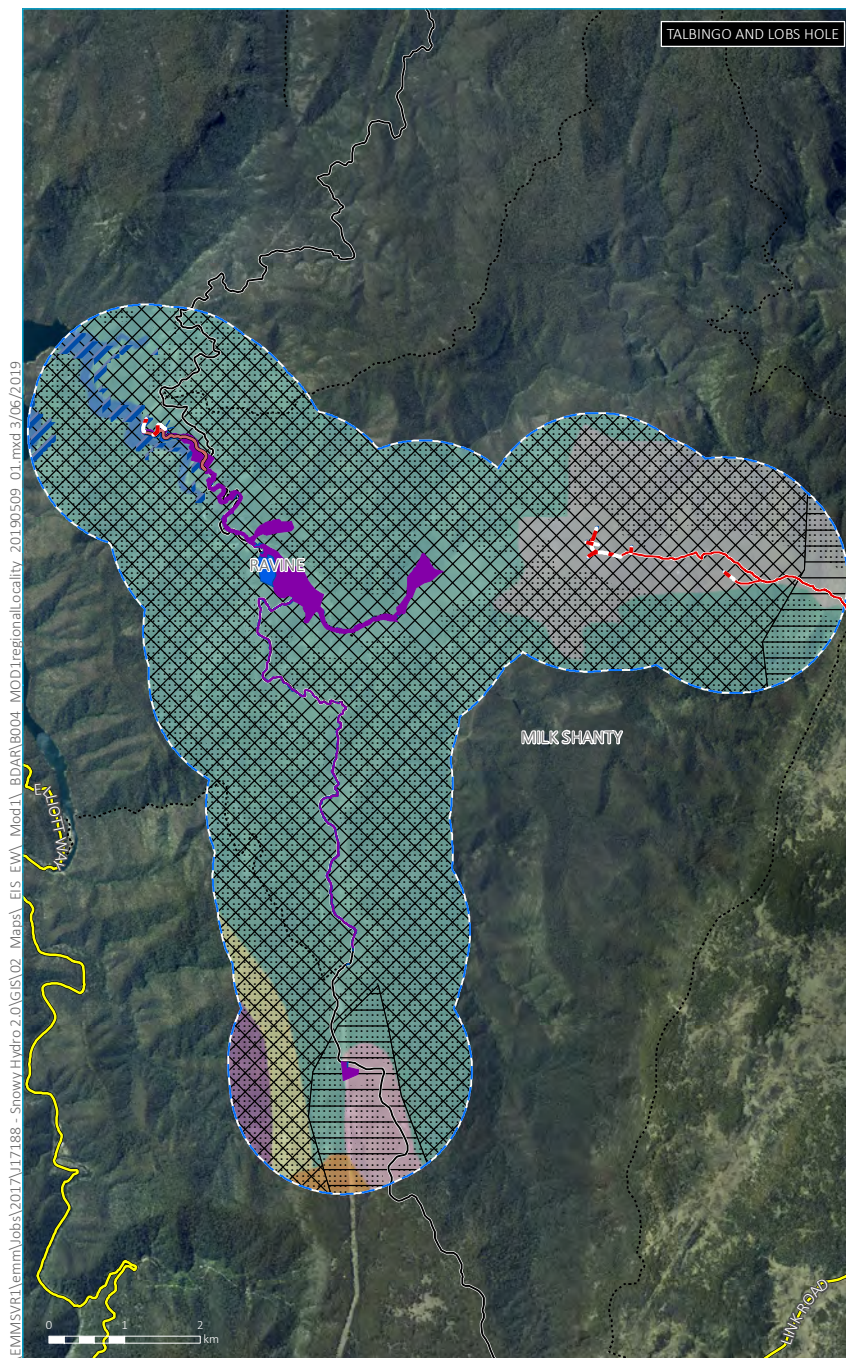
4.2 Assessment of site context

The site context has been assessed in accordance with Section 4.3 of the BAM (OEH 2017) for site-based developments.

Mapping of vegetation within a 1,500 m buffer of the Modification 1 project area was undertaken using aerial mapping interpretation and spatial data from the State Vegetation Type Map: Riverina Region Version v1.2 - VIS_ID 4469. This mapping was modified using the vegetation extent as mapped by EMM (see Section 5). Forty-two PCTs were mapped within the 1500 m buffer (Figure 4.2).

A conservative approach was undertaken to include all areas of native vegetation, including the mapped candidate native grassland (as verified) that are likely to be derived from the mapped woodland communities. This approach allowed a greater list of threatened species to be filtered in for later assessment of habitat suitability for Modification 1.

Approximately 7, 023 ha of native vegetation was mapped within the 7,778 ha buffer area. Native vegetation cover within the buffer area is approximately 90%.



- KEY**
- Main road
 - Local road
 - Vehicular track
 - Existing access track
 - - - Proposed access track
 - Approved EW access
 - EW EIS approved construction footprint
 - EW EIS modification construction footprint (additional)
 - 1500 m buffer
 - NSW wetlands (OEH, 2009)
 - Native vegetation
 - IBRA 7 (region - Sub region)
 - ▨ South Eastern Highlands - Bondo
 - ▨ Australian Alps - Snowy Mountains
 - Mitchell landscape
 - Cabramurra - Kiandra Basalt Caps and Sands
 - Cootamundra - Tumut Serpentine and Ultramafics
 - Kings Cross Montane
 - Pinbayan - Ravine Ranges
 - Tantangara High Plains and Peaks
 - Tooma Granite Ranges
 - Water
 - Native vegetation

DRAFT

Regional locality

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 4.1

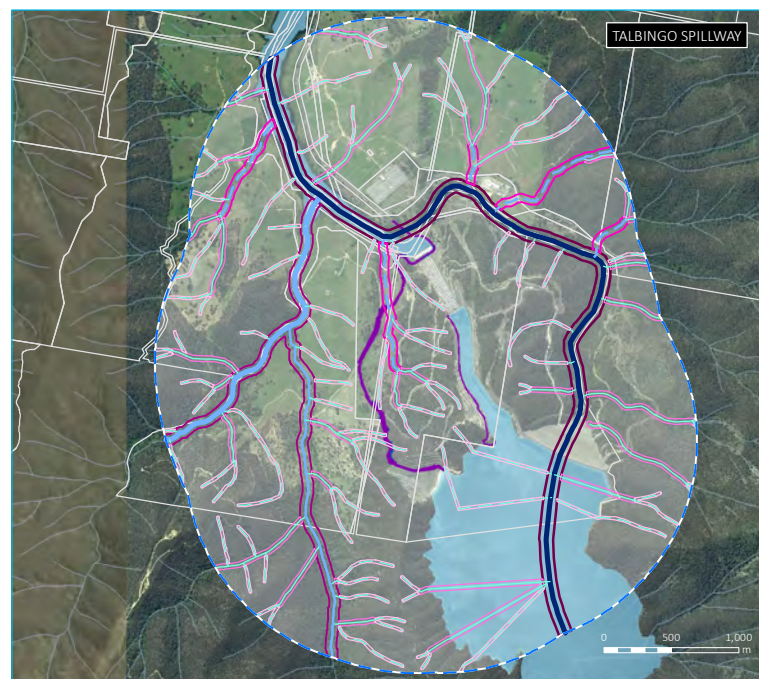
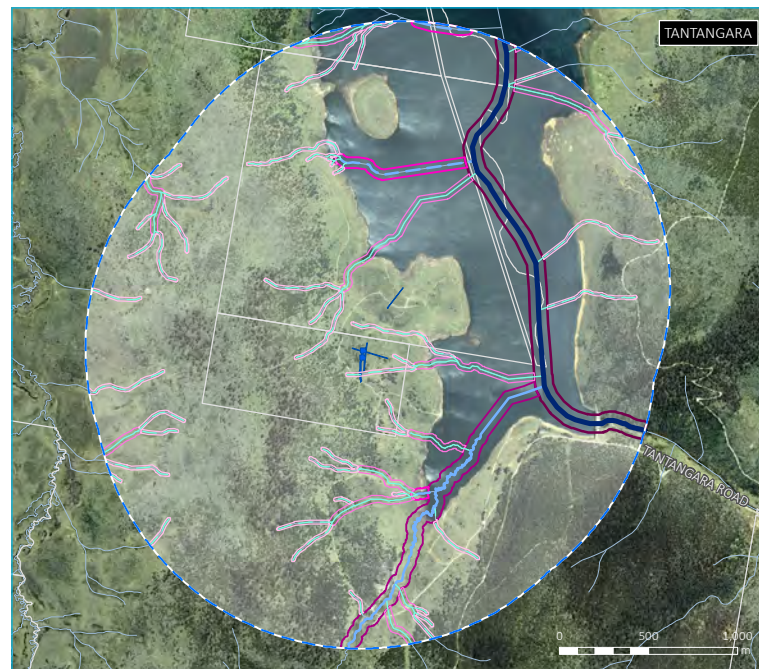
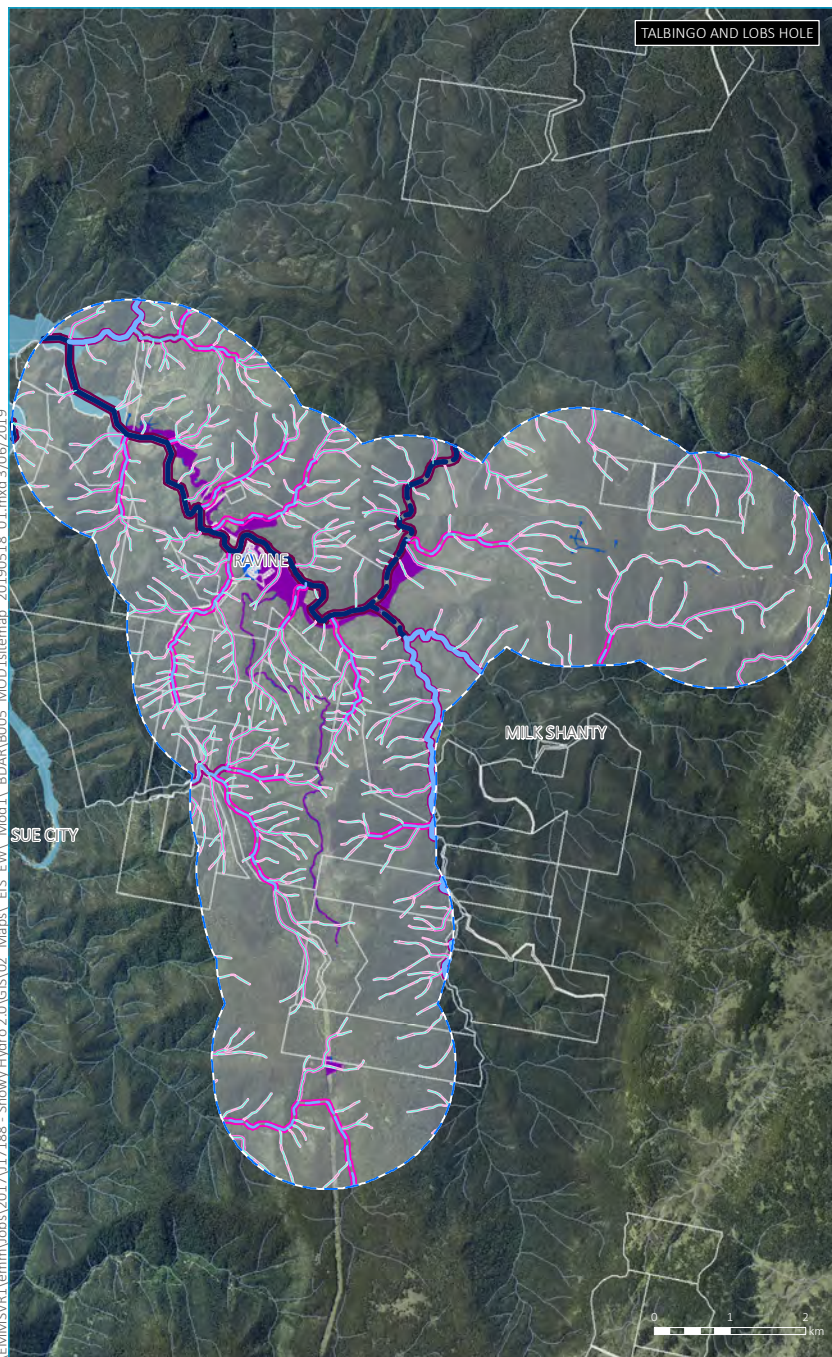


Source: EMM (2019); Snowy Hydro (2019); LPI (2019); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011); OEH (2014, 2016, 2017); DOE (2014)

GDA 1994 MGA Zone 55



\\EMMSVR1\emm\loba\2017\17188 - Snowy Hydro 2.0\GIS\02 Maps\ EIS EW Mod1\ BDAR\B005 MOD1\itemap_20190518_01.mxd 3/06/2019



- KEY**
- Watercourse
 - Cadastre
 - 1500 m buffer
 - EW EIS approved construction footprint
 - EW EIS modification construction footprint (additional)
 - NSW Wetlands (OEH, 2009)
- Strahler stream order**
- 1st order
 - 2nd order
 - 3rd order
 - 4th order
 - 5th order
 - 6th order
 - 7th order
- Riparian buffer**
- 10 m
 - 20 m
 - 30 m
 - 40 m
 - 50 m

DRAFT

Site map

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 4.2

Source: EMM (2019); Snowy Hydro (2019); LPI (2019); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011); OEH (2014, 2016); DPI (2013)

GDA 1994 MGA Zone 55



5 Native vegetation

The extent of native vegetation within the Modification 1 project area was determined using Section 5 of the BAM (OEH 2017), as summarised within this chapter.

5.1 Background review

A review of regional native vegetation mapping was undertaken to inform the site survey. The presence of these PCTs was assessed and confirmed in line with the methods outlined below.

5.2 Methods

The following sections outline the methods employed to map vegetation, and to assess the vegetation integrity of native vegetation within the survey area.

5.2.1 Detailed vegetation mapping and habitat assessment

A preliminary assessment of the survey area was undertaken between August 2017 and October 2017. Additional mapping was undertaken in February and March 2018 due to the inclusion of additional survey areas. This preliminary assessment included detailed vegetation mapping and habitat assessments. Revision of this preliminary vegetation mapping was undertaken in November and December 2019, in response to additional plots being undertaken and review of the PCTs across the Snowy 2.0 survey area. This revision has resulted in revisions to the PCTs identified within and adjacent to the Exploratory Works project area.

To map vegetation, the survey area was traversed on foot and by vehicle, with vegetation mapped and aligned with NSW PCTs. PCTs were stratified into vegetation zones based on broad condition state using the definitions in Table 5.1.

Table 5.1 Definitions used in delineation of vegetation zones

Condition class	Description
Moderate/good – High	Largely intact with all stratum present and minimal disturbance
Moderate/good – Medium	Some elements or stratum missing or immature, but minimal disturbance
Moderate/good – Poor	Tree stratum present, but understorey vegetation degraded due to weeds or other major disturbance.
Moderate/good – Derived grassland	Trees stratum missing, with sparse shrub layer. Native vegetation restricted to groundcover.
Moderate/good – Other	Regeneration is occurring due to previous human impacts, such as clearing or fire, but minimal to moderate disturbance to other stratum
Low	Tree stratum and shrub stratum missing. Predominantly exotic groundcover.

Where there was some uncertainty about correct PCT alignment, or to justify PCT alignment, a series of rapid vegetation assessments (RVAs) were undertaken, with the three dominant species in the overstorey, midstorey and groundcover recorded.

Vegetation was mapped in the field using GPS-enabled tablet computers using Collector for ArcGIS™. Field data was then aligned with a canopy height model (CHM) developed using Light Detection and Ranging (LiDAR) data in a GIS.

5.2.2 Vegetation integrity assessment

Following the stratification of vegetation zones within the survey area, native vegetation integrity was assessed using data obtained via a series of plots, as per the methodology outlines in Section 5 of the BAM (OEH 2017). Plot data was collected from the survey area between November 2017 and April 2019. At each plot location the following was undertaken:

- one 20x20 m plot from assessment of composition and structure; and
- one 20 x 50 m plots for assessment of function, including a series of five 1 x 1 m plots to assess average leaf litter cover.

The assessment of composition and structure, based on a 20 x 20 m plot, recorded species name, stratum, growth form, cover and abundance rating for each species present within the plot. Cover (foliage cover) was estimated for all species rooted in or overhanging the plot, and recorded using decimals (if less than 1%, rounded to whole number (1-5%) or estimated to the nearest 5% (5- 100%). Abundance was counted (up to 20) and estimated above 20, and recorded using the following intervals: 1, 2, 3, 4, 5, 10, 20, 50, 100, 500, 1,000, 1,500, 2,000 etc.

The assessment of function recorded the number of large trees, the presence of tree stem size class, tree regeneration, number of trees with hollows and length of fallen logs, as well as leaf litter cover within the 20 x 50 m plot and five 1 x 1 m subplots. The minimum number of plots and transects per vegetation zone was determined using Table 4 of the BAM (OEH 2017). Datasheets are provided in Appendix A while compiled plot data is provided in Appendix B.

A small number of plots were completed after flowering period with some species unidentifiable to genus level. Species that were recorded to family level were recorded as native with the relevant growth form as a conservative approach.

5.3 Results

5.3.1 Vegetation description

The Modification 1 project area is located across three key areas:

- Lobs Hole and areas adjacent to Talbingo Reservoir;
- the Marica area, located west of Wallace's Creek Fire Trail; and
- areas adjacent to Tantangara Reservoir.

Vegetation in the lower section of Lobs Hole at Talbingo Reservoir consists of dry sclerophyll forests and grassy woodlands. 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, a weed of national significance, has established itself to the point of infestation within the area, particularly in gullies and along the Yarrangobilly River.

The vegetation within the Marica area consists of tall montane forests and grassy woodlands. Disturbance in this area is minimal, and vegetation is largely intact.

Vegetation within the southern end of Tantangara Reservoir mainly consists of grasslands and grassy woodlands, moderately disturbed as a result of fire damage, historical clearing, recreational use of Tantangara Reservoir and weed invasion. In 2003 a large-scale bushfire burnt thousands of hectares within the Australian Alps, particularly affecting Tantangara. Native vegetation has re-established itself throughout Tantangara with regeneration occurring. The high threat weed Ox-eye Daisy (*Leucanthemum vulgare*) has established itself to the point of infestation within the southern part of Tantangara and adjacent Kelly's Plain, spanning west towards Nungar Track. The NSW National Parks and Wildlife Service (NPWS) are currently undertaking weed control measure including spraying and track closures.

5.3.2 Plant community types

Site investigations, including determination of vegetation communities using the methods described in Section 5.2.1, identified the presence of fourteen PCTs within the Modification 1 disturbance and avoidance footprints (Figure 5.1). The PCT, vegetation formation and vegetation class (Keith 2004) are described within Table 5.2.

Table 5.2 Plant community types mapped within the Modification 1 disturbance footprint and avoidance footprint

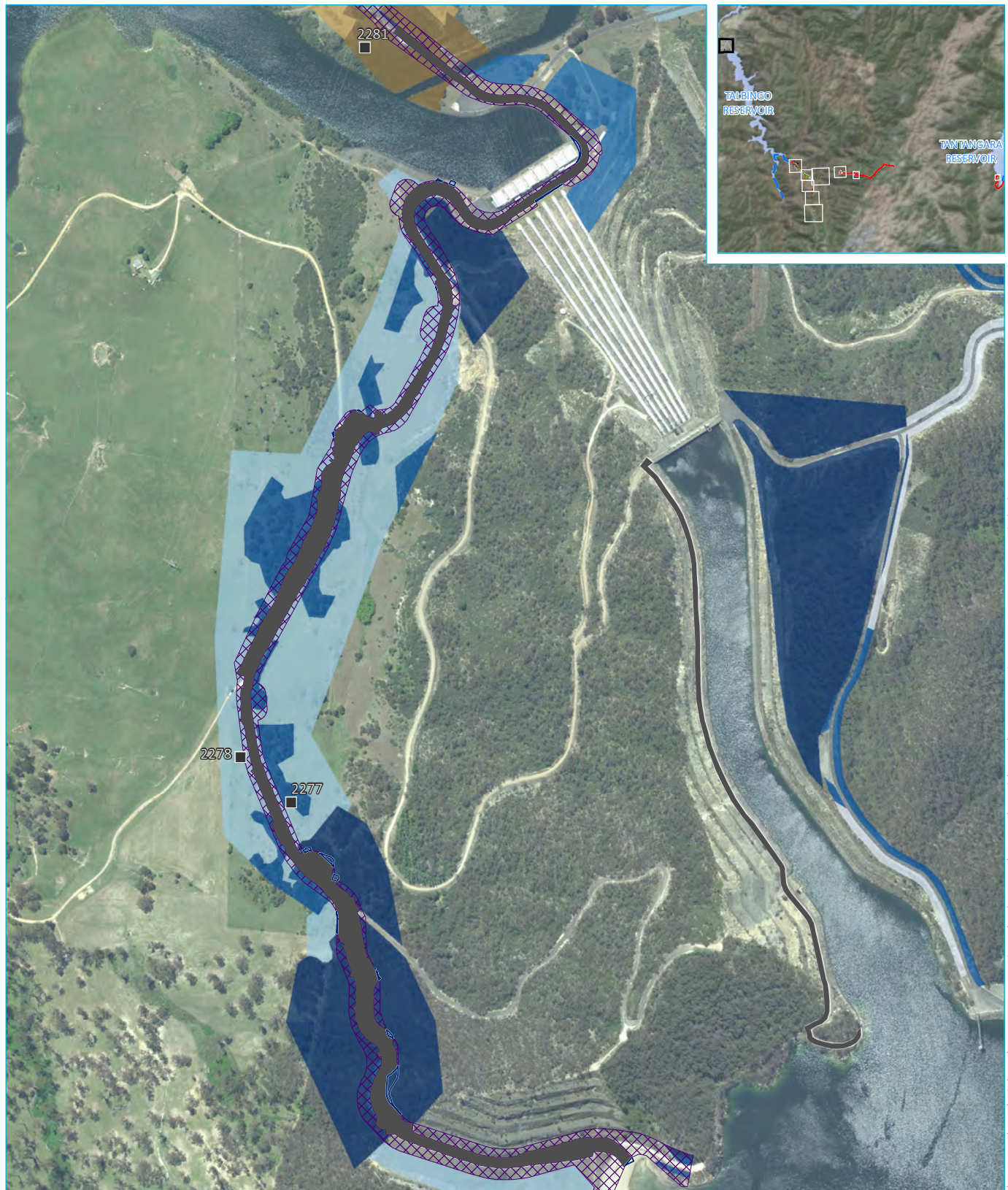
Plant community type	Vegetation formation	Vegetation class	Area (ha) in disturbance footprint	Area (ha) in avoidance footprint
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	Dry Sclerophyll Forest (Shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests	0.11	-0.96
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 western Kosciuszko escarpment	Wet Sclerophyll Forests (Grassy sub-formation)	Southern Tableland Wet Sclerophyll Forests	1.67	-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	1.61	-1.22
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	Southern Tableland Grassy Woodlands	0.31	0.00
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	0.09	-3.15
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	0.01	0.00
PCT 650 – Apple Box - Candlebark - Snow Gum shrubby open forest on valley floors, southern South Eastern Highlands Bioregion	Grassy Woodlands	Subalpine Woodlands	0.00	-0.36

Table 5.2 Plant community types mapped within the Modification 1 disturbance footprint and avoidance footprint

Plant community type	Vegetation formation	Vegetation class	Area (ha) in disturbance footprint	Area (ha) in avoidance footprint
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	6.62	-3.74
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)	Southern Tableland Dry Sclerophyll Forests	1.09	0.00
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	-0.36
PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	Grassy Woodlands	Subalpine Woodlands	0.47	-0.02
PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	Grassy Woodlands	Subalpine Woodlands	0.61	-0.11
PCT 1224 – Sub alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	Grasslands	Temperate Montane Grasslands	0.15	0.00
PCT 1225 – Sub-alpine grasslands of valley floors, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	Grasslands	Temperate Montane Grasslands	<0.01 ¹	0.00
TOTAL			13.38	-11.54

Notes: 1. The area of impact for this PCT is below 0.01 ha and is not discussed further below.

Overall, 13.38 ha of native vegetation was mapped across 13 PCTs within the disturbance footprint, with a reduction in impacts to 11.54 ha of native vegetation (EMM 2018d). These PCTs are described in further detail within the following section.



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

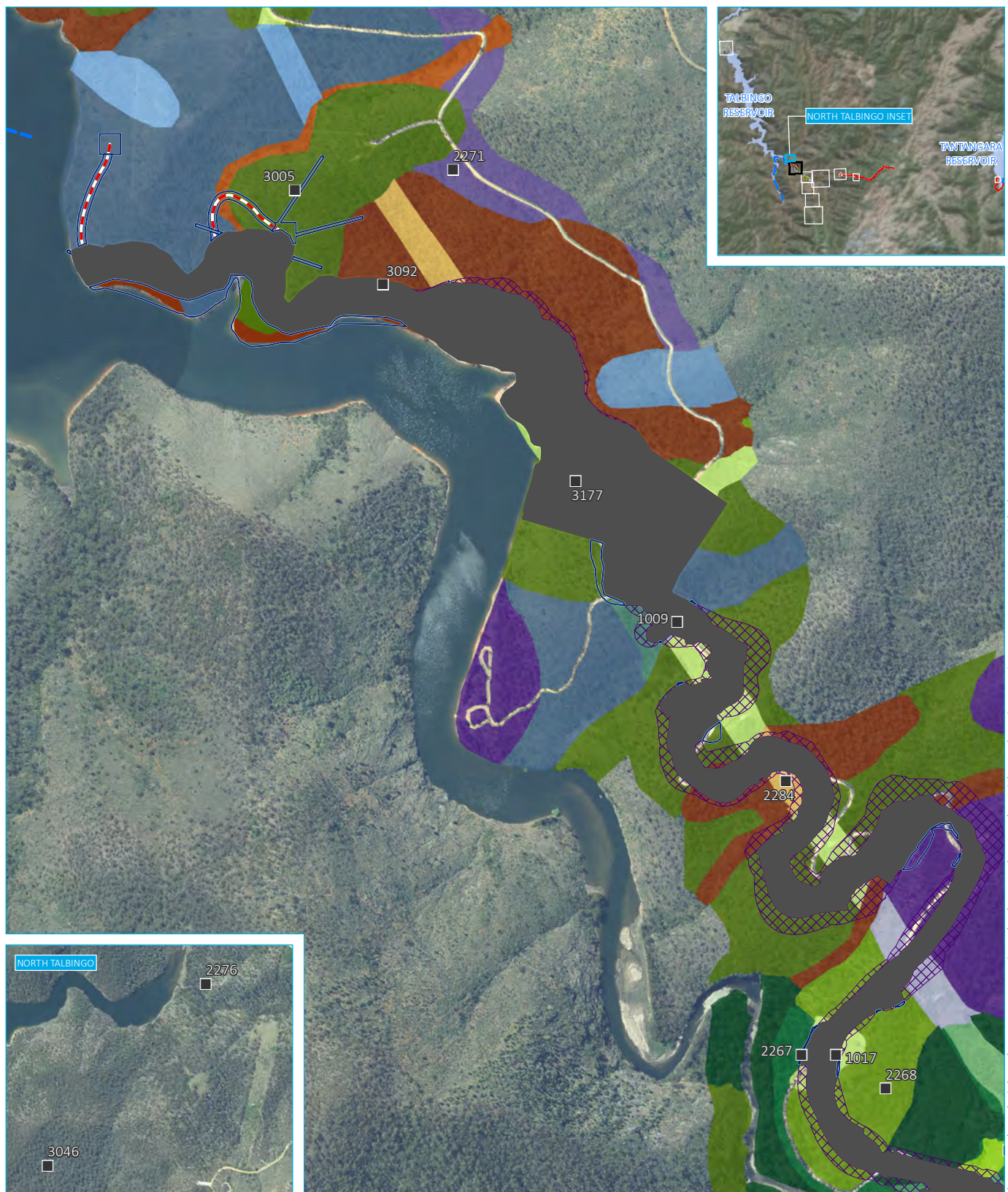
KEY

- 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 5.1a





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

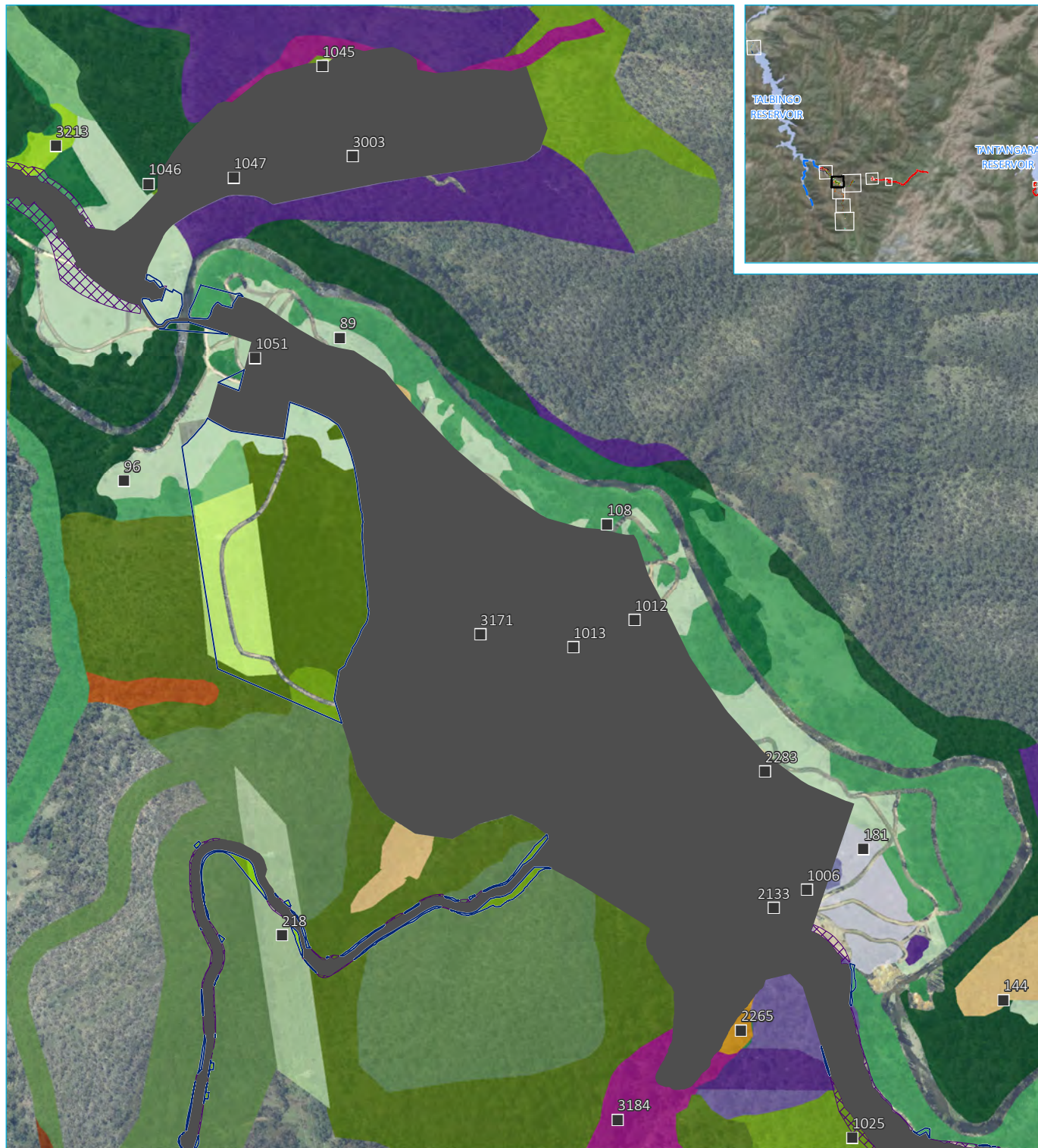
- Moderate/good - Derived grassland
- PCT 1191
 - Moderate/good - High
 - Moderate/good - Derived grassland
- PCT 1196
 - Moderate/good - High

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 5.1b



\\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

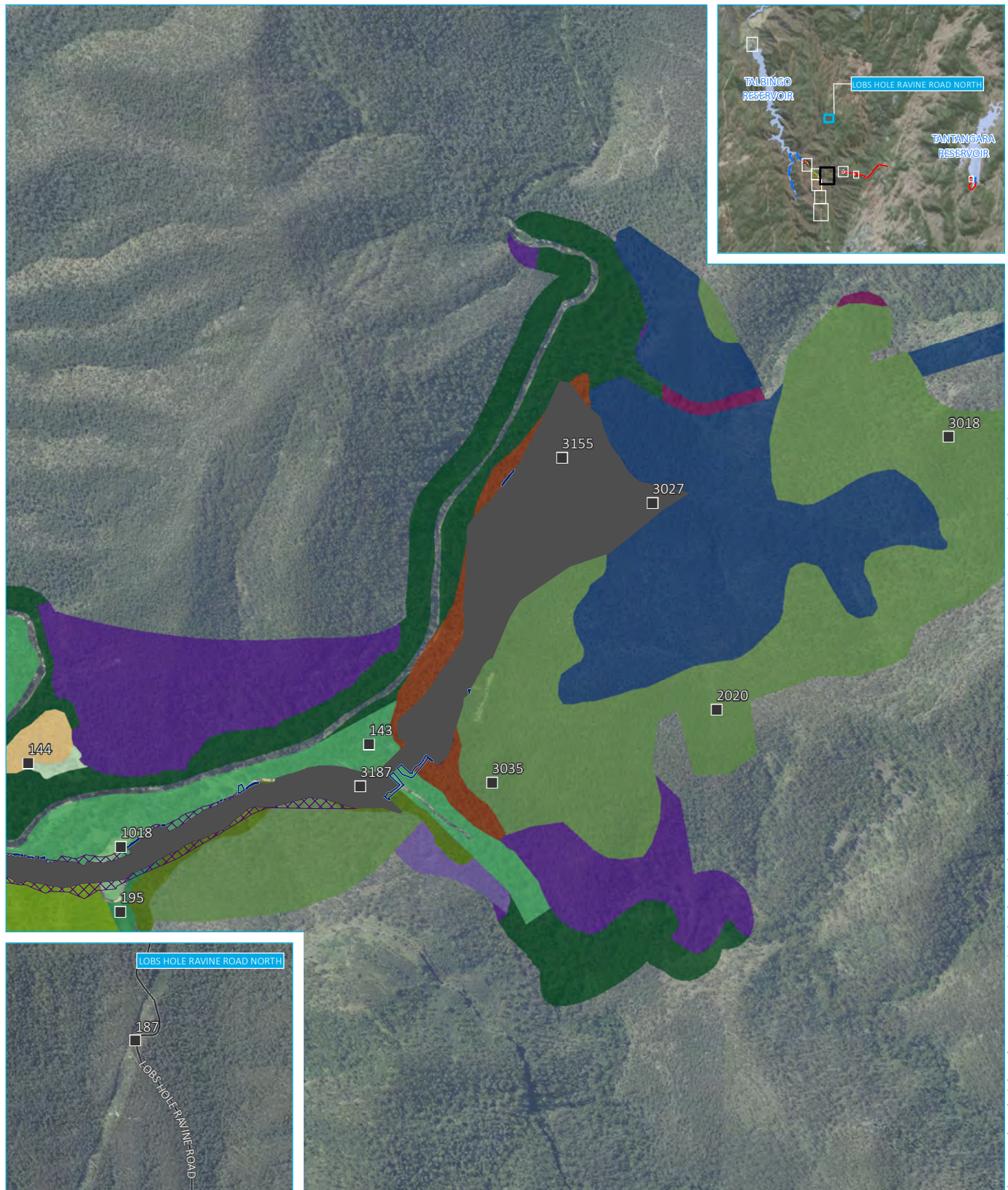
- Low
- PCT 299
 - Moderate/good - Medium
- PCT 300
 - Moderate/good - High
 - Moderate/good - Medium
- PCT 302
 - Moderate/good - High
 - Moderate/good - Medium
 - Moderate/good - Poor
 - Moderate/good - Other
 - Moderate/good - Derived grassland
 - Low

- 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

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 5.1c





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

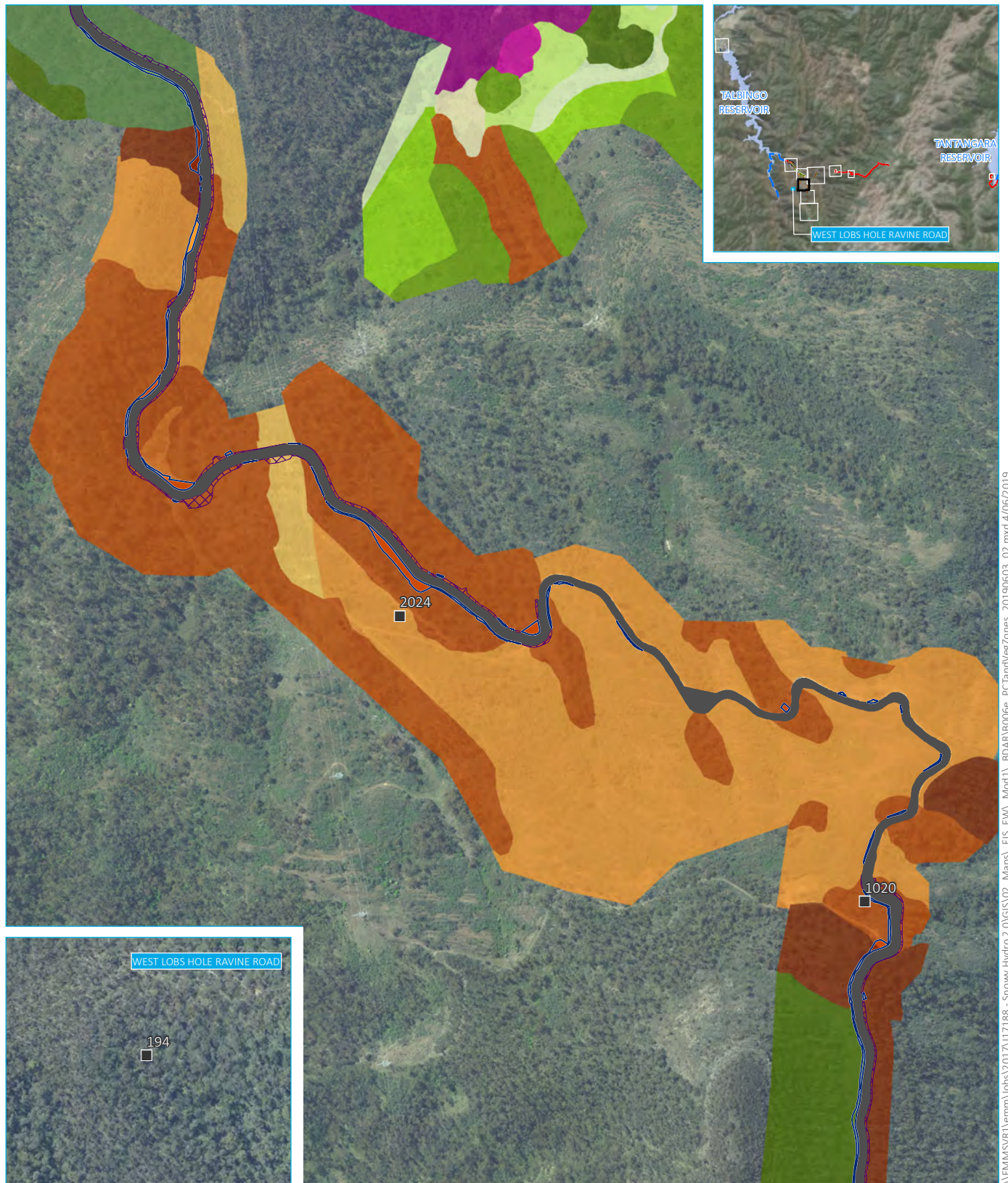
- PCT 300
 - Moderate/good - High
- PCT 302
 - Moderate/good - High
 - Moderate/good - Poor
 - Moderate/good - Other
 - Moderate/good - Derived grassland
 - Low
- PCT 311
 - Moderate/good - High
- PCT 729
 - Moderate/good - High

- 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 5.1d





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

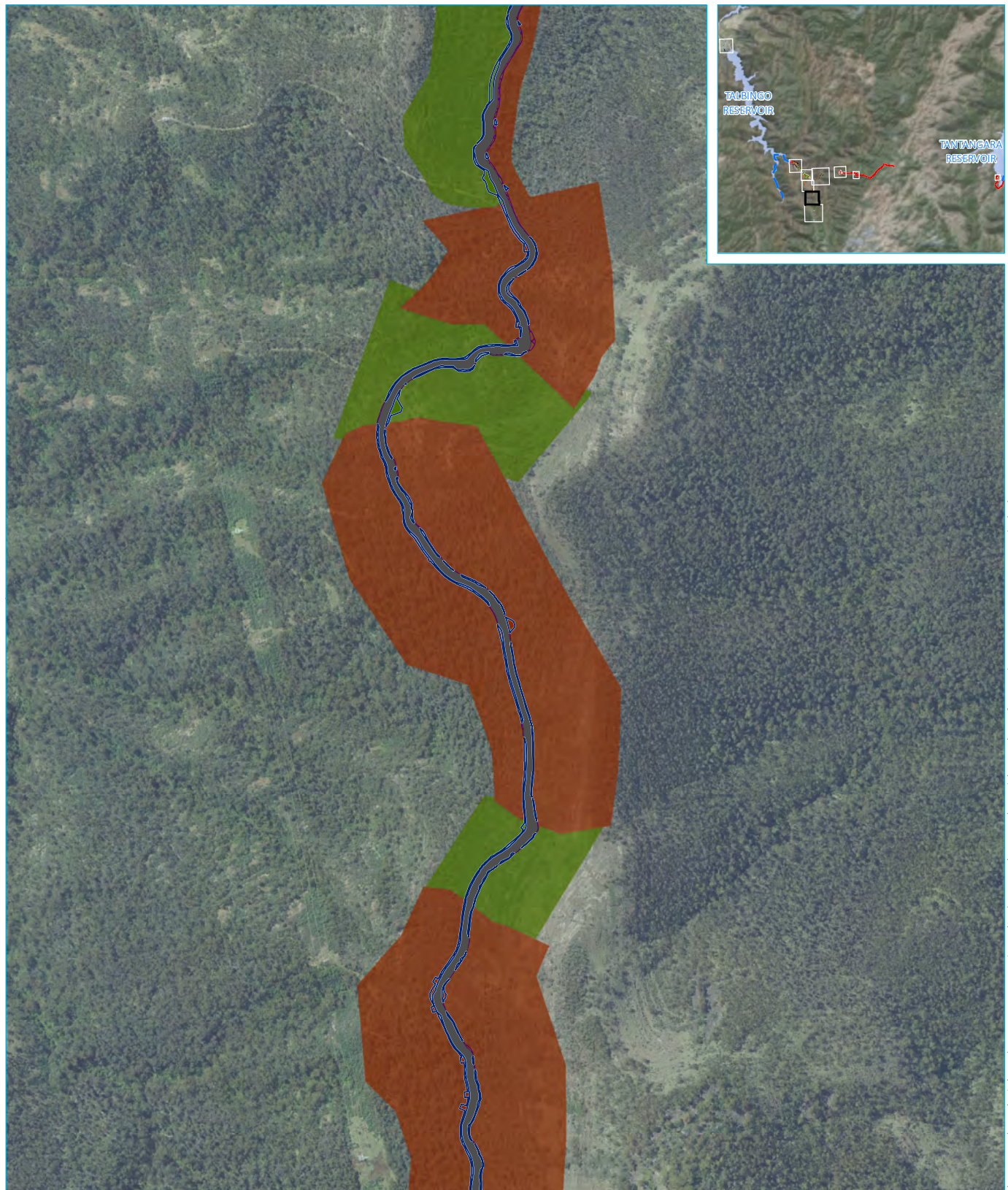
KEY

- 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 5.1e





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

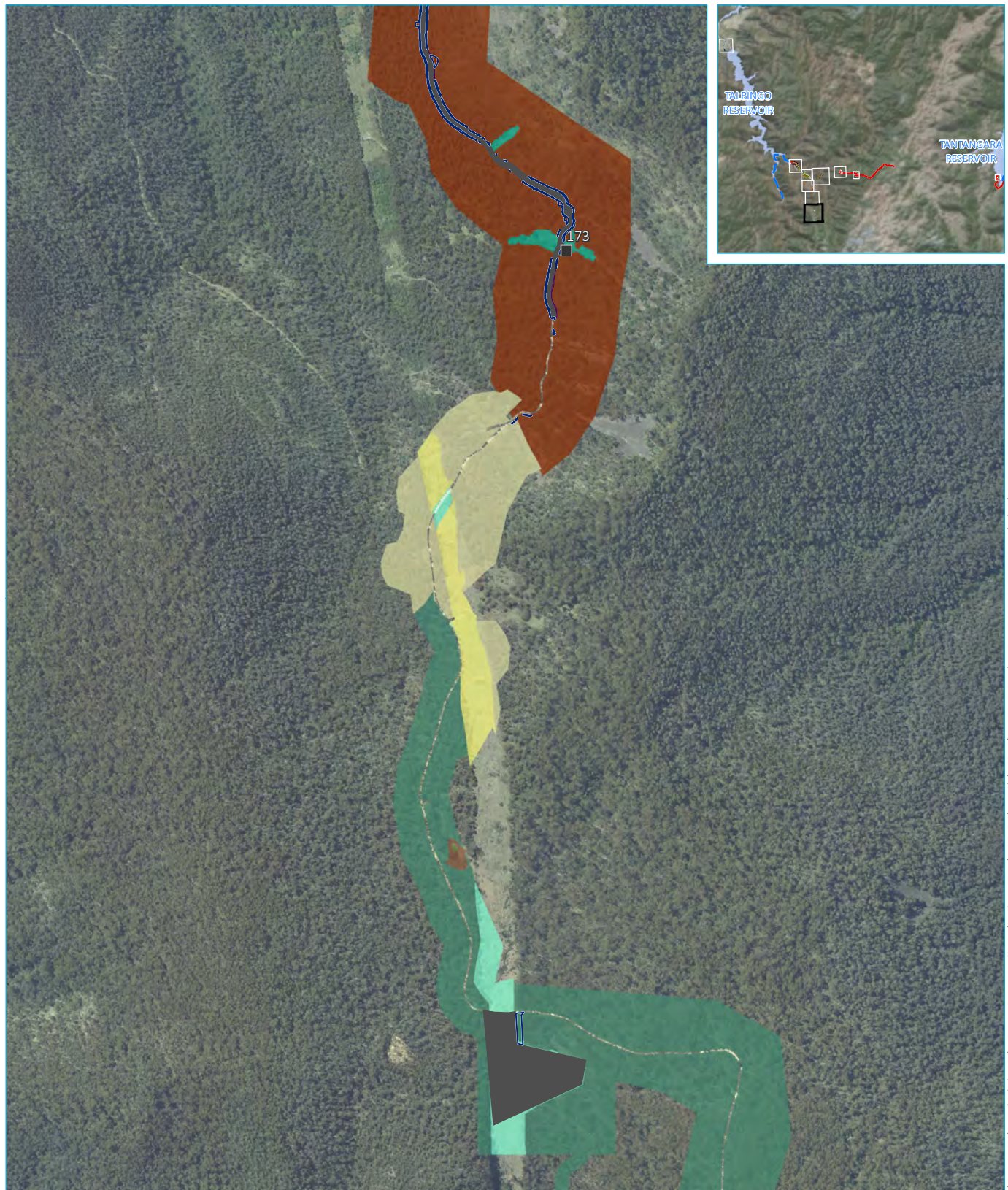
PCT 729

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 5.1f





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

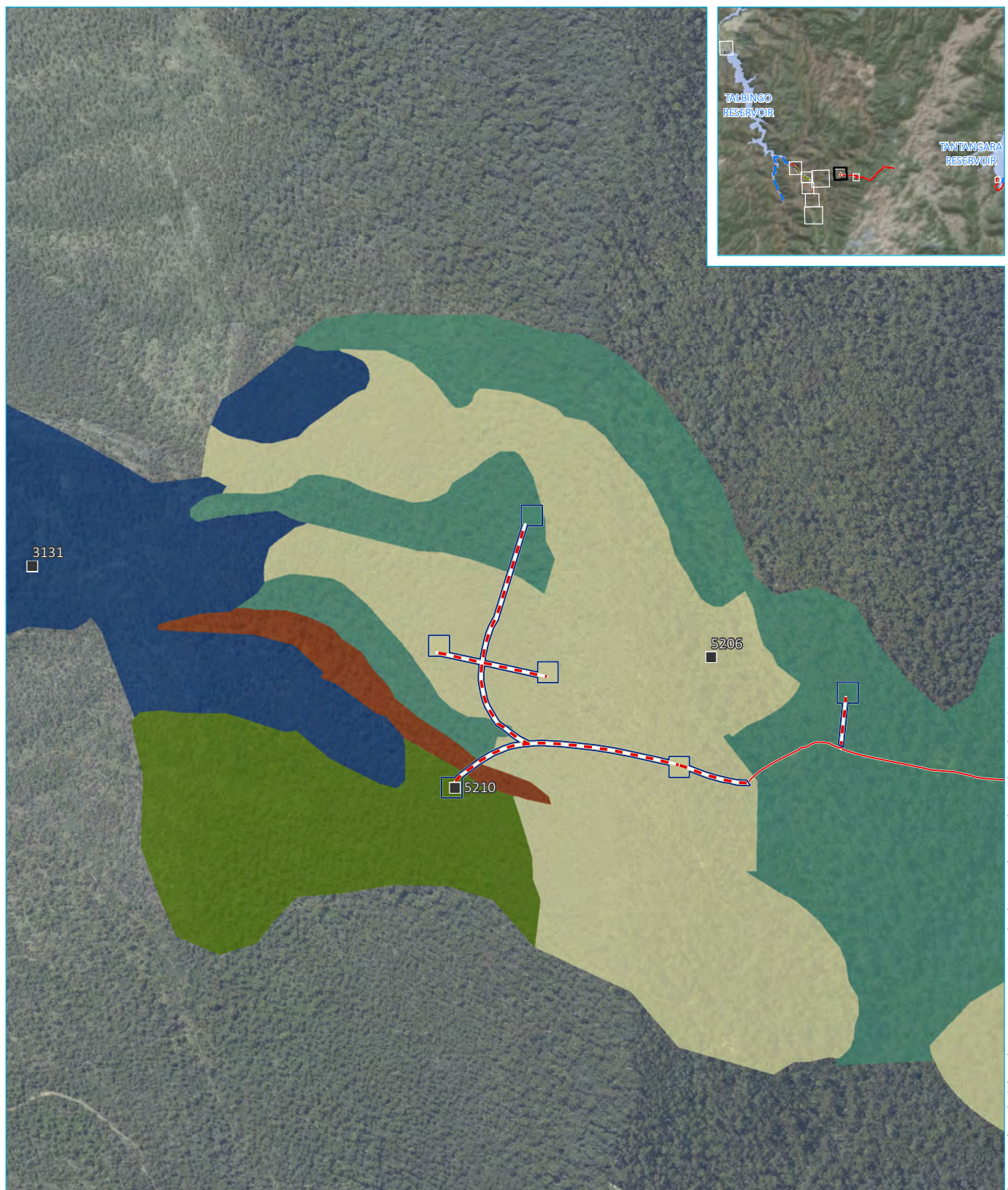
KEY

- | | |
|---|-----------------------------------|
| ■ Plot location | PCT 643 |
| □ EW approved construction footprint (additional) | Moderate/good - High |
| ■ EW approved construction footprint | PCT 953 |
| □ EW approved construction footprint reduced | Moderate/good - High |
| PCTsEMM1500mBuffer_20190508 | Moderate/good - Derived grassland |
| PCT 300 | PCT 1196 |
| Moderate/good - High | Moderate/good - High |
| PCT 303 | Moderate/good - Derived grassland |
| Moderate/good - High | |
| PCT 637 | |
| 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 5.1g





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

KEY

- Plot location
- Existing access track
- - - Proposed access track
- EW approved construction footprint (additional)
- PCT 300
- Moderate/good - High
- PCT 311
- Moderate/good - High
- PCT 729
- Moderate/good - High
- PCT 953
- Moderate/good - High
- 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 5.1h





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

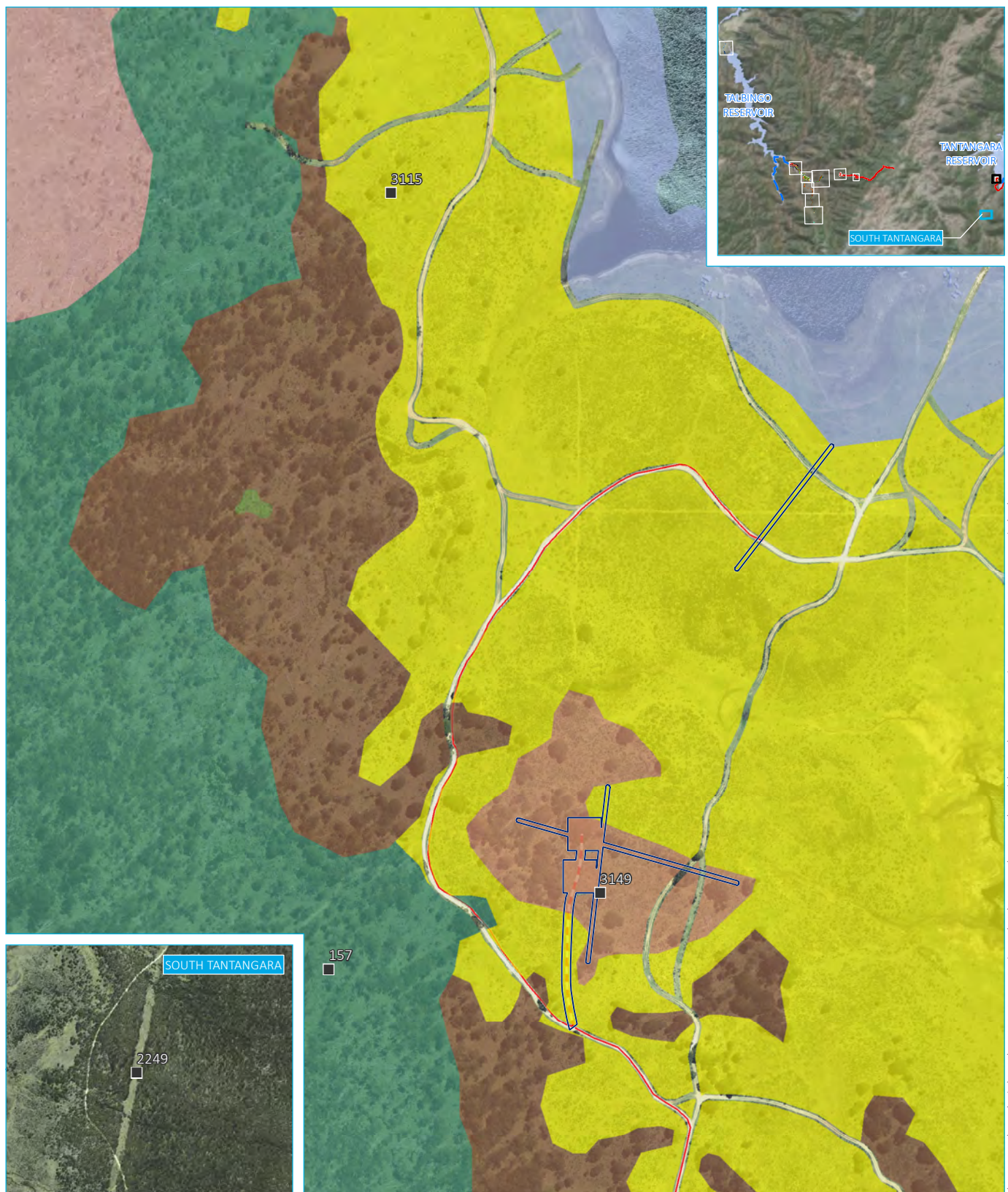
KEY

- Existing access track
- Proposed access track
- EW approved construction footprint (additional)
- PCT 300
 - Moderate/good - High
- PCT 639
 - Moderate/good - High
 - Moderate/good - Other
- PCT 765
 - Moderate/good - High
- 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 5.1i





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

KEY

- Plot location
- Existing access track
- - - Proposed access track
- EW approved construction footprint (additional)
- PCT 303
 - Moderate/good - High
 - Moderate/good - Other
- PCT 644
 - Moderate/good - Other
- PCT 637
 - Moderate/good - High

- PCT 1196
 - Moderate/good - High
- PCT 1224
 - Moderate/good - High
- PCT 1225
 - Low

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 5.1j



5.3.3 Vegetation zones

Each of the fourteen PCTs identified within the Modification 1 disturbance footprint was stratified into vegetation zones based on broad condition state, as per the method outlined in Section 5.2.1, and allocated a condition class as per the descriptions in Table 5.1. This process identified thirty-six vegetation zones within the modified project area, including the disturbance footprint and avoidance footprint, as outlined in Table 5.3.

Table 5.3 **Vegetation zones mapped within the Modification 1 disturbance footprint and avoidance footprint**

Plant community type	Condition	Ancillary code	Area (ha) in disturbance footprint	Area (ha) in avoidance footprint
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	Low	-	<0.01	<0.01
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	Moderate/good	Derived grassland	<0.01	0.19
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	Moderate/good	Medium	0.01	0.01
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	Moderate/good	High	0.10	0.71
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 western Kosciuszko escarpment	Moderate/good	Derived grassland	<0.01	0.16
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 western Kosciuszko escarpment	Moderate/good	Poor	0.01	0.00
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 western Kosciuszko escarpment	Moderate/good	Other	0.07	0.04
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 western Kosciuszko escarpment	Moderate/good	Medium	0.33	0.38
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 western Kosciuszko escarpment	Moderate/good	High	1.26	1.09
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	Low	-	0.95	0.32

Table 5.3 **Vegetation zones mapped within the Modification 1 disturbance footprint and avoidance footprint**

Plant community type	Condition	Ancillary code	Area (ha) in disturbance footprint	Area (ha) in avoidance footprint
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	Moderate/good	Derived Grassland	0.32	0.15
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	Moderate/good	Poor	0.01	0.06
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	Moderate/good	Other	0.29	0.56
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	Moderate/good	Medium	0.01	0.00
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	Moderate/good	High	0.03	0.12
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	Moderate/good	Other	0.31	0.00
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	Moderate/good	Derived grassland	<0.01	1.29
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	Moderate/good	Poor	0.00	<0.01
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	Moderate/good	Other	0.00	<0.01
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	Moderate/good	Medium	0.00	0.97
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	Moderate/good	High	0.09	0.89

Table 5.3 **Vegetation zones mapped within the Modification 1 disturbance footprint and avoidance footprint**

Plant community type	Condition	Ancillary code	Area (ha) in disturbance footprint	Area (ha) in avoidance footprint
PCT 643 – Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion	Moderate/good	High	0.01	0.00
PCT 650 – Apple Box - Candlebark - Snow Gum shrubby open forest on valley floors, southern South Eastern Highlands Bioregion	Moderate/good	Derived grassland	0.00	<0.01
PCT 650 – Apple Box - Candlebark - Snow Gum shrubby open forest on valley floors, southern South Eastern Highlands Bioregion	Moderate/good	Medium	0.00	0.36
PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	Moderate good	Derived grassland	1.70	0.46
PCT 729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	Moderate/good	Poor	0.00	0.05
PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	Moderate good	Medium	<0.01	1.00
PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	Moderate good	High	4.82	2.22
PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	Moderate/good	High	1.09	0.00
PCT 999 – Norton’s Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	Moderate/good	Derived grassland	0.06	0.01
PCT 999 – Norton’s Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	Moderate/good	High	0.58	0.36
PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	Moderate/good	Derived grassland	0.00	0.01
PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	Moderate/good	High	0.47	0.01
PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	Moderate/good	Derived grassland	<0.01	0.00
PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	Moderate/good	High	0.61	0.11

Table 5.3 **Vegetation zones mapped within the Modification 1 disturbance footprint and avoidance footprint**

Plant community type	Condition	Ancillary code	Area (ha) in disturbance footprint	Area (ha) in avoidance footprint
PCT 1224 – Sub alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	Moderate/good	High	0.15	0.00
TOTAL			13.38	11.54

Notes: Vegetation zones with an area less than 0.01 ha were not inputted into the BAM calculator.

Descriptions of each PCT are provided in the following tables. PCTs and vegetation zones are mapped in Figure 5.1.

Table 5.4 **PCT 296 – Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion**

PCT 296 - Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	
PCT ID	296
Common name	Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion
Condition class	Six vegetation zones were mapped within the project area: • Low • Moderate/good – Derived Grassland • Moderate/good – Medium • Moderate/good – High The vegetation zone assigned an ancillary code of Low was not inputted into the calculator as the area of this vegetation zone is less than 0.01 ha.
Extent within Modification 1 project area	1.02 ha (0.11 ha in disturbance footprint and 0.91 ha in avoidance footprint)

Table 5.4 PCT 296 – Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion

PCT 296 - Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion

Description	Brittle Gum (<i>Eucalyptus mannifera</i> subsp. <i>mannifera</i>), Broad-leaved Peppermint (<i>Eucalyptus dives</i>) and Red Stringybark (<i>Eucalyptus macrorhyncha</i>) are the dominant canopy trees within this vegetation community. Robertson's Peppermint (<i>Eucalyptus robertsonii</i> subsp. <i>robertsonii</i>) was recorded scattered throughout. The midstorey varies between a fairly sparse to dense cover comprising of Silver wattle (<i>Acacia dealbata</i>), Native Blackthorn (<i>Bursaria spinosa</i>), Common Fringe-myrtle (<i>Calytrix tetragona</i>), Hoary guinea flower (<i>Hibbertia obtusifolia</i>), Mountain Banksia (<i>Banksia canei</i>) and <i>Cassinia longifolia</i>. The groundcover consists of a variety of native grasses, forbs, rushes and sedges. Grasses including Tussock (<i>Poa labillardierei</i>), Snowgrass (<i>Poa sieberiana</i> var. <i>sieberiana</i>), Silvertop Wallaby Grass (<i>Rytidosperma pallidum</i>) and <i>Poa sieberiana</i> var. <i>cyanophylla</i> while native forbs comprise of Raspwort (<i>Gonocarpus teucroides</i>), Grass Trigger plant (<i>Stylidium graminifolium</i>), Small St John's Wort (<i>Hypericum gramineum</i>) and Hairy Apple Berry (<i>Billardiera scandens</i>). Rushes and sedges include Wattle Mat-rush (<i>Lomandra filiformis</i> subsp. <i>filiformis</i>) and Fluke Bogrush (<i>Schoenus apogon</i>). Exotic species recorded within this vegetation type include St John's Wort (<i>Hypericum perforatum</i>), Blackberry (<i>Rubus fruticosus</i> sp. <i>agg</i>), Sweet Briar (<i>Rosa rubiginosa</i>) and Common Centaury (<i>Centaureum erythraea</i>). This PCT is mapped on steep to moderate slopes, on a variety of light grey to brown clay loam, rocky loam and sandy clay loam soils within the Exploratory Works. Often found located adjacent and upslope from PCT 285 and PCT 302.
Survey effort	Moderate/good – Derived Grassland: one plot (187) Moderate/good – Poor: one plot (1006) Moderate /good – Other: one plot (3003) Moderate/good – Medium: one plots (2271) Moderate/good – High: one plot (2161)
Condition description	The community covers a large portion of the study area and the condition varied between both moderate/good to low. Some areas in Lobs Hole have been cleared and are mapped in Low condition. Adjacent areas, where clearing has occurred but regeneration is present, were mapped in as being in the Other condition class. Cleared areas with a higher native component were mapped as Derived Grasslands; this included underneath powerlines and small areas in Lobs Hole. Some areas in Lobs Hole where there is significant weed invasion were mapped as being in Poor condition. Areas outside of Lobs Hole were generally mapped in Medium or High condition depending on stratum present.
Characteristic species used for identification of PCT	According to the NSW VIS Classification Version 2.1, the canopy layer species recorded within this community align with the dominant species listed as characteristic for this PCT. These include Brittle Gum and Broad-leaved Peppermint. Aligning midstorey species include Silver wattle, Native Blackthorn and <i>Cassinia longifolia</i>. Ground layer species include Snowgrass, Silvertop Wallaby Grass and Wattle Mat-rush.
Justification of evidence used to identify the PCT	Apart from species composition, the stated distribution is within the IBRA Bioregions of NSW South Western Slopes, South Eastern Highland and Australian Alps is consistent with the identification of the PCT. The occurrence of the community on sandy loamy clay soils as well as the landscape position on steep hillslopes within a mountainous and/or hilly landform is consistent for this PCT. The characteristic species, as listed above, are consistent with the PCT with the main diagnostic feature being a canopy dominated by Brittle Gum and Broad-leaved Peppermint. The mid-storey contains a number of characteristic species as does the ground layer.
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed

Table 5.4 **PCT 296 – Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion**

PCT 296 - Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	
Estimate of percent cleared value of PCT	40%



Photograph 5.1 **Brittle Gum – peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion – Plot 2161**

Table 5.5 **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 description**

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	
PCT ID	300
Common name	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

Table 5.5 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 description

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

Condition class	Five vegetation zones were mapped within the project area: • Moderate/good – Derived Grassland • Moderate/good – Poor • Moderate /good – Other • Moderate/good – Medium • Moderate/good – High
Extent within Modification 1 project area	3.34 ha (1.67 ha in disturbance footprint and 1.67 ha in avoidance footprint)
Description	Ribbon Gum (<i>Eucalyptus viminalis</i>) and Narrow-leaved Peppermint dominate this community. The midstorey comprises of Silver wattle, Handsome Flat Pea (<i>Platylobium formosum</i>), Wedge-leaved Wattle (<i>Acacia pravissima</i>), Narrow Leaf Hop Bush (<i>Dodonaea viscosa</i> subsp. <i>angustissima</i>), Bulbine Lily (<i>Bulbine bulbosa</i>), <i>Cassinia longifolia</i> and River Lomatia (<i>Lomatia myricoides</i>). Ground cover includes a number of native grasses, rushes and forbs. Grasses recorded include Slender Wallaby Grass (<i>Rytidosperma penicillatum</i>), <i>Dichelachne rara</i>, Longhair Plume Grass (<i>Dichelachne crinita</i>), Tussock and Speargrass (<i>Austrostipa scabra</i>). Native forbs include Bidgee-widgee (<i>Acaena novae-zelandiae</i>), Tall Bluebell (<i>Wahlenbergia stricta</i> subsp. <i>stricta</i>), Small St John's Wort, <i>Glycine tabacina</i>, Prickly Woodruff (<i>Asperula scoparia</i>) and Native violet (<i>Viola betonicifolia</i>). The exotic species Delicate Hairgrass (<i>Aira elegantissima</i>), Common Centaury, St John's Wort and Blackberry were recorded within the community. This community was mapped on sheltered hill slopes at slightly higher elevations and adjacent to PCT 296. Located on a variety of red/brown loam to clay loam soils within the Exploratory Works project area.
Survey effort	Moderate/good – Derived Grassland: one plot (2284) Moderate/good – Poor: one plot (194) Moderate /good – Other: one plot (2024) Moderate/good – Medium: one plot (1020) Moderate/good – High: three plots (3046, 3092, 3155)
Condition description	This community's condition was recorded as moderate/good throughout the study area; however, it does vary between High and other ancillary codes. Patches assigned to the condition class Other are located in areas previously cleared on the slopes above Lobs Hole Ravine adjacent to Lobs Hole Ravine Road. In these areas, some regeneration is present. An adjacent area is lacking in regeneration and was assigned to Derived Grassland condition class. Areas adjacent to the two areas described previously, where some level of disturbance is still evident but a mature overstorey is present, were assigned to the Medium condition class. Areas with largely intact strata were assigned to the High condition class.
Characteristic species used for identification of PCT	According to the NSW VIS Classification Version 2.1, the canopy layer species recorded within this community align with the dominant species listed as characteristic for this PCT. These include Ribbon Gum and Robertson's Peppermint. Aligning midstorey species include Silver Wattle, Handsome Flat Pea, Wedge-leaved Wattle and River Lomatia. Understorey species that were used as an identifying species include Bidgee-widgee, Small St John's Wort, <i>Glycine tabacina</i>, Prickly Woodruff and Native Violet.

Table 5.5 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 description

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

Justification of evidence used to identify the PCT	Apart from species composition, the stated distribution within the South Eastern Highland and Australian Alps IBRA Bioregions is consistent. Occurs on deep red/brown loam soils derived from granite and sedimentary substrates on sheltered hill slopes in a mountain landform pattern at elevations between 700 m and 1,150 m on the south-western edge of the south Eastern Highlands Bioregion including in Kosciuszko National Park.
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed
Estimate of percent cleared value of PCT	20%



Photograph 5.2 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 – Plot 3046

Table 5.6 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 description

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

PCT ID	302
Common name	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
Condition class	Six vegetation zones were mapped within the project area: • Low • Moderate/good – Derived Grassland • Moderate/good – Poor • Moderate /good – Other • Moderate/good – Medium • Moderate/good – High
Extent within Modification 1 project area	2.83 ha (1.61 ha in disturbance footprint and 1.22 ha in avoidance footprint)
Description	Ribbon Gum, Black Sally (<i>Eucalyptus stellulata</i>) and <i>Eucalyptus camphora</i> subsp. <i>humeana</i> are the dominant overstorey species in this PCT. The midstorey comprises of Wedge-leaved Wattle, Native Blackthorn, Dolly Bush (<i>Cassinia aculeata</i>), Hazel Pomaderris (<i>Pomaderris aspera</i>), <i>Pomaderris angustifolia</i>, Hoary Guinea Flower, Matted Parrot-pea (<i>Dillwynia sericea</i>), Blackwood (<i>Acacia melanoxylon</i>), Dwarf Cherry (<i>Exocarpus stricta</i>), <i>Cassinia longifolia</i>, Rosemary Grevillea (<i>Grevillea rosmarinifolia</i>) and River Lomatia. Ground cover includes a number of native grasses, rushes and forbs. Grasses recorded include Kangaroo Grass (<i>Themeda triandra</i>), Common Couch (<i>Cynodon dactylon</i>), Tussock and <i>Poa sieberiana</i>, Bulbine Lily, Variable Glycine (<i>Glycine tabacina</i>), Common Woodruff (<i>Asperula conferta</i>), Bracken Fern (<i>Pteridium esculentum</i>), Tall Sedge (<i>Carex appressa</i>) and Stinking Pennywort (<i>Hydrocotyle laxiflora</i>). A high number of exotic species were recorded in some vegetation zones, including Square Tail Fescue (<i>Vulpia bromoides</i>), Delicate Hairgrass, Common Centaury, St John's Wort, Catsear (<i>Hypercharis redicata</i>), Common Sowthistle (<i>Sonchus oleraceus</i>), Sheep Sorrel (<i>Acetosella vulgaris</i>) and Blackberry. This community is found on a variety of brown loam to clay loam soils within the Exploratory Works disturbance footprint, adjacent to creek and watercourses. This is the predominant riparian community along the Yarrangobilly River.
Survey effort	Low: three plots (89, 96, 1051) Moderate/good – Derived Grassland: one plot (1018) Moderate/good – Poor: one plot (195) Moderate /good – Other: two plots (108, 143) Moderate/good – Medium: one plot (2267) Moderate/good – High: one plot (1046)
Condition description	This community's condition was recorded as both moderate/good and Low. The areas where a Low condition class was recorded are in areas subject to historical clearing, and subject to ongoing disturbance from recreational use. These areas have high exotic weed cover. Some adjacent areas show regeneration of canopy species, and were assigned to the Other condition class. Several patches on midslopes, where clearing has occurred but a largely native groundcover is maintained, were assigned to the Derived Grassland condition class. Areas assigned to a Medium condition class show a more native groundcover, were lacking either the midstorey or had a disturbed overstore. The patches assigned to a High condition class are generally located away from human influence, and thus have a more intact strata.

Table 5.6 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 description

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	
Characteristic species used for identification of PCT	According to the NSW VIS Classification Version 2.1, the canopy layer species recorded within this community align with the dominant species listed as characteristic for this PCT. These include Ribbon Gum and <i>Eucalyptus camphora</i> subsp. <i>humeana</i> . Aligning midstorey species include Blackwood, Hazel Pomaderris, <i>Pomaderris angustifolia</i> and River Lomatia. Understorey species that were used as a identifying species include Kangaroo Grass, Tall Sedge and Common Couch.
Justification of evidence used to identify the PCT	Apart from species composition, the stated distribution is within the South Eastern Highland IBRA Bioregions and on clays or humic gleys over gravel along creeks is consistent with the PCT; this community was recorded running adjacent to and on the flats around the Yarrangobilly River. Overall, PCT 302 was considered best fit, but does not provide an ideal fit for this PCT.
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed
Estimate of percent cleared value of PCT	50%



Photograph 5.3 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 – Plot 1046

Table 5.7 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 description

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

PCT ID	303
Common name	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
Condition class	One vegetation zones was mapped within the project area: • Moderate/good – Other
Extent within Modification 1 project area	0.31 ha (disturbance footprint only)
Description	Black Sally is the dominant canopy species in this PCT. The midstorey comprises of Tree Violet (<i>Hymenanthera dentata</i>), Small-fruit Hakea (<i>Hakea microcarpa</i>), <i>Pimelea pauciflora</i> and Mountain mireblia (<i>Mirbelia oxylobioides</i>). Groundcover consists of mainly native forbs with some native grasses. Forbs include Common Woodruff, Pale Vanilla-lily (<i>Arthropodium milleflorum</i>), <i>Cynoglossum australe</i>, Native Geranium (<i>Geranium solanderi</i>), <i>Acaena ovina</i>, <i>Epilobium sp.</i>, Bidgee-Widgee, Two-flowered Knawel (<i>Scleranthus biflorus</i>) and Bulbine Lily. Grass species include Kangaroo Grass and <i>Poa sieberiana</i>. This community is restricted to Tantangara within the Exploratory Works modification project area. It occurs on a valley bottom and adjacent footslopes next to the reservoir.
Survey effort	Moderate/good – Other: one plot (149)
Condition description	This community's condition was recorded as moderate/good – other. This community was mapped as other due to regeneration of canopy species as a result of a fire. These areas are in generally good condition with some disturbance from pest species including horses and rabbits as well as some invasive weeds.
Characteristic species used for identification of PCT	According to the NSW VIS Classification Version 2.1, the canopy layer species, Black Sally, recorded within this community aligns with the dominant species listed as characteristic for this PCT. Aligning midstorey species includes Tree Violet. Understorey species used as an identifying species includes Kangaroo grass, Bidgee-Widgee, Native Geranium and <i>Acaena ovina</i> .
Justification of evidence used to identify the PCT	Apart from species composition, the stated distribution within the South Eastern Highlands, NSW South Western Slopes and Australian Alps IBRA Bioregions is consistent.
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed
Estimate of percent cleared value of PCT	95%

Table 5.7 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 description

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



Photograph 5.4 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 – Plot 149

Table 5.8 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 description

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

PCT ID	311
Common name	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

Table 5.8 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 description

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

Condition class	Five vegetation zones were mapped within the project area:: • Moderate/good – Derived grassland • Moderate/good – Poor • Moderate/good – Other • Moderate/good – Medium • Moderate/good – High The vegetation zones assigned an ancillary code of Poor and Other were not inputted into the calculator as the area of these vegetation zones is less than 0.01 ha.
Extent within Modification 1 project area	3.24 ha (0.09 ha in disturbance footprint and 3.15 ha in avoidance footprint)
Description	Nortons Box (<i>Eucalyptus nortonii</i>), Red Stringybark and Broad-leaved Peppermint dominate this community. The midstorey comprises of Common Fringe-myrtle, Narrow-leaved Hopbush, Hoary guinea flower, Native Blackthorn, <i>Cassinia longifolia</i>, Dwarf Cherry, Silver wattle, Daphne Heath (<i>Brachyloma daphnoides</i>), <i>Dillwynia sieberi</i> and Creamy Stackhousia (<i>Stackhousia monogyna</i>). This community has a diverse ground cover comprising of native forbs, sedges, rushes and grasses. Native grasses include Speargrass, Ringed Wallaby Grass (<i>Rytidosperma caespitosum</i>) and Plumegrass (<i>Dichelachne hirtella</i>). Native forbs, rushes and sedges recorded include Purple Coral Pea (<i>Hardenbergia violacea</i>), <i>Senecio bathurstianus</i>, Native Geranium, Poisen Rock Fern (<i>Cheilanthes sieberi</i>), <i>Gonocarpus tetragynus</i>, Stinking Pennywort, Twining glycine (<i>Glycine clandestine</i>), <i>Lomandra filiformis</i> subsp. <i>coriacea</i>, and <i>Carex breviculmis</i>. A number of exotic species were recorded including Delicate Hairgrass, Common Centaury, St Johns Wort, Scarlet pimpernel (<i>Lysimachia arvensis</i>), Sweet Briar and Silver Grass (<i>Vulpia bromoides</i>). This community is found on a red/brown soil with a clay loam texture, along the lower sections of Lobs Hole Ravine Road and at the northern end of Talbingo Reservoir, within the Exploratory Works disturbance footprint.
Survey effort	Moderate/good – Derived grassland: one plot (2278) Moderate/good – Medium: one plot (2277) Moderate/good – High: two plots (3027, 3131)
Condition description	Patches of this community along Lobs Hole Ravine Road were assigned to a High condition class, with most strata present and little evidence of disturbance. Patches at Talbingo were assigned to Medium condition class due to disturbance along road edges, but transitioned into High condition class away from the road edge. All areas had little evidence of weed invasion, although impacts from past clearing were evident.
Characteristic species used for identification of PCT	According to the NSW VIS Classification Version 2.1, the canopy layer species recorded within this community align with the dominant species listed as characteristic for this PCT. These include Nortons Box, Red Stringybark and Broad-leaved Peppermint. Aligning midstorey species include Daphne Heath, <i>Cassinia longifolia</i> , Native Blackthorn and Hoary Guinea Flower. Understorey species that were used as identifying species include <i>Lomandra filiformis</i> subsp. <i>coriacea</i> , Purple Coral Pea, Twining Glycine, and Stinking Pennywort.
Justification of evidence used to identify the PCT	Apart from species composition, the stated distribution is within the South Eastern Highland and Australian Alps IBRA Bioregions aligns. This community was recorded on the mid slopes leading into Lobs Hole on red/brown soils which is consistent with NSW VIS Classification Version 2.1.

Table 5.8 **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 description**

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

Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed
Estimate of percent cleared value of PCT	40%



Photograph 5.5 **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 – Plot 3027**

Table 5.9 **PCT 643 – Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion**

PCT 643 – Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion

PCT ID	643
Common name	Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion
Condition class	A single vegetation zone was mapped within the project area: • Moderate/good - High
Extent within Modification 1	0.01 ha (disturbance footprint only)

Table 5.9 **PCT 643 – Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion**

PCT 643 – Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion

Description	This PCT was used to map granite blockstreams on Lobs Hole Ravine Road. While no canopy species are listed to be present in this PCT by the NSW VIS Classification Version 2, Ribbon Gum and White Sally (<i>Eucalyptus pauciflora</i>) were recorded due to the configuration of the 20m x 20m assessment plot, with these species overhanging the plot. The shrub layer is largely absent, with a low cover of <i>Casinia longifolia</i> , Small-fruited Hakea (<i>Hakea macrocarpa</i>), Blackwood, Silver Wattle and Matted Parrot Pea (<i>Dillwynia prostrata</i>) at the edges of the plot. Ground cover is sparse, but present in the accumulated debris and soils in the blockstream. Ground cover species include a number of native grasses, rushes and forbs. Grasses recorded include Kangaroo Grass, Rock Tussock-grass (<i>Poa petrophila</i>), Tussock, and <i>Poa sieberiana</i> var. <i>cyanophylla</i> . Native forbs Bracken Fern, Australian Indigo (<i>Indigofera australis</i>), Blanket Leaf (<i>Bedfordia arborescens</i>), Native Geranium, <i>Polyscias sambucifolia</i> subsp., <i>Crypandra amara</i> var. <i>amara</i> , Grass Trigger plant and Bidgee Widgee. Blackberry was the only exotic species recorded within the community.
Survey effort	Moderate/good – High: one plot (173)
Condition description	The PCT consists largely of granite boulders. Little vegetation is present in the blockstream; however, this lack of cover is natural and it was assigned to the High condition class. Minor occurrences of Blackberry were evident.
Characteristic species used for identification of PCT	Species were not used to identify the PCT.
Justification of evidence used to identify the PCT	The presence of blockstreams was used to justify the presence of the PCT; however, the PCT is located below the 1,300 m elevation limit outlined in VIS. Considered best fit.
Status	Commonwealth EPBC Act: not listed
Estimate of percent cleared value of PCT	0%



Photograph 5.6 **Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion – Plot 173**

Table 5.10 **PCT 650 – Apple Box - Candlebark - Snow Gum shrubby open forest on valley floors, southern South Eastern Highlands Bioregion**

PCT ID	650
Common name	Apple Box - Candlebark - Snow Gum shrubby open forest on valley floors, southern South Eastern Highlands Bioregion
Condition class	Two vegetation zones were mapped within the project area: • Moderate/good – Derived grassland • Moderate/good – Medium The vegetation zone assigned an ancillary code of Derived grassland was not inputted into the calculator as the area of this vegetation zone is less than 0.01 ha.
Extent within Modification 1 project area	0.36 ha (avoidance footprint only)
Description	This communities canopy has some presence of Apple Box (<i>Eucalyptus bridgesiana</i>) and planted Yellow Box (<i>Eucalyptus melliodora</i>). The midstorey comprises of Silver Wattle, <i>Melaleuca</i> sp., Native Blackthorn, Rosemary Grevillea, <i>Leptospermum obovatum</i> and Mountain Mirbelia. Groundcover includes native grasses, rushes and forbs. Grasses recorded include Tall Sedge, Wallaby grass, Weeping Grass (<i>Microlaena stipoides</i>) and <i>Juncus</i> sp. Forb species include <i>Geranium</i> sp., <i>Rumex</i> sp. and <i>Oxalis perennans</i>. This community consisted of exotic ground cover species including Cocksfoot (<i>Dactylis glomerata</i>), Sweet Briar, St John's Wort and Blackberry. This community occurs at the top of Talbingo, adjacent to Talbingo Reservoir.
Survey effort	Moderate/good – Medium: one plot (2281)
Condition description	This PCT is mapped as moderate condition due to disturbance along road edges. Weed invasion is evident within this community.
Characteristic species used for identification of PCT	Apple Box and Silver Wattle were the only two species within the PCT associated with this PCT.
Justification of evidence used to identify the PCT	This PCT was best fit for the community of vegetation, with Candlebark occurring within adjacent areas. The stated distribution is within the Southern Eastern Highlands and Australian Alps Bioregion.
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed
Estimate of percent cleared value of PCT	60%

Table 5.10 PCT 650 – Apple Box - Candlebark - Snow Gum shrubby open forest on valley floors, southern South Eastern Highlands Bioregion



Photograph 5.7 Apple Box - Candlebark - Snow Gum shrubby open forest on valley floors, southern South Eastern Highlands Bioregion – Plot 2281

Table 5.11 PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion description

PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	
PCT ID	729
Common name	Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion
Condition class	Four vegetation zones were mapped within the project area:: • Moderate/good – Derived grassland • Moderate/good – Poor • Moderate/good – Medium • Moderate/good – High
Extent within Modification 1 project area	10.36 ha (6.62 ha in disturbance footprint and 3.74 ha in avoidance footprint)

Table 5.11 PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion description

PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion

Description	Candlebark (<i>Eucalyptus rubida</i>), Broad-leaved Peppermint and Robertsons Peppermint dominate this community. The midstorey comprises of Common Fringe-myrtle, Hoary guinea, Mountain Banksia, Native Blackthorn, <i>Cassinia longifolia</i>, Dwarf Cherry, Wedge-leaved Wattle, Silver wattle, Daphne Heath, Pink Beard Heath (<i>Leucopogon ericoides</i>) and Showy Parrot Pea (<i>Dillwynia sericea</i>). Ground cover comprising of native forbs, sedges, rushes and grasses. Native grasses include Kangaroo Grass, Snowgrass, and <i>Dichelachne rara</i>. Native forbs, rushes and sedges recorded include Scaly Buttons (<i>Leptorhynchus squamatus</i>), Raspwort, Poverty Raspwort (<i>Gonocarpus tetragynus</i>), Stinking Pennywort, Bears-ear (<i>Cymbonotus lawsonianus</i>), <i>Oxalis perennans</i>, Rough Bedstraw (<i>Galium gaudichaudii</i>), Tall Bluebell, Creeping Cudweed (<i>Euchiton japonicas</i>), Honeypots (<i>Acrotriche serrulata</i>), Small St Johns Wort, Wattle Mat-rush, Mat-rush (<i>Lomandra confertifolia</i>) and <i>Juncus usitatus</i>. A number of exotic species were recorded including Delicate Hairgrass, Common Centaury, St John's Wort, Catsear, Sweet Briar and Haresfoot Clover (<i>Trifolium arvense</i>). This community is mapped on lower slopes, adjacent to and in Lobs Hole. Occurs on fairly open sites on loam/clay soils.
Survey effort	Moderate/good – Derived grassland: three plots (1017, 1045, 3177) Moderate/good – Poor: one plot (3213) Moderate/good – Medium: three plots (1025, 1047, 2268) Moderate/good – High: four plots (3005, 3171, 3187, 5210)
Condition description	Areas assigned to the High condition class occur on the southern side of Lobs Hole, in areas where clearing has likely been less extensive and regeneration is more advanced, and thus most strata are present and disturbance is less evident. Areas assigned to the Medium, Poor, Other and Derived Grassland condition classes are located on the northern side the Yarrangobilly River and have been subject to varying levels of disturbance. Areas assigned to Derived Grassland and Other condition classes have been subject to clearing, with varying levels of regeneration (limited to nil respectively). These areas show a largely native midstorey and groundcover. A small area in Poor condition has significant weed invasion. Areas in Medium condition have a mature overstorey, but shows moderate levels of disturbance, with some strata limited.
Characteristic species used for identification of PCT	According to the NSW VIS Classification Version 2.1, the canopy layer species recorded within this community align with the dominant species listed as characteristic for this PCT. These include Candlebark, Robertson's Peppermint and Broad-leaved Peppermint. Aligning midstorey species include Daphne Heath, <i>Cassinia longifolia</i> and Silver Wattle. Understorey species that were used as an identifying species include Snowgrass and <i>Dichelachne rara</i>.
Justification of evidence used to identify the PCT	Apart from species composition, the stated distribution within the South Eastern Highland and Australian Alps IBRA Bioregions, and the location on fairly open sites on loam/clay soils, positioned on exposed, lower slopes is consistent with NSW VIS Classification Version 2.1.
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed
Estimate of percent cleared value of PCT	35%

Table 5.11 **PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion description**

PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion



Photograph 5.8 **Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion – Plot 3005**

Table 5.12 **PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion description**

PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion

PCT ID	953
Common name	Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion
Condition class	A single vegetation zones was mapped within the project area: • Moderate/good – High

Table 5.12 PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion description

PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion

Extent within Modification 1 project area	10.9 ha (disturbance footprint only)
Description	The canopy is composed of Mountain Gum (<i>Eucalyptus dalrympleana</i>), Snowy Gum (<i>Eucalyptus pauciflora</i>) and Broad-leaved Peppermint with occasional Robertson's peppermint. The midstorey mainly consists of Silver Wattle, Red-leaved Wattle (<i>Acacia rubida</i>), Daphne Heath, <i>Cassinia longifolia</i>, <i>Cassinia uncata</i>, <i>Daviesia latifolia</i>, Dwarf Cherry, Pink-tip Daisy-bush (<i>Olearia erubescens</i>), Common Shaggy Pea (<i>Oxylobium ellipticum</i>), <i>Daviesia mimosoides</i> subsp. <i>mimosoides</i> and Handsome Flat Pea (<i>Platylobium formosum</i>). Ground cover comprises of native forbs, rushes, grasses and ferns. Native forbs include Prickly Woodruff, <i>Glycine clandestina</i>, <i>Senecio gunnii</i>, <i>Stackhousia monogyna</i>, Grass Trigger-plant (<i>Stylidium graminifolium</i>) and Native Violet. Other ground stratum species include Spiny-head Mat-rush (<i>Lomandra longifolia</i>), Mountain Geebung (<i>Persoonia chamaepitys</i>) and Common Bracken (<i>Pteridium esculentum</i>). This community occurs as an open forest with shrubby understorey, occurring within montane areas mainly west of Wallace's Creek Fire Trail and a small patch along Lobs Hole Ravine Road.
Survey effort	Moderate/good – High: one plot (5206)
Condition description	This PCT is generally in High condition within the Exploratory Works modification project area, with large old trees present. Minimal disturbance is evident within the areas mapped west of Wallace's Creek Fire trail. Along Lobs Hole Ravine Road there are areas
Characteristic species used for identification of PCT	According to the NSW VIS Classification Version 2.1, the canopy layer species just fi recorded within this community align with dominant species listed as characteristic for this PCT. These include Mountain Gum, Snowy Gum and Broad-leaved Peppermint.
Justification of evidence used to identify the PCT	Along with the species composition, the stated distribution is within the South Eastern Highlands and Australian Alps Bioregions.
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed
Estimate of percent cleared value of PCT	5%

Table 5.12 PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion description

PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion



Photograph 5.9 Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion – Plot 5206

Table 5.13 PCT 999 – Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion description

PCT 999 – Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion

PCT ID	999
Common name	Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion
Condition class	Two vegetation zones were mapped within the project area: • Moderate/good – Derived grassland • Moderate/good – High
Extent within Modification 1 project area	1.01 ha (0.64 ha in disturbance footprint and 0.36 ha in avoidance footprint)

Table 5.13 PCT 999 – Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion description

PCT 999 – Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion

Description	Nortons Box, and Broad-leaved Peppermint and dominate canopy within this community. The midstorey comprises of Common Fringe-myrtle , Hoary guinea flower, Native Blackthorn, <i>Cassinia longifolia</i>, <i>Cassinia aculeate</i> subsp. <i>aculeate</i>, <i>Cassytha pubescens</i>, <i>Pimelea curviflora</i> var. <i>sericea</i>, Dwarf Cherry, Silver Wattle, Daphne Heath, <i>Leucopogon virgatus</i> and Showy Parrot Pea. Ground cover comprising of native forbs, sedges, rushes and grasses. Native grasses include Kangaroo Grass, Snowgrass, Plumegrass Smooth-flower Wallaby Grass (<i>Rytidosperma pilosum</i>) and <i>Austrostipa scabra</i> subsp. <i>falcate</i>. Native forbs, rushes and sedges recorded include Poverty Raspwort, Australian indigo, <i>Dianella longifolia</i> var. <i>longifolia</i>, <i>Cheilanthes sieberi</i>, Native Carrot (<i>Daucus glochidiatus</i>), Tufted Bluebell (<i>Wahlenbergia communis</i>), Tall Bluebell, Wattle Mat-rush, <i>Lepidosperma laterale</i>, Blue Flax Lily (<i>Dianella revolute</i> var. <i>revolute</i>) and Native Geranium. A number of exotic species were recorded including Delicate Hairgrass, Common Centaury, and St Johns Wort. This community is mapped on the lower reaches of Lobs Hole Ravine Road, on fairly shallow red brown soils with a loamy clay to silt clay texture.
Survey effort	Moderate/good – Derived grassland: One plot (218) Moderate/good – High: three plots (2020, 3018, 3035)
Condition description	This community was assigned to two condition class. Areas mapped as High have a largely intact strata, while areas of Derived Grassland have had the overstorey cleared due to an electricity easement. This has resulted in differences in cover of various species.
Characteristic species used for identification of PCT	According to the NSW VIS Classification Version 2.1, the canopy layer species recorded within this community align with the dominant species listed as characteristic for this PCT. These include Nortons Box and Broad-leaved Peppermint; the lack of Red Stringybark was used to differentiate this from PCT 311. Aligning midstorey species include Common Fringe-myrtle and <i>Cassinia longifolia</i> while understorey species that were used as an identifying species include Snowgrass, <i>Austrostipa scabra</i> subsp. <i>falcate</i>, <i>Dianella longifolia</i> var. <i>longifolia</i>, Native Geranium and Kangaroo Grass.
Justification of evidence used to identify the PCT	Apart from species composition, the stated distribution is within the South Eastern Highland IBRA Bioregion and with a landscape position on lower slopes and valleys.
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed
Estimate of percent cleared value of PCT	15%

Table 5.13 PCT 999 – Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion description

PCT 999 – Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion



Photograph 5.10 Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion – Plot 2020

Table 5.14 PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion description

PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion

PCT ID	1191
Common name	Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion
Condition class	Two vegetation zones were mapped within the project area: • Moderate/good – High • Moderate/good – Derived grassland

Table 5.14 PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion description

PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion

Extent within Modification 1 project area	0.49 ha (0.47 in disturbance footprint and 0.02 ha in avoidance footprint)
Description	This communities canopy is dominated by Snow Gum, Candlebark and Black Sally. The midstorey consists of Blackwood, Native Blackthorn, Dwarf Cherry, Mountain Banksia, Hoary Guinea Flower and Narrow-leaf Hop-bush. Ground cover predominantly consists of native grasses and forbs. Native grasses include <i>Themeda australis</i>, Bog Snowgrass, Tall sedge, Wattle Matt-rush, Spiny-headed Mat-rush and Many-flowered Mat-rush. Forb species within this community include Poverty Raspwort, Stinking Pennywort, Kidney Weed, Small St John's Wort, Sheep's Burr, Austral Bugle (<i>Ajuga australis</i>), Prickly Starwort and Native Violet.. A number of exotic species were recorded including Sweet Briar, Blackberry, St Johns Wort, Sheep Sorrel and Catsear. This community occurs at the edge of Talbingo Reservoir within open forest, occurring on footslopes.
Survey effort	Moderate/good – Derived grassland: one plot (1009) Moderate/good – High: one plot (2276)
Condition description	This communities condition was recorded as moderate/good with a high ancillary code within the project area. These areas are in relatively good condition, with minimal disturbance from weeds. Areas mapped with a derived grassland ancillary code occur beneath powerlines and near road edges. These areas are in relative good condition, lacking canopy species.
Characteristic species used for identification of PCT	According to the NSW VIS Classification Version 2.1, the canopy species recorded within this community align with the dominant species listed as characteristic for this PCT. These include Snow Gum, Candlebark, Black Sally, Blackwood, <i>Themeda australis</i>, Hoary Guinea Flower and Kidney Weed.
Justification of evidence used to identify the PCT	Apart from species composition, the stated distribution within the South Eastern Highland and Australian Alps IBRA Bioregions is consistent with the NSW VIS Classification Version 2.1. Additionally PCT 1191 often occurs on forest-hollow flats and footslope between 600 and 1100 m. The bottom of Lobs Hole, where this PCT occurs, is within the elevation range for this PCT.
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed
Estimate of percent cleared value of PCT	95%

Table 5.14 PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion description

PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion



Photograph 5.11 Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion – Plot 2276

Table 5.15 PCT 1196 – Snow Gum – Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion

PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion

PCT ID	1196
Common name	Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion
Condition class	Two vegetation zones were mapped within the project area: • Moderate/good – Derived grassland • Moderate/good – High The vegetation zone assigned an ancillary code of Derived grassland was not inputted into the calculator as the area of this vegetation zone is less than 0.01 ha.
Extent within Modification 1 project area	0.72 ha (0.61 ha in disturbance footprint and 0.11 ha in avoidance footprint)

Table 5.15 PCT 1196 – Snow Gum – Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion

PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion

Description	Mountain Gum and Snow Gum, dominate the canopy within this community. There is a diverse midstorey comprising of, <i>Daviesia ulicifolia</i>, <i>Daviesia mimosoides</i> subsp. <i>mimosoides</i>, <i>Platylobium formosum</i> subsp. <i>formosum</i>, Dolly Bush, Mountain Hickory (<i>Acacia obliquinerva</i>), Slender Rice-flower (<i>Pimelea linifolia</i> var. <i>linifolia</i>), Creamy Candles (<i>Stackhousia monogyna</i>), River Lomatia, Coffee Berry (<i>Coprosma hirtella</i>), Dwarf Cherry, Leaf Bossiaea (<i>Bossiaea foliosa</i>) and Blackwood. Ground cover comprising of native forbs, sedges, rushes and grasses. Native grasses include Snowgrass, <i>Poa induta</i> and Tussock. Native forbs, rushes and sedges recorded include Native Violet, Prickly Starwort (<i>Stellaria pungens</i>), Variable Glycine, Native Geranium, Small Poranthera (<i>Poranthera microphylla</i>), Trailing Speedwell (<i>Veronica plebeia</i>), Spiny-headed Mat-rush, Common Woodruff, Native Violet, Grass Trigger plant, <i>Acaena agnipila</i>, Bulbine Lily, Swamp Dock (<i>Rumex brownii</i>), <i>Senecio gunnii</i>, Alpine Shaggy Pea (<i>Podolobium alpestre</i>), Mountain Caladenia (<i>Caladenia alpine</i>), Common Buttercup (<i>Ranunculus lappaceus</i>), Slender Woodruch (<i>Luzula atrata</i>), Old Man's Beard (<i>Clematis aristata</i>), <i>Lomandra filiformis</i> subsp. <i>coriacea</i>, <i>Brachyscome spathulata</i> and Bidgee Widgee. Exotic species such as Catsear, White Clover (<i>Trifolium repens</i>) and Blackberry were recorded within the community. This community occurs as a tall shrubby forest, and is found on the upper slopes and ridges along Lobs Hole Ravine Road to around 1,200 m. Found on brown to dark brown soils with a loamy clay texture. Depth of the soils varies between medium to deep.
Survey effort	Moderate/good – Derived grassland: two plots (2219, 2249) Moderate/good – High: one plot (157)
Condition description	This PCT is generally in High condition within the Exploratory Works project area, with large old trees present and minimal disturbance evident. An area, previously cleared beneath the powerline and to be used as a laydown area, is mapped in Derived grassland condition.
Characteristic species used for identification of PCT	According to the NSW VIS Classification Version 2.1, the canopy layer species recorded within this community align with the dominant species listed as characteristic for this PCT. These include Mountain Gum and Snow Gum. Aligning midstorey species include <i>Daviesia ulicifolia</i>, <i>Daviesia mimosoides</i> subsp. <i>mimosoides</i>, <i>Platylobium formosum</i> subsp. <i>formosum</i> and Coffee Berry. While understorey species that were used as an identifying species include Snowgrass, Prickly Starwort, Bidgee Widgee, <i>Senecio gunnii</i>, Small Poranthera, Spiny-headed Mat-rush, Native Violet and <i>Brachyscome spathulata</i>.
Justification of evidence used to identify the PCT	Apart from species composition, the stated distribution is within the South Eastern Highland and Australian Alps IBRA Bioregions and landscape position along the upper slopes and ridges of Lobs Hole Ravine Road is consistent with NSW VIS Classification Version 2.1.
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed Justification: This VIS states that this PCT forms part of the Tablelands Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions EEC. Due to the lack of grassy understory throughout this woodland it is not considered to align with the threatened ecological communities above.
Estimate of percent cleared value of PCT	5%

Table 5.15 **PCT 1196 – Snow Gum – Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion**

PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion



Photograph 5.12 **Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion – Plot 157**

Table 5.16 **PCT 1224 – Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion description**

PCT 1224 – Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion

PCT ID	1224
Common name	Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion

Table 5.16 PCT 1224 – Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion description

PCT 1224 – Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion

Condition class	A single vegetation zones was mapped within the project area: Moderate/good – High
Extent within Modification 1 project area	.015 ha (disturbance area only)
Description	This community includes a high number of native midstorey and ground cover species. The midstorey consists predominantly of <i>Hakea microcarpa</i>, <i>Acrothamnus hookeri</i>, Hairy Anchor Plant (<i>Discaria pubescens</i>) and Slender Rice Flower (<i>Pimelea linifolia</i>). This community has a diverse ground cover comprising of native forbs and grasses. Native forbs include Bidgee-widgee, <i>Acaena ovina</i>, Native Violet, Common Woodruff, <i>Geranium solanderi</i>, Small St. John's Wort and Prickly Starwort. Native grasses include <i>Carex breviculmis</i>, Granite Buttercup (<i>Ranunculus graniticola</i>), <i>Luzula sp.</i>, <i>Dichelachne sp.</i>, Kangaroo Grass, Wheatgrass, <i>Poa sieberiana</i> and <i>Dichelachne rara</i>. Exotic species were recorded within the community include Sweet Vernal Grass (<i>Anthoxanthum odoratum</i>), Smooth Hawksbeard (<i>Crepis capillaris</i>), Spear Thistle (<i>Cirsium vulgare</i>) and Sheep Sorrel. This community is mapped within broad, flat valley bottoms in montane to sub-alpine areas within the Exploratory Works modification project area.
Survey effort	Moderate/good – High: one plot (3115)
Condition description	This community's condition was recorded as moderate/good – high within the study area. This community occurs adjacent to Tantangara reservoir and has minimal disturbance with largely intact strata.
Characteristic species used for identification of PCT	According to the NSW VIS Classification Version 2.1, the midstorey and groundcover species recorded within this community align with the dominant species listed as characteristic for this PCT. Aligning midstorey species include <i>Hakea microcarpa</i> , <i>Acrothamnus hookeri</i> and Slender Rice Flower. Ground cover species include <i>Carex breviculmis</i> and Granite Buttercup.
Justification of evidence used to identify the PCT	This PCT occurs on broad, flat valley bottoms in montane to sub-alpine areas. The community occurs adjacent to Tantangara Reservoir above 1200 m. The stated distribution is within the IBRA Bioregions of NSW Australian Alps and South Eastern Highlands, consistent with the identification of the PCT. The characteristic species, as listed above, are consistent with the PCT.
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed
Estimate of percent cleared value of PCT	5%

Table 5.16 PCT 1224 – Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion description

PCT 1224 – Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion



Photograph 5.13 Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion – Plot 3115

5.3.4 Assessment of patch size

For each vegetation zone within the Modification 1 disturbance footprint, patch size was assessed using a select process in ArcGIS, using existing vegetation mapping and aerial imagery. All intact native vegetation separated by a distance of less than 100m (woody vegetation ecosystems) or 30 m (non-woody vegetation ecosystems) was mapped sequentially.

This process showed that vegetation within the modification project area forms part of large patches of connecting vegetation throughout KNP, with patch sizes of greater than 100 ha. This patch size was used in the calculator.

5.3.5 Vegetation integrity score

The vegetation integrity score for each vegetation zone is provided in Table 5.17.

Table 5.17 **Vegetation integrity scores for all vegetation zones mapped within the Modification 1 disturbance footprint and avoidance footprint**

Plant community type	Condition	Ancillary code	Vegetation integrity score
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	Moderate/good	Derived grassland	40.4
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	Moderate/good	Medium	67.5
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	Moderate/good	High	67.5
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 western Kosciuszko escarpment	Moderate/good	Derived grassland	4.5
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 western Kosciuszko escarpment	Moderate/good	Poor	71.7
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 western Kosciuszko escarpment	Moderate/good	Other	37.7
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 western Kosciuszko escarpment	Moderate/good	Medium	56.2
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 western Kosciuszko escarpment	Moderate/good	High	68.2
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	Low	-	1.8
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	Moderate/good	Derived Grassland	61
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	Moderate/good	Poor	0.1
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	Moderate/good	Other	68.3

Table 5.17 **Vegetation integrity scores for all vegetation zones mapped within the Modification 1 disturbance footprint and avoidance footprint**

Plant community type	Condition	Ancillary code	Vegetation integrity score
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	Moderate/good	Medium	66.4
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	Moderate/good	High	37.4
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	Moderate/good	Other	32.1
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	Moderate/good	Derived grassland	22.8
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	Moderate/good	Medium	56.9
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	Moderate/good	High	77.3
PCT 643 – Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion	Moderate/good	High	9.2
PCT 650 – Apple Box - Candlebark - Snow Gum shrubby open forest on valley floors, southern South Eastern Highlands Bioregion	Moderate/good	Medium	26.6
PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	Moderate good	Derived grassland	31.1
PCT 729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	Moderate/good	Poor	0.6
PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	Moderate good	Medium	72.9
PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	Moderate good	High	87.4
PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	Moderate/good	High	89.7

Table 5.17 **Vegetation integrity scores for all vegetation zones mapped within the Modification 1 disturbance footprint and avoidance footprint**

Plant community type	Condition	Ancillary code	Vegetation integrity score
PCT 999 – Norton’s Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	Moderate/good	Derived grassland	38.3
PCT 999 – Norton’s Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	Moderate/good	High	60.7
PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	Moderate/good	Derived grassland	31.5
PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	Moderate/good	High	85.3
PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	Moderate/good	High	83.4
PCT 1224 – Sub alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	Moderate/good	High	86.4

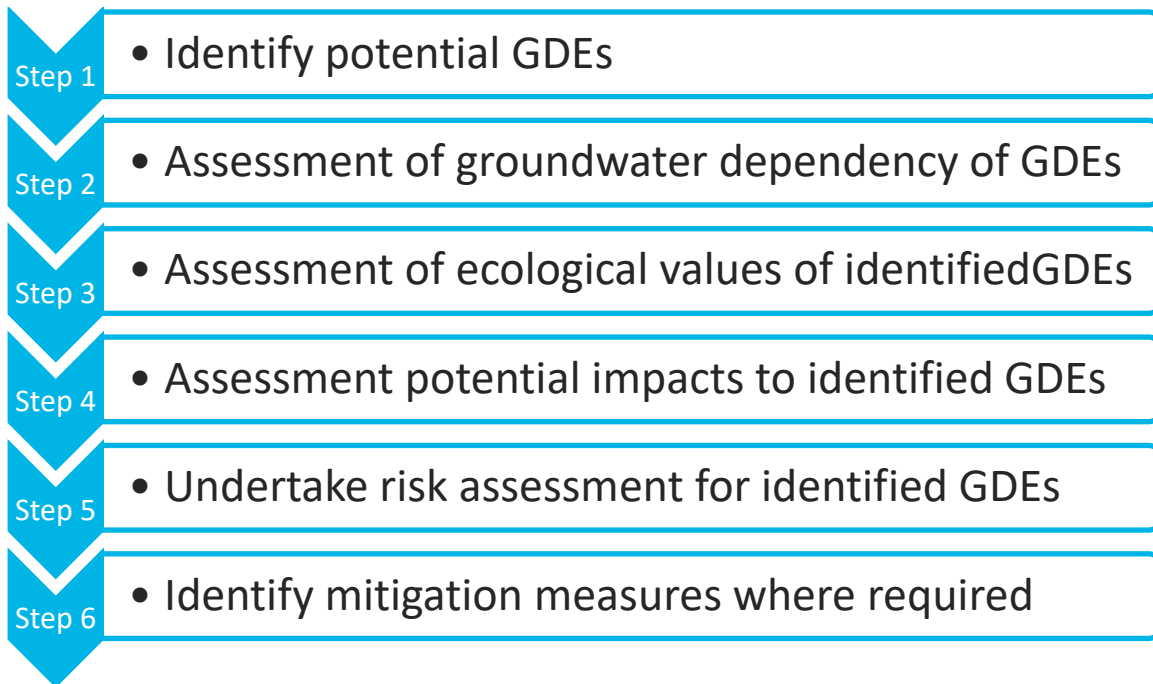
An offset is not required for impacts on native vegetation for the following vegetation zones as the vegetation integrity score is below 17 (the PCT is associated with threatened species habitat but is not an endangered or critically endangered ecological community):

- 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 western Kosciuszko escarpment (Moderate/good – Derived grassland);
- 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 (Low);
- 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 (Moderate/good – Poor);
- PCT 643 – Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion (Moderate/good – High); and
- PCT 729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion (Moderate/good – Poor).

All other PCTs require offsets in accordance with Section 10.3 of the BAM (OEH 2017).

5.4 Groundwater dependent ecosystems

A groundwater dependent ecosystem (GDE) risk assessment has been completed in accordance with the NSW Government *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (Serov et al. 2012). This assessment follows the process detailed below:



5.4.1 Identification of potential GDEs

Ecosystems that could rely on either the surface or subsurface expression of groundwater within or surrounding the Modification 1 project area are those associated with:

- creeks where deep groundwater is discharging and provides baseflow. This includes the Yarrangobilly River and some drainage lines in the northern and western areas of the project area;
- shallow (perched) groundwater systems;
- springs associated with the steep escarpment across the eastern extent of the Modification 1 project area; and
- terrestrial vegetation overlying shallow groundwater (within the vegetation's root zone).

These ecosystems have been classified into three categories according to their dependence on groundwater:

- non-dependent;
- facultative;
- entirely dependent/obligate:
 - opportunistic;

- proportional; and
- highly dependent.

Considerations in evaluating PCTs and their potential dependency on groundwater included:

- the physiology of plant species that occur in that community and their likely dependence on water availability;
- the PCTs location in the landscape; and
- if the rooting depth of vegetation would be able to take up groundwater based on likely depth of the aquifer and soil characteristics.

Access to the groundwater is dependent on a number of factors with the core factor being the depth to the water table. As terrestrial vegetation communities are composed of a range of vegetation types with a range of rooting depths and strategies there is a relationship between groundwater depth and the types and composition of the vegetation that is able to access it (Serov P 2013).

i Potential GDEs

Table 5.18 Terrestrial GDE assessment

Plant community type	Area (ha) in disturbance footprint	Assigned category of groundwater dependency	Justification
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	0.11	Facultative	This PCT occurs broadly across the survey area, on mid to lower slopes, including in some areas where groundwater is less than 5 m deep. This community does not occur in areas where groundwater flows are likely to be concentrated, such as riparian areas or gullies. A conservative assessment has been undertaken and it is assumed that this PCT has a facultative reliance on groundwater, with some dependence on groundwater inflows to maintain structure and function.
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 western Kosciuszko escarpment	1.67	Non-dependent	This community does not occur in areas of shallow groundwater.
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	1.61	Entirely/obligate - proportional	This community is located in alluvial and colluvial soils along the Yarrangobilly River. The watercourses in the project area are generally gaining streams, where the base of a stream is lower in elevation than the surrounding water table, and the stream can gain water from groundwater inflow (ie baseflow). Based on this, the vegetation along this zone is likely to be entirely/obligate groundwater dependent, with an opportunistic dependency where the PCT gets some of its water requirements via groundwater, but can exist without the input of groundwater, as long as there is no prolonged drought.
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	0.31	Non-dependent	This PCT occurs broadly across the survey area, often in association with frost hollows. This community does not occur in areas of shallow groundwater.
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	0.09	Non-dependent	This community does not occur in areas of shallow groundwater.

Table 5.18 Terrestrial GDE assessment

Plant community type	Area (ha) in disturbance footprint	Assigned category of groundwater dependency	Justification
PCT 643 – Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion	0.01	Non-dependent	This community does not occur in areas of shallow groundwater.
PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	6.62	Non-dependent	This community does not occur in areas of shallow groundwater.
PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	1.09	Non-dependent	This community does not occur in areas of shallow groundwater.
PCT 999 – Norton’s Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	0.64	Non-dependent	This community does not occur in areas of shallow groundwater.
PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	0.47	Non-dependent	This community does not occur in areas of shallow groundwater.
PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	0.61	Non-dependent	This community does not occur in areas of shallow groundwater.
PCT 1224 – Sub alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	0.15	Non-dependent	This community does not occur in areas of shallow groundwater.

5.4.2 Final risk assessment for identified GDEs

A detailed assessment of potential groundwater impacts is provided in EMM (2018). In line with this assessment, the GDEs present in the project area and the impacts arising from the project, the overall risk assessment, prepared in accordance with Serov et al. (2012), GDEs are considered as having high ecological value/low risk of impact (category A).

The mitigation measures required by Serov et al. (2012) for this risk level include:

- protection measures for aquifer and GDEs;
- continue protection measures for aquifers and GDEs;
- undertake baseline risk monitoring;
- undertake periodic monitoring and assessment; and
- continue monitoring as a part of adaptive management.

Management and monitoring of groundwater is outlined in EMM (2018).

6 Threatened species

6.1 Fauna habitat assessment

A fauna habitat assessment is provided in EMM (2018). Fauna habitat within the Modification 1 project area is largely consistent with this assessment, except for areas adjacent to Tantangara Reservoir.

Vegetation along the waters edge of Tantangara Reservoir mainly consists of grasslands and adjacent grassy woodlands. No tree cover is present within the project area, with adjacent vegetation providing low tree cover largely of species such as Black Sally. In some areas a moderate midstorey is present. Groundcover consists of tussock grasses, with limited large logs, coarse woody debris or leaf litter. These areas have been impacted by recreational use, and show moderate weed cover, and erosion due to use of the area by recreational vehicles.

6.2 Ecosystem credit species assessment

A list of ecosystem credit species predicted to occur within the Modification 1 project area, based on the PCTs present and generated by the calculator associated within the BAM (OEH 2017) is provided in Table 6.1. The potential for these species to occur within the Modification 1 disturbance footprint was assessed in accordance with Section 6.2 of the BAM (OEH 2017).

Table 6.1 **Assessment of ecosystem credit species within the Modification 1 disturbance footprint**

Scientific name	Common name	Justification for exclusion
<i>Anthochaera phrygia</i>	Regent Honeyeater (Foraging)	Excluded from cleared vegetation zones (condition class Low or Derived grassland).
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	Excluded from cleared vegetation zones (condition class Low or Derived grassland).
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo (Foraging)	Excluded from cleared vegetation zones (condition class Low or Derived grassland).
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo (Foraging)	Excluded from cleared vegetation zones (condition class Low or Derived grassland).
<i>Chthonicola sagittata</i>	Speckled Warbler	Excluded from cleared vegetation zones (condition class Low or Derived grassland).
<i>Circus assimilis</i>	Spotted Harrier	Not excluded.
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	Excluded from cleared vegetation zones (condition class Low or Derived grassland).
<i>Daphoenositta chrysoptera</i>	Varied Sittella	Excluded from cleared vegetation zones (condition class Low or Derived grassland).
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	Not excluded.
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	Excluded from cleared vegetation zones (condition class Low or Derived grassland).
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (Foraging)	The White-bellied Sea-eagle feeds on fish and freshwater turtles, but also waterbirds, reptiles, mammals and carrion, using a perch near water. Species excluded from all PCTs not associated with the Yarrangobilly River, Talbingo Reservoir or Tantangara Reservoir (all PCTs except PCTs 296, 300, 302, 303, 1191 and 1224) and from cleared vegetation zones (condition class Low or Derived grassland).
<i>Hieraaetus morphnoides</i>	Little Eagle (Foraging)	Not excluded.
<i>Lophoictinia isura</i>	Square-tailed Kite (Foraging)	Not excluded.
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	Excluded from Low condition vegetation zones.
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat (Foraging)	Excluded from cleared vegetation zones (condition class Low or Derived grassland).
<i>Neophema pulchella</i>	Turquoise Parrot	Not excluded.
<i>Ninox connivens</i>	Barking Owl (Foraging)	Not excluded.
<i>Ninox strenua</i>	Powerful Owl (Foraging)	Excluded from cleared vegetation zones (condition class Low or Derived grassland).

Table 6.1 Assessment of ecosystem credit species within the Modification 1 disturbance footprint

Scientific name	Common name	Justification for exclusion
<i>Pachycephala olivacea</i>	Olive Whistler	Excluded from cleared vegetation zones (condition class Low or Derived grassland).
<i>Petaurus australis</i>	Yellow-bellied Glider	Excluded from cleared vegetation zones (condition class Low or Derived grassland) due to lack of hollow bearing trees.
<i>Petroica boodang</i>	Scarlet Robin	Excluded from Low condition vegetation zones.
<i>Petroica phoenicea</i>	Flame Robin	Excluded from Low condition vegetation zones.
<i>Phascolarctos cinereus</i>	Koala (Foraging)	Excluded from all PCTs as the species is rare in KNP and no evidence was observed during targeted surveys.
<i>Stagonopleura guttata</i>	Diamond Firetail	Not excluded.
<i>Suta flagellum</i>	Little Whip Snake	Not excluded.
<i>Tyto novaehollandiae</i>	Masked Owl (Foraging)	Excluded from cleared vegetation zones (condition class Low or Derived grassland).
<i>Varanus rosenbergi</i>	Rosenberg's Goanna	Not excluded.

6.3 Species credit species assessment

6.3.1 Habitat constraints assessment (Step 2)

An assessment of habitat constraints for threatened species was undertaken in accordance with Step 2 of Section 6.4 of the BAM (OEH 2017). For those threatened species predicted to occur, for which habitat constraints are listed, an assessment was undertaken of the presence of the habitat features within the Modification 1 disturbance footprint.

The species generated by the calculator with habitat constraints, as well as the results of the habitat constraints assessment, are shown in Table 6.2.

Table 6.2 **Assessment of habitat constraint features within the Modification 1 survey area**

Scientific name	Common name	Feature	Sensitivity to gain class	Habitat constraint present in development site	Justification
<i>Grevillea iaspicula</i>	Wee Jasper Grevillea	Confined to an area between 0 and 10 km west of the Goodradigbee River and extending 5 km to the south and 15 km to the north of Wee Jasper	High	No	The modification survey area is not located in any of the areas identified in the calculator.
<i>Litoria spenceri</i>	Spotted Tree Frog	- Waterbodies - River environments with rocky habitat or with 500 m of rocky river	Very high	Yes	The survey area contains waterbodies and river environments with rocky habitat.
<i>Myotis macropus</i>	Southern Myotis	- Hollow bearing trees - Within 200 m of riparian zone - Bridges, caves or artificial structures within 200 m of riparian zone	High	Yes	The project area contains hollow bearing trees with parts of the project area are located within 200 m of a riparian zone.
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	Hollow bearing trees	High	Yes	The project area contains hollow bearing trees.
<i>Pomaderris cotoneaster</i>	Cotoneaster Pomaderris	South of northern Kosciuszko National Park boundary	High	Yes	The project area is located to the south of the northern boundary of KNP.
<i>Pseudophryne pengilleyi</i>	Northern Corroboree Frog	Above 700 m above sea level (ASL)	Very high	Yes	The majority of the modification is located above 700 m ASL.
<i>Thesium australe</i>	Austral Toadflax	Kosciuszko National Park	Moderate	Yes	The project area is located within KNP.

Using the process outlined in Step 2 of Section 6.4 of the BAM (OEH 2017) only one species, Wee Jasper Grevillea, was excluded from requiring further consideration. No further assessment is required as per Section 6.4.1.13 of the BAM (OEH 2017).

The Leafy Anchor Plant, Spotted Tree Frog, Southern Myotis, Brush-tailed Phascogale, Cotoneaster Pomaderris, Northern Corroboree Frog and Austral Toadflax have not been excluded on the basis of the identified habitat constraints. Further consideration is given to these species in Section 6.3.2.

6.3.2 Identifying candidate species credit species for further assessment (Step 3)

To develop a list of species credit species for further assessment, an assessment was undertaken in accordance with Step 3 of Section 6.4 of the BAM (OEH 2017), as shown in Table 6.3.

Table 6.3 **Species credit species and status and habitat suitability assessment**

Scientific name	Common name	Candidate species	Justification
Flora			
<i>Euphrasia scabra</i>	Rough Eyebright	No	Rough Eyebright occurs in or at the margins of swampy grassland or in sphagnum bogs, often in wet, peaty soil. The species appears to be self-fertilising but seed production is variable, perhaps depending on season. There are three known populations in NSW: Bondi State Forest, South East Forests National Park and near Nunnock Swamp. The modification project area does not contain suitable habitat for this species, therefore it is unlikely to occur.
<i>Pomaderris cotoneaster</i>	Cotoneaster Pomaderris	Yes	Cotoneaster Pomaderris has a very disjunct distribution, being known from the Nungatta area, northern KNP (near Tumut). 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. Although unlikely to occur, based on the species geographic distribution, the survey area contains forest and rocky forested slopes that are considered suitable habitat to support this species based on the limited understanding of the species ecology.
<i>Pterostylis foliata</i>	Slender Greenhood	Yes	The Slender Greenhood grows in eucalypt forests amongst an understorey of shrubs, ferns and grasses. It's known to occur on loam or clay loam soils, found on sheltered slopes. The species is endemic to south-eastern Australia. This species was not predicted to occur but was added manually. Species was recorded within the Modification 1 disturbance footprint.
<i>Thesium australe</i>	Austral Toadflax	Yes	Austral Toadflax occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast, often in association with Kangaroo Grass and often in wet areas. This species is a root parasite that takes water and some nutrients from other plants, especially Kangaroo Grass. This species is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands region. Most PCTs within the Modification 1 survey area are unlikely to support this species, as they are shrubby and lack moist areas. Suitable damp, grassy woodland habitat likely to be restricted to PCT 285 and damp areas of PCT 1196 within the project area.

Table 6.4 Species credit species and status and habitat suitability assessment

Scientific name	Common name	Candidate species	Justification
Fauna			
<i>Anthochaera phrygia</i>	Regent Honeyeater (Breeding)	No	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. The species particularly favours Box-Ironbark woodland, and riparian forests of River Sheoak. Woodlands with significantly large numbers of mature trees with high canopy cover and abundance of mistletoe are favoured. The modification project area does not support suitable breeding habitat for this species and is not located within mapped important areas.
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo (Breeding)	Yes	In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Nests are located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts. The modification project area contains suitable breeding habitat to support this species.
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo (Breeding)	No	The Glossy Black-cockatoo inhabits coastal woodlands and drier forest areas, open inland woodlands, or timbered watercourses where its main food source, the casuarina (she-oak) is common. The species prefers to nest in hollows of large, old eucalypt trees, alive or dead, typically around 3 to 30 metres above the ground. The current known distribution within NSW covers areas from the coast to the tablelands, and as far west as the Riverina and Pilliga Scrub. The modification project area does not support suitable breeding habitat with dominant She-oak (<i>Allocasuarina</i> spp.). The species is not known to occur within the project area.
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	Yes	The Eastern Pygmy-possum is found in a broad range of habitats from rainforest through sclerophyll forest and woodland to heath, but in most areas woodlands and heath appear to be preferred. Feeds largely on nectar and pollen collect from banksias, eucalypts and bottlebrushes. Also feeds on insects throughout the year. This feed source may be more important in habitats where flowers are less abundant such as wet forests. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (<i>Pseudocheirus peregrinus</i>) dreys or thickets of vegetation (eg grass-tree skirts). Nest-building appears to be restricted to breeding females. Tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks. The modification project area supports suitable habitat for this species.

Table 6.4 Species credit species and status and habitat suitability assessment

Scientific name	Common name	Candidate species	Justification
<i>Cyclodomorphus praealtus</i>	Alpine She-oak Skink	Yes	The Alpine She-oak Skink is found in treeless or very lightly treed areas that contain tussock grasses, low heath or a combination of both. The species preferences areas with litter, rocks, logs and other ground debris to use as shelter. Within NSW it has been observed in alpine to sub-alpine grasslands in flat to gently sloping areas. This species was not predicted to occur, but was added manually. The modification project area supports suitable habitat for this species.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (Breeding)	No	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'. Nests are large structures built from sticks and lined with leaves or grass. No nests suitable for the species were observed during the habitat assessment. Breeding habitat unlikely to occur within the Modification 1 project area.
<i>Hieraetus morphnoides</i>	Little Eagle (Breeding)	No	The Little Eagle occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. The species nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. No nests suitable for the species were observed during the habitat assessment. Breeding habitat is unlikely to occur within the Modification 1 project area.
<i>Litoria booroolongensis</i>	Booroolong Frog	Yes	The Booroolong Frog is associated with permanent streams in a variety of vegetation types. Primary habitat requirements are extensive rock bank structures along permanent rivers with the key feature of these rock structures being rock crevices in relatively shallow, slow to medium-flowing sections of stream. Suitable habitat for this species was identified along the Yarrangobilly River and Wallaces Creek within the Modification 1 project area during the habitat assessment.
<i>Litoria spenceri</i>	Spotted Tree Frog	No	The Spotted Tree Frog is extremely rare and occurs in scattered, geographically isolated populations. Historically it was known from two streams in southern NSW on the north-west side of the Great Dividing Range; however both populations appeared to have become locally extinct. One population has been re-established via a reintroduction program. Occur among boulders or debris along naturally vegetated, rocky fast flowing upland streams and rivers. Due to extremely limited population distribution in NSW this species is considered unlikely to occur within the modification project area.

Table 6.4 Species credit species and status and habitat suitability assessment

Scientific name	Common name	Candidate species	Justification
<i>Litoria verreauxii alpina</i>	Alpine Tree Frog	Yes	The Alpine Tree Frog occurs in the south-eastern NSW and Victorian high country (alpine and sub-alpine zones) generally above 1,100 m ASL. Most locations are within the KNP and some are close to alpine resorts. Found in a wide variety of habitats including woodland, heath, grassland and herb fields. Breed in natural and artificial wetlands including ponds, bogs, fens, streamside pools, stock dams and drainage channels that are still or slow flowing. Part of the modification work is located within Tantangara above 1,100 m ASL. This area supports suitable sub-alpine grasslands and steam habitat, therefore this species is likely to occur within the Modification 1 project area.
<i>Lophoictinia isura</i>	Square-tailed Kite (Breeding)	No	The Square-tailed Kite is found in a variety of timbered habitats including dry woodlands and open forests. The species shows a particular preference for timbered watercourses, where nests are constructed in a fork or on large, horizontal limbs. No nests suitable for the species were observed during the habitat assessment. Breeding habitat is unlikely to occur within the Modification 1 project area.
<i>Mastacomys fuscus</i>	Broad-toothed Rat	No	The Broad-toothed Rat occurs in two widely separated areas: the wet alpine and subalpine heaths and woodlands in KNP. The Broad-toothed Rat lives in a complex of runways through the dense vegetation of its wet grass, sedge or heath environment, and under the snow in winter. Food is mostly, gathered at night, in summer and autumn and during the afternoon and early evening in winter. The diet consists almost solely of greenery - grass and sedge stems, supplemented by seeds and moss spore cases. The habitat assessment recorded the scats of the species as abundant in dense tussock grasslands, including PCT 1225 and 637. Open grasslands within the Modification 1 project area including sub-alpine dry grassland at Tantangara do not provide habitat for this species.
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat (Breeding)	No	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Maternity caves have very specific temperature and humidity regimes, and are known from a limited number of sites across the species range. The Modification 1 project area contains no suitable roosting structures for this species. This species is unlikely to roost within the project area.
<i>Myotis macropus</i>	Southern Myotis	Yes	This species roost in groups close to water in caves, mine shafts, hollow-bearing trees, storm water channels, building, under bridges and in dense foliage. The Southern Myotis relies on waterways with pools of 3 m wide or greater for foraging, breeding and roosting. The Modification 1 project area contains suitable habitat for the species, as defined in OEH (2018a).

Table 6.4 Species credit species and status and habitat suitability assessment

Scientific name	Common name	Candidate species	Justification
<i>Ninox connivens</i>	Barking Owl (Breeding)	Yes	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. It typically breeds in hollows of large eucalypts or paperbarks, usually near watercourses or wetlands. Nest-hollow entrances are 2-35 m above the ground with a diameter of 20-46 cm and depth of 20-300 cm. During nesting season, the male perches in a nearby tree overlooking the hollow entrance. The Modification 1 project area contains suitable habitat. Suitable nesting habitat is limited to areas of mature trees that are mainly located along the Yarrangobilly River.
<i>Ninox strenua</i>	Powerful Owl (Breeding)	Yes	The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest, requiring large tracts of forest or woodland habitat. The species nests in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old. Nest in unburnt gullies and lower slopes within 100 m of streams. The modification project area contains suitable habitat. Suitable nesting habitat is limited to areas of mature trees along the Yarrangobilly River.
<i>Petaurus norfolcensis</i>	Squirrel Glider	Yes	The Squirrel Glider inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. The species prefers mixed species stands with a shrub or Acacia mid-storey. The species relies on large old trees with hollows for breeding and nesting; however, trees need to be less than 50 m apart. Suitable feed and nesting trees are limited to the habitat west of Wallaces creek within the modification project area.
<i>Petroica rodinogaster</i>	Pink Robin	No	Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies. Like most Robins, requires perching habitat from which it can predate insects and spiders, but does spend significant time on the ground. Habitat is highly limited within the region for this species, and was not recorded in the Modification 1 project area during the habitat assessment.
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	Yes	The Brush-tailed Phascogale prefers dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. The species also inhabits heath, swamps, rainforest and wet sclerophyll forest. Nests and shelters in tree hollows with entrances 2.5 - 4 cm wide. Known to use many different hollows over a short time span. The species is scarce in the KNP, with a single record. Potential suitable habitat occurs within the project area and therefore the species will be retained as a candidate species.

Table 6.4 Species credit species and status and habitat suitability assessment

Scientific name	Common name	Candidate species	Justification
<i>Phascolarctos cinereus</i>	Koala (Breeding)	Yes	Koalas live in eucalypt woodlands and forests. Home range size varies according to quality of habitat, ranging from less than two to several hundred hectares. The trees within the Modification 1 project area provide foraging or sheltering resources for Koala. Ribbon Gum, identified as a Koala feed tree, is present within the Modification 1 project area. Recent Koala records are scarce in KNP; however, as suitable habitat exists, the species is retained as a candidate species.
<i>Pseudomys fumeus</i>	Smoky Mouse	Yes	The precise habitat requirements of the Smoky Mouse are not clear. A wide range of vegetation communities are occupied, from damp coastal heath in East Gippsland, to sub-alpine heath. A characteristic of Smoky Mouse localities, except those in wet gullies, is a floristically diverse midstorey with members of the plant families Epacridaceae, Fabaceae and Mimosaceae well represented. Ground cover is also likely to be critical and can be in the form of dense low vegetation, such as occurs in heaths, or grass tussocks, rocks and logs in more open habitats. Soil conditions also need to be conducive to burrowing and growth of hypogeal fungi, a major component of the diet (Menkhorst and Broome 2006, 2008). Suitable habitat for the Smoky Mouse is located in the higher regions of the modification project area above 1,100 m.
<i>Pseudophryne pengilleyi</i>	Northern Corroboree Frog	No	The Northern Corroboree Frog occurs in forests, sub-alpine woodlands and tall heath in the Fiery Range from the Snowy Mountains Highway to Wee Jasper. Populations also occur in the pine plantations near Tumut. Summer breeding habitat includes pools and seepages in sphagnum bogs, wet heath, wet tussock grasslands and herbfields in low-lying depressions. Outside the breeding season adults move away from the bogs into the surrounding heath, woodland and forest to overwinter under litter, logs and dense groundcover. The area of the modification project area above 700 m ASL does not provide suitable habitat for this species, either within or in proximity to the project area.
<i>Tyto novaehollandiae</i>	Masked Owl (Breeding)	Yes	The Masked Owl lives in dry eucalypt forests and woodlands from sea level to 1,100 m. The species requires old hollow-bearing eucalypts greater than 90 cm diameter at breast height, with hollows greater than 40 cm wide, greater than 100 cm deep and at least 3 m above the ground, for breeding. Will breed in a variety of topographic positions. The Modification 1 project area contains suitable nesting habitat along the Yarrangobilly River and within Marica, where suitable sized hollows are present.

Several threatened flora species have been recorded adjacent to the study area. These species did not appear in the BAM calculator for consideration as candidate species as the South East Highlands IBRA region and Bongo IBRA subregion was selected and the species are associated with the Australian Alps IBRA region. Despite these species not appearing they have been considered. Detailed targeted surveys were undertaken across the project area (Section 6.3.4i) and these species were not recorded within the disturbance footprint.

This assessment identified the following species as candidate species requiring further assessment:

- Cotoneaster Pomaderris;
- Slender Greenhood;
- Austral Toadflax;
- Gang-gang Cockatoo (breeding habitat only);
- Eastern Pygmy-possum;
- Alpine She-oak Skink;
- Booroolong Frog;
- Alpine Tree Frog;
- Southern Myotis;
- Barking Owl (breeding habitat only);
- Powerful Owl (breeding habitat only);
- Squirrel Glider;
- Brush-tailed Phascogale;
- Koala;
- Smoky Mouse; and
- Masked Owl (breeding habitat only).

The following additional species were included as candidate species for the purposes of the EPBC Act assessment process (EMM 2018e):

- two threatened flora species:
 - Curtis' Colobanth (*Colobanthus curtisiae*);
 - Blue-tongued Greenhood (*Pterostylis oreophila*);
- three migratory bird species:
 - Rainbow Bee-eater;

- Satin Flycatcher;
- Rufous Fantail; and
- Greater Glider (*Petauroides volans*).

Targeted surveys were undertaken, and the presence or absence of these species in the modification survey area determined, in accordance with Section 6.4 of the BAM (OEH 2017). Survey methods and outcomes are discussed further below.

6.3.3 Targeted survey methods

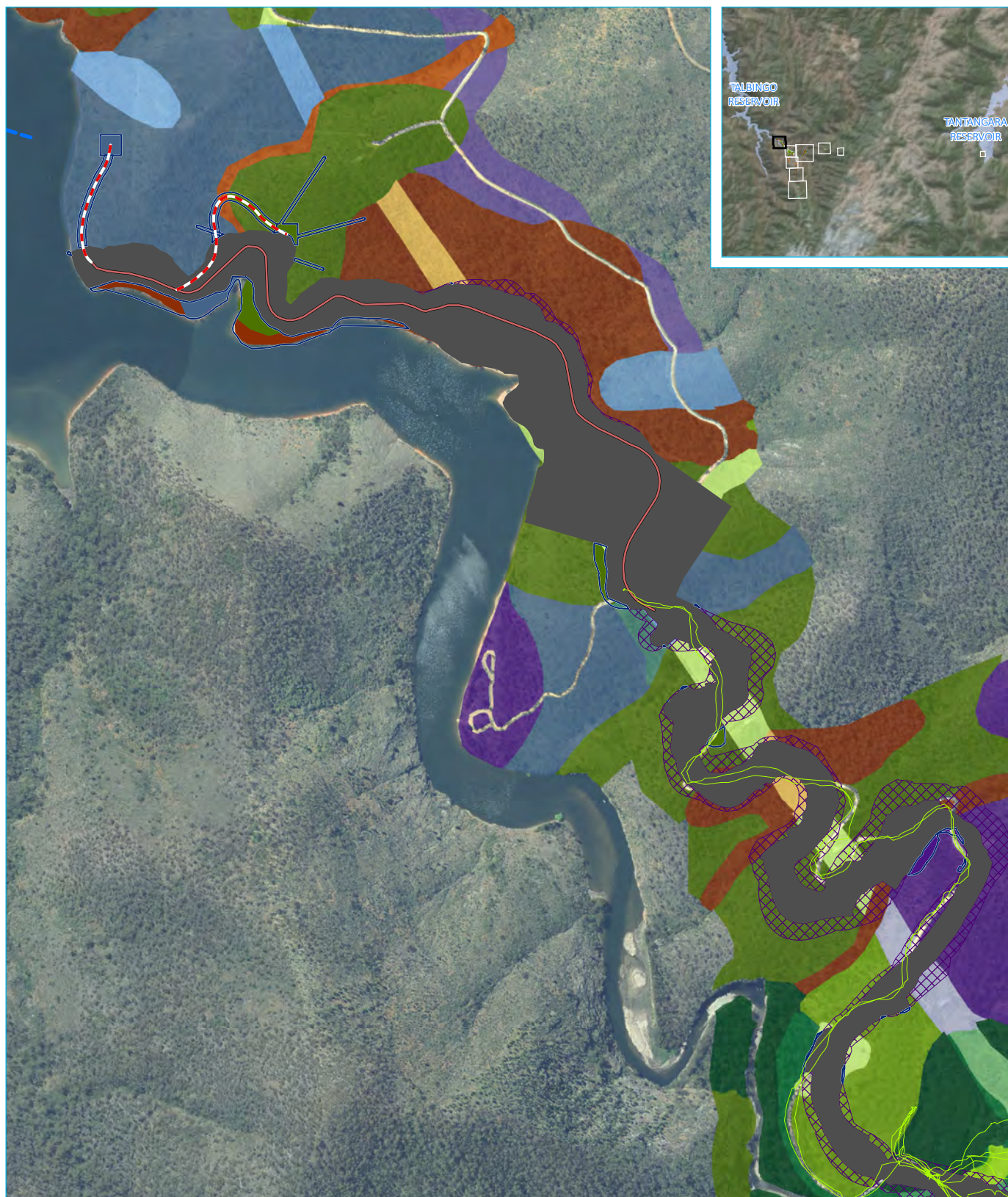
i Targeted flora surveys

Targeted flora surveys have been undertaken in accordance with OEH (2016) and DoE (2013) guidelines, and included transects spaced at intervals of 10 m. Targeted species along roads were undertaken with an observer walking either side of the road 5 to 7 m from the road edge.

In the western section of the project area, areas with basalt derived soils along Lobs Hole Ravine Road in the south of the survey area, and areas dominated by Kangaroo Grass were targeted based on suitability of habitat for candidate species. As the likelihood of threatened flora species occurring in many montane PCTs is low, surveys focused on sub-alpine areas and suitable habitat, with targeted flora surveys in montane areas limited to key microhabitats, such as along riparian areas for *Cotoneaster Pomaderris*.

In the eastern section of the study area all PCTs were considered to provide suitable habitat for threatened flora species and were subject to targeted surveys.

Targeted flora surveys were undertaken within the survey area during January 2018, and between December 2018 and January 2019. Targeted flora survey locations are illustrated in Figure 6.1.



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

0 100 200
m
GDA 1994 MGA Zone 55

KEY

- Flora survey transect
- - - Proposed access track
- - - Approved EW access
- - - Boat access
- EW approved construction footprint (additional)
- EW approved construction footprint
- ▨ EW approved construction footprint reduced
- PCT 296
 - Moderate/good - High
 - Moderate/good - Medium
 - Moderate/good - Derived grassland
- PCT 300
 - Moderate/good - High

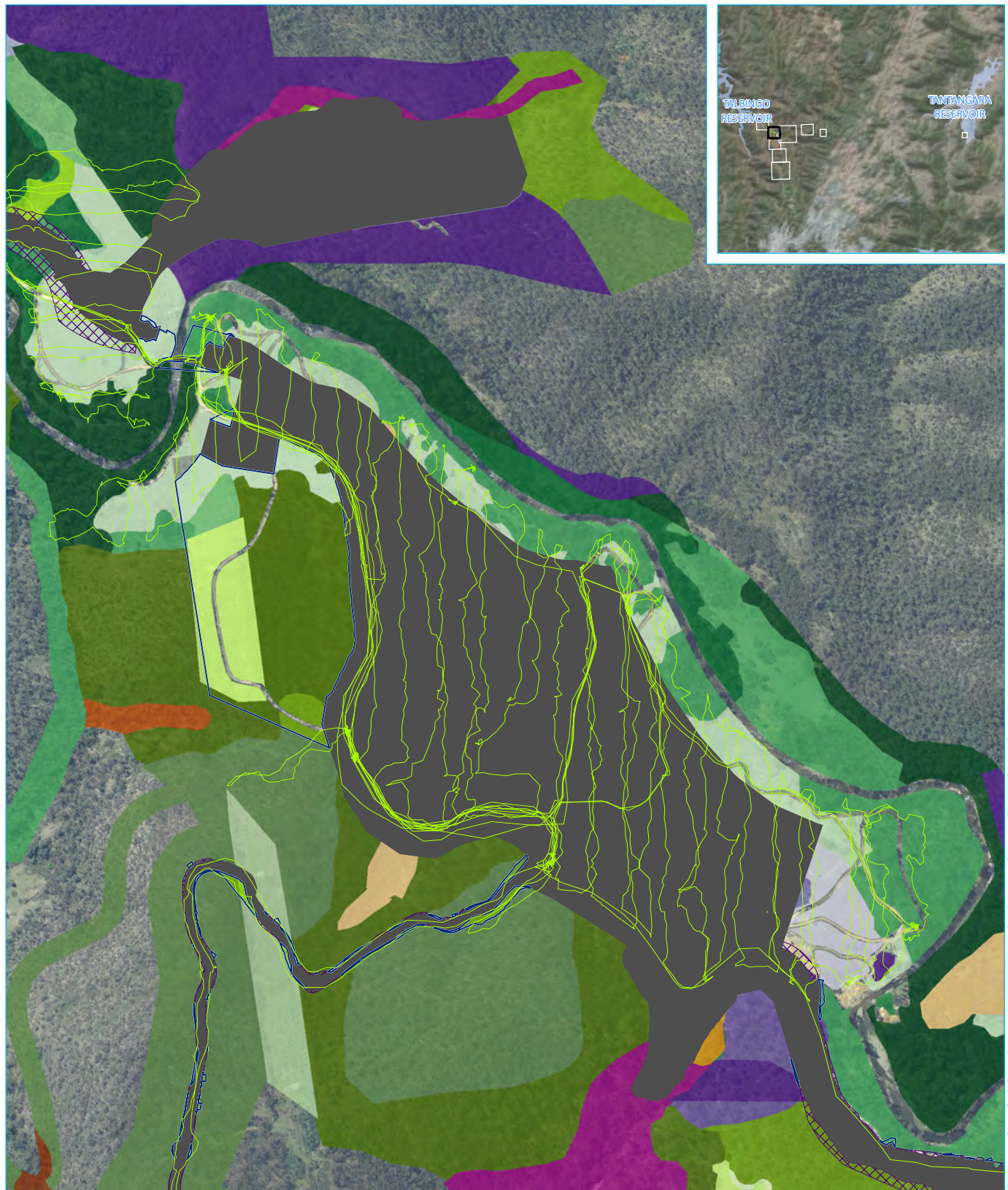
- Moderate/good - Medium
- Moderate/good - Derived grassland
- PCT 302
 - Moderate/good - High
 - Moderate/good - Medium
 - Moderate/good - Other
 - Moderate/good - Derived grassland
- PCT 729
 - Moderate/good - High
 - Moderate/good - Medium
 - Moderate/good - Poor
 - Moderate/good - Derived grassland

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

Flora survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.1a





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

KEY

- Flora survey transect
- 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

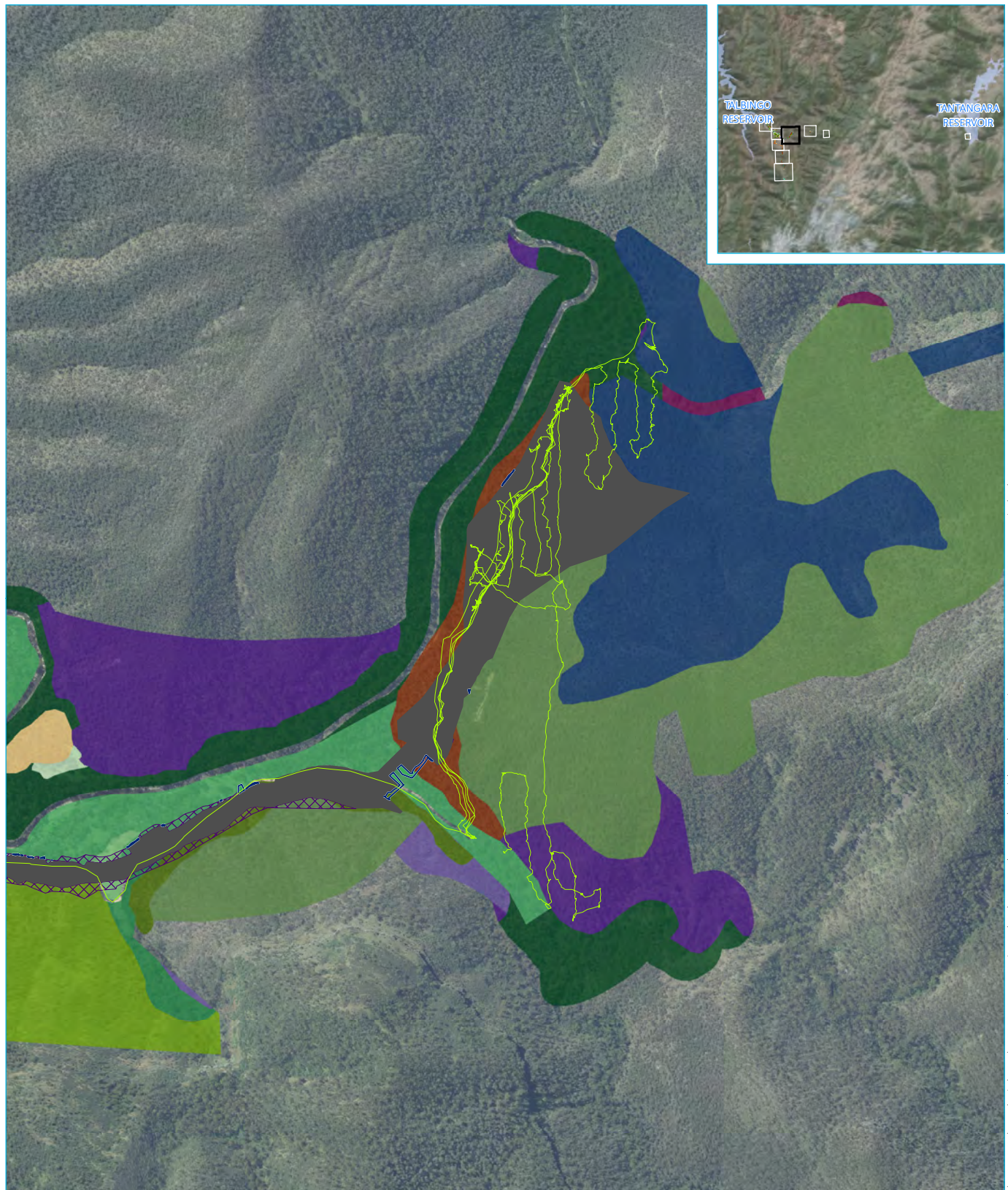
- Moderate/good - Other
- Moderate/good - Derived grassland
- Low
- PCT 729
 - Moderate/good - High
 - Moderate/good - Medium
 - Moderate/good - Poor
 - Moderate/good - Derived grassland
 - Low
- PCT 999
 - Moderate/good - High
 - Moderate/good - Derived grassland

Flora survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.1b



\\EMMSVR1\lenm\Jobs\2017\117188 - Snowy Hydro 2.0\GIS\02_Maps\EIS_EWA_Mod1\BDAR\8007b_FloraSurveyLocation_20190520_01.mxd 4/06/2019



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

KEY

- Flora survey transect
- 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

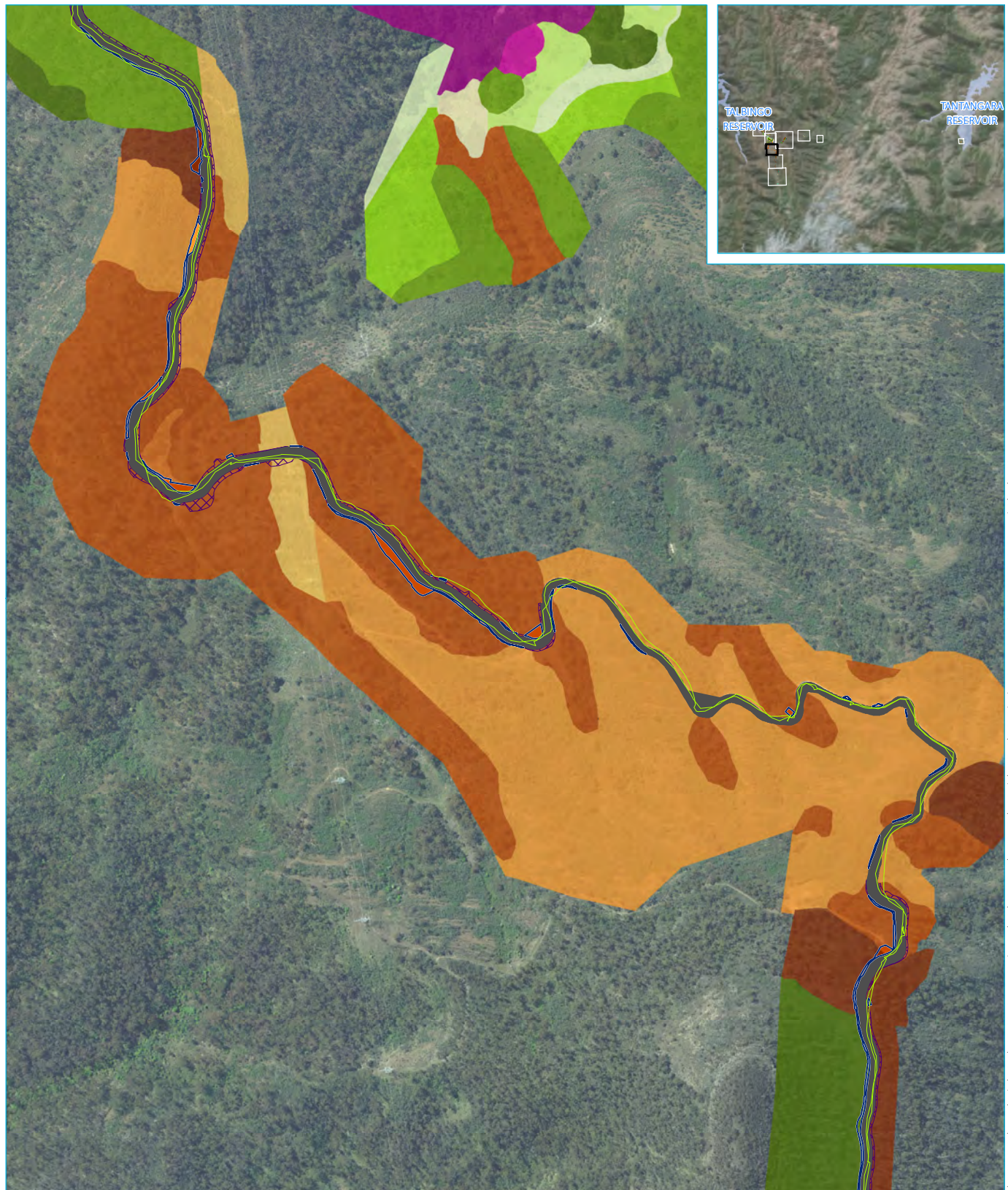
- PCT 300
 - Moderate/good - High
- PCT 302
 - Moderate/good - High
 - Moderate/good - Poor
 - Moderate/good - Other
 - Moderate/good - Derived grassland
 - Low
- PCT 311
 - Moderate/good - High
- PCT 729
 - Moderate/good - High

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

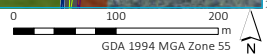
Flora survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.1c





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



KEY

- Flora survey transect
- 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

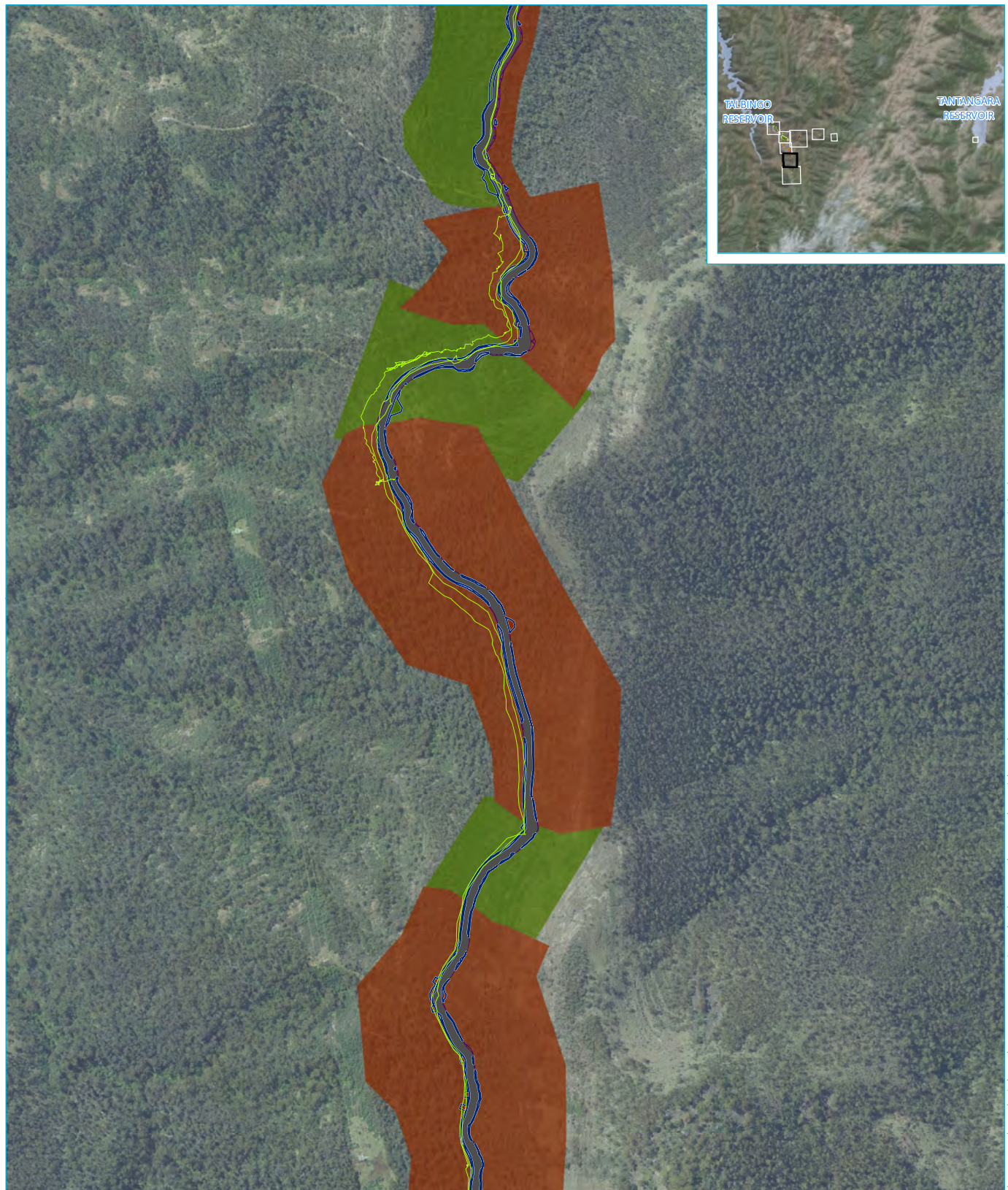
- Moderate/good - Poor
- Moderate/good - Other
- Moderate/good - Derived grassland
- Low
- PCT 302
 - Moderate/good - Poor
 - Moderate/good - Derived grassland
- PCT 729
 - Moderate/good - High
 - Moderate/good - Medium

- Moderate/good - Poor
- Moderate/good - Derived grassland
- Low
- PCT 999
 - Moderate/good - High

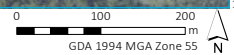
Flora survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.1d





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



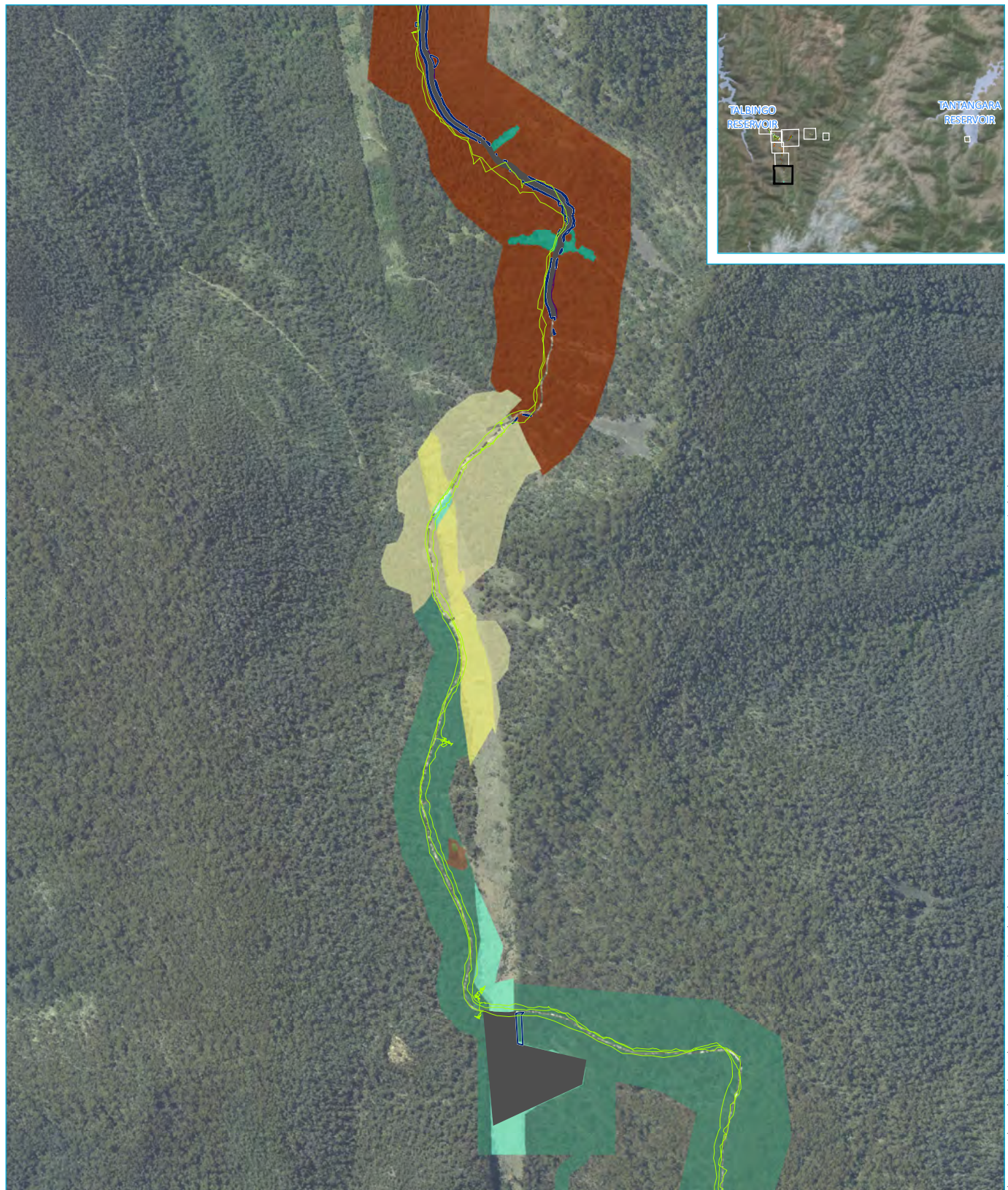
KEY

- Flora survey transect
- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced
- PCT 300
- Moderate/good - High
- PCT 729
- Moderate/good - High

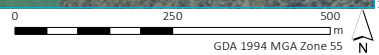
Flora survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.1e





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



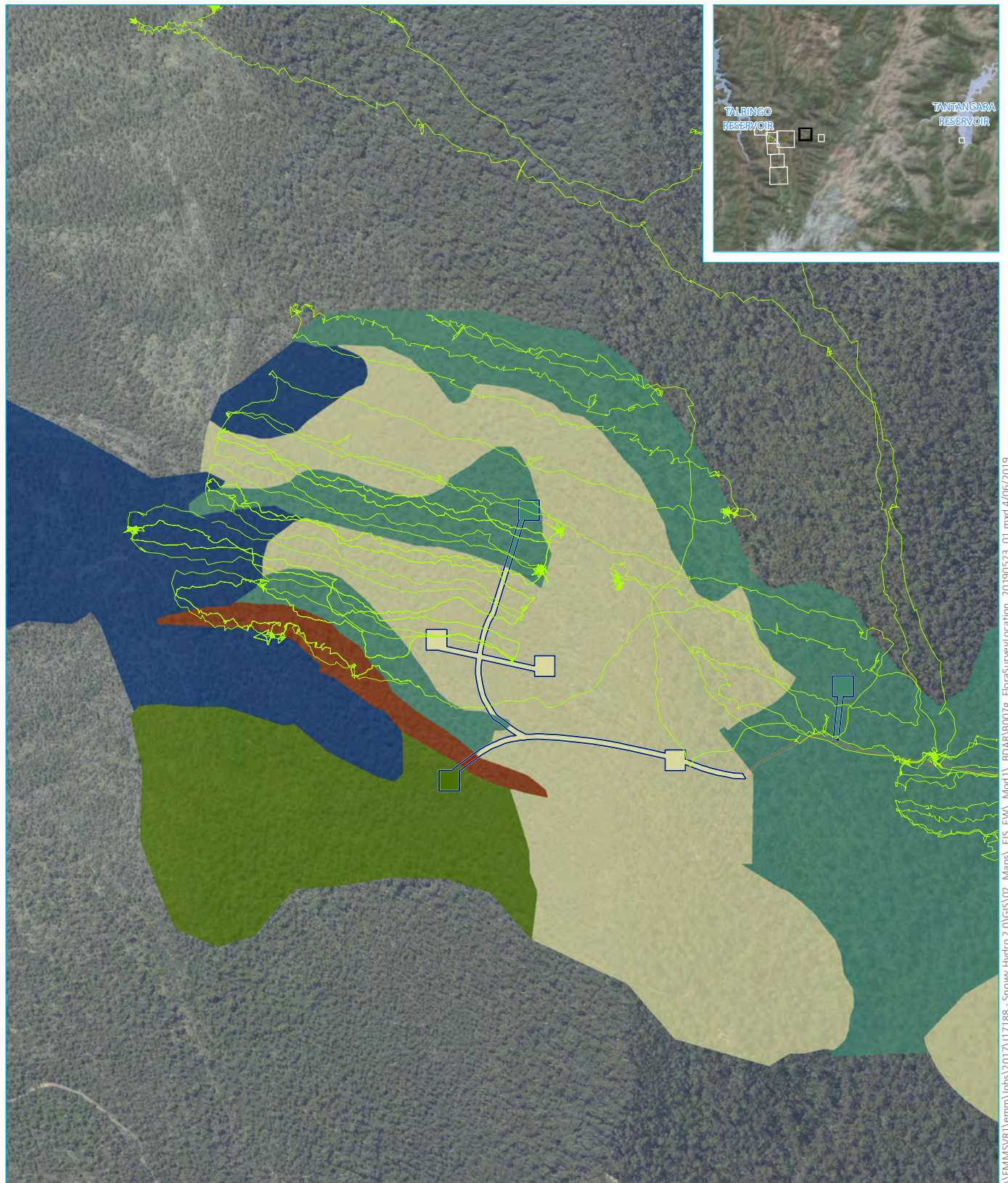
KEY

Flora survey transect	PCT 643
EW approved construction footprint (additional)	Moderate/good - High
EW approved construction footprint	PCT 953
EW approved construction footprint reduced	Moderate/good - High
PCT 300	Moderate/good - Derived grassland
Moderate/good - High	PCT 1196
PCT 303	Moderate/good - High
Moderate/good - High	Moderate/good - Derived grassland
PCT 637	
Moderate/good - High	

Flora survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.1f





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

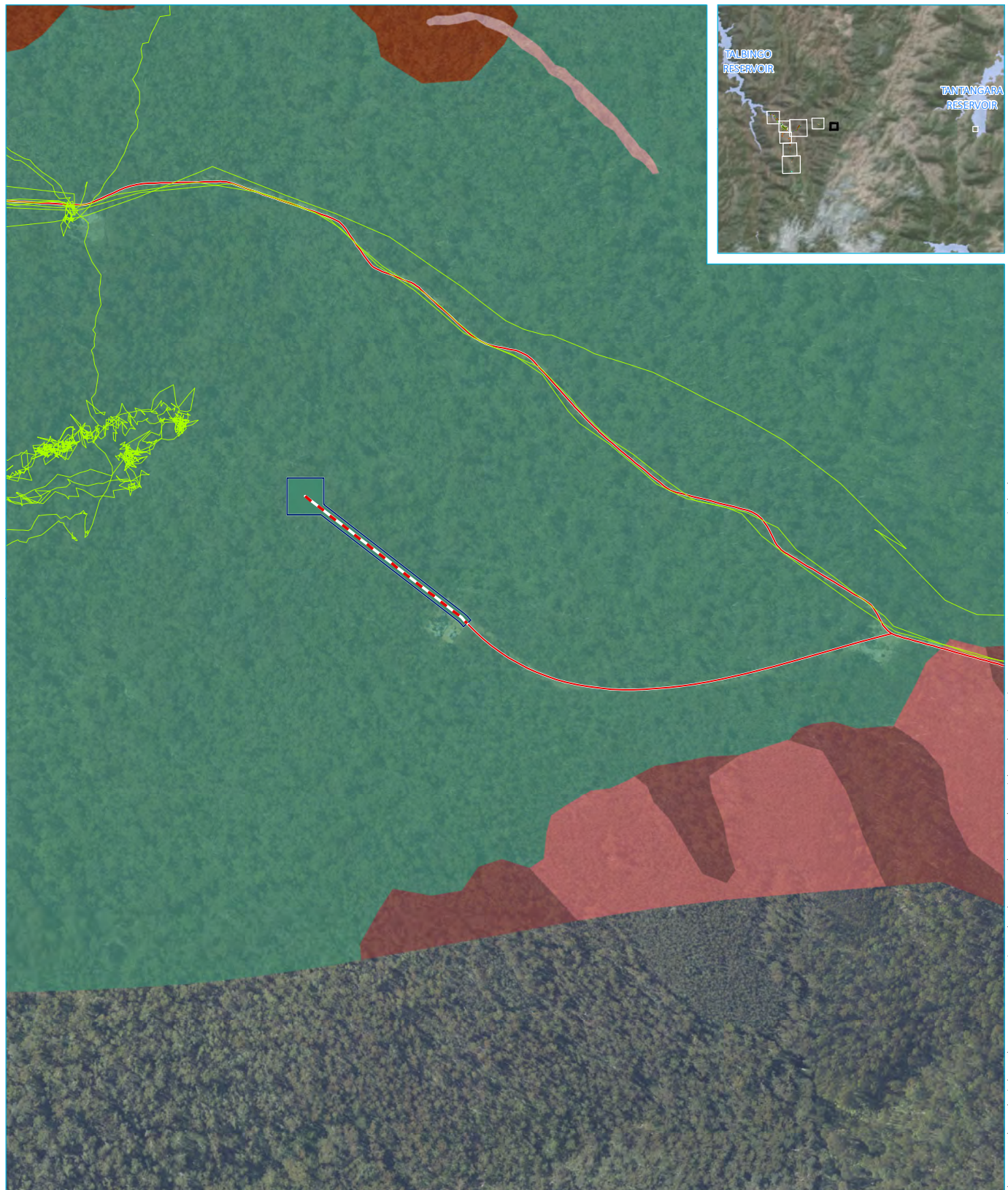
KEY

- Flora survey transect
- Existing access track
- Proposed access track
- PCT 300
- PCT 311
- PCT 729
- PCT 953
- Moderate/good - High
- PCT 1196
- Moderate/good - High
- Moderate/good - High
- Moderate/good - High
- Moderate/good - High

Flora survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.1g





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

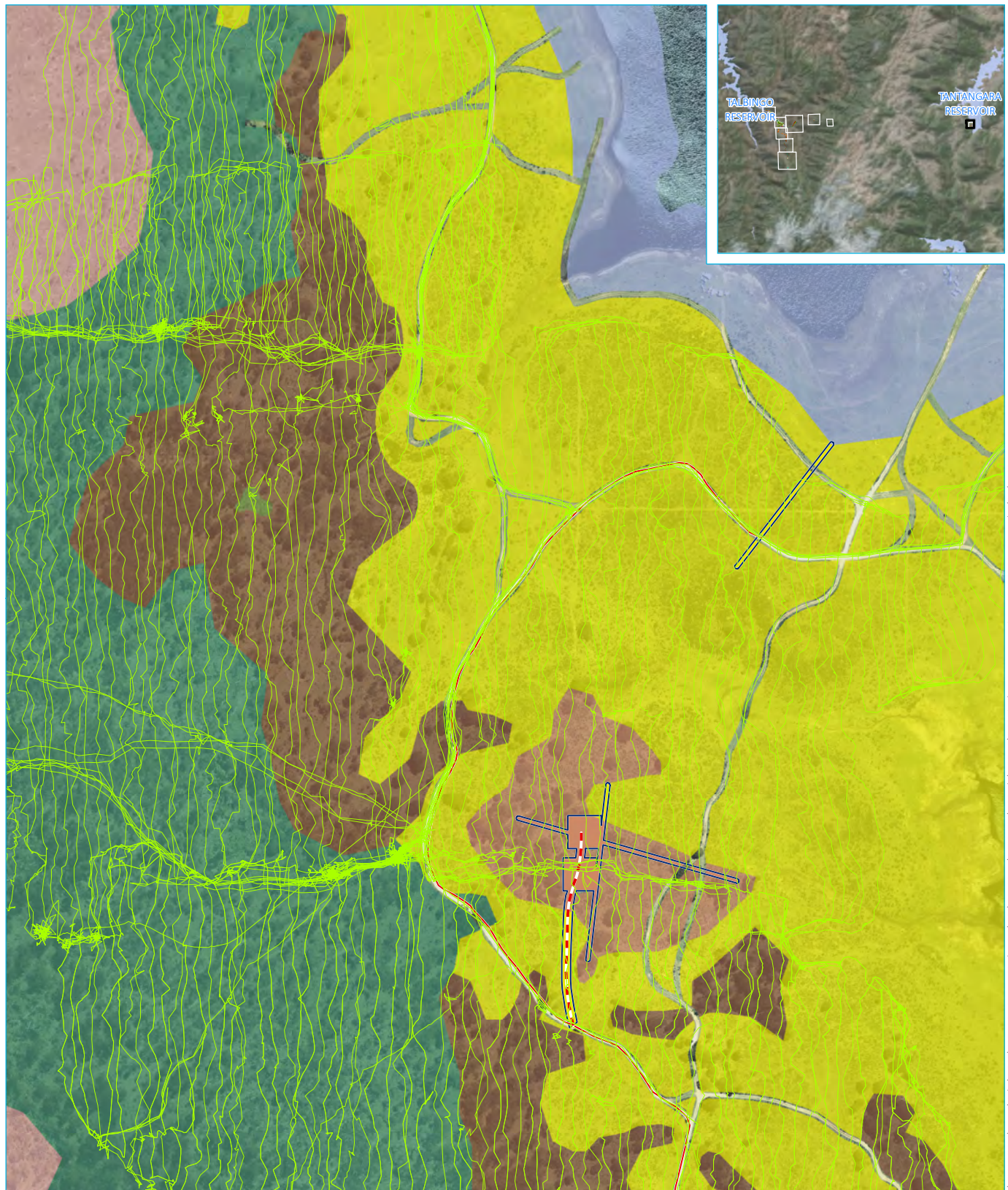
KEY

- Flora survey transect
- Existing access track
- Proposed access track
- PCT 300
- Moderate/good - High
- PCT 639
- Moderate/good - High
- Moderate/good - Other
- PCT 765
- Moderate/good - High
- PCT 1196
- Moderate/good - High

Flora survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.1h





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

KEY

- Flora survey transect
- Existing access track
- Proposed access track
- PCT 303
- Moderate/good - High
- Moderate/good - Other
- PCT 644
- Moderate/good - Other
- PCT 637
- Moderate/good - High
- PCT 1196
- Moderate/good - High
- PCT 1224
- Moderate/good - High
- PCT 1225
- Low

Flora survey location

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.1i



ii Targeted fauna surveys

Targeted fauna surveys have been undertaken across the Snowy 2.0 project area, including both the Exploratory Works survey area (EMM 2018d) and the Modification 1 project area. Given the extensive nature of these surveys, the following section refers to surveys undertaken both within and adjacent to the Modification 1 project area, and more broadly across the Main Works survey area where they are relevant.

a Diurnal birds

Bird surveys for diurnal birds were undertaken for five species listed under the BC Act and three additional migratory species listed under the EPBC Act. Targeted bird species included:

- Gang-Gang Cockatoo (breeding habitat)
- breeding habitat for birds of prey, including:
 - Little Eagle;
 - Square-tailed Kite; and
 - White-bellied Sea-Eagle.
- Latham's Snipe;
- Rainbow Bee-eater;
- Rufous Fantail; and
- Satin Flycatcher.

Little Eagle, Square-tailed Kite and White-bellied Sea-Eagle were included in targeted diurnal bird surveys to identify potential breeding habitat including nests within the disturbance footprint. These surveys were used to assist in determining whether these species are likely to be a candidate species.

Stratification units and area of each survey unit in the survey area is shown in Table 6.5.

Table 6.5 **Stratification units and survey area – diurnal birds**

Vegetation class/survey area	Area (ha) ¹
Southern Tablelands Dry Sclerophyll Forests	8.46
Southern Tablelands Grassy Woodlands	0.31
Southern Tablelands Wet Sclerophyll Forests	1.67
Subalpine Woodlands	1.08
Upper Riverina Dry Sclerophyll Forests	1.70
TOTAL	13.22

Note: 1. Area is the area of vegetation within the disturbance footprint.

Bird survey methods and survey effort have been developed in accordance with DEC (2004) and DSEWPac (2010a) guidelines. Methods include a mix of transect and areas searches, to record bird activity, and targeted nest searches for the Gang-gang Cockatoo, Pink Robin and birds of prey. Methods and survey effort are outlined in Table 6.6.

Table 6.6 Methods and survey effort – diurnal birds

Method	Survey description	Survey effort
Transects and area searches	- Land based areas searches and transects. - Surveyors walked transect (access tracks) or area searches within a 1-3 ha area (other areas). - All calls and habitat features were investigated. - Birds observed or heard were recorded.	DEC (2004) has not resolved bird survey requirements. DSEWPac (2010a) was reviewed and sympatric species survey efforts indicated a requirement for 10 hours over 5 days (2 hours per day) for sites less than 50 ha. No survey effort for larger sites is provided. To date, 57 bird surveys have been completed with a total of 126 survey hours within and adjacent to the Modification 1 disturbance footprint between December 2017 and April 2019.
Targeted nest searches	- Observers travelled across available habitat, seeking out habitat features including nest trees and hollows. - Resources will be marked and watched to determine if they are being used by the target species.	DEC (2004) has not resolved nest search requirements. DSEWPac (2010a) was reviewed and sympatric species survey efforts indicated 8 hours over 4 days (2 hours per day) for sites less than 50 ha. Survey effort is outlined above.

b Nocturnal birds

Bird surveys for nocturnal birds were undertaken to identify breeding habitat for three forest owl species listed under the BC Act. Targeted bird species include:

- Barking Owl;
- Powerful Owl; and
- Masked Owl

Although breeding habitat is restricted within the modification project area (see Table 6.7), surveys were undertaken across all breeding and foraging habitat to determine if forest owls were active within the survey area. If found to be active surveys would focus on identifying breeding locations, if present. Stratification units and area of each survey unit in the survey area is shown in Table 6.7.

Table 6.7 Stratification units and survey area – nocturnal birds

Vegetation class/survey area	Area (ha) ¹
Breeding habitat	
Southern Tablelands Dry Sclerophyll Forests	8.46
Southern Tablelands Wet Sclerophyll Forests	1.67
Subalpine Woodlands	1.08
TOTAL	11.21

Note: 1. Area is the area of vegetation within the disturbance footprint.

Bird survey methods and survey effort have been developed in accordance with DEC (2004). Methods included call playback and spotlighting, with listening periods to listen for the call between roosting males and nesting females where appropriate. Methods and survey effort are outlined in Table 6.8.

Table 6.8 Methods and survey effort – nocturnal birds

Method	Survey description	Survey effort
Call playback and spotlighting	DEC (2004) recommends call playback and spotlighting are undertaken to target these owl species - Commence surveys with a 10-15 minute listening period. This will target the male and female calling back and forth to one another and is useful in identifying nesting trees. - This will be followed by spotlighting for 10 minutes in the immediate vicinity. - Call playback is then undertaken with the call of each target species played intermittently for a 5 minutes period followed by a 10 minute listening period. - Following call playback a further 10 minutes of spotlighting is undertaken. If forest owls were found to be present within the survey area, surveys would try to identify nesting sites by listening to roosting males calling to nesting females on dusk. Females calls would be triangulated and nest searches undertaken in identified areas over several nights.	DEC (2004) recommends at least 5 visits for the Powerful Owl and Barking Owl, 6 visits for the Sooty Owl and 8 visits for the Masked Owl. Sites should be separated by 1 km. Based on the above, and availability of suitable habitat, up to 18 survey sites would need to be completed for the Masked Owl. To date, surveys have been completed at 22 sites within and adjacent to Modification 1 project area, with 46 hours of survey completed.

c Small terrestrial mammals

Small terrestrial mammal surveys were undertaken to target three small terrestrial mammal species listed under the EPBC Act and/or BC Act:

- Eastern Pygmy-possum;
- Broad-toothed Rat; and
- Smoky Mouse

Stratification units and area of each survey unit in the survey area are shown in Table 6.9.

Table 6.9 Stratification units and survey area – small terrestrial mammals

Vegetation class/survey area	Area (ha) ¹
Alpine Heaths	0.01
Southern Tablelands Dry Sclerophyll Forests	8.46
Southern Tablelands Wet Sclerophyll Forests	1.67
Subalpine Woodlands	1.08
Temperate Montane Grasslands	0.15
Upper Riverina Dry Sclerophyll Forests	1.70
TOTAL	13.07

Notes: 1. Area is the area of vegetation within the disturbance footprint.

Initially, surveys were undertaken across all vegetation classes within the Modification 1 survey area, as the precise habitat requirements of the Smoky Mouse are not clear (Menkhorst and Broome 2006, 2008). The Broad-toothed Rat was deemed to have potential to occur in sub-alpine grasslands in Tantangara, which is considered marginal habitat for this species. The Eastern Pygmy-possum was survey across all PCTs within the survey area.

Table 6.10 Methods and survey effort – small terrestrial mammals

Method	Survey description	Survey effort
Trapping	20 Elliot A traps placed 10 m apart in two parallel lines separated by 25 m (access roads) or 25 Elliot A traps placed 10 m apart in a 5 x 5 grid (other areas): • Traps baited with a mixture of peanut butter, rolled oats and honey. • Traps checked early in the morning and closed for the day. • Traps opened and rebaited in the late afternoon. • Animals to be temporarily marked to allow mark-recapture data to be collected.	DSEWPaC (2011) specifies two sites per 5 ha stratification unit with replication across habitat types in areas of greater than 5 ha. No level of replication is specified. Consultation was undertaken with Linda Broome (OEH) to determine a suitable survey effort per stratification unit. This consultation determined that a suitable effort would be 25 Elliot A traps placed out for 4 nights = 100 trap nights, per 50 ha site, with additional replicates for every additional 100 ha. Based on the areas above this would require six survey sites equating to 600 trap nights. Trapping within and adjacent to the modified disturbance boundary was conducted between December 2017 and April 2019 at 34 sites, equating to 340 trap nights.
Remote cameras	Remote camera surveys were undertaken in accordance with the following guidelines: • Cameras placed at least 100 m apart. • Cameras were attached to tree or stake and positioned approximately 25cm above ground with bait stations placed 1.5m away. • Bait stations were baited with a mixture of peanut butter, rolled oats and honey. • DSEWPaC (2011) recommends cameras are placed out for at least one week. However, Nelson et al. (2009) detected the Smoky Mouse on cameras on or before the tenth night of survey. As such, it was determined one week may not be sufficient to reliably detect the species, and surveys were extended to a minimum of 14 nights for Round 2 and above.	DSEWPaC (2011) recommends that for the Smoky Mouse two cameras are placed out for one week, in areas up to 5 ha. Based on the areas above this would require 23 survey sites. If surveys are undertaken for one week, as outlined in DSEWPaC (2011), this equates to 322 camera nights. No guidelines are available for the Broad-toothed Rat or Eastern Pygmy-possum. Remote camera surveys were undertaken between December 2017 and May 2019 at 962 sites (124 cameras) with a minimum of 14 nights per site and up to 31 nights for some sites. A total of 9,069 camera nights has been completed across within and adjacent to Modification 1 project area.
Regional surveys	Regional surveys for the Smoky Mouse were undertaken to put recent findings of the Smoky Mouse at Lobs Hole and Marica in context. Surveys undertaken as per above, with two cameras placed out for 14 nights, separated by 100m. Cameras baited as per above. Sites were selected based on a 1km grid of all areas above 1000m AHD.	A total of 66 sites were surveyed, with two cameras placed out per site for minimum of 14 nights. Sites where Smoky Mouse was not recorded during the first round of survey had an additional round of survey. This equates to a total of 5808 nights (220 cameras placed out).

d Large terrestrial mammals

Large terrestrial mammal surveys were undertaken to target the Spotted-tail Quoll. Stratification units and area of each survey unit in the Modification 1 disturbance boundary area are shown in Table 6.11.

Table 6.11 Stratification units and survey area – large terrestrial mammals

Vegetation class/survey area	Area (ha) ¹
Southern Tableland Dry Sclerophyll Forests	8.46
Southern Tableland Wet Sclerophyll Forests	1.67
Subalpine Woodlands	1.08
Temperate Montane Grasslands	0.15
Upper Riverina Dry Sclerophyll Forests	1.70
TOTAL	13.06

All forest habitat within the Modification 1 project area was considered to have potential to support the species given the species is known to have home ranges of several hundred to several thousand hectares in size (DELWP 2016, DEWHA 2009, DSE 2011a).

Methods and survey effort have been developed in accordance with DSEWPaC (2011), specifically the species profile for the Spotted-tailed Quoll, and the Victorian Survey Standard for the Spot-tail Quoll (DSE 2011a). Surveys have been undertaken at a broad-scale, in line with the recommendations of DSE (2011a), and have included areas outside of the Exploratory Works survey area and project area. Methods and survey effort are outlined in Table 6.12.

Table 6.12 Methods and survey effort – large terrestrial mammals

Method	Survey description	Survey effort
Remote Cameras	Remote camera surveys were undertaken in accordance with the following guidelines for each 100 ha site: - Two cameras placed out for one month. - Cameras placed at least 500 m apart. - Cameras will be set for 24 hour operation - Cameras placed out in associated with bait stations filled with chuditch bait (meat meal, sardines, fish oil, chicken oil and rolled oats). - Cameras were attached to either a tree or stake and placed approximately 1 m above the ground and 2-3 m from the bait station.	DSE (2011a) recommends two cameras per 100 ha sampling unit (or part thereof) placed out for 30 days. Based on the areas above, this equates to five survey sites (five if two small stratification units less than 5 ha are excluded) and 300 camera nights. Surveys were undertaken between February and April 2018 across six survey sites (12 cameras), equating to 402 camera nights.

e Arboreal mammals

Arboreal mammal surveys were undertaken within the Modification 1 project area to target four arboreal species listed under the EPBC Act and/or BC Act. Targeted arboreal mammal species include:

- Koala;
- Squirrel Glider;
- Brush-tailed Phascogale; and

- Greater Glider.

Stratification units and area of each survey unit in the survey area is shown in Table 6.13.

Table 6.13 Stratification units and survey area – arboreal mammals

Vegetation class/survey area	Area (ha) ¹
Southern Tableland Dry Sclerophyll Forests	8.46
Southern Tableland Wet Sclerophyll Forests	1.67
Subalpine Woodlands	1.08
Upper Riverina Dry Sclerophyll Forests	1.70
TOTAL	12.91

Notes: 1. Area is the area of vegetation within the disturbance footprint.

The Koala was deemed to have potential to occur in suitable Eucalypt forest and woodland below 800 m elevation (DSEWPaC 2012, DoE 2014, TSSC 2012).

The Squirrel Glider has been recorded in the locality in

Methods and survey effort have been developed in accordance with DEC (2004), DSEWPaC (2011), the Victorian Survey Standard for the Greater Glider (DSE 2011b) and Biolink (2008) for the Koala. Methods and survey effort is outlined in Table 6.14.

Table 6.14 Methods and survey effort – arboreal mammals

Method	Survey description	Survey effort
Trapping	Ten Elliot B or cage traps were placed at 2-4 m above the ground, 50 m apart in two parallel lines separated by 50 m: • Traps were baited with a mixture of peanut butter, rolled oats and honey. • A mixture of water and honey was sprayed on tree trunk. • Traps were checked early in the morning and closed for the day. • Traps were re-opened and rebaited in the late afternoon. • Animals to be temporarily marked to allow mark-recapture data to be collected. • Trapping was undertaken in conjunction with terrestrial mammal trapping where suitable habitat occurs.	DEC (2004) requires 24 trap nights over 3-4 consecutive days per 50 ha of stratification unit. Based on the above stratification units, this would equate to five surveys and 144 trap nights. Surveys were undertaken between December 2017 and April 2019 at twenty-seven survey sites, equating to 1,080 trap nights.

Table 6.14 Methods and survey effort – arboreal mammals

Method	Survey description	Survey effort
Spotlighting	DSEWPac (2011) recommends two parallel 200 m transects per 5 ha site. No survey effort for larger sites is specified. In line with DSE (2011b) and DEC (2004), a survey effort of two parallel 2,000 m transects per 100 ha site (half the survey effort, but over a larger area) was deemed suitable in consultation with OEH. Surveys included: • 2,000 m transects were undertaken by 2 observers (4,000 m total transect), with 25 m between transects. • Observers moved at a speed of 10 m per minute (ie 200 minutes for a 2,000 m transect). • All animals observed were recorded, including the distance of the animals from the observer.	DSEWPac (2011) recommends two parallel transects per 5 ha site, while DEC (2004) recommends 2 transects per 200 ha of stratification unit. Given the size of the survey area and the fact that no species specific guidelines are available for the Greater Glider a survey effort of two 2,000 m transects per 100 ha stratification unit, repeated on two separate occasions, was deemed appropriate based on DSE (2011b) and DEC (2004). Based on this, four 2,000 m transects would be required to be repeated on two occasions (8 transects). Surveys were undertaken between December 2017 and May 2019, with fifty-six 2,000 m transects (minimum distance) completed. Survey guidelines have been exceeded.
Regularised Grid Based (RGB) Spot Assessment Technique (SAT) (Koala)	The RGB SAT method requires application of a uniform assessment method across a broad area. A 350 m x 350 m grid was applied to the survey area to identify survey locations. At each grid point, the SAT (Phillips and Callaghan 2011) was undertaken, as follows: • Centre tree was located and marked with flagging tape. • The 29 nearest trees to the centre tree were also identified and marked. • Koala faecal pellets were searched for beneath each of the 30 trees within a distance of 100 cm. Initial inspections were checked in undisturbed ground surface, followed by a more thorough inspection involving disturbance of leaf litter and ground cover (if no faecal pellets were initially detected). • An average of approximately two person minutes per tree should be dedicated to the faecal pellet search. Activity levels can be interpreted using Table 2 from Phillips and Callaghan (2011).	Grid points located below 800 m and in proximity to and surrounding the survey area were included for survey. A total of 58 grid locations have been surveyed within and adjacent to the disturbance boundary.
Songmeters (Koala)	Following recent use of acoustic recorders to document calling by male Koalas (, Law et al. 2018) Songmeters were deployed during the breeding season to record males bellowing: • Songmeters set to record between dusk and dawn • Songmeters deployed at sites separated by at least 3 km, over a mix of landscape positions (ridge, valley, gully and flat). • Songmeters deployed at each site for a minimum of 7 nights. Songmeter data was analysed by Dr Brad Law of the NSW Department of Primary Industry.	No survey effort has been determined for the use of Songmeters. Songmeters were placed out at 4 sites within and adjacent to the disturbance footprint for a minimum of 61 nights per site. This equates to 246 nights of survey.

f Reptiles

Reptile surveys were undertaken to target the Alpine She-oak Skink. For the Alpine She-oak Skink, stratification unit is based on plant community type, as this is considered more representative of the species' habitat requirements. Stratification units and area of each survey unit in the assessment area is shown in Table 6.15.

Table 6.15 Stratification units and survey area – Reptiles

Plant community type	Area (ha) ¹
PCT 1224 - Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	0.15
TOTAL	0.15

Notes: 1. Area is the area of vegetation within the disturbance footprint.

No specific survey guidelines for the Alpine She-oak Skink exist, and they are not included in Commonwealth of Australia (2011). A review of relevant literature indicates that shelter surveys are a productive survey technique. Survey methods have been adapted from the recommended survey effort for the Striped Legless Lizard (*Delma impar*) outlined in Commonwealth of Australia (2011) and following consultation with OEH. In 2018 tile grids were adapted to tile transects, following consultation with OEH. Methods and survey effort are outlined in Table 6.16.

Table 6.16 Methods and survey effort – reptiles

Method	Survey description	Survey effort
Tile grids	Each tile grid was set out as follows: • Tile grid, consisting of 25 tiles spaced at 5 m spacing between tiles in a 5 x 5 grid (N.Clemmens pers. comm.). • The corner of each grid will be marked with a star picket, and each tile labelled A1 to E5. • Tile grids to be checked at least twice a month, when temperatures are below 28°C. If the species is detected at a tile grid the grid will be collected and moved to an alternate location to increase survey coverage.	Minimum survey requirements for the Striped Legless Lizard recommends that 10 tile grids are deployed for sites greater than 30 ha in size using a 5 x 10 grid. In consultation with species experts we propose to use smaller 5 x 5 grids to increase survey coverage, with a minimum of 20 tile grids to be deployed (D.Hunter person comm., N.Clemmens pers. comm.). A total of 32 tile grids were deployed between December 2017 and April 2018. Two of these were adjacent to the disturbance area.
Tile transects	Each tile transect was set out as follows: • Tile transect, consisting of 10 tiles spaced at 5 m spacing between tiles in a transect. • Tile transects to be checked at least twice a month, when temperatures are below 28°C. If the species is detected at a tile transect the transect will be collected and moved to an alternate location to increase survey coverage.	The tile transect survey effort extends the previous tile grid survey effort, which exceeded survey requirements specified. 14 tile grids, surveyed over 2017/18, have been converted to tile transects. Tile transects have been deployed at an additional 44 locations. Four of these tile transects were adjacent to the disturbance area.

g Amphibians

Amphibian surveys were undertaken to target two species:

- Booroolong Frog; and
- Alpine Tree Frog.

Stream lengths for all suitable watercourses for Booroolong Frog within 1500m of the Modification 1 project area are shown in Table 6.17.

Table 6.17 Stream lengths – Amphibians

Species	Waterway	Length (m)
Booroolong Frog	Stable Creek	251
	Sheep Station Creek	253
	Wallaces Creek	918
	Yarrangobilly River	4,692
TOTAL		6,114
Alpine Tree Frog	Kellys Plain Creek	1,955
	Murrumbidgee River	658
TOTAL		2, 613

All permanent and intermittent watercourses within the survey area which provided optimal to marginal habitat, as identified during the habitat assessment, were surveyed.

Methods and survey effort have been developed in accordance with DECC (2009) and DSEWPac (2010b). Methods and survey effort is outlined in Table 6.18.

Table 6.18 Methods and survey effort – amphibians

Method	Survey description	Survey effort
Habitat assessment	A habitat assessment was undertaken to identify suitable habitat along all watercourses within the survey area.	All streams will be assessed for suitable habitat.

Table 6.18 Methods and survey effort – amphibians

Method	Survey description	Survey effort
Nocturnal searches (visual encounter surveys (VES))	VES were undertaken in accordance with the following: • Surveys were undertaken in temperatures of greater than 10°C, and not during rain. • Two observers walked a 200 m transect along a stream. • Using a spotlight and head torch searches were completed for surrounding vegetation, rocks and other microhabitats. • All frogs observed or heard were recorded. • Hygiene protocols were followed to prevent the spread of chytrid fungus, with full wash down between streams.	DECC (2009) and DSEWPac (2010b) specify a minimum survey effort of one 200 m transect per stream, repeated on four nights (two nights in DECC 2009). Booroolong Frog: Based on the four streams within the survey area this would equate to 4 x 200m transects repeated on four nights, equating to 3,200 m of transect survey. Surveys were undertaken in December 2017 to January 2019. All four watercourses have been surveyed for their entire length (rather than 200 m transects) to gain an understanding of the distribution of the species across these watercourses, with surveys repeated on four nights. Overall, a total of 80,667 m of transect surveys (two observers) have been completed. Alpine Tree Frog: Based on the two streams adjacent to the survey area this would equate to 2 x 200m transects repeated on four nights, equating to 1,600 m transect surveys. Surveys were undertaken in January 2018. Overall, a total of seven survey efforts, with a total of 22, 639 (two observers) have been completed.
Egg mass and tadpole sampling surveys	Egg mass and tadpole sampling were undertaken in accordance with the following: • Egg mass will be detected during VES listed above. • Tadpole sampling will be undertaken using a dip net, with the net dragged along a transect for 1-2 minutes. • Samples will then be keyed out using Anstis (2013).	DECC (2009) and DSEWPac (2010b) do not specify minimum survey requirements for tadpoles. One transect was undertaken per stream during VES surveys.

h Microchiropteran bats

Microbat surveys were undertaken within the Exploratory Works modification boundary to target the Southern Myotis (breeding). Stratification units and area of each survey unit in the survey area is shown in Table 6.19.

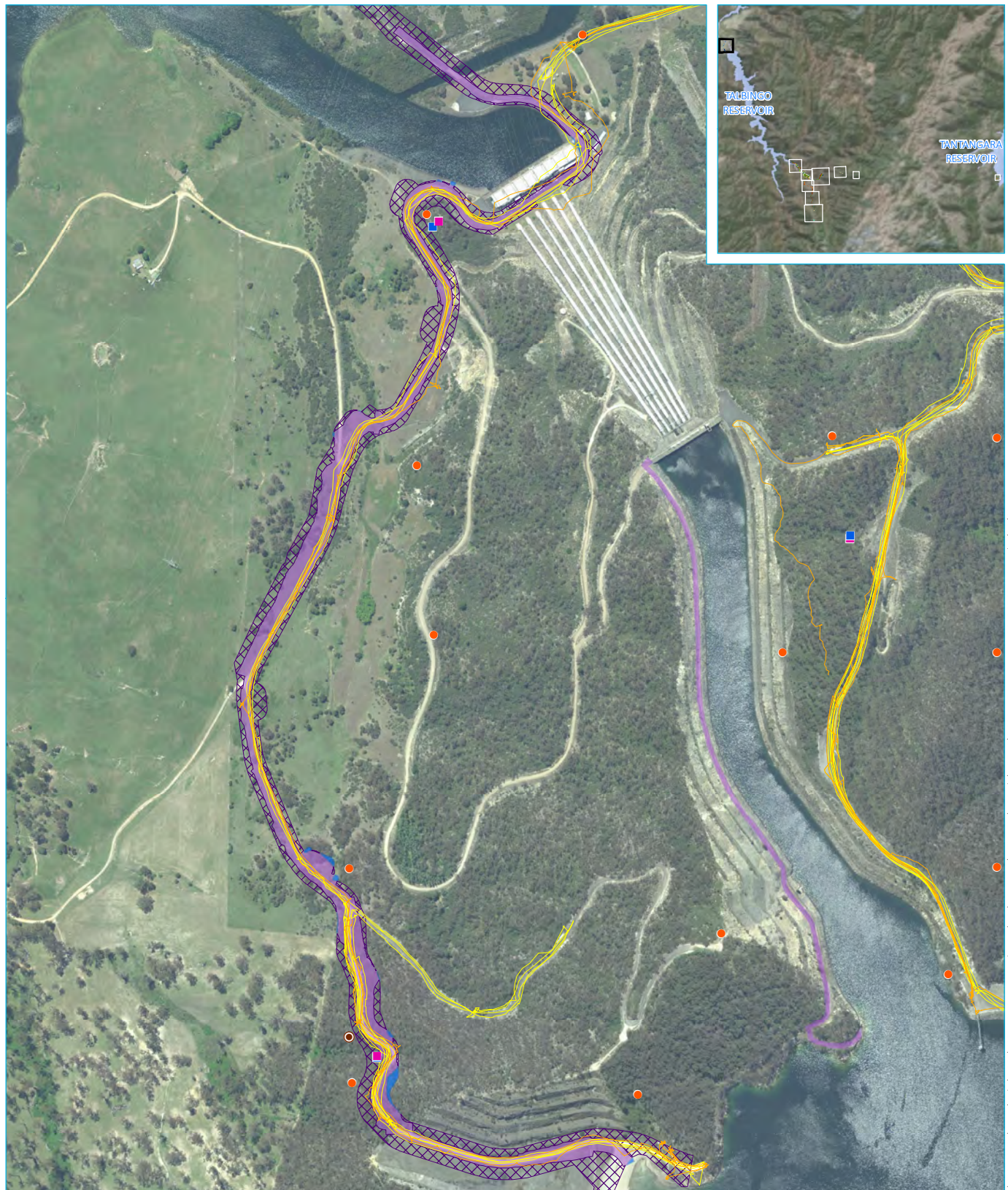
Table 6.19 Stratification units and survey area – microchiropteran bats

PCT	Area (ha)
PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion (within 200m of waterways)	0.47

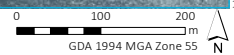
Methods and survey effort have been developed in accordance with DEC (2004) and OEH (2018a). Methods and survey effort are outlined in Table 6.20.

Table 6.20 **Methods and survey effort – microchiropteran bats**

Method	Survey description	Survey effort
Acoustic detection	OEH (2018a) permits the use of acoustic devices to record presence of the Southern Myotis. Detectors were set out over waterways and placed out for a minimum of 4 nights. Call analysis was undertaken by Amy Rowles of Corymbia Ecology, who has over 10 years experience in bat call analysis.	OEH (2018a) specifies a total effort of 16 nights for each 2.5 km of suitable habitat. Acoustic detection was completed at four sites within and adjacent to the Modification 1 disturbance footprint. This equates to a total effort of 18 nights.



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



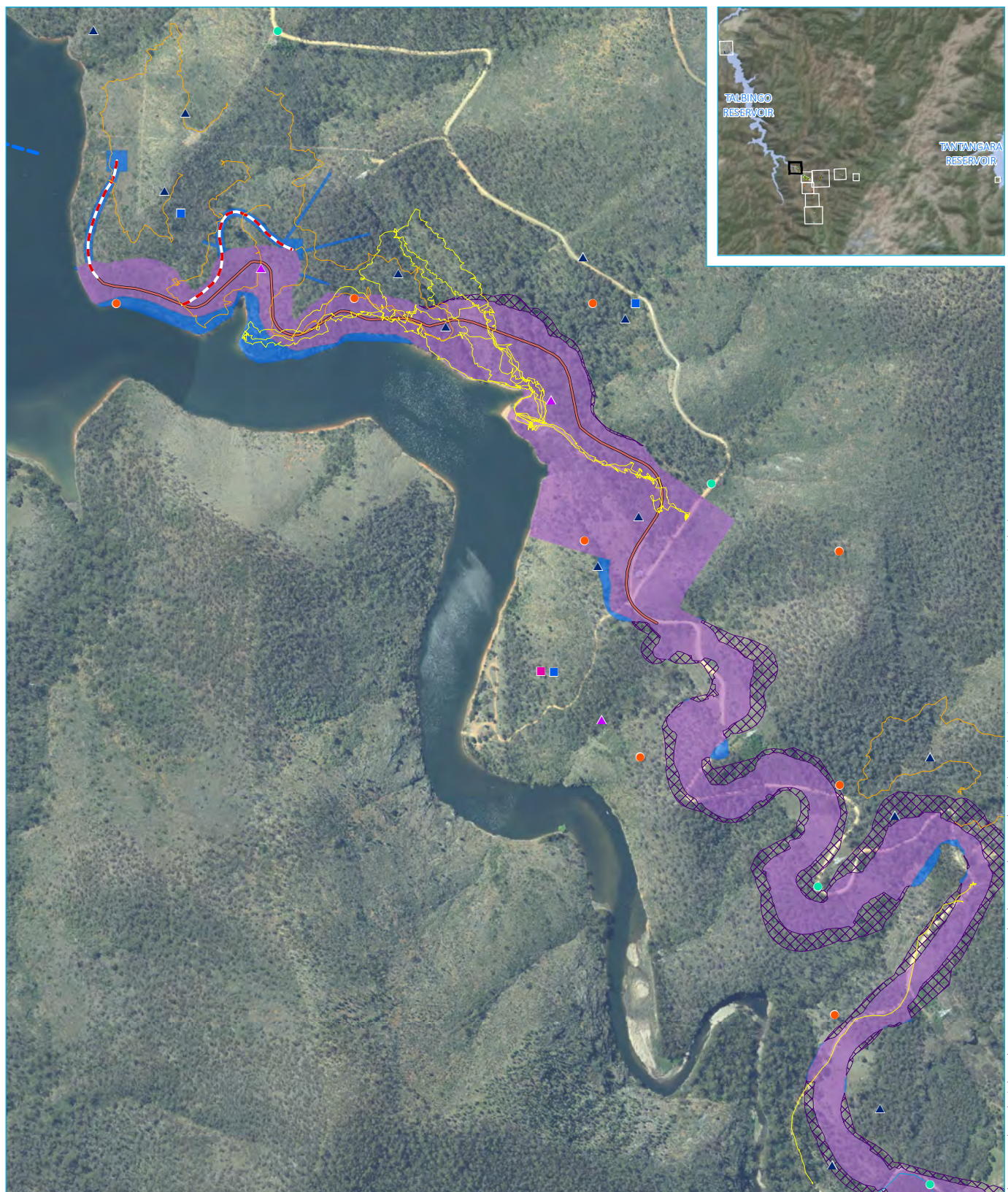
KEY

- | | |
|-------------------------------------|---|
| ● Koala songmeter | ■ EW approved construction footprint (additional) |
| ● Koala SAT survey | ■ EW approved construction footprint |
| ■ Small mammal terrestrial trapping | ▨ EW approved construction footprint reduced |
| ■ Arboreal trapping | |
| Fauna survey transect | |
| — Bird survey | |
| — Spotlighting | |

Fauna survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.2a





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

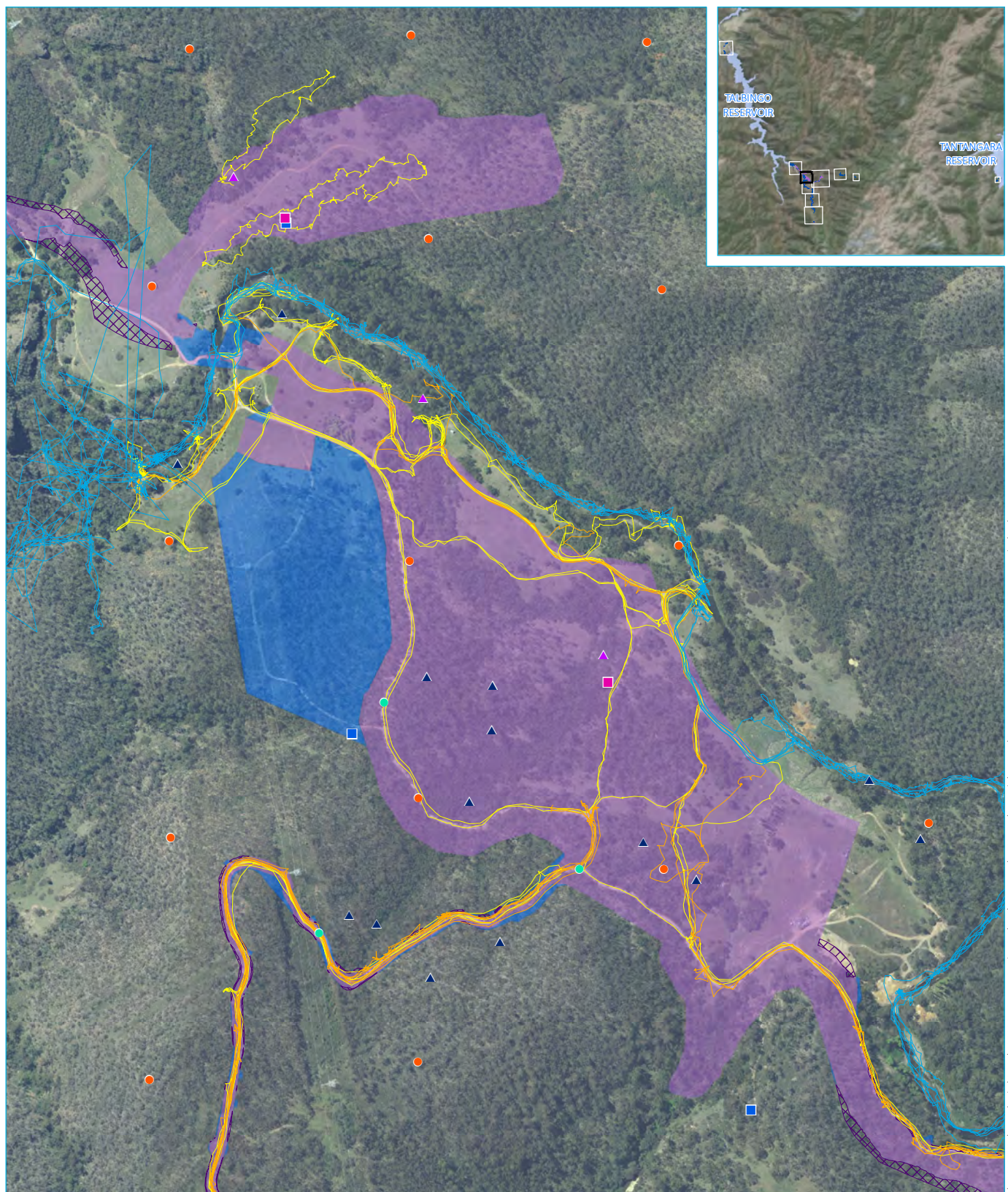
KEY

- Koala SAT survey
- Nocturnal bird survey
- Small mammal terrestrial trapping
- Arboreal trapping
- ▲ Remote camera - large
- ▲ Remote camera - small
- Fauna survey transect
 - Bird survey
 - Booroolong Frog survey
 - Spotlighting
- Proposed access track
- Approved EW access
- Boat access
- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced

Fauna survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.2b





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

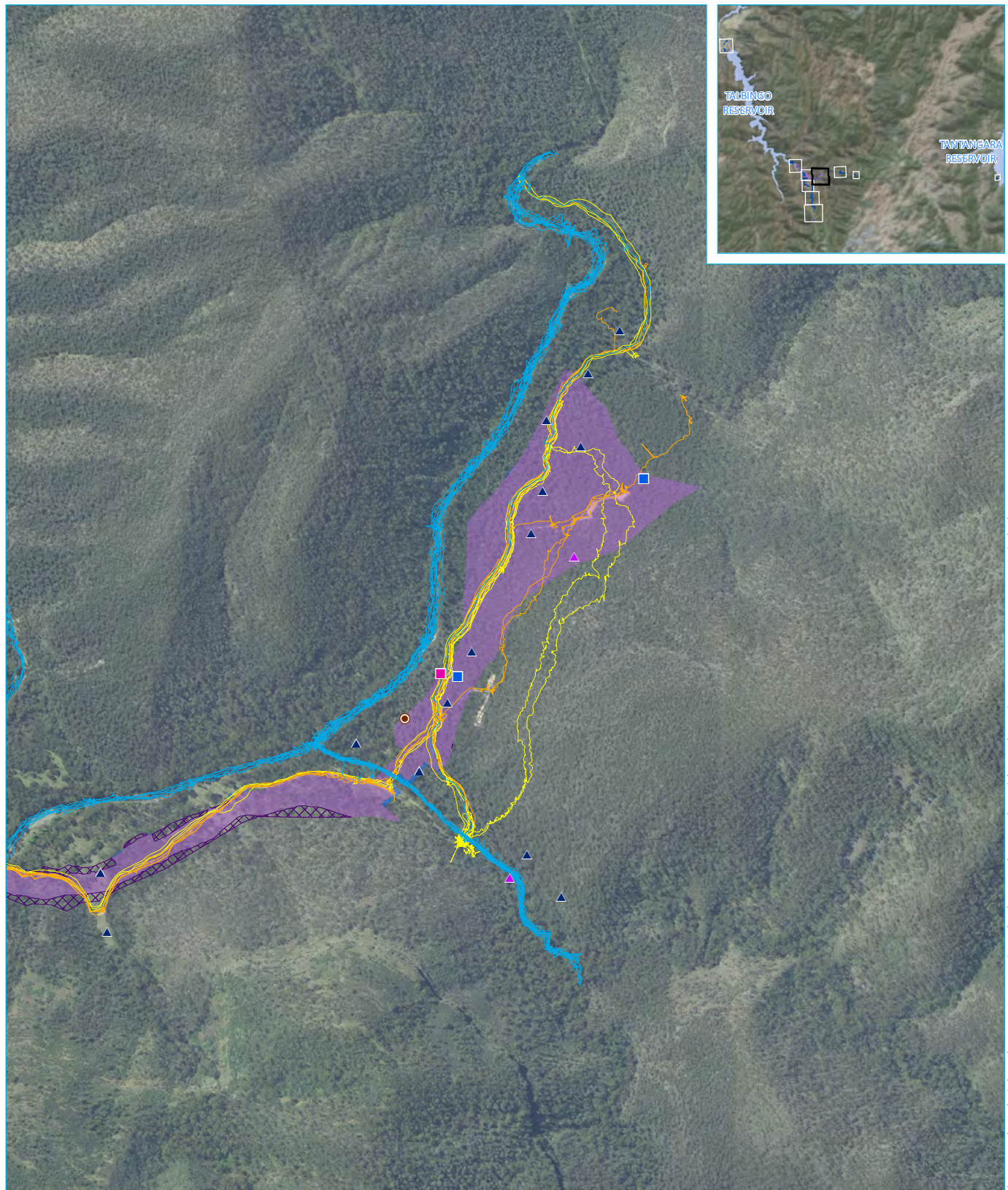
KEY

- Koala SAT survey
- Nocturnal bird survey
- Small mammal terrestrial trapping
- Arboreal trapping
- ▲ Remote camera - large
- ▲ Remote camera - small
- Fauna survey transect
- Bird survey
- Booroolong Frog survey
- Spotlighting
- EW approved construction footprint (additional)
- EW approved construction footprint
- ▨ EW approved construction footprint reduced

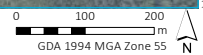
Fauna survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.2c





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



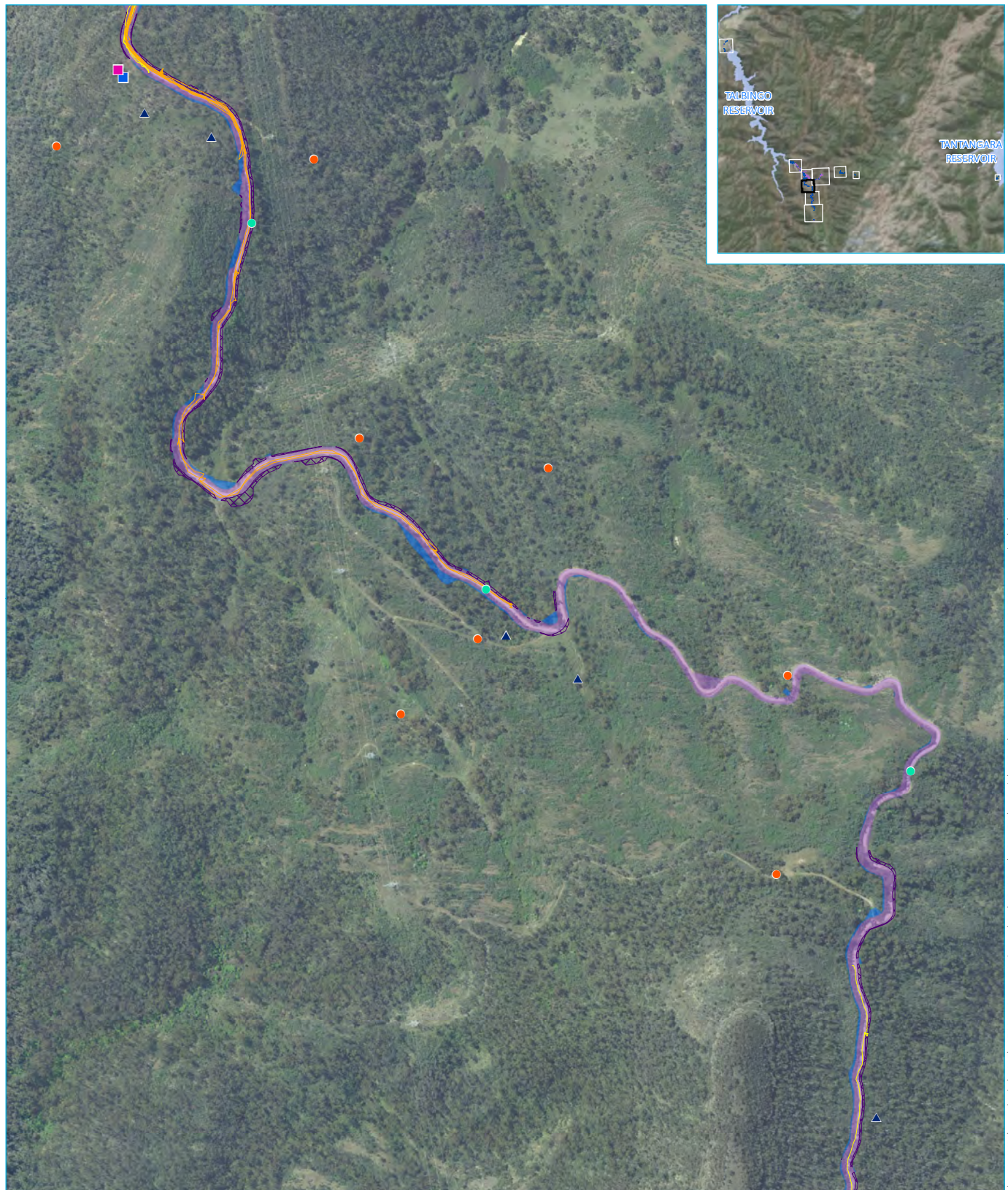
KEY

- | | |
|-------------------------------------|---|
| ● Koala songmeter | EW approved construction footprint (additional) |
| ■ Small mammal terrestrial trapping | EW approved construction footprint |
| ■ Arboreal trapping | EW approved construction footprint reduced |
| ▲ Remote camera - large | |
| ▲ Remote camera - small | |
| Fauna survey transect | |
| — Bird survey | |
| — Booroolong Frog survey | |
| — Spotlighting | |

Fauna survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.2d





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

0 100 200 m
GDA 1994 MGA Zone 55

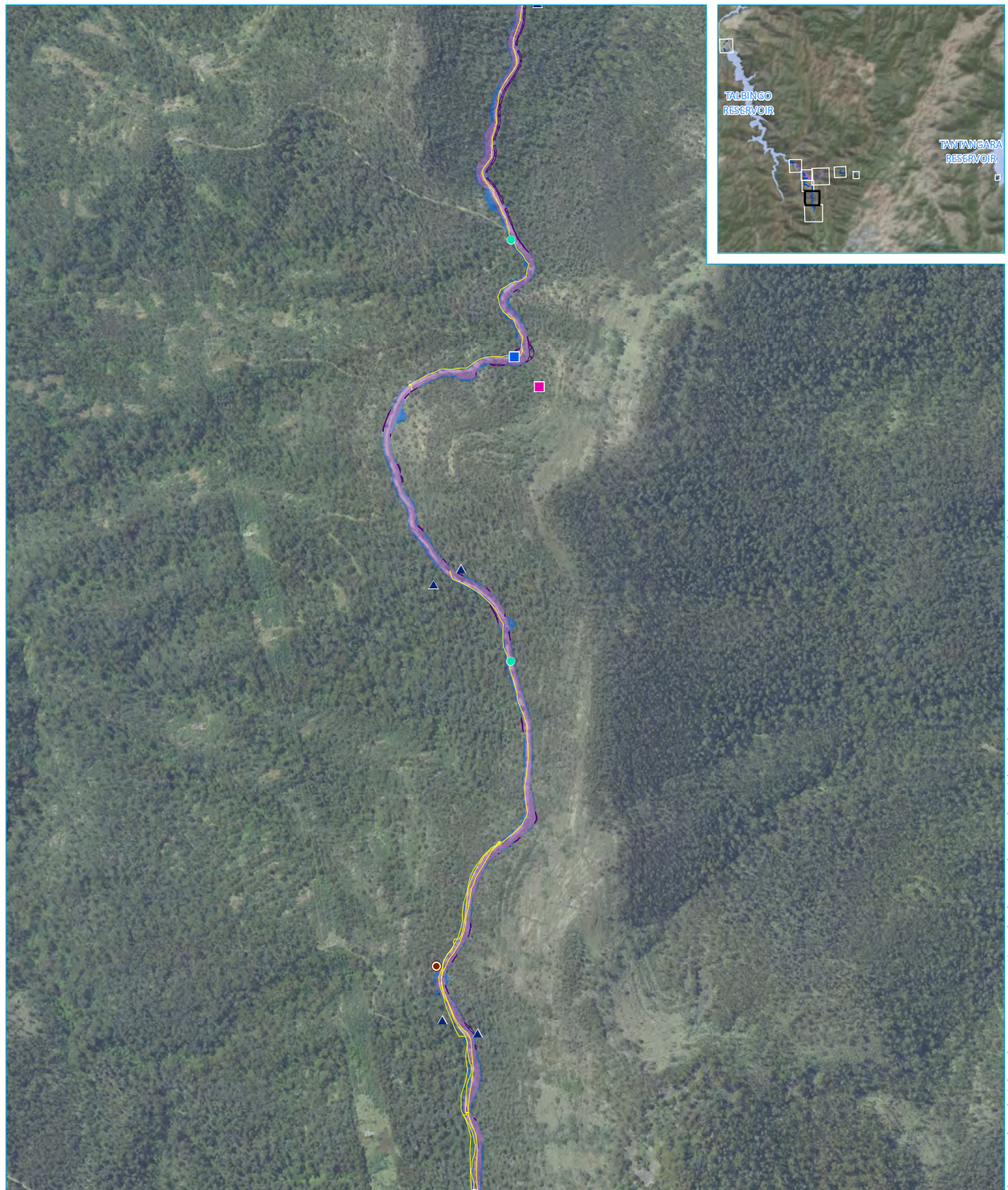
KEY

- Koala SAT survey
- Nocturnal bird survey
- Small mammal terrestrial trapping
- Arboreal trapping
- ▲ Remote camera - small
- Fauna survey transect
- Bird survey
- Booroolong Frog survey
- Spotlighting
- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced

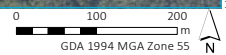
Fauna survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.2e





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



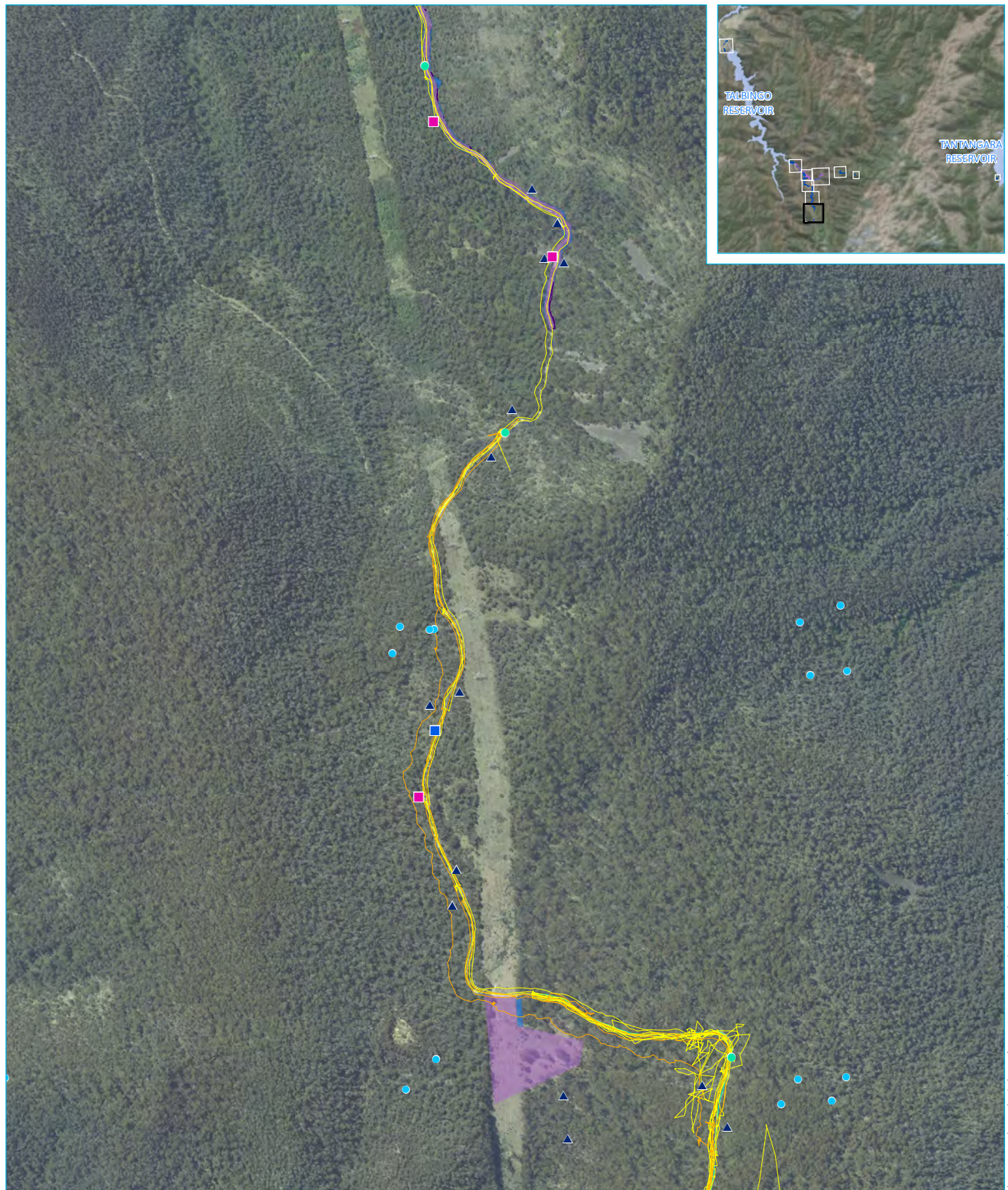
KEY

- Koala songmeter
- Nocturnal bird survey
- Small mammal terrestrial trapping
- Arboreal trapping
- ▲ Remote camera - small
- Fauna survey transect
- Spotlighting
- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced

Fauna survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.2f





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

0 100 200
m
GDA 1994 MGA Zone 55

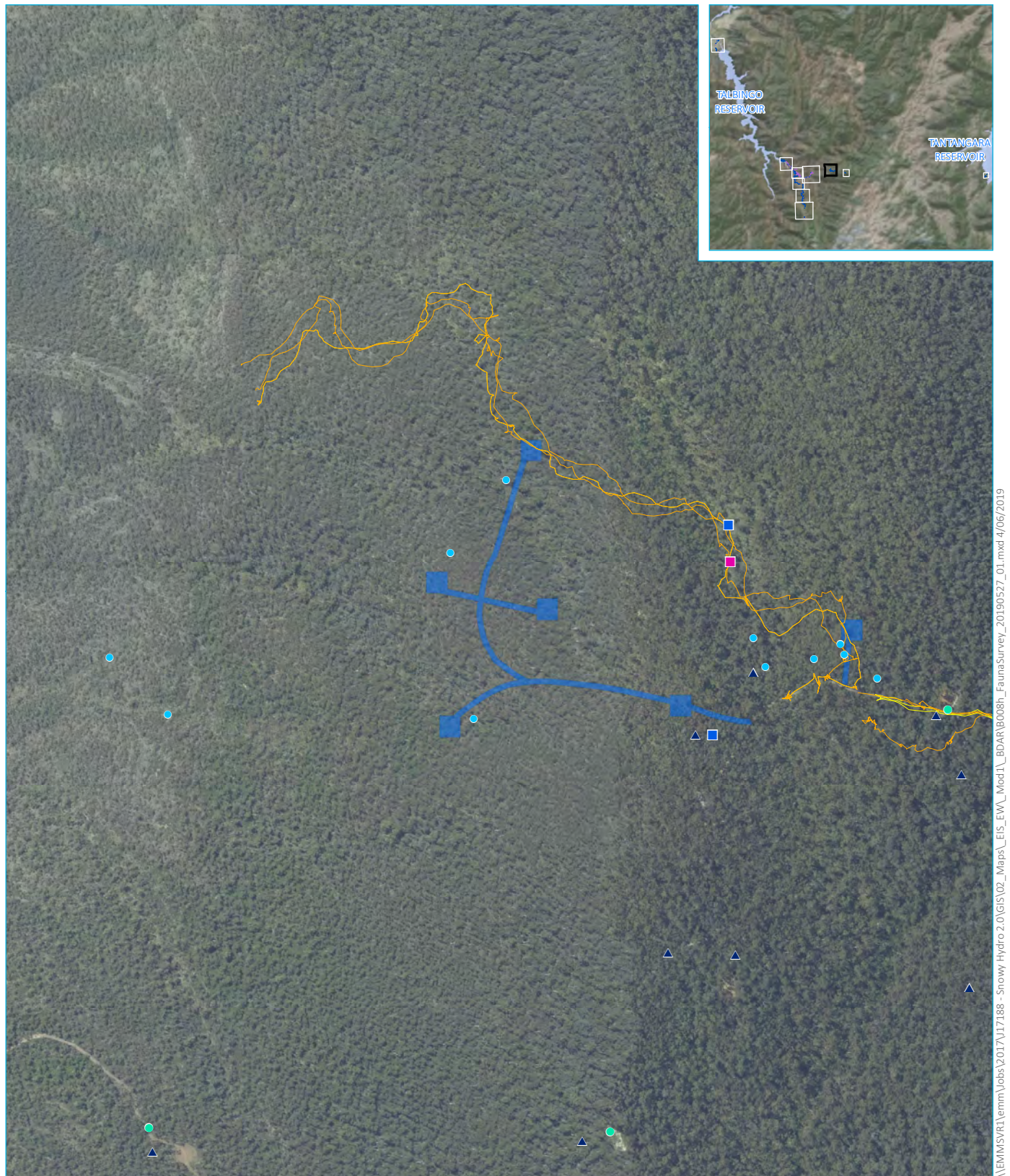
KEY

- Smoky mouse regional camera
- Nocturnal bird survey
- Small mammal terrestrial trapping
- Arboreal trapping
- ▲ Remote camera - small
- Fauna survey transect
- Bird survey
- Alpine Tree Frog survey
- Spotlighting
- EW approved construction footprint (additional)
- EW approved construction footprint
- ⊠ EW approved construction footprint reduced

Fauna survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.2g





KEY

- Smoky Mouse regional camera
- Nocturnal bird survey
- Small mammal terrestrial trapping
- Arboreal trapping
- ▲ Remote camera - small
- EW approved construction footprint (additional)

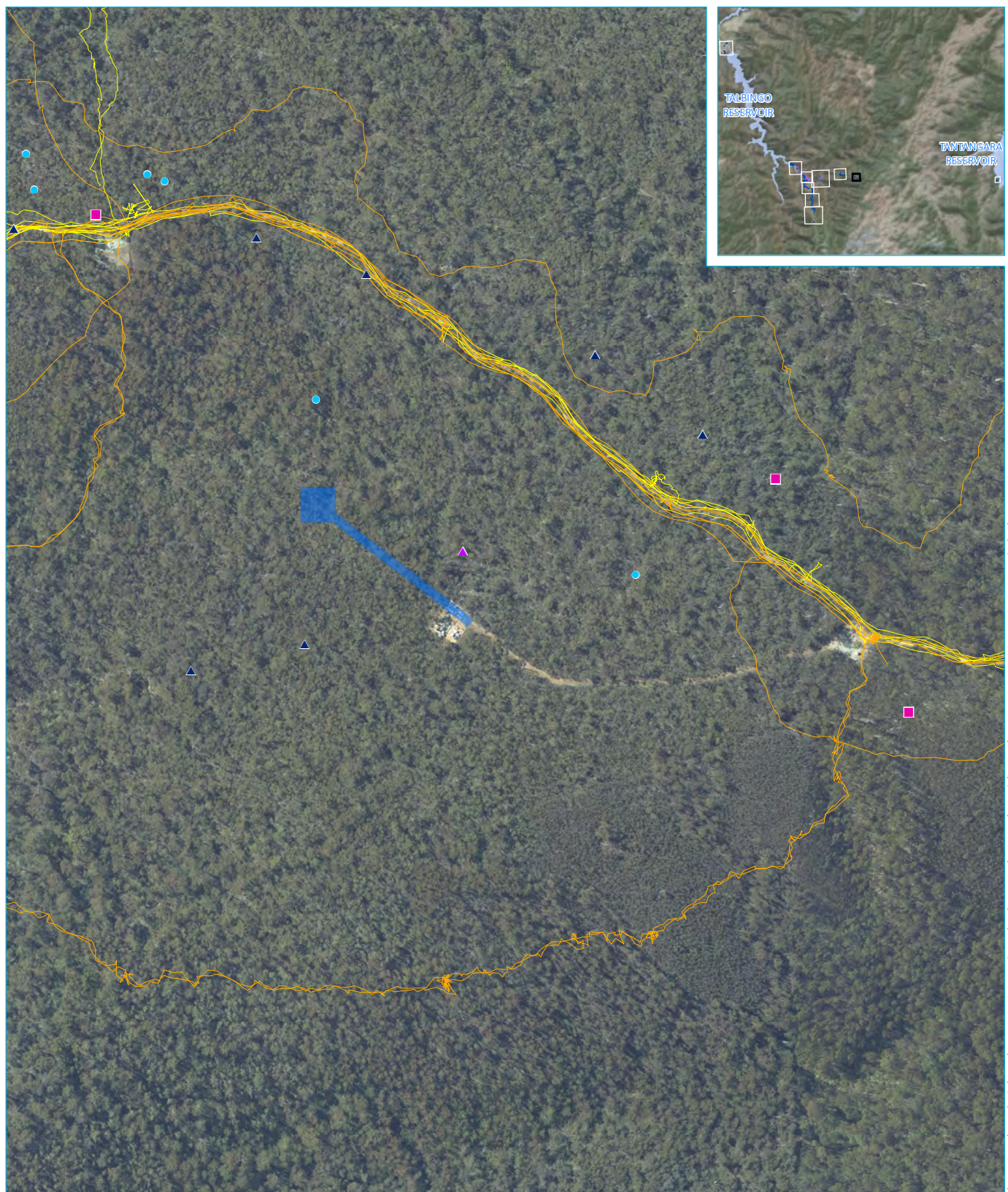
Fauna survey transect

- Bird survey
- Spotlighting

Fauna survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.2g





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

KEY

- Smoky Mouse regional camera
- Small mammal terrestrial trapping
- ▲ Remote camera - large
- ▲ Remote camera - small
- EW approved construction footprint (additional)

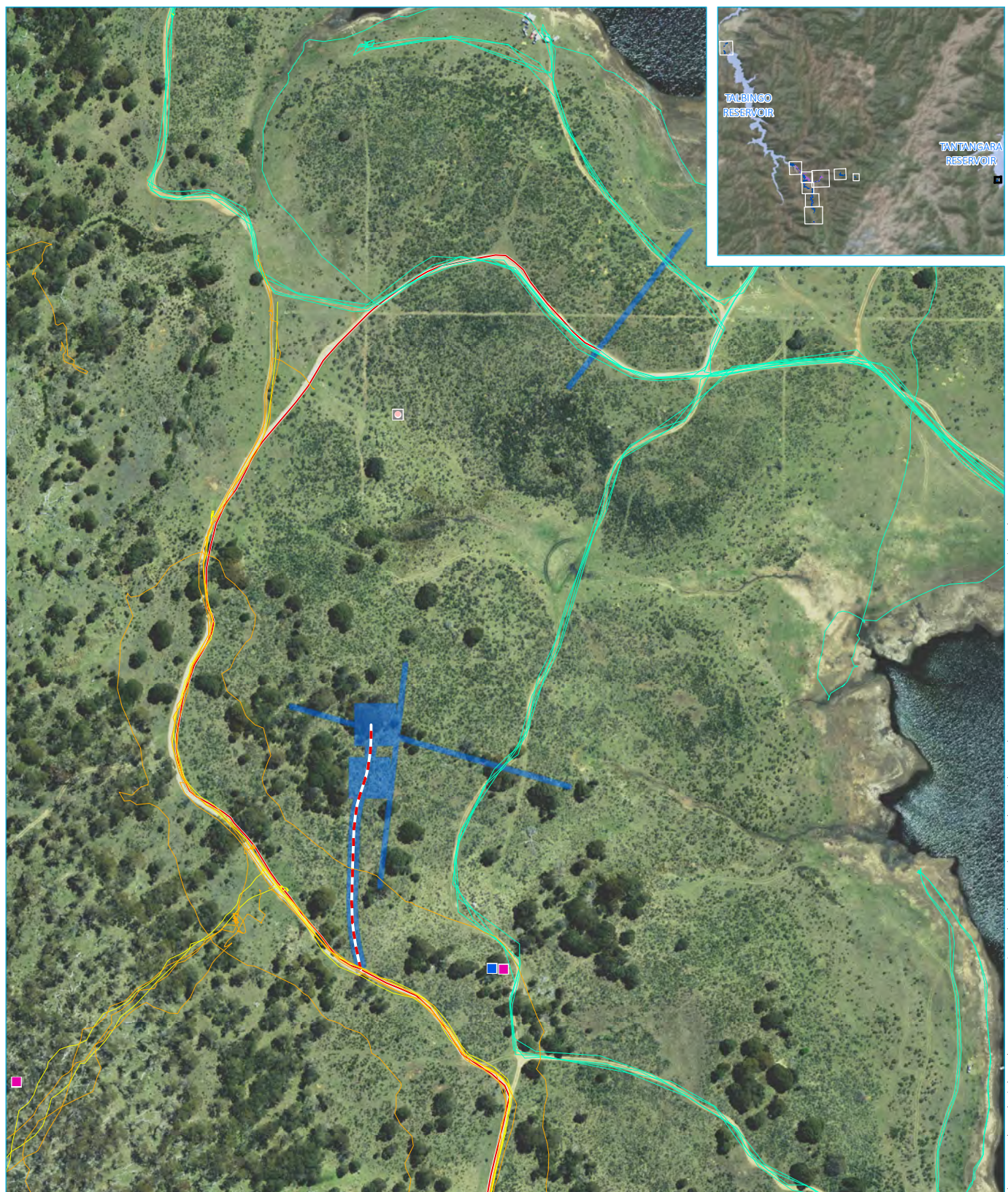
Fauna survey transect

- Bird survey
- Spotlighting

Fauna survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.2i





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

0 100 200 m
GDA 1994 MGA Zone 55

KEY

- Tile grid
- Tile transect
- Small mammal terrestrial trapping
- Arboreal trapping
- Existing access track
- - Proposed access track
- EW approved construction footprint (additional)

Fauna survey transect

- Bird survey
- Alpine Tree Frog survey
- Spotlighting

Fauna survey locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.2j



6.3.4 Targeted survey results

i Threatened flora survey results

Three species of threatened flora species were recorded adjacent to the Modification 1 project area (Figure 6.3). These include:

- *Glycine latrobeana*;
- Leafy Anchor Plant (*Discaria nitida*);
- Mauve Burr-daisy (*Calotis glandulosa*); and

One threatened flora species, the Slender Greenhood, was recorded during the targeted survey within the Modification 1 disturbance footprint. Additional candidate threatened flora species, including Cotoneaster Pomaderris and Austral Toadflax, are considered to have a low likelihood of occurrence within the disturbance footprint following targeted surveys.

a Slender Greenhood

The Slender Greenhood was recorded within the disturbance boundary in PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion in the Marica area. As per Section 6.4.1.29 of the BAM (OEH 2017), all vegetation within 30 m of this record was deemed suitable habitat and used to define the species polygon.

ii Threatened fauna survey results

Fourteen threatened fauna species have been recorded within or adjacent to the Modification 1 disturbance footprint and two EPBC listed species (Figure 6.3):

- ten threatened bird species, including three EPBC listed species:
 - Brown Treecreeper (ecosystem credit species);
 - Diamond Firetail (ecosystem credit species);
 - Dusky Woodswallow (ecosystem credit species);
 - Flame Robin (ecosystem credit species);
 - Gang-gang Cockatoo;
 - Latham's Snipe (EPBC listed migratory species);
 - Masked Owl;
 - Olive Whistler (ecosystem credit species);
 - Rainbow Bee-eater (EPBC listed marine species);
 - Satin Flycatcher (EPBC listed migratory species);
 - Scarlet Robin (ecosystem credit species);

- Varied Sittella (ecosystem credit species); and
- White-bellied Sea-Eagle.
- four threatened mammal species:
 - Broad-toothed Rat;
 - Eastern Pygmy-possum;
 - Smoky Mouse; and
 - Spotted-tailed Quoll.
- two threatened amphibian species:
 - Booroolong Frog; and
 - Alpine Tree Frog.

Threatened fauna survey results are outlined for each survey group in the section below. Ecosystem credit species are not discussed further in this section, as they are not candidate threatened species credit species.

a Diurnal birds

One target species, the Gang-gang Cockatoo, was recorded within and adjacent to the Modification 1 disturbance footprint and is considered to be impacted by Modification 1 (Figure 6.4). No other diurnal bird candidate species credit species were recorded, and all area considered a low likelihood of occurring in the disturbance footprint.

Gang-gang Cockatoo

The Gang-gang Cockatoo was found to be common throughout the Modification 1 disturbance area, with the species observed foraging at numerous locations (Figure 6.4). The species was observed to be most common in sub-alpine woodlands (such as at the top of Lobs Hole Ravine Road and Marica), riparian areas at lower elevations (close to the Yarrangobilly River) and dry sclerophyll forests (within Marica). Targeted nest searches were undertaken across the Exploratory Works survey area. The Gang-gang Cockatoo was not observed nesting but was observed investigating hollows on four occasions, one of which was recorded within 100m of Modification 1 disturbance boundary once along the Yarrangobilly River. The other occurrences outside of the project boundary were along the upper sections of Lobs Hole Ravine Road and once within Marica heard calling from within a hollow.

The Gang-gang Cockatoo nests in the trunks, limbs or dead spouts of tall living trees, in tall, mature sclerophyll forests, often near water (NSWSC 2005, 2008). Nests are located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts (OEH 2018b). Suitable hollows are most common in the areas where the species was observed to be most common; along the upper reaches of Lobs Hole Ravine Road, in PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion, along the Yarrangobilly River, in 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, and along Marica, in PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion.

The threatened biodiversity data collection (TBDC) does not specify how the species polygon for the Gang-gang Cockatoo should be defined. Thus, the species polygon has been established based on the requirements of the Superb Parrot, by providing a circular buffer of 100m around the three nest trees identified above.

On this basis, 0.01 ha of PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion was identified as potential breeding habitat for this species within the Modification 1 disturbance boundary. This data was used to determine species polygons for the species (Figure 6.4).



Photograph 6.1 **Gang-gang Cockatoo**

b **Nocturnal birds**

One target species, the Masked Owl, was recorded within or adjacent to the Modification 1 disturbance footprint and is considered to be impacted by Modification 1 (Figure 6.5). The Powerful Owl is considered likely to forage within the disturbance footprint on occasion given the species large home range, provided a nesting pair is found within the locality. A deceased Powerful Owl was recorded within Lobs Hole; however, no evidence of nesting was observed and the species was not recorded during targeted surveys.

The Barking Owl is considered a low likelihood of occurring within the Exploratory Works modification disturbance footprint. The Barking Owl is considered scarce at higher elevations of the tablelands (NPWS 2003) and the species is known to respond strongly to call playback. Given the failure to record this species during targeted surveys it is considered unlikely to occur.

Masked Owl

The Masked Owl was recorded at two locations within and adjacent to the Exploratory Works modification 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 (Figure 6.5). Both records were from the species being “called in” as a result of call playback.

The Masked Owl nests in large (greater than 90 cm diameter at breast height), old, hollow eucalypts. Nesting hollows are greater than 40 cm wide and 100 cm deep. Unlike other forest owls, there is no relationship with distance to watercourses and the species will breed in a variety of topographic positions (DEC 2006b). Suitable sized trees and hollows are restricted to the two areas where the species was observed; the upper sections or Lobs Hole Ravine Road in areas of PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion and along the Yarrangobilly River in 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. However, no nesting birds were identified during surveys.

As per the TBDC, the species polygon should be established by providing a circular buffer of 100m around the nest tree. As no nesting birds were observed a species polygon for the Masked Owl has not been identified, and offsets are not required.



Photograph 6.2 **Masked Owl**

c **Small terrestrial mammals**

Two target species, the Eastern Pygmy-possum and Smoky Mouse, were recorded within or adjacent to the Exploratory Works modification disturbance footprint and are considered to be impacted by Modification 1 (Figure 6.6).

Eastern Pygmy-possum

The Eastern Pygmy-possum was recorded at numerous locations within or adjacent to the Exploratory Works modification disturbance footprint, within the upper reaches of Lobs Hole Ravine Road to Lobs Hole and spanning across to Marica (Figure 6.6). The species has been recorded in the following PCTs:

- PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion;
- 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 western Kosciuszko escarpment;
- 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;
- PCT 729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion;
- PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion.

The Eastern Pygmy-possum can be found in a broad range of habitats from rainforest through sclerophyll forest and woodland to heath, but in most areas woodlands and heath appear to be preferred. The species feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes and there is a strong association with Banksias (Tulloch and Dickman 2006) and a dense, flowering understorey (Harris et al. 2014, Law et al. 2017).

On this basis, the PCTs listed above, plus 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 and PCT 999 – Norton’s Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion were used to develop the species polygon on the basis of suitably dense understorey habitat with flowering Banksias (Figure 6.6). PCTs in Low or Derived grassland condition classes were excluded as they do not provide a sufficiently dense understorey selected by the species.



Photograph 6.3 **Eastern Pygmy-possum (image courtesy of Lachlan Hall)**

Smoky Mouse

Extensive targeted surveys for the Smoky Mouse have been undertaken, with the species identified at 62 locations within and adjacent to the Exploratory Works modification disturbance footprint (four by terrestrial trapping and 59 by remote camera, Figure 6.7).

The species distribution 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 and Snow Gum, 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. At around 1,100 m, vegetation transitions to drier communities dominated by Peppermint, Brittle Gum and Candlebark with a moderate to sparse midstorey and sparse grassy groundcover. Soils also become much rockier and may be less suitable for burrowing.

A conservative assessment of habitat has been undertaken, 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) to around 1,100 m identified as potential habitat (Figure 6.6). This includes the following PCTs:

- PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion;
- PCT 953 - Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion; and
- PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion.

This data was used to determine species polygons for this species (Figure 6.6).



Photograph 6.4 **Smoky Mouse**

d **Large terrestrial mammals**

No Spotted-tail Quolls were recorded during targeted surveys within the Modification 1 disturbance footprint. However, an incidental record of Quoll scat was recorded off Wallaces Creek Firetrail.

The Spotted-tail Quoll is known to have home ranges of several hundred to several thousand hectares and occurs at low densities (DELWP 2016, DEWHA 2009, DSE 2011a). The species is primarily forest-dependent, and occupies a wide range of habitat types, including rainforest, wet and dry sclerophyll forest, coastal heathland, scrub and dunes, woodland, heathy woodland, swamp forest, mangroves, on beaches and sometimes in grassland or pastoral areas adjacent to forested areas. Given this, the species has potential to occupy the Exploratory Works disturbance footprint at low densities, with large areas of suitable habitat present throughout the locality; the species is likely to be wide ranging. All areas of the survey area are deemed to provide suitable habitat, with suitable denning sites focused on boulderfields on Lobs Hole Ravine Road, and areas with a high density of hollow logs in sub-alpine areas at the top of Lobs Hole Ravine Road and along the Yarrangobilly River.

However, as the species is an ecosystem credit species for the purposes of the BAM a species polygon has not been developed.

e Arboreal mammals

No arboreal mammals were recorded during targeted surveys.

Although there is some potential for these species to occur at low densities and/or utilise habitats within the Modification 1 project area on occasion the species are not considered present for the purposes of this assessment. Habitat for the Greater Glider, which coincides with Smoky Mouse habitat, will not be significantly impacted (see Section 7).

The Koala is rare in the KNP, with a single record within 10 km of the Exploratory Works modification survey area and a recent record in November 2016 from near Blowering Dam, east of Tumut (ABC News 2018). There is insufficient evidence to undertake a Koala habitat assessment in accordance with the Koala habitat assessment tool outlined in DoE (2014). Therefore, RGB SAT surveys, spotlighting and Songmeter surveys were undertaken. The Koala was not observed during these surveys and is considered unlikely to occur for the purposes of this assessment.

f Reptiles

The Alpine She-oak Skink was not recorded within the disturbance boundary however records were found within adjacent areas. The species is known to occur in temperate montane grasslands, favouring tree-less or very lightly treed areas containing tussock grasses, low heath or a combination of both. Records were found within PCT 1224 – Sub alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion.

PCT 1224 – Sub alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion is located in south Tantangara within the disturbance footprint. This area is subject to high levels of human disturbance from campers and fishing activities as well as additional horse activity close to the water. Therefore, considering high levels of disturbance and no records of the species around Tantangara Dam it is considered unlikely the species occurs within the project boundary and therefore a species polygon has not been developed.

g Amphibians

Two target species, the Booroolong Frog and Alpine Tree Frog, were recorded within or adjacent to the Modification 1 disturbance footprint

Booroolong Frog

Extensive targeted surveys were undertaken of all permanent to intermittent watercourses within the Exploratory Works modification survey area. The Booroolong Frog was recorded 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. It is likely that this population extends upstream to at least Blue Creek Firetrail (Dave Hunter OEH, pers. comm.).

The Yarrangobilly River is a major regional watercourse that flows into the Talbingo Reservoir. The Yarrangobilly River catchment is wholly within the KNP. Water quality sampling has been undertaken by EMM at four locations in the Yarrangobilly River and at three locations in Wallaces Creek. All sampling was undertaken during base flow conditions. A summary of the water quality results is presented in Appendix F, with locations shown in Figure 6.9. Key results from water quality sampling are summarised as follows:

- pH ranged between 6.7 to 8.3, sitting outside the ANZECC (2000) guideline range of 6.8 to 8.5;
- electrical conductivity (an indicator of salinity) ranged between 43 to 184 $\mu\text{S}/\text{cm}$, 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 within guideline values; and
- all dissolved metal concentrations were below guideline values following hardness adjustments with the exception of:
 - 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 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 River, see Figure 6.8).

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. This criterion was used to develop the species polygon for the Booroolong Frog (Figure 6.8).



Photograph 6.5 **Booroolong Frog**

Alpine Tree Frog

The Alpine Tree Frog was recorded adjacent to the Exploratory Works modification footprint in southern Tantangara, and the species was recorded breeding in Tantangara Reservoir between minimum operating level (MOL) and full supply level (FSL) on several occasions as water levels fluctuated (Photograph 6.6).

Water quality sampling has been undertaken by EMM at five locations within Kellys Plain Creek and minor watercourses along Tantangara Reservoir. A summary of the water quality results is presented in Appendix F, with locations shown in Figure 6.9. Key results from water quality sampling are summarised as follows:

- pH ranged between 6.0 to 7.8, sitting out of the ANZECC (2000) guideline range of 6.8 to 8.5;
- electrical conductivity ranged between 26 and 68 $\mu\text{S}/\text{cm}$, sitting out of the guidelines range of 30 to 350 $\mu\text{S}/\text{cm}$;
- suspended solids and turbidity were

The Alpine Tree Frog occurs in the south-eastern NSW and Victorian high country (alpine and sub-alpine zones) generally above 1100 m asl. Most locations are within National Park and some are close to alpine resorts. This species is found in a wide variety of habitats including woodland, heath, grassland and herb fields. They will utilise natural and artificial wetlands for breeding. Non-breeding habitat and overwintering refuges are poorly known but are likely to include flat rocks, fallen logs, leaf litter and other ground debris.

On the basis of the above information, and consistent with the Booroolong Frog, the species polygon for the Alpine Tree Frog has been defined as areas within the 50 m from FSL (Figure 6.8).

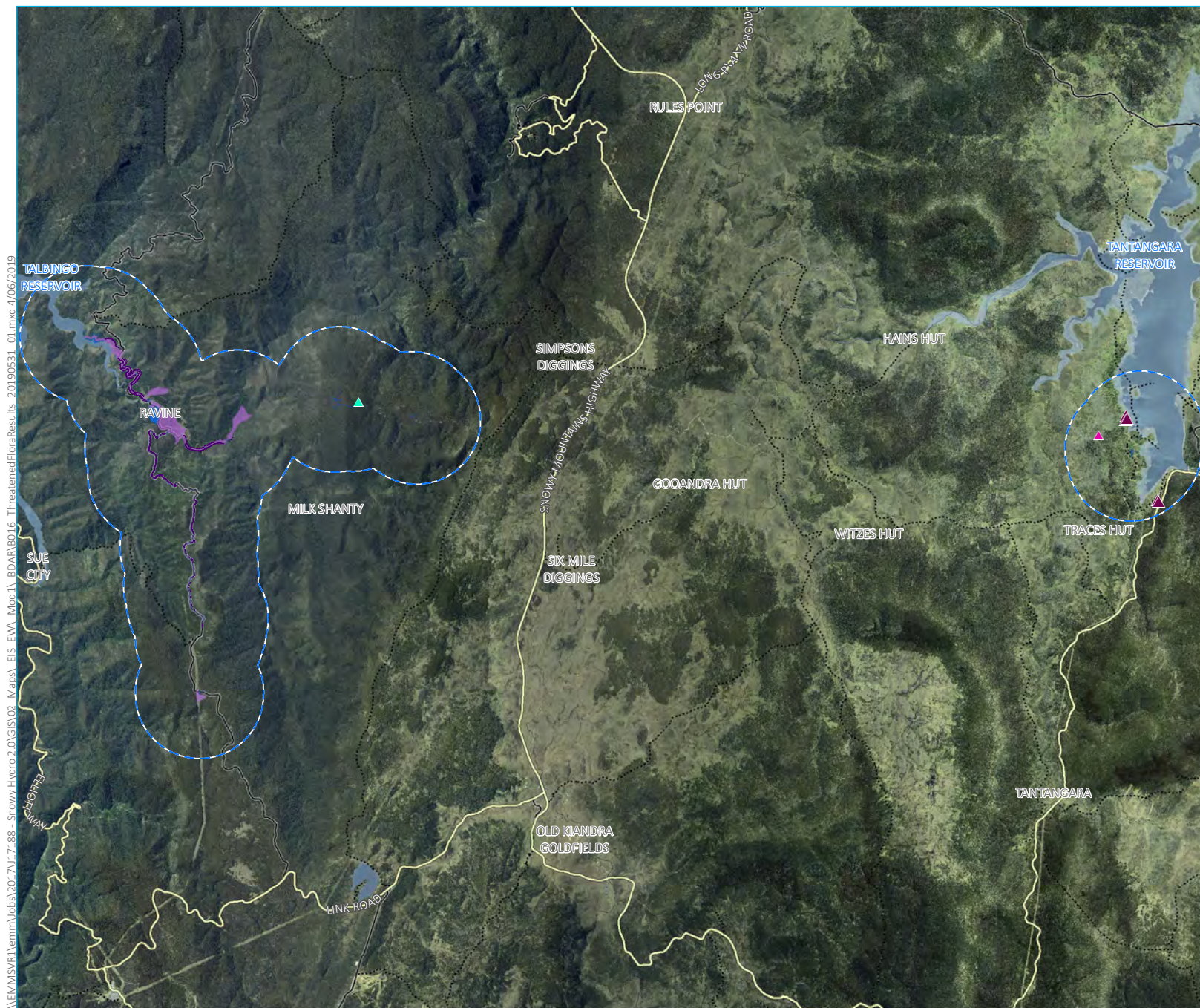


Photograph 6.6 Alpine Tree Frog recorded breeding in Tantangara Reservoir

h Microchiropteran bats

Two target species, the Eastern Bentwing-bat and Eastern False Pipistrelle were recorded within or adjacent to the Exploratory Works modification footprint. The Eastern False Pipistrelle is an ecosystem credit species. No breeding habitat for the Eastern Bentwing-bat was recorded in or adjacent to the Modification 1 project area. The Southern Myotis was not recorded within the Modification 1 project area.

As such, no species polygon is required for these target species.



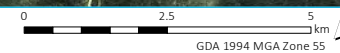
- KEY**
- Main road
 - Local road
 - Vehicular track
 - Waterbody
 - EW approved construction footprint (additional)
 - EW approved construction footprint
 - EW approved construction footprint reduced
 - 1500 m buffer
- Threatened flora**
- Leafy Anchor Plant (2)
 - Mauve Burr-daisy (1)
 - Slender Greenhood (1)
 - Glycine latrobeana* (5)

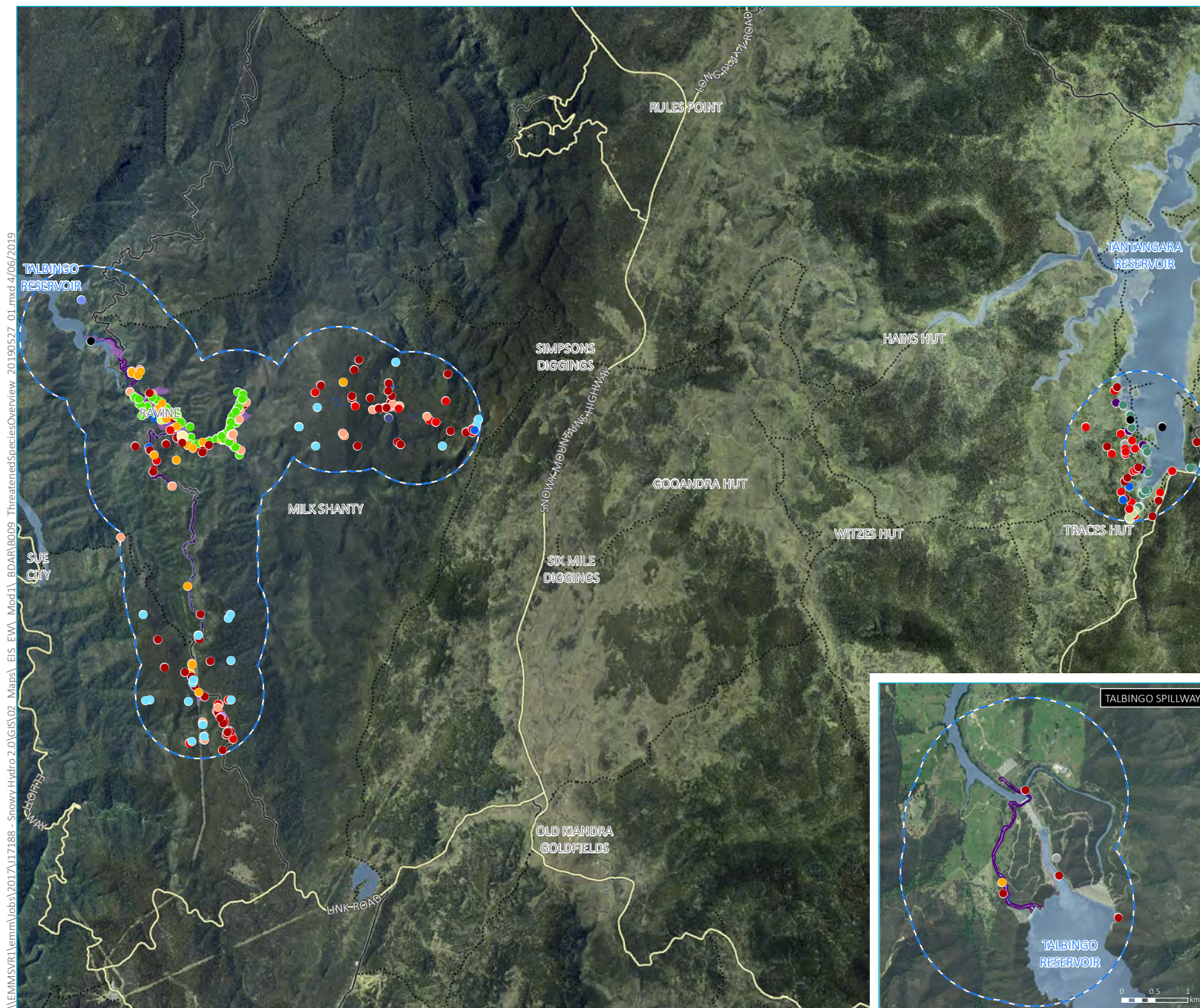
Flora survey results

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.3



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





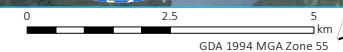
- KEY**
- Main road
 - Local road
 - Vehicular track
 - Waterbody
 - 1500 m buffer
 - EW approved construction footprint (additional)
 - EW approved construction footprint
 - EW approved construction footprint reduced
- Threatened fauna**
- Alpine Tree Frog
 - Booroolong Frog
 - Broad-toothed Rat
 - Brown Treecreeper
 - Diamond Firetail
 - Dusky Woodswallow
 - Eastern Pygmy-possum
 - Flame Robin
 - Gang-gang Cockatoo
 - Latham's Snipe
 - Masked Owl
 - Murray Crayfish
 - Olive Whistler
 - Rainbow Bee-eater
 - Satin Flycatcher
 - Scarlet Robin
 - Smoky Mouse
 - Spotted-tailed Quoll
 - Varied Sittella
 - White-bellied Sea-Eagle

Threatened fauna overview

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.4



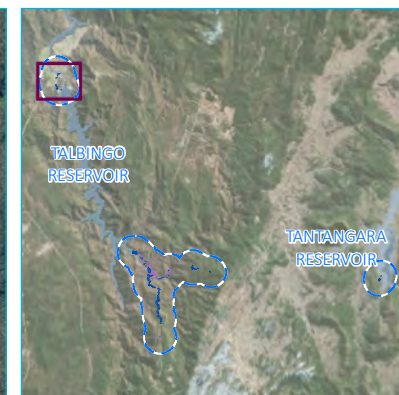
Source: EMM (2019); Snowy Hydro (2019); LPI (2019); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)



\\EMMSVR1\emm\Jobs\2017\U17188 - Snowy Hydro 2.0\GIS\02 Maps\ EIS EW Mod1\ BDAR\B010 DiurnalBirdSurvey 20190527 01.mxd 4/06/2019



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



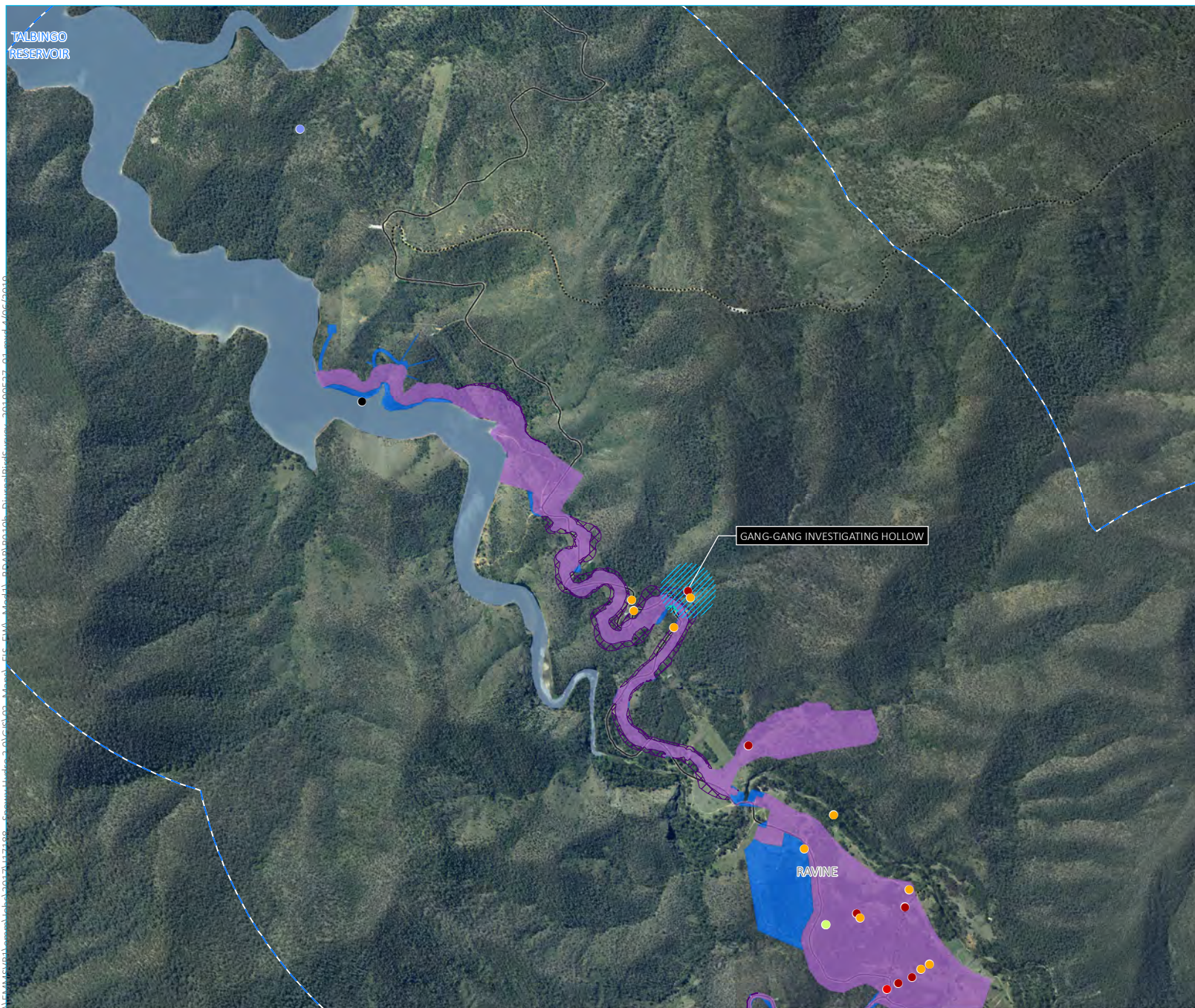
KEY

- Main road
- Local road
- Vehicular track
- Waterbody
- 1500 m buffer
- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced
- Threatened fauna
- Dusky Woodswallow (1)
- Gang-gang Cockatoo (4)
- Varied Sittella (1)

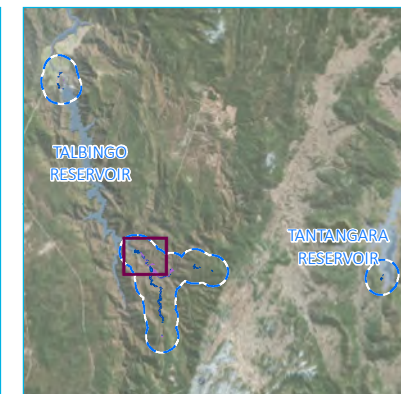
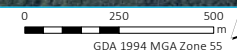
Diurnal bird survey results

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.5a





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



KEY

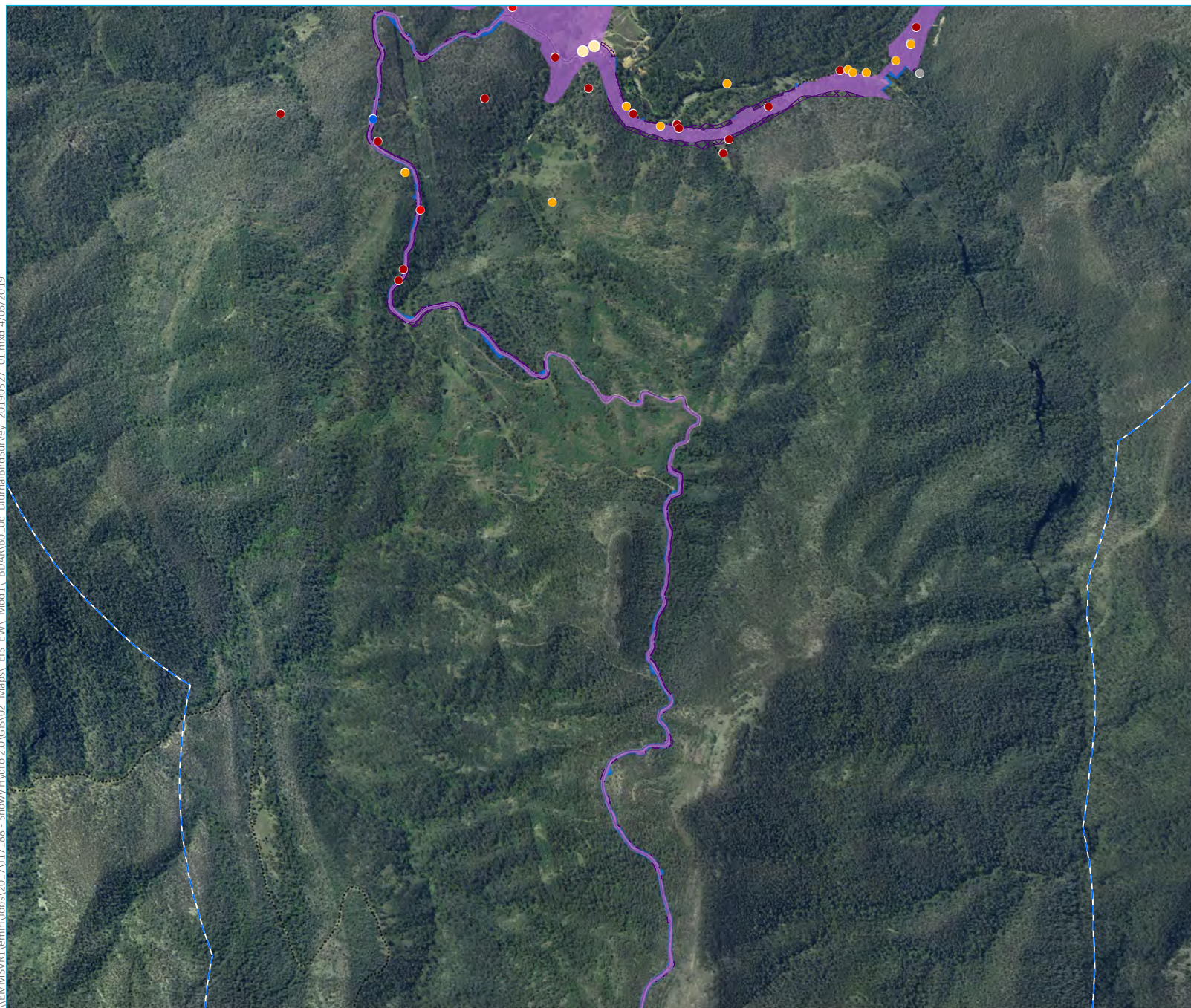
- Local road
- Vehicular track
- Waterbody
- 1500 m buffer
- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced
- Gang-gang Cockatoo species polygon
- Gang-gang Cockatoo breeding habitat
- Threatened fauna
- Brown Treecreeper (2)
- Dusky Woodswallow (10)
- Flame Robin (1)
- Gang-gang Cockatoo (6)
- Rainbow Bee-eater (1)
- White-bellied Sea-Eagle (1)

Diurnal bird survey results

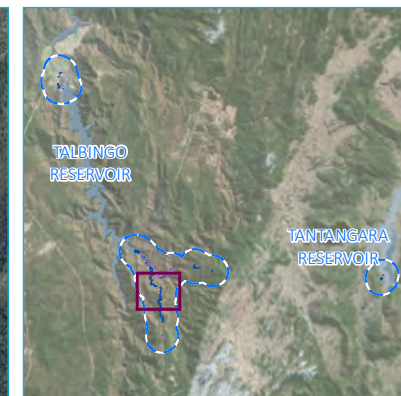
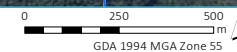
Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.5b



\\EMMSVR1\emm\Jobs\2017\U17188 - Snowy Hydro 2.0\GIS\02 Maps\ EIS EW Mod1\ BDAR\B010c DiurnalBirdSurvey 20190527 01.mxd 4/06/2019



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



KEY

- Local road
- Vehicular track
- 1500 m buffer
- EW approved construction footprint (additional)
- EW approved construction footprint
- ⊗ EW approved construction footprint reduced

Threatened fauna

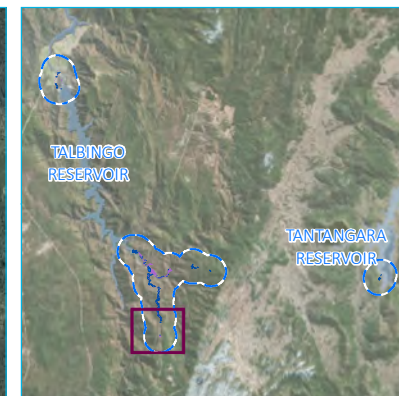
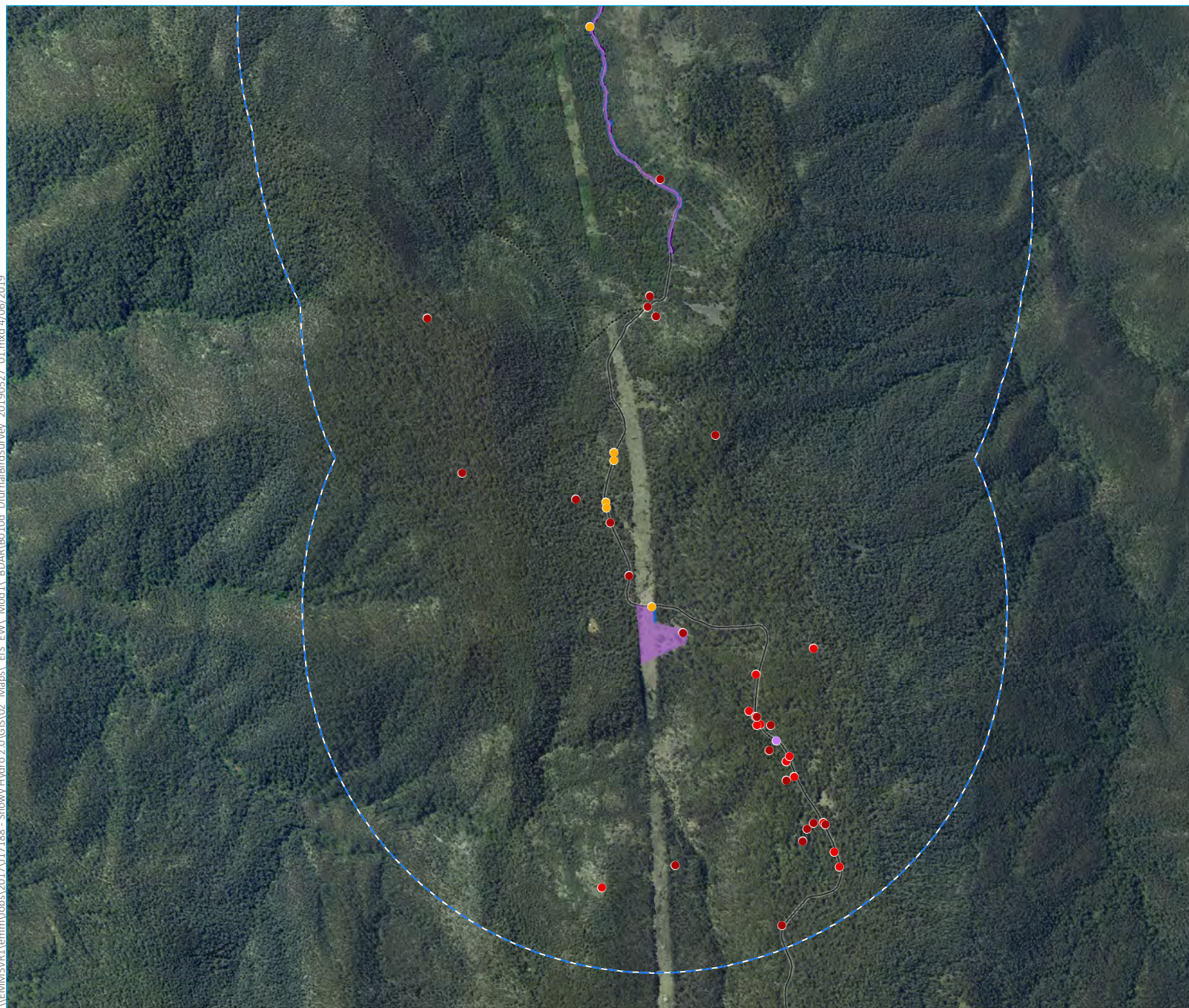
- Diamond Firetail (2)
- Dusky Woodswallow (10)
- Flame Robin (2)
- Gang-gang Cockatoo (16)
- Scarlet Robin (1)
- Varied Sittella (2)

Diurnal bird survey results

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.5c



\\EMMSVR1\emm\Jobs\2017\17188 - Snowy Hydro 2.0\GIS\02 Maps\ EIS EW Mod1\ BDAR\B010d DiurnalBirdSurvey 20190527 01.mxd 4/06/2019



KEY

- Local road
- Vehicular track
- 1500 m buffer
- EW approved construction footprint (additional)
- EW approved construction footprint
- ⊗ EW approved construction footprint reduced

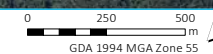
Threatened fauna

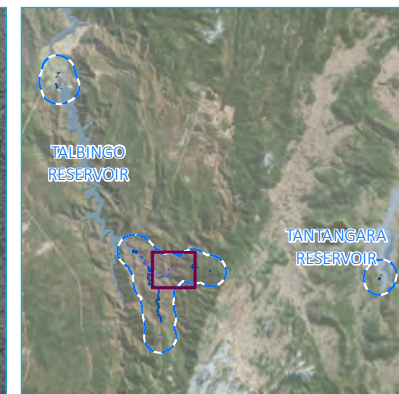
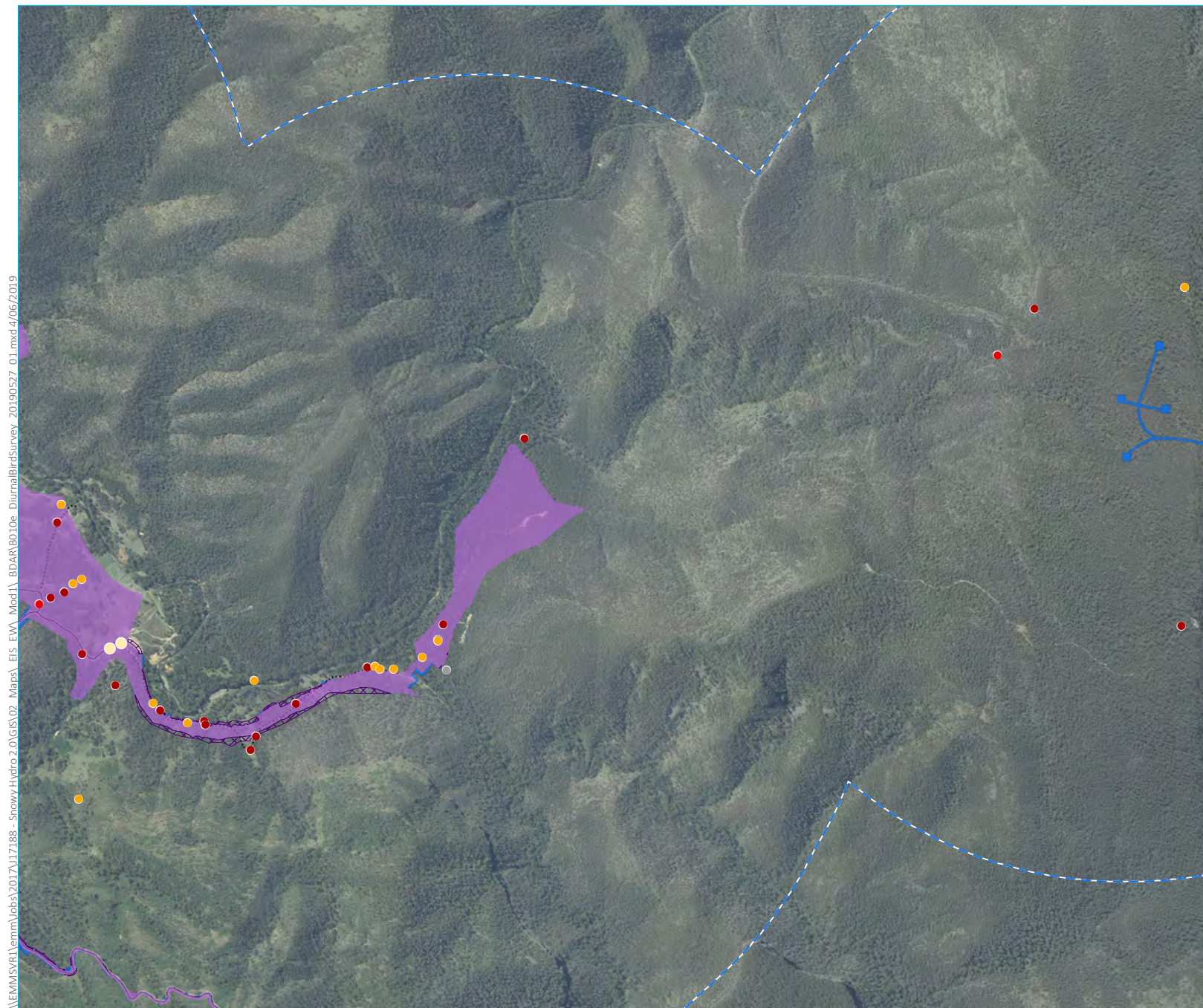
- Dusky Woodswallow (6)
- Flame Robin (13)
- Gang-gang Cockatoo (22)
- Olive Whistler (1)

Diurnal bird survey results

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.5d

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





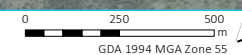
- KEY**
- Local road
 - Vehicular track
 - 1500 m buffer
 - EW approved construction footprint (additional)
 - EW approved construction footprint
 - EW approved construction footprint reduced
- Threatened fauna**
- Diamond Firetail (2)
 - Dusky Woodswallow (13)
 - Flame Robin (2)
 - Gang-gang Cockatoo (16)
 - Varied Sittella (2)

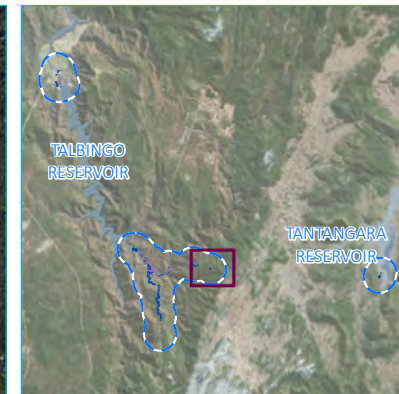
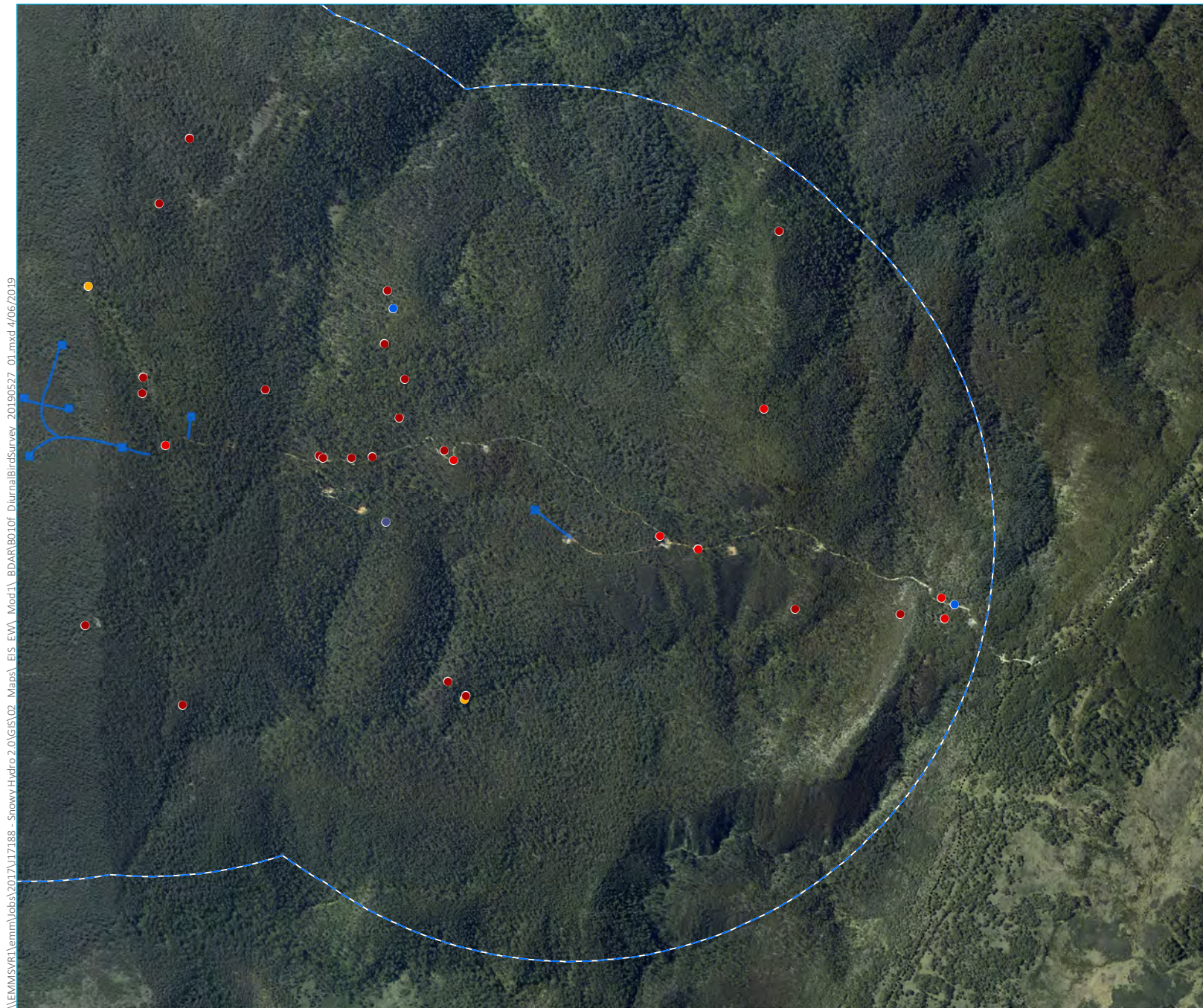
Diurnal bird survey results

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.5e



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





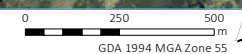
- KEY**
- Vehicular track
 - 1500 m buffer
 - EW approved construction footprint (additional)
- Threatened fauna**
- Dusky Woodswallow (2)
 - Flame Robin (7)
 - Gang-gang Cockatoo (21)
 - Satin Flycatcher (1)
 - Scarlet Robin (2)

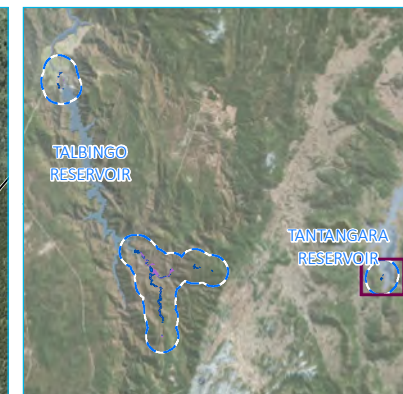
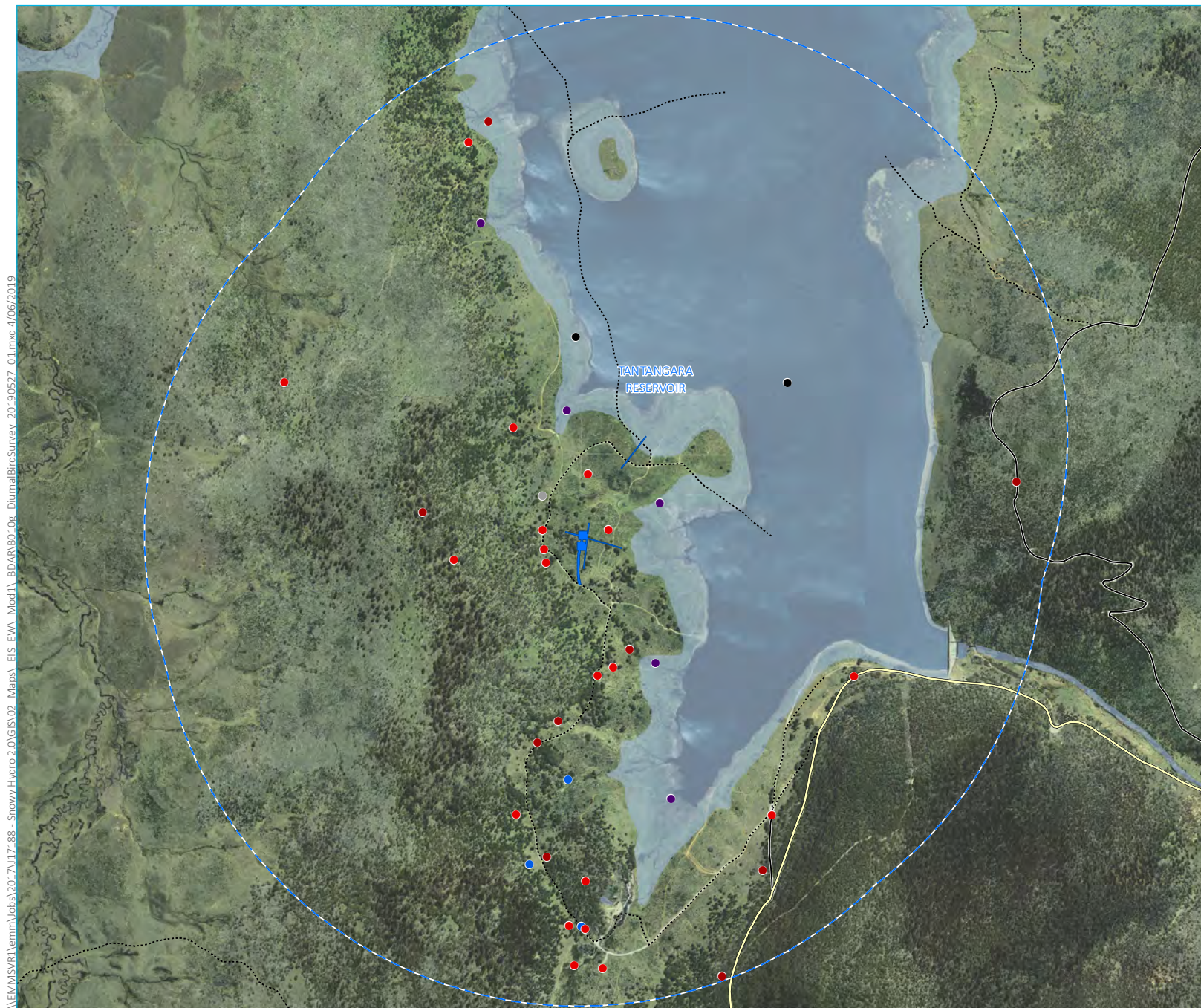
Diurnal bird survey results

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.5f



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





KEY

- Main road
- Local road
- Vehicular track
- Waterbody
- 1500 m buffer
- EW approved construction footprint (additional)

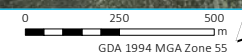
Threatened fauna

- Flame Robin (19)
- Gang-gang Cockatoo (9)
- Latham's Snipe (5)
- Scarlet Robin (3)
- Varied Sittella (1)
- White-bellied Sea-Eagle (2)

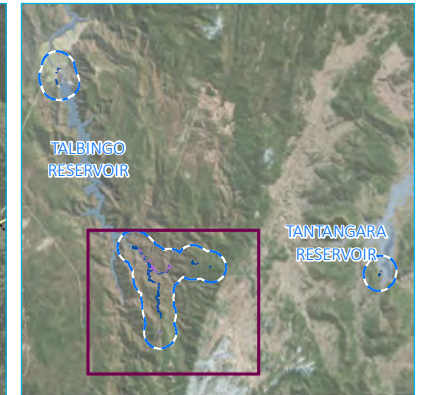
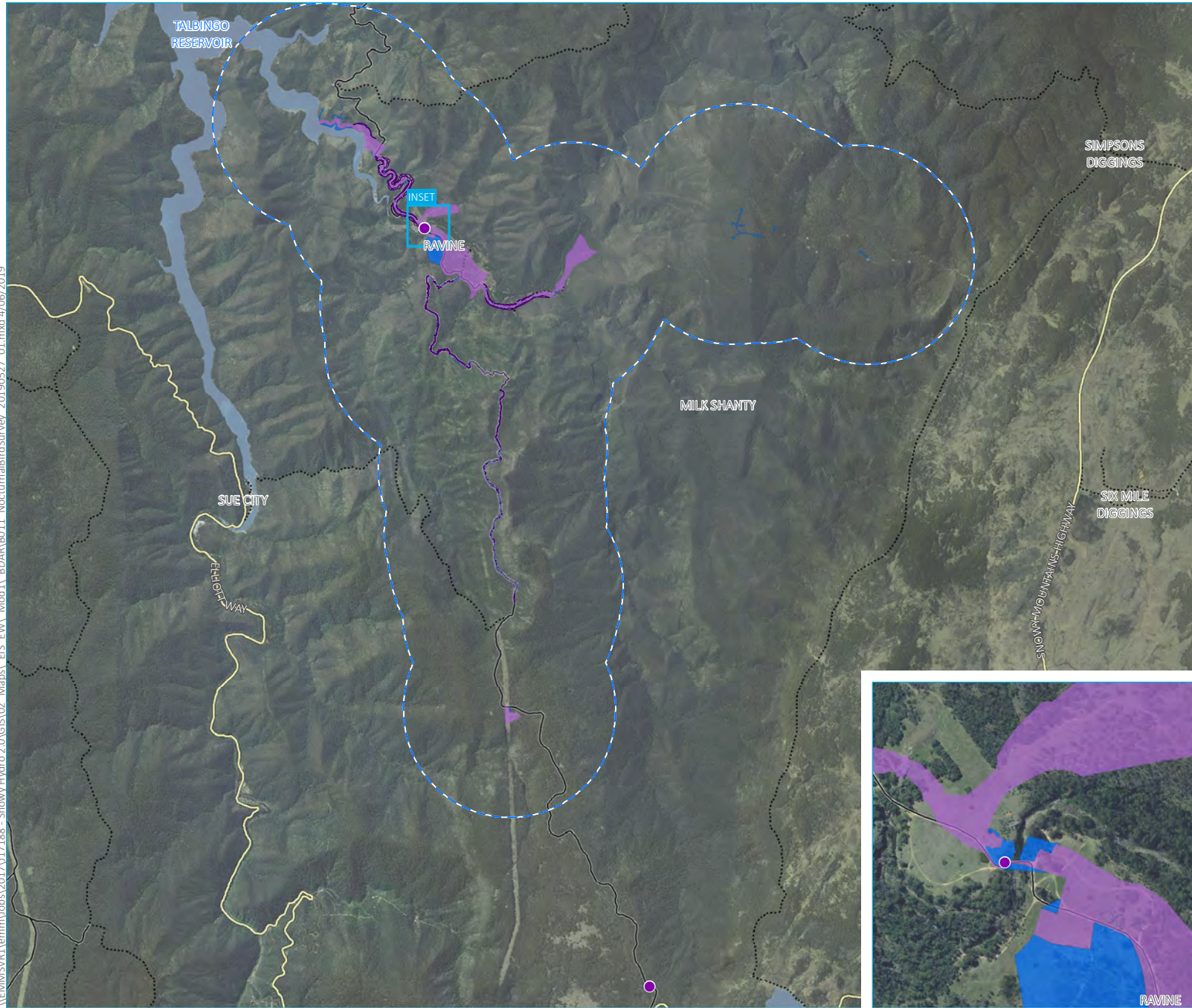
Diurnal bird survey results

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.5g

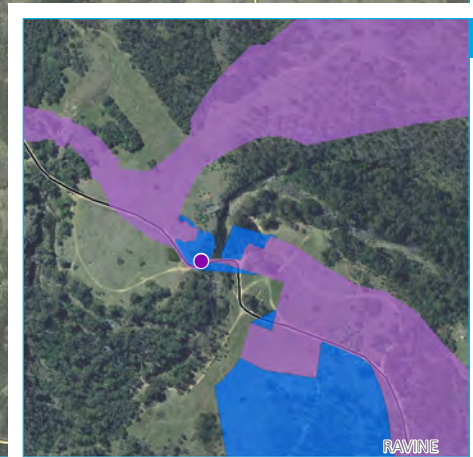
Source: EMM (2019); Snowy Hydro (2019); LPI (2019); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)



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- KEY**
- Main road
 - Local road
 - Vehicular track
 - Waterbody
 - 1500 m buffer
 - EW approved construction footprint (additional)
 - EW approved construction footprint
 - EW approved construction footprint reduced
 - Threatened fauna
 - Masked Owl

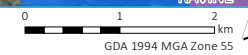


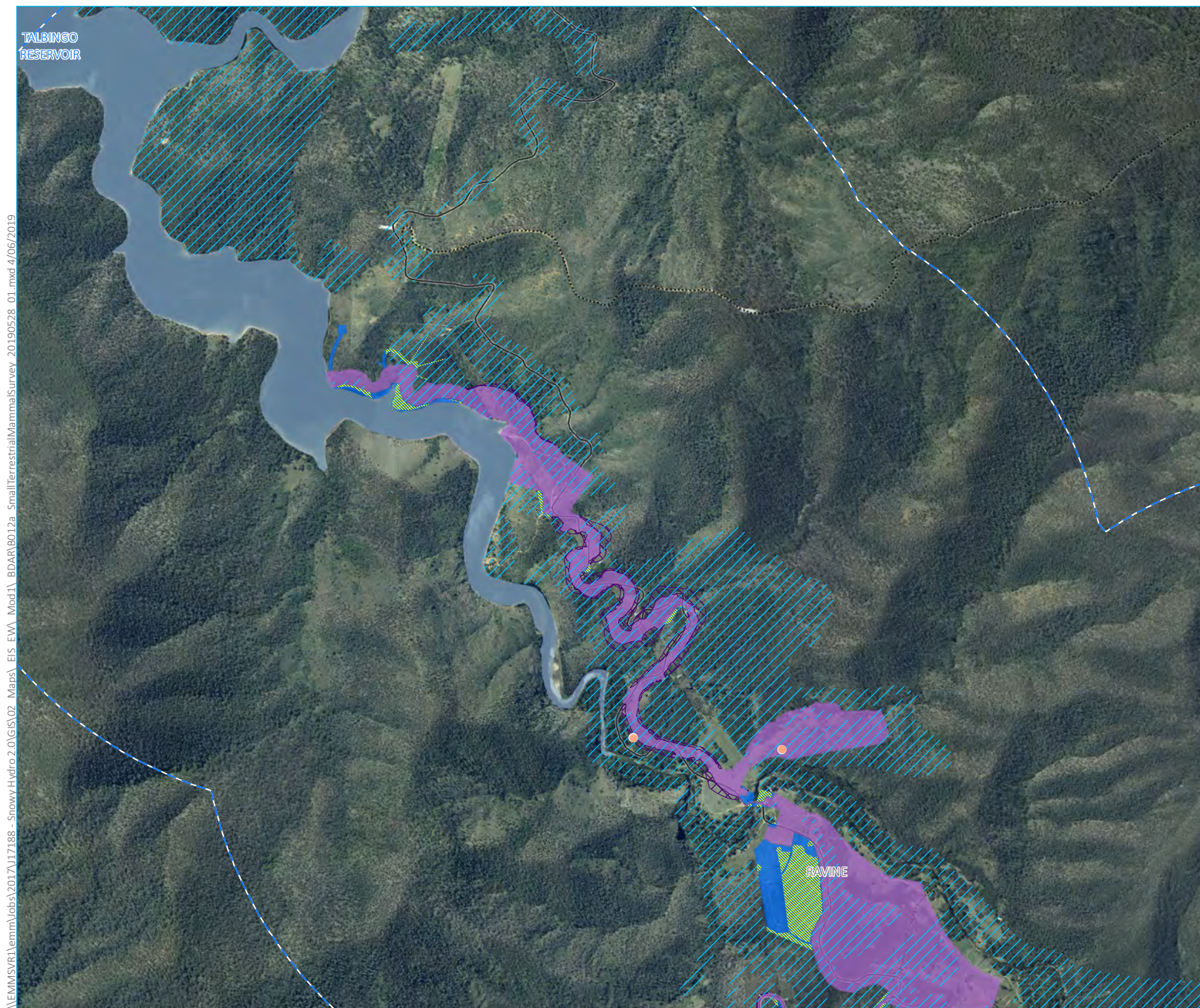
Nocturnal bird survey results

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.6



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

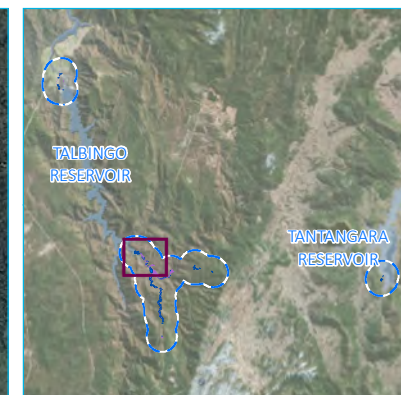




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Source: EMM (2019); Snowy Hydro (2019); LPI (2019); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

0 250 500
m
GDA 1994 MGA Zone 55



KEY

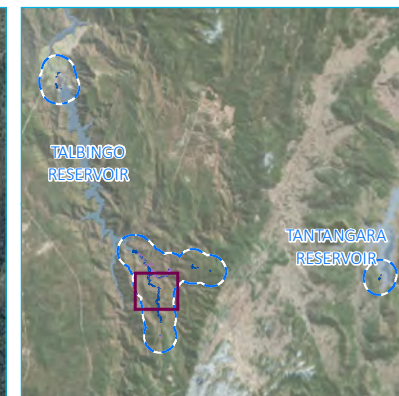
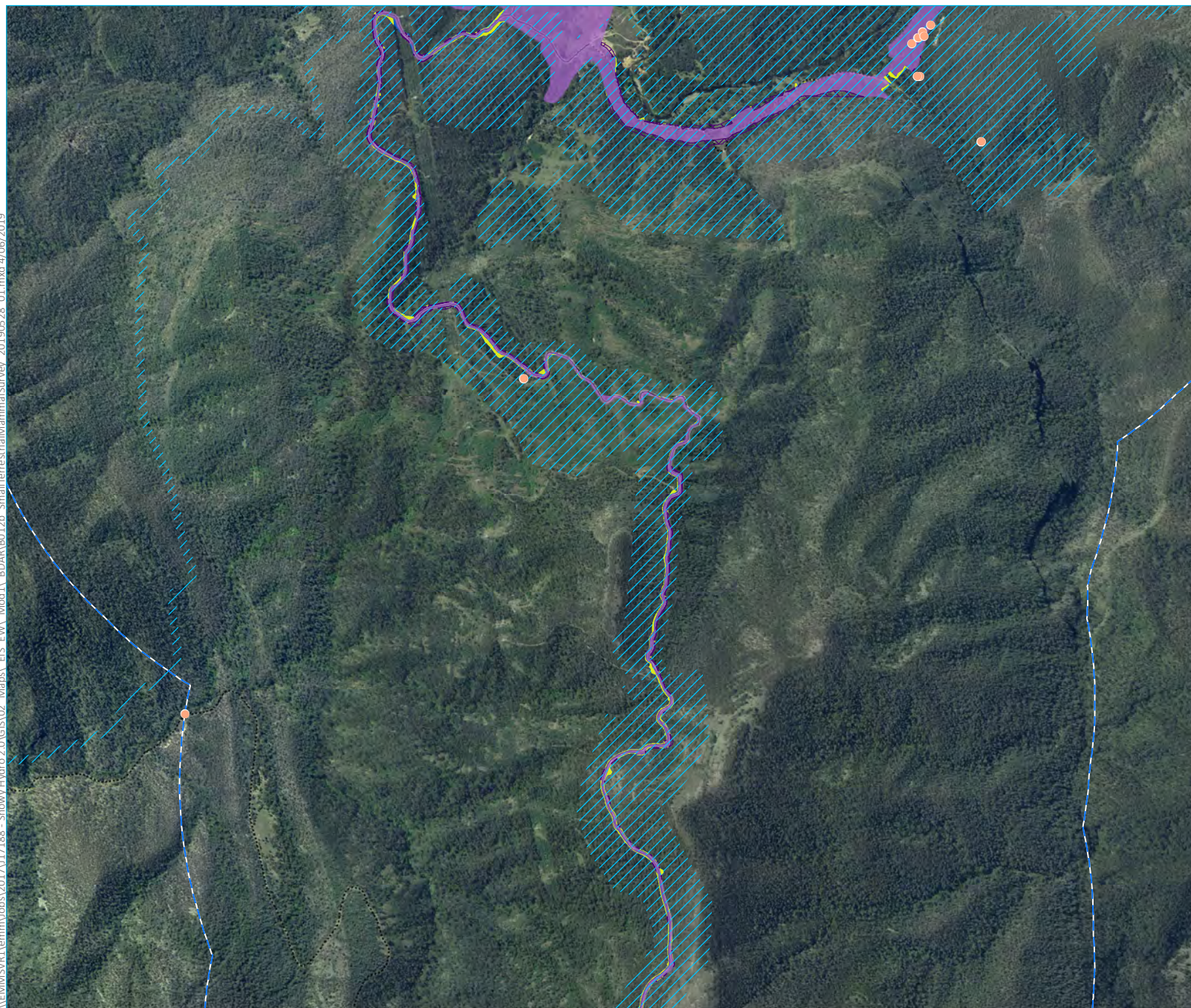
- Local road
- Vehicular track
- Waterbody
- 1500 m buffer
- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced
- Eastern Pygmy-possum species polygon
- Eastern Pygmy-possum habitat
- Threatened fauna
- Eastern Pygmy-possum (3)

Small terrestrial mammal survey results

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.7a



\\EMMSVR1\emm\Jobs\2017\U17188 - Snowy Hydro 2.0\GIS\02 Maps\ EIS EWI Mod1\ BDAR\B012b - SmallTerrestrialMammalSurvey_20190528_01.mxd 4/06/2019

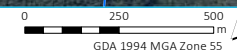


- KEY**
- Local road
 - Vehicular track
 - - - 1500 m buffer
 - EW approved construction footprint (additional)
 - EW approved construction footprint
 - EW approved construction footprint reduced
 - Eastern Pygmy-possum species polygon
 - Eastern Pygmy-possum habitat
 - Threatened fauna
 - Eastern Pygmy-possum (13)

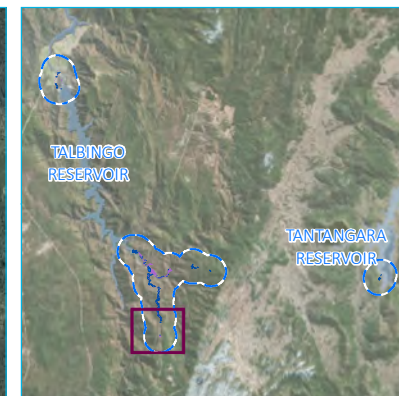
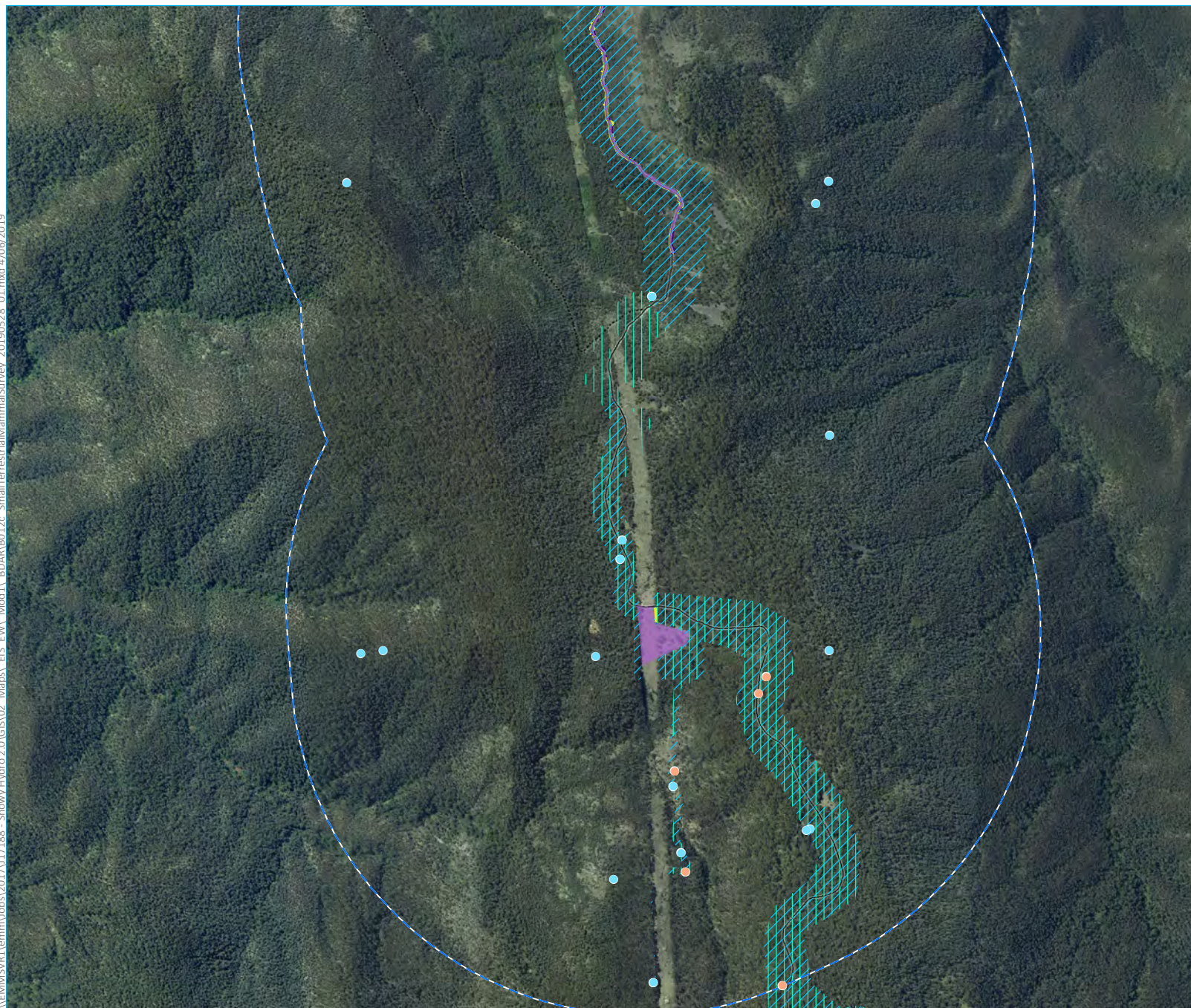
Small terrestrial mammal survey results

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.7b

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



\\EMMSVR1\emm\jobs\2017\17188 - Snowy Hydro 2.0\GIS\02 Maps\ EIS EW Mod1\ BDAR\B012c SmallTerrestrialMammalSurvey 20190528_01.mxd 4/06/2019

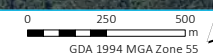


- KEY**
- Local road
 - Vehicular track
 - 1500 m buffer
 - EW approved construction footprint (additional)
 - EW approved construction footprint
 - ▨ EW approved construction footprint reduced
 - Eastern Pygmy-possum species polygon
 - ▨ Eastern Pygmy-possum habitat
 - ▨ Smoky Mouse habitat
 - Smoky Mouse species polygon
 - Threatened fauna
 - Eastern Pygmy-possum (9)
 - Smoky Mouse (23)

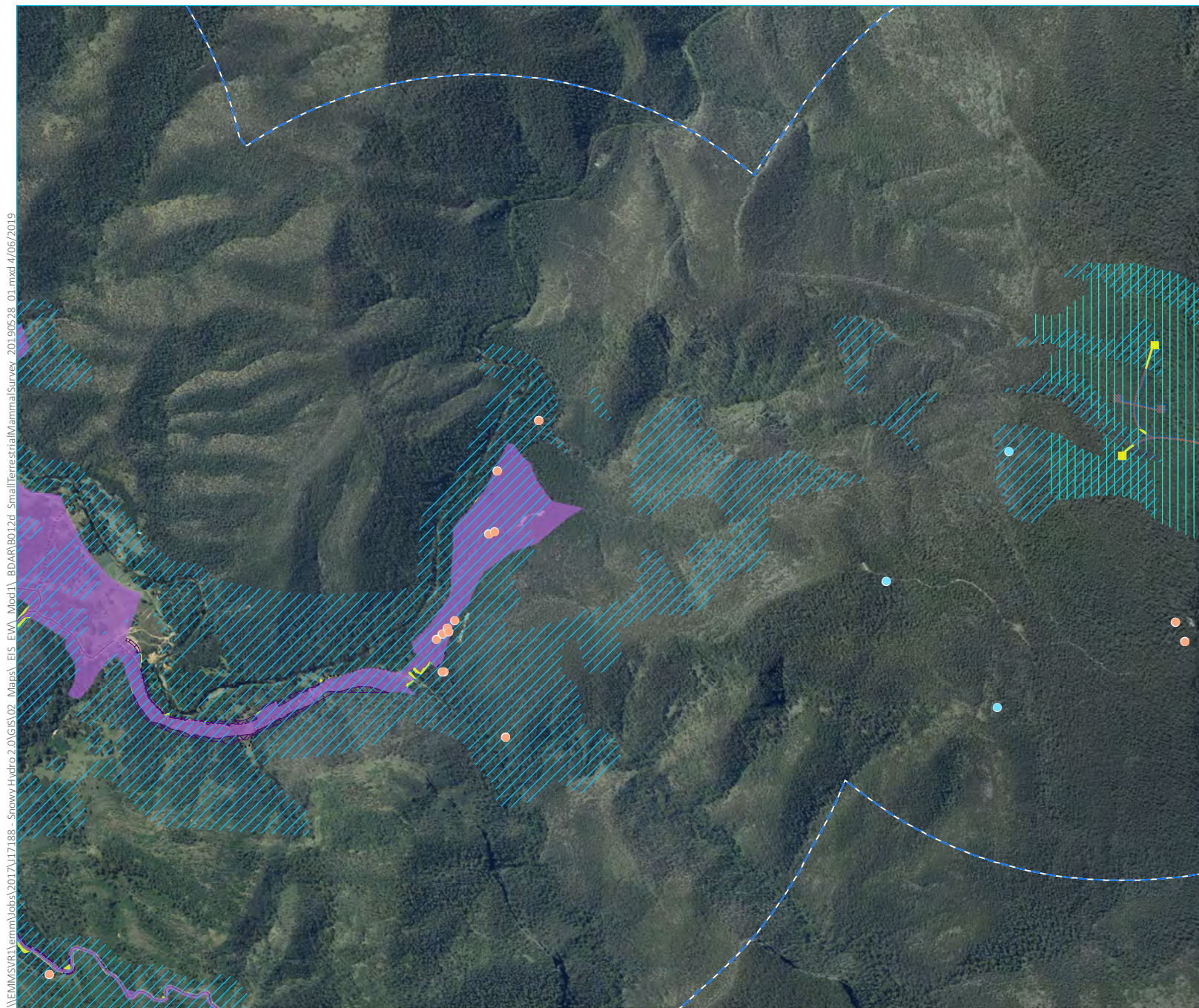
Small terrestrial mammal survey results

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.7c

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

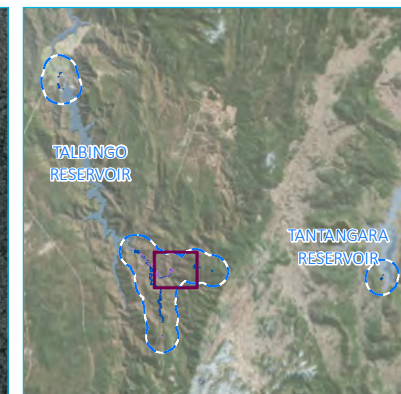


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Source: EMM (2019); Snowy Hydro (2019); LPI (2019); SMEC (2019); DFSI (2017); GA (2015); LPMA (2011)

0 250 500
m
GDA 1994 MGA Zone 55



KEY

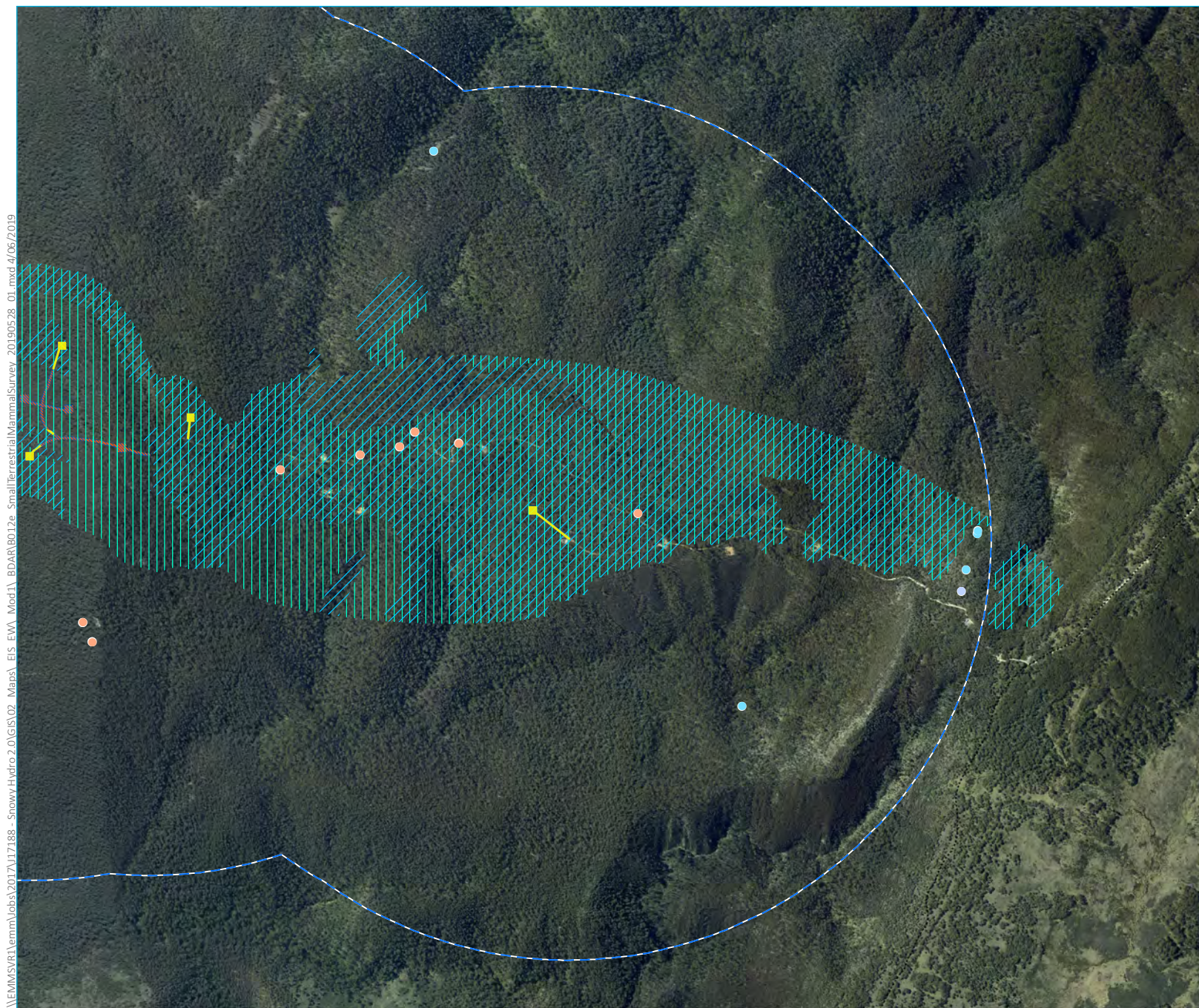
- Local road
- - - - - Vehicular track
- 1500 m buffer
- EW approved construction footprint (additional)
- EW approved construction footprint
- ▨ EW approved construction footprint reduced
- Eastern Pygmy-possum species polygon
- ▨ Eastern Pygmy-possum habitat
- ▨ Smoky Mouse habitat
- ▨ Smoky Mouse species polygon
- Threatened fauna
- Eastern Pygmy-possum (23)
- Smoky Mouse (4)

Small terrestrial mammal survey results

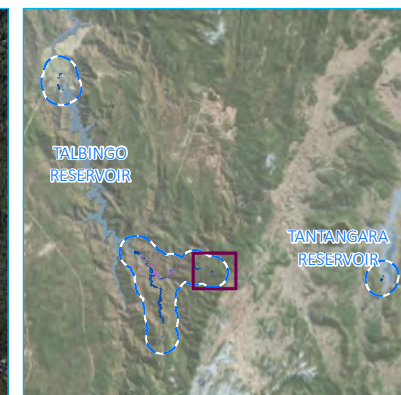
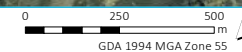
Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.7d



\\EMMSVR1\emm\Jobs\2017\U17188 - Snowy Hydro 2.0\GIS\Q2 Maps\ EIS EW Mod1\ BDAR\B012e - SmallTerrestrialMammalSurvey 20190528 01.mxd 4/06/2019



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



KEY

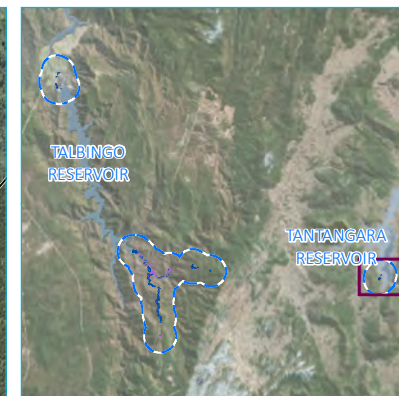
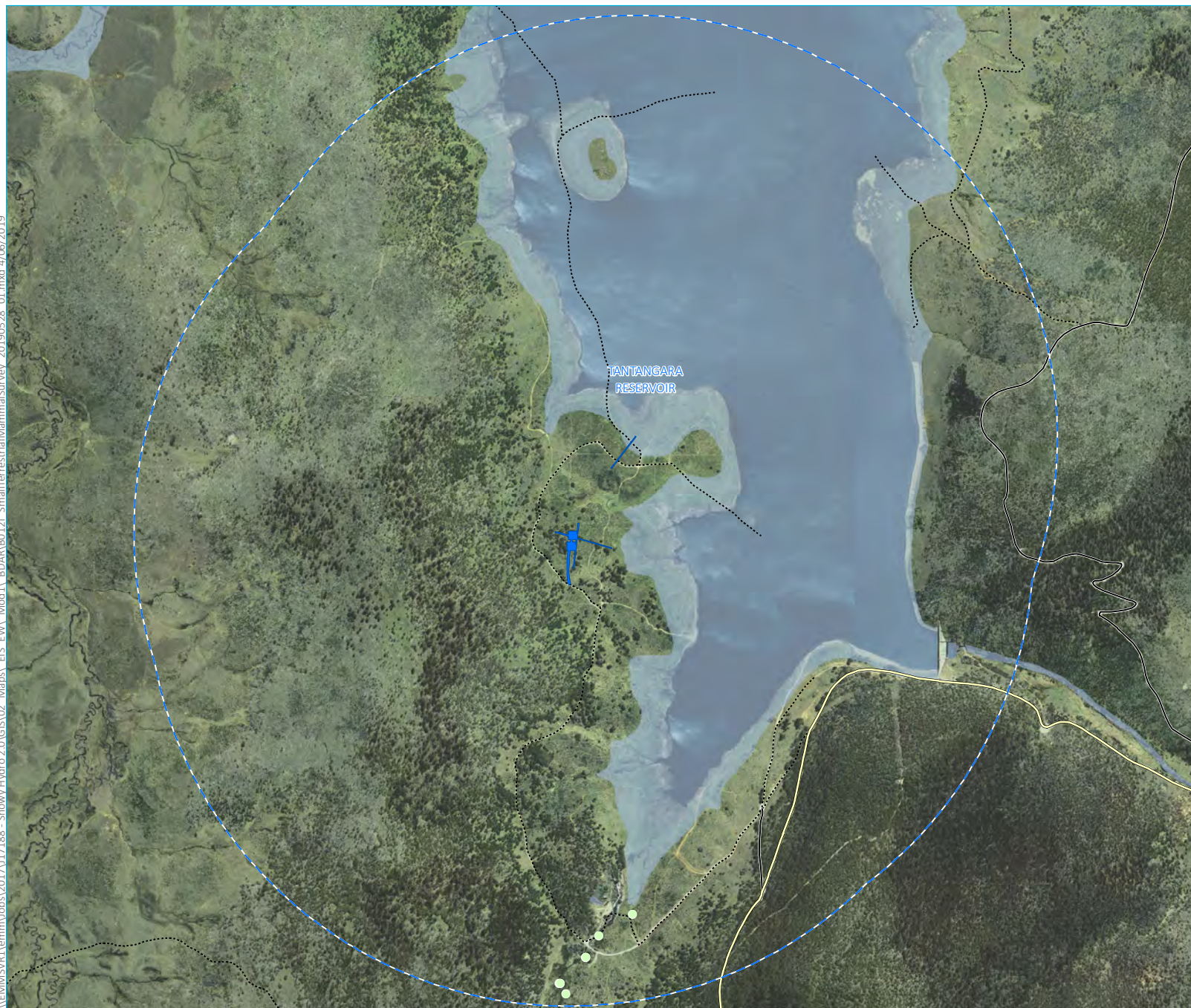
- Vehicular track
- 1500 m buffer
- EW approved construction footprint (additional)
- Eastern Pygmy-possum species polygon
- Eastern Pygmy-possum habitat
- Smoky Mouse habitat
- Smoky Mouse species polygon
- Threatened fauna
 - Eastern Pygmy-possum (15)
 - Smoky Mouse (5)
 - Spotted-tailed Quoll (1)

Small terrestrial mammal survey results

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.7e



\\EMMSVR1\emm\Jobs\2017\U17188 - Snowy Hydro 2.0\GIS\02 Maps\ EIS EWI Mod1\ BDAR\B012f SmallTerrestrialMammalSurvey_20190528_01.mxd 4/06/2019

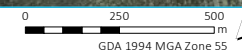


- KEY**
- Main road
 - Local road
 - Vehicular track
 - Waterbody
 - 1500 m buffer
 - EW approved construction footprint (additional)
 - Threatened fauna
 - Broad-toothed Rat (8)

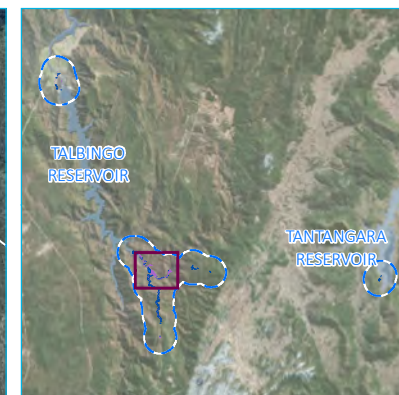
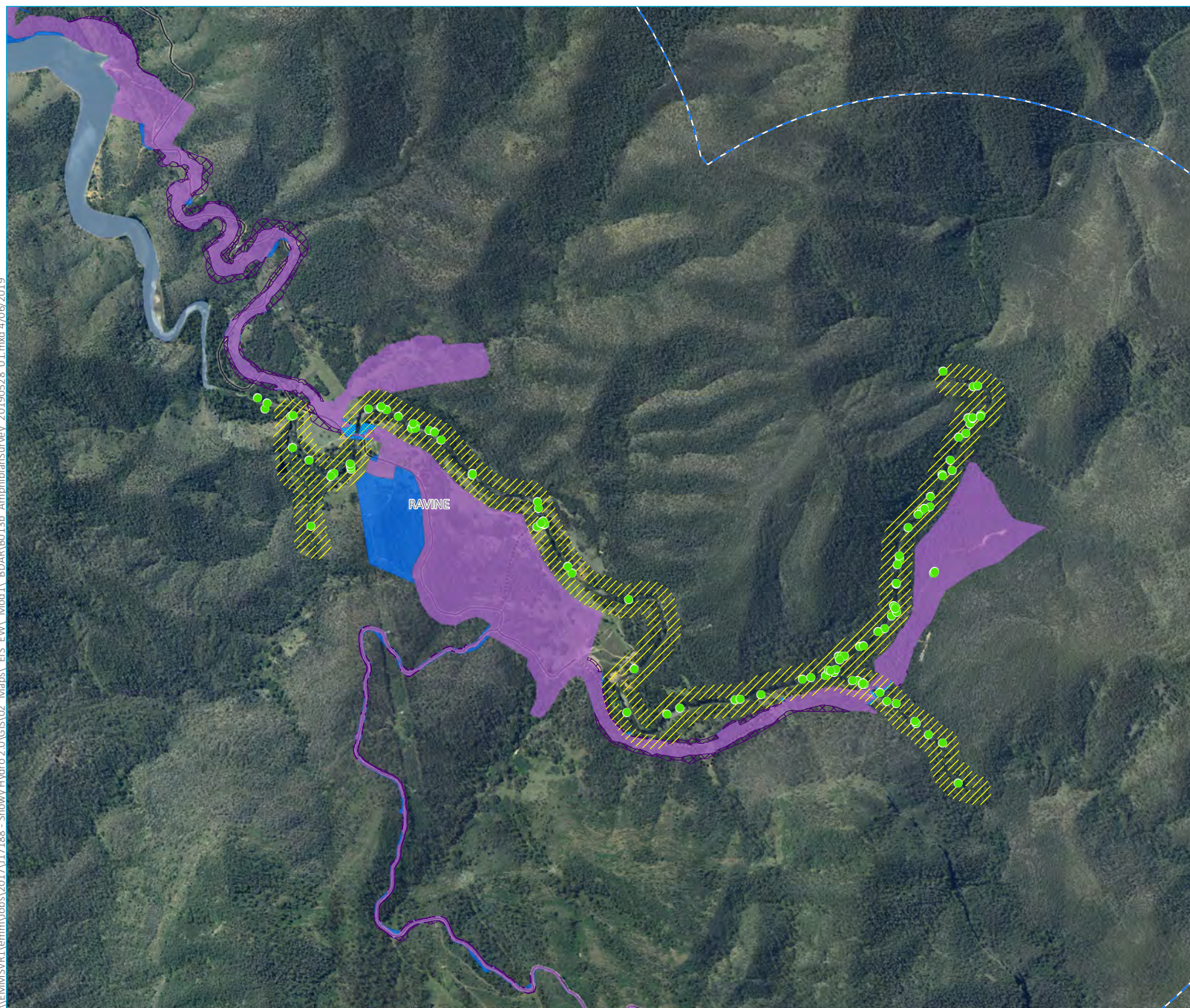
Small terrestrial mammal survey results

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.7f

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



\\EMMSVR1\emm\Jobs\2017\17188 - Snowy Hydro 2.0\GIS\02 Maps\ EIS EWI Mod1\ BDAR\B013b AmphibianSurvey 20190528 01.mxd 4/06/2019

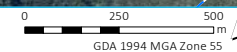


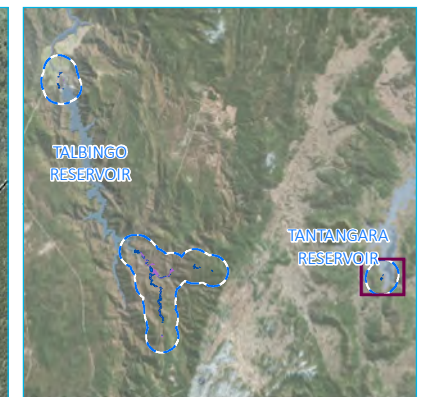
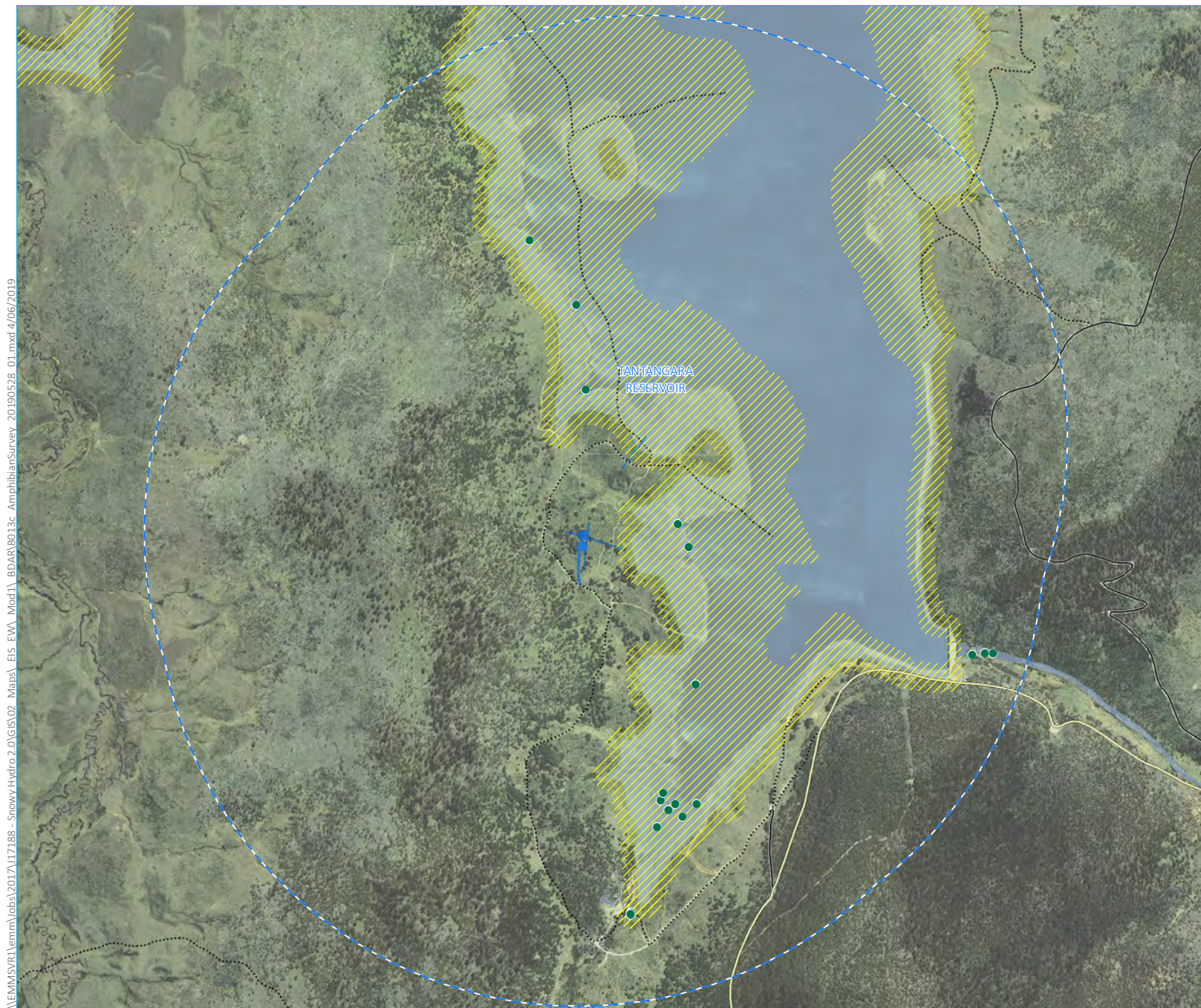
- KEY**
- Local road
 - Vehicular track
 - Waterbody
 - 1500 m buffer
 - EW approved construction footprint (additional)
 - EW approved construction footprint
 - EW approved construction footprint reduced
 - Booroolong Frog habitat
 - Booroolong Frog species polygon
 - Threatened fauna
 - Booroolong Frog (110)

Amphibian survey results

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.8a

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





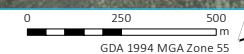
- KEY**
- Main road
 - Local road
 - Vehicular track
 - Waterbody
 - 1500 m buffer
 - EW approved construction footprint (additional)
 - Alpine Tree Frog species polygon
 - Alpine Tree Frog habitat
 - Threatened fauna
 - Alpine Tree Frog (19)

Amphibian survey results

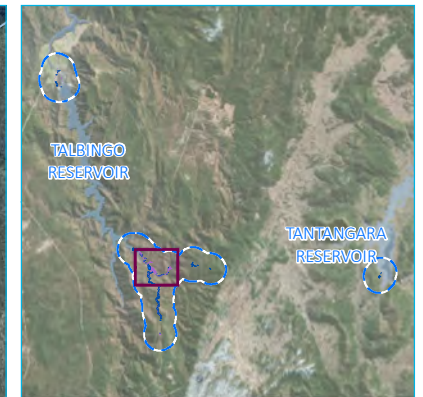
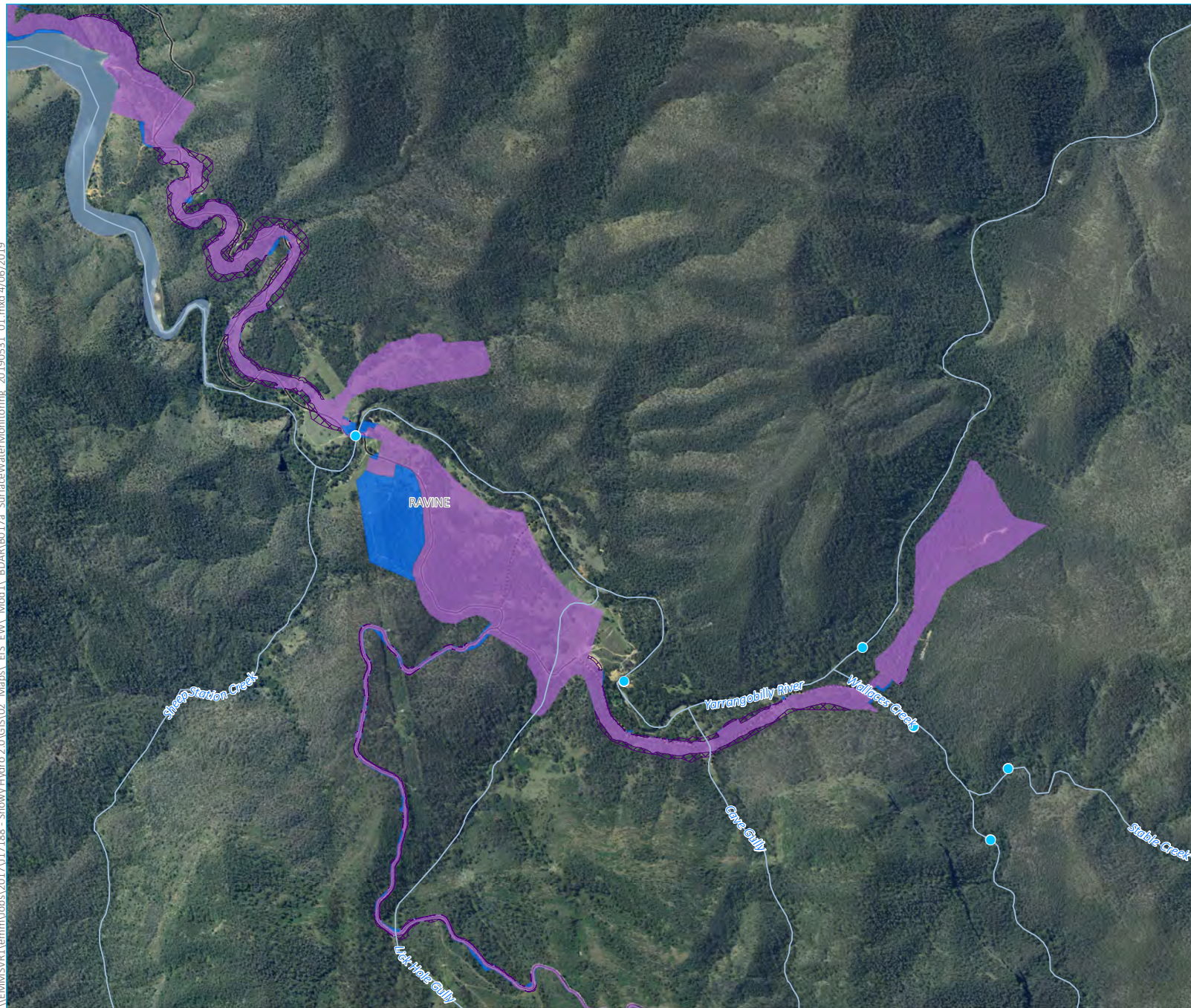
Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.8b



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



\\EMMSVR1\emm\Jobs\2017\17188 - Snowy Hydro 2.0\GIS\02 Maps\ EIS EWI Mod1\ BDAR\B017a SurfaceWaterMonitoring_20190531_01.mxd 4/06/2019



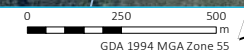
KEY

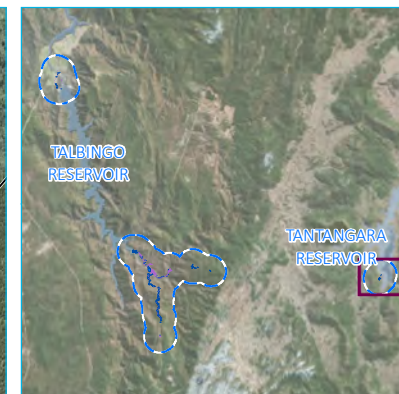
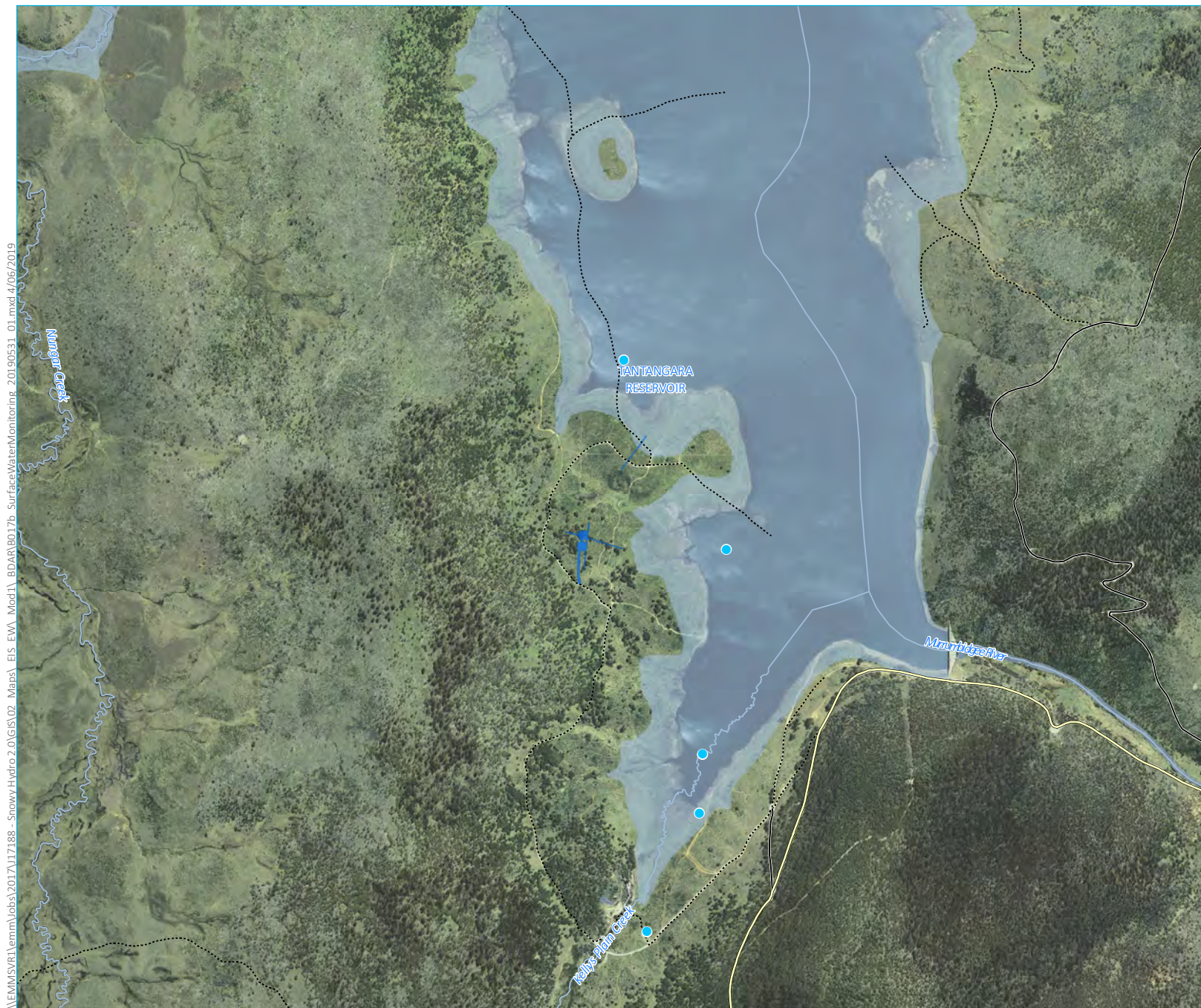
- Surface water monitoring location
- EW approved construction footprint (additional)
- EW approved construction footprint
- ▨ EW approved construction footprint reduced
- Waterbody
- Watercourse / drainage line
- Local road
- Vehicular track

Indicative water monitoring locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.9a

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





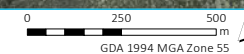
KEY

- Surface water monitoring location
- EW approved construction footprint (additional)
- Waterbody
- Watercourse / drainage line
- Main road
- Local road
- Vehicular track

Indicative water
monitoring locations

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 6.9b

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



6.3.5 Species credit species

A list of candidate species credit species predicted to occur within Modification 1, along with an assessment of whether the survey area provides suitable habitat, whether the species was recorded during targeted surveys and whether the species will be impacted by the modification is provided within

Based on targeted surveys, the following species will be impacted:

- Slender Greenhood – 0.28 ha;
- Gang-gang Cockatoo (breeding habitat only) – 0.01 ha;
- Eastern Pygmy possum – 8.32 ha;
- Smoky Mouse – 1.57 ha;
- Booroolong Frog – 0.44 ha; and
- Alpine Tree Frog – 0.03 ha.

These species will require offsets in accordance with the BAM (OEH 2017). Species polygons across the survey area are shown in Figure 6.3 to Figure 6.8.

Table 6.21 Species credit species, habitat suitability and targeted survey results

Scientific name	Common name	Biodiversity risk weighting	Habitat present within the Exploratory Works modification disturbance footprint	Recorded during field surveys	Impacted by development	Justification
Flora						
<i>Pomaderris cotoneaster</i>	Cotoneaster Pomaderris	2.00	Yes. Predominantly riparian zones.	No	No	Not recorded during targeted surveys.
<i>Pterostylis foliata</i>	Slender Greenhood	1.00	Yes.	Yes	Yes	All areas of PCT 1196.
<i>Thesium australe</i>	Austral Toadflax	1.50	Yes. Upper sections of Lobs Hole Ravine Road in damp sections of PCT 1196 and in Lobs Hole in damp areas such as PCT 285.	No	No	Not recorded during targeted surveys.
Fauna						
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo (Breeding)	2.00	Yes. Breeding habitat largely restricted to areas with suitably sized hollows in PCT 1196 along the upper section of Lobs Hole Ravine Road and in PCT 302 along the Yarrangobilly River. Species forages more broadly across the survey area.	Yes	Yes	All areas of PCT 1196, PCT 953 and PCT 302 not in Low, Derived Grassland or Other condition classes have been considered breeding habitat on the basis of suitable hollows being located in these areas. PCT 1196 will be largely avoided (see Section 7).
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	2.00	Yes. Species occurs in a broad range of habitats within the survey area, usually associated with a dense midstorey and/or feed species such as Banksias.	Yes	Yes	PCTs 296, 300, 302, 729, 999 and 1196 have been considered suitable habitat on the basis of suitably dense understorey habitat with flowering Banksias. PCTs in Low or Derived Grassland condition classes were excluded as they do not provide a sufficiently dense understorey selected by the species. PCTs 639 and 1196 will be largely avoided (Section 7).

Table 6.21 Species credit species, habitat suitability and targeted survey results

Scientific name	Common name	Biodiversity risk weighting	Habitat present within the Exploratory Works modification disturbance footprint	Recorded during field surveys	Impacted by development	Justification
<i>Cyclodomorphus praealtus</i>	Alpine She-oak Skink	2.00	Yes. Restricted to south Tantangara in PCT 1224.	Yes	No	Species was not recorded within areas adjacent to the disturbance footprint. PCT 1224 within the disturbance footprint is subject to high human and horse disturbance. Species is not considered likely to occur within these areas.
<i>Litoria booroolongensis</i>	Booroolong Frog	2.00	Yes. Yarrangobilly River and Wallace's Creek.	Yes	Yes	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.
<i>Litoria verreauxii alpina</i>	Alpine Tree Frog	2.00	Yes. Kellys Plain Creek and Murrumbidgee River.	Yes	No	Kellys Plain Creek and Murrumbidgee River are not within the development footprint. No habitat will be impacted.
<i>Mastacomys fuscus</i>	Broad-toothed Rat	2.00	Yes. Sub-alpine grassy woodlands in the upper reaches of Lobs Hole Ravine Road, and a small area of dense <i>Poa</i> spp. dominated grassland adjacent to the Mines Trail in Lobs Hole.	Yes	Yes	Species was recorded in adjacent areas of the disturbance boundary within PCT 1224.
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat (Breeding)	3.00	No. After completing roost searches, no suitable caves, mines or storm-water tunnels are within the disturbance boundary.	Yes	No	Species was recorded during anabat surveys foraging. No suitable breeding habitat was recorded.
<i>Myotis macropus</i>	Southern Myotis	2.00	Yes. Suitable habitat within woodlands adjacent to Yarrangobilly River and Wallaces Creek.	No	No	Not recorded during targeted surveys.

Table 6.21 Species credit species, habitat suitability and targeted survey results

Scientific name	Common name	Biodiversity risk weighting	Habitat present within the Exploratory Works modification disturbance footprint	Recorded during field surveys	Impacted by development	Justification
<i>Ninox connivens</i>	Barking Owl (Breeding)	2.00	Yes. Suitable nesting habitat is limited to areas of mature trees along the Yarrangobilly River.	No	No	The Barking Owl is considered scarce at higher elevations of the tablelands (NPWS 2003). Given the species is known to respond strongly to call playback but was not recorded during targeted surveys it is considered unlikely to occur.
<i>Ninox strenua</i>	Powerful Owl (Breeding)	2.00	Yes. Suitable nesting habitat is limited to areas of mature trees along the Yarrangobilly River.	No	No	No evidence of nesting was observed, and the species was not recorded during targeted surveys.
<i>Petaurus norfolcensis</i>	Squirrel Glider	2.00	Yes. Suitable feed and nesting trees are limited to the habitat along the Yarrangobilly River and the upper sections of Lobs Hole Ravine Road.	No	No	Not recorded during targeted surveys.
<i>Petroica rodinogaster</i>	Pink Robin	2.00	Yes. Tall, open eucalypt forest, particularly in densely vegetated gullies largely on upper sections of Lobs Hole Ravine Road and along the Yarrangobilly River. Some minor gullies along lower sections of Lobs Hole Ravine Road.	No	No	Not recorded during targeted surveys.
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	2.00	Yes.	No	No	Not recorded during targeted surveys.
<i>Phascolarctos cinereus</i>	Koala (Breeding)	2.00	Yes. Scarce in the KNP, but potential to occur in Eucalypt forest and woodland below 800 m elevation.	No	No	Not recorded during targeted surveys.

Table 6.21 Species credit species, habitat suitability and targeted survey results

Scientific name	Common name	Biodiversity risk weighting	Habitat present within the Exploratory Works modification disturbance footprint	Recorded during field surveys	Impacted by development	Justification
<i>Pseudomys fumeus</i>	Smoky Mouse	3.00	Yes. Tall forests dominated by Mountain Gum and Snow Gum, with a moderate to dense shrubby midstorey dominated by shrubs from the plant family <i>Fabaceae</i> (with some <i>Epacridaceae</i> and <i>Mimosaceae</i>), and dense groundcover with abundant sub-shrubs, logs and leaf litter.	Yes	Yes	
<i>Tyto novaehollandiae</i>	Masked Owl (Breeding)	2.00	Yes. Breeding habitat containing suitable hollows limited to PCT 1196 along Lobs Hole Ravine Road and PCT 302 along the Yarrangobilly River.	Yes	Yes	All areas of PCT 1196 and PCT 302, excluding areas without tree cover (condition classes Low and Derived Grassland) or areas with only regenerating trees (condition class Other), have been considered to provide breeding habitat for the Masked Owl. PCT 1196 will be largely avoided (see Section 7).

Part B

Stage 2: Impact Assessment

7 Impact assessment (biodiversity values)

This chapter identifies the potential impacts of Exploratory Works, including Modification 1, on the biodiversity values identified above. Measures taken to date to avoid and minimise impacts are summarised and recommendations to assist in the design a development that further avoids, minimises and mitigates impacts are provided

7.1 Potential direct, indirect and prescribed impacts

The potential impacts arising from Modification 1 will remain consistent with those outlined in the Exploratory Works BDAR (EMM 2018). These impacts are not discussed in detail in this report. Please refer to EMM (2018) for detailed information on potential direct, indirect and prescribed impacts.

The main direct impacts of Modification 1 will be associated with clearing of native vegetation communities and loss of species habitat.

7.2 Measures to avoid, minimise and mitigate impacts

Snowy Hydro, in consultation with EMM and the design team (SMEC) and construction contractor (Future Generation Joint Venture, FGJV) have undertaken significant steps to avoid, minimise and mitigate impacts.

A key focus of project design for Modification 1 has been to avoid and minimise impacts to biodiversity values identified during the field surveys. In recognition of the location of the Exploratory Works in the KNP, and associated biodiversity and other values of the Park, the project has undergone significant steps to avoid, minimise and mitigate impacts. The process below has been followed to ensure impacts are avoided and minimised to the greatest extent possible, within the design and other limitations of Modification 1:

- identification of biodiversity values through comprehensive, rigorous and thorough biodiversity surveys;
- communication of identified values to the project team, including Snowy Hydro and the design team;
- consultation between the design team and project ecologists on various elements to consider both direct and indirect impacts and work through an iterative design process, with multiple iterations of design elements to achieve best practice outcomes;
- consultation with key government stakeholders, including the OEH, NPWS and DoEE, including species experts and accountable officers, to seek input and discuss measures proposed to avoid, minimise and mitigate impacts;
- feedback of consultation into the design process; and
- finalisation of measures to avoid, minimise and mitigate impacts.

Measures undertaken to avoid, minimise and mitigate impacts that have arisen during the process outlined above are discussed below for each project element.

7.2.1 Geotechnical investigations

During the design of the geotechnical investigation program several iterations of the number of boreholes and borehole locations was considered. Initial designs included 12 boreholes, construction of 2,810 m of additional access tracks as well as passing bays. This initial design would have resulted in 2.20ha of native vegetation removal in the Marica area (3.29 ha within the entire Modification 1 area), including impacts to Smoky Mouse habitat. The final design for the geotechnical investigation program has reduced the clearing required to 2.79 ha.

Removal of native vegetation is required for construction of drilling pads and access tracks to these pads. Native vegetation removal has been limited to the minimum required to construct the drilling pads and access tracks, with pads limited to a 30 x 30 m area (0.09 ha), while access tracks will be limited to a 4 m wide corridor. Vegetation clearing works will be undertaken in accordance with the Exploratory Works Biodiversity Management Plan (EMM 2019), including staged clearing – see EMM (2019) for further detail.

Along Lobs Hole Ravine Road, existing restrictions on traffic movement will remain in place to avoid risks of fauna vehicle strike. In the Marica area this is not feasible due to operations needing to access laydown areas at the eastern extent of the Marica area during operations. To mitigate the risk of fauna vehicle strike on Smoky Mouse, vehicle movements will be limited to a speed of 20 km/h. These restrictions will be in place from dusk until dawn.

Following completion of the geotechnical investigation program all pads and access tracks will be rehabilitated, should the Main Works project not proceed. The approach to rehabilitation is based on using existing ecological resources at the sites and to minimise the use of additional materials such as seed, tubestock and mulch. The following rehabilitation principles have been adopted and will be applied to the activities:

- any cleared vegetation will be stockpiled adjacent to the cleared site and windrowed for use later during rehabilitation work;
- successful rehabilitation is based on the principle of “No Bare Ground” after rehabilitation works have been carried out;
- overburden material will be returned to drilling hole or will be removed from site, and any rock or Geotech material used to establish the pads or access tracks will be removed. Bare ground will be covered with
- cover any bare ground with rice straw – 1 bale per 20m², and place windrowed vegetation across rehabilitated area;
- monitor weeds in line with the biodiversity management plan (EMM 2019) and undertake control as required.

A complete Rehabilitation Management Plan will be developed for this site. This will be included as part of the CEMP.

The existing Smoky Mouse monitoring program will be extended to include the Marica area.

7.2.2 Construction power connection

The siting of the construction power connection is constrained by the location of the 330 kV powerline and a suitable area for construction of the substation, including suitable geotechnics, to enable a stable platform for construction. As such, options for avoiding and minimising impacts through design are limited. A larger envelope has been identified than required for the substation, with the substation to be micro-sited within this larger area. The final location of the substation will be confirmed following geotechnical investigation program. Despite this constraint, the location of the substation adjacent to existing, cleared, powerline easement will minimise tree removal. It is expected that clearing of native vegetation to construct the substation and feeder line will result in removal of 6.97 ha of native vegetation.

Vegetation clearing works will be undertaken in accordance with the Exploratory Works Biodiversity Management Plan (EMM 2019), including staged clearing – see EMM (2019) for further detail.

7.2.3 Project boundary changes

During detailed design of Lobs Hole Ravine Road, minor revisions to the road design have been realised. These design revisions are largely minor in nature, are located immediately adjacent to the approved Exploratory Works disturbance footprint and include both additional areas required for clearing, as well as some areas within the approved Exploratory Works disturbance footprint which are no longer required. The project boundary changes will result in clearing of an additional 3.62 ha of native vegetation and a reduction of 11.54 ha, resulting in an overall reduction of 1.84 ha. No additional clearing of Smoky Mouse habitat along the upper sections of Lobs Hole Ravine Road will result from Modification 1.

Review of the area designated for the construction of the two bridges over the Yarrangobilly River and Wallaces Creek determined that some additional areas were required for construction purposes. Although the bridge design and overall footprint remains the same, these additional areas are required to allow access for pile construction and other ancillary works. These additional areas will be rehabilitated following the completion of the bridge construction, should the Main Works project not proceed.

Vegetation clearing works will be undertaken in accordance with the Exploratory Works Biodiversity Management Plan (EMM 2019), including staged clearing – see EMM (2019) for further detail.

7.2.4 Dangerous tree removal

The quantified tree risk assessment (Tree Survey 2018) identified 91 trees that present a safety risk to traffic on Lobs Hole Ravine Road:

- a total of 29 trees were identified as Priority 2 for removal, requiring removal within 3 months;
 - one tree, Tree 57, is recommended for the removal of dead branches (greater than 150 mm in diameter) that overhang the access road;
 - remaining trees are recommended for complete removal;
- a total of 62 trees were identified as Priority 3 for removal, requiring removal within 6 months;
 - two trees, Tree 16 and 53, are recommended for the removal of dead branches (greater than 150mm in diameter) that overhang the access road; and
 - remaining trees are recommended for complete removal.

A total of 88 trees are likely to require complete removal. Some of the trees identified for removal contain small to large-sized hollows, providing habitat for threatened species including the Gang-gang Cockatoo, Masked Owl and Eastern Pygmy Possum.

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.

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.

7.3 Impact summary

7.3.1 Summary of measures to avoid, minimise and mitigate impacts

A summary of impacts arising from Modification 1, and measures to avoid, minimised and mitigate impacts, is provided in Table 7.2.

Table 7.1 Summary of impacts, and measures to avoid, minimise and mitigate these impacts

Project element	Impact	Impact avoidance	Impact minimisation	Impact mitigation
Geotechnical investigations – additional boreholes	<i>Removal and trimming of native vegetation and threatened species habitat.</i> Type: direct impact. Frequency: once, during construction. Intensity: up to 2.79ha of native vegetation removal. Duration: initial stages of construction. Consequence: potential impacts to native vegetation and fauna habitat, including habitat for Smoky Mouse, Slender Greenhood and Alpine Tree Frog.	- Reduction in the number of boreholes proposed, and length of access tracks. - Using existing access tracks as far as possible to access boreholes.	Restriction of native vegetation removal to 30 x 30 m boreholes and 4 m wide access tracks.	- Pre-clearing process. - Rehabilitation of boreholes and access tracks should Main Works not proceed. - Smoky Mouse monitoring program.
	<i>Introduction of weeds and pathogens into the works area.</i> Type: indirect impact. Frequency: potential for daily impacts. Intensity: unknown. Duration: ongoing through construction phase. Consequence: potential to impact on threatened species, resulting in decline in habitat quality. Identified as a key threat to the Smoky Mouse.	Not required.	- Construction of wash-down stations at a suitable location. - Washdown required for weeds as well as <i>P.cimmamomi</i>. - Wash-down of all vehicles will be completed prior to movement from Link Road to Lobs Hole Ravine and vice versa.	- Implementation of a weed and pathogen monitoring program. - Implementation of a weed control program if weeds are identified along road verges.
	<i>Fauna vehicle strike and impacts to Smoky Mouse.</i> Type: prescribed impact. Frequency: potential for daily impacts if unmitigated. Intensity: unknown. Duration: ongoing through construction phase. Consequence: potential to impact local population of Smoky Mouse.	Restriction of vehicle movements on Lobs Hole Ravine Road to daytime only.	- Night time vehicle movements on Lobs Hole Ravine Road to be restricted to emergency situations only. - Restrictions on vehicle movements in the Marica area limited to speeds of 20 km/h between dusk and dawn.	Implementation of a Smoky Mouse monitoring program.

Table 7.1 Summary of impacts, and measures to avoid, minimise and mitigate these impacts

Project element	Impact	Impact avoidance	Impact minimisation	Impact mitigation
Construction of a new substation	<i>Removal and trimming of native vegetation and threatened species habitat.</i> Type: direct impact Frequency: once, during construction Intensity: up to 6.97 ha of native vegetation removal. Duration: initial stages of construction. Consequence: potential impacts to native vegetation and fauna habitat.	Options for impact avoidance are limited due to constraints.	- Micrositing of the substation and feeder line to minimise impacts to key biodiversity values. - Location of the substation within and adjacent to the cleared powerline easement.	Pre-clearing process.
Project boundary changes	<i>Removal of native vegetation and threatened species habitat.</i> Type: direct impact. Frequency: once, during construction. Intensity: removal of 3.62 ha of native vegetation. Duration: initial stages of construction. Consequence: impacts to native vegetation and fauna habitat, including foraging and refuge habitat for the Booroolong Frog.	- Avoidance of works in the upper section of Lobs Hole Ravine Road, in Smoky Mouse habitat. - Restriction of works on lower sections of Lobs Hole Ravine Road.	Minimisation of works within the 50 m buffer zone of the Yarrangobilly River.	- Pre-clearing process. - Smoky Mouse monitoring program.
	<i>Introduction of weeds and pathogens into the works area.</i> Type: indirect impact. Frequency: potential for daily impacts. Intensity: Duration: Consequence: potential to impact on threatened species, resulting in decline in habitat quality. Identified as a key threat to the Smoky Mouse.	Not required.	- Construction of wash-down stations at a suitable location. - Washdown required for weeds as well as <i>P.cinnamomi</i>. - Wash-down of all vehicles will be completed prior to movement from Link Road to Lobs Hole Ravine and vice versa.	- Implementation of a weed and pathogen monitoring program. - Implementation of a weed control program if weeds are identified along road verges.

Table 7.1 Summary of impacts, and measures to avoid, minimise and mitigate these impacts

Project element	Impact	Impact avoidance	Impact minimisation	Impact mitigation
	<i>Changes to runoff regimes</i> Type: indirect impact and prescribed impact. Frequency: potential for daily impacts. Intensity: potential to mobilise large amounts of sediment and significantly impact on breeding habitat for Booroolong Frog. Duration: initial stages of construction. Consequence: impact water quality, erosion and sedimentation in the area and impact on breeding habitat for an endangered species.	Development of a 50 m buffer zone along the Yarrangobilly River and avoidance works within this buffer wherever possible.	Management of sedimentation via sediment and erosion control plants for each construction zone.	- Implementation of a Booroolong Frog monitoring program. - Implementation of a surface water monitoring program in the Yarrangobilly River.
Dangerous tree removal	<i>Dangerous tree removal</i> Type: prescribed impact. Frequency: once, during construction. Intensity: removal of 91 trees. Duration: initial stages of construction Consequence: potential impacts to threatened species habitat (Gang-gang Cockatoo, Masked Owl and Eastern-Pygmy Possum).	Retention of trees wherever possible and limiting of clearing to a single tree (Tree 47).	Reduction of tree height by at least 50% (rather than removal).	- Removal of trees to be undertaken with pre-clearance and clearing procedures. - Hollow bearing limbs and sections of trunk to be retained in adjacent areas.

7.3.2 Serious and irreversibly impacts (SAIL)

The Smoky Mouse is identified as a candidate species for serious and irreversible impacts (SAIL). The SAIL threshold for Smoky Mouse is identified in the Threatened Biodiversity Data Collection (TBDC) as “mapped important areas”. Given the population that has been identified regionally (see below) this area would be considered important to the conservation of the species.

Impacts to 1.57 ha of Smoky Mouse habitat will result from the Exploratory Works (including Modification 1) and is identified as SAIL. Significant design works have been undertaken to avoid impacts to Smoky Mouse habitat, as outlined in Section 7.2 and summarised in Table 7.2. This work has been undertaken in consultation with key staff from OEH, NPWS and DoEE.

The size of the local population of Smoky Mouse is unknown. The species was recorded at 12 locations along the upper section of Lobs Hole Ravine Road to around 1,100 m elevation in 2017/18. Regional surveys undertaken in 2018/19 across 66 sites have recorded the Smoky Mouse at 41 locations. These surveys have demonstrated that the population found within the Modification 1 project area is part of an extensive population in this southern section of KNP, ranging from Coppermine Firetrail in the north, to Wallace’s Creek Firetrail in the east, Link Road in the south and close to the Tumut River in the west. The species is likely to have a sporadic but extensive distribution within this area.

Given the controls put in place it is expected that the impacts to Smoky Mouse will be minimal. The Exploratory Works project, including the original approval plus Modification 1, will result in removal of 1.98 ha of habitat. Controls put in place to avoid, minimise and mitigate indirect impacts from fauna vehicle strike, weeds and pathogens are expected to ensure negligible impacts to key habitat required for the species lifecycle, including breeding habitat, foraging and dispersal. No fragmentation will occur.

The relationship of this population to other populations is unknown. The nearest live records to survey area are from an artificial boulderfield constructed on an old rock stockpile at Happy Jacks dating to 2015.

The species is also well-represented as subfossil remains in the pellets at roost sites of the Sooty Owl (*Tyto tenebricosa*) at Yarrangobilly Caves (Ford 1998), and three Smoky Mouse were found deceased at Yarrangobilly Caves, suspected cat kills. Several recent remains (estimated between one and three years old) have also been identified amongst hundreds of small mammals remains at Sooty Owl roosts currently in use in this cave system (R. Bilney, Forestry Corporation, pers comm. March 2018, cited in Schulz 2018). This suggests a population occurs within the foraging range of the Sooty Owl (200-1000 ha, DECC 2006b). However, recent surveys in this area have failed to re-locate the species (Schulz and Broome 2018). If this species is extant in this area, there is potential that the regional population outlined above.

7.3.3 Impacts requiring offsets

This section provides an assessment of the impacts requiring offsetting in accordance with Section 10 of the BAM (OEH 2017).

i Impacts on native vegetation

Impacts to native vegetation requiring offsets include:

- direct impacts on 0.11 ha of PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion;
- direct impacts on 1.67 ha of 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 western Kosciuszko escarpment;

- direct impacts on 1.61 ha of 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;
- direct impacts on 0.31 ha of 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;
- direct impacts on 0.09 ha of 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;
- direct impacts on 0.01 ha of PCT 643 – Alpine shrubland on scree, blockstreams and rocky sites of high-altitude areas of Kosciuszko National Park, Australian Alps Bioregion;
- direct impacts on 6.62 ha of PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion;
- direct impacts on 1.09 ha of PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion;
- direct impacts on 0.64 ha of PCT 999 – Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion;
- direct impacts on 0.47 ha of PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion;
- direct impacts on 0.61 ha of PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion; and
- direct impacts on 0.15 ha of PCT 1224 – Sub alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion.

A summary of ecosystem credits required for all vegetation zones, including changes in vegetation integrity score, are provided in Table 7.2.

Table 7.2 **Summary of ecosystem credits required for impacts to all vegetation zones for the Modification 1**

Vegetation zone number	PCT	Vegetation zone name	Area	Vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
1	PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	296_MG_Derived	<0.01	40.4	0.0	-40.4	0
2	PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	296_MG_High	0.10	67.5	0.0	-67.5	2
3	PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	296_MG_Medium	0.01	67.5	0.0	-67.5	1
4	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 western Kosciuszko escarpment	300_MG_High	1.26	68.2	0.0	-68.2	32
5	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 western Kosciuszko escarpment	300_MG_Medium	0.33	56.2	0.0	-56.2	2
6	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 western Kosciuszko escarpment	300_MG_Other	0.07	37.7	0.0	-37.7	1
7	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 western Kosciuszko escarpment	300_MG_Poor	0.01	71.7	0.0	-71.7	1
8	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 western Kosciuszko escarpment	300_MG_Derived	<0.01	4.5	0.0	-4.5	0
9	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	302_Low	0.95	1.8	0.0	-1.8	0

Table 7.2 **Summary of ecosystem credits required for impacts to all vegetation zones for the Modification 1**

Vegetation zone number	PCT	Vegetation zone name	Area	Vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required	
10		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	302_MG_Derived	0.32	61	0.0	-61	9
11		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	302_MG_High	0.03	37.4	0.0	-37.4	0
12		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	302_MG_Medium	0.01	66.4	0.0	-66.4	1
13		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	302_MG_Other	0.29	68.3	0.0	-68.3	9
14		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	302_MG_Poor	0.01	0.1	0.0	-0.1	0
15		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	303_MG_Other	0.31	32.1	0.0	-32.1	6
16		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	311_MG_Derived	<0.01	22.8	0.0	-22.8	0
17		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	311_MG_High	0.09	77.3	0.0	-77.3	2

Table 7.2 Summary of ecosystem credits required for impacts to all vegetation zones for the Modification 1

Vegetation zone number	PCT	Vegetation zone name	Area	Vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
18	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	311_MG_Medium	0.00	56.9	0.0	-56.9	0
19	PCT 643 – Alpine shrubland on scree, blockstreams and rocky sites of high-altitude areas of Kosciuszko National Park, Australian Alps Bioregion	643_MG_High	0.01	9.2	0.0	-9.2	0
20	PCT 650 – Apple Box - Candlebark - Snow Gum shrubby open forest on valley floors, southern South Eastern Highlands Bioregion	650_MG_Medium	0.00	26.6	0.0	-26.6	0
21	PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	729_MG_Derived	1.70	31.1	0.0	-31.1	20
22	PCT 729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	729_MG_High	4.82	87.4	0.0	-87.4	160
23	PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	729_MG_Medium	<0.01	72.9	0.0	-72.9	0
24	PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	729_MG_Poor	0.00	0.6	0.0	-0.6	0
25	PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	953_MG_High	1.09	89.7	0.0	-89.7	37
26	PCT 999 – Norton’s Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	999_MG_Derived	0.06	38.3	0.0	-38.3	1
27	PCT 999 – Norton’s Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	999_MG_High	0.58	60.7	0.0	-60.7	13
28	PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	1191_MG_Derived	0.00	31.5	0.0	-31.5	0

Table 7.2 Summary of ecosystem credits required for impacts to all vegetation zones for the Modification 1

Vegetation zone number	PCT	Vegetation zone name	Area	Vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required	
29	PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion		1191_MG_High	0.47	85.3	0.0	-85.3	25
30	PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion		1196_MG_High	0.61	83.4	0.0	-83.4	19
31	PCT 1224 – Sub alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion		1224_MG_High	0.15	86.4	0.0	-86.4	5
TOTAL								346

Exploratory Works Modification 1 has also resulted in a reduction in impacts, as there are areas within the Exploratory Works approved disturbance boundary that are no longer required for construction. This has resulted in a reduction of the disturbance footprint. The reduction in ecosystem credits required is summarised in Table 7.3.

Table 7.3 Summary of the reduction in ecosystem credits required due to avoidance of impacts to all vegetation zones for the Modification 1

Vegetation zone number	PCT	Vegetation zone name	Area	Vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
1	PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	296_MG_Derived	-0.19	40.4	0.0	-40.4	-3
2	PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	296_MG_High	-0.71	67.5	0.0	-67.5	-18

Table 7.3 Summary of the reduction in ecosystem credits required due to avoidance of impacts to all vegetation zones for the Modification 1

Vegetation zone number	PCT	Vegetation zone name	Area	Vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required	
3		PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	296_MG_Medium	-0.01	67.5	0.0	-67.5	-1
4		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 western Kosciuszko escarpment	300_MG_High	-1.09	68.2	0.0	-68.2	-28
5		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 western Kosciuszko escarpment	300_MG_Medium	-0.28	56.2	0.0	-56.2	-3
6		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 western Kosciuszko escarpment	300_MG_Other	-0.04	37.7	0.0	-37.7	-1
7		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 western Kosciuszko escarpment	300_MG_Poor	0.00	71.7	0.0	-71.7	0
8		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 western Kosciuszko escarpment	300_MG_Derived	-0.16	4.5	0.0	-4.5	0
9		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	302_Low	-0.32	1.8	0.0	-1.8	0
10		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	302_MG_Derived	-0.15	61	0.0	-61	-4

Table 7.3 Summary of the reduction in ecosystem credits required due to avoidance of impacts to all vegetation zones for the Modification 1

Vegetation zone number	PCT	Vegetation zone name	Area	Vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
11	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	302_MG_High	-0.12	37.4	0.0	-37.4	-2
12	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	302_MG_Medium	0	66.4	0.0	-66.4	0
13	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	302_MG_Other	-0.56	68.3	0.0	-68.3	-16
14	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	302_MG_Poor	-0.06	0.1	0.0	-0.1	0
15	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	303_MG_Other	0	32.1	0.0	-32.1	0
16	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	311_MG_Derived	-1.29	22.8	0.0	-22.8	-11
17	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	311_MG_High	-0.89	77.3	0.0	-77.3	-19
18	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	311_MG_Medium	-0.97	56.9	0.0	-56.9	-21

Table 7.3 Summary of the reduction in ecosystem credits required due to avoidance of impacts to all vegetation zones for the Modification 1

Vegetation zone number	PCT	Vegetation zone name	Area	Vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
19	PCT 643 – Alpine shrubland on scree, blockstreams and rocky sites of high-altitude areas of Kosciuszko National Park, Australian Alps Bioregion	643_MG_High	0.00	9.2	0.0	-9.2	0
20	PCT 650 – Apple Box - Candlebark - Snow Gum shrubby open forest on valley floors, southern South Eastern Highlands Bioregion	650_MG_Medium	-0.36	26.6	0.0	-26.6	-4
21	PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	729_MG_Derived	-0.46	31.1	0.0	-31.1	-5
22	PCT 729 - Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	729_MG_High	-2.22	87.4	0.0	-87.4	-74
23	PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	729_MG_Medium	-1.00	72.9	0.0	-72.9	-28
24	PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	729_MG_Poor	-0.05	0.6	0.0	-0.6	0
25	PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	953_MG_High	0.00	89.7	0.0	-89.7	0
26	PCT 999 – Norton’s Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	999_MG_Derived	-0.01	38.3	0.0	-38.3	-1
27	PCT 999 – Norton’s Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	999_MG_High	-0.36	60.7	0.0	-60.7	-8
28	PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	1191_MG_Derived	-0.01	31.5	0.0	-31.5	-1
29	PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	1191_MG_High	-0.01	85.3	0.0	-85.3	-1

Table 7.3 **Summary of the reduction in ecosystem credits required due to avoidance of impacts to all vegetation zones for the Modification 1**

Vegetation zone number	PCT	Vegetation zone name	Area	Vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
30	PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	1196_MG_High	-0.11	83.4	0.0	-83.4	-4
31	PCT 1224 – Sub alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	1224_MG_High	0.00	86.4	0.0	-86.4	0
TOTAL							-250-253

A total of 346 ecosystem credits are required to offset the residual impacts of the Exploratory Works Modification 1, while 250 credits are no longer required due to avoidance of areas approved for disturbance in the original Exploratory Works approval. Overall, there is a net increase in credits required by Exploratory Works of 96 credits (Table 7.4).

Table 7.4 Overall number of credits required due to impacts, and reductions in credits, arising from Modification 1

PCT	Credits required	Credits reduced	Net
PCT 296 – Brittle Gum – Peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion	3	-21	-18
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 western Kosciuszko escarpment	37	-31	6
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	19	-22	-3
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	6	0	6
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	2	-51	-49
PCT 643 – Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion	0	0	0
PCT 650 – Apple Box - Candlebark - Snow Gum shrubby open forest on valley floors, southern South Eastern Highlands Bioregion	0	-4	-4
PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion	180	-107	73
PCT 953 – Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion	37	0	37
PCT 999 – Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion	14	-8	6
PCT 1191 – Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion	25	-2	24
PCT 1196 – Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion	19	-4	16
PCT 1224 – Sub alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion	5	0	5
TOTAL	347	-250	97

A credit report is provided in Appendix F.

Offsets will be provided in accordance with the biodiversity offset framework outlined in Section 7.4.

ii Impacts on threatened species

Impacts to threatened species habitat requiring offsets include:

- direct impacts on 0.28 ha of habitat for the Slender Greenhood;
- direct impacts on 0.01 ha of habitat for the Gang-gang Cockatoo;
- direct impacts on 8.32 ha of habitat for the Eastern Pygmy-possum;
- direct impacts on 1.57 ha of habitat for the Smoky Mouse;
- direct impacts on 0.44 ha of habitat for the Booroolong Frog;
- direct impacts on 0.03 ha of Alpine Tree Frog habitat.

A summary of the species credits required for all vegetation zones occupied by the threatened species, including changes in vegetation integrity score, are provided in Table 7.5. A total of 455 species credits are required to offset the residual impacts of Modification 1. A credit report is provided in Appendix F.

Offsets will be provided in accordance with the biodiversity offset framework outlined in Section 7.4.

Table 7.5 **Summary of threatened species credit required for Modification 1**

Species	Vegetation zone name	Area (ha)/individual (HL)	Habitat condition	Future habitat condition	Loss of habitat condition	Candidate SAIL	Species credits
Gang-gang Cockatoo	296_MG_High	0.01	67.5	0.0	-67.5	No	0 ¹
Eastern Pygmy-possum	296_MG_High	0.10	67.5	0.0	-67.5	No	3
Eastern Pygmy-possum	296_MG_Medium	0.01	67.5	0.0	-67.5	No	0 ¹
Eastern Pygmy-possum	300_MG_High	1.26	68.2	0.0	-68.2	No	43
Eastern Pygmy-possum	300_MG_Medium	0.33	56.2	0.0	-56.2	No	9
Eastern Pygmy-possum	300_MG_Other	0.07	37.7	0.0	-37.7	No	1
Eastern Pygmy-possum	300_MG_Poor	0.01	71.7	0.0	-71.7	No	0 ¹
Eastern Pygmy-possum	302_MG_High	0.03	37.4	0.0	-37.4	No	1
Eastern Pygmy-possum	302_MG_Medium	0.01	66.4	0.0	-66.4	No	0 ¹
Eastern Pygmy-possum	302_MG_Other	0.29	68.3	0.0	-68.3	No	10
Eastern Pygmy-possum	302_MG_Poor	0.01	0.1	0.0	-0.1	No	0 ¹
Eastern Pygmy-possum	311_MG_High	0.09	77.3	0.0	-77.3	No	3
Eastern Pygmy-possum	729_MG_High	4.9	87.4	0.0	-87.4	No	215
Eastern Pygmy-possum	729_MG_Medium	0.00	72.9	0.0	-72.9	No	0
Eastern Pygmy-possum	999_MG_High	0.58	60.7	0.0	-60.7	No	18
Eastern Pygmy-possum	1196_MG_High	0.61	83.4	0.0	-83.4	No	25
Booroolong Frog	296_MG_Medium	0.00	67.5	0.0	-67.5	No	0
Booroolong Frog	300_MG_High	0.03	68.2	0.0	-68.2	No	1
Booroolong Frog	302_Low	0.16	1.8	0.0	-1.8	No	0
Booroolong Frog	302_MG_High	0.03	37.4	0.0	-37.4	No	1
Booroolong Frog	302_MG_Other	0.21	68.3	0.0	-68.3	No	7
Booroolong Frog	302_MG_Poor	0.00	0.1	0.0	-0.1	No	0
Booroolong Frog	729_MG_High	0.02	87.4	0.0	-87.4	No	1

Table 7.5 **Summary of threatened species credit required for Modification 1**

Species	Vegetation zone name	Area (ha)/individual (HL)	Habitat condition	Future habitat condition	Loss of habitat condition	Candidate SAI	Species credits
Alpine Tree Frog	303_MG_Other	0.01	32.1	0.0	-32.1	No	0 ¹
Alpine Tree Frog	1224_MG_High	0.02	86.4	0.0	-86.4	No	1
Smoky Mouse	729_MG_High	0.10	87.4	0.0	-87.4	Yes	7 ²
Smoky Mouse	953_MG_High	0.87	89.7	0.0	-89.7	Yes	59 ²
Smoky Mouse	1196_MG_High	0.60	83.4	0.0	-83.4	No	38 ²
Slender Greenhood	1196_MG_High	0.28	83.4	0.0	-83.4	No	12 ²

Notes: 1. Some species do not require credits due to the size of the impact.

2. At the time of preparation of this BDAR, the credit calculator appeared to be incorrectly calculating credits for some species. Credits required have been updated based on Equation 2 of the BAM (OEHS 2017a)

iii Impacts not requiring offsets

Areas not requiring assessment in accordance with Section 10.4 of the BAM (OEH 2017) include:

- cleared and highly disturbed land; and
- watercourses.

7.4 Biodiversity offset framework

Significant and extensive consultation has been undertaken with NPWS, OEH and DoEE regarding the biodiversity offset for Snowy 2.0, including for this Exploratory Works modification. Throughout this consultation process, the objective of the offset framework has been to ensure any offsets achieve best value for the management of biodiversity values in KNP from offset payments from Snowy 2.0.

The offsets delivered for this Exploratory Works Modification 1 will be consistent with those delivered for Exploratory Works, with Snowy Hydro to make payment of to OEH for in-Park conservation measures to be implemented.



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

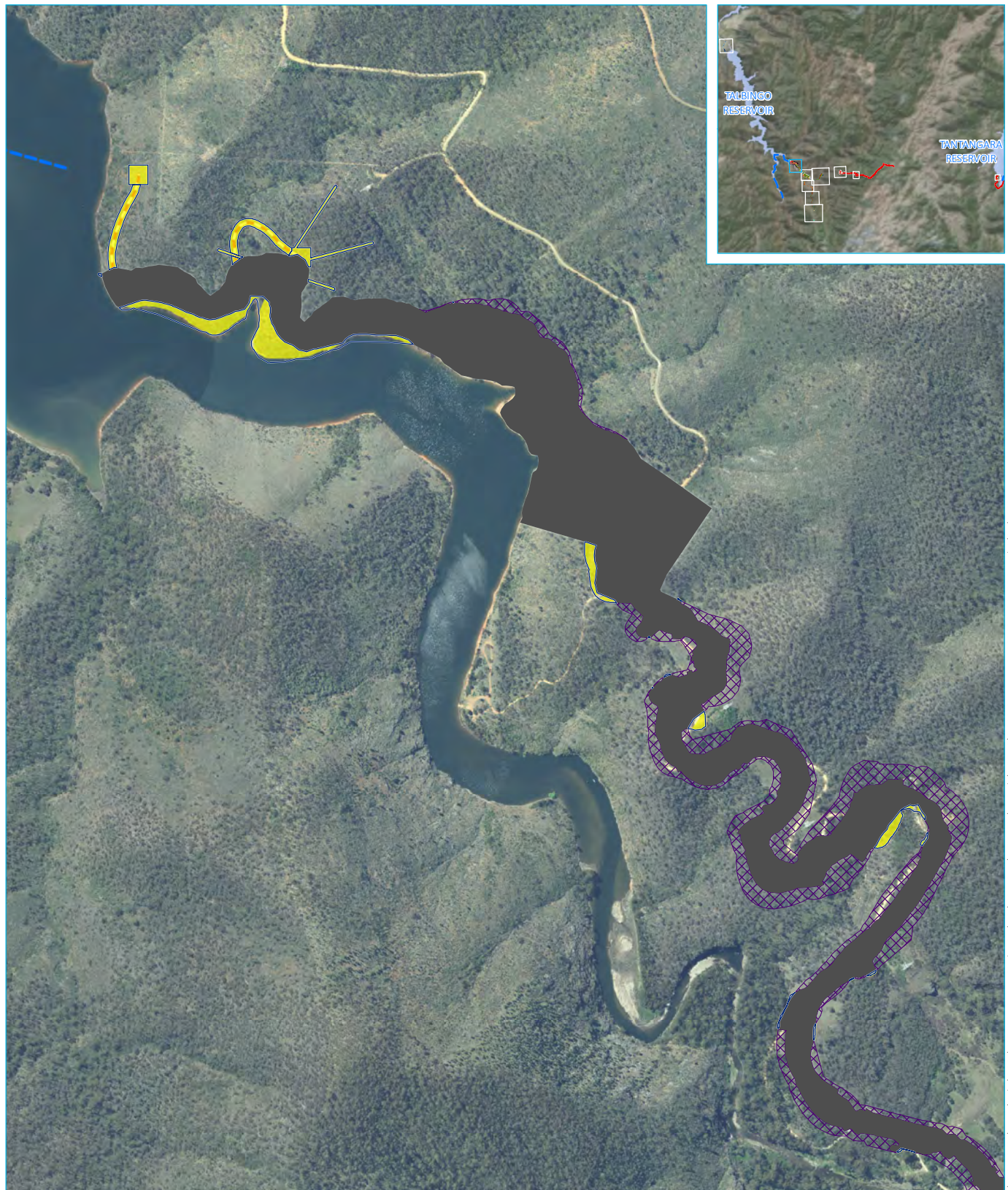
KEY

- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced
- Impacts requiring offsets

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 7.1a





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

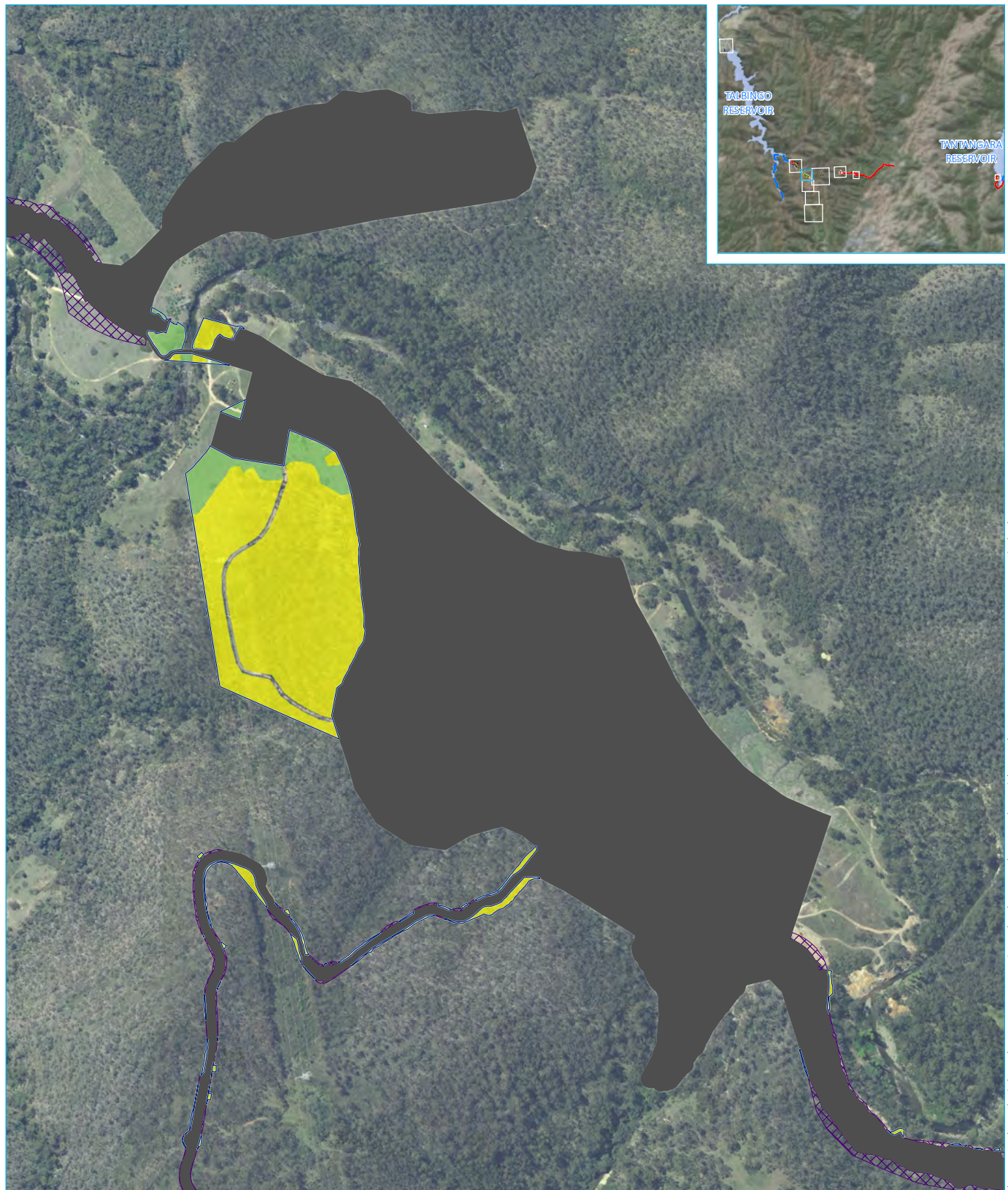
KEY

- Proposed access track
- Approved EW access
- Boat access
- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced
- Impacts requiring offsets
- Impacts not requiring offsets

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 7.1b





KEY

- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced
- Impacts requiring offsets
- Impacts not requiring offsets

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 7.1c





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

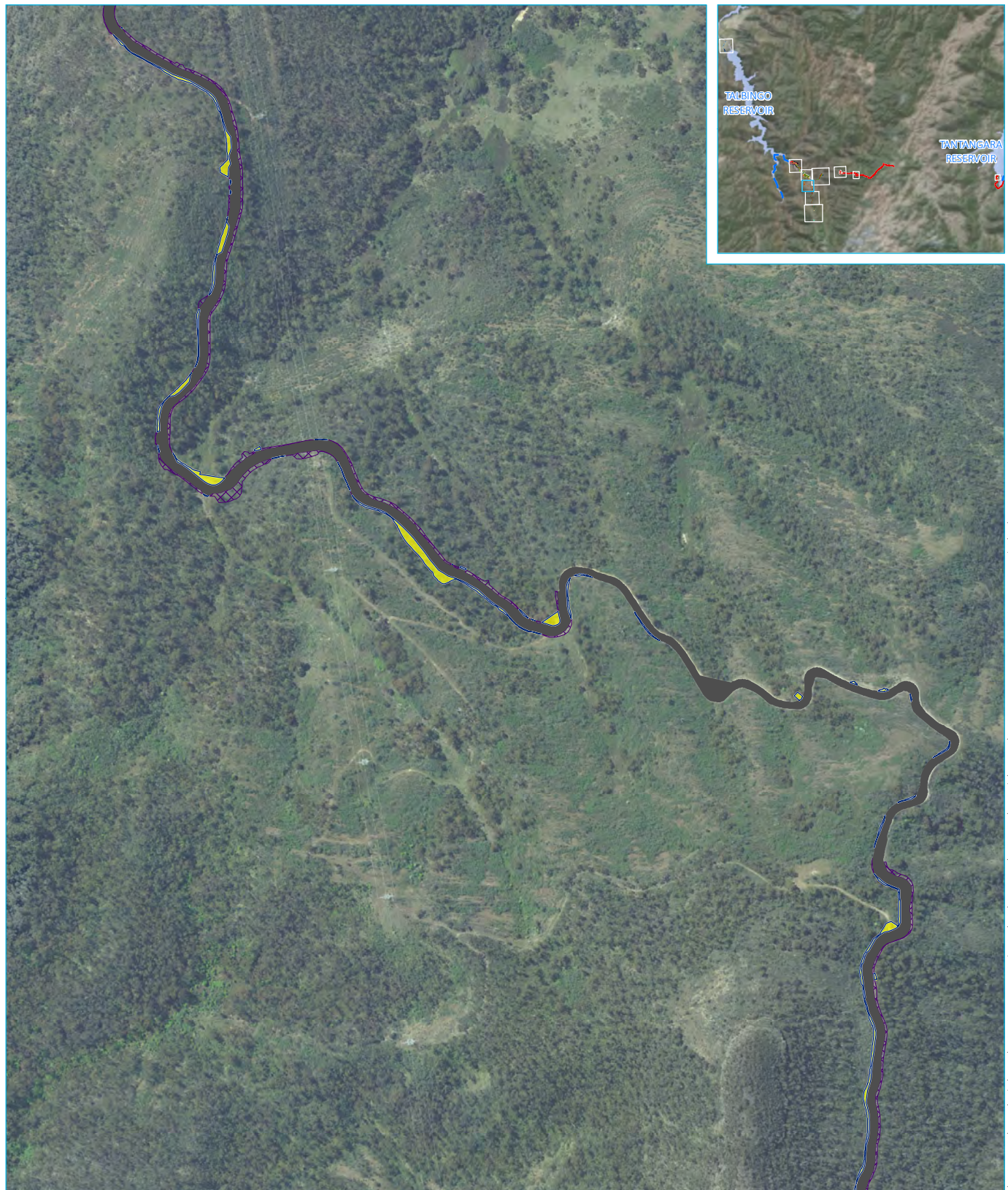
KEY

- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced
- Impacts requiring offsets

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 7.1d





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
- Impacts requiring offsets
- Impacts not requiring offsets

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 7.1e





KEY

- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced
- Impacts requiring offsets

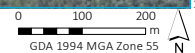
Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 7.1f





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



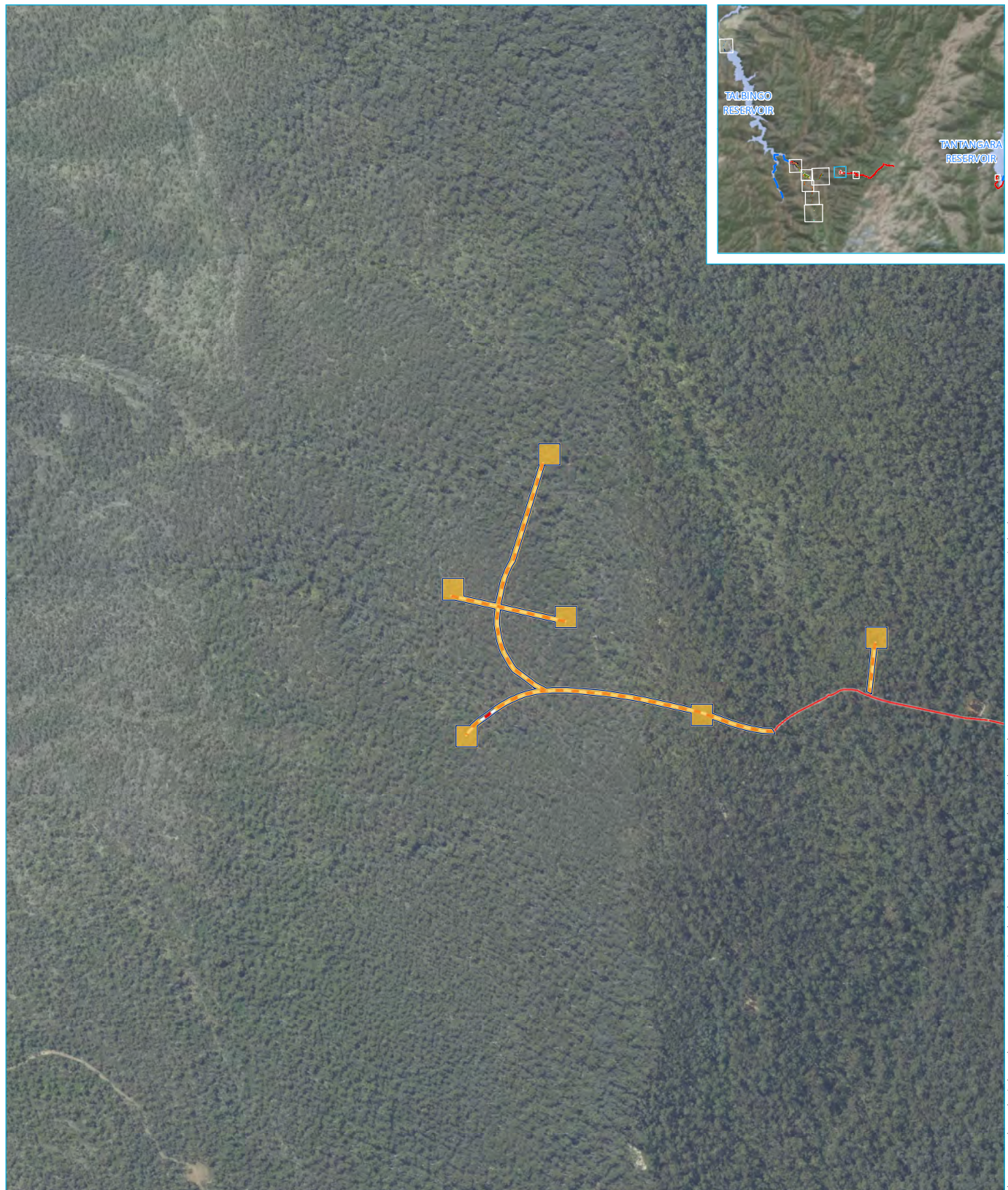
KEY

- EW approved construction footprint (additional)
- EW approved construction footprint
- EW approved construction footprint reduced
- Serious and irreversible impacts
- Impacts requiring offsets
- Impacts not requiring offsets

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 7.1g





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

KEY

- Existing access track
- - - Proposed access track
- EW approved construction footprint (additional)
- Serious and irreversible impacts

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 7.1h





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

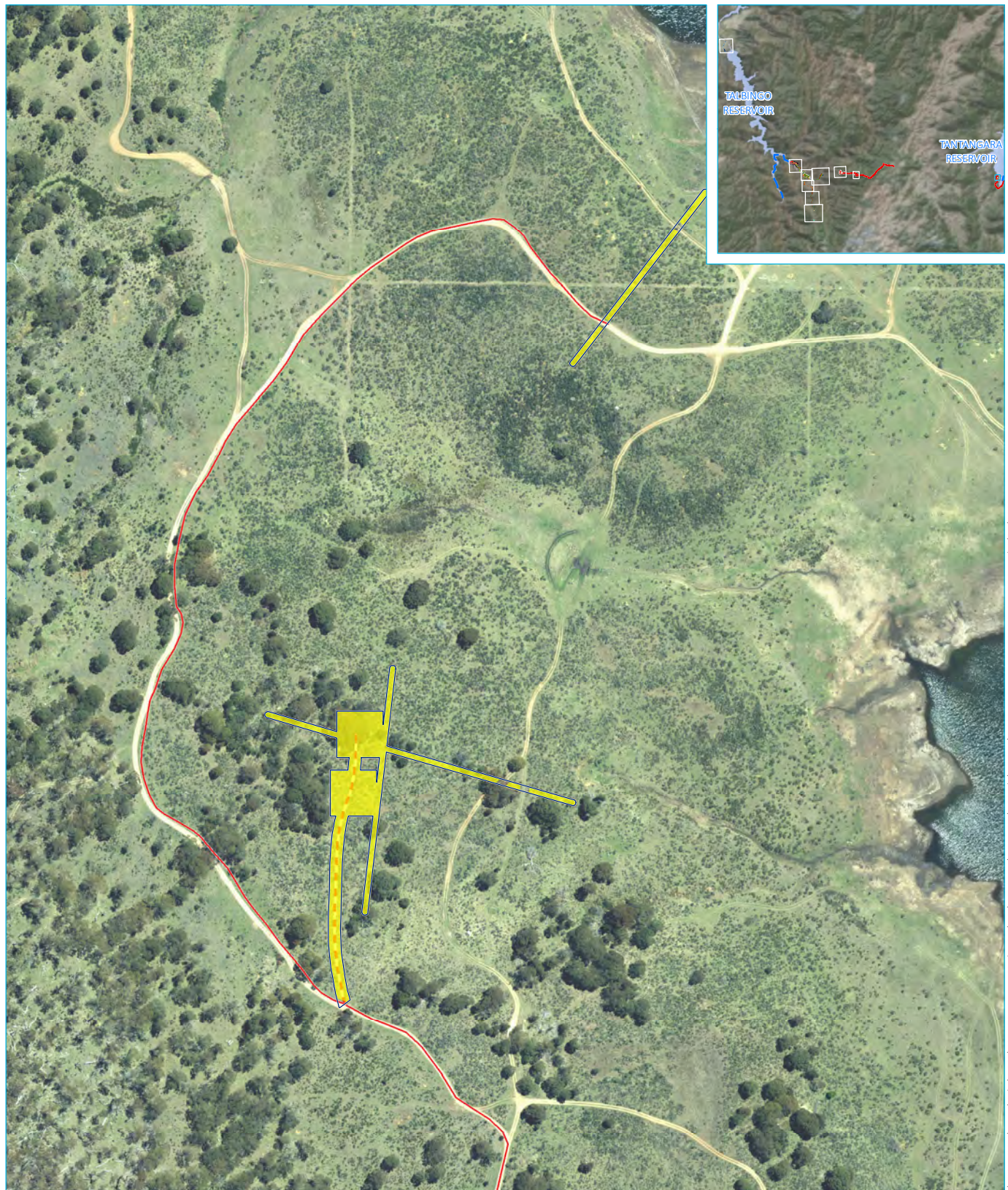
KEY

- Existing access track
- - - Proposed access track
- EW approved construction footprint (additional)
- Serious and irreversible impacts

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 7.1i





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

KEY

- Existing access track
- - Proposed access track
- EW approved construction footprint (additional)
- Impacts requiring offsets

Serious and irreversible impacts, impacts requiring offsets, impacts not requiring offsets and areas not requiring assessment

Snowy 2.0
Biodiversity development assessment
Modification 1
Figure 7.1j



8 Assessment of biodiversity legislation

8.1 Environment Protection and Biodiversity Conservation Act 1999

This section provides an assessment of the project's impacts specific to species and communities listed under the EPBC Act.

8.1.1 Threatened ecological communities

Recorded PCTs were compared to four listed ecological communities predicted to occur in the region by the PMST search. An assessment of likelihood was completed (Table F.1), concluding no threatened ecological communities were recorded or considered to occur within Modification 1.

8.1.2 Threatened species

Thirty-nine species were predicted to occur in the region by the PMST search. Table F.2 provides an assessment of the likelihood of flora species and Table F.3 provides an assessment of likelihood for fauna species utilising habitat within the project area. Three species listed as threatened under the EPBC Act were recorded as being present in the project area and are considered likely to occur and utilise habitat on-site. These include:

- Alpine Tree Frog;
- Booroolong Frog; and
- Smoky Mouse.

An assessment of significance was completed for each of these species (Appendix I). These assessments concluded that a significant impact was unlikely to result from cumulative impacts associated with Exploratory Works, including Modification 1.

8.1.3 Migratory species

Twelve migratory species listed as under the EPBC Act were predicted to occur in the project area based by the PMST search. Table F.4 provides an assessment of the likelihood of these species utilising habitat within the project area. Two migratory species were recorded within the Modification 1 project area.

An assessment of significance was completed for each of these species (Appendix I). These assessments concluded that a significant impact was unlikely to result from cumulative impacts associated with Exploratory Works, including Modification 1.

9 Conclusion

Significant field surveys have been undertaken across the Modification 1 survey area, including initial field assessments, detailed vegetation mapping, vegetation integrity assessments and comprehensive targeted flora and fauna surveys which have exceeded NSW and Commonwealth survey guidelines. These surveys have been undertaken to understand the biodiversity values within the survey area, allowing consideration of these values during design.

Native vegetation within Modification 1 reflects past land use. Historical use of Lobs Hole for the movement of stock, as a settlement and copper mining to 1917 and more contemporarily for recreation, have resulted in significant amounts of clearing and disturbance of vegetation in the area. Native vegetation and fauna habitats have been modified by past disturbances associated with land clearing, livestock grazing and weed invasion. Vegetation mapping identified 14 PCTs within the Modification 1 disturbance and avoidance footprints which were stratified into 36 vegetation zones on the basis of broad condition state. Nineteen vegetation zones show significant levels of disturbance, while a further six show some degree of impact. Eleven vegetation zones are considered representative of relatively intact vegetation of high quality. Vegetation integrity scores reflect this condition, with scores varying between 0.1 and 89.7.

Threatened species surveys identified one flora species recorded within Modification 1 disturbance footprint. Fourteen threatened fauna species have been recorded within or adjacent to Modification 1; seven ecosystem credit species and nine species credit species. A significant result was the identification of a population of the critically endangered Smoky Mouse within areas west of Wallaces Creek Fire Trail. This species is known from a limited number of extant sites in NSW. Other species identified include the Gang-gang Cockatoo and Masked Owl, with breeding habitat for these two species identified in the riparian zone of the Yarrangobilly River and the Marica area. The Eastern Pygmy-possum was recorded at numerous locations within Modification 1, within Lobs Hole and the Marica area. A healthy population of the Booroolong Frog was recorded along the entire length of the Yarrangobilly River within and adjacent to the Modification 1 disturbance footprint; this population is likely to extend upstream to at least Blue Creek Firetrail. The Alpine Tree Frog was recorded within adjacent areas of Modification 1 near Tantangara Reservoir.

A key focus of project design has been to avoid and minimise impacts to biodiversity values identified during the field surveys, in recognition of the location of Modification 1 in the KNP. This has resulted in significant design revisions to avoid and minimise direct impacts. Significant controls have been put in place to avoid, minimise and mitigate indirect impacts. Residual impacts following implementation of all controls include:

- clearing of 13.38 ha of native vegetation; and
- impacts to 10.64 ha of threatened species habitat for six species credit species.

In summary, a significant effort has been undertaken to understand the biodiversity values Modification 1 and design the project to avoid and minimise impacts to identified values. Modification 1 has been sited, where possible, within disturbed areas as a priority. Where this could not be achieved impacts have been minimised and mitigated through implementation of appropriate controls. Residual impacts will be offset in accordance with the objective and principles outlined in the biodiversity offset framework

For the purposes of the Assessment Report for Modification 1, the biodiversity mitigation measures are summarised in Table 9.1.

Table 9.1 Mitigation measures - Biodiversity

Impact	Reference #	Environmental management measures
Biodiversity		
Impact to biodiversity	ECO01	The CEMP will include the following: • 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; • 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 <i>AS 4970-2009 Protection of trees on development sites</i>; terrestrial and aquatic weed, pest and pathogen prevention and management protocols, including washdown facilities at suitable locations.
	ECO02	Ground disturbance within the avoidance footprint (Yarrangobilly River and Smoky Mouse habitat) will be prohibited and marked with environmental controls as an exclusion area.
Impacts to threatened species	ECO03	A Threatened Species Management sub plan will be developed and implemented as part of the CEMP during construction. The sub plan will include: • pre-clearance procedures; • an unexpected threatened species finds procedure; • Murray Crayfish monitoring program (Talbingo Reservoir); • Smoky Mouse monitoring program; and • Boorooloong Frog monitoring program.
	ECO04	Vehicle traffic movements along Upper Lobs Hole Ravine Road will be: • limited to daytime hours only (except for emergencies); and • limited to 40km/h.
Impacts to fish eggs and larvae due to extraction of water from Talbingo Reservoir	ECO05 ¹	The water pipeline intake will be designed to: • prevent/discourage adult fish from approaching or entering the intake • 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 initial slow water velocity to reduce likelihood of aquatic biota being drawn into the pump.
Impacts to fish passage	ECO06 ¹	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).
	ECO07 ¹	The temporary bridges at Yarrangobilly River and at Wallaces Creek will be designed and constructed to: • adhere to guidelines for temporary structures in Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update) (Fisheries NSW 2013) and recommended crossing design considerations in Fairfull and Witheridge (2003); and • ensure any build-up of debris potentially obstructing fish passage will be removed.

Table 9.1 Mitigation measures - Biodiversity

Impact	Reference #	Environmental management measures
	ECO08 ¹	Construction of the temporary bridge at Yarrangobilly River will avoid or minimise works during the migration time of Macquarie Perch (October to January).
Impact to aquatic ecology from erosion and sedimentation	ECO09 ¹	The water quality controls described in the Surface water assessment (Appendix M) and Aquatic ecology assessment (Appendix G) will be implemented will be implemented.
Impacts to aquatic habitat and biota during dredging and subaqueous placement	ECO10 ¹	The subaqueous placement monitoring program for Talbingo Reservoir (described in Appendix D of Appendix L) will be implemented and include measures relevant to aquatic ecology including: • 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, stop or scale back further works and revise control measures; • 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; • mapping of aquatic habitats within and adjacent to the subaqueous placement areas to confirm the presence/absence of the aquatic habitats and vegetation within and adjacent to the placement area and minimise the disturbance of aquatic habitat where feasible; and • minimising suspension of sediment and turbidity by using the methods described in the Barge Access Infrastructure Report (Appendix L).

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Appendix A

Vegetation integrity assessment – datasheets

BAM Site – Field Survey Form

Plot ID:	143	Date:	22/11/17	Survey Name:	Lobs Hole Ravine adjusted location for 143			Recorders:	ED, LH
Zone:	55	Easting:	627654.339	Plot dimensions:	20m x 50m			Midline bearing:	20
Datum:	GDA94	Northing:	6038148.99	IBRA region:	South Eastern Highlands (Bondo)			Zone ID:	
Plant Community Type:		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				Confidence:	Low	Photo #:	
Vegetation Class:		Upper Riverina Dry Sclerophyll Forests				EEC:	Yes	Confidence:	Low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	14
	Grasses etc.:	5
	Forbs:	7
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	35
	Shrubs:	132.9
	Grasses etc.:	20.5
	Forbs:	0.8
	Ferns:	0.6
	Other:	0.1
High Threat Weed cover:		16.3

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	1	0	0
30 – 49 cm:	1	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	1	0	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	12		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	40	25	80	80	25	0	0	0	0	0	2	0	0	0	0	0	0	0	0	25
Average of the 5 subplots:	50					0					0.4					5				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Valley flat	Lf Pattern (A)	Alluvial plain	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture	Fine loam	Soil Colour	Dark brown	Soil Depth	Deep
Lithology (B)							
Slope	Flat	Aspect		Site Drainage		Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	Light	greater than 10yo	Previous clearing
Cultivation (inc. pasture):			No evidence
Soil erosion:			No evidence
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:			
Storm damage:			
Weediness:	Moderate	greater than 10yo	Blackberry
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Lobs Hole Ravine adjusted location for 143					
	Date:	22/11/17	Plot ID:	143	Recorders:	ED, LH

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Shrub (SG)	<i>Acacia pravissima</i>	60	200		N	
Shrub (SG)	<i>Pomaderris aspera</i>	45	10		N	
Grass & grasslike	<i>Poa helmsii</i>	20	200		N	
	<i>Rosa rubiginosa</i>	0.7	5		HTE	
	<i>Rubus fruticosus</i> spp. agg	15	100		HTE	
Shrub (SG)	<i>Mirbelia oxylobioides</i>	4	20		N	
Shrub (SG)	<i>Cassinia longifolia</i>	15	40		N	
Tree (TG)	<i>Eucalyptus stellulata</i>	10	15		N	
Forb (FG)	<i>Geranium solanderi</i>	0.2	10		N	
Shrub (SG)	<i>Cassinia aculeata</i>	5	10		N	
	<i>Hypericum perforatum</i>	0.2	30		HTE	
Shrub (SG)	<i>Banksia collina</i>	0.5	1		N	
	<i>Bromus diandrus</i>	0.4	20		HTE	
Forb (FG)	<i>Oxalis perennans</i>	0.1	5		N	
Shrub (SG)	<i>Leucopogon gelidus</i>	0.2	5		N	
Grass & grasslike	<i>Carex appressa</i>	0.1	1		N	
Grass & grasslike	<i>Poa sieberiana</i>	0.2	10		N	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	0.2	4		N	
Fern (EG)	<i>Pteridium esculentum</i>	0.6	10		N	
Shrub (SG)	<i>Dillwynia prostrata</i>	0.1	6		N	
Forb (FG)	<i>Asperula conferta</i>	0.1	10		N	
Grass & grasslike	<i>Lomandra micrantha</i>	0.1	1		N	
Shrub (SG)	<i>Bursaria spinosa</i>	1	5		N	
Shrub (SG)	<i>Gynatrix pulchella</i>	1	5		N	
Other (OG)	<i>Glycine tabacina</i>	0.1	1		N	
Forb (FG)	<i>Poranthera microphylla</i>	0.1	3		N	
Forb (FG)	<i>Hydrocotyle laxiflora</i>	0.1	2		N	
Forb (FG)	<i>Asperula scoparia</i>	0.1	10		N	
Shrub (SG)	<i>Exocarpos strictus</i>	0.6	3		N	
Forb (FG)	<i>Dichondra repens</i>	0.1	2		N	
Grass & grasslike	<i>Carex breviculmis</i>	0.1	1		N	
Tree (TG)	<i>Eucalyptus viminalis</i>	25			N	
	<i>Malus</i> spp.	0.1	1		E	
Shrub (SG)	<i>Rubus parvifolius</i>	0.1	5		N	
	<i>Vulpia bromoides</i>	0.1	10		E	
Shrub (SG)	<i>Gynatrix pulchella</i>	0.2	1		N	

BAM Site – Field Survey Form

Plot ID:	157	Date:	24/11/17	Survey Name:	Tantangara Reservoir	Recorders:	SW, AM	
Zone:	55	Easting:	648754.053	Plot dimensions:	20m x 50m	Midline bearing:	150	
Datum:	GDA94	Northing:	6037746.24	IBRA region:	Australian Alps (Snowy Mountains)	Zone ID:		
Plant Community Type:	1196: Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion				Confidence:	High	Photo #:	
Vegetation Class:	Subalpine Woodlands				EEC:	No	Confidence:	High

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	6
	Grasses etc.:	3
	Forbs:	17
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	40
	Shrubs:	16.6
	Grasses etc.:	30.3
	Forbs:	5.9
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	1	0	1
50 – 79 cm:	4	0	3
30 – 49 cm:	1	0	3
20 – 29 cm:	1	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	0	0	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	60		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	60	70	15	75	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Average of the 5 subplots:	52					0					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Mountains	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture	Loam	Soil Colour	Brown	Soil Depth	at least 100mm
Lithology (B)							
Slope		Aspect	Eastern	Site Drainage		Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	Moderate	less than 3yo	Numerous cut stumps within the vicinity
Cultivation (inc. pasture):			No evidence
Soil erosion:			No evidence
Firewood / CWD removal:	Severe	less than 3yo	No fallen timber in areas close to tracks, actually saw person dragging a small tree away with vehicle
Grazing (identify native/stock):	Light		Native herbivores
Fire damage:	Light	greater than 10yo	
Storm damage:			No evidence
Weediness:	Moderate	less than 3yo	Exotic forbs and grasses present
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Tantangara Reservoir						
	Date:	24/11/17	Plot ID:	157	Recorders:	SW, AM	

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Tree (TG)	<i>Eucalyptus pauciflora</i>	40	20		N	
Shrub (SG)	<i>Daviesia ulicifolia</i>	3	20		N	
Shrub (SG)	<i>Hakea microcarpa</i>	0.3	4		N	
Shrub (SG)	<i>Mirbelia oxylobioides</i>	3	20		N	
	<i>Anthoxanthum odoratum</i>	50	1000		E	
Forb (FG)	<i>Asperula conferta</i>	3	500		N	
Grass & grasslike	<i>Poa sieberiana</i>	30	200		N	
Forb (FG)	<i>Ranunculus lappaceus</i>	0.5	100		N	
Forb (FG)	<i>Poranthera microphylla</i>	0.1	50		N	
Forb (FG)	<i>Dlchondra repens</i>	0.3	200		N	
Grass & grasslike	<i>Lomandra filiformis subsp. coriacea</i>	0.1	10		N	
Forb (FG)	<i>Veronica subtilis</i>	0.2	500		N	
Forb (FG)	<i>Senecio gunnii</i>	0.2	50		N	
Forb (FG)	<i>Ajuga australis</i>	0.4	100		N	
	<i>Medicago lupulina</i>	0.1	10		E	
	<i>Cirsium vulgare</i>	0.5	20		E	
	<i>Sonchus oleraceus</i>	0.1	10		E	
Shrub (SG)	<i>Acrothamnus hookeri</i>	10	50		N	
Forb (FG)	<i>Xerochrysum bracteatum</i>	0.1	20		N	
	<i>Hypochaeris radicata</i>	1	200		E	
Forb (FG)	<i>Cymbonotus preissianus</i>	0.1	20		N	
Forb (FG)	<i>Acaena novae-zelandiae</i>	0.2	100		N	
Forb (FG)	<i>Veronica derwentiana subsp. maideniana</i>	0.1	3		N	
Grass & grasslike	<i>Themeda triandra</i>	0.2	10		N	
Forb (FG)	<i>Hovea heterophylla</i>	0.1	5		N	
Forb (FG)	<i>Geranium solanderi</i>	0.2	50		N	
Forb (FG)	<i>Stellaria pungens</i>	0.1	5		N	
Shrub (SG)	<i>Pimelea pauciflora</i>	0.1	2		N	
	<i>Centaurium erythraea</i>	0.1	20		E	
Forb (FG)	<i>Acaena agnipila</i>	0.1	10		N	
Forb (FG)	<i>Oreomyrrhis eriopoda</i>	0.1	10		N	
	<i>Myosotis discolor</i>	0.1	20		E	
Forb (FG)	<i>Chrysocephalum semipapposum</i>	0.1	10		N	
Shrub (SG)	<i>Grevillea lanigera</i>	0.2	5		N	

BAM Site – Field Survey Form

Enter BAM Plot data table range

A1:DG98

Enter BAM Species data table range

A1:M6902

Plot ID:	173	Date:	20/11/17	Survey Name:	Lobs hole ravine track			Recorders:	ED/LH
Zone:	55	Easting:	627163	Plot dimensions:	20m x 50m			Midline bearing:	84
Datum:	GDA94	Northing:	6033834	IBRA region:	South Eastern Highlands			Zone ID:	
Plant Community Type:	643: Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion					Confidence:	high	Photo #:	
Vegetation Class:	Alpine Heaths					EEC:	yes	Confidence:	low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m ² plot)		Sum values
Count of Native Richness	Trees:	3
	Shrubs:	4
	Grasses etc.:	0
	Forbs:	2
	Ferns:	1
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	4
	Shrubs:	8.2
	Grasses etc.:	0
	Forbs:	0.2
	Ferns:	1
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m ² plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	0	0	0
5 – 9 cm:	0	1	0
< 5 cm:	0	1	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	17		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	10	75	5	10	10	0	0	0	0	0	15	0	0	0	0	75	25	85	90	90
Average of the 5 subplots:	22					0					3					73				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Mountains	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Basalt	Soil Surface Texture	Volcanic boulderfield	Soil Colour		Soil Depth	
Lithology (B)							
Slope	Steep	Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:	light	greaterthan10yo	Charred logs
Storm damage:			
Weediness:			
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

[illegible]

BAM Site – Field Survey Form								
Plot ID:	187	Date:	08/01/18	Survey Name:	Lobbs Hole Ravine Road north		Recorders:	Douglas
Zone:	55	Easting:	628142.379	Plot dimensions:	20m x 50m		Midline bearing:	90
Datum:	GDA94	Northing:	6046952.08	IBRA region:	South Eastern Highlands (Bondo)		Zone ID:	
Plant Community Type:	296: Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion				Confidence:	Medium	Photo #:	
Vegetation Class:	Southern Tableland Dry Sclerophyll Forests				EEC:	No	Confidence:	High

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	3
	Shrubs:	9
	Grasses etc.:	6
	Forbs:	6
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	2
	Shrubs:	10.1
	Grasses etc.:	7.2
	Forbs:	3.8
	Ferns:	60
	Other:	0.5
High Threat Weed cover:		1.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	0	0	0
10 – 19 cm:	0	0	0
5 – 9 cm:	0	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	84		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	60	98	100	40	90	20	5	5	60	5	0	20	10	70	40	0	0	0	0	0
Average of the 5 subplots:	77.6					19					28					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Sedimentary rock (unidentified)	Soil Surface Texture	Clay	Soil Colour	Brown	Soil Depth	Medium
Lithology (B)							
Slope	17/01/1900	Aspect	East	Site Drainage	Medium	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	Severe	greater than 10yo	Poweline easement
Cultivation (inc. pasture):			
Soil erosion:	Moderate	greater than 10yo	Powerline clearing
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:			
Storm damage:			
Weediness:	Light	3 to 10 yo	
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Lobbs Hole Ravine Road north				
	Date:	08/01/18	Plot ID:	187	Recorders: Douglas

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Tree (TG)	<i>Acacia dealbata</i>	1	10		N	
Fern (EG)	<i>Pteridium esculentum</i>	60	1000		N	
Shrub (SG)	<i>Cassinia ochracea</i>	1	20		N	
Forb (FG)	<i>Asperula scoparia</i>	1	100		N	
Grass & grasslike	<i>Lomandra longifolia</i>	2	80		N	
	<i>Platylobium montanum</i>	0.7	40		N	
Shrub (SG)	<i>Daviesia latifolia</i>	1	30		N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	0.5	40		N	
Other (OG)	<i>Cassytha glabella</i>	0.5	20		N	
	<i>Hypericum perforatum</i>	1	200		HTE	
Shrub (SG)	<i>Pimelea linifolia</i>	3	200		N	
Shrub (SG)	<i>Leucopogon fletcheri</i> subsp. <i>brevisepalus</i>	3	200		N	
Grass & grasslike	<i>Deyeuxia quadriseta</i>	0.5	50		N	
Forb (FG)	<i>Stylidium graminifolium</i>	1	200		N	
Grass & grasslike	<i>Poa sieberiana</i> var. <i>sieberiana</i>	3	300		N	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	0.5	30		N	
Tree (TG)	<i>Eucalyptus dalrympleana</i>	0.5	2		N	
Tree (TG)	<i>Eucalyptus mannifera</i> subsp. <i>mannifera</i>	0.5	2		N	
Shrub (SG)	<i>Persoonia chamaepeuce</i>	0.2	5		N	
Forb (FG)	<i>Stellaria pungens</i>	1	100		N	
Shrub (SG)	<i>Tetradlea bauerifolia</i>	1	50		N	
Shrub (SG)	<i>Baeckea utilis</i>	0.1	10		N	
	<i>Centaurium erythraea</i>	0.3	30		E	
	<i>Taraxacum officinale</i>	0.5	50		E	
	<i>Hypochaeris glabra</i>	0.3	30		E	
Grass & grasslike	<i>Anthosachne scabra</i>	0.5	50		N	
Forb (FG)	<i>Scleranthus fasciculatus</i>	0.2	10		N	
Grass & grasslike	<i>Poa sieberiana</i> var. <i>cyanophylla</i>	0.7	50		N	
	<i>Aira elegantissima</i>	0.2	20		E	
	<i>Holcus lanatus</i>	0.2	20		E	
Shrub (SG)	<i>Lomatia myricoides</i>	0.3	2		N	
	<i>Agrostis capillaris</i>	0.1	5		HTE	
Grass & grasslike	<i>Aristida ramosa</i>	0.5	30		N	
Forb (FG)	<i>Microtis unifolia</i>	0.1	1		N	

BAM Site – Field Survey Form

Plot ID:	194	Date:	12/12/17	Survey Name:	O'Hares Creek Trail	Recorders:	SW, AM
Zone:	55	Easting:	625172.182	Plot dimensions:	20m x 50m	Midline bearing:	180
Datum:	GDA94	Northing:	6036523.66	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:	
Plant Community Type:	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 western Kosciuszko escarpment				Confidence:	Low	Photo #:
Vegetation Class:	Southern Tableland Wet Sclerophyll Forests				EEC:	No	Confidence:
				Low			

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	5
	Shrubs:	15
	Grasses etc.:	12
	Forbs:	21
	Ferns:	1
	Other:	3
Sum of Cover of native vascular plants by growth form group	Trees:	48.3
	Shrubs:	53
	Grasses etc.:	27.2
	Forbs:	3.6
	Ferns:	25
	Other:	0.4
High Threat Weed cover:		2.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	1	0	3
30 – 49 cm:	1	0	1
20 – 29 cm:	1	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	1	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	111		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	95	80	90	90	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Average of the 5 subplots:	83					0					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Mountains	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture	Loamy clay	Soil Colour	Brown	Soil Depth	At least 100mm
Lithology (B)							
Slope	15°	Aspect	ESE	Site Drainage		Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			No evidence
Cultivation (inc. pasture):			No evidence
Soil erosion:	Light	less than 3yo	Some feral pig damage
Firewood / CWD removal:			No evidence
Grazing (identify native/stock):			No evidence
Fire damage:	Light	greater than 10yo	
Storm damage:			No evidence
Weediness:	Light	less than 3yo	Exotic forbs
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	O'Hares Creek Trail						
		Date:	12/12/17	Plot ID:	194	Recorders:	SW, AM

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Tree (TG)	<i>Acacia dealbata</i> subsp. <i>subalpina</i>	0.3	3		N	
Tree (TG)	<i>Eucalyptus viminalis</i>	20	5		N	
Tree (TG)	<i>Eucalyptus robertsonii</i> subsp. <i>robertsonii</i>	20	7		N	
Tree (TG)	<i>Eucalyptus dives</i>	7	3		N	
Shrub (SG)	<i>Cassinia longifolia</i>	5	20		N	
Shrub (SG)	<i>Platylobium formosum</i> subsp. <i>formosum</i>	10	100		N	
Forb (FG)	<i>Cymbonotus preissianus</i>	0.1	5		N	
Shrub (SG)	<i>Mirbelia oxylobioides</i>	25	70		N	
Fern (EG)	<i>Pteridium esculentum</i>	25	200		N	
Shrub (SG)	<i>Exocarpos strictus</i>	1	5		N	
Grass & grasslike	<i>Anthosachne scabra</i>	5	300		N	
Grass & grasslike	<i>Lomandra longifolia</i>	2	20		N	
Grass & grasslike	<i>Poa tenera</i>	2	100		N	
Forb (FG)	<i>Stellaria pungens</i>	0.2	50		N	
Forb (FG)	<i>Viola betonicifolia</i>	0.1	30		N	
Shrub (SG)	<i>Banksia canei</i>	0.5	8		N	
Forb (FG)	<i>Plantago varia</i>	1	100		N	
Grass & grasslike	<i>Dichelachne rara</i>	5	500		N	
Other (OG)	<i>Glycine clandestina</i>	0.1	50		N	
Forb (FG)	<i>Wahlenbergia stricta</i> subsp. <i>stricta</i>	0.1	20		N	
Forb (FG)	<i>Picris angustifolia</i> subsp. <i>merxmulleri</i>	0.2	50		N	
Forb (FG)	<i>Hydrocotyle laxiflora</i>	0.2	100		N	
Forb (FG)	<i>Hovea heterophylla</i>	0.1	10		N	
Grass & grasslike	<i>Poa sieberiana</i> var. <i>hirtella</i>	10	100		N	
	<i>Rosa rubiginosa</i>	0.1	2		HTE	
Other (OG)	<i>Hardenbergia violacea</i>	0.2	20		N	
Other (OG)	<i>Cassytha pubescens</i>	0.1	5		N	
Shrub (SG)	<i>Pimelea linifolia</i> subsp. <i>linifolia</i>	0.3	20		N	
Forb (FG)	<i>Geranium solanderi</i> var. <i>solanderi</i>	0.2	50		N	
	<i>Taraxacum officinale</i>	0.1	5		E	
Forb (FG)	<i>Senecio quadridentatus</i>	0.1	20		N	
Forb (FG)	<i>Poranthera microphylla</i>	0.1	20		N	
Forb (FG)	<i>Gonocarpus teucrioides</i>	0.2	200		N	
	<i>Hypochaeris radicata</i>	0.1	20		E	
Shrub (SG)	<i>Bursaria spinosa</i>	0.3	4		N	
Tree (TG)	<i>Acacia melanoxylon</i>	1	2		N	
Shrub (SG)	<i>Tetradlea bauerifolia</i>	10	500		N	
Forb (FG)	<i>Microtis unifolia</i>	0.1	5		N	
	<i>Hypericum perforatum</i>	2	100		HTE	
Forb (FG)	<i>Pimelea curviflora</i> var. <i>sericea</i>	0.1	20		N	
Forb (FG)	<i>Stylidium graminifolium</i>	0.1	20		N	
	<i>Rubus fruticosus</i>	5	30		E	
Shrub (SG)	<i>Gompholobium huegelii</i>	0.2	10		N	
Shrub (SG)	<i>Pimelea pauciflora</i>	0.1	2		N	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	0.1	5		N	
Shrub (SG)	<i>Acacia pravissima</i>	0.2	1		N	
Grass & grasslike	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	0.2	20		N	

Forb (FG)	<i>Dianella revoluta</i> var. <i>revoluta</i>	0.1	5		N	
Grass & grasslike	<i>Rytidosperma penicillatum</i>	2	100		N	
Forb (FG)	<i>Oxalis perennans</i>	0.1	10		N	
Forb (FG)	<i>Chrysocephalum semipapposum</i>	0.2	40		N	
	<i>Centaurium erythraea</i>	0.1	20		E	
Grass & grasslike	<i>Luzula flaccida</i>	0.1	20		N	
Grass & grasslike	<i>Poa sieberiana</i> var. <i>sieberiana</i>	0.5	50		N	
Shrub (SG)	<i>Leucopogon virgatus</i>	0.1	5		N	
Forb (FG)	<i>Acaena novae-zelandiae</i>	0.1	30		N	
Shrub (SG)	<i>Acrotriche serrulata</i>	0.1	2		N	
Shrub (SG)	<i>Leucopogon attenuatus</i>	0.1	3		N	
Forb (FG)	<i>Senecio gunnii</i>	0.1	10		N	
	<i>Cassinia aculeata</i> subsp. <i>aculeata</i>	0.4	2		N	
Forb (FG)	<i>Dlchondra repens</i>	0.1	50		N	
Grass & grasslike	<i>Echinopogon ovatus</i>	0.1	10		N	
Grass & grasslike	<i>Lachnagrostis filiformis</i>	0.2	20		N	
Grass & grasslike	<i>Lomandra multiflora</i>	0.1	10		N	

BAM Site – Field Survey Form

Plot ID:	195	Date:	12/12/17	Survey Name:	Ravine early works	Recorders:	SD, EL
Zone:	55	Easting:	627135.821	Plot dimensions:	20m x 50m	Midline bearing:	131
Datum:	GDA94	Northing:	6037799.62	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:	
Plant Community Type:	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				Confidence:		Photo #:
Vegetation Class:	Upper Riverina Dry Sclerophyll Forests				EEC:		Confidence:

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	0
	Grasses etc.:	1
	Forbs:	1
	Ferns:	1
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0
	Grasses etc.:	0.1
	Forbs:	0.1
	Ferns:	5
	Other:	0
High Threat Weed cover:		0.3

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	0	0	0
10 – 19 cm:	0	0	0
5 – 9 cm:	0	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	5	5	5	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Average of the 5 subplots:	6					0					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Valley flat	Lf Pattern (A)	Alluvial plain	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Alluvial loams and clays	Soil Surface Texture	Loam	Soil Colour	Black	Soil Depth	Deep
Lithology (B)							
Slope	2/01/1900	Aspect	NNE	Site Drainage	Good	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	Severe	greater than 10yo	Logged
Cultivation (inc. pasture):			No evidence
Soil erosion:	Moderate	greater than 10yo	
Firewood / CWD removal:			No evidence
Grazing (identify native/stock):	Moderate	greater than 10yo	Native and exotic herbivores
Fire damage:			No evidence
Storm damage:			No evidence
Weediness:	Moderate	less than 3yo	
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Ravine early works					
	Date:	12/12/17	Plot ID:	195	Recorders:	SD, EL

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Grass & grasslike	<i>Anthosachne scabra</i>	0.1	20		N	
Fern (EG)	<i>Pteridium esculentum</i>	5	200		N	
	<i>Anagallis arvensis</i>	0.1	10		E	
	<i>Rubus anglocandicans</i>	2	40		E	
	<i>Hypericum perforatum</i>	0.2	20		HTE	
	<i>Trifolium pratense</i>	0.2	20		E	
	<i>Cirsium vulgare</i>	0.2	20		E	
	<i>Conyza canadensis</i> var. <i>canadensis</i>	0.1	10		E	
	<i>Hypericum androsaemum</i>	0.1	5		E	
	<i>Prunella vulgaris</i>	0.1	10		E	
	<i>Trifolium repens</i>	0.1	10		E	
	<i>Bromus molliformis</i>	0.1	10		E	
	<i>Rosa rubiginosa</i>	0.1	5		HTE	
Forb (FG)	<i>Geranium neglectum</i>	0.1	5		N	
	<i>Medicago polymorpha</i>	0.1	10		E	

BAM Site – Field Survey Form

Enter BAM Plot data table range

A1:DG98

Enter BAM Species data table range

A1:M6902

Plot ID:	218	Date:	12/12/17	Survey Name:	Access Roads	Recorders:	SD/EL
Zone:	55	Easting:	625998	Plot dimensions:	20x50	Midline bearing:	318
Datum:	GDA94	Northing:	6038194	IBRA region:	South Eastern Highlands	Zone ID:	
Plant Community Type:	999: Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion				Confidence:	high	Photo #:
Vegetation Class:	Southern Tableland Dry Sclerophyll Forests				EEC:		Confidence:

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m ² plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	14
	Grasses etc.:	5
	Forbs:	9
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0.2
	Shrubs:	85.6
	Grasses etc.:	3.6
	Forbs:	3.3
	Ferns:	0.2
	Other:	1
High Threat Weed cover:		0

BAM Attribute (1000 m ² plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	0	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	1	0	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	40	10	10	10	30	25	25	35	10	15	0	0	0	20	4	10	10	4	4	4
Average of the 5 subplots:	20					22					4.8					6.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)		Lf Pattern (A)	Hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture	Silty clay	Soil Colour	Red	Soil Depth	Shallow
Lithology (B)							
Slope	20	Aspect	ENE	Site Drainage	Good	Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	severe	greaterthan10yo	Historical. Single age class no old trees in adjacent community.
Cultivation (inc. pasture):			Not evident
Soil erosion:	moderate	3to10yo	Associated with removal of overstorey and also access road adjacent.
Firewood / CWD removal:			Not evident
Grazing (identify native/stock):	light		Native and exotic herbivores
Fire damage:	light	3to10yo	Burnt logs
Storm damage:			Not evident
Weediness:	light	lessthan3yo	Roadside weeds
Other:	moderate	3to10yo	Clearing associated with power line corridor.

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

GF Code : see Growth Form definitions in Appendix 1; N : native, E : exotic, HTE : high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)

Survey Name:	Access Roads						
	Date:	12/12/17	Plot ID:	218	Recorders:	SD/EL	

[illegible]

BAM Site – Field Survey Form

Enter BAM Plot data table range

A1:DG98

Enter BAM Species data table range

A1:M6902

Plot ID:	1009	Date:	16/03/18	Survey Name:	X9	Recorders:	JA, ACM
Zone:	55	Easting:	625222	Plot dimensions:	20mx20m	Midline bearing:	140
Datum:	GDA94	Northing:	6039994	IBRA region:	South Eastern Highlands	Zone ID:	
Plant Community Type:	1191: Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion				Confidence:		Photo #:
Vegetation Class:	Subalpine Woodlands				EEC:	no	Confidence:

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m ² plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	4
	Grasses etc.:	4
	Forbs:	1
	Ferns:	1
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	2.7
	Grasses etc.:	31.3
	Forbs:	0.1
	Ferns:	0.1
Other:	0	
High Threat Weed cover:		0

BAM Attribute (1000 m ² plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	0	0	0
10 – 19 cm:	0	0	0
5 – 9 cm:	0	0	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	70	80	30	30	10	5	20	20	25	30	30	10	60	50	60	0	0	0	0	0
Average of the 5 subplots:	44					20					42					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Footslope	Lf Pattern (A)	Low_hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Clay	Soil Surface Texture	Fine gravelly-clay in grsssed area	Soil Colour	light brown-orange	Soil Depth	shallow
Lithology (B)							
Slope	Slight slope, midline perpendicular to downslope area	Aspect	140_T_SE	Site Drainage	downslope	Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	severe	greaterthan10yo	cleared area adjacent to unsealed track
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:			
Storm damage:			
Weediness:	moderate	3to10yo	blackberry, briar rose.
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Abundance : 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	X9						
	Date:	16/03/18	Plot ID:	1009	Recorders:	JA, ACM	

[illegible]

BAM Site – Field Survey Form

Enter BAM Plot data table range

A1:DG98

Enter BAM Species data table range

A1:M6902

Plot ID:	1018	Date:	20/03/18	Survey Name:	Lobs Hole	Recorders:	AM, CK
Zone:	55	Easting:	627137	Plot dimensions:	20m x50m	Midline bearing:	330
Datum:	GDA94	Northing:	6037935	IBRA region:	South Eastern Highlands	Zone ID:	
Plant Community Type:	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				Confidence:	high	Photo #:
Vegetation Class:	Upper Riverina Dry Sclerophyll Forests				EEC:	no	Confidence:
				high			

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m ² plot)		Sum values
Count of Native Richness	Trees:	3
	Shrubs:	8
	Grasses etc.:	8
	Forbs:	1
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	47
	Shrubs:	6.2
	Grasses etc.:	61.5
	Forbs:	0.1
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m ² plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	1	0	0
30 – 49 cm:	1	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	1	0	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	54		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	93	85	70	80	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average of the 5 subplots:	79.6					0					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Valley_flat	Lf Pattern (A)	Mountains	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture	Clay loam	Soil Colour		Soil Depth	
Lithology (B)							
Slope	2	Aspect	NW	Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	moderate	greaterthan10yo	Historical clearing
Cultivation (inc. pasture):			No evidence
Soil erosion:			No evidence
Firewood / CWD removal:			No evidence
Grazing (identify native/stock):			No evidence
Fire damage:	light	greaterthan10yo	
Storm damage:			No evidence
Weediness:	moderate		
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

[illegible]

BAM Site – Field Survey Form

Enter BAM Plot data table range

A1:DG98

Enter BAM Species data table range

A1:M6902

Plot ID:	1020	Date:	21/03/18	Survey Name:	Lobs Hole		Recorders:	AM, CK	
Zone:	55	Easting:	626931	Plot dimensions:	20m x50m		Midline bearing:	319	
Datum:	GDA94	Northing:	6036666	IBRA region:	South Eastern Highlands		Zone ID:		
Plant Community Type:	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 western Kosciuszko escarpment				Confidence:		Photo #:		
Vegetation Class:	Southern Tableland Wet Sclerophyll Forests				EEC:	no	Confidence:	high	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m ² plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	5
	Grasses etc.:	7
	Forbs:	6
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	45
	Shrubs:	22.3
	Grasses etc.:	40.2
	Forbs:	0.6
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m ² plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	1	0	0
30 – 49 cm:	1	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	0	0	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	90	95	95	98	95	0	0	0	2	1	0	1	0	0	0	0	0	0	0	0
Average of the 5 subplots:	94.6					0.6					0.2					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Mountains	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture		Soil Colour		Soil Depth	
Lithology (B)							
Slope	5	Aspect	NE	Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	moderate	greaterthan10yo	
Cultivation (inc. pasture):			No evidence
Soil erosion:			No evidence
Firewood / CWD removal:			No evidence
Grazing (identify native/stock):	light		
Fire damage:	light	greaterthan10yo	
Storm damage:			No evidence
Weediness:	severe		
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

[illegible]

BAM Site – Field Survey Form

Enter BAM Plot data table range

A1:DG98

Enter BAM Species data table range

A1:M6902

Plot ID:	1045	Date:	14/03/18	Survey Name:	Talbingo			Recorders:	J Armstrong C Waerzeggers
Zone:	55	Easting:	626051	Plot dimensions:	20x20			Midline bearing:	0
Datum:	GDA94	Northing:	6039332	IBRA region:	South Eastern Highlands			Zone ID:	
Plant Community Type:	729: Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion					Confidence:	high	Photo #:	
Vegetation Class:	Southern Tableland Dry Sclerophyll Forests					EEC:	no	Confidence:	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m ² plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	2
	Grasses etc.:	3
	Forbs:	2
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	1.1
	Grasses etc.:	70.2
	Forbs:	0.3
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m ² plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	0	0	0
10 – 19 cm:	0	0	0
5 – 9 cm:	0	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...).
For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	5	30	20	20	30	3	30	25	5	5	0	0	0	0	0	0	2	0	0	0
Average of the 5 subplots:	21					13.6					0					0.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Valley_flat	Lf Pattern (A)	Plain	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Alluvial_loams_and_clays	Soil Surface Texture	loamy	Soil Colour	grey Brown	Soil Depth	shallow
Lithology (B)							
Slope		Aspect		Site Drainage	poor	Distance to nearest water and type	50m

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):	moderate	greaterthan10yo	historical grazing
Fire damage:			
Storm damage:			
Weediness:			
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

[illegible]

BAM Site – Field Survey Form

Enter BAM Plot data table range

A1:DG98

Enter BAM Species data table range

A1:M6902

Plot ID:	1046	Date:	14/03/18	Survey Name:	Talbingo	Recorders:	j Armstrong C Waerzeggers
Zone:	55	Easting:	625823	Plot dimensions:	20x20	Midline bearing:	0
Datum:	GDA94	Northing:	6039178	IBRA region:	South Eastern Highlands	Zone ID:	
Plant Community Type:	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				Confidence:	high	Photo #:
Vegetation Class:	Upper Riverina Dry Sclerophyll Forests				EEC:	no	Confidence:
							high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m ² plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	3
	Grasses etc.:	4
	Forbs:	3
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	70
	Shrubs:	20.2
	Grasses etc.:	8.4
	Forbs:	0.3
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m ² plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	3	0	0
10 – 19 cm:	35	0	0
5 – 9 cm:	24	0	0
< 5 cm:	45	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	25		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	95	80	70	70	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average of the 5 subplots:	77					0					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Gully	Lf Pattern (A)	Plain	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Conglomerate	Soil Surface Texture	loamy	Soil Colour	grey Brown	Soil Depth	shallow
Lithology (B)							
Slope		Aspect		Site Drainage	poor	Distance to nearest water and type	150m

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:			
Storm damage:			
Weediness:	moderate	greaterthan10yo	
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

[illegible]

BAM Site – Field Survey Form

Enter BAM Plot data table range

A1:DG98

Enter BAM Species data table range

A1:M6902

Plot ID:	1051	Date:	23/11/17	Survey Name:	Lobs Hole Ravine extra plot 3		Recorders:	SW & AM
Zone:	55	Easting:	625963	Plot dimensions:	20 x 50		Midline bearing:	121
Datum:	GDA94	Northing:	6038950	IBRA region:	South Eastern Highlands		Zone ID:	
Plant Community Type:	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				Confidence:	medium	Photo #:	
Vegetation Class:	Upper Riverina Dry Sclerophyll Forests				EEC:	no	Confidence:	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m ² plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	0
	Grasses etc.:	4
	Forbs:	1
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0
	Grasses etc.:	5.3
	Forbs:	0.1
	Ferns:	0
	Other:	0
High Threat Weed cover:		0

BAM Attribute (1000 m ² plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	0	0	0
10 – 19 cm:	0	0	0
5 – 9 cm:	0	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	5	5	15	5	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	
Average of the 5 subplots:	6.2					0.6					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Footslope	Lf Pattern (A)	Alluvial_plain	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture	clay loam	Soil Colour	light brown	Soil Depth	at least 100mm
Lithology (B)							
Slope		Aspect	WNW	Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			historical clearing. Site used for camping
Cultivation (inc. pasture):			No evidence
Soil erosion:			No evidence
Firewood / CWD removal:			No evidence
Grazing (identify native/stock):	light		Native herbivores (eastern grey kangaroo)
Fire damage:			No evidence
Storm damage:			No evidence
Weediness:	severe		
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

GF Code : see Growth Form definitions in Appendix 1; N : native, E : exotic, HTE : high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)

Survey Name:	Lobs Hole Ravine extra plot 3						
	Date:	23/11/17	Plot ID:	1051	Recorders:	SW & AM	

[illegible]

BAM Site – Field Survey Form

Plot ID:	2024	Date:	30/01/19	Survey Name:	Lower Lobs Hole Ravine	Recorders:	SW, KM
Zone:	55	Easting:	626303.183	Plot dimensions:	20m x 50m	Midline bearing:	108
Datum:	GDA94	Northing:	6037051.19	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:	
Plant Community Type:	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 western Kosciuszko escarpment				Confidence:	High	Photo #:
Vegetation Class:	Southern Tableland Wet Sclerophyll Forests				EEC:	No	Confidence:
					No	Medium	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	2
	Grasses etc.:	6
	Forbs:	8
	Ferns:	1
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	40
	Shrubs:	40
	Grasses etc.:	52
	Forbs:	79
	Ferns:	1
	Other:	0
High Threat Weed cover:		52

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	2	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	0	0	0
5 – 9 cm:	1	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	3		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	10	10	20	20	40	0	0	2	3	2	0	3	0	0	1	1	1	1	0	
Average of the 5 subplots:	20					1.4					0.8					0.8				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Alluvial loams and clays	Soil Surface Texture	Course	Soil Colour	Orange to light brown	Soil Depth	At least 30cm
Lithology (B)							
Slope	9/02/1900	Aspect	N	Site Drainage	Good drainage	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	Moderate	greater than 10yo	NPWS/fire trail adjacent to plot
Cultivation (inc. pasture):			No evidence
Soil erosion:	Moderate	less than 3yo	Moderate erosion on northern side of plot closest to road clearing
Firewood / CWD removal:			No evidence
Grazing (identify native/stock):			No evidence
Fire damage:			No evidence
Storm damage:			No evidence
Weediness:	Severe	less than 3yo	Highly abundant blackberry in plot, St Johns Wort and Thistles present in plot
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Lower Lobs Hole Ravine						
		Date:	30/01/19	Plot ID:	2024	Recorders:	SW, KM

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Shrub (SG)	<i>Bursaria spinosa</i>	20	40		N	
Shrub (SG)	<i>Exocarpos strictus</i>	20	100		N	
	<i>Rubus anglocandicans</i>	25	50		E	
	<i>Rosa rubiginosa</i>	2	20		HTE	
	<i>Hypericum perforatum</i>	20	500		HTE	
	<i>Centaurium erythraea</i>	5	50		E	
Forb (FG)	<i>Picris angustifolia</i>	45	1000		N	
	<i>Potentilla recta</i>	1	2		E	
Forb (FG)	<i>Wahlenbergia stricta</i>	2	50		N	
Grass & grasslike	<i>Dichelachne rara</i>	30	1000		N	
Grass & grasslike	<i>Rytidosperma erianthum</i>	10	500		N	
Forb (FG)	<i>Geranium solanderi</i> var. <i>solanderi</i>	10	2000		N	
	<i>Acetosella vulgaris</i>	30	3000		HTE	
	<i>Anagallis arvensis</i>	2	50		E	
	<i>Conium maculatum</i>	1	2		E	
Forb (FG)	<i>Chrysocephalum semipapposum</i>	5	50		N	
Grass & grasslike	<i>Carex appressa</i>	2	25		N	
	<i>Verbascum virgatum</i>	5	20		E	
Grass & grasslike	<i>Poa</i> spp.	1	50		E	
Forb (FG)	<i>Oxalis</i> spp.	5	1000		N	
Fern (EG)	<i>Cheilanthes sieberi</i>	1	10		N	
Forb (FG)	<i>Brachyscome spathulata</i>	2	20		N	
Forb (FG)	<i>Oxalis perennans</i>	5	500		N	
	<i>Cirsium vulgare</i>	3	15		E	
Grass & grasslike	<i>Microlaena stipoides</i>	5	100		N	
	<i>Plantago lanceolata</i>	2	50		E	
	<i>Trifolium arvense</i>	1	20		E	
Grass & grasslike	<i>Panicum effusum</i>	4	100		N	
Forb (FG)	<i>Ranunculus lappaceus</i>	5	200		N	
Tree (TG)	<i>Acacia dealbata</i> subsp. <i>subalpina</i>	40	100		N	

BAM Site – Field Survey Form

Plot ID:	2161	Date:	31/01/19	Survey Name:	Lobs Hole Ravine	Recorders:	SW, KM	
Zone:	55	Easting:	625815.44	Plot dimensions:	20m x 50m	Midline bearing:	277	
Datum:	GDA94	Northing:	6039431.51	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:		
Plant Community Type:	296: Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion				Confidence:	High	Photo #:	
Vegetation Class:	Southern Tableland Dry Sclerophyll Forests				EEC:	No	Confidence:	Medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	12
	Grasses etc.:	4
	Forbs:	2
	Ferns:	0
	Other:	2
Sum of Cover of native vascular plants by growth form group	Trees:	100
	Shrubs:	188
	Grasses etc.:	5
	Forbs:	4
	Ferns:	0
	Other:	5
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	2	0	0
30 – 49 cm:	3	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	1	0	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	8		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	70	70	90	80	25	1	1	5	1	0	0	1	1	0	0	0	0	1	0	1
Average of the 5 subplots:	67					1.6					0.4					0.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Low hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture	Course grained	Soil Colour	Orange-brown	Soil Depth	At least 30cm
Lithology (B)							
Slope	10/01/1900	Aspect	W	Site Drainage	Moderate drainage	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			No evidence
Cultivation (inc. pasture):			No evidence
Soil erosion:			No evidence
Firewood / CWD removal:			No evidence
Grazing (identify native/stock):			No evidence
Fire damage:	Light	greater than 10yo	Burnt trunks on some Eucalypts
Storm damage:			No evidence
Weediness:			No evidence in plot, surrounding areas have high levels of Blackberry and St Johns Wort
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Lobs Hole Ravine						
		Date:	31/01/19	Plot ID:	2161	Recorders:	SW, KM

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Tree (TG)	<i>Eucalyptus dives</i>	60	24		N	
Tree (TG)	<i>Eucalyptus mannifera</i>	40	15		N	
Shrub (SG)	<i>Banksia canei</i>	80	200		N	
Shrub (SG)	<i>Acacia pravissima</i>	40	150		N	
Shrub (SG)	<i>Calytrix tetragona</i>	30	100		N	
Shrub (SG)	<i>Pimelea linifolia</i> subsp. <i>linifolia</i>	13	50		N	
Shrub (SG)	<i>Daviesia ulicifolia</i>	15	30		N	
Grass & grasslike	<i>Lomandra longifolia</i>	2	15		N	
Grass & grasslike	<i>Poa sieberiana</i> var. <i>cyanophylla</i>	1	50		N	
Grass & grasslike	<i>Lomandra filiformis</i>	1	50		N	
Other (OG)	<i>Desmodium varians</i>	2	20		N	
Forb (FG)	<i>Stellaria pungens</i>	1	200		N	
Other (OG)	<i>Cassytha pubescens</i>	3	5		N	
Shrub (SG)	<i>Brachyloma daphnoides</i>	1	30		N	
Forb (FG)	<i>Galium ciliare</i>	3	75		N	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	4	100		N	
Shrub (SG)	<i>Tetradlea thymifolia</i>	1	20		N	
Shrub (SG)	<i>Hovea montana</i>	1	10		N	
Shrub (SG)	<i>Leucopogon virgatus</i>	1	10		N	
Shrub (SG)	<i>Leucopogon attenuatus</i>	1	5		N	
Grass & grasslike	<i>Poa sieberiana</i>	1	100		N	
Shrub (SG)	<i>Acacia sicutiformis</i>	1	5		N	

BAM Site – Field Survey Form

Plot ID:	2267	Date:	10/04/19	Survey Name:	Lobs Hole			Recorders:	MP, IM
Zone:	55	Easting:	625402.14	Plot dimensions:	20 x 50			Midline bearing:	274
Datum:	GDA94	Northing:	6039366.71	IBRA region:	South Eastern Highlands (Bondo)			Zone ID:	
Plant Community Type:	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					Confidence:	Medium	Photo #:	
Vegetation Class:	Upper Riverina Dry Sclerophyll Forests					EEC:	No	Confidence:	High

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	3
	Shrubs:	10
	Grasses etc.:	10
	Forbs:	6
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	60.1
	Shrubs:	23.6
	Grasses etc.:	10.1
	Forbs:	1
	Ferns:	0
	Other:	0
High Threat Weed cover:		83

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	15	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	1	1	0
5 – 9 cm:	1	1	0
< 5 cm:	1	1	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	67		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	90	95	90	50	94	0	0	5	45	1	0	0	0	0	0	0	0	0	0	
Average of the 5 subplots:	83.8					10.2					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Footslope	Lf Pattern (A)	Hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture		Soil Colour	Red-brown	Soil Depth	Deep
Lithology (B)							
Slope		Aspect	Sw	Site Drainage	Good	Distance to nearest water & type	Less than 200m

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:			
Storm damage:	Moderate	greater than 10yo	Charred stumps
Weediness:	Severe	less than 3yo	Thick near 95% cover of blackberry with some st johns wort
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Lobs Hole						
		Date:	10/04/19	Plot ID:	2267	Recorders:	MP, IM

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Tree (TG)	<i>Acacia dealbata</i>	0.1	1		N	
Forb (FG)	<i>Geranium solanderi</i> var. <i>solanderi</i>	0.3	200		N	
Shrub (SG)	<i>Pimelea linifolia</i> subsp. <i>caesia</i>	2	30		N	
Shrub (SG)	<i>Cassinia longifolia</i>	0.5	10		N	
Shrub (SG)	<i>Acacia pravissima</i>	15	100		N	
Forb (FG)	<i>Hydrocotyle</i> spp.	0.1	3		E	
Shrub (SG)	<i>Acacia siculiformis</i>	0.1	1		N	
Grass & grasslike	<i>Aristida ramosa</i>	0.2	6		N	
Forb (FG)	<i>Asperula conferta</i>	0.2	10		N	
Shrub (SG)	<i>Banksia canei</i>	0.2	1		N	
Shrub (SG)	<i>Bursaria spinosa</i>	0.3	2		N	
Grass & grasslike	<i>Carex appressa</i>	2	30		N	
Grass & grasslike	<i>Carex</i> spp.	0.1	3		N	
Shrub (SG)	<i>Cassinia aculeata</i>	3	30		N	
Forb (FG)	<i>Dichondra repens</i>	0.2	30		N	
Grass & grasslike	<i>Elymus scaber</i>	0.2	15		N	
Tree (TG)	<i>Eucalyptus mannifera</i>	20	25		N	
Tree (TG)	<i>Eucalyptus viminalis</i>	40	30		N	
Shrub (SG)	<i>Exocarpos strictus</i>	2	10		N	
	<i>Hypericum perforatum</i>	3	100		HTE	
	<i>Hypochaeris radicata</i>	0.1	4		E	
Grass & grasslike	<i>Lomandra filiformis</i>	0.2	8		N	
Grass & grasslike	<i>Lomandra multiflora</i>	0.2	4		N	
Grass & grasslike	<i>Luzula flaccida</i>	0.1	1		N	
Grass & grasslike	<i>Microlaena stipoides</i>	0.1	20		N	
Shrub (SG)	<i>Mirbelia oxylobioides</i>	0.2	6		N	
	<i>Rubus fruticosus</i> spp. <i>agg</i>	80	1000		HTE	
Shrub (SG)	<i>Rubus parvifolius</i>	0.3	5		N	
Grass & grasslike	<i>Rytidosperma</i> spp.	1	30		N	
Forb (FG)	<i>Stellaria pungens</i>	0.1	1		N	
Grass & grasslike	<i>Themeda australis</i>	6	200		N	
Forb (FG)	<i>Viola betonicifolia</i>	0.1	1		N	

BAM Site – Field Survey Form

Plot ID:	2268	Date:	10/04/19	Survey Name:	Lobs Hole	Recorders:	MP, IM	
Zone:	55	Easting:	625523.975	Plot dimensions:	20 x 50	Midline bearing:	36	
Datum:	GDA94	Northing:	6039317.18	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:		
Plant Community Type:	729: Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion				Confidence:	High	Photo #:	
Vegetation Class:	Southern Tableland Dry Sclerophyll Forests				EEC:	No	Confidence:	High

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	3
	Shrubs:	15
	Grasses etc.:	4
	Forbs:	10
	Ferns:	0
	Other:	2
Sum of Cover of native vascular plants by growth form group	Trees:	45.1
	Shrubs:	80.2
	Grasses etc.:	4.4
	Forbs:	1.9
	Ferns:	0
	Other:	0.2
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	8	0	2
20 – 29 cm:	1	0	2
10 – 19 cm:	1	0	0
5 – 9 cm:	1	0	0
< 5 cm:	1	1	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	114		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	95	90	85	95	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Average of the 5 subplots:	92					0					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Footslope	Lf Pattern (A)	Hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture	Loam	Soil Colour	Red-brown	Soil Depth	
Lithology (B)							
Slope		Aspect	N	Site Drainage	Good	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:	Moderate	greater than 10yo	Charred tree trunks, some standing dead timber
Storm damage:			
Weediness:			
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Lobs Hole						
		Date:	10/04/19	Plot ID:	2268	Recorders:	MP, IM

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Shrub (SG)	<i>Acacia pravissima</i>	10	200		N	
Shrub (SG)	<i>Acacia siculiformis</i>	0.1	1		N	
Forb (FG)	<i>Hovea heterophylla</i>	0.1	1		N	
Forb (FG)	<i>Hydrocotyle</i> spp.	0.1	3		E	
Shrub (SG)	<i>Monotoca scoparia</i>	2	30		N	
Forb (FG)	<i>Veronica subtilis</i>	1	30		N	
Shrub (SG)	<i>Tetradlea bauerifolia</i>	0.1	2		N	
Grass & grasslike	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	0.2	10		N	
Shrub (SG)	<i>Epacris</i> spp.	0.1	1		N	
Shrub (SG)	<i>Pimelea linifolia</i> subsp. <i>caesia</i>	0.2	15		N	
Shrub (SG)	<i>Leucopogon fletcheri</i> subsp. <i>brevisepalus</i>	0.1	2		N	
Tree (TG)	<i>Callitris</i> spp.	0.1	2		N	
Shrub (SG)	<i>Leucopogon gelidus</i>	0.1	2		N	
Forb (FG)	<i>Asperula conferta</i>	0.1	1		N	
Shrub (SG)	<i>Banksia canei</i>	15	300		N	
Other (OG)	<i>Billardiera scandens</i>	0.1	2		N	
Shrub (SG)	<i>Brachyloma daphnoides</i>	0.2	4		N	
Shrub (SG)	<i>Bursaria spinosa</i>	2	20		N	
Other (OG)	<i>Cassytha pubescens</i>	0.1	2		N	
	<i>Centaurium</i> spp.	0.1	1		E	
Forb (FG)	<i>Dianella revoluta</i>	0.1	3		N	
Forb (FG)	<i>Dichondra repens</i>	0.1	6		N	
Tree (TG)	<i>Eucalyptus dives</i>	40	18		N	
Tree (TG)	<i>Eucalyptus mannifera</i>	5	2		N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	0.1	5		N	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	0.1	8		N	
Shrub (SG)	<i>Leucopogon</i> spp.	0.1	4		N	
Grass & grasslike	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	1	50		N	
Grass & grasslike	<i>Microlaena stipoides</i>	0.2	10		N	
Shrub (SG)	<i>Mirbelia oxylobioides</i>	50	1000		N	
Shrub (SG)	<i>Olearia myrsinoides</i>	0.1	3		N	
Grass & grasslike	<i>Poa sieberiana</i> var. <i>sieberiana</i>	3	100		N	
Forb (FG)	<i>Poranthera microphylla</i>	0.1	10		N	
Forb (FG)	<i>Stellaria pungens</i>	0.1	3		N	
Forb (FG)	<i>Stylidium graminifolium</i>	0.1	1		N	

BAM Site – Field Survey Form

Plot ID:	2271	Date:	11/04/19	Survey Name:		Recorders:	MP, IM	
Zone:	55	Easting:	624896.548	Plot dimensions:	20 x 50 m	Midline bearing:	135	
Datum:	GDA94	Northing:	6040649.37	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:		
Plant Community Type:	296: Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion				Confidence:		Photo #:	
Vegetation Class:	Southern Tableland Dry Sclerophyll Forests				EEC:	No	Confidence:	Low

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	12
	Grasses etc.:	8
	Forbs:	17
	Ferns:	0
	Other:	2
Sum of Cover of native vascular plants by growth form group	Trees:	41
	Shrubs:	62.1
	Grasses etc.:	33.5
	Forbs:	3.6
	Ferns:	0
	Other:	0.6
High Threat Weed cover:		1.5

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	2	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	1	0	0
< 5 cm:	1	1	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	23		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	20	30	10	10	20	10	0	20	15	10	25	20	0	0	0	53	0	60	5	25
Average of the 5 subplots:	18					11					9					28.6				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)		Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture	Silty clay	Soil Colour	Red brown	Soil Depth	
Lithology (B)							
Slope	15 -20	Aspect	SW	Site Drainage		Distance to nearest water & type	500m upslope of talbingo dam

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:			
Storm damage:			
Weediness:	Light		St johns wort
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:						
	Date:	11/04/19	Plot ID:	2271	Recorders:	MP, IM

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Shrub (SG)	<i>Acacia pravissima</i>	5	20	No	N	
Forb (FG)	<i>Acaena</i> spp.	0.1	4	No	N	
	<i>Aira</i> spp.	0.2	60	No	E	
Forb (FG)	<i>Ajuga australis</i>	0.1	2	No	N	
Shrub (SG)	<i>Brachyloma daphnoides</i>	10	50	No	N	
Shrub (SG)	<i>Bursaria spinosa</i>	0.2	1	No	N	
Other (OG)	<i>Cassytha pubescens</i>	0.5	10	No	N	
Forb (FG)	<i>Chrysocephalum semipapposum</i>	1.5	20	No	N	
Forb (FG)	<i>Corybas hispidus</i>	0.1	60	No	N	
Shrub (SG)	<i>Cryptandra amara</i>	7	200	No	N	
Grass & grasslike	<i>Dichelachne</i> spp.	2	80	No	N	
Shrub (SG)	<i>Dillwynia phyllicoides</i>	0.2	4	No	N	
Shrub (SG)	<i>Dodonaea viscosa</i> subsp. <i>angustissima</i>	35	100	No	N	
Grass & grasslike	<i>Elymus scaber</i>	0.1	10	No	N	
Forb (FG)	<i>Eriochilus cucullatus</i>	0.1	6	No	N	
Tree (TG)	<i>Eucalyptus dives</i>	40	20	No	N	
Tree (TG)	<i>Eucalyptus pauciflora</i>	1	5	No	N	
Forb (FG)	<i>Euchiton involucratus</i>	0.1	30	No	N	
Shrub (SG)	<i>Gompholobium huegelii</i>	0.1	2	No	N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	0.2	40	No	N	
Forb (FG)	<i>Hydrocotyle laxiflora</i>	0.4	100	No	N	
Forb (FG)	<i>Hypericum gramineum</i>	0.1	20	No	N	
	<i>Hypericum perforatum</i>	1.5	200	No	HTE	
Grass & grasslike	<i>Lomandra filiformis</i>	0.1	20	No	N	
Grass & grasslike	<i>Lomandra multiflora</i>	0.1	8	No	N	
Shrub (SG)	<i>Melichrus urceolatus</i>	0.3	8	No	N	
Forb (FG)	<i>Orchidaceae</i> indeterminate	0.1	7	No	E	
Forb (FG)	<i>Orchidaceae</i> indeterminate	0.1	6	No	E	
Shrub (SG)	<i>Pimelea linifolia</i>	0.1	8	No	N	
Grass & grasslike	<i>Poa induta</i>	25	300	No	N	
	<i>Centaurium</i> spp.	0.3	200	No	E	
Forb (FG)	<i>Geranium</i> spp.	0.2	100	No	E	
Grass & grasslike	<i>Luzula</i> spp.	0.1	50	No	N	
Grass & grasslike	<i>Carex</i> spp.	0.1	10	No	N	
Shrub (SG)	<i>Pimelea curviflora</i> var. <i>gracilis</i>	0.1	8	No	N	
Forb (FG)	Unidentified seedling	0.1	60	No		
	<i>Petrorhagia</i> spp.	0.1	10	No	E	
Shrub (SG)	<i>Leucopogon fletcheri</i> subsp. <i>brevisepalus</i>	4	100	No	N	
Forb (FG)	<i>Hovea heterophylla</i>	0.1	4	No	N	
Other (OG)	<i>Cassytha</i> spp.	0.1	1	No	N	
Shrub (SG)	<i>Cassinia longifolia</i>	0.1	1	No	N	
Grass & grasslike	<i>Rytidosperma</i> spp.	6	300	No	N	
Forb (FG)	<i>Stellaria pungens</i>	0.1	20	No	N	
Forb (FG)	<i>Stylidium graminifolium</i>	0.1	10	No	N	
	<i>Trifolium</i> spp.	0.1	4	No	E	
Forb (FG)	<i>Viola betonicifolia</i>	0.1	6	No	N	
	<i>Vulpia</i> spp.	0.2	40	No	E	

BAM Site – Field Survey Form							
Plot ID:	2276	Date:	14/04/19	Survey Name:	2276	Recorders:	MP, CE
Zone:	55	Easting:	624563.614	Plot dimensions:	20 x 50 m	Midline bearing:	154
Datum:	GDA94	Northing:	6041770.87	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:	
Plant Community Type:	1191: Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion				Confidence:	High	Photo #:
Vegetation Class:	Subalpine Woodlands				EEC:	No	Confidence:

Record easting and northing at 0 m on midline. Dimensions (Shope) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	5
	Shrubs:	12
	Grasses etc.:	8
	Forbs:	14
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	15.9
	Shrubs:	46.6
	Grasses etc.:	61.2
	Forbs:	1.7
	Ferns:	0
	Other:	0.2
High Threat Weed cover:		6.3

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	2	0	0
30 – 49 cm:	3	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	1	0	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	33		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	20	70	50	60	45	50	0	0	0	0	0	0	3	2	0	10	0	15	0	0
Average of the 5 subplots:	49					10					1					5				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Quartzs and stone	Soil Surface Texture	Loamy	Soil Colour	Browm	Soil Depth	Moderate
Lithology (B)							
Slope		Aspect	SW	Site Drainage	Good	Distance to nearest water & type	50m

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:			
Storm damage:			
Weediness:	Moderate	less than 3yo	Rubus fruticosus agg
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	25/03/1906 0:00					
	Date:	14/04/19	Plot ID:	2276	Recorders:	MP, CE

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Tree (TG)	<i>Acacia melanoxylon</i>	1.5	3	No	N	
Forb (FG)	<i>Acaena</i> spp.	0.2	10	No	N	
	<i>Acetosella vulgaris</i>	0.1	12	No	HTE	
Shrub (SG)	<i>Acrotriche serrulata</i>	0.1	2	No	N	
Forb (FG)	<i>Ajuga australis</i>	0.1	4	No	N	
Forb (FG)	<i>Asperula conferta</i>	0.1	50	No	N	
Shrub (SG)	<i>Banksia canei</i>	3	10	No	N	
Shrub (SG)	<i>Brachyloma daphnoides</i>	2	40	No	N	
Shrub (SG)	<i>Bursaria spinosa</i>	20	100	No	N	
	<i>Centaurium</i> spp.	0.1	60	No	E	
Forb (FG)	<i>Dlchondra repens</i>	0.2	100	No	N	
Shrub (SG)	<i>Dodonaea viscosa</i> subsp. <i>angustissima</i>	3	30	No	N	
Tree (TG)	<i>Eucalyptus dalrympleana</i>	7	11	No	N	
Tree (TG)	<i>Eucalyptus dives</i>	0.4	1	No	N	
Tree (TG)	<i>Eucalyptus rubida</i>	2	2	No	N	
Tree (TG)	<i>Eucalyptus stellulata</i>	5	3	No	N	
Shrub (SG)	<i>Exocarpos strictus</i>	1	20	No	N	
Other (OG)	<i>Glycine clandestina</i>	0.2	15	No	N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	0.1	60	No	N	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	0.1	4	No	N	
Forb (FG)	<i>Hydrocotyle laxiflora</i>	0.1	10	No	N	
Forb (FG)	<i>Hypericum gramineum</i>	0.1	4	No	N	
	<i>Hypericum perforatum</i>	1	100	No	HTE	
	<i>Hypochaeris radicata</i>	0.1	8	No	E	
Shrub (SG)	<i>Leucopogon ericoides</i>	0.4	20	No	N	
Grass & grasslike	<i>Lomandra filiformis</i>	0.6	20	No	N	
	<i>Potentilla recta</i>	0.6	50	No	E	
Grass & grasslike	<i>Lomandra multiflora</i>	0.1	1	No	N	
Forb (FG)	<i>Geranium</i> spp.	0.1	10	No	E	
	<i>Conyza</i> spp.	0.1	4	No	E	
Shrub (SG)	<i>Leucopogon virgatus</i>	0.8	20	No	N	
Forb (FG)	<i>Dianella</i> spp.	0.2	15	No	N	
Grass & grasslike	<i>Dichelachne rara</i>	0.1	10	No	N	
Forb (FG)	<i>Oxalis perennans</i>	0.1	4	No	N	
Forb (FG)	<i>Hovea heterophylla</i>	0.1	6	No	N	
Grass & grasslike	<i>Luzula</i> spp.	0.1	8	No	N	
Forb (FG)	<i>Cymbonotus</i> spp.	0.1	4	No	N	
Forb (FG)	<i>Plantago</i> spp.	0.1	6	No	N	
Shrub (SG)	<i>Mirbelia oxylobioides</i>	15	25	No	N	
	<i>Paspalum dilatatum</i>	0.1	10	No	HTE	
Shrub (SG)	<i>Pimelea curviflora</i>	0.2	20	No	N	
Shrub (SG)	<i>Pimelea linifolia</i>	1	100	No	N	
Grass & grasslike	<i>Poa costiniana</i>	5	100	No	N	
Grass & grasslike	<i>Poa helmsii</i>	0.2	4	No	N	
	<i>Rosa rubiginosa</i>	0.1	3	No	HTE	
	<i>Rubus fruticosus</i> spp. <i>agg</i>	5	20	No	HTE	
Grass & grasslike	<i>Rytidosperma</i> spp.	0.1	10	No	N	

Grass & grasslike	<i>Themeda australis</i>	55	500	No	N	
	<i>Verbascum virgatum</i>	0.1	4	No	E	
Forb (FG)	<i>Viola betonicifolia</i>	0.1	4	No	N	

BAM Site – Field Survey Form

Plot ID:	2277	Date:	14/04/19	Survey Name:	2277	Recorders:	MP, CW
Zone:	55	Easting:	616594.166	Plot dimensions:	20 x 50 m	Midline bearing:	339
Datum:	GDA94	Northing:	6057388.97	IBRA region:	NSW South Western Slopes (Inland Slopes)	Zone ID:	
Plant Community Type:	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				Confidence:	High	Photo #:
Vegetation Class:	Upper Riverina Dry Sclerophyll Forests				EEC:	No	Confidence:
						High	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	3
	Shrubs:	1
	Grasses etc.:	7
	Forbs:	8
	Ferns:	1
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	63.1
	Shrubs:	0.1
	Grasses etc.:	2
	Forbs:	1.1
	Ferns:	0.5
	Other:	0
High Threat Weed cover:		0.5

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	2	0	0
50 – 79 cm:	2	0	0
30 – 49 cm:	0	2	0
20 – 29 cm:	0	1	0
10 – 19 cm:	0	0	0
5 – 9 cm:	0	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	67		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	90	80	85	75	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average of the 5 subplots:	78					0					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Quartzs and stone	Soil Surface Texture	Loamy	Soil Colour	Brown grey	Soil Depth	Moderate
Lithology (B)							
Slope		Aspect	N	Site Drainage	Good	Distance to nearest water & type	720m

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):	Moderate	less than 3yo	Cows
Fire damage:			
Storm damage:			
Weediness:			
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	26/03/1906 0:00						
		Date:	14/04/19	Plot ID:	2277	Recorders:	MP, CW

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Tree (TG)	<i>Acacia melanoxylon</i>	18	12	No	N	
Forb (FG)	<i>Acaena novae-zelandiae</i>	0.1	6	No	N	
Forb (FG)	<i>Acaena</i> spp.	0.1	4	No	N	
	<i>Acetosella vulgaris</i>	0.2	100	No	HTE	
	<i>Anagallis arvensis</i>	0.1	4	No	E	
	<i>Anthoxanthum odoratum</i>	80	1000	No	E	
Tree (TG)	<i>Brachychiton populneus</i>	0.1	2	No	N	
	<i>Briza maxima</i>	0.1	10	No	E	
Grass & grasslike	<i>Carex appressa</i>	0.3	25	No	N	
	<i>Dactylis glomerata</i>	3.5	100	No	E	
Forb (FG)	<i>Dlchondra repens</i>	0.1	40	No	N	
Tree (TG)	<i>Eucalyptus nortonii</i>	45	12	No	N	
	<i>Holcus lanatus</i>	1	60	No	E	
Forb (FG)	<i>Hydrocotyle laxiflora</i>	0.2	100	No	N	
	<i>Hypochaeris radicata</i>	0.4	60	No	E	
Shrub (SG)	<i>Leptospermum brevipes</i>	0.1	1	No	N	
Grass & grasslike	<i>Lomandra filiformis</i>	0.2	20	No	N	
Grass & grasslike	<i>Lomandra longifolia</i>	0.1	1	No	N	
Grass & grasslike	<i>Lomandra multiflora</i>	0.2	20	No	N	
Forb (FG)	<i>Geranium</i> spp.	0.2	200	No	E	
	<i>Plantago lanceolata</i>	0.2	80	No	E	
Forb (FG)	<i>Oxalis perennans</i>	0.1	4	No	N	
Grass & grasslike	<i>Juncus</i> spp.	0.1	8	No	N	
Forb (FG)	<i>Galium</i> spp.	0.2	500	No	E	
Forb (FG)	<i>Solanum</i> spp.	0.1	6	No	E	
Grass & grasslike	<i>Bromus</i> spp.	0.5	50	No	E	
	<i>Cirsium</i> spp.	0.1	100	No	E	
Fern (EG)	<i>Pteridium esculentum</i>	0.5	70	No	N	
	<i>Rosa rubiginosa</i>	0.1	4	No	HTE	
	<i>Rubus fruticosus</i> spp. agg	0.2	25	No	HTE	
Grass & grasslike	<i>Themeda australis</i>	0.6	40	No	N	

BAM Site – Field Survey Form

Plot ID:	2278	Date:	14/04/19	Survey Name:	2278	Recorders:	MP, CW	
Zone:	55	Easting:	616512.113	Plot dimensions:	20 x 50 m	Midline bearing:	159	
Datum:	GDA94	Northing:	6057462.72	IBRA region:	NSW South Western Slopes (Inland Slopes)	Zone ID:		
Plant Community Type:	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				Confidence:	Low	Photo #:	
Vegetation Class:	Upper Riverina Dry Sclerophyll Forests				EEC:	No	Confidence:	High

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	1
	Grasses etc.:	5
	Forbs:	4
	Ferns:	1
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	1
	Shrubs:	1.5
	Grasses etc.:	53.2
	Forbs:	0.5
	Ferns:	8
	Other:	0
High Threat Weed cover:		1.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	0	1	0
10 – 19 cm:	0	1	0
5 – 9 cm:	0	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	15	15	30	50	20	8	15	0	0	10	0	0	0	0	0	0	0	0	0	0
Average of the 5 subplots:	26					6.6					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillcrest	Lf Pattern (A)	Low hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Quartzs and stone	Soil Surface Texture	Loamy	Soil Colour	Grey light brown	Soil Depth	Moderate
Lithology (B)							
Slope		Aspect		Site Drainage	Moderate	Distance to nearest water & type	760m

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):	Severe	less than 3yo	Cow scat, patches of missing ground cover
Fire damage:			
Storm damage:			
Weediness:			
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	27/03/1906 0:00					
	Date:	14/04/19	Plot ID:	2278	Recorders:	MP, CW

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Tree (TG)	<i>Acacia melanoxylon</i>	1	1	No	N	
	<i>Acetosella vulgaris</i>	0.1	40	No	HTE	
Forb (FG)	<i>Asteraceae indeterminate</i>	0.1	30	No	N/E	
Grass & grasslike	<i>Bothriochloa macra</i>	10	100	No	N	
	<i>Centaureium spp.</i>	0.1	40	No	E	
	<i>Cynosurus spp.</i>	0.2	80	No	E	
Forb (FG)	<i>Euchiton involucratus</i>	0.2	50	No	N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	0.1	30	No	N	
	<i>Holcus lanatus</i>	10	250	No	E	
	<i>Hypericum perforatum</i>	1	80	No	HTE	
	<i>Hypochaeris radicata</i>	2	200	No	E	
Shrub (SG)	<i>Kunzea ericoides</i>	1.5	6	No	N	
	<i>Plantago lanceolata</i>	0.6	80	No	E	
Fern (EG)	<i>Pteridium esculentum</i>	8	150	No	N	
Grass & grasslike	<i>Poaceae spp.</i>	3	500	No		
Grass & grasslike	<i>Aristida spp.</i>	0.1	20	No	N/E	
Forb (FG)	<i>Geranium spp.</i>	0.1	40	No	E	
Grass & grasslike	<i>Rytidosperma spp.</i>	0.1	10	No	N	
Grass & grasslike	<i>Themeda australis</i>	40	600	No	N	

BAM Site – Field Survey Form							
Plot ID:	2281	Date:	15/04/19	Survey Name:	2281	Recorders:	MP, CW
Zone:	55	Easting:	616715.057	Plot dimensions:	20 x 50 m	Midline bearing:	141
Datum:	GDA94	Northing:	6058620.5	IBRA region:	NSW South Western Slopes (Inland Slopes)	Zone ID:	
Plant Community Type:	650: Alpine Snow Gum - Snow Gum shrubby woodland at intermediate altitudes in northern Kosciuszko NP, South Eastern Highlands Bioregion and Australian Alps Bioregion				Confidence:	High	Photo #:
Vegetation Class:	Subalpine Woodlands				EEC:	No	Confidence:
						High	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	7
	Grasses etc.:	6
	Forbs:	6
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	4
	Shrubs:	103
	Grasses etc.:	6.8
	Forbs:	2.5
	Ferns:	0
	Other:	0
High Threat Weed cover:		6.2

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	0	1	0
10 – 19 cm:	0	1	0
5 – 9 cm:	0	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	8		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	90	20	60	5	80	2	15	0	5	0	8	30	25	85	20	0	0	15	5	20
Average of the 5 subplots:	51					4.4					33.6					8				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Drainage depression	Lf Pattern (A)	Plateau	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Quartzs and stone	Soil Surface Texture	Silty	Soil Colour	Brown yellow	Soil Depth	Moderate
Lithology (B)							
Slope		Aspect		Site Drainage	Good	Distance to nearest water & type	30m

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:			
Storm damage:			
Weediness:	Moderate	less than 3yo	Rosa rubiginosa, rubus fruticosis agg
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	30/03/1906 0:00					
	Date:	15/04/19	Plot ID:	2281	Recorders:	MP, CW

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Tree (TG)	<i>Acacia dealbata</i>	4	12	No	N	
Shrub (SG)	<i>Bursaria spinosa</i>	4	8	No	N	
Grass & grasslike	<i>Carex appressa</i>	1.5	60	No	N	
	<i>Centaurium spp.</i>	0.1	4	No	E	
	<i>Dactylis glomerata</i>	0.1	4	No	E	
Shrub (SG)	<i>Dodonaea viscosa</i>	0.2	1	No	N	
Shrub (SG)	<i>Grevillea rosmarinifolia</i>	2	10	No	N	
	<i>Hypericum perforatum</i>	0.1	15	No	HTE	
	<i>Malus domestica</i>	2.5	1	No	E	
Grass & grasslike	<i>Microlaena stipoides</i>	1	250	No	N	
Shrub (SG)	<i>Mirbelia oxylobioides</i>	4	10	No	N	
Grass & grasslike	<i>Carex spp.</i>	0.2	40	No	N	
Shrub (SG)	<i>Melaleuca spp.</i>	2	2	No	N	
Forb (FG)	<i>Geranium spp.</i>	0.1	40	No	E	
Forb (FG)	<i>Rumex spp.</i>	0.1	25	No	N/E	
Shrub (SG)	<i>Grevillea parviflora</i>	0.8	3	No	N	
Shrub (SG)	<i>Leptospermum obovatum</i>	90	60	No	N	
Forb (FG)	Unidentified seedling	2	500	No		
Forb (FG)	<i>Hydrocotyle spp.</i>	0.1	60	No	E	
Grass & grasslike	<i>Phragmites australis</i>	2.5	20	No	N	
Grass & grasslike	<i>Juncus spp.</i>	0.1	4	No	N	
Forb (FG)	<i>Solanum spp.</i>	0.1	4	No	E	
Forb (FG)	<i>Oxalis perennans</i>	0.1	8	No	N	
	<i>Rosa rubiginosa</i>	0.1	1	No	HTE	
	<i>Rubus fruticosus spp. agg</i>	6	40	No	HTE	
Grass & grasslike	<i>Rytidosperma spp.</i>	1.5	100	No	N	

BAM Site – Field Survey Form

Plot ID:	2284	Date:	14/05/19	Survey Name:	LHRR	Recorders:	JB, DK
Zone:	55	Easting:	625378.911	Plot dimensions:	20 x 50 m	Midline bearing:	172
Datum:	GDA94	Northing:	6039762.78	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:	
Plant Community Type:	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 western Kosciuszko escarpment				Confidence:	High	Photo #:
Vegetation Class:	Southern Tableland Wet Sclerophyll Forests				EEC:	No	Confidence:
				High			

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)	Sum values
Count of Native Richness	Trees: 0
	Shrubs: 3
	Grasses etc.: 2
	Forbs: 10
	Ferns: 0
	Other: 0
Sum of Cover of native vascular plants by growth form group	Trees: 0
	Shrubs: 7.6
	Grasses etc.: 36
	Forbs: 5.9
	Ferns: 0
	Other: 0
High Threat Weed cover:	40.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	0	0	0
10 – 19 cm:	0	0	0
5 – 9 cm:	0	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	5	1	5	2	5	5	2	0	5	3	5	10	0	2	10	0	0	0	0	0
Average of the 5 subplots:	3.6					3					5.4					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)		Lf Pattern (A)		Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture		Soil Colour		Soil Depth	
Lithology (B)							
Slope		Aspect		Site Drainage		Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	Severe	greater than 10yo	D. Grassland
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):	Light	less than 3yo	Rabbits
Fire damage:			
Storm damage:			
Weediness:	Light	less than 3yo	Weeds
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	LHRR					
	Date:	14/05/19	Plot ID:	2284	Recorders:	JB, DK

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
	<i>Acetosella vulgaris</i>	20	600	No	HTE	
Forb (FG)	<i>Asteraceae sp</i>	0.1	1	No	N/E	
Forb (FG)	<i>Asteraceae sp</i>	0.1	1	No	N/E	
Shrub (SG)	<i>Brachyloma daphnoides</i>	5	20	No	N	
Shrub (SG)	<i>Exocarpos strictus</i>	0.1	2	No	N	
	<i>Hypericum perforatum</i>	20	500	No	HTE	
Shrub (SG)	<i>Mirbelia oxylobioides</i>	2.5	2	No	N	
Grass & grasslike	<i>Poa sieberiana</i> var. <i>sieberiana</i>	1	10	No	N	
	<i>Rosa rubiginosa</i>	0.1	5	No	HTE	
	<i>Taraxacum officinale</i>	0.2	20	No	E	
	<i>Potentilla spp.</i>	0.1	1	No	E	
Forb (FG)	<i>Patersonia spp.</i>	5	40	No	N	
Grass & grasslike	<i>Themeda triandra</i>	35	300	No	N	
Forb (FG)	<i>Oxalis spp.</i>	0.1	1	No	N	
Forb (FG)	<i>Plantago spp.</i>	0.1	40	No	N	
Forb (FG)	<i>Geranium spp.</i>	0.1	10	No	E	
Forb (FG)	<i>Acaena spp.</i>	0.1	20	No	N	
	<i>Sphagnum spp.</i>	0.1	1	No	N/E	
Forb (FG)	<i>Geranium spp.</i>	0.1	10	No	E	
	<i>Verbascum spp.</i>	0.1	2	No	E	
Forb (FG)	<i>Mentha spp.</i>	0.1	1	No	E	
Forb (FG)	<i>Iridaceae spp.</i>	0.1	1	No	E	

BAM Site – Field Survey Form

Plot ID:	3005	Date:	03/02/19	Survey Name:	Lobs Hole Ravine	Recorders:	SW, KM	
Zone:	55	Easting:	624666.847	Plot dimensions:	20 x 50 m	Midline bearing:	125	
Datum:	GDA94	Northing:	6040619.94	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:		
Plant Community Type:	729: Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion				Confidence:	High	Photo #:	
Vegetation Class:	Southern Tableland Dry Sclerophyll Forests				EEC:	No	Confidence:	Medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	13
	Grasses etc.:	2
	Forbs:	3
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	58
	Shrubs:	182
	Grasses etc.:	40
	Forbs:	6
	Ferns:	0
	Other:	4
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	1	0	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	6		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	30	25	25	20	60	3	3	5	2	1	1	0	1	1	1	0	0	0	5	2
Average of the 5 subplots:	32					2.8					0.8					1.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture	Medium-course grained	Soil Colour	Deep brown-mauve	Soil Depth	At least 30cm
Lithology (B)							
Slope	9/02/1900	Aspect	S	Site Drainage	Good drainage	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			No evidence
Cultivation (inc. pasture):			No evidence
Soil erosion:			No evidence
Firewood / CWD removal:			No evidence
Grazing (identify native/stock):			No evidence
Fire damage:	Light	greater than 10yo	Some burnt trunks and stumps
Storm damage:	Moderate	less than 3yo	At least 2 fallen Eucalytus trees
Weediness:			No evidence
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Lobs Hole Ravine					
	Date:	03/02/19	Plot ID:	3005	Recorders:	SW, KM

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Shrub (SG)	<i>Acacia gunnii</i>	3	10	No	N	
Shrub (SG)	<i>Acacia pravissima</i>	5	10	No	N	
Shrub (SG)	<i>Leucopogon virgatus</i>	20	200	No	N	
Shrub (SG)	<i>Kunzea muelleri</i>	40	1000	No	N	
Shrub (SG)	<i>Epacris celata</i>	5	100	No	N	
Shrub (SG)	<i>Pimelea linifolia</i> subsp. <i>linifolia</i>	3	50	No	N	
Grass & grasslike	<i>Poa sieberiana</i> var. <i>cyanophylla</i>	20	300	No	N	
Shrub (SG)	<i>Brachyloma daphnoides</i>	3	30	No	N	
Shrub (SG)	<i>Bursaria spinosa</i>	1	1	No	N	
Other (OG)	<i>Cassytha pubescens</i>	4	10	No	N	
Shrub (SG)	<i>Dodonaea viscosa</i> subsp. <i>angustissima</i>	5	50	No	N	
Tree (TG)	<i>Eucalyptus dives</i>	55	30	No	N	
Tree (TG)	<i>Eucalyptus mannifera</i>	3	1	No	N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	2	200	No	N	
Shrub (SG)	<i>Grevillea arenaria</i> subsp. <i>canescens</i>	10	10	No	N	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	5	20	No	N	
Shrub (SG)	<i>Leucopogon attenuatus</i>	80	1000	No	N	
Grass & grasslike	<i>Poa sieberiana</i>	20	500	No	N	
Forb (FG)	<i>Stellaria pungens</i>	1	20	No	N	
Forb (FG)	<i>Stylidium graminifolium</i>	3	20	No	N	
Shrub (SG)	<i>Tetratheca thymifolia</i>	2	200	No	N	

BAM Site – Field Survey Form

Plot ID:	3027	Date:	19/02/19	Survey Name:	Lobbs hole	Recorders:	RP, CG
Zone:	55	Easting:	628246.085	Plot dimensions:	20 x 50 m	Midline bearing:	33
Datum:	GDA94	Northing:	6038651.11	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:	
Plant Community Type:	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				Confidence:	Low	Photo #:
Vegetation Class:	Upper Riverina Dry Sclerophyll Forests				EEC:	No	Confidence:
				High			

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)	Sum values
Count of Native Richness	Trees: 3
	Shrubs: 22
	Grasses etc.: 6
	Forbs: 9
	Ferns: 0
	Other: 5
Sum of Cover of native vascular plants by growth form group	Trees: 40
	Shrubs: 95.3
	Grasses etc.: 38.1
	Forbs: 2.6
	Ferns: 0
	Other: 0.7
High Threat Weed cover:	0

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	9	0	1
20 – 29 cm:	1	0	1
10 – 19 cm:	1	0	0
5 – 9 cm:	1	0	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	62		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	50	55	60	78	50	33	33	6	0	0	0	0	1	0	6	0	0	0	0	0
Average of the 5 subplots:	58.6					14.4					1.4					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Footslope	Lf Pattern (A)	Hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture		Soil Colour		Soil Depth	
Lithology (B)							
Slope	Steep, -22	Aspect	NNW	Site Drainage	Good	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:	Light	greater than 10yo	2003 fires
Storm damage:			
Weediness:	Light	greater than 10yo	None observed
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Lobbs hole					
	Date:	19/02/19	Plot ID:	3027	Recorders:	RP, CG

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Shrub (SG)	<i>Acacia floribunda</i>	1	5	Yes	N	
Shrub (SG)	<i>Acacia pravissima</i>	5	75	No	N	
Forb (FG)	<i>Asperula scoparia</i>	0.1	3	Yes	N	
Shrub (SG)	<i>Banksia canei</i>	50	180	No	N	
Other (OG)	<i>Billardiera scandens</i>	0.2	20	No	N	
Shrub (SG)	<i>Calytrix tetragona</i>	0.1	2	No	N	
Shrub (SG)	<i>Cassinia aculeata</i>	0.2	1	No	N	
Other (OG)	<i>Cassytha pubescens</i>	0.1	20	No	N	
	<i>Centaurium erythraea</i>	0.1	30	No	E	
Tree (TG)	<i>Eucalyptus dives</i>	30	20	No	N	
Tree (TG)	<i>Eucalyptus nortonii</i>	5	6	No	N	
Shrub (SG)	<i>Platylobium formosum</i>	5	200	No	N	
Shrub (SG)	<i>Pomaderris subcapitata</i>	0.2	1	Yes	N	
Shrub (SG)	<i>Leucopogon fraseri</i>	0.2	300	Yes	N	
Forb (FG)	<i>Euchiton japonicus</i>	0.1	10	No	E	
Shrub (SG)	<i>Acacia spp.</i>	5	75	No	N/E	
Other (OG)	<i>Cassytha melantha</i>	0.2	20	Yes	N	
Shrub (SG)	<i>Tetratheca bauerifolia</i>	1	500	Yes	N	
Grass & grasslike	<i>Rytidosperma spp.</i>	0.5	30	Yes	N	
Forb (FG)	<i>Hovea heterophylla</i>	1	50	No	N	
Grass & grasslike	<i>Dichelachne rara</i>	0.1	25	Yes	N	
Forb (FG)	<i>Dianella nervosa</i>	0.5	15	Yes	N	
Shrub (SG)	<i>Cassinia longifolia</i>	2	35	Yes	N	
Forb (FG)	<i>Ranunculus collinus</i>	0.1	15	Yes	N	
Shrub (SG)	<i>Monotoca scoparia</i>	0.2	5	Yes	N	
Forb (FG)	<i>Senecio gunnii</i>	0.1	1	Yes	N	
Grass & grasslike	<i>Poa phillipsiana</i>	5	200	Yes	N	
Forb (FG)	<i>Boronia nana</i> var. <i>hyssopifolia</i>	0.1	20	No	N	
Tree (TG)	<i>Eucalyptus spp.</i>	5	6	Yes	N	
Shrub (SG)	<i>Exocarpos strictus</i>	1	50	No	N	
Forb (FG)	<i>Galium gaudichaudii</i>	0.1	10	Yes	N	
Other (OG)	<i>Glycine clandestina</i>	0.1	70	No	N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	0.5	200	No	N	
Shrub (SG)	<i>Grevillea arenaria</i> subsp. <i>canescens</i>	0.1	2	No	N	
Other (OG)	<i>Hardenbergia violacea</i>	0.1	3	No	N	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	1	60	No	N	
Grass & grasslike	<i>Lepidosperma laterale</i>	2	50	No	N	
Shrub (SG)	<i>Leucopogon attenuatus</i>	0.5	20	No	N	
Shrub (SG)	<i>Leucopogon ericoides</i>	0.1	3	No	N	
Grass & grasslike	<i>Lomandra longifolia</i>	0.5	120	No	N	
Shrub (SG)	<i>Mirbelia oxylobioides</i>	20	100	No	N	
Shrub (SG)	<i>Pimelea curviflora</i>	0.1	2	No	N	
Shrub (SG)	<i>Pimelea glauca</i>	0.1	5	Yes	N	
Grass & grasslike	<i>Poa sieberiana</i>	30	1500	No	N	
Shrub (SG)	<i>Podolobium procumbens</i>	0.5	12	No	N	
Shrub (SG)	<i>Pomaderris ledifolia</i>	2	30	Yes	N	

BAM Site – Field Survey Form

Plot ID:	3035	Date:	20/02/19	Survey Name:	Lobs Hole Ravine	Recorders:	RP, CG, KM	
Zone:	55	Easting:	627911.35	Plot dimensions:	20 x 50 m	Midline bearing:	315	
Datum:	GDA94	Northing:	6038068.7	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:		
Plant Community Type:	999: Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion				Confidence:	High	Photo #:	
Vegetation Class:	Southern Tableland Dry Sclerophyll Forests				EEC:	No	Confidence:	High

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	17
	Grasses etc.:	3
	Forbs:	4
	Ferns:	0
	Other:	3
Sum of Cover of native vascular plants by growth form group	Trees:	30
	Shrubs:	112.5
	Grasses etc.:	16.1
	Forbs:	3
	Ferns:	0
	Other:	1.2
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	2	0	0
20 – 29 cm:	1	0	1
10 – 19 cm:	1	0	0
5 – 9 cm:	1	0	0
< 5 cm:	1	1	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	25		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	78	75	75	80	65	3	4	1	1	9	1	6	1	3	1	0	0	0	0	0
Average of the 5 subplots:	74.6					3.6					2.4					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Footslope	Lf Pattern (A)	Hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture	Medium-fine grained	Soil Colour	Pale brown	Soil Depth	At least 30cm
Lithology (B)							
Slope	Steep	Aspect	SW	Site Drainage	Good	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			No evidence
Cultivation (inc. pasture):			No evidence
Soil erosion:			No evidence
Firewood / CWD removal:			No evidence
Grazing (identify native/stock):			No evidence
Fire damage:	Moderate	greater than 10yo	2003 fires, up to crown on some trees
Storm damage:	Light	3 to 10 yo	Fallen down Eucalyptus with snapped branch
Weediness:	Light	greater than 10yo	None observed
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Lobs Hole Ravine					
	Date:	20/02/19	Plot ID:	3035	Recorders:	RP, CG, KM

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Shrub (SG)	<i>Acacia gunnii</i>	0.2	2	No	N	
Shrub (SG)	<i>Banksia canei</i>	65	400	No	N	
Other (OG)	<i>Billardiera scandens</i>	0.5	2	No	N	
Shrub (SG)	<i>Calytrix tetragona</i>	5	100	No	N	
Other (OG)	<i>Cassytha pubescens</i>	0.2	10	No	N	
Grass & grasslike	<i>Dichelachne</i> spp.	0.1	10	No	N	
Tree (TG)	<i>Eucalyptus dives</i>	30	10	No	N	
Shrub (SG)	<i>Platylobium formosum</i>	8	200	No	N	
Forb (FG)	<i>Boronia nana</i> var. <i>hyssopifolia</i>	0.5	30	No	N	
Shrub (SG)	<i>Pimelea linifolia</i> subsp. <i>caesia</i>	1	75	No	N	
Shrub (SG)	<i>Monotoca scoparia</i>	10	70	No	N	
Shrub (SG)	<i>Leucopogon virgatus</i>	1	30	No	N	
Forb (FG)	<i>Hovea heterophylla</i>	1	30	No	N	
Shrub (SG)	<i>Grevillea neurophylla</i> subsp. <i>neurophylla</i>	3	50	No	N	
Shrub (SG)	<i>Leucopogon fraseri</i>	2	46	No	N	
Shrub (SG)	<i>Acacia penninervis</i> var. <i>penninervis</i>	0.5	2	No	N	
Shrub (SG)	<i>Tetratheca ericifolia</i>	3	200	No	N	
Shrub (SG)	<i>Leucopogon fletcheri</i>	0.1	1	No	N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	0.5	80	No	N	
Shrub (SG)	<i>Grevillea arenaria</i> subsp. <i>canescens</i>	0.1	1	No	N	
Other (OG)	<i>Hardenbergia violacea</i>	0.5	3	No	N	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	1.5	80	No	N	
Grass & grasslike	<i>Lomandra longifolia</i>	1	12	No	N	
Shrub (SG)	<i>Mirbelia oxylobioides</i>	10	220	No	N	
Grass & grasslike	<i>Poa sieberiana</i> var. <i>sieberiana</i>	15	600	No	N	
Shrub (SG)	<i>Podolobium procumbens</i>	2	150	No	N	
Forb (FG)	<i>Stylidium graminifolium</i>	1	100	No	N	
Shrub (SG)	<i>Tetratheca thymifolia</i>	0.1	3	No	N	

BAM Site – Field Survey Form

Plot ID:	3046	Date:	05/02/19	Survey Name:	Lobs Hole Ravine	Recorders:	SW, KM
Zone:	55	Easting:	623989.525	Plot dimensions:	20 x 50 m	Midline bearing:	83
Datum:	GDA94	Northing:	6041111.99	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:	
Plant Community Type:	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 western Kosciuszko escarpment				Confidence:	High	Photo #:
Vegetation Class:	Southern Tableland Wet Sclerophyll Forests				EEC:	No	Confidence:
				Medium			

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)	Sum values
Count of Native Richness	Trees: 2
	Shrubs: 7
	Grasses etc.: 6
	Forbs: 9
	Ferns: 1
	Other: 3
Sum of Cover of native vascular plants by growth form group	Trees: 80
	Shrubs: 119
	Grasses etc.: 50
	Forbs: 24
	Ferns: 10
	Other: 5
High Threat Weed cover:	11

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	4	0	0
20 – 29 cm:	1	0	1
10 – 19 cm:	1	0	0
5 – 9 cm:	1	0	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	14		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	75	70	20	90	15	1	10	0	5	0	5	5	3	2	5	0	10	0	5	0
Average of the 5 subplots:	54					3.2					4					3				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture	Medium grained	Soil Colour	Pale brown	Soil Depth	At least 30cm
Lithology (B)							
Slope	9/02/1900	Aspect	S	Site Drainage	Good drainage	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			No evidence
Cultivation (inc. pasture):			No evidence
Soil erosion:			No evidence
Firewood / CWD removal:			No evidence
Grazing (identify native/stock):			No evidence
Fire damage:	Light	greater than 10yo	Some burnt trunks and leftover burnt stumps
Storm damage:	Moderate	3 to 10 yo	At least 4 fallen Eucalyptus/Acacias
Weediness:	Severe	less than 3yo	Blackberry, Centaurea ethyru and St Johns Wort present in plot
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Lobs Hole Ravine						
		Date:	05/02/19	Plot ID:	3046	Recorders:	SW, KM

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Shrub (SG)	<i>Acacia pravissima</i>	60	60	No	N	
Shrub (SG)	<i>Cassinia longifolia</i>	5	10	No	N	
Forb (FG)	<i>Geranium solanderi</i> var. <i>solanderi</i>	1	50	No	N	
Forb (FG)	<i>Pimelea curviflora</i> var. <i>sericea</i>	5	100	No	N	
Grass & grasslike	<i>Carex appressa</i>	1	20	No	N	
Fern (EG)	<i>Pteridium esculentum</i>	10	200	No	N	
	<i>Aira</i> spp.	4	100	No	E	
Shrub (SG)	<i>Cassinia aculeata</i>	30	50	No	N	
Grass & grasslike	<i>Poa sieberiana</i> var. <i>cyanophylla</i>	15	300	No	N	
	<i>Centaurium erythraea</i>	4	200	No	E	
Other (OG)	<i>Clematis aristata</i>	2	20	No	N	
Other (OG)	<i>Desmodium varians</i>	1	10	No	N	
Forb (FG)	<i>Dichondra repens</i>	2	100	No	N	
Grass & grasslike	<i>Elymus scaber</i>	1	50	No	N	
Tree (TG)	<i>Eucalyptus robertsonii</i>	70	30	No	N	
Tree (TG)	<i>Eucalyptus viminalis</i>	10	1	No	N	
Forb (FG)	<i>Euchiton involucratus</i>	5	100	No	N	
Shrub (SG)	<i>Exocarpos strictus</i>	1	1	No	N	
Other (OG)	<i>Glycine clandestina</i>	2	20	No	N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	1	50	No	N	
	<i>Holcus lanatus</i>	5	50	No	E	
	<i>Hypericum perforatum</i>	1	100	No	HTE	
Forb (FG)	<i>Lagenophora stipitata</i>	2	20	No	N	
Grass & grasslike	<i>Lomandra filiformis</i>	1	50	No	N	
Shrub (SG)	<i>Lomatia myricoides</i>	10	20	No	N	
Grass & grasslike	<i>Poa sieberiana</i>	30	500	No	N	
Shrub (SG)	<i>Podolobium</i> spp.	10	500	No	N	
	<i>Rosa rubiginosa</i>	10	10	No	HTE	
	<i>Rubus anglocandicans</i>	30	100	No	E	
Grass & grasslike	<i>Rytidosperma erianthum</i>	2	50	No	N	
Forb (FG)	<i>Senecio quadridentatus</i>	1	10	No	N	
Forb (FG)	<i>Stellaria pungens</i>	5	100	No	N	
Shrub (SG)	<i>Tetradlea thymifolia</i>	3	50	No	N	
Forb (FG)	<i>Viola betonicifolia</i>	2	20	No	N	

BAM Site – Field Survey Form

Plot ID:	3092	Date:	06/02/19	Survey Name:	Lobs Hole Ravine	Recorders:	SW, KM
Zone:	55	Easting:	624794.576	Plot dimensions:	20 x 50 m	Midline bearing:	259
Datum:	GDA94	Northing:	6040483.15	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:	
Plant Community Type:	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 western Kosciuszko escarpment				Confidence:	High	Photo #:
Vegetation Class:	Southern Tableland Wet Sclerophyll Forests				EEC:	No	Confidence:
				High			

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	2
	Shrubs:	10
	Grasses etc.:	8
	Forbs:	12
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	50
	Shrubs:	199
	Grasses etc.:	82
	Forbs:	41
	Ferns:	0
	Other:	0
High Threat Weed cover:		5

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	1	0	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	15		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	20	30	20	20	85	0	2	5	5	2	5	15	2	20	4	0	1	30	2	1
Average of the 5 subplots:	35					2.8					9.2					6.8				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Low hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture	Fine grained	Soil Colour	Dark brown	Soil Depth	At least 30cm
Lithology (B)							
Slope	20/01/1900	Aspect	S	Site Drainage	Good drainage	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			No evidence
Cultivation (inc. pasture):			No evidence
Soil erosion:			No evidence
Firewood / CWD removal:			No evidence
Grazing (identify native/stock):			No evidence
Fire damage:	Light	greater than 10yo	Some burnt stumps
Storm damage:	Moderate	less than 3yo	At least 2 snapped branches from Eucalyptus and Acacia. Leaves all browned off
Weediness:	Moderate	less than 3yo	St Johns Wort present
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Lobs Hole Ravine						
		Date:	06/02/19	Plot ID:	3092	Recorders:	SW, KM

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Shrub (SG)	<i>Acacia pravissima</i>	50	200	No	N	
Shrub (SG)	<i>Cassinia longifolia</i>	15	50	No	N	
	<i>Aira spp.</i>	10	1000	No	E	
Shrub (SG)	<i>Pimelea spp.</i>	10	500	No	N	
Shrub (SG)	<i>Epacris celata</i>	30	500	No	N	
Forb (FG)	<i>Acaena ovina</i>	3	50	No	N	
Grass & grasslike	<i>Poa sieberiana</i> var. <i>cyanophylla</i>	10	200	No	N	
Grass & grasslike	<i>Themeda triandra</i>	3	20	No	N	
Forb (FG)	<i>Geranium solanderi</i> var. <i>solanderi</i>	1	50	No	N	
Forb (FG)	<i>Oxalis perennans</i>	3	50	No	N	
Grass & grasslike	<i>Entolasia stricta</i> var. <i>hirsuta</i>	2	50	No	N	
Shrub (SG)	<i>Calytrix tetragona</i>	60	500	No	N	
Grass & grasslike	<i>Carex appressa</i>	1	20	No	N	
	<i>Centaurium erythraea</i>	4	100	No	E	
Grass & grasslike	<i>Elymus scaber</i>	1	150	No	N	
Forb (FG)	<i>Erigeron conyzoides</i>	3	10	No	N	
Tree (TG)	<i>Eucalyptus dives</i>	40	20	No	N	
Tree (TG)	<i>Eucalyptus mannifera</i>	10	3	No	N	
Shrub (SG)	<i>Exocarpos strictus</i>	5	10	No	N	
Forb (FG)	<i>Geranium retrorsum</i>	1	20	No	N	
Shrub (SG)	<i>Gompholobium huegelii</i>	1	2	No	N	
Forb (FG)	<i>Gonocarpus teucrioides</i>	5	200	No	N	
Shrub (SG)	<i>Grevillea arenaria</i> subsp. <i>canescens</i>	3	10	No	N	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	5	20	No	N	
Forb (FG)	<i>Hypericum gramineum</i>	10	1000	No	N	
Shrub (SG)	<i>Leucopogon ericoides</i>	20	100	No	N	
Grass & grasslike	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	5	100	No	N	
Grass & grasslike	<i>Poa sieberiana</i>	40	2000	No	N	
	<i>Rosa rubiginosa</i>	5	10	No	HTE	
	<i>Rubus anglocandicans</i>	5	10	No	E	
Grass & grasslike	<i>Rytidosperma erianthum</i>	20	500	No	N	
Forb (FG)	<i>Senecio quadridentatus</i>	2	10	No	N	
Forb (FG)	<i>Stellaria pungens</i>	10	1000	No	N	
Forb (FG)	<i>Stylidium graminifolium</i>	1	50	No	N	
Forb (FG)	<i>Viola betonicifolia</i>	1	50	No	N	
Forb (FG)	<i>Wahlenbergia communis</i>	1	3	No	N	

BAM Site – Field Survey Form

Plot ID:	3115	Date:	19/02/19	Survey Name:	Tantangara	Recorders:	JA, DK	
Zone:	55	Easting:	628057.31	Plot dimensions:	20 x 50 m	Midline bearing:	165	
Datum:	GDA94	Northing:	6038746.06	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:		
Plant Community Type:	1224: Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion				Confidence:	High	Photo #:	
Vegetation Class:	Temperate Montane Grasslands				EEC:	No	Confidence:	High

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	9
	Grasses etc.:	5
	Forbs:	21
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	39
	Grasses etc.:	57.3
	Forbs:	18
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	0	0	0
10 – 19 cm:	0	0	0
5 – 9 cm:	0	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	10	15	20	30	15	0	0	1	0	15	0	0	0	0	0	0	0	0	0	0
Average of the 5 subplots:	18					3.2					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Other	Microrelief	
		Lf Element (B)		Lf Pattern (B)	Valley		
Lithology (A)		Soil Surface Texture		Soil Colour		Soil Depth	
Lithology (B)							
Slope	7/01/1900	Aspect	E	Site Drainage	Good	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):	Light		Wombats rabbits horsea and macropods
Fire damage:			
Storm damage:			
Weediness:	Moderate		Sweet vernal
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Tantangara					
	Date:	19/02/19	Plot ID:	3115	Recorders:	JA, DK

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Forb (FG)	<i>Acaena novae-zelandiae</i>	1	300	No	N	
	<i>Acetosella vulgaris</i>	0.1	100	No	HTE	
	<i>Anthoxanthum odoratum</i>	10	500	No	E	
Forb (FG)	<i>Arthropodium milleflorum</i>	0.1	20	No	N	
Forb (FG)	<i>Asperula conferta</i>	0.1	100	No	N	
Forb (FG)	<i>Asperula</i> spp.	0.1	200	No	N	
Shrub (SG)	<i>Bossiaea foliosa</i>	0.5	3	No	N	
Forb (FG)	<i>Chrysocephalum semipapposum</i>	15	200	No	N	
	<i>Cirsium vulgare</i>	0.1	1	No	E	
	<i>Crepis capillaris</i>	0.1	50	No	E	
Grass & grasslike	<i>Dichelachne</i> spp.	0.1	20	No	N	
Shrub (SG)	<i>Leptospermum myrtifolium</i>	1	4	No	N	
Shrub (SG)	<i>Pimelea</i> spp.	0.1	10	No	N	
Forb (FG)	<i>Epilobium</i> spp.	0.2	400	No	N	
Forb (FG)	<i>Acaena ovina</i>	0.1	30	No	N	
Grass & grasslike	<i>Themeda triandra</i>	55	500	No	N	
Shrub (SG)	<i>Discaria pubescens</i>	0.1	25	No	N	
Forb (FG)	<i>Oreomyrrhis</i> spp.	0.1	50	No	N	
Forb (FG)	<i>Hovea heterophylla</i>	0.1	10	No	N	
Forb (FG)	<i>Galium ciliare</i>	0.1	1	No	N	
Forb (FG)	<i>Geranium antrorsum</i>	0.1	20	No	N	
Shrub (SG)	<i>Acrothamnus hookeri</i>	0.1	2	No	N	
Forb (FG)	<i>Senecio</i> spp.	0.1	1	No	N/E	
Grass & grasslike	<i>Elymus scaber</i>	0.1	50	No	N	
Forb (FG)	<i>Solenogyne gunnii</i>	0.1	1	No	N	
Forb (FG)	<i>Geranium solanderi</i>	0.1	50	No	N	
Other (OG)	<i>Glycine clandestina</i>	0.1	40	No	N	
Shrub (SG)	<i>Grevillea lanigera</i>	7	55	No	N	
Shrub (SG)	<i>Hakea microcarpa</i>	30	35	No	N	
	<i>Holcus lanatus</i>	0.1	20	No	E	
Forb (FG)	<i>Hypericum gramineum</i>	0.1	2	No	N	
	<i>Hypochaeris radicata</i>	0.1	10	No	E	
Forb (FG)	<i>Leptorhynchus squamatus</i>	0.1	2	No	N	
Shrub (SG)	<i>Mirbelia oxylobioides</i>	0.1	1	No	N	
Shrub (SG)	<i>Olearia myrsinoides</i>	0.1	5	No	N	
Grass & grasslike	<i>Poa sieberiana</i>	2	100	No	N	
Forb (FG)	<i>Poranthera microphylla</i>	0.1	100	No	N	
	<i>Rubus fruticosus</i>	0.1	1	No	E	
Grass & grasslike	<i>Rytidosperma</i> spp.	0.1	50	No	N	
Forb (FG)	<i>Scleranthus biflorus</i>	0.1	20	No	N	
Forb (FG)	<i>Stellaria pungens</i>	0.1	10	No	N	
	<i>Tragopogon porrifolius</i>	0.1	1	No	E	
	<i>Trifolium repens</i>	0.1	200	No	E	
Forb (FG)	<i>Viola betonicifolia</i>	0.1	50	No	N	
Forb (FG)	<i>Xerochrysum subundulatum</i>	0.1	5	No	N	

BAM Site – Field Survey Form

Plot ID:	3149	Date:	20/02/19	Survey Name:	Tantangara	Recorders:	JA, DK
Zone:	55	Easting:	649000.24	Plot dimensions:	20 x 50 m	Midline bearing:	249
Datum:	GDA94	Northing:	6037815.4	IBRA region:	Australian Alps (Snowy Mountains)	Zone ID:	
Plant Community Type:	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				Confidence:	Low	Photo #:
Vegetation Class:	Southern Tableland Grassy Woodlands				EEC:	No	Confidence:
						High	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)	Sum values
Count of Native Richness	Trees: 1
	Shrubs: 5
	Grasses etc.: 2
	Forbs: 13
	Ferns: 0
	Other: 0
Sum of Cover of native vascular plants by growth form group	Trees: 4
	Shrubs: 30.9
	Grasses etc.: 6
	Forbs: 2.1
	Ferns: 0
	Other: 0
High Threat Weed cover:	0.3

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	1	0	0
30 – 49 cm:	1	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	0	0	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	4		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	50	40	25	20	40	2	0	20	15	0	0	0	0	0	0	0	0	0	0	
Average of the 5 subplots:	35					7.4					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Other	Microrelief	
		Lf Element (B)		Lf Pattern (B)	Valley		
Lithology (A)		Soil Surface Texture		Soil Colour		Soil Depth	
Lithology (B)							
Slope	5/01/1900	Aspect	SE	Site Drainage	Good	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):	Moderate		Rabbit, horse, macropod
Fire damage:			
Storm damage:			
Weediness:	Severe		Sweet vernal
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Tantangara						
		Date:	20/02/19	Plot ID:	3149	Recorders:	JA, DK

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Forb (FG)	<i>Acaena novae-zelandiae</i>	0.5	300	No	N	
	<i>Acetosella vulgaris</i>	0.3	400	No	HTE	
	<i>Anthoxanthum odoratum</i>	60	800	No	E	
Forb (FG)	<i>Arthropodium milleflorum</i>	0.1	20	No	N	
Forb (FG)	<i>Asperula conferta</i>	0.2	100	No	N	
Forb (FG)	<i>Asperula spp.</i>	0.2	200	No	N	
Shrub (SG)	<i>Bossiaea foliosa</i>	0.1	1	No	N	
Forb (FG)	<i>Bulbine bulbosa</i>	0.3	150	No	N	
	<i>Cirsium vulgare</i>	0.1	50	No	E	
Shrub (SG)	<i>Pimelea pauciflora</i>	0.6	2	No	N	
Grass & grasslike	<i>Themeda triandra</i>	4	250	No	N	
	<i>Crepis capillaris</i>	0.1	50	No	E	
Forb (FG)	<i>Senecio spp.</i>	0.1	20	No	N/E	
Forb (FG)	<i>Epilobium spp.</i>	0.1	200	No	N	
Forb (FG)	<i>Cynoglossum australe</i>	0.1	20	No	N	
Forb (FG)	<i>Acaena ovina</i>	0.1	50	No	N	
Forb (FG)	<i>Oreomyrrhis spp.</i>	0.1	5	No	N	
Forb (FG)	<i>Geranium antrorsum</i>	0.1	20	No	N	
Tree (TG)	<i>Eucalyptus stellulata</i>	4	1	No	N	
Forb (FG)	<i>Geranium solanderi</i>	0.1	50	No	N	
Shrub (SG)	<i>Hakea microcarpa</i>	30	40	No	N	
	<i>Holcus lanatus</i>	0.1	20	No	E	
Shrub (SG)	<i>Hymenanthera dentata</i>	0.1	1	No	N	
Shrub (SG)	<i>Mirbelia oxylobioides</i>	0.1	1	No	N	
Grass & grasslike	<i>Poa sieberiana</i>	2	100	No	N	
	<i>Rubus fruticosus</i>	0.5	5	No	E	
Forb (FG)	<i>Scleranthus biflorus</i>	0.1	50	No	N	
	<i>Tragopogon porrifolius</i>	0.1	2	No	E	
	<i>Trifolium repens</i>	0.5	500	No	E	

BAM Site – Field Survey Form

Plot ID:	3177	Date:	04/02/19	Survey Name:	Lobs Hole Ravine	Recorders:	SW, KM
Zone:	55	Easting:	625074.174	Plot dimensions:	20 x 50 m	Midline bearing:	318
Datum:	GDA94	Northing:	6040197.7	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:	
Plant Community Type:	729: Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion				Confidence:	High	Photo #:
Vegetation Class:	Southern Tableland Dry Sclerophyll Forests				EEC:	No	Confidence:
							Medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	3
	Shrubs:	7
	Grasses etc.:	7
	Forbs:	7
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	13
	Shrubs:	181
	Grasses etc.:	95
	Forbs:	22
	Ferns:	0
	Other:	1
High Threat Weed cover:		3

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	0	0	0
10 – 19 cm:	0	0	0
5 – 9 cm:	1	0	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	10	10	5	20	20	3	0	25	10	25	5	0	0	5	0	0	0	0	5	3
Average of the 5 subplots:	13					12.6					2					1.6				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Low hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Alluvial loams and clays	Soil Surface Texture	Medium-fine grained	Soil Colour	Dark brown	Soil Depth	At least 30cm
Lithology (B)							
Slope	20/01/1900	Aspect	NW	Site Drainage	Good drainage	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	Severe	3 to 10 yo	Derived grassland under power easement. Close to boatramp in Lobs Hole, extensive clearing in surro
Cultivation (inc. pasture):			No evidence
Soil erosion:			No evidence
Firewood / CWD removal:			No evidence
Grazing (identify native/stock):	Light	less than 3yo	Rabbit scats present
Fire damage:	Light	3 to 10 yo	Some burnt logs present
Storm damage:			No evidence
Weediness:	Severe	less than 3yo	Blackberry, St Johns Wort and Centorium erthyum present in plot
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Lobs Hole Ravine						
		Date:	04/02/19	Plot ID:	3177	Recorders:	SW, KM

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Shrub (SG)	<i>Acacia pravissima</i>	50	100	No	N	
Grass & grasslike	<i>Themeda triandra</i>	50	2000	No	N	
Forb (FG)	<i>Pimelea curviflora</i> var. <i>sericea</i>	2	50	No	N	
Grass & grasslike	<i>Dichelachne rara</i>	10	200	No	N	
Forb (FG)	<i>Oxalis perennans</i>	5	100	No	N	
Forb (FG)	<i>Acaena ovina</i>	5	200	No	N	
Forb (FG)	<i>Ranunculus collinus</i>	4	20	No	N	
Shrub (SG)	<i>Bossiaea foliosa</i>	70	300	No	N	
Shrub (SG)	<i>Brachyloma daphnoides</i>	10	50	No	N	
Shrub (SG)	<i>Bursaria spinosa</i>	40	30	No	N	
Tree (TG)	<i>Callitris endlicheri</i>	1	1	No	N	
Grass & grasslike	<i>Carex appressa</i>	5	20	No	N	
	<i>Centaurium erythraea</i>	10	200	No	E	
	<i>Centaurium erythraea</i>	3	50	No	E	
Forb (FG)	<i>Chrysocephalum semipapposum</i>	1	50	No	N	
Grass & grasslike	<i>Elymus scaber</i>	1	20	No	N	
Tree (TG)	<i>Eucalyptus robertsonii</i>	2	1	No	N	
Tree (TG)	<i>Eucalyptus rubida</i>	10	5	No	N	
Shrub (SG)	<i>Exocarpos strictus</i>	5	5	No	N	
Other (OG)	<i>Glycine clandestina</i>	1	1	No	N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	2	200	No	N	
	<i>Hypericum perforatum</i>	1	200	No	HTE	
Grass & grasslike	<i>Lomandra multiflora</i>	2	10	No	N	
Shrub (SG)	<i>Pimelea linifolia</i>	5	200	No	N	
Grass & grasslike	<i>Poa sieberiana</i>	25	500	No	N	
Forb (FG)	<i>Ranunculus lappaceus</i>	3	50	No	N	
	<i>Rosa rubiginosa</i>	2	1	No	HTE	
	<i>Rubus anglocandicans</i>	20	50	No	E	
Grass & grasslike	<i>Rytidosperma</i> spp.	2	50	No	N	
	<i>Taraxacum officinale</i>	1	1	No	E	
Shrub (SG)	<i>Tetradlea thymifolia</i>	1	20	No	N	

BAM Site – Field Survey Form

Plot ID:	3187	Date:	20/02/19	Survey Name:	Lobs Hole Ravine	Recorders:	RP, CG, KM	
Zone:	55	Easting:	627635.705	Plot dimensions:	20 x 50 m	Midline bearing:	95	
Datum:	GDA94	Northing:	6038060.6	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:		
Plant Community Type:	729: Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion				Confidence:	High	Photo #:	
Vegetation Class:	Southern Tableland Dry Sclerophyll Forests				EEC:	No	Confidence:	Medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	4
	Shrubs:	6
	Grasses etc.:	11
	Forbs:	11
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	36
	Shrubs:	20.7
	Grasses etc.:	38.2
	Forbs:	4.1
	Ferns:	0.5
	Other:	0.1
High Threat Weed cover:		2

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	1	0	0
30 – 49 cm:	1	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	1	1	0
< 5 cm:	1	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	29		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	90	25	85	20	20	0	15	5	0	1	1	0	1	0	1	0	2	0	0	0
Average of the 5 subplots:	48					4.2					0.6					0.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Footslope	Lf Pattern (A)	Low hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture		Soil Colour		Soil Depth	
Lithology (B)							
Slope	Moderate	Aspect	N	Site Drainage	Good	Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:	Moderate	greater than 10yo	2003 fires
Storm damage:	Light	greater than 10yo	Many fallen trees
Weediness:	Severe	greater than 10yo	Infestation of blackberry. Centaurea erythraea and hypericum perforatum also present.
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	Lobs Hole Ravine						
		Date:	20/02/19	Plot ID:	3187	Recorders:	RP, CG, KM

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Shrub (SG)	<i>Acacia pravissima</i>	12	120	No	N	
	<i>Anagallis arvensis</i>	0.1	17	No	E	
Shrub (SG)	<i>Brachyloma daphnoides</i>	0.2	2	No	N	
Shrub (SG)	<i>Calytrix tetragona</i>	0.3	2	No	N	
Grass & grasslike	<i>Carex appressa</i>	2	55	No	N	
	<i>Centaurium erythraea</i>	1	200	No	E	
	<i>Cerastium glomeratum</i>	0.1	1	No	E	
Forb (FG)	<i>Chrysocephalum semipapposum</i>	0.1	3	No	N	
	<i>Conyza</i> spp.	0.1	1	No	E	
Forb (FG)	<i>Cullen microcephalum</i>	0.1	2	No	N	
Forb (FG)	<i>Dianella revoluta</i> var. <i>revoluta</i>	2	60	No	N	
Grass & grasslike	<i>Elymus scaber</i>	2	50	No	N	
Tree (TG)	<i>Eucalyptus dives</i>	4	2	No	N	
Tree (TG)	<i>Eucalyptus mannifera</i>	4	4	No	N	
Tree (TG)	<i>Eucalyptus rubida</i>	8	6	No	N	
Tree (TG)	<i>Eucalyptus stellulata</i>	20	16	No	N	
Shrub (SG)	<i>Exocarpos strictus</i>	3	45	No	N	
Shrub (SG)	<i>Cassinia longifolia</i>	5	35	No	N	
Other (OG)	<i>Glycine clandestina</i>	0.1	3	No	N	
Forb (FG)	<i>Acaena ovina</i>	0.1	3	No	N	
Grass & grasslike	<i>Themeda triandra</i>	2	75	No	N	
Grass & grasslike	<i>Rytidosperma</i> spp.	0.1	1	No	N	
Forb (FG)	<i>Geranium solanderi</i> var. <i>solanderi</i>	0.5	20	No	N	
Shrub (SG)	<i>Pimelea curviflora</i> var. <i>gracilis</i>	0.2	5	No	N	
Grass & grasslike	<i>Dichelachne rara</i>	0.1	2	No	N	
Grass & grasslike	<i>Carex breviculmis</i>	0.5	75	No	N	
Forb (FG)	<i>Brachyscome tenuiscapa</i>	0.1	1	No	N	
Forb (FG)	<i>Ranunculus collinus</i>	0.1	6	No	N	
Forb (FG)	<i>Oxalis exilis</i>	0.1	6	No	N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	0.8	80	No	N	
Forb (FG)	<i>Oxalis perennans</i>	0.1	1	No	N	
	<i>Hypericum perforatum</i>	1	250	No	HTE	
	<i>Hypochaeris radicata</i>	0.1	3	No	E	
Grass & grasslike	<i>Lomandra longifolia</i>	1	45	No	N	
Grass & grasslike	<i>Microlaena stipoides</i>	15	400	No	N	
Grass & grasslike	<i>Poa labillardierei</i>	10	120	No	N	
Grass & grasslike	<i>Poa sieberiana</i>	5	75	No	N	
Fern (EG)	<i>Pteridium esculentum</i>	0.5	11	No	N	
	<i>Rosa rubiginosa</i>	1	12	No	HTE	
	<i>Rubus anglocandicans</i>	20	250	No	E	
Forb (FG)	<i>Rumex brownii</i>	0.1	1	No	N	
Grass & grasslike	<i>Rytidosperma eriantha</i>	0.5	26	No	N	

BAM Site – Field Survey Form							
Plot ID:	3213	Date:	22/02/19	Survey Name:	Lobs hole	Recorders:	IM, CK
Zone:	55	Easting:	625702.303	Plot dimensions:	20 x 50 m	Midline bearing:	215
Datum:	GDA94	Northing:	6039227.35	IBRA region:	South Eastern Highlands (Bondo)	Zone ID:	
Plant Community Type:		729: Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion			Confidence:		Photo #:
Vegetation Class:		Southern Tableland Dry Sclerophyll Forests			EEC:		Confidence:

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	0
	Grasses etc.:	2
	Forbs:	0
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0
	Grasses etc.:	50.1
	Forbs:	0
	Ferns:	0
	Other:	0
High Threat Weed cover:		30.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	0	0	0
50 – 79 cm:	0	0	0
30 – 49 cm:	0	0	0
20 – 29 cm:	0	0	0
10 – 19 cm:	0	0	0
5 – 9 cm:	0	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	1	1	0	1	2	10	15	60	5	5	2	0	0	0	0	0	0	0	0	0
Average of the 5 subplots:	1					19					0.4					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillcrest	Lf Pattern (A)	Mountains	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)		Soil Surface Texture		Soil Colour	Brown	Soil Depth	
Lithology (B)							
Slope	8/01/1900	Aspect	W	Site Drainage		Distance to nearest water & type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):	Severe	greater than 10yo	
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):	Light		
Fire damage:			
Storm damage:			
Weediness:	Moderate		
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name: Lobs hole						
		Date:	22/02/19	Plot ID:	3213	Recorders: IM, CK
GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Grass & grasslike	<i>Themeda triandra</i>	50	1000	No	N	
	<i>Hypericum perforatum</i>	30	500	No	HTE	
Grass & grasslike	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	0.1	2	No	N	
	<i>Rubus fruticosus</i> spp. <i>agg</i>	0.1	3	No	HTE	

BAM Site – Field Survey Form

Plot ID:	5206	Date:	05/03/19	Survey Name:	BH5206			Recorders:	JA, CW
Zone:	55	Easting:	630621.258	Plot dimensions:	20 x 50 m			Midline bearing:	102
Datum:	GDA94	Northing:	6039048.4	IBRA region:	South Eastern Highlands (Bondo)			Zone ID:	
Plant Community Type:		953: Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion				Confidence:	High	Photo #:	
Vegetation Class:		Southern Tableland Dry Sclerophyll Forests				EEC:	No	Confidence:	High

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	5
	Shrubs:	15
	Grasses etc.:	4
	Forbs:	11
	Ferns:	0
	Other:	3
Sum of Cover of native vascular plants by growth form group	Trees:	79
	Shrubs:	15.7
	Grasses etc.:	51.2
	Forbs:	1.4
	Ferns:	0
	Other:	0.4
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	2	0	1
50 – 79 cm:	2	0	1
30 – 49 cm:	6	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	1	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	108		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	80	75	60	70	75	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Average of the 5 subplots:	72					0					0.2					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Hillslope	Lf Pattern (A)	Low hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Quartzs and stone	Soil Surface Texture	Loamy	Soil Colour	Grey brown	Soil Depth	Moderate
Lithology (B)							
Slope		Aspect	E	Site Drainage	Moderate	Distance to nearest water & type	190m

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:	Moderate	greater than 10yo	Charred trees
Storm damage:			
Weediness:			
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	BH5206					
	Date:	05/03/19	Plot ID:	5206	Recorders:	JA, CW

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Shrub (SG)	<i>Acacia pravissima</i>	0.3	10	No	N	
Shrub (SG)	<i>Acrotriche serrulata</i>	0.1	10	No	N	
Forb (FG)	<i>Arthropodium milleflorum</i>	0.1	5	No	N	
Forb (FG)	<i>Asperula</i> spp.	0.2	100	No	N	
Shrub (SG)	<i>Banksia canei</i>	3	7	No	N	
Forb (FG)	<i>Brachyscome</i> spp.	0.1	5	Yes	N	
Shrub (SG)	<i>Cassinia aculeata</i>	5	25	No	N	
Other (OG)	<i>Clematis aristata</i>	0.1	5	No	N	
Shrub (SG)	<i>Daviesia latifolia</i>	2	60	No	N	
Tree (TG)	<i>Eucalyptus dalrympleana</i>	15	5	No	N	
Tree (TG)	<i>Eucalyptus dives</i>	55	30	No	N	
Tree (TG)	<i>Eucalyptus pauciflora</i>	3	3	No	N	
Tree (TG)	<i>Eucalyptus robertsonii</i>	1	1	No	N	
Tree (TG)	<i>Eucalyptus viminalis</i>	5	2	No	N	
Other (OG)	<i>Glycine clandestina</i>	0.2	100	No	N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	0.1	50	No	N	
Shrub (SG)	<i>Persoonia chamaepeuce</i>	2	50	No	N	
Shrub (SG)	<i>Platylobium formosum</i>	1	300	No	N	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	0.3	20	No	N	
Shrub (SG)	<i>Tetradlea bauerifolia</i>	0.1	30	No	N	
Shrub (SG)	<i>Leucopogon virgatus</i>	0.1	5	No	N	
Shrub (SG)	<i>Pimelea</i> spp.	0.1	2	No	N	
Forb (FG)	<i>Euchiton</i> spp.	0.1	1	No	N	
Other (OG)	<i>Cassytha</i> spp.	0.1	5	No	N	
Shrub (SG)	<i>Leucopogon fletcheri</i>	0.1	5	No	N	
Forb (FG)	<i>Ranunculus</i> spp.	0.1	10	No	N	
Forb (FG)	<i>Hypericum gramineum</i>	0.1	20	No	N	
Forb (FG)	<i>Hypericum gramineum</i>	0.1	1	No	N	
	<i>Hypochaeris radicata</i>	0.1	1	No	E	
Grass & grasslike	<i>Lomandra filiformis</i>	1	250	No	N	
Grass & grasslike	<i>Lomandra multiflora</i>	0.1	20	No	N	
Shrub (SG)	<i>Mirbelia oxylobioides</i>	1	20	No	N	
Shrub (SG)	<i>Olearia erubescens</i>	0.1	2	No	N	
Grass & grasslike	<i>Poa sieberiana</i>	50	500	No	N	
Shrub (SG)	<i>Polyscias sambucifolia</i>	0.5	10	No	N	
Grass & grasslike	<i>Rytidosperma</i> spp.	0.1	1	No	N	
Forb (FG)	<i>Stackhousia monogyna</i>	0.1	10	No	N	
Forb (FG)	<i>Veronica plebeia</i>	0.3	50	No	N	
Forb (FG)	<i>Viola betonicifolia</i>	0.1	20	No	N	

BAM Site – Field Survey Form

Plot ID:	5210	Date:	08/03/19	Survey Name:	BH5210			Recorders:	JA, CW
Zone:	55	Easting:	630249.883	Plot dimensions:	20 x 50 m			Midline bearing:	10
Datum:	GDA94	Northing:	6038859.17	IBRA region:	South Eastern Highlands (Bondo)			Zone ID:	
Plant Community Type:		729: Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion				Confidence:	High	Photo #:	
Vegetation Class:		Southern Tableland Dry Sclerophyll Forests				EEC:	No	Confidence:	High

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	4
	Shrubs:	16
	Grasses etc.:	7
	Forbs:	9
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	43.2
	Shrubs:	111.1
	Grasses etc.:	24
	Forbs:	1.6
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		0

BAM Attribute (1000 m2 plot) DBH			
DBH	Stem count (euc)	Stem count (non-euc)	Stems with Hollows
80 + cm:	2	0	1
50 – 79 cm:	5	0	0
30 – 49 cm:	7	0	0
20 – 29 cm:	1	0	0
10 – 19 cm:	1	0	0
5 – 9 cm:	0	0	0
< 5 cm:	0	0	0
Length of logs (m) (≥10 cm diameter, >50 cm in length)	54		

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living. For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each):	60	25	15	7	80	0	0	0	2	0	0	0	0	0	0	0	0	0	0	
Average of the 5 subplots:	37.4					0.4					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Lf Element (A)	Gully	Lf Pattern (A)	Low hills	Microrelief	
		Lf Element (B)		Lf Pattern (B)			
Lithology (A)	Quartzs and stone	Soil Surface Texture	Loamy	Soil Colour	Grey brown	Soil Depth	Moderate
Lithology (B)							
Slope		Aspect	N	Site Drainage	Good	Distance to nearest water & type	30m

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging):			
Cultivation (inc. pasture):			
Soil erosion:			
Firewood / CWD removal:			
Grazing (identify native/stock):			
Fire damage:	Moderate	greater than 10yo	Charred trees and felled trees
Storm damage:			
Weediness:			
Other:			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF -- circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Survey Name:	BH5210					
	Date:	08/03/19	Plot ID:	5210	Recorders:	JA, CW

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	Cover	Abund	Voucher	N, E or HTE	Stratum
Shrub (SG)	<i>Acacia pravissima</i>	0.2	10	No	N	
Shrub (SG)	<i>Acrotriche serrulata</i>	0.1	5	No	N	
Forb (FG)	<i>Asperula spp.</i>	0.1	20	No	N	
Shrub (SG)	<i>Banksia canei</i>	15	18	No	N	
Shrub (SG)	<i>Cassinia aculeata</i>	5	10	No	N	
Shrub (SG)	<i>Daviesia latifolia</i>	5	40	No	N	
Forb (FG)	<i>Dianella longifolia</i>	0.3	4	No	N	
Grass & grasslike	<i>Dichelachne spp.</i>	0.2	10	No	N	
Grass & grasslike	<i>Dichelachne spp.</i>	0.1	1	No	N	
Tree (TG)	<i>Eucalyptus dalrympleana</i>	3	1	No	N	
Tree (TG)	<i>Eucalyptus dives</i>	30	13	No	N	
Tree (TG)	<i>Eucalyptus radiata subsp. robertsonii</i>	0.2	2	No	N	
Tree (TG)	<i>Eucalyptus rubida</i>	10	2	No	N	
Other (OG)	<i>Glycine clandestina</i>	0.1	50	No	N	
Forb (FG)	<i>Gonocarpus tetragynus</i>	0.5	100	No	N	
Shrub (SG)	<i>Hibbertia obtusifolia</i>	0.3	20	No	N	
Shrub (SG)	<i>Pimelea spp.</i>	1	10	No	N	
Forb (FG)	<i>Hovea heterophylla</i>	0.2	50	No	N	
Shrub (SG)	<i>Persoonia chamaepeuce</i>	0.2	15	No	N	
Shrub (SG)	<i>Platylobium formosum</i>	0.2	20	No	N	
Shrub (SG)	<i>Grevillea neurophylla</i>	0.5	15	No	N	
Shrub (SG)	<i>Tetradlea bauerifolia</i>	2	50	No	N	
Shrub (SG)	<i>Acrothamnus hookeri</i>	0.5	1	No	N	
Shrub (SG)	<i>Leucopogon fletcheri</i>	0.5	1	No	N	
Shrub (SG)	<i>Leucopogon virgatus</i>	0.5	1	No	N	
Forb (FG)	<i>Brachycome spathulata</i>	0.1	10	No	N	
Forb (FG)	<i>Veronica subtilis</i>	0.1	1	No	N	
Grass & grasslike	<i>Lomandra filiformis</i>	1	30	No	N	
Grass & grasslike	<i>Lomandra longifolia</i>	0.2	5	No	N	
Grass & grasslike	<i>Lomandra multiflora</i>	2	50	No	N	
Shrub (SG)	<i>Mirbelia oxylobioides</i>	80	800	No	N	
Shrub (SG)	<i>Olearia erubescens</i>	0.1	5	No	N	
Grass & grasslike	<i>Poa labillardierei</i>	0.5	10	No	N	
Grass & grasslike	<i>Poa sieberiana</i>	20	600	No	N	
Forb (FG)	<i>Stackhousia monogyna</i>	0.1	5	No	N	
Forb (FG)	<i>Stylidium graminifolium</i>	0.1	5	No	N	
Forb (FG)	<i>Viola betonicifolia</i>	0.1	20	No	N	

Appendix B

Vegetation integrity assessment – plot data

Table B.1 Vegetation integrity plot data

plot	zone	easting	northing	bearing	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic
187	55	628142	6046952	90	3	9	6	6	1	1	2.0	10.1	7.2	3.8	60.0	0.5	0	0	77.6	84.0	0	0	0	0	0	0	1.1
2161	55	625815	6039432	277	2	12	4	2	0	2	100.0	188.0	5.0	4.0	0.0	5.0	2	0	67.0	8.0	1	1	1	1	1	1	0.0
2271	55	624896	6040649	135	2	12	8	16	0	2	41.0	62.1	33.5	3.5	0.0	0.6	0	0	18.0	23.0	1	1	1	1	0	1	1.5
3046	55	623989	6041112	83	2	6	6	9	1	3	80.0	89.0	50.0	24.0	10.0	5.0	0	1	54.0	14.0	1	1	1	1	0	1	11.0
3092	55	624795	6040483	259	2	10	8	12	0	0	50.0	199.0	82.0	41.0	0.0	0.0	0	0	35.0	15.0	1	1	1	0	0	1	5.0
1020	55	626931	6036666	319	2	5	7	6	0	0	45.0	22.3	40.2	0.6	0.0	0.0	0	0	94.6	0.0	0	1	1	1	1	1	0.0
2024	55	626303	6037051	108	1	2	6	8	1	0	40.0	40.0	52.0	79.0	1.0	0.0	0	0	20.0	3.0	0	1	0	1	0	0	52.0
194	55	625172	6036524	180	5	15	12	21	1	3	48.3	53.0	27.2	3.6	25.0	0.4	0	4	83.0	111.0	1	1	1	1	1	0	2.1
2284	55	625379	6039763	172	0	3	2	10	0	0	0.0	7.6	36.0	5.9	0.0	0.0	0	0	3.6	0.0	0	0	0	0	0	0	40.1
1051	55	625963	6038950	121	0	0	4	1	0	0	0.0	0.0	5.3	0.1	0.0	0.0	0	0	6.2	0.0	0	0	0	0	0	0	0.0
1018	55	627137	6037935	330	3	8	8	1	0	0	47.0	6.2	61.5	0.1	0.0	0.0	0	0	79.6	54.0	1	1	1	1	1	1	0.0
1046	55	625823	6039178	0	1	2	4	2	0	0	70.0	20.1	8.4	0.2	0.0	0.0	0	0	77.0	25.0	1	1	1	0	0	1	0.0
2267	55	625402	6039367	274	3	10	10	6	0	0	60.1	23.6	10.1	1.0	0.0	0.0	0	0	83.8	67.0	1	1	1	1	0	1	3.0
143	55	627654	6038149	20	2	14	5	7	1	1	35.0	132.9	20.5	0.8	0.6	0.1	1	0	50.0	12.0	1	1	1	1	1	1	1.3
195	55	627136	6037800	131	0	0	1	1	1	0	0.0	0.0	0.1	0.1	5.0	0.0	0	0	6	0	0	0	0	0	0	0	0.3
3149	55	649000	6037815	249	1	5	2	13	0	0	4.0	30.9	6.0	2.1	0.0	0.0	1	0	35.0	4.0	0	1	1	1	1	1	0.3
2278	55	616512	6057463	159	1	1	5	4	1	0	1.0	1.5	53.2	0.5	8.0	0.0	0	0	26.0	0.0	0	1	1	0	0	0	1.1
3027	55	628246	6038651	33	3	22	6	9	0	5	40.0	95.3	38.1	2.6	0.0	0.7	0	2	58.6	62.0	1	1	1	1	0	1	0.0
2277	55	616594	6057389	339	3	1	7	8	1	0	63.1	0.1	2.0	1.1	0.5	0.0	4	0	78.0	67.0	0	0	1	1	1	0	0.3
173	55	627163	6033834	84	3	3	0	2	1	0	4.0	6.2	0.0	0.2	1.0	0.0	0	0	22.0	17.0	1	0	1	0	0	1	0.0
2281	55	616715	6058621	141	1	7	6	6	0	0	4.0	103.0	6.8	2.5	0.0	0.0	0	0	51.0	8.0	0	0	1	1	0	0	0.2
3177	55	625074	6040198	318	3	7	7	7	0	1	13.0	181.0	95.0	22.0	0.0	1.0	0	0	13.0	0.0	1	0	0	0	0	1	3.0
1045	55	626051	6039332	0	0	2	3	1	0	1	0.0	1.1	70.2	0.1	0.0	0.1	0	0	21.0	0.0	0	0	0	0	0	0	0.8
5210	55	630250	6038859	10	4	16	6	9	0	1	43.2	111.1	24.0	1.6	0.0	0.1	7	1	37.4	54.0	0	1	1	1	1	0	0.0
3005	55	624667	6040620	125	2	13	2	3	0	1	58.0	182.0	40.0	6.0	0.0	4.0	0	0	32.0	6.0	1	1	1	0	0	1	0.0
3187	55	627636	6038061	95	4	6	11	11	1	1	36.0	20.7	38.2	4.1	0.5	0.1	1	0	48.0	29.0	1	1	1	1	1	1	2.0
2268	55	625524	6039317	36	3	15	4	10	0	2	45.1	80.2	4.4	1.9	0.0	0.2	0	4	92.0	114.0	1	1	1	1	0	1	0.0
3213	55	625702	6039227	215	0	0	2	0	0	0	0.0	0.0	50.1	0.0	0.0	0.0	0	0	1.0	0.0	0	0	0	0	0	0	30.0
5206	55	630621	6039048	102	5	15	4	10	0	3	79.0	15.7	51.2	1.3	0.0	0.4	4	2	72.0	108.0	1	1	1	1	1	0	0.0

Table B.1 Vegetation integrity plot data

	plot	zone	easting	northing	bearing	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic
218	55	625998	6038194	318	2	14	5	9	1	1	0.2	85.6	3.6	3.3	0.2	1.0	0	0	20.0	0.0	1	1	0	0	0	1	0.0	
3035	55	627911	6038069	315	1	17	3	4	0	3	30.0	112.5	16.1	3.0	0.0	1.2	0	1	74.6	25.0	1	1	1	1	0	1	0.0	
1009	55	625222	6039994	140	0	4	4	1	1	0	0.0	2.7	31.3	0.1	0.1	0.0	0	0	44.0	0.0	0	0	0	0	0	1	0.0	
2276	55	624564	6041771	154	5	12	8	14	0	1	15.9	46.6	61.2	1.7	0.0	0.2	2	0	49.0	33.0	1	1	1	1	1	1	1.3	
157	55	648754	6037746	150	1	5	3	14	0	0	40.0	16.4	30.3	5.6	0.0	0.0	5	7	52.0	60.0	0	1	1	1	1	1	0.0	
3115	55	648811	6038450	165	0	9	5	21	0	1	0.0	39.0	57.3	18.0	0.0	0.1	0	0	18.0	0.0	0	0	0	0	0	0	0.1	

Appendix C

Fauna survey effort summary

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Bird surveys	Marica		GM & LH	07-12-17	07-12-17	14:55	15:55	1:00
Bird surveys	Lobs Hole		DJ & AR	21-01-18	21-01-18	16:40	17:40	1:00
Bird surveys	Marica		AR & ACM	30-01-18	30-01-18	11:00	15:00	4:00
Bird surveys	Lobs Hole Ravine		GM & CK	07-02-18	07-02-18	7:25	8:25	1:00
Bird surveys	Lobs Hole Ravine		GM & CK	07-02-18	07-02-18	9:45	10:45	1:00
Bird surveys	Tantangara south		GM & CK	08-02-18	08-02-18	8:50	9:50	1:00
Bird surveys	Talbingo Dam	transect 1	DJ	16-03-18	16-03-18	8:20	9:00	0:40
Bird surveys	Talbingo Dam	transect 2	DJ	16-03-18	16-03-18	9:00	9:40	0:40
Bird surveys	Talbingo Dam	transect 3	DJ	16-03-18	16-03-18	9:45	10:25	0:40
Bird surveys	Talbingo Dam	transect 4	DJ	16-03-18	16-03-18	10:40	11:20	0:40
Bird surveys	Talbingo Dam	transect 5	DJ	16-03-18	16-03-18	12:00	12:40	0:40
Bird surveys	Talbingo Dam	transect 6	DJ	16-03-18	16-03-18	12:45	13:25	0:40
Bird surveys	Talbingo Dam	transect 7	DJ	16-03-18	16-03-18	13:30	14:10	0:40
Bird surveys	Talbingo Dam	transect 8	DJ	16-03-18	16-03-18	14:10	14:50	0:40
Bird surveys	Talbingo Dam	transect 9	DJ	16-03-18	16-03-18	15:00	15:30	0:30
Bird surveys	Talbingo Dam	transect 10	DJ	16-03-18	16-03-18	15:30	16:10	0:40
Bird surveys	Talbingo	BS1	GD & DK	16-10-18	16-10-18	8:08	9:08	1:00
Bird surveys	Talbingo	BS2	GD & DK	16-10-18	16-10-18	9:36	10:37	1:01
Bird surveys	Talbingo	BS3	GD & DK	16-10-18	16-10-18	10:48	11:48	1:00
Bird surveys	Talbingo	BS4	GD & DK	16-10-18	16-10-18	12:44	13:44	1:00

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Bird surveys	Talbingo	BS5	GD & DK	16-10-18	16-10-18	13:52	14:52	1:00
Bird surveys	Lobs Hole Ravine rd	BS14	BR, CK, JB	05-11-18	05-11-18	10:45	13:39	2:54
Bird surveys	Tantangara	BS23	AS, AR	05-11-18	05-11-18	8:30	11:00	2:30
Bird surveys	Tantangara	BS24	AS, AR	05-11-18	05-11-18	11:30	13:45	2:15
Bird surveys	Lobs Hole Ravine rd	BS10	JB, DJ	29-11-18	29-11-18	10:55	11:40	0:45
Bird surveys	Lobs Hole Ravine rd	BS11	JB, DJ	29-11-18	29-11-18	8:26	9:30	1:04
Bird surveys	Lobs Hole Ravine rd	BS12	JB, DJ	29-11-18	29-11-18	9:40	10:29	0:49
Bird surveys	Tantangara	BS24	EL, AR	10-01-19	10-01-19	13:00	14:10	1:10
Bird surveys	Marica	BS3	EL, AR	12-01-19	12-01-19	10:10	11:50	1:40
Bird surveys	Marica	BS1	EL, AR	13-01-19	13-01-19	12:45	16:15	3:30
Bird surveys	Marica	BS2	EL, AR	13-01-19	13-01-19	10:00	12:00	2:00
Bird surveys	Lobs Hole Ravine rd	BS11	EL, AR	15-01-19	15-01-19	17:40	19:00	1:20
Bird surveys	Lobs Hole Ravine rd	BS12	AS, BR	15-01-19	15-01-19	17:45	18:45	1:00
Bird surveys	Tantangara	BS25	AS, BR	15-01-19	15-01-19	10:52	12:00	1:08
Bird surveys	Marica	BS4	ER, AM	16-01-19	16-01-19	7:43	10:53	3:10
Bird surveys	Lobs Hole Ravine rd	BS9	EL, AR	16-01-19	16-01-19	12:18	13:20	1:02
Bird surveys	Lobs Hole Ravine rd	BS10	AS, BR	16-01-19	16-01-19	12:30	13:45	1:15
Bird surveys	Lobs Hole Ravine rd	BS14	EL, AR	16-01-19	16-01-19	9:21	11:25	2:04
Bird surveys	Tantangara	BS25	ER, AM	16-01-19	16-01-19	13:04	14:49	1:45
Bird surveys	Talbingo Dam	BS5	EL, AR	17-01-19	17-01-19	11:30	11:55	0:25

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Bird surveys	Talbingo Dam Wall	BS6	AR, EL	17-01-19	17-01-19	12:50	13:50	1:00
Bird surveys	Lobs Hole Ravine rd	BS14	CK, IC	20-01-19	20-01-19	14:20	15:40	1:20
Bird surveys	Tantangara	BS23	ER, MW	21-01-19	21-01-19	9:30	11:30	2:00
Bird surveys	Marica	BS2	JW, GS	31-01-19	31-01-19	16:48	17:28	0:40
Bird surveys	Marica	BS3	JW, GS	01-02-19	01-02-19	16:05	17:10	1:05
Bird surveys	Marica	BS4	JW, GS	01-02-19	01-02-19	17:34	17:51	0:17
Bird surveys	Tantangara	BS23	JW, GS	04-02-19	04-02-19	17:13	17:50	0:37
Bird surveys	Tantangara	BS24	JW, GS	04-02-19	04-02-19	15:32	16:00	0:28
Bird surveys	Lobs Hole Ravine rd	BS11	JW, GS	05-02-19	05-02-19	17:01	17:37	0:36
Bird surveys	Lobs Hole Ravine rd	BS12	JW, GS	05-02-19	05-02-19	16:11	16:55	0:44
Bird surveys	Tantangara	BS25	GS, JW	08-02-19	08-02-19	13:48	14:40	0:52
Bird surveys	Marica	BS2	AS, IC	11-02-19	11-02-19	13:00	13:42	0:42
Bird surveys	Marica	BS1	AS, IC	12-02-19	12-02-19	13:40	14:40	1:00
Bird surveys	Marica	BS4	AS, IC	14-02-19	14-02-19	15:00	15:40	0:40
Bird surveys	Lobs Hole Ravine rd	BS10	JB, DF	14-02-19	14-02-19	13:52	14:52	1:00
Bird surveys	Marica	BS3	JB, IC	05-03-19	05-03-19	10:37	11:39	1:02
Bird surveys	Middle Creek	BS26	CW, DK	11-04-19	11-04-19	12:08	13:44	1:36
Owl surveys	Lobs Hole Ravine	LHRR5	JB & DK	07-05-18	11-05-18			1:40
Owl surveys	Lobs Hole Ravine	LHRR6	JB & DK	07-05-18	11-05-18			1:40
Owl surveys	Lobs Hole Ravine	LHRR8	JB & DK	07-05-18	11-05-18			1:40

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Owl surveys	Lobs Hole Ravine	LHRR9	JB & DK	07-05-18	11-05-18			1:40
Owl surveys	Lobs Hole Ravine	LHRR10	JB & DK	07-05-18	11-05-18			1:40
Owl surveys	Lobs Hole Ravine	LHRR11	JB & DK	07-05-18	11-05-18			1:40
Owl surveys	Lobs Hole Ravine	LHRR12	JB & DK	07-05-18	11-05-18			1:40
Owl surveys	Lobs Hole Ravine	LHRR13	JB & DK	07-05-18	11-05-18			1:40
Owl surveys	Lobs Hole Ravine	LHRR14	JB & DK	07-05-18	11-05-18			1:40
Owl surveys	Lobs Hole Ravine	LHRR15	JB & DK	07-05-18	11-05-18			1:40
Owl surveys	Lobs Hole Ravine	LHRR16	JB & DK	07-05-18	11-05-18			1:40
Owl surveys	Lobs Hole Ravine	LHRR17	JB & DK	07-05-18	11-05-18			1:40
Owl surveys	Lobs Hole Ravine	LHRR18	JB & DK	07-05-18	11-05-18			1:40
Owl surveys	Lobs Hole Ravine	LHRR19	JB & DK	07-05-18	11-05-18			1:40
Owl surveys	Lobs Hole Ravine	LHRR20	JB & DK	07-05-18	11-05-18			1:40
Owl surveys	Lobs Hole Ravine	LHRR21	JB & DK	07-05-18	11-05-18			1:40
Owl surveys	Marica	MT3	JB & DK	08-05-18	12-05-18			1:40
Owl surveys	Marica	MT4	JB & DK	08-05-18	12-05-18			1:40
Owl surveys	Marica	MT5	JB & DK	08-05-18	12-05-18			1:40
Owl surveys	Marica	MT6	JB & DK	08-05-18	12-05-18			1:40
Owl surveys	Marica	MT7	JB & DK	08-05-18	12-05-18			1:40
Owl surveys	Marica	MT8	JB & DK	08-05-18	08-05-18			0:20

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Terrestrial trapping	Lobs Hole Ravine, Wallaces creek	TT-53	DK, CW	09-04-19	13-04-19			4
Terrestrial trapping	Lobs Hole Ravine	TT-55	DK, CW	09-04-19	13-04-19			4
Terrestrial trapping	Marica	TT-56	CW, MP	13-04-19	17-04-19			4
Terrestrial trapping	Lobs Hole Ravine	TT-57	DK, CW	09-04-19	13-04-19			4
Terrestrial trapping	Lobs Hole Ravine	TT-58	DK, CW	10-04-19	14-04-19			4
Terrestrial trapping	Marica	TT04	NG & ED	08-12-17	12-12-17			4
Terrestrial trapping	Lobs Hole Ravine rd	TT-10	CK, GM	14-10-18	18-10-18			4
Terrestrial trapping	Lobs Hole Ravine rd	TT-11	CK, GM	14-10-18	18-10-18			4
Terrestrial trapping	Lobs Hole Ravine rd	TT-12	CK, GM	14-10-18	18-10-18			4
Terrestrial trapping	Tantangara south	TT-14	AR, ER	29-11-18	03-12-18			4
Terrestrial trapping	Tantangara south	TT-15	AR, ER	29-11-18	03-12-18			4
Terrestrial trapping	Talbingo	TT-29	PF, AS	18-11-18	26-11-18			4
Terrestrial trapping	Talbingo	TT-30	PF, AS	18-11-18	26-11-18			4
Terrestrial trapping	Talbingo	TT-31	PF, AS	18-11-18	26-11-18			4
Terrestrial trapping	Talbingo	TT-32	PF, AS	18-11-18	26-11-18			4
Terrestrial trapping	Marica	TT-33	BR, LH	29-11-18	03-12-18			4
Terrestrial trapping	Marica	TT-34	BR, LH	29-11-18	03-12-18			4
Terrestrial trapping	Marica	TT-35	BR, LH	29-11-18	03-12-18			4
Terrestrial trapping	Lobs Hole Ravine rd	TT-7	DJ, KS	12-10-18	16-10-18			4

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Terrestrial trapping	Lobs Hole Ravine rd	TT-8	DJ, KS	12-10-18	16-10-18			4
Terrestrial trapping	Lobs Hole Ravine rd	TT-9	JB, AS	16-03-19	20-03-19			4
Terrestrial trapping	Talbingo Intake	TAT07	SW, DJ & KS	17-03-18	22-03-18			4
Terrestrial trapping	Lobs Hole	TAT01	NG & ED	12-12-17	16-12-17			4
Terrestrial trapping	Lobs Hole Ravine	TA02	GM & LH	04-12-17	08-12-17			4
Terrestrial trapping	Talbingo Reservoir (south of boat ramp)	TAT02	SW, DJ & KS	17-03-18	22-03-18			4
Terrestrial trapping	Marica	TAT05	NG & ED	08-12-17	12-12-17			4
Terrestrial trapping	Yarrangobilly River	TAT08	SW, DJ & KS	17-03-18	22-03-18			4
Remote cameras		RC01-0743	GM & LH	06-12-17	11-12-17			5
Remote cameras		RC01-5218	GM & LH	06-12-17	11-12-17			5
Remote cameras		RC01-0593	GM & LH	06-12-17	11-12-17			5
Remote cameras		RC01-4961	GM & LH	06-12-17	11-12-17			5
Remote cameras		RC01-5257	NG & ED	06-12-17	11-12-17			5
Remote cameras		RC01-0411	NG & ED	06-12-17	11-12-17			5
Remote cameras		RC02-0576		12-12-17	16-12-17			4
Remote cameras		RC02-0743		12-12-17	16-12-17			4
Remote cameras		RC02-5198		12-12-17	16-12-17			4
Remote cameras		RC02-5219		12-12-17	16-12-17			4
Remote cameras		RC02-5412		12-12-17	16-12-17			4

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Remote cameras		RC03-0411		17-12-17	30-12-17			13
Remote cameras		RC03-0561		17-12-17	30-12-17			13
Remote cameras		RC03-0593		17-12-17	30-12-17			13
Remote cameras		RC03-0743		17-12-17	30-12-17			13
Remote cameras		RC03-0759		17-12-17	30-12-17			13
Remote cameras		RC03-4961		17-12-17	30-12-17			13
Remote cameras		RC03-5143		17-12-17	30-12-17			13
Remote cameras		RC03-5219		17-12-17	30-12-17			13
Remote cameras		RC03-5220		17-12-17	30-12-17			13
Remote cameras		RC03-5254		17-12-17	30-12-17			13
Remote cameras		RC03-5257		17-12-17	30-12-17			13
Remote cameras		RC03-5412		17-12-17	30-12-17			13
Remote cameras	Lobs Hole Ravine	RC04-7487	CD & LH	09-01-18	26-01-18			17
Remote cameras	Lobs Hole Ravine	RC04-7906	CD & LH	09-01-18	26-01-18			17
Remote cameras	Lobs Hole Ravine	RC04-7510	CD & LH	09-01-18	26-01-18			17
Remote cameras	Lobs Hole Ravine	RC04-4961	CD & LH	09-01-18	26-01-18			17
Remote cameras	Lobs Hole Ravine	RC04-5412	CD & LH	09-01-18	26-01-18			17
Remote cameras	Lobs Hole Ravine	RC04-7480	CD & LH	09-01-18	26-01-18			17
Remote cameras	Lobs Hole Ravine	RC04-7774	CD & LH	09-01-18	25-01-18			16
Remote cameras	Lobs Hole Ravine	RC04-5257	CD & LH	09-01-18	26-01-18			17

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Remote cameras	Lobs Hole Ravine	RC04-7855	CD & LH	09-01-18	26-01-18			17
Remote cameras	Lobs Hole Ravine	RC04-5218	CD & LH	09-01-18	26-01-18			17
Remote cameras	Lobs Hole Ravine	RC04-7778	CD & LH	09-01-18	26-01-18			17
Remote cameras	Lobs Hole Ravine	RC04-5143	CD & LH	09-01-18	26-01-18			17
Remote cameras	Lobs Hole Ravine	RC04-7636	CD & LH	09-01-18	26-01-18			17
Remote cameras	Lobs Hole Ravine	RC04-0898	CD & LH	09-01-18	26-01-18			17
Remote cameras	Lobs Hole Ravine	RC04-5220	CD & LH	09-01-18	26-01-18			17
Remote cameras	Lobs Hole Ravine	RC04-5219	CD & LH	09-01-18	26-01-18			17
Remote cameras	Lobs Hole Ravine	RC04-7683	CD & LH	09-01-18	26-01-18			17
Remote cameras	Lobs Hole Ravine	RC04-5198	CD & LH	09-01-18	26-01-18			17
Remote cameras	Lobs Hole Ravine	RC04-7716	CD & LH	09-01-18	26-01-18			17
Remote cameras	Lobs Hole Ravine	RC04-7495	CD & LH	09-01-18	26-01-18			17
Remote cameras	Marica	RC05-5143	CK & SW	27-01-18	10-02-18			14
Remote cameras	Marica	RC05-5412	CK & SW	27-01-18	10-02-18			14
Remote cameras	Marica	RC05-5218	CK & SW	27-01-18	10-02-18			14
Remote cameras	Marica	RC05-4961	CK & SW	27-01-18	10-02-18			14
Remote cameras	Marica	RC05-5219	CK & SW	27-01-18	10-02-18			14
Remote cameras	Marica	RC05-5257	CK & SW	27-01-18	10-02-18			14
Remote cameras	Marica	RC05-5198	CK & SW	27-01-18	10-02-18			14
Remote cameras	Marica	RC05-5220	CK & SW	27-01-18	10-02-18			14

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Remote cameras	Marica	RC05-7480	CK & SW	28-01-18	10-02-18			13
Remote cameras	Marica	RC05-7495	CK & SW	28-01-18	10-02-18			13
Remote cameras	Talbingo Intake	RC05-7906	CK & SW	28-01-18	10-02-18			13
Remote cameras	Talbingo Intake	RC05-0898	CK & SW	28-01-18	10-02-18			13
Remote cameras	Talbingo Intake	RC05-7855	CK & SW	28-01-18	10-02-18			13
Remote cameras	Talbingo Intake	RC05-7510	CK & SW	28-01-18	10-02-18			13
Remote cameras	Talbingo Intake	RC05-7636	CK & SW	28-01-18	10-02-18			13
Remote cameras	Talbingo Intake	RC05-7778	CK & SW	28-01-18	10-02-18			13
Remote cameras	Talbingo Intake	RC05-7683	CK & SW	28-01-18	10-02-18			13
Remote cameras	Talbingo Intake	RC05-7774	CK & SW	28-01-18	10-02-18			13
Remote cameras	Talbingo Intake	RC05-7487	CK & SW	28-01-18	10-02-18			13
Remote cameras	Talbingo Intake	RC05-7716	CK & SW	28-01-18	10-02-18			13
Remote cameras	Marica	RC06-7683	CK & GM	11-02-18	22-02-18			11
Remote cameras	Marica	RC06-7480	CK & GM	11-02-18	22-02-18			11
Remote cameras	Marica	RC06-7487	CK & GM	11-02-18	22-02-18			11
Remote cameras	Marica	RC06-0898	CK & GM	11-02-18	22-02-18			11
Remote cameras	Wallace Creek Fire Trail	RC06-5219	CK & GM	11-02-18	22-02-18			11
Remote cameras	Marica	RC06-7495	CK & GM	12-02-18	22-02-18			10
Remote cameras	Marica	RC06-5412	CK & GM	12-02-18	22-02-18			10

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Remote cameras	Marica	RC06-5220	CK & GM	12-02-18	22-02-18			10
Remote cameras		RC07-7487	DK & AR	23-02-18	09-03-18			14
Remote cameras		RC07-4961	DK & AR	23-02-18	09-03-18			14
Remote cameras		RC07-5257	DK & AR	23-02-18	09-03-18			14
Remote cameras		RC07-7683	DK & AR	23-02-18	09-03-18			14
Remote cameras		RC07-5412	DK & AR	23-02-18	09-03-18			14
Remote cameras		RC07-7774	DK & AR	23-02-18	09-03-18			14
Remote cameras		RC07-7855	DK & AR	23-02-18	09-03-18			14
Remote cameras		RC07-7636	DK & AR	23-02-18	09-03-18			14
Remote cameras		RC07-7495	DK & AR	23-02-18	09-03-18			14
Remote cameras		RC07-5219	DK & AR	23-02-18	09-03-18			14
Remote cameras		RC07-7716	DK & AR	23-02-18	09-03-18			14
Remote cameras		RC07-7096	DK & AR	23-02-18	09-03-18			14
Remote cameras		RC07-0898	DK & AR	23-02-18	09-03-18			14
Remote cameras		RC07-7778	DK & AR	23-02-18	09-03-18			14
Remote cameras	Lobs Hole	RC08-0898	JB & KS	10-03-18	24-03-18			14
Remote cameras	Lobs Hole	RC08-4961	JB & KS	10-03-18	24-03-18			14
Remote cameras	Lobs Hole	RC08-7683	JB & KS	10-03-18	24-03-18			14
Remote cameras	Lobs Hole	RC08-7510	JB & KS	10-03-18	24-03-18			14
Remote cameras	Lobs Hole	RC08-7778	JB & KS	10-03-18	24-03-18			14

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Remote cameras	Lobs Hole	RC08-7774	JB & KS	10-03-18	24-03-18			14
Remote cameras	Wallace Creek Fire Trail	RC09-7716	SW & KS	26-03-18	20-04-18			25
Remote cameras	Wallace Creek Fire Trail	RC09-5198	SW & KS	26-03-18	20-04-18			25
Remote cameras	Lobs Hole Ravine	RC09-5218	SW & KS	26-03-18	19-04-18			24
Remote cameras	Lobs Hole Ravine	RC09-7855	SW & KS	26-03-18	20-04-18			25
Remote cameras	Talbingo Intake	RC09-7906	SW & KS	26-03-18	20-04-18			25
Remote cameras	Talbingo Intake	RC09-7495	SW & KS	26-03-18	20-04-18			25
Remote cameras	Boat Ramp	RC09-7683	SW & KS	26-03-18	20-04-18			25
Remote cameras	Boat Ramp	RC09-7774	SW & KS	26-03-18	20-04-18			25
Remote cameras		RC09-4961	SW & KS	26-03-18	20-04-18			25
Remote cameras		RC09-5257	SW & KS	26-03-18	20-04-18			25
Remote cameras	Lobs Hole Ravine	RC09-7636	SW & KS	26-03-18	19-04-18			24
Remote cameras	Lobs Hole Ravine	RC09-7480	SW & KS	26-03-18	19-04-18			24
Remote cameras	Lobs Hole Ravine	RC09-5220	SW & KS	26-03-18	19-04-18			24
Remote cameras	Lobs Hole Ravine	RC09-5219	SW & KS	26-03-18	19-04-18			24
Remote cameras	Lobs Hole Ravine	RC09-5143	SW & KS	26-03-18	19-04-18			24
Remote cameras	Lobs Hole Ravine	RC09-7510	SW & KS	26-03-18	19-04-18			24
Remote cameras	Lobs Hole Ravine	RC09-7487	SW & KS	26-03-18	19-04-18			24
Remote cameras	Lobs Hole Ravine	RC09-0898	SW & KS	26-03-18	19-04-18			24

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Remote cameras	Lobs Hole Ravine	RC09-5412	SW & KS	26-03-18	19-04-18			24
Remote cameras	Lobs Hole Ravine	RC10-01A	DK, CW	10-04-19	09-05-19			29
Remote cameras	Lobs Hole Ravine	RC10-01B	DK, CW	10-04-19	09-05-19			29
Remote cameras	Lobs Hole Ravine	RC10-03A	DK, CW	10-04-19	09-05-19			29
Remote cameras	Lobs Hole Ravine	RC10-03B	DK, CW	10-04-19	09-05-19			29
Remote cameras	Marica	RCL01-0593	CK & GM	10-02-18	13-03-18			31
Remote cameras	Marica	RCL01-9048	CK & GM	10-02-18	14-03-18			32
Remote cameras	Tantagara South	RCL01-0411	CK & GM	12-02-18	13-03-18			29
Remote cameras	Tantagara South	RCL01-8914	CK & GM	12-02-18	13-03-18			29
Remote cameras		RCL01-0743	CK & GM	12-02-18	13-03-18			29
Remote cameras	Lobs Hole	RCL02-0561	CK & DJ	15-03-18	20-04-18			36
Remote cameras	Lobs Hole	RCL02-0593	CK & DJ	15-03-18	20-04-18			36
Remote cameras	Lobs Hole	RCL02-0411	CK & DJ	15-03-18	20-04-18			36
Remote cameras	Lobs Hole	RCL02-0759	CK & DJ	15-03-18	20-04-18			36
Remote cameras	Lobs Hole	RCL02-9048	CK & DJ	15-03-18	20-04-18			36
Remote cameras	Lobs Hole	RCL02-8914	CK & DJ	15-03-18	20-04-18			36
Remote cameras	Lobs Hole	RCL02-8909	CK & DJ	15-03-18	20-04-18			36
Remote cameras	Marica	RSM-BH4104A	JB, AS	15-03-19	04-04-19			20
Remote cameras	Marica	RSM-BH5212	JB, AS	15-03-19	04-04-19			20
Remote cameras	Marica	RSM-BH4104B	JB, AS	15-03-19	04-04-19			20

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Remote cameras	Marica	RSM-BH5201	JB, AS	15-03-19	04-04-19			20
Remote cameras	Marica	RSM-BH5202	JB, AS	15-03-19	04-04-19			20
Remote cameras	Marica	RSM-BH5203	JB, AS	15-03-19	04-04-19			20
Remote cameras	Marica	RSM-BH5204	JB, AS	15-03-19	04-04-19			20
Remote cameras	Marica	RSM-BH5211	JB, AS	15-03-19	04-04-19			20
Remote cameras	Marica	RSM-BH5208	JB, AS	15-03-19	04-04-19			20
Remote cameras	Marica	RSM-BH5206	JB, AS	15-03-19	04-04-19			20
Regional surveys	Goat ridge road	RSM-1A	DK, GD	12-10-18	30-10-18			18
Regional surveys	Goat ridge road	RSM-1B	DK, GD	12-10-18	30-10-18			18
Regional surveys	Goat ridge road	RSM-2A	DK, GD	12-10-18	30-10-18			18
Regional surveys	Goat ridge road	RSM-2B	DK, GD	12-10-18	30-10-18			18
Regional surveys	Link road	RSM-4A	DK, GD	12-10-18	31-10-18			19
Regional surveys	Link road	RSM-4B	DK, GD	12-10-18	31-10-18			19
Regional surveys	Goat ridge road	RSM-3A	DK, GD	13-10-18	31-10-18			18
Regional surveys	Goat ridge road	RSM-3B	DK, GD	13-10-18	31-10-18			18
Regional surveys	Link road	RSM-7A	DK, GD	13-10-18	30-10-18			17
Regional surveys	Link road	RSM-7B	DK, GD	13-10-18	30-10-18			17
Regional surveys	Link road	RSM-8A	DK, GD	13-10-18	30-10-18			17
Regional surveys	Link road	RSM-8B	DK, GD	13-10-18	30-10-18			17
Regional surveys	Goat ridge road	RSM-5A	DK, GD	14-10-18	31-10-18			17

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Regional surveys	Goat ridge road	RSM-5B	DK, GD	14-10-18	31-10-18			17
Regional surveys	Link road	RSM-6A	DK, GD	14-10-18	31-10-18			17
Regional surveys	Link road	RSM-6B	DK, GD	14-10-18	31-10-18			17
Regional surveys	Goat ridge road	RSM-12A	DK, GD	14-10-18	30-10-18			16
Regional surveys	Goat ridge road	RSM-12B	DK, GD	14-10-18	30-10-18			16
Regional surveys	Lobs Hole Ravine rd	RSM-9A	DK, GD	15-10-18	30-10-18			15
Regional surveys	Lobs Hole Ravine rd	RSM-9B	DK, GD	15-10-18	30-10-18			15
Regional surveys	Goat ridge road	RSM-11A	DK, GD	15-10-18	30-10-18			15
Regional surveys	Goat ridge road	RSM-11B	DK, GD	15-10-18	30-10-18			15
Regional surveys	Lobs Hole Ravine rd	RSM-15A	DK, GD	15-10-18	30-10-18			15
Regional surveys	Lobs Hole Ravine rd	RSM-15B	DK, GD	15-10-18	30-10-18			15
Regional surveys	Dead Man's Firetrail	RSM-17A	DK, SV	25-10-18	17-12-18			53
Regional surveys	Dead Man's Firetrail	RSM-17B	DK, SV	25-10-18	17-12-18			53
Regional surveys	Dead Man's Firetrail	RSM-23A	DK, SV	25-10-18	17-12-18			53
Regional surveys	Dead Man's Firetrail	RSM-23B	DK, SV	25-10-18	17-12-18			53
Regional surveys	Dead Man's Firetrail	RSM-18A	DK, SV	26-10-18	17-12-18			52
Regional surveys	Dead Man's Firetrail	RSM-18B	DK, SV	26-10-18	17-12-18			52
Regional surveys	West of Wallace Creek Fire Trail	RSM-30A	GM, PF	26-10-18	20-11-18			25
Regional surveys	West of Wallace Creek Fire Trail	RSM-30B	GM, PF	26-10-18	20-11-18			25

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Regional surveys	Wallaces creek fire trail	RSM-46A	GM, PF	26-10-18	20-11-18			25
Regional surveys	Wallaces creek fire trail	RSM-46B	GM, PF	26-10-18	20-11-18			25
Regional surveys	Wallaces creek trail	RSM-57A	GM, PF	26-10-18	16-12-18			51
Regional surveys	Wallaces creek trail	RSM-57B	GM, PF	26-10-18	16-12-18			51
Regional surveys	Wallaces creek trail	RSM-63A	GM, PF	26-10-18	20-11-18			25
Regional surveys	Wallaces creek trail	RSM-63B	GM, PF	26-10-18	20-11-18			25
Regional surveys	Coppermine trail	RSM-65A	GM, PF	26-10-18	20-11-18			25
Regional surveys	Coppermine trail	RSM-65B	GM, PF	26-10-18	20-11-18			25
Regional surveys	Dead Man's Firetrail	RSM-13A	DK, SV	27-10-18	15-11-18			19
Regional surveys	Dead Man's Firetrail	RSM-13B	DK, SV	27-10-18	15-11-18			19
Regional surveys	Dead Man's Firetrail	RSM-19A	DK, SV	27-10-18	15-11-18			19
Regional surveys	Dead Man's Firetrail	RSM-19B	DK, SV	27-10-18	15-11-18			19
Regional surveys	Dead Man's Firetrail	RSM-24A	DK, SV	27-10-18	17-12-18			51
Regional surveys	Dead Man's Firetrail	RSM-24B	DK, SV	27-10-18	17-12-18			51
Regional surveys	Ravine Road	RSM-27A	DK, SV	27-10-18	22-11-18			26
Regional surveys	Ravine Road	RSM-27B	DK, SV	27-10-18	22-11-18			26
Regional surveys	Ravine Road	RSM-32A	DK, SV	27-10-18	22-11-18			26
Regional surveys	Ravine Road	RSM-32B	DK, SV	27-10-18	22-11-18			26
Regional surveys	Ravine Road	RSM-14A	DK, SV	28-10-18	15-11-18			18

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Regional surveys	Ravine Road	RSM-14B	DK, SV	28-10-18	15-11-18			18
Regional surveys	Ravine Road	RSM-21A	DK, SV	28-10-18	28-11-18			31
Regional surveys	Ravine Road	RSM-21B	DK, SV	28-10-18	28-11-18			31
Regional surveys	Ravine Road	RSM-28A	DK, SV	28-10-18	27-11-18			30
Regional surveys	Ravine Road	RSM-28B	DK, SV	28-10-18	27-11-18			30
Regional surveys	Ravine Road	RSM-33A	DK, SV	29-10-18	20-12-18			52
Regional surveys	Ravine Road	RSM-33B	DK, SV	29-10-18	20-12-18			52
Regional surveys	O'Hares Firetrail	RSM-38A	DK, SV	29-10-18	20-12-18			52
Regional surveys	O'Hares Firetrail	RSM-38B	DK, SV	29-10-18	20-12-18			52
Regional surveys	Ravine Road	RSM-26A	DK, SV	30-10-18	18-12-18			49
Regional surveys	Ravine Road	RSM-26B	DK, SV	30-10-18	18-12-18			49
Regional surveys	O'Hares Firetrail	RSM-36A	DK, SV	30-10-18	18-12-18			49
Regional surveys	O'Hares Firetrail	RSM-36B	DK, SV	30-10-18	18-12-18			49
Regional surveys	O'Hares Firetrail	RSM-37A	DK, SV	30-10-18	18-12-18			49
Regional surveys	O'Hares Firetrail	RSM-37B	DK, SV	30-10-18	18-12-18			49
Regional surveys	Dead Man's Firetrail	RSM-20A	DK, SV	31-10-18	15-11-18			15
Regional surveys	Dead Man's Firetrail	RSM-20B	DK, SV	31-10-18	15-11-18			15
Regional surveys	O'Hares Firetrail	RSM-31A	DK, SV	31-10-18	18-12-18			48
Regional surveys	O'Hares Firetrail	RSM-31B	DK, SV	31-10-18	18-12-18			48
Regional surveys	Marica	RSM-49A	AS, AR	01-11-18	27-11-18			26

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Regional surveys	Marica	RSM-49B	AS, AR	01-11-18	27-11-18			26
Regional surveys	Marica	RSM-50A	AS, AR	01-11-18	20-11-18			19
Regional surveys	Marica	RSM-50B	AS, AR	01-11-18	20-11-18			19
Regional surveys	Marica	RSM-51A	AS, AR	01-11-18	20-11-18			19
Regional surveys	Marica	RSM-51B	AS, AR	01-11-18	20-11-18			19
Regional surveys	Marica	RSM-52A	AS, AR	02-11-18	16-12-18			44
Regional surveys	Marica	RSM-52B	AS, AR	02-11-18	16-12-18			44
Regional surveys	Marica	RSM-54A	AS, AR	02-11-18	29-11-18			27
Regional surveys	Marica	RSM-54B	AS, AR	02-11-18	29-11-18			27
Regional surveys	Marica	RSM-56A	AS, AR	02-11-18	16-12-18			44
Regional surveys	Marica	RSM-56B	AS, AR	02-11-18	16-12-18			44
Regional surveys	Marica	RSM-53A	AS, AR	03-11-18	16-12-18			43
Regional surveys	Marica	RSM-53B	AS, AR	03-11-18	16-12-18			43
Regional surveys	Marica	RSM-55A	AS, AR	03-11-18	29-11-18			26
Regional surveys	Marica	RSM-55B	AS, AR	03-11-18	29-11-18			26
Regional surveys	Coppermine trail	RSM-62A	AS, AR	03-11-18	20-11-18			17
Regional surveys	Coppermine trail	RSM-62B	AS, AR	03-11-18	20-11-18			17
Regional surveys	Coppermine trail	RSM-64A	AS, AR	03-11-18	24-11-18			21
Regional surveys	Coppermine trail	RSM-64B	AS, AR	03-11-18	24-11-18			21
Regional surveys	Coppermine trail	RSM-66A	AS, AR	03-11-18	24-11-18			21

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Regional surveys	Coppermine trail	RSM-66B	AS, AR	03-11-18	24-11-18			21
Regional surveys	Wallaces creek fire trail	RSM-48A	AS, AR	05-11-18	27-11-18			22
Regional surveys	Wallaces creek fire trail	RSM-48B	AS, AR	05-11-18	27-11-18			22
Regional surveys	Link Rd/ Wallaces Ck firetrail/transmission line	RSM-10A	PF, ER	15-11-18	17-12-18			32
Regional surveys	Link Rd/ Wallaces Ck firetrail/transmission line	RSM-10B	PF, ER	15-11-18	17-12-18			32
Regional surveys	Wallaces creek fire trail	RSM-16A	PF, SW	16-11-18	19-12-18			33
Regional surveys	Wallaces creek fire trail	RSM-16B	PF, SW	16-11-18	19-12-18			33
Regional surveys	Wallaces creek fire trail	RSM-22A	PF, SW	16-11-18	19-12-18			33
Regional surveys	Wallaces creek fire trail	RSM-22B	PF, SW	16-11-18	19-12-18			33
Regional surveys	Wallaces creek fire trail	RSM-25A	PF, SW	16-11-18	08-01-19			53
Regional surveys	Wallaces creek fire trail	RSM-25B	PF, SW	16-11-18	08-01-19			53
Regional surveys	Wallaces creek fire trail	RSM-35A	LH, AS	25-11-18	09-01-19			45

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Regional surveys	Wallaces creek fire trail	RSM-35B	LH, AS	25-11-18	09-01-19			45
Regional surveys	Wallaces creek fire trail	RSM-34A	AS, LH	26-11-18	09-01-19			44
Regional surveys	Wallaces creek fire trail	RSM-34B	AS, LH	26-11-18	09-01-19			44
Regional surveys	Wallaces creek fire trail	RSM-44A	BR, LH	27-11-18	09-01-19			43
Regional surveys	Wallaces creek fire trail	RSM-44B	BR, LH	27-11-18	09-01-19			43
Regional surveys	Wallaces creek fire trail	RSM-45A	BR, LH	27-11-18	09-01-19			43
Regional surveys	Wallaces creek fire trail	RSM-45B	BR, LH	27-11-18	09-01-19			43
Regional surveys	West of Wallace Creek Fire Trail	RSM-29A	ER, AR	03-12-18	08-01-19			36
Regional surveys	West of Wallace Creek Fire Trail	RSM-29B	ER, AR	03-12-18	08-01-19			36
Regional surveys	Wallaces creek fire trail	RSM-47A	BR, DJ	03-12-18	10-01-19			38
Regional surveys	Wallaces creek fire trail	RSM-47B	BR, DJ	03-12-18	10-01-19			38
Regional surveys	Wallaces creek fire trail	RSM-39A	BR, DJ	04-12-18	09-01-19			36

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Regional surveys	Wallaces creek fire trail	RSM-39B	BR, DJ	04-12-18	09-01-19			36
Regional surveys	Wallaces creek fire trail	RSM-40A	BR, DJ	04-12-18	09-01-19			36
Regional surveys	Wallaces creek fire trail	RSM-40B	BR, DJ	04-12-18	09-01-19			36
Regional surveys	Wallaces creek fire trail	RSM-41A	BR, DJ	04-12-18	09-01-19			36
Regional surveys	Wallaces creek fire trail	RSM-41B	BR, DJ	04-12-18	09-01-19			36
Regional surveys	Wallaces creek fire trail	RSM-42A	BR, DJ	04-12-18	11-01-19			38
Regional surveys	Wallaces creek fire trail	RSM-42B	BR, DJ	04-12-18	11-01-19			38
Regional surveys	Marica	RSM-60A	AS, AR	04-12-18	08-01-19			35
Regional surveys	Marica	RSM-60B	AS, AR	04-12-18	08-01-19			35
Regional surveys	Marica	RSM-61A	AS, AR	04-12-18	08-01-19			35
Regional surveys	Marica	RSM-61B	AS, AR	04-12-18	08-01-19			35
Regional surveys	Wallaces creek fire trail	RSM-43A	BR, DJ	05-12-18	09-01-19			35
Regional surveys	Wallaces creek fire trail	RSM-43B	BR, DJ	05-12-18	09-01-19			35
Regional surveys	Marica	RSM-58A	BR, DJ	06-12-18	08-01-19			33

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Regional surveys	Marica	RSM-58B	BR, DJ	06-12-18	08-01-19			33
Regional surveys	Marica	RSM-59A	BR, DJ	06-12-18	08-01-19			33
Regional surveys	Marica	RSM-59B	BR, DJ	06-12-18	08-01-19			33
Regional surveys	Goat ridge road	RSM-1C	AS, BR	11-01-19	01-02-19			21
Regional surveys	Goat ridge road	RSM-1D	AS, BR	11-01-19	01-02-19			21
Regional surveys	Goat ridge road	RSM-2C	AS, BR	11-01-19	01-02-19			21
Regional surveys	Goat ridge road	RSM-2D	AS, BR	11-01-19	01-02-19			21
Regional surveys	Goat ridge road	RSM-3C	AS, BR	12-01-19	30-01-19			18
Regional surveys	Goat ridge road	RSM-3D	AS, BR	12-01-19	30-01-19			18
Regional surveys	Link road	RSM-4C	AS, BR	12-01-19	30-01-19			18
Regional surveys	Link road	RSM-4D	AS, BR	12-01-19	30-01-19			18
Regional surveys	Goat ridge road	RSM-5C	AS, BR	12-01-19	04-02-19			23
Regional surveys	Goat ridge road	RSM-5D	AS, BR	12-01-19	04-02-19			23
Regional surveys	Link road	RSM-6C	AS, BR	12-01-19	04-02-19			23
Regional surveys	Link road	RSM-6D	AS, BR	12-01-19	04-02-19			23
Regional surveys	Lobs Hole Ravine rd	RSM-15C	AS, BR	12-01-19	04-02-19			23
Regional surveys	Lobs Hole Ravine rd	RSM-15D	AS, BR	12-01-19	04-02-19			23
Regional surveys	Link road	RSM-8C	AS, BR	14-01-19	03-02-19			20
Regional surveys	Link road	RSM-8D	AS, BR	14-01-19	03-02-19			20
Regional surveys	Dead Man's Firetrail	RSM-13C	AS, BR	14-01-19	03-02-19			20

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Regional surveys	Dead Man's Firetrail	RSM-13D	AS, BR	14-01-19	03-02-19			20
Regional surveys	Dead Man's Firetrail	RSM-18C	AS, BR	14-01-19	05-02-19			22
Regional surveys	Dead Man's Firetrail	RSM-18D	AS, BR	14-01-19	05-02-19			22
Regional surveys	Dead Man's Firetrail	RSM-19C	AS, BR	14-01-19	03-02-19			20
Regional surveys	Dead Man's Firetrail	RSM-19D	AS, BR	14-01-19	03-02-19			20
Regional surveys	Dead Man's Firetrail	RSM-20C	AS, BR	14-01-19	30-01-19			16
Regional surveys	Dead Man's Firetrail	RSM-20D	AS, BR	14-01-19	30-01-19			16
Regional surveys	O'Hares Firetrail	RSM-31C	AR, EL	14-01-19	07-02-19			24
Regional surveys	O'Hares Firetrail	RSM-31D	AR, EL	14-01-19	07-02-19			24
Regional surveys	Ravine Road	RSM-32C	AR, EL	14-01-19	03-02-19			20
Regional surveys	Ravine Road	RSM-32D	AR, EL	14-01-19	03-02-19			20
Regional surveys	Ravine Road	RSM-33C	AR, EL	14-01-19	07-02-19			24
Regional surveys	Ravine Road	RSM-33D	AR, EL	14-01-19	07-02-19			24
Regional surveys	Ravine Road	RSM-14C	AM, ER	15-01-19	04-02-19			20
Regional surveys	Ravine Road	RSM-14D	AM, ER	15-01-19	04-02-19			20
Regional surveys	Ravine Road	RSM-21C	AM, ER	15-01-19	06-02-19			22
Regional surveys	Ravine Road	RSM-21D	AM, ER	15-01-19	06-02-19			22
Regional surveys	Marica	RSM-50C	CK, IC	15-01-19	05-02-19			21
Regional surveys	Marica	RSM-50D	CK, IC	15-01-19	05-02-19			21
Regional surveys	Marica	RSM-51C	CK, IC	15-01-19	05-02-19			21

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Regional surveys	Marica	RSM-51D	CK, IC	15-01-19	05-02-19			21
Regional surveys	Wallaces creek trail	RSM-63C	CK, IC	15-01-19	05-02-19			21
Regional surveys	Wallaces creek trail	RSM-63D	CK, IC	15-01-19	05-02-19			21
Regional surveys	Wallaces creek fire trail	RSM-46C	CK, IC	16-01-19	07-02-19			22
Regional surveys	Wallaces creek fire trail	RSM-46D	CK, IC	16-01-19	07-02-19			22
Regional surveys	Coppermine trail	RSM-64C	CK, IC	16-01-19	04-02-19			19
Regional surveys	Coppermine trail	RSM-64D	CK, IC	16-01-19	04-02-19			19
Regional surveys	Coppermine trail	RSM-65C	CK, IC	16-01-19	04-02-19			19
Regional surveys	Coppermine trail	RSM-65D	CK, IC	16-01-19	04-02-19			19
Regional surveys	Coppermine trail	RSM-66C	CK, IC	16-01-19	04-02-19			19
Regional surveys	Coppermine trail	RSM-66D	CK, IC	16-01-19	04-02-19			19
Regional surveys	Link Rd/ Wallaces Ck firetrail/transmission line	RSM-10C	AR, EL	17-01-19	05-02-19			19
Regional surveys	Link Rd/ Wallaces Ck firetrail/transmission line	RSM-10D	AR, EL	17-01-19	05-02-19			19
Regional surveys	Wallaces creek fire trail	RSM-16C	ER, MW	20-01-19	07-02-19			18
Regional surveys	Wallaces creek fire trail	RSM-16D	ER, MW	20-01-19	07-02-19			18

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Regional surveys	Marica	RSM-58C	CK, IC	20-01-19	06-02-19			17
Regional surveys	Marica	RSM-58D	CK, IC	20-01-19	06-02-19			17
Regional surveys	Marica	RSM-59C	CK, IC	20-01-19	06-02-19			17
Regional surveys	Marica	RSM-59D	CK, IC	20-01-19	06-02-19			17
Regional surveys	Wallaces creek fire trail	RSM-35C	ER, MW	21-01-19	08-02-19			18
Regional surveys	Wallaces creek fire trail	RSM-35D	ER, MW	21-01-19	08-02-19			18
Regional surveys	Marica	RSM-54C	CK, IC	21-01-19	06-02-19			16
Regional surveys	Marica	RSM-54D	CK, IC	21-01-19	06-02-19			16
Regional surveys	Marica	RSM-55C	CK, IC	21-01-19	06-02-19			16
Regional surveys	Marica	RSM-55D	CK, IC	21-01-19	06-02-19			16
Regional surveys	West of Wallace Creek Fire Trail	RSM-29C	ER, MW	22-01-19	10-02-19			19
Regional surveys	West of Wallace Creek Fire Trail	RSM-29D	ER, MW	22-01-19	10-02-19			19
Regional surveys	Marica	RSM-56C	CK, IC	22-01-19	07-02-19			16
Regional surveys	Marica	RSM-56D	CK, IC	22-01-19	07-02-19			16
Regional surveys	Marica	RSM-61C	CK, IC	22-01-19	07-02-19			16
Regional surveys	Marica	RSM-61D	CK, IC	22-01-19	07-02-19			16
Regional surveys	West of Wallace Creek Fire Trail	RSM-30C	ER, MW	23-01-19	08-02-19			16

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Regional surveys	West of Wallace Creek Fire Trail	RSM-30D	ER, MW	23-01-19	08-02-19			16
Regional surveys	Wallaces creek trail	RSM-57C	CK, IC	23-01-19	07-02-19			15
Regional surveys	Wallaces creek trail	RSM-57D	CK, IC	23-01-19	07-02-19			15
Regional surveys	Wallaces creek fire trail	RSM-22C	ER, MW	24-01-19	09-02-19			16
Regional surveys	Wallaces creek fire trail	RSM-22D	ER, MW	24-01-19	09-02-19			16
Regional surveys	O'Hares Firetrail	RSM-36C	SV, LM	30-01-19	13-02-19			14
Regional surveys	O'Hares Firetrail	RSM-36D	SV, LM	30-01-19	13-02-19			14
Regional surveys	Wallaces creek fire trail	RSM-47C	SV, LM	31-01-19	14-02-19			14
Regional surveys	Wallaces creek fire trail	RSM-47D	SV, LM	31-01-19	14-02-19			14
Regional surveys	Wallaces creek fire trail	RSM-39C	JW, GS	02-02-19	21-01-19			-12
Regional surveys	Wallaces creek fire trail	RSM-39D	JW, GS	02-02-19	21-01-19			-12
Regional surveys	Wallaces creek fire trail	RSM-41C	JW, GS	02-02-19	21-02-19			19
Regional surveys	Wallaces creek fire trail	RSM-41D	JW, GS	02-02-19	21-02-19			19
Regional surveys	Wallaces creek fire trail	RSM-42C	JW, GS	02-02-19	21-02-19			19

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Regional surveys	Wallaces creek fire trail	RSM-42D	JW, GS	02-02-19	21-02-19			19
Regional surveys	Wallaces creek fire trail	RSM-45C	LM, SV	02-02-19	26-02-19			24
Regional surveys	Wallaces creek fire trail	RSM-45D	LM, SV	02-02-19	26-02-19			24
Regional surveys	Ravine Road	RSM-28C	JB, AS	16-03-19	04-04-19			19
Regional surveys	Ravine Road	RSM-28D	JB, AS	16-03-19	04-04-19			19
Arboreal trapping	Lobs Hole Ravine, Wallaces creek	TT-53	DK, CW	09-04-19	13-04-19			4
Arboreal trapping	Lobs Hole Ravine	TT-55	DK, CW	09-04-19	13-04-19			4
Arboreal trapping	Marica	TT-56	CW, MP	13-04-19	17-04-19			4
Arboreal trapping	Lobs Hole Ravine	TT-57	DK, CW	09-04-19	13-04-19			4
Arboreal trapping	Lobs Hole Ravine	TT-58	DK, CW	10-04-19	14-04-19			4
Arboreal trapping	Marica	TT04	NG & ED	08-12-17	12-12-17			4
Arboreal trapping	Lobs Hole Ravine rd	TT-10	CK, GM	14-10-18	18-10-18			4
Arboreal trapping	Lobs Hole Ravine rd	TT-11	CK, GM	14-10-18	18-10-18			4
Arboreal trapping	Lobs Hole Ravine rd	TT-12	CK, GM	14-10-18	18-10-18			4
Arboreal trapping	Tantangara south	TT-14	AR, ER	29-11-18	03-12-18			4
Arboreal trapping	Tantangara south	TT-15	AR, ER	29-11-18	03-12-18			4
Arboreal trapping	Talbingo	TT-29	PF, AS	18-11-18	26-11-18			4
Arboreal trapping	Talbingo	TT-30	PF, AS	18-11-18	26-11-18			4

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Arboreal trapping	Talbingo	TT-31	PF, AS	18-11-18	26-11-18			4
Arboreal trapping	Talbingo	TT-32	PF, AS	18-11-18	26-11-18			4
Arboreal trapping	Marica	TT-33	BR, LH	29-11-18	03-12-18			4
Arboreal trapping	Marica	TT-34	BR, LH	29-11-18	03-12-18			4
Arboreal trapping	Marica	TT-35	BR, LH	29-11-18	03-12-18			4
Arboreal trapping	Lobs Hole Ravine rd	TT-7	DJ, KS	12-10-18	16-10-18			4
Arboreal trapping	Lobs Hole Ravine rd	TT-8	DJ, KS	12-10-18	16-10-18			4
Arboreal trapping	Lobs Hole Ravine rd	TT-9	JB, AS	16-03-19	20-03-19			4
Arboreal trapping	Talbingo Intake	TAT07	SW, DJ & KS	17-03-18	22-03-18			4
Arboreal trapping	Lobs Hole	TAT01	NG & ED	12-12-17	16-12-17			4
Arboreal trapping	Lobs Hole Ravine	TA02	GM & LH	04-12-17	08-12-17			4
Arboreal trapping	Talbingo Reservoir (south of boat ramp)	TAT02	SW, DJ & KS	17-03-18	22-03-18			4
Arboreal trapping	Marica	TAT05	NG & ED	08-12-17	12-12-17			4
Arboreal trapping	Yarrangobilly River	TAT08	SW, DJ & KS	17-03-18	22-03-18			4
Spotlighting	Boat Ramp		SW & DJ	19-03-18	19-03-18	21:07	22:30	1:23
Spotlighting	Proposed campsite		SW & DJ	20-03-18	20-03-18	2:30	3:30	1:00
Spotlighting	Proposed campsite		SW & DJ	20-03-18	20-03-18	3:45	4:05	0:20
Spotlighting	Wallace Creek		SW & DJ	19-03-18	20-03-18	23:28	1:00	1:32
Spotlighting	Talbingo Reservoir		SW & KS	22-03-18	23-03-18	19:30	0:00	4:30

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Spotlighting	Lobs Hole Ravine		SW & KS	23-03-18	23-03-18	22:00	23:00	1:00
Spotlighting	Yarrangobilly River	SL-10	JB, JW	16-12-18	16-12-18	21:55	0:14	2:19
Spotlighting	Yarrangobilly River	SL-10	JB, JW	15-12-18	16-12-18	23:21	0:22	1:01
Spotlighting	Mines trail	SL-12	JB, JW	16-12-18	16-12-18	0:20	0:58	0:38
Spotlighting	Yarrangobilly River	SL-10	JB, JW	18-12-18	18-12-18	20:55	21:46	0:51
Spotlighting	Mines trail	SL-12	JB, JW	17-12-18	17-12-18	0:20	0:58	0:38
Spotlighting	Lobs Hole Ravine rd	SL-11	JB, JW	20-12-18	20-12-18	21:12	22:02	0:50
Spotlighting	Mines trail	SL-12	JB, JW	09-01-19	09-01-19	1:02	1:42	0:40
Spotlighting	Lobs Hole Ravine rd	SL-11	JB, JW	10-01-19	10-01-19	0:44	1:26	0:42
Spotlighting	Lobs Hole Ravine rd	SL-11	JB, JW	11-01-19	11-01-19	0:11	1:30	1:19
Spotlighting	Wallaces creek trail	SL-2	JB, JW	11-01-19	11-01-19	23:14	23:39	0:25
Spotlighting	Talbingo	SL-5	JB, JW	11-01-19	11-01-19	20:59	21:13	0:14
Spotlighting	Talbingo	SL-6	JB, JW	11-01-19	11-01-19	21:36	21:53	0:17
Spotlighting	Wallaces creek trail	SL-1	JB, JW	11-01-19	12-01-19	23:40	0:22	0:42
Spotlighting	Tantangara South	SL-23	JB, JW	12-01-19	12-01-19	21:07	22:03	0:56
Spotlighting	Tantangara South	SL-24	JB, JW	12-01-19	12-01-19	22:10	23:24	1:14
Spotlighting	Tantangara South	SL-25	JB, JW	14-01-19	14-01-19	21:00	22:03	1:03
Spotlighting	Talbingo	SL-5	JB, DF	05-02-19	05-02-19	22:54	23:02	0:08
Spotlighting	Talbingo	SL-6	JB, DF	05-02-19	05-02-19	22:03	22:27	0:24
Spotlighting	Tantangara South	SL-23	JB, DF	09-02-19	09-02-19	21:18	22:09	0:51

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Spotlighting	Tantangara South	SL-24	JB, DF	10-02-19	10-02-19	1:04	2:03	0:59
Spotlighting	Tantangara South	SL-25	JB, DF	10-02-19	10-02-19	0:03	1:03	1:00
Spotlighting	Wallaces creek trail	SL-1	JB, DF	11-02-19	11-02-19	21:45	22:39	0:54
Spotlighting	Wallaces creek trail	SL-2	JB, DF	11-02-19	11-02-19	21:14	21:45	0:31
Spotlighting	Wallaces creek trail	SL-4	JB, DF	11-02-19	11-02-19	22:40	23:00	0:20
Spotlighting	Talbingo	SL-5	JB, DF	13-02-19	13-02-19	22:41	22:53	0:12
Spotlighting	Talbingo	SL-6	JB, DF	13-02-19	13-02-19	21:47	22:09	0:22
Spotlighting	Marica	SL-1	JB, OM	10-04-19	10-04-19	20:02	21:28	1:26
Spotlighting	Marica	SL-2	JB, OM	10-04-19	10-04-19	19:11	20:00	0:49
Spotlighting	Marica	SL-4	JB, OM	10-04-19	10-04-19	21:29	21:59	0:30
Spotlighting	Lobs Hole Ravine rd	SL-14	JB, DK	15-05-19	15-05-19	17:40	19:59	2:19
Spotlighting	Lobs Hole Ravine rd	SL-30	JB, DK	15-05-19	15-05-19	23:14	23:57	0:43
Spotlighting	Lobs Hole Ravine rd	SL-31	JB, DK	15-05-19	15-05-19	21:16	21:56	0:40
Spotlighting	Lobs Hole Ravine rd	SL-32	JB, DK	15-05-19	15-05-19	20:32	20:55	0:23
Spotlighting	Lobs Hole Ravine rd	SL-14	JB, JD	10-02-19	11-02-19	23:27	0:39	1:12
Spotlighting	Lobs Hole Ravine		GM & LH	25-01-18	25-01-18	0:45	1:45	1:00
Spotlighting	Lobs Hole Ravine		GM & CK	08-02-18	08-02-18	21:00	22:00	1:00
Spotlighting	O'Hares Firetrail		GM & LH	14-12-17	15-12-17	23:30	1:30	2:00
Spotlighting	Wallace Creek		GM & LH	13-12-17	13-12-17	21:00	23:00	2:00
Spotlighting	Yarrangobilly River		GM & LH	13-12-17	14-12-17	23:50	1:50	2:00

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Spotlighting	Lobs Hole Ravine		GM & LH	14-12-17	14-12-17	2:30	4:30	2:00
Spotlighting	Lobs Hole Ravine rd	SL-14	AR, EL	20-02-19	20-02-19	0:20	2:35	2:15
Spotlighting	Marica		GM & LH	27-01-18	27-01-18	0:45	1:45	1:00
Spotlighting	Lobs Hole Ravine		AR & DL	28-01-18	28-01-18	1:05	2:05	1:00
Spotlighting	Lobs Hole Ravine		AR & ACM	29-01-18	30-01-18	22:55	0:05	1:10
Spotlighting	Lobs Hole Ravine		AR & ACM	30-01-18	30-01-18	0:40	1:55	1:15
Spotlighting	O'Hares Firetrail		AR & DL	27-01-18	28-01-18	23:20	0:20	1:00
Spotlighting	Marica		AR & ACM	29-01-18	29-01-18	2:20	3:00	0:40
Spotlighting	Marica		GM & LH	28-01-18	28-01-18	0:20	1:20	1:00
Spotlighting	Marica		GM & LH	29-01-18	29-01-18	21:30	22:45	1:15
Spotlighting	Lobs Hole Ravine		AR & ACM	29-01-18	29-01-18	21:00	22:30	1:30
Koala SAT	Talbingo Dam	EW1	CK & PF	18-05-18	18-05-18			
Koala SAT	Lobs Hole Ravine rd	EW100	CK & PF	16-05-18	16-05-18			
Koala SAT	Talbingo	EW101	CK, CW & PF	19-05-18	19-05-18			
Koala SAT	Lobs Hole Ravine rd	EW102	CK & PF	15-05-18	15-05-18			
Koala SAT	Talbingo	EW111	CK, CW & PF	19-05-18	19-05-18			
Koala SAT	Upper Lob's Hole Ravine rd	EW130	DK & CW	03-05-18	03-05-18			
Koala SAT	Talbingo North	EW2	DK & JB	21-04-18	21-04-18			
Koala SAT	Talbingo	EW23	CK & PF	19-05-18	19-05-18			

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Koala SAT	Talbingo	EW25	CK & PF	20-05-18	20-05-18			
Koala SAT	Talbingo North	EW26	DK & JB	21-04-18	21-04-18			
Koala SAT	Talbingo North	EW27	DK & JB	21-04-18	21-04-18			
Koala SAT	Talbingo	EW28	CK & PF	20-05-18	20-05-18			
Koala SAT	Talbingo	EW29	CK & PF	20-05-18	20-05-18			
Koala SAT	Talbingo North	EW30	DK & JB	21-04-18	21-04-18			
Koala SAT	Talbingo	EW31	CK & PF	18-05-18	18-05-18			
Koala SAT	Talbingo	EW32	CK, CW & PF	20-05-18	20-05-18			
Koala SAT	Talbingo	EW33	CK, CW & PF	20-05-18	20-05-18			
Koala SAT	Talbingo	EW35	CK, CW & PF	19-05-18	19-05-18			
Koala SAT	Talbingo North	EW38	DK & JB	21-04-18	21-04-18			
Koala SAT	Talbingo	EW39	CK, CW & PF	19-05-18	19-05-18			
Koala SAT	Yarrangobilly River	EW41	CK & PF	18-05-18	18-05-18			
Koala SAT	Yarrangobilly River	EW42	CK & PF	17-05-18	17-05-18			
Koala SAT	Yarrangobilly River	EW43	CK & PF	17-05-18	17-05-18			
Koala SAT	Yarrangobilly River	EW45	CK & PF	17-05-18	17-05-18			
Koala SAT	Yarrangobilly River	EW46	CK & PF	18-05-18	18-05-18			
Koala SAT	Yarrangobilly River	EW48	CK & PF	17-05-18	17-05-18			
Koala SAT	Lobs Hole Ravine rd	EW49	CK & PF	17-05-18	17-05-18			
Koala SAT	Lobs Hole Ravine rd	EW50	CK & PF	17-05-18	17-05-18			

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Koala SAT	Construction camp	EW51	DK & CW	04-05-18	04-05-18			
Koala SAT	Construction camp	EW52	DK & CW	04-05-18	04-05-18			
Koala SAT	Construction camp	EW53	DK & CW	05-05-18	05-05-18			
Koala SAT	Construction camp	EW54	DK & CW	05-05-18	05-05-18			
Koala SAT	Talbingo	EW55	CK & PF	18-05-18	18-05-18			
Koala SAT	Lobs Hole Ravine rd	EW56	CK & PF	17-05-18	17-05-18			
Koala SAT	Construction camp	EW57	DK & CW	04-05-18	04-05-18			
Koala SAT	Construction camp	EW58	DK & CW	05-05-18	05-05-18			
Koala SAT	Construction camp	EW59	DK & CW	05-05-18	05-05-18			
Koala SAT	Construction camp	EW62	DK & CW	04-05-18	04-05-18			
Koala SAT	Construction camp	EW63	DK & CW	05-05-18	05-05-18			
Koala SAT	Construction camp	EW64	DK & CW	06-05-18	06-05-18			
Koala SAT	Talbingo	EW68	CK & PF	18-05-18	18-05-18			
Koala SAT	Construction camp	EW69A	DK & CW	06-05-18	06-05-18			
Koala SAT	Lobs Hole Ravine rd	EW69B	CK & PF	16-05-18	16-05-18			
Koala SAT	Construction camp	EW70	DK & CW	06-05-18	06-05-18			
Koala SAT	Construction camp	EW71A	DK & CW	06-05-18	06-05-18			
Koala SAT	Lobs Hole Ravine rd	EW71B	CK & PF	16-05-18	16-05-18			
Koala SAT	Construction camp	EW72	DK & CW	06-05-18	06-05-18			
Koala SAT	Construction camp	EW77A	DK & CW	06-05-18	06-05-18			

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Koala SAT	Lobs Hole Ravine rd	EW77B	CK & PF	16-05-18	16-05-18			
Koala SAT	Lobs Hole Ravine rd	EW78	CK & PF	17-05-18	17-05-18			
Koala SAT	Talbingo	EW85	CK & PF	19-05-18	19-05-18			
Koala SAT	Lobs Hole Ravine rd	EW86	CK & PF	16-05-18	16-05-18			
Koala SAT	Lobs Hole Ravine rd	EW87	CK & PF	16-05-18	16-05-18			
Koala SAT	Lobs Hole Ravine rd	EW94	CK & PF	15-05-18	15-05-18			
Koala SAT	Lobs Hole Ravine rd	EW95	CK & PF	17-05-18	17-05-18			
Koala SAT	Lobs Hole Ravine rd	EW97	CK & PF	15-05-18	15-05-18			
Koala SAT	Lobs Hole Ravine rd	EW98	CK & PF	15-05-18	15-05-18			
Koala SAT	Lobs Hole Ravine rd	EW99	CK & PF	15-05-18	15-05-18			
Songmeter	Talbingo	KSM1	CK, GM	16-10-18	16-12-18			61
Songmeter	Lobs Hole Ravine rd	KSM3	DJ, KS	16-10-18	17-12-18			62
Songmeter	Wallaces creek trail	KSM4	DJ, KS	16-10-18	17-12-18			62
Songmeter	Marica	KSM5	DJ, KS	16-10-18	16-12-18			61
Tile grids		TG02	NG & ED	09-12-17	17-01-18			39
Tile grids		TG07	NG & ED	09-12-17	12-01-18			34
Tile grids		TG13	NG & ED	09-12-17	13-01-18			35
Tile grids		TG16	NG & ED	09-12-17	17-01-18			39
Tile grids	Snowy Mountains Hwy	TG17	NG & ED	09-12-17	09-10-18			304

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Tile grids	Bullocks Hill track	TG18	NG & ED	09-12-17	09-10-18			304
Tile grids	Bullocks Hill track	TG19	NG & ED	09-12-17	18-10-18			313
Tile grids	Goandra	TG04	ED, GM & LH	10-12-17	19-10-18			313
Tile grids		TG05	ED, GM & LH	10-12-17	29-01-18			50
Tile grids	Tantagara Rd South	TG06	ED, GM & LH	10-12-17	11-10-18			305
Tile grids	Tantagara Rd South	TG10	ED, GM & LH	10-12-17	09-10-18			303
Tile grids	Tantagara Rd South	TG11	ED, GM & LH	10-12-17	09-10-18			303
Tile grids	Goandra	TG15	ED, GM & LH	10-12-17	11-10-18			305
Tile grids	Port Phillip Track	TG08	LH	11-12-17	18-10-18			311
Tile grids		TG21	LH	11-12-17	29-01-18			49
Tile grids	Hains Hut track	TG01	LH	22-12-17	10-10-18			292
Tile grids	Bullocks Hill track	TG09	SW & LH	22-12-17	18-10-18			300
Tile grids	Tantagara North	TG03	LH	23-12-17	10-10-18			291
Tile grids	Tantagara North	TG12	LH	23-12-17	10-10-18			291
Tile grids	Port Phillip Track	TG14	LH	23-12-17	10-10-18			291
Tile grids		TG22	SW & LH	12-01-18	18-10-18			279
Tile grids	Snowy Mountains Hwy	TG20	LH, SW, KS & HB	13-01-18	09-10-18			269
Tile grids		TG23	NG & AR	17-01-18	29-01-18			12
Tile grids	Bullocks Hill track	TG24	NG & AR	17-01-18	18-10-18			274

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Tile grids		TG25	LH & GM	29-01-18	09-10-18			253
Tile grids		TG26	LH & GM	29-01-18	25-02-18			27
Tile grids	Port Phillip Track	TG27	LH & GM	29-01-18	18-10-18			262
Tile grids		TG28	DK & JB	06-03-18	10-10-18			218
Tile grids		TG31	JB & DK	06-03-18	18-10-18			226
Tile grids		TG32	JB & DK	06-03-18	18-10-18			226
Tile grids		TG29	JB & DK	07-03-18	04-11-18			242
Tile grids		TG30	JB & DK	07-03-18	18-10-18			225
Tile transects	Tantangara south	TG10		09-10-18				
Tile transects	Tantangara south	TG11		09-10-18				
Tile transects	Wallaces creek trail	TG17		09-10-18	26-02-19			
Tile transects	East of Snowy Mountains HWY	TG25		09-10-18				
Tile transects	Prt Phillip Trail	TG14		10-10-18	14-12-18			
Tile transects	Tantangara road below powerline easement	TG06		11-10-18				
Tile transects	Gooandara trail	TG15		11-10-18				
Tile transects	East of Snowy Mountains HWY	TG22		18-10-18				
Tile transects	Prt Phillip Trail	TG27		18-10-18	14-12-18			
Tile transects	Wallaces creek trail	TG30		18-10-18	12-02-19			

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Tile transects	Wallaces creek trail	TG31		18-10-18				
Tile transects	Wallaces creek trail	TG32		18-10-18				
Tile transects	Connors Hill west slope	TG33		18-10-18				
Tile transects	Old Kiandra gold fields	TG34		18-10-18	21-11-18			
Tile transects	Kiandra old highway	TG35		18-10-18	12-02-19			
Tile transects	Kiandra Ticket Both	TG36		18-10-18				
Tile transects	Link Road	TG37		18-10-18	05-03-19			
Tile transects	Wallaces Creek Trail	TG38		18-10-18	27-11-18			
Tile transects	Three Mile Dam	TG39		18-10-18	27-11-18			
Tile transects	Three Mile Dam	TG40		18-10-18	27-11-18			
Tile transects	Wallaces creek trail	TG41		18-10-18	27-11-18			
Tile transects	Bullocks Hill Trail	TG43		18-10-18				
Tile transects	Bullocks Hill Trail	TG44		18-10-18	27-11-18			
Tile transects	Nungar Trail	TG45		18-10-18	27-11-18			
Tile transects	Nungar Trail	TG46		18-10-18				
Tile transects	Port Phillip Trail	TG48		18-10-18	14-12-18			
Tile transects	Gooandra trail	TG04		19-10-18	19-11-18			
Tile transects	Murrumbidgee River and Nungar Creek	TG47		19-10-18				

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Tile transects	Prt Phillip Trail	TG49		19-10-18	29-11-18			
Tile transects	West of Currango Homestead	TG50		19-10-18	29-11-18			
Tile transects	Tantangara dam wall	TG51		19-10-18	18-02-19			
Tile transects	Gulf Creek Trail	TG52		19-10-18	18-02-19			
Tile transects	Gulf Creek Trail	TG53		19-10-18	18-02-19			
Tile transects	Bugtown road south	TG54		19-10-18				
Tile transects	Tantangara south	TG029		20-10-18	17-02-19			
Tile transects	Tantangara south	TG030		20-10-18	17-02-19			
Tile transects	Tantangara south	TG034		20-10-18	18-02-19			
Tile transects	Tantangara road powerline easement	TG035		20-10-18	15-01-19			
Tile transects	Nungar Trail	TG036		20-10-18	10-01-19			
Tile transects	Tantangara south	TG037		20-10-18				
Tile transects	Tantangara south	TG038		20-10-18				
Tile transects	Kings Cross Road	TG001		24-10-18				
Tile transects	Dip creek, Snowy Hwy	TG006		24-10-18				
Tile transects	Gooandara trail	TG022		24-10-18	07-04-19			
Tile transects	Gooandara trail	TG027		24-10-18				
Tile transects	Gooandara trail	TG028		24-10-18				

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Tile transects	Circuits trail	TG031		24-10-18	17-02-19			
Tile transects	Circuits trail	TG032		24-10-18	17-02-19			
Tile transects	Circuits trail	TG033		24-10-18	17-02-19			
Tile transects	Tantangara dam firetrail	TG039		24-10-18				
Tile transects	Lobs Hole Ravine Rd	TG29		04-11-18				
Tile transects	Kings Cross Road	TG55		05-11-18				
Tile transects	Tantangara Dam rd	TG56		08-11-18				
Tile transects	Gooandra Hill	TG57		20-12-18				
Tile transects	Gooandra Hill	TG58		20-12-18				
Tile transects	Rock Forest	TG59		06-04-19				
Tile transects	Rock Forest	TG60		06-04-19				
Tile transects	Rock Forest	TG61		06-04-19				
Booroolong surveys	Bottom of Yarra 1	Yarra 1	JB, JW	11-12-18	12-12-18	21:43	1:35	3:52
Booroolong surveys	Top of Yarra 1 & Wallace Creek	Yarra 1 & Yarra 2	JB, JW	12-12-18	13-12-18	20:41	0:25	3:44
Booroolong surveys	Wallace Creek	Yarra 2	JB, JW	15-12-18	15-12-18	21:29	22:29	1:00
Booroolong surveys	Yarrangobilly River & Wallace Creek	Yarra 2	JB, JW	16-12-18	17-12-18	21:54	1:26	3:32
Booroolong surveys	Yarrangobilly River	Yarra 1	JB, JW	17-12-18	18-12-18	21:02	3:02	6:00
Booroolong surveys	Yarrangobilly River & Wallace Creek	Yarra 2	JB, JW	18-12-18	19-12-18	21:44	1:19	3:35

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Booroolong surveys	Bottom of Yarra 1	Yarra 1	JB, JW	19-12-18	20-12-18	22:03	0:42	2:39
Booroolong surveys	Yarrangobilly River	Yarra 1 & Yarra 2	JB, JW	08-01-19	09-01-19	20:56	0:25	3:29
Booroolong surveys	Yarrangobilly River	Yarra 1	JB, JW	09-01-19	10-01-19	21:03	0:19	3:16
Booroolong surveys	Yarrangobilly River & Wallace Creek	Yarra 2	JB, JW	10-01-19	10-01-19	21:38	23:50	2:12
Booroolong surveys	Sheepstation Creek		GM & LH	14-12-17	14-12-17	21:00	22:40	1:40
Booroolong surveys	Yarrangobilly River		NG & CD	11-01-18	12-01-18	21:12	3:20	6:08
Booroolong surveys	Yarrangobilly River		NG & KS	12-01-18	12-01-18	21:13	23:52	2:39
Booroolong surveys	Wallace Creek		NG & KS	12-01-18	12-01-18	0:45	2:13	1:28
Booroolong surveys	Wallace creek		NG & AR	19-01-18	19-01-18	21:21	22:36	1:15
Booroolong surveys	Yarrangobilly River		NG & AR	20-01-18	20-01-18	0:04	2:01	1:57
Booroolong surveys	Wallace creek		AR & DL	23-01-18	23-01-18	21:40	22:45	1:05
Booroolong surveys	Yarrangobilly River		AR & DL	23-01-18	24-01-18	23:40	1:50	2:10
Booroolong surveys	Sheepstation Creek		GM & LH	24-01-18	25-01-18	23:57	0:40	0:43
Alpine Tree Frog surveys	Murrumbidgee River 3		NG & CD	10-01-18	11-01-18	21:40	0:06	2:26
Alpine Tree Frog surveys	Kellys Plain Creek		NG & CD	11-01-18	11-01-18	1:03	3:05	2:02
Alpine Tree Frog surveys	Kellys Plain Creek		AR & DL	26-01-18	26-01-18	21:30	22:30	1:00
Alpine Tree Frog surveys	Tantangara south		AR & DL	26-01-18	26-01-18	23:00	0:00	1:00

Table C.1 **Fauna survey effort summary**

Survey type	Site name	Location	Surveyors	Start date	End date	Start time	End time	Total effort
Alpine Tree Frog surveys	Kellys Plain Creek		GM & LH	27-01-18	27-01-18	21:20	23:00	1:40
Alpine Tree Frog surveys	Kellys Plain Creek		AR & ACM	28-01-18	28-01-18	21:10	22:00	0:50
Alpine Tree Frog surveys	Tantangara south		AR & ACM	28-01-18	29-01-18	22:30	0:30	2:00
Anabat surveys	Middle Creek	MB-Middle	CW, DK	11-04-19	17-04-19			6
Anabat surveys	Wallaces Creek	MB-WC	CW, MP	13-04-19	17-04-19			4
Anabat surveys	Yarrangobilly River	MB-YR1	CW, MP	13-04-19	17-04-19			4
Anabat surveys	Yarrangobilly River	MB-YR2	CW, MP	13-04-19	17-04-19			4

Appendix D

Targeted survey weather conditions

Table D.1 Targeted survey weather conditions

Date	Min Temp (oC)	Max Temp (oC)	Rain (mm)	Max wind direction	Max wind speed (km/hr)
4/12/2017	4.3	10	1.6	ESE	61
5/12/2017	4.7	10.6	22.6	ESE	70
6/12/2017	6	11.4	0.2	WSW	41
7/12/2017	7.3	16.1	0.8	W	59
8/12/2017	5.4	12.9	3.4	NNW	46
12/12/2017	12.2	21.8	0	NW	37
13/12/2017	14.7	23.8	0	W	50
14/12/2017	17.1	21.9	0	NW	57
15/12/2017	12.9	20.6	1.4	W	41
16/12/2017	13.6	21.9	0	WNW	35
9/01/2018	12.2	18.2	36	NW	52
10/01/2018	8.7	21	2.4	E	30
11/01/2018	12.1	21.8	0	N	37
12/01/2018	15.1	22	0	WSW	70
13/01/2018	9.6	13	37.2	W	76
14/01/2018	1.4	12.7	31	S	56
17/01/2018	7.6	20.3	0	ESE	48
18/01/2018	12.3	23.9	0	W	24
19/01/2018	16.4	27.5	0	ENE	44
20/01/2018	20.1	29.6	0	E	52
21/01/2018	20.1	27	0	NNE	48
22/01/2018	20.4	25	0	W	72
23/01/2018	15.7	25.7	1	NW	74
24/01/2018	15.5	19.7	11.4	N	44
25/01/2018	15.5	21.8	0.8	NNW	30
26/01/2018	15.7	24.7	0.8	E	43
27/01/2018	15.2	22	0	E	46
28/01/2018	14.8	24.9	0	ENE	39
29/01/2018	15	24.5	2.4	ENE	35
30/01/2018	17	18.6	0	WNW	46
7/02/2018	13.1	24.2	0	WNW	39
8/02/2018	16.8	26.5	0	E	43
19/02/2018	11.9	15.6	0	ESE	83
20/02/2018	6.7	16.8	0	ESE	93
21/02/2018	7.6	19.2	0	ESE	30

Table D.1 Targeted survey weather conditions

Date	Min Temp (oC)	Max Temp (oC)	Rain (mm)	Max wind direction	Max wind speed (km/hr)
22/02/2018	12.7	21.3	0	E	28
23/02/2018	14.2	23.3	0	WNW	31
24/02/2018	16.2	23.3	0	WNW	70
25/02/2018	15.3	16	31.6	ESE	80
26/02/2018	5.8	14.6	3.2	E	81
27/02/2018	4.7	20.8	0	E	39
28/02/2018	12	22.1	0	WNW	91
1/03/2018	9.5	20.2	0	ESE	48
2/03/2018	7	19.1	0	E	41
3/03/2018	9.5	22.1	0	WNW	44
4/03/2018	13.4	22.5	0	WNW	44
5/03/2018	8.9	19.6	0	ESE	63
6/03/2018	4.7	14.5	0	ESE	65
7/03/2018	6.9	20.2	0	ESE	44
8/03/2018	9.5	21.9	0	E	41
9/03/2018	11.9	22.7	0	ESE	28
10/03/2018	12	22.8	0	W	26
11/03/2018	13.1	23.3	0	SE	35
12/03/2018	14	22.9	0	ESE	50
13/03/2018	5.9	20	0	ESE	41
14/03/2018	8.5	19.8	0	ESE	44
15/03/2018	11.9	20.5	0	NW	43
16/03/2018	8.5	20.2	0	WNW	39
17/03/2018	8.9	22.2	1.4	W	43
18/03/2018	13.4	19.3	0	WNW	83
19/03/2018	6.1	17.3	0	W	35
20/03/2018	6.7	16.8	0	ESE	93
21/03/2018	5.4	11.3	0	ESE	80
22/03/2018	4.8	14	0	ESE	89
23/03/2018	14.2	23.3	0	WNW	31
24/03/2018	8.5	15	0	NNW	39
25/03/2018	11.4	13.7	1.8	W	83
26/03/2018	-0.6	6	21.6	WNW	91
27/03/2018	-0.5	14.9	0	NNE	26
28/03/2018	5.3	18.5	0	WNW	30

Table D.1 Targeted survey weather conditions

Date	Min Temp (oC)	Max Temp (oC)	Rain (mm)	Max wind direction	Max wind speed (km/hr)
29/03/2018	11.9	21.4	0	NW	46
30/03/2018	13	19.8	0	WNW	37
31/03/2018	10.4	19.9	0	NW	33
1/04/2018	9.9	18.7	0	W	30
2/04/2018	12.7	20.2	0	W	46
3/04/2018	6.9	19.3	0	E	35
4/04/2018	10.8	20.1	0	E	24
5/04/2018	11.9	20.2	0	NW	41
6/04/2018	12.6	19.8	0	WNW	41
7/04/2018	9.8	18.5	0	WNW	39
8/04/2018	11.1	19.8	0	WSW	41
9/04/2018	13.1	19.6	0	W	50
10/04/2018	12.4	20.6	0	W	41
11/04/2018	14.7	23.3	0	N	39
12/04/2018	15	21.7	0	NW	80
13/04/2018	11.1	17.6	0	NNW	89
14/04/2018	5.2	10	13.8	WNW	106
15/04/2018	1.8	8.2	18.8	WNW	91
16/04/2018	2.5	9.5	26.2	W	81
17/04/2018	5.1	14.7	1.6	WSW	39
18/04/2018	6.9	14.7	0	ENE	22
19/04/2018	8.4	16.3	0	WSW	30
20/04/2018	9.4	17.2	0	ESE	31
21/04/2018	9.8	16.9	0	WNW	26
1/05/2018	6.5	15.2	0	ESE	26
2/05/2018	8.8	12.3	0	NNW	41
3/05/2018	8.1	15.2	0	NNW	57
4/05/2018	4.4	4.9	36.6	WNW	89
5/05/2018	0.8	8	13.6	W	57
6/05/2018	3.1	11	0	SSW	30
7/05/2018	5.2	11.3	0	WNW	52
8/05/2018	5.8	12.4	0	WSW	31
9/05/2018	5.6	10.2	0	NW	41
10/05/2018	2.3	2.4	1	W	72
11/05/2018	-3.3	4.6	11.8		

Table D.1 Targeted survey weather conditions

Date	Min Temp (oC)	Max Temp (oC)	Rain (mm)	Max wind direction	Max wind speed (km/hr)
12/05/2018	-2.9	3.4	0.2		
15/05/2018	3.5	8.6	0	ESE	33
16/05/2018	-0.3	7.3	0	ESE	50
17/05/2018	1.2	8.1	0	WNW	24
18/05/2018	0.3	7.4	0	WSW	30
19/05/2018	0.9	5.4	0.2	WNW	28
20/05/2018	-1.2	4.2	0	W	43
1	4	14	0	W	28
2	6.9	15.5	0	WNW	31
3	10.1	10.6	0	NW	50
4	5	9.5	18.8	ESE	67
5	2.3	8.1	0	ESE	67
6	-0.1	13.8	0	ESE	54
7	4.6	15.2	0	ESE	52
8	6.2	16.3	0	WNW	30
9	7.2	15.3	0	WNW	37
10	2.4	5.8	18	ESE	83
11	-0.7	8.5	0	ESE	91
12	0.2	10.3	0	ESE	76
13	1.4	14.4	0	ESE	65
14	5.5	14.2	0	NE	54
15	5.8	17.2	0	NE	52
16	7.3	19.1	0	NE	52
17	8.7	11.9	5.2	NW	41
18	7.6	13.3	14.8	NW	50
19	7.1	17.2	0	NNW	31
20	9.4	15.6	0	WNW	74
21	1.4	12.6	1.2	ESE	33
22	6.5	16.3	0	W	31
23	8.8	19.3	0	WNW	59
24	3.4	15.5	0	ESE	43
25	3.2	14.4	0	E	35
26	5.3	15.1	0	WSW	35
27	7.9	15	0	W	65
28	1.5	15.7	0	WNW	26

Table D.1 Targeted survey weather conditions

Date	Min Temp (oC)	Max Temp (oC)	Rain (mm)	Max wind direction	Max wind speed (km/hr)
29	7.4	17.3	0	WSW	30
30	7.4	17.5	0	W	43
31	10.1	20.5	0	SW	48
1	13.1	24.3	0	NNW	61
2	14.9	20.8	0	NNW	83
3	5.3	14.5	1.8	W	67
4	5.6	17.2	0	WSW	39
5	9.8	15.9	0	NNW	52
6	11.5	12.9	8	WNW	70
7	9.4	9.7	66.2	WNW	65
8	-1.3	8.5	10.6	W	35
9	1.3	9.9	0	WNW	39
10	4.1	13.8	0	W	37
11	7.7	17	0	ESE	35
12	8.6	19.4	0	W	31
13	13.5	16.9	0	N	39
14	9.8	14	8.4	NNW	50
15	9.9	16.7	16.6	ESE	54
16	2.7	15.4	0	ESE	46
17	5.6	14.8	0	ESE	63
18	3.6	17.5	0	ESE	65
19	6.3	17.8	0	E	30
20	10.8	18.3	0	N	57
21	10.8	12	24.2	W	63
22	-0.4	2.5	34	W	91
23	-0.1	4.2	33.2	WNW	70
24	1.2	8.6	61.4	SW	46
25	3	11.3	3	WSW	37
26	3.7	15.5	0	ESE	50
27	6.1	15.7	0	ENE	35
28	7.6	10.6	1	ESE	76
29	4.8	14.3	0.2	ESE	63
30	6.7	16	0.6	WNW	50
1	8.7	19.7	0	WNW	44
2	11.2	11.3	0.2	WNW	76

Table D.1 Targeted survey weather conditions

Date	Min Temp (oC)	Max Temp (oC)	Rain (mm)	Max wind direction	Max wind speed (km/hr)
3	2.4	11.7	9	W	70
4	4.3	18	0	ESE	48
5	6.8	19	0	E	43
6	9.6	21.2	0	WNW	35
7	14.2	23.3	0	WNW	31
8	15.6	23.5	0	SE	54
9	15.9	21.2	0	ESE	43
10	9.8	20.5	13.2	ESE	43
11	10.3	20.3	0	NE	41
12	11.3	20.8	0	NE	37
13	11.3	16.4	16	ENE	74
14	9.6	17.8	20.2	E	56
15	10.9	17.1	8.8	NE	54
16	10.9	15.1	0	N	37
17	10.3	20	0.4	NW	39
18	10.8	22.6	0	ESE	44
19	12.8	20.7	0		
20	14.4	22.9	0	E	41
21	9.1	17.8	0	SE	63
22	4.2	13.7	2.6	ESE	70
23	3.7	17.3	0	ESE	44
24	9.2	20.7	0	WNW	30
25	14.1	23.4	0	WNW	33
26	16.2	26.2	0	WNW	54
27	17	28.2	0	N	37
28	19.1	25.2	0	N	46
29	19.1	27.5	0	WNW	50
30	18.2	23.5	0	NNE	43
31	16.2	21.8	0.4	WNW	57
1	14.7	25.6	1.4	W	33
2	18.5	27.5	0	WNW	61
3	15.9	26.2	0	N	44
4	18.1	29.1	0.6	WNW	44
5	19.8	23.2	0	NNW	54
6	6.7	21.5	1.4	E	46

Table D.1 Targeted survey weather conditions

Date	Min Temp (oC)	Max Temp (oC)	Rain (mm)	Max wind direction	Max wind speed (km/hr)
7	9.5	21.7	0	ESE	44
8	13.8	21.4	0	WNW	87
9	11.5	20.8	19.8	W	59
10	9.3	21.9	0	E	46
11	12.2	21.2	0	SW	57
12	13.2	25.4	9.4	NNE	35
13	13.4	27.3	0	ESE	50
14	13.2	27.6	0	ESE	39
15	20.3	30.6	0	ESE	44
16	20.8	32.3	0	ESE	63
17	20.1	30.4	0	ESE	69
18	18.3	28.3	0.4	ESE	69
19	14.6	26.6	7.8	SW	39
20	14.1	26.1	0	ESE	57
21	13.7	26.5	0	ESE	56
22	18.3	26.9	0	NW	31
23	19.6	27.9	2.8	ESE	48
24	15.4	28.3	0	E	35
25	19.7	30.6	0	WNW	43
26	21.7	29.3	0	N	61
27	14.7	17.4	4.6	W	41
28	13.1	17.5	2.2	NE	33
29	13.2	24.6	3.6	NNW	37
30	15.1	24.8	4.6	N	54
31	16.5	23.7	8	NNW	65
1	7.5	19.7	0	ESE	56
2	10.1	22.4	0	ENE	46
3	14.8	25.1	0	WSW	44
4	14.3	25.5	5.6	E	57
5	13.3	18.8	18.6		
6	13.4	24.1	6.8	ESE	57
7	12.7	18.9	0	ENE	35
8	13.6	17.6	8.8	NW	43
9	9.5	11.9	4.8	W	81
10	2.9	16.2	2.8	SW	39

Table D.1 Targeted survey weather conditions

Date	Min Temp (oC)	Max Temp (oC)	Rain (mm)	Max wind direction	Max wind speed (km/hr)
11	7.1	18.7	0	W	50
12	11.4	17.9	0	WNW	96
13	2.3	12.2	0	W	48
14	3.9	18.1	0	ESE	50
15	7.8	23	0	ESE	48
16	13.2	21.4	0	NW	28
17	14.6	22.9	0	NW	50
18	16.4	24.7	0	WNW	91
19	13	20.5	3.8	NNW	48
20	7.1	20.2	0	ESE	35
21	8.6	21.5	0	ESE	54
22	8.5	22.4	0	ESE	46
23	8.8	20.4	0	ESE	63
24	6.4	20.7	0	ESE	76
25	10.4	22.5	0	ESE	44
26	12.9	23.2	0	ESE	46
27	13.6	24.9	0	ESE	46
28	13.7	23.2	0	ENE	28
5	12.8	20.2	14.4	N	67
12	9.2	15.3	0	WNW	48
15	8.1	17.9	0	ESE	76
16	8.5	18.2	0	ESE	74
6	9.5	16.3	0	N	43
9	6.4	9.6	0	WNW	52
10	-0.1	11.4	0	ESE	39
11	3.3	12.8	0	E	30
13	7.9	14.1	0	ESE	46
15	4.9	11.8	0	N	17

Appendix E

Water Quality Results

Table E.1 **Baseline water quality results summary: Yarrangobilly River and Wallaces Creek**

	Unit	Trigger value ²	Yarrangobilly River (PN_SW_001, LH_SW_004, LH_SW_006, LH_SW_007)						Wallaces Creek (LH_SW_001, LH_SW_002, LH_SW_003)					
			Number of Samples	Number of Detects	Number of Exceedance s ⁷	10 th percentile ⁶	Median	90 th percentile ⁶	Number of Samples	Number of Detects	Number of Exceedance s ⁷	10 th percentile ⁶	Median	90 th percentile ⁶
Field Parameters														
Temperature	°C	-	54	54	0	4.5	16.2	22.6	18	18	0	5.3	13.3	16.4
Dissolved oxygen	%	90-110 ¹	50	50	42	35	77	96	16	16	13	70	77	98
Electrical conductivity	µS/cm	30-350 ¹	54	54	0	43	97	184	18	18	0	43	88	179
pH	-	6.5-8.0 ¹	54	54	24	7.3	7.9	8.3	18	18	3	6.7	7.7	8.0
Oxidising and reducing potential	-	-	50	50	0	21	117	188	17	17	0	26	144	205
Turbidity	NTU	2-25 ¹	40	40	0	0.1	1.3	3.4	13	13	1	0.3	0.7	1.5
Analytical results – general														
Suspended Solids	mg/L	-	54	6	0	<5	<5	5	18	1	0	<5	<5	<5
Total Hardness (as CaCO ₃)	mg/L	-	47	47	0	11	43	84	15	15	0	18	42	81
Total Alkalinity (as CaCO ₃)	mg/L	-	8	8	0	16	77	109	3	3	0	38	99	104
Analytical results – nutrients														
Ammonia	mg/L	0.013	53	8	5	<0.01	<0.01	0.02	18	0	0	<0.01	<0.01	<0.1
Oxidised nitrogen	mg/L	0.015	50	30	25	<0.01	0.015	0.05	15	6	6	<0.01	<0.01	0.026

Table E.1 Baseline water quality results summary: Yarrangobilly River and Wallaces Creek

			Yarrangobilly River (PN_SW_001, LH_SW_004, LH_SW_006, LH_SW_007)						Wallaces Creek (LH_SW_001, LH_SW_002, LH_SW_003)					
Total kjeldahl nitrogen	mg/L	-	49	6	0	<0.1	<0.1	0.1	15	1	0	<0.1	<0.1	<0.1
Total nitrogen	mg/L	0.25	53	11	1	0.1	0.1	0.1	18	2	1	0.085	0.1	0.115
Reactive phosphorus	mg/L	0.015	47	1	1	<0.01	<0.01	<0.01	15	2	2	<0.01	<0.01	0.016
Total phosphorus	mg/L	0.020	53	9	2	<0.01	<0.01	0.01	18	6	0	<0.01	<0.01	0.013
Total organic carbon	mg/L	-	46	43	0	1	2	3	15	14	0	1	1	5.6
Dissolved organic carbon	mg/L	-	46	43	0	1	2	4	15	15	0	1	2	3.2
Analytical results – inorganics														
Cyanide	mg/L	0.004	28	0	0	<0.004	<0.004	<0.004	7	0	0	<0.004	<0.004	<0.004
Fluoride	mg/L	2.4	8	5	0	0.1	0.1	0.6	3	3	0	0.09	0.1	0.1
Analytical results – metals (dissolved)														
Aluminium (Al)	mg/L	0.027	46	31	22	<0.01	0.02	0.08	15	5	0	<0.01	<0.01	0.02
Arsenic (As)	mg/L	0.0008 ⁴	46	0	0	<0.001	<0.001	<0.001	15	0	0	<0.001	<0.001	<0.001
Barium (Ba)	mg/L	0.008	46	46	46	0.0125	0.022	0.032	15	15	15	0.032	0.051	0.0856
Beryllium (Be)	mg/L	-	46	0	0	<0.001	<0.001	<0.001	15	0	0	<0.001	<0.001	<0.001
Boron (B)	mg/L	0.09	46	0	0	<0.05	<0.05	<0.05	15	0	0	<0.05	<0.05	<0.05
Cadmium (Cd)	mg/L	0.00006	46	0	0	<0.0001	<0.0001	<0.0001	15	0	0	<0.0001	<0.0001	<0.0001

Table E.1 Baseline water quality results summary: Yarrangobilly River and Wallaces Creek

		Yarrangobilly River (PN_SW_001, LH_SW_004, LH_SW_006, LH_SW_007)							Wallaces Creek (LH_SW_001, LH_SW_002, LH_SW_003)					
Total chromium (Cr)	mg/L	0.00001 ⁵	46	2	2	<0.001	<0.001	<0.001	15	0	0	<0.001	<0.001	<0.001
Cobalt (Co)	mg/L	0.0014 ³	46	0	0	<0.001	<0.001	<0.001	15	0	0	<0.001	<0.001	<0.001
Copper (Cu)	mg/L	0.001	46	6	2	<0.001	<0.001	0.001	15	5	3	<0.001	<0.001	0.002
Iron (Fe)	mg/L	0.3 ³	46	13	0	<0.05	<0.05	0.085	15	1	0	<0.05	<0.05	<0.05
Lead (Pb)	mg/L	0.001	46	0	0	<0.001	<0.001	<0.001	15	0	0	<0.001	<0.001	<0.001
Manganese (Mn)	mg/L	1.2	46	39	0	<0.001	0.0015	0.0025	15	10	0	<0.001	0.001	0.002
Mercury (Hg)	mg/L	0.00006	46	0	0	<0.0001	<0.0001	<0.0001	15	0	0	<0.0001	<0.0001	<0.0001
Nickel (Ni)	mg/L	0.008	46	4	0	<0.001	<0.001	<0.001	15	2	0	<0.001	<0.001	0.001
Selenium (Se)	mg/L	0.005	46	0	0	<0.01	<0.01	<0.01	15	0	0	<0.01	<0.01	<0.01
Silver (Ag)	mg/L	0.00002	46	0	0	<0.001	<0.001	<0.001	15	0	0	<0.001	<0.001	<0.001
Vanadium (V)	mg/L	0.006 ³	46	0	0	<0.01	<0.01	<0.01	15	0	0	<0.01	<0.01	<0.01
Zinc (Zn)	mg/L	0.0024	46	7	7	<0.005	<0.005	0.006	15	4	4	<0.005	<0.005	0.006

Notes:

1. The trigger values for field parameters and nutrients refer to the trigger values for physical and chemical stressors in south-east Australia (upland river) that are reported in Tables 3.3.2 and 3.3.3 of ANZECC/ARMCANZ (2000).
2. Trigger values refer to the values established in **Error! Reference source not found.**. It is noted that no hardness adjustments have been made.
3. Refers to a low reliability trigger value.
4. For As (V).
5. For Cr (VI).
6. If less than 10 samples are available, the minimum value is reported instead of the 10th percentile value and the maximum value is reported instead of the 90th percentile value.
7. An exceedance refers to any result that is above detection limit and exceeds the trigger value. Where a range is given for the trigger value, exceedances are determined in relation to the upper limit for turbidity and electrical conductivity, the lower limit for dissolved oxygen and the lower and upper limit for pH.

Bold denotes trigger value is exceeded.

Table E.2 **Baseline water quality results summary: Southern end of Tantangara Dam**

Southern end of Tantangara Dam (TanS_SW_001, TanS_SW_003, TanS_SW_004, TanS_SW_005, TanS_SW_006)								
	Unit	Trigger value ²	Number of Samples	Number of Detects	Number of Exceedances ⁷	10 th percentile ⁶	Median	90 th percentile ⁶
Field Parameters								
Temperature	°C	-	32	32	0	6.6	15.0	21.3
Dissolved oxygen	%	90-110 ¹	22	22	21	2	72	87
Electrical conductivity	µS/cm	30-350 ¹	32	32	0	26	39	68
pH	-	6.5-8.0 ¹	28	28	8	6.0	7.0	7.8
Oxidising and reducing potential	-	-	32	32	0	47	98	194
Turbidity	NTU	2-25 ¹	24	24	3	2.2	5.6	32.2
Analytical results – general								
Suspended Solids	mg/L	-	32	22	0	<5	18.5	58.6
Total Hardness (as CaCO ₃)	mg/L	-	32	30	0	2.3	13	26
Total Alkalinity (as CaCO ₃)	mg/L	-	-	-	-	-	-	-
Analytical results – nutrients								
Ammonia	mg/L	0.013	32	6	4	<0.01	<0.01	0.028
Oxidised nitrogen	mg/L	0.015	32	25	24	<0.01	0.02	0.06
Total kjeldahl nitrogen	mg/L	-	32	20	0	<0.1	0.1	0.59
Total nitrogen	mg/L	0.25	32	20	13	<0.1	0.2	0.6
Reactive phosphorus	mg/L	0.015	32	1	0	<0.01	<0.01	<0.01

Table E.2 **Baseline water quality results summary: Southern end of Tantangara Dam**

Southern end of Tantangara Dam (TanS_SW_001, TanS_SW_003, TanS_SW_004, TanS_SW_005, TanS_SW_006)								
Total phosphorus	mg/L	0.020	32	20	12	<0.01	0.015	0.108
Total organic carbon	mg/L	-	32	32	0	1	2	6
Dissolved organic carbon	mg/L	-	32	32	0	1	2	6
Analytical results – inorganics								
Cyanide	mg/L	0.004	22	0	0	<0.004	<0.004	<0.004
Fluoride	mg/L	2.4	-	-	-	-	-	-
Analytical results – metals (dissolved)								
Aluminium (Al)	mg/L	0.027	32	32	31	0.04	0.055	0.149
Arsenic (As)	mg/L	0.0008 ⁴	32	2	2	<0.001	<0.001	<0.001
Barium (Ba)	mg/L	0.008	32	32	32	0.01	0.017	0.0259
Beryllium (Be)	mg/L	-	32	0	0	<0.001	<0.001	<0.001
Boron (B)	mg/L	0.09	32	0	0	<0.05	<0.05	<0.05
Cadmium (Cd)	mg/L	0.00006	32	0	0	<0.0001	<0.0001	<0.0001
Total chromium (Cr)	mg/L	0.00001 ⁵	32	0	0	<0.001	<0.001	<0.001
Cobalt (Co)	mg/L	0.0014 ³	32	1	0	<0.001	<0.001	<0.001
Copper (Cu)	mg/L	0.001	32	8	3	<0.001	<0.001	0.001
Iron (Fe)	mg/L	0.3 ³	32	28	6	<0.05	0.1	0.386
Lead (Pb)	mg/L	0.001	32	0	0	<0.001	<0.001	<0.001
Manganese (Mn)	mg/L	1.2	32	32	0	0.002	0.0055	0.0389

Table E.2 **Baseline water quality results summary: Southern end of Tantangara Dam**

Southern end of Tantangara Dam (TanS_SW_001, TanS_SW_003, TanS_SW_004, TanS_SW_005, TanS_SW_006)								
Mercury (Hg)	mg/L	0.00006	32	0	0	<0.0001	<0.0001	<0.0001
Nickel (Ni)	mg/L	0.008	32	1	0	<0.001	<0.001	<0.001
Selenium (Se)	mg/L	0.005	32	0	0	<0.01	<0.01	<0.01
Silver (Ag)	mg/L	0.00002	32	0	0	<0.001	<0.001	<0.001
Vanadium (V)	mg/L	0.006 ³	32	0	0	<0.01	<0.01	<0.01
Zinc (Zn)	mg/L	0.0024	32	7	7	<0.005	<0.005	0.007

Notes:

1. The trigger values for field parameters and nutrients refer to the trigger values for physical and chemical stressors in south-east Australia (upland river) that are reported in Tables 3.3.2 and 3.3.3 of ANZECC/ARMCANZ (2000).
2. Trigger values refer to the values established in **Error! Reference source not found.**. It is noted that no hardness adjustments have been made.
3. Refers to a low reliability trigger value.
4. For As (V).
5. For Cr (VI).
6. If less than 10 samples are available, the minimum value is reported instead of the 10th percentile value and the maximum value is reported instead of the 90th percentile value.
7. An exceedance refers to any result that is above detection limit and exceeds the trigger value. Where a range is given for the trigger value, exceedances are determined in relation to the upper limit for turbidity and electrical conductivity, the lower limit for dissolved oxygen and the lower and upper limit for pH.

Bold denotes trigger value is exceeded.

Appendix F

Credit Report

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00015116/BAAS17037/19/00015119	Snowy Hydro Exploratory Works MOD1	03/06/2019
Assessor Name	Report Created	BAM Data version *
Nathan Garvey	07/06/2019	9
Assessor Number	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.	
BAAS17037		
Revision No		
1		

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAIL	Ecosystem credits
Alpine shrubland on scree, blockstreams and rocky sites of high altitude areas of Kosciuszko National Park, Australian Alps Bioregion								
19	643_MG_High	9.2	0.0	0.25	Moderate Sensitivity to Potential Gain	1.25		0
							Subtotal	0

BAM Credit Summary Report

Apple Box - Candlebark - Snow Gum shrubby open forest on valley floors, southern South Eastern Highlands Bioregion								
20	650_MG_Medium	26.6	0.4	0.25	High Sensitivity to Potential Gain	1.75		4
							Subtotal	4
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								
15	303_MG_Other	32.1	0.3	0.25	High Sensitivity to Potential Gain	2.50		6
							Subtotal	6
Brittle Gum - peppermint open forest of the Woomargama to Tumut region, NSW South Western Slopes Bioregion								
1	296_MG_Derived	40.4	0.2	0.25	High Sensitivity to Potential Gain	1.50		3
2	296_MG_High	67.5	0.8	0.25	High Sensitivity to Potential Gain	1.50		20
3	296_MG_Medium	67.5	0.0	0.25	High Sensitivity to Potential Gain	1.50		1
							Subtotal	24
Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion								
21	729_MG_Derived	31.1	2.2	0.25	High Sensitivity to Potential Gain	1.50		25
22	729_MG_High	87.4	7.1	0.25	High Sensitivity to Potential Gain	1.50		234
23	729_MG_Medium	72.9	1.0	0.25	High Sensitivity to Potential Gain	1.50		28
24	729_MG_Poor	0.6	0.1	0.25	High Sensitivity to Potential Gain	1.50		0

BAM Credit Summary Report

						Subtotal	287
Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion							
25	953_MG_High	89.7	1.1	0.25	High Sensitivity to Potential Gain	1.50	37
						Subtotal	37
Norton's Box - Broad-leaved Peppermint open forest on footslopes, central and southern South Eastern Highlands Bioregion							
26	999_MG_Derived	38.3	0.1	0.25	High Sensitivity to Potential Gain	1.50	1
27	999_MG_High	60.7	0.9	0.25	High Sensitivity to Potential Gain	1.50	21
						Subtotal	22
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							
16	311_MG_Derived	22.8	1.3	0.25	High Sensitivity to Potential Gain	1.50	11
17	311_MG_High	77.3	1.0	0.25	High Sensitivity to Potential Gain	1.50	28
18	311_MG_Medium	56.9	1.0	0.25	High Sensitivity to Potential Gain	1.50	21
						Subtotal	60
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 western Kosciuszko escarpment							
4	300_MG_High	68.2	2.4	0.25	High Sensitivity to Potential Gain	1.50	60
5	300_MG_Medium	56.2	0.7	0.25	High Sensitivity to Potential Gain	1.50	15

BAM Credit Summary Report

6	300_MG_Other	37.7	0.1	0.25	High Sensitivity to Potential Gain	1.50		2
7	300_MG_Poor	71.7	0.0	0.25	High Sensitivity to Potential Gain	1.50		1
8	300_MG_Derived	4.5	0.2	0.25	High Sensitivity to Potential Gain	1.50		0
						Subtotal		78
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								
9	302_Low	1.8	1.3	0.25	High Sensitivity to Potential Gain	1.75		0
10	302_MG_Derived	61.0	0.5	0.25	High Sensitivity to Potential Gain	1.75		13
11	302_MG_High	37.4	0.2	0.25	High Sensitivity to Potential Gain	1.75		2
12	302_MG_Medium	66.4	0.0	0.25	High Sensitivity to Potential Gain	1.75		1
13	302_MG_Other	68.3	0.9	0.25	High Sensitivity to Potential Gain	1.75		25
14	302_MG_Poor	0.1	0.1	0.25	High Sensitivity to Potential Gain	1.75		0
						Subtotal		41
Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands Bioregion								
28	1191_MG_Derived	31.5	0.0	0.25	High Sensitivity to Potential Gain	2.50		1
29	1191_MG_High	85.3	0.5	0.25	High Sensitivity to Potential Gain	2.50		26
						Subtotal		27

BAM Credit Summary Report

Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion							
30	1196_MG_High	83.4	0.7	0.25	High Sensitivity to Potential Gain	1.50	23
						Subtotal	23
Sub-alpine dry grasslands and heathlands of valley slopes, southern South Eastern Highlands Bioregion and Australian Alps Bioregion							
31	1224_MG_High	86.4	0.2	0.25	High Sensitivity to Potential Gain	1.50	5
						Subtotal	5
						Total	614

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAIL	Species credits
<i>Callocephalon fimbriatum</i> / Gang-gang Cockatoo (Fauna)						
296_MG_High	67.5	0.01	0.25	2	N/A	0
						Subtotal
						0
<i>Cercartetus nanus</i> / Eastern Pygmy-possum (Fauna)						
296_MG_High	67.5	0.1	0.25	2	False	3
296_MG_Medium	67.5	0.01	0.25	2	False	0
300_MG_High	68.2	1.26	0.25	2	False	43
300_MG_Medium	56.2	0.33	0.25	2	False	9

BAM Credit Summary Report

300_MG_Other	37.7	0.07	0.25	2	False	1
300_MG_Poor	71.7	0.01	0.25	2	False	0
302_MG_High	37.4	0.03	0.25	2	False	1
302_MG_Medium	66.4	0.01	0.25	2	False	0
302_MG_Other	68.3	0.29	0.25	2	False	10
302_MG_Poor	0.1	0.01	0.25	2	False	0
311_MG_High	77.3	0.09	0.25	2	False	3
729_MG_High	87.4	4.92	0.25	2	False	215
729_MG_Medium	72.9	0	0.25	2	False	0
999_MG_High	60.7	0.58	0.25	2	False	18
1196_MG_High	83.4	0.61	0.25	2	False	25
					Subtotal	328
<i>Litoria booroolongensis / Booroolong Frog (Fauna)</i>						
296_MG_Medium	67.5	0	0.25	2	False	0
300_MG_High	68.2	0.03	0.25	2	False	1
302_Low	1.8	0.16	0.25	2	False	0
302_MG_High	37.4	0.03	0.25	2	False	1
302_MG_Other	68.3	0.21	0.25	2	False	7

BAM Credit Summary Report

302_MG_Poor	0.1	0	0.25	2	False	0
729_MG_High	87.4	0.02	0.25	2	False	1
					Subtotal	10
<i>Litoria verreauxii alpina / Alpine Tree Frog (Fauna)</i>						
303_MG_Other	32.1	0.01	0.25	2	False	0
1224_MG_High	86.4	0.02	0.25	2	False	1
					Subtotal	1
<i>Pseudomys fumeus / Smoky Mouse (Fauna)</i>						
729_MG_High	87.4	0.1	0.25		True	0
953_MG_High	89.7	0.87	0.25		True	0
1196_MG_High	83.4	0.6	0.25		True	0
					Subtotal	0
<i>Pterostylis foliata / Slender Greenhood (Flora)</i>						
1196_MG_High	N/A	1	0.25	1	N/A	0
					Subtotal	0

Appendix G

MNES Protected Matters Search



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 31/05/19 13:46:50

[Summary](#)

[Details](#)

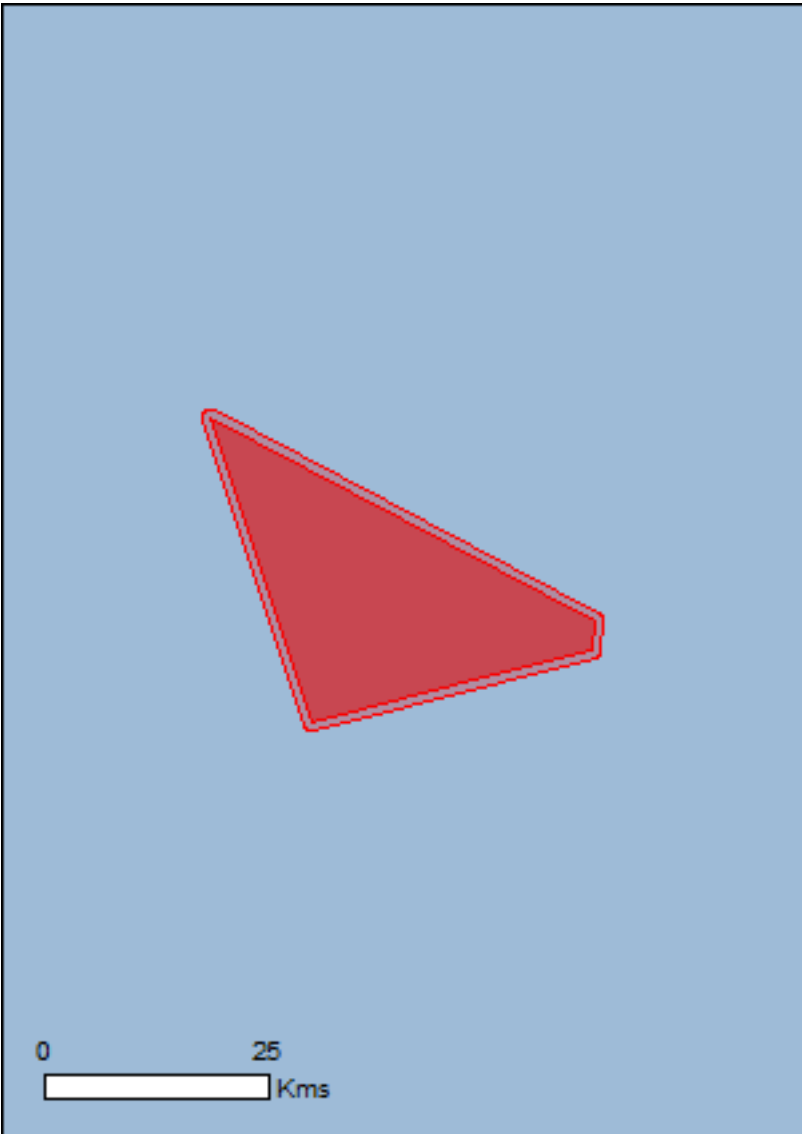
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

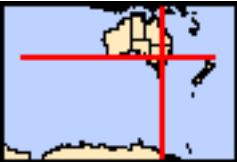
[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	2
Wetlands of International Importance:	4
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	39
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	18
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	1
Invasive Species:	32
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

National Heritage Properties		[Resource Information]
Name	State	Status
Natural		
Australian Alps National Parks and Reserves	NSW	Listed place
Historic		
Snowy Mountains Scheme	NSW	Listed place

Wetlands of International Importance (Ramsar)		[Resource Information]
Name	Proximity	
Banrock station wetland complex	700 - 800km upstream	
Hattah-kulkyne lakes	500 - 600km upstream	
Riverland	600 - 700km upstream	
The coorong, and lakes alexandrina and albert wetland	700 - 800km upstream	

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Alpine Sphagnum Bogs and Associated Fens	Endangered	Community known to occur within area
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community may occur within area
Natural Temperate Grassland of the South Eastern Highlands	Critically Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour may occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Fish		
Maccullochella macquariensis Trout Cod [26171]	Endangered	Species or species habitat may occur within area
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Translocated population known to occur within area
Frogs		
Litoria booroolongensis Booroolong Frog [1844]	Endangered	Species or species habitat known to occur within area
Litoria raniformis Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog [1828]	Vulnerable	Species or species habitat may occur within area
Litoria verreauxii alpina Alpine Tree Frog, Verreaux's Alpine Tree Frog [66669]	Vulnerable	Species or species habitat known to occur within area
Pseudophryne pengilleyi Northern Corroboree Frog [66670]	Critically Endangered	Species or species habitat likely to occur within area
Insects		
Synemon plana Golden Sun Moth [25234]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Burramys parvus Mountain Pygmy-possum [267]	Endangered	Species or species habitat may occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Mastacomys fuscus mordicus Broad-toothed Rat (mainland), Tooarrana [87617]	Vulnerable	Species or species habitat known to occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat may occur within area
Pseudomys fumeus Smoky Mouse, Konoom [88]	Endangered	Species or species habitat known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Plants		

Name	Status	Type of Presence
Amphibromus fluitans River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat may occur within area
Calotis glandulosa Mauve Burr-daisy [7842]	Vulnerable	Species or species habitat known to occur within area
Colobanthus curtisiae Curtis' Colobanth [23961]	Vulnerable	Species or species habitat likely to occur within area
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat may occur within area
Leucochrysum albicans var. tricolor Hoary Sunray, Grassland Paper-daisy [56204]	Endangered	Species or species habitat likely to occur within area
Prasophyllum bagoense Bago Leek-orchid [84276]	Critically Endangered	Species or species habitat known to occur within area
Prasophyllum innubum Brandy Marys Leek-orchid [83603]	Critically Endangered	Species or species habitat known to occur within area
Prasophyllum petilum Tarengo Leek Orchid [55144]	Endangered	Species or species habitat may occur within area
Pterostylis oreophila Blue-tongued Orchid, Kiandra Greenhood [22903]	Critically Endangered	Species or species habitat known to occur within area
Rutidosis leiolepis Monaro Golden Daisy [21490]	Vulnerable	Species or species habitat known to occur within area
Swainsona recta Small Purple-pea, Mountain Swainson-pea, Small Purple Pea [7580]	Endangered	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat known to occur within area
Xerochrysum palustre Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat may occur within area
Cyclodomorphus praealtus Alpine She-oak Skink [64721]	Endangered	Species or species habitat may occur within area
Delma impar Striped Legless Lizard [1649]	Vulnerable	Species or species habitat likely to occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur

Name	Threatened	Type of Presence within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area

Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species

Name	Threatened	Type of Presence
Calidris acuminata Sharp-tailed Sandpiper [874]	Critically Endangered	habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]		Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Critically Endangered	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]	Critically Endangered	Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]	Endangered*	Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Kosciuszko	NSW
Regional Forest Agreements	[Resource Information]
Note that all areas with completed RFAs have been included.	
Name	State
Southern RFA	New South Wales

Invasive Species

[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-35.619078 148.291697,-35.784128 148.675532,-35.807519 148.673472,-35.867081 148.39332,-35.619078 148.291697

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

Appendix H

EPBC Act protected matters likelihood of occurrence assessment

Table H.1 **Likelihood of occurrence assessment – threatened ecological communities**

Threatened Ecological Community	EPBC Act	BC Act	Likelihood of occurrence	Justification
Alpine Sphagnum Bogs and Associated Fens	EN	E1	Negligible	Alpine Sphagnum Bogs and Associated Fens community is found in permanently wet areas, such as along streams, drainage lines, valley edges and valley floors in alpine, sub-alpine and montane areas, on general to moderate slopes. The characteristic floristics, of which Sphagnum is a major component, are maintained by summer groundwater seepage. Desktop assessment did not identify any communities within the survey area that are associated with this TEC. The community was not identified during detailed vegetation mapping.
Grey Box (<i>Eucalyptus microcarpa</i>) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	EN	E3	Negligible	Grey Box Grassy Woodlands occurs as a transitional community between temperate woodlands and forests of the lower slopes and tablelands of south-eastern Australia and the semi-arid communities further inland. The community generally occurs in areas of low relief, on productive soils derived from alluvial or colluvial materials and is dominated by Grey Box. The survey area does not support the landform elements and/or productive soils required by this community. No PCTs were found to be dominated by Grey Box during detailed vegetation mapping.
Natural Temperate Grassland of the South Eastern Highlands	CE	-	Negligible	Natural Temperate Grasslands of the South Eastern Highlands occurs at elevations of 250-1200 m, on a wide range of topographic positions and on soils derived from a variety of substrates. It occurs as a naturally treeless or sparsely treed community. The survey area does not support naturally treeless areas of grassland. All grassland communities are derived due to clearing.

Table H.1 **Likelihood of occurrence assessment – threatened ecological communities**

Threatened Ecological Community	EPBC Act	BC Act	Likelihood of occurrence	Justification
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E4A	Negligible	White Box-Yellow Box-Blakely's Red Gum Grassy Woodlands occurs from Queensland to South Australia, with the predicted distribution of the community including the northern end of the survey area at Talbingo. The community occurs as a grassy woodland or derived grassland community dominated by White Box (<i>Eucalyptus albens</i>), Yellow Box (<i>E.melliodora</i>) or Blakely's Red Gum (<i>E.blakelyi</i>) in the east of the community's range, or Grey Box (<i>E.microcarpa</i> or <i>E. moluccana</i>) in the Nandewar bioregion. One PCT mapped during the detailed vegetation mapping (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) aligns with this TEC. However, this community is not dominated by any of the characteristics species outlined above. This PCT does not meet the criteria outlined in DEH (2006) for the community. The community was not identified during detailed vegetation mapping.

Notes: 1. EPB Act status: CE- critically endangered, EN – endangered, VU – vulnerable
2. BC Act status: E4A – critically endangered, E1 – endangered, E2 – endangered population, V - vulnerable

Table H.2 **Likelihood of occurrence assessment – threatened flora**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Amphibromus fluitans</i>	River Swamp Wallaby-grass	V	V	Negligible	River Swamp Wallaby-grass, is a slender aquatic or semi-aquatic perennial grass, occurring in natural and man-made water-bodies, including swamps, lagoons, billabongs and dams from southern NSW, into Victoria, South Australia and Tasmania. The species needs wetlands which are at least moderately fertile and which have some bare ground, conditions which are produced by seasonally-fluctuating water levels. The species has not been recorded within 10 km of the survey area. Suitable habitat is restricted to the margins of Talbingo Reservoir. Soils in this area are composed of skeletal soils, with little to no organic material. In addition, these areas are subject to frequent, not seasonal, water fluctuations due to the operation of power stations associated with the Snowy Scheme.
<i>Calotis glandulosa</i>	Mauve Burr-daisy	V		Moderate	The Mauve Burr-daisy is a sprawling, branches herb occurring in montane and subalpine grasslands in the Australian Alps. It is mostly found in subalpine grassland (dominated by <i>Poa spp.</i>) and montane or natural temperate grassland dominated by Kangaroo Grass and Snow Gum Woodlands within the Monaro area. The species is common on roadsides as it known to colonise on bare patches. Suitable habitat is restricted to Tantangara Reservoir. Vegetation here consists of subalpine grassland and Snowy Gum Woodlands. The species was recorded adjacent to Modification 1 boundary during targeted surveys, however no individuals were observed within the disturbance footprint.

Table H.2 **Likelihood of occurrence assessment – threatened flora**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Colobanthus curtisiae</i>	Curtis' Colobanth	VU	-	Low	Curtis' Colobanth, is a glabrous tufted perennial herb to 40 mm high, forming small clumps from laterally branching short stems. The species is known to occur in a wide variety of vegetation communities, including lowland Poa and Themeda grasslands, to grassy and shrubby woodland/forests and rockplates. It occurs on gentle slopes with elevations of between 160 m to 1300 m. The species is most commonly found on soils derived from sandstone as well as clay loams derived from dolerite and basalt. The species has not been recorded within 10 km of the survey area. Given the limited understanding of the species' ecology, Curtis' Colobanth was considered a candidate species requiring further consideration. The species was considered to have potential to occur on gently sloping areas with basalt derived soils in the upper reaches of Lobs Hole Ravine Road. This species was not recorded during targeted surveys.
<i>Glycine latrobeana</i>	Clover Glycine	V	E4A	Moderate	Clover Glycine is a decumbent to ascending herb growing to only a few centimetres high. Leaves are trifoliate, providing the name. The species is endemic to south-eastern Australia, where it is widely distributed from Port Pirie in South Australia, through much of Victoria to near Hobart in Tasmania. There are historical records of the species from Delegate and near Tom Groggin; however, subsequent searches have failed to locate these plants. In 2011 a population of Clover Glycine was located at Kellys Plain in Kosciuszko National Park. The species is recorded from grassland and grassy woodland, with the species restricted to a ~ 3 ha area in NSW. The species was recorded adjacent to Modification 1 boundary during targeted surveys, however no individuals were observed within the disturbance footprint.
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	Hoary Sunray	EN	-	Negligible	The Hoary Sunray is a small, perennial paper daisy endemic to south-eastern Australia, where it occurs in NSW, the ACT Victoria and Tasmania. In NSW the species occurs in an area roughly bounded by Albury, Bega and Goulburn, occupying grasslands, grassy areas in woodlands and dry open forests, and modified habitats, on a variety of soil types. The species has not been recorded within 10 km of the survey area. Modification 1 is outside the known distribution of the species and does not support suitable grassland or open grassy woodland habitats.

Table H.2 **Likelihood of occurrence assessment – threatened flora**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Prasophyllum bagoense</i>	Bago Leek-orchid	CE	E4A	Negligible	The Bago Leek-orchid is a slender, tuberous, terrestrial orchid growing singly or in loose groups. The species is known from a single population at McPhersons Plain, east of Tumbarumba in the Southern Tablelands of New South Wales. The species' habitat is a sub-alpine treeless plain at an elevation of approximately 1200 m where it grows in wet sedgeland, tall wet heathland, open heathland extending onto adjacent eucalypt woodland. The species grows in moist to wet shallow clay loam. The underlying basalt geology may be an important feature. There are six records of this species within 10 km of the survey area, all to the west of the survey area. Modification 1 is outside the known distribution of the species and does not support suitable treeless plain habitat.
<i>Prasophyllum innubum</i>	Brandy Marys Leek-orchid	CE	E4A	Negligible	Brandy Mary's Leek-orchid is a terrestrial herb growing singly or in loose groups, with an erect leaf 25–50 cm long and with 6–20 small brownish-purple flowers with white or pinkish labellums. The species is restricted to a 45 km² area east of Tumbarumba in the Southern Tablelands in Bago State Forest and adjacent private land. It grows beside small streams and peatland Sphagnum hummocks, in adjacent grassy flats and also extending into open woodland at around 1,200 m elevation. The underlying basalt geology may be an important feature. There are three records of this species within 10 km of the survey area, all to the west of the survey area. Modification 1 is outside the known distribution of the species and does not support suitable sub-alpine streamside habitat with Sphagnum tussocks.
<i>Prasophyllum petilum</i>	Tarengo Leek Orchid	EN	E1	Negligible	The Tarengo Leek-orchid is a slender herb to 30 cm, its cylindrical leaf reaching 25 cm. A narrow flowering spike is produced in October to November, with 5 to 18 flowers. The species is found at four sites in NSW at Captains Flat, Ilford, near Delegate and near Boorowa (north of the survey area) where it occurs on relatively fertile soils in grassy woodland or natural grassland. The species has not been recorded within 10 km of the survey area. Modification 1 is outside the known distribution of the species and does not support suitable natural grassland or grassy woodland habitat.

Table H.2 **Likelihood of occurrence assessment – threatened flora**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Pterostylis oreophila</i>	Blue-tongued Orchid	CE	E4A	Low	The Blue-tongued Greenhood is a terrestrial orchid growing to 200 mm tall, with dark green, fleshy, flat leaves. The solitary flowers are erect, light green and white. The recurved labellum is a distinctive bluish or blue-green (aqua) colour. The species occurs at 20 locations in four distinct geographic locations including the Kiandra and Bago areas of NSW. The species grows beside small montane and subalpine streams under tall dense thickets of Mountain Tea Tree (<i>Leptospermum grandiflorum</i>), in black oozing mud or less commonly in peaty soils and sphagnum mounds. There are four records within 10 km of the survey area, all to the west of the survey area. Marginal habitat was conservatively assumed to occur in the survey area, in the south of the survey area along Lobs Hole Ravine Road. The species was not recorded during targeted surveys.
<i>Rutidosia leiolepis</i>	Monaro Golden Daisy	VU	V	Negligible	The Monaro Golden Daisy, is a low, tufted perennial with dark green leaves, with a woolly under surface, to about 10 cm. The solitary, slightly domed flower-heads are about 15 mm across, and occur on erect woolly stems to about 25 cm tall. The species is known from 21 locations in Kosciuszko National Park on high (sub-alpine) treeless plains, mainly above an altitude of 1,200 m. The species has not been recorded within 10 km of the survey area. Modification 1 is outside the known distribution of the species and does not support suitable treeless plains grassland habitat.
<i>Swainsona recta</i>	Small Purple-pea	E		Negligible	The Small Purple-pea is a slender erect herb growing 30 cm tall. Pre-European settlement the species occurred in the grassy understorey of woodlands and open-forests dominated by Blakely's Red Gum, Yellow Box and Candlebark. The Small Purple-pea is known to grow in association with understorey dominants including Kangaroo Grass, Poa Tussocks and Spear-grasses. The species has not been recorded within 10 km of the survey area Modification 1 is outside the known distribution of the species and does not support suitable natural grassland or grassy woodland habitat.

Table H.2 **Likelihood of occurrence assessment – threatened flora**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Thesium australe</i>	Austral Toadflax	VU	V	Low	Austral Toadflax is a hairless, yellow-green perennial herb with slender wiry stems to 40 cm high and tiny white flowers. The species occurs in NSW, the ACT, Queensland and Victoria and has a sporadic and widespread distribution within this range. The species occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast, and is often found in association with Kangaroo Grass (<i>Themeda australis</i>). There are 19 records of the species within 10 km of the survey area. The species was considered to have potential to occur within the survey area, particularly in discrete locations where Kangaroo Grass was prevalent. The species was not recorded during targeted surveys.
<i>Xerochrysum palustre</i>	Swamp Everlasting	VU	-	Negligible	The Swamp Everlasting is a small erect herb, endemic to south-eastern Australia with a distribution spanning south-eastern NSW through Victoria to north-eastern Tasmania. It is found growing at elevations of up to 1,300 m. The species grows in wetlands including sedge swamps and shallow freshwater marshes, often on heavy black clay soils. The species has not been recorded within 10 km of the survey area. Modification 1 does not support suitable wetland habitat.

Notes: 1. EPB Act status: CE- critically endangered, EN – endangered, VU – vulnerable
2. BC Act status: E4A – critically endangered, E1 – endangered, E2 – endangered population, V - vulnerable

Table H.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
Birds					
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	E4A	Negligible	The Regent Honeyeater is a striking, predominantly black and yellow bird. Its head and neck are black, with warty pink or yellow skin around the eyes. Endemic to mainland south-eastern Australia, the species has a patchy distribution from south-east Queensland, through NSW and the ACT into central Victoria. Records are widely distributed across this range, but the species is only found regularly at a few localities in NSW and Victoria. Most records of regent honeyeaters come from box-ironbark eucalypt associations, where the species seems to prefer more fertile sites with higher soil water content. Other forest types regularly utilised by the Regent Honeyeater include wet lowland coastal forest dominated by Swamp Mahogany (<i>Eucalyptus robusta</i>), Spotted Gum-Ironbark associations and riverine woodlands. The species has not been recorded within 10 km of the survey area. Modification 1 does not support key habitat or feed tree species. The species has been recorded in the Southeast Highlands bioregion, but most records are located north east of the survey area on more fertile plains.
<i>Botaurus poiciloptilus</i>	Australasian Bittern	EN	E1	Negligible	The Australasian Bittern's preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds or cutting grass growing over a muddy or peaty substrate. The species has not been recorded within 10 km of the survey area. The Yarrangobilly River is the only waterway providing potential habitat for this species; however, the river does not support dense beds of vegetation required by this species.
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE, Mi, M	E1	Negligible	The Curlew Sandpiper is a small, slim sandpiper. Inland, the species mainly occur around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They forage at the edges of shallow pools and drains of intertidal mudflats and sandy. The species has not been recorded within 10 km of the survey area. Modification 1 does not provide suitable waterbodies with muddy or sandy edges.

Table H.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Grantiella picta</i>	Painted Honeyeater	VU	V	Negligible	The Painted Honeyeater has black upperparts, white underparts, black spots on its flanks and yellow edges to the flight and tail feathers. The bill is a deep pink and the eye red. The species is sparsely distributed from south-eastern Australia to north-western Queensland and eastern Northern Territory, with inland slopes of the Great Dividing Range seeing greatest concentrations and almost all records of breeding. The species has a specialist diet mainly consisting of mistletoe fruits, but also includes nectar. The species inhabits mistletoes in a variety of vegetation types, including eucalypt forests/woodlands, riparian woodlands, box-ironbark-yellow gum woodlands, acacia-dominated woodlands, paperbarks, casuarinas, callitris, and trees on farmland or gardens. The species has not been recorded within 10 km of the survey area and the species has not been recorded from similar montane or sub-alpine habitats in the region. Modification 1 is outside the known distribution of the species and does not support suitable habitat providing abundant Mistletoes.
<i>Lathamus discolor</i>	Swift Parrot	CE	E1	Negligible	The Swift Parrot is a small fast-flying, nectarivorous parrot which occurs in eucalypt forests in south eastern Australia. The species breeds in Tasmania and migrate to mainland Australia in autumn. During winter the parrots disperse across a broad landscape, foraging on nectar and lerps in eucalypt forests, particularly inland box-ironbark and grassy woodlands, and Coastal Swamp Mahogany (<i>E. robusta</i>) and Spotted Gum (<i>Corymbia maculata</i>) woodland when in flower. The species was not recorded within 10 km of the survey area, although the species was observed by Martin Schulz along Lobs Hole Ravine Road in March 2018. Although the species may be vagrant within the survey area, the survey area does not provide abundant winter flowering eucalypts which would provide a key food source during the winter mainland migration period.
<i>Numenius madagascariensis</i>	Eastern Curlew	CE, Mi, M		Negligible	The Eastern Curlew is the largest migratory shorebird in the world, migrating to Australia during the northern hemisphere winter. In Australia, the species has a primarily coastal distribution, inhabiting sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. The species has not been recorded within 10 km of the survey area. Modification 1 does not provide suitable intertidal habitat.

Table H.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Rostratula australis</i>	Australian Painted Snipe	EN, M	E1	Negligible	The Australian Painted Snipe is a stocky wading bird, endemic to Australia and has been recorded at wetlands in all states and territories. The species inhabits shallow ephemeral and permanent freshwater (occasionally brackish) wetlands. The species has not been recorded within 10 km of the survey area. Modification 1 does not provide suitable wetland habitat for this species.
Small terrestrial mammals					
<i>Burramys parvus</i>	Mountain Pygmy-possum	EN	E1	Negligible	The Mountain Pygmy-possum is the largest of the five species of Pygmy-possum with a head-body length of 10–11 cm, a tail length of 13–15 cm and adults weigh 35–80 g. The species is endemic to alpine, sub-alpine and montane areas of mainland south-eastern Australia, occurring in three separate regions: Kosciuszko National Park in NSW, and Mt Buller and Mt Bogong-Mt Higginbotham in Victoria. The species' ecology is linked to the highly seasonal environment. It occupies mostly boulderfields and rock scree, around or above the upper limits of the tree-line, associated with shrubby heath vegetation. Boulderfields with good rock structure and long snow duration provide a favourable microclimate. Proximity to permanent water has been found to be a key driver of suitable habitat. There are 72 records of the species within 10 km of the survey area; all are from the Happy Jacks spoil site, 8km south of the survey area. Boulderfields in the survey area, along Lobs Hole Ravine Road, have been previously surveyed for the species by OEH. These sites are not located close to permanent water, and thought to be unsuitable for the species. This species was not recorded during surveys.

Table H.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Mastacomys fuscus</i>	Broad-toothed Rat	VU	V, E2	Moderate	The Broad-toothed Rat is a native rodent with a broad face, short tail and stocky body. It has fine, dense fur which is brown tinged with rufous above, merging to a paler grey underneath. The fur may have a green tinge due to the presence of algae. The species has a highly fragmented distribution, with scattered records across the Great Dividing Range from near Warburton in Victoria to the Brindabella Range in the ACT and up into the Barrington Tops in NSW, with at least one poorly-known subpopulation in coastal areas of far East Gippsland and south-eastern NSW. In alpine and sub-alpine areas the species inhabits alpine and subalpine heathlands, grassland adjacent to boulder outcrops, swamps, sedgeland and occasionally forests with grassy understories. The species was recorded adjacent to Modification 1 within Tantangara South during targeted surveys. Open grasslands within the Modification 1 project area including sub-alpine dry grassland at Tantangara do not provide habitat for this species.
<i>Pseudomys fumeus</i>	Smoky Mouse	EN	E4A	Recorded	The Smoky Mouse is a small native rodent endemic to mainland south-eastern Australia, where it occurs in Victoria, NSW and the ACT. The species has a relatively wide but disjunct distribution within this broad range; populations are small and fragmented. The precise habitat requirements of the Smoky Mouse are not clear. A wide range of vegetation communities are occupied, from damp coastal heath in East Gippsland, to sub-alpine heath. However, in the South Eastern Highland most records are from ridgeline dry heathy open-forest. There is a single historical record of the species from near Yarrangobilly Caves, recorded from a Quoll scat. Bones of the Smoky Mouse have also been recorded in owl pellets during the excavation of a number of caves in the Lobs Hole Ravine area (to the south-west of the survey area) and around Yarrangobilly Caves. The species was recorded at 28 locations within and adjacent to Modification 1, above 1,100 m ASL. Sub-alpine woodlands above 1,100 m are deemed suitable habitat.
Large terrestrial mammals					

Table H.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	EN	V	Low	The Spotted-tailed Quoll is one of Australia’s largest extant marsupial carnivores, and has a distinctive spotted appearance. The species is primarily forest-dependent , and occupies a wide range of habitat types, including rainforest, wet and dry sclerophyll forest, coastal heathland, scrub and dunes, woodland, heathy woodland, swamp forest, mangroves, on beaches and sometimes in grassland or pastoral areas adjacent to forested areas. The species has home ranges of several hundred to several thousand hectares in size and will use multiple dens. moving between den sites every 1-4 days. The species occurs at low densities. There are 10 records of the species within 10 km of the survey area, to the west and north. The species has potential to occupy the survey area at low densities, with large areas of suitable habitat present. In the survey area, the species is likely to be wide ranging, making detection challenging. All areas of the survey area are deemed to provide suitable habitat, with suitable denning sites focused on boulderfields, and areas with a high density of hollow logs (sub-alpine areas and along the Yarrangobilly River. One scat record was recorded near Wallaces Creek Fire Trail, however the species was not detected during targeted surveys. The species is considered a high likelihood of occurrence in the survey area, albeit at low densities.
Arboreal mammals					
<i>Petauroides volans</i>	Greater Glider	VU	E2	Low	The Greater Glider is the largest gliding possum in Australia. The species is distributed across eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level. The species is restricted to eucalypt forests and woodlands, typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows. The species distribution may be patchy even in suitable habitat. There are nine records of the species within 10 km of the survey area, to the west and north. Suitable, taller, montane, moist eucalypt forests with old trees and abundant hollows is found along the upper sections of Lobs Hole Ravine Road an along the Yarrngobilly River. Suitable habitat on Lobs Hole Ravine Road is located above 1200 m. The species was not recorded during targeted surveys.

Table H.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Phascolarctos cinereus</i>	Koala	VU	V, E2	Low	The Koala is a tree-dwelling, medium-sized marsupial, distributed from Cairns to South Australia, however, the listed population does not include Victoria or South Australia. Koalas inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by species from the genus <i>Eucalyptus</i>. The distribution of Koalas is also affected by altitude, with the species limited to below 800 m ASL. There is a single record of the species north of the survey area, near Talbingo. Although the species is considered rare in Kosciuszko National Park, a precautionary approach to the species occupancy was undertaken, with suitable <i>Eucalypt</i> forest and woodland below 800 m elevation deemed to provide suitable habitat. The species was not recorded during targeted surveys.
Bats					
<i>Nyctophilus corbeni</i>	Corben's Long-eared Bat	VU	V	Negligible	The Corben's Long-eared Bat is a relatively large solid member of the Vespertilionidae family, with a broad, robust skull. The species is found from southern central Queensland, through central western NSW into north-western Victoria and eastern South Australia, where it is patchily distributed, with most of its range in the Murray Darling Basin. The species is uncommon within this distribution and is rarely recorded. The species inhabits a wide range of inland woodland vegetation types, including box/ironbark/cypress pine woodlands, Buloke woodlands, Brigalow woodland, Belah woodland, smooth-barked apple woodland, river red gum forest, black box woodland, and various types of tree mallee. The species has not been recorded within 10 km of the survey area. Modification 1 is well outside the known distribution of the species and does not support preferred habitat types or even close analogues.

Table H.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	VU	V	Low	The Grey-headed Flying-fox is a large, endemic megachiropteran bat occurring in south-eastern Australia. The species distribution extends from Bundaberg in Queensland to Melbourne in Victoria, and from the coast inland to the western slopes of NSW. There are some contemporary records from South Australia. The Grey-headed Flying-fox feeds on nectar and pollen from flowers of canopy trees and fleshy fruits from rainforest trees and vines, with regional preferences shown. The species has not been recorded within 10 km of the survey area. Modification 1 is outside the known distribution of the species, with records to the north and west of the survey area considered areas of unusual occupation or vagrant records in the species' recovery plan. The species may occur as a vagrant within the survey area on occasion.
Amphibians					
<i>Litoria booroolongensis</i>	Booroolong Frog	EN	E1	Recorded	The Booroolong Frog is a medium size, stream dwelling frog. It is nocturnal but can be seen during day on rocks in or near the water. The species is restricted to NSW and north-eastern Victoria, predominantly along western-flowing streams of the Great Dividing Range between 200 and 1,300 m above sea level. The Booroolong Frog is associated with permanent streams in a variety of vegetation types. Primary habitat requirements are extensive rock bank structures along permanent rivers with the key feature of these rock structures being rock crevices in relatively shallow, slow to medium-flowing sections of stream. By day frogs shelter under rocks or amongst vegetation near the ground along the edge of the stream. Breeding is known to occur in spring and early summer, from October to early January. Egg deposition sites are typically in shallow, slow-flowing sections of stream or isolated rock pools along stream margins. Tadpoles take 2-4 months to develop, metamorphosing in late summer to early autumn. There are four records within 10 km of the survey area, from the Yarrangobilly River and Jounama Creek catchments. The Booroolong Frog was recorded along the entire length of the Yarrangobilly River within the survey area and is likely to extend upstream to at least Blue Creek Firetrail.

Table H.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Litoria raniformis</i>	Southern Bell Frog	VU	E1	Negligible	The Growling Grass Frog is a large frog, with females exceeding 100 mm in length. The species is endemic to south-eastern Australia. In NSW the species occurs from Bombala in the far south-eastern corner of the state, through the Southern Tablelands, and along the Murrumbidgee and Murray Rivers. The Growling Grass Frog inhabits a wide range of still waterbodies, including lagoons, swamps, lakes, ponds, farm dams, irrigation channels and quarries and may occupy slow-flowing sections of streams and rivers. The species has not been recorded within 10 km of the survey area. Modification 1 is outside the known distribution of the species, and the survey area does not support suitable still waterbodies or slow-flowing stream habitat.
<i>Litoria verreauxii alpina</i>	Alpine Tree Frog	VU	E1	Recorded	The Alpine Tree Frog is a relatively small Hyliid frog, growing to approximately 3 cm in length. The species occurs in the alpine and sub-alpine zones of south-eastern NSW and Victoria, generally higher than 1100 metres above sea level and is the only frog species known to occur above the winter snowline on the Australian mainland. The Alpine Tree Frog breeds in natural and artificial wetlands including ponds, bogs, fens, streamside pools, stock dams and drainage channels that are slow flowing or still. Non-breeding habitat and overwintering refuges are poorly known but are likely to include flat rocks, fallen logs, leaf litter and other ground debris. The Alpine Tree Frog was recorded within adjacent areas to Modification 1 project boundary within Tantangara South.

Table H.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Pseudophryne pengilleyi</i>	Northern Corroboree Frog	CE	E4A	Negligible	The Southern Corroboree Frog and Northern Corroboree are distinctive and easily recognised because of their striking dorsal colour patterns consisting of bright yellow or green longitudinal stripes alternating with black stripes. The two frog species have a limited geographic distribution. The Southern Corroboree Frog now occurs in a small number of remnant populations along the north-western edge of its former range (within Kosciuszko National Park, from Smiggin Holes in the south, and northwards to the Maragle Range. The Northern Corroboree Frog occurs throughout the Fiery Range and Bogong Mountains in Kosciuszko National Park, Bondo State Forest, Micalong State Forest, and Wee Jasper State Forest in NSW, and along the Brindabella Ranges in Namadgi National Park in the ACT, and Bimberi Nature Reserve and Brindabella National Park in NSW. The two species breed in pools and seepages in sphagnum bogs, wet tussock grasslands, fens and wet heath. They also forage and shelter in montane forest, sub-alpine woodland and tall heath adjacent to the breeding areas. There is a single record of each species within 10 km of the survey area, to the west (Northern Corroboree Frog) and south-west (Southern Corroboree Frog) of the survey area. Modification 1 does not support suitable breeding habitat.
Reptiles					
<i>Aprasia parapulchella</i>	Pink-tailed Worm-lizard	VU	V	Negligible	The Pink-tailed Worm-lizard a small, legless and very slender lizard that lives underground. Colouration is predominantly grey-brown to pale grey, with a slightly darker head and nape and a paler underside. The end part of the tail is pinkish to reddish-brown. The species occurs in NSW, Victoria and the ACT where it is widely but patchily distributed along the foothills of the western slopes of the Great Dividing Range between Bendigo in Victoria and Gunnedah in NSW. Habitat includes primary and secondary grassland, grassy woodland and woodland communities, and the species usually inhabits sloping sites that contain rocky outcrops or scattered, partially buried rocks. Habitat tends to be well-drained mid-slope or ridge-top sites with loosely embedded rocks on soil substrate with ant galleries present. The species has not been recorded within 10 km of the survey area. Modification 1 is well outside the known distribution of the species and does not support grassy or grassy woodland habitat with scattered or partially buried rock.

Table H.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Cyclodomorphus praealtus</i>	Alpine She-oak Skink	EN	E1	Low	The Alpine She-oak Skink is a medium-sized member of the lizard family Scincidae. The species has a restricted distribution, known from eight broad locations above 1,500 m in the Australian Alps from Omeo Plain in the south, to Kiandra in the north. It occupies alpine grasslands, alpine heathland, alpine grassy heathland and grassy areas with a very sparse cover of Snow Gums (<i>Eucalyptus pauciflora</i>). There is one record of the species within 10 km of the survey area. The species was found to be moderately abundant in sub-alpine grasslands during targeted surveys for the broader Snowy 2.0 project. The Modification 1 project boundary does not support suitable habitat for this species.
<i>Delma impar</i>	Striped Legless Lizard	VU	V	Negligible	The Striped Legless Lizard is a member of the family Pygopodidae. As with other members of the legless lizard family, the species lacks forelimbs and has only very reduced vestigial hind limbs. The species is patchily distributed in grasslands of south-eastern NSW, the ACT, north-eastern, central and south-western Victoria, and, possibly, south-eastern South Australia. The species inhabits both native, derived and exotic grasslands; the presence of a relatively dense and continuous structure, rather than the floristic composition of the grasslands, may be important in influencing the persistence of the species. There are no records of the species within 10 km of the survey area. Modification 1 is well outside the known distribution of the species, and does not support suitable grassland habitat.
Invertebrates					
<i>Synemon plana</i>	Golden Sun Moth	CE	E1	Negligible	The Golden Sun Moth is a medium-sized day-flying moth. The larval stage of the species feeds exclusively on wallaby grasses (<i>Austrodanthonia</i> species), spear grasses (<i>Austrostipa</i> species) and the exotic Chilean needle grass (<i>Nassella</i> species), with the distribution mirroring the distribution of native temperate grassland habitat from NSW, the ACT, Victoria and South Australia. There are no records of the species within 10 km of the survey area. Modification 1 is well outside the known distribution of the species, and does not support suitable native temperate grassland habitat.

Table H.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
Fish		EPBC Act	FM Act		
<i>Maccullochella macquariensis</i>	Trout Cod	EN	E	Moderate	Trout Cod were described originally from the Macquarie River, but there is now only one self-sustaining population of Trout Cod remaining in the wild in the Murray River between Yarrawonga and Barmah. No waterways within the survey area are identified by DPI (2016) as supporting the species, although the survey area lies within the natural distribution of this species. Although the only self-sustaining population occurs in the Murray River, this species has recently been stocked in Talbingo Reservoir. Its predicted distribution also includes the survey area. May occur in Talbingo Reservoir and/or Yarrangobilly River only.
<i>Maccullochella peelii</i>	Murray Cod	VU		Low	The Murray Cod was formerly widespread and abundant in the lower and mid-altitude reaches of the Murray-Darling Basin but now has a patchy distribution and abundance across its historic range. The species has been found in diverse habitats including flowing and standing waters, small, clear, rocky streams on the inland slopes and uplands of the Great Dividing Range, large, turbid, meandering slow-flowing rivers, creeks, anabranches, and lakes and larger billabongs of the inland plains of the Murray Darling Basin. No waterways within the survey area are identified by DPI (2016) as supporting the species. Modification 1 is outside the natural distribution of the species, and no stocking of Talbingo Reservoir has occurred.

Table H.3 **Likelihood of occurrence assessment – threatened fauna**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Macquaria australasica</i>	Macquarie Perch	EN	E	Moderate	The Macquarie Perch is found in the Murray-Darling Basin, particularly the upstream reaches of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW. The draft National Recovery Plan for Macquarie Perch identifies four self-sustaining populations; none are within the survey area. Macquarie Perch prefer clear water and deep, rocky holes with extensive cover in the form of aquatic vegetation, large boulders, debris and overhanging banks. They spawn in spring or summer and lay their eggs over stones and gravel in shallow, fast-flowing upland streams or flowing parts of rivers. Macquarie Perch inhabiting impoundments would likely undertake upstream spawning migration in October to mid-January after which adults usually move from the streams to the lake. Migration may not be necessary in stream dwelling fish. The Tumut River and Yarrangobilly River are identified as habitat for this species (DPI 2016). A stocked population may occur in Talbingo Reservoir within the Survey area.

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable, Mi – migratory, M – marine
2. BC Act status: E4A – critically endangered, E1 – endangered, E2 – endangered population, V – vulnerable
3. FM Act status: E – Endangered

Table H.4 **Likelihood of occurrence assessment – migratory species**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
Migratory Marine Birds					
<i>Apus pacificus</i>	Fork-tailed Swift	Mi, M		Negligible	Almost exclusively aerial (foraging). The Fork-tailed Swift breeds in Asia but migrates to Australia from September to April. Individuals or flocks can be observed hawking for insects at varying heights from only a few metres from the ground and up to 300 metres high. There is one record of the Fork-tailed Swift within 10 km of the survey area. Modification 1 is outside the known distribution of the species, and the disturbance area does not support suitable habitat.
Migratory Terrestrial Species					
<i>Hirundapus caudacutus</i>	White-throated Needletail	Mi, M		Low	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges. Breeds in Asia. White-throated Needletails almost always forage aerially, at heights up to 'cloud level'. There are five records of the White-throated Needletail within 10 km of the survey area.
<i>Monarcha melanopsis</i>	Black-faced Monarch	Mi, M		Negligible	A migratory species found during the breeding season in damp gullies in temperate rainforests. Disperses after breeding into more open woodland. The species has not been recorded within 10 km of the survey area. Modification 1 is outside the known distribution of the species, and the survey area does not support suitable rainforest habitat.
<i>Motacilla flava</i>	Yellow Wagtail	Mi, M		Negligible	Regular spring-summer visitor in north of Australia, rare vagrant or occasional visitor farther south. Found in marshes, damp paddocks, airfields, cultivated fields, lawns and estuaries. The species has not been recorded within 10 km of the survey area. Modification 1 is outside the known distribution of the species, and the survey area does not support suitable habitat.
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	Mi, M		Recorded	The Satin Flycatcher inhabits heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. The species can occur at elevations of up to 1,400 m ASL. The Satin Flycatcher breeds in heavily vegetated gullies. The Satin Flycatcher was recorded nesting within adjacent vegetation to the Modification 1 project area.

Table H.4 **Likelihood of occurrence assessment – migratory species**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Rhipidura rufifrons</i>	Rufous Fantail	Mi, M		Moderate	Migratory species that prefers dense, moist undergrowth of tropical rainforests and scrubs. The species mainly inhabits wet sclerophyll forests often in gullies dominated by eucalypts such as Tallow-wood (<i>Eucalyptus microcorys</i>), Mountain Grey Gum (<i>E. cypellocarpa</i>), Narrow-leaved Peppermint (<i>E. radiata</i>), Mountain Ash (<i>E. regnans</i>), Alpine Ash (<i>E. delegatensis</i>), Blackbutt (<i>E. pilularis</i>). During migration it can stray into gardens and more open areas. The Rufous Fantail has been recorded within 10 km of the survey area. Modification 1 provides sub-optimal habitat.
Migratory Wetlands Species					
<i>Actitis hypoleucos</i>	Common Sandpiper	Mi, M		Negligible	Inhabits a wide range of coastal and inland wetlands, often with muddy or rocky margins. Also known to occur at estuaries, billabongs, dams, pools and lakes, often associated with mangroves. The species has not been recorded within 10 km of the survey area. Modification 1 is outside the known distribution of the species, and the survey area does not support suitable habitat.
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi, M		Negligible	The Sharp-tailed Sandpiper forages at the edge of water within wetlands or intertidal mudflats, either on bare wet mud, sand or shallow water. They will also foraging among inundated vegetation of saltmarsh, grass or sedges. Roosting occurs at the edges of wetlands, on wet open mud or sand or in sparse vegetation. The species has not been recorded within 10 km of the survey area. Modification 1 is outside the known distribution of the species, and the survey area does not support suitable habitat.
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE, Mi, M	E1	Negligible	Inhabits sheltered intertidal mudflats. Also non-tidal swamps, lagoons and lakes near the coast. Infrequently recorded inland. The species has not been recorded within 10 km of the survey area. Modification 1 does not provide suitable waterbodies with muddy or sandy edges.

Table H.4 **Likelihood of occurrence assessment – migratory species**

Scientific name	Common name	EPBC Act	BC Act	Likelihood of occurrence	Justification
<i>Calidris melanotos</i>	Pectoral Sandpiper	Mi, M		Negligible	Scarce, but regular visitor, usually recorded in summer from November to March. Widespread but scattered records in Australia. Usually found in fresh to saline wetlands, floodplains, swamps, estuaries and lagoons, sometimes with emergent or fringing vegetation such as grass. The species has not been recorded within 10 km of the survey area. Modification 1 is outside the known distribution of the species, and the survey area does not support suitable habitat.
<i>Gallinago hardwickii</i>	Latham's Snipe	Mi, M		Recorded	Typically found on wet soft ground or shallow water with good cover of tussocks. Often found in wet paddocks, seepage areas below dams. This species was recorded adjacent to the Modification 1 project area.
<i>Numenius madagascariensis</i>	Eastern Curlew	CE, Mi		Negligible	Occurs in sheltered coasts, especially estuaries, embayments, harbours, inlets and coastal lagoons with large intertidal mudflats or sandflats often with beds of seagrass. The species has not been recorded within 10 km of the survey area. Modification 1 does not provide suitable intertidal habitat.

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable, Mi – migratory, M – marine
2. BC Act status: E4A – critically endangered, E1 – endangered, E2 – endangered population, V – vulnerable

Appendix I

EPBC Act significant impact criteria assessments

I.1 Significant impact criteria assessment for Smoky Mouse



Table I.1

Significant impact criteria assessment for Smoky Mouse

Species profile

Smoky Mouse (*Pseudomys fumeus*)

Status: Endangered (EPBC Act), Critically Endangered (BC Act)

Distribution: The Smoky Mouse is endemic to mainland south-eastern Australia, where it occurs in Victoria, New South Wales and the Australian Capital Territory. The species has a relatively wide but disjunct distribution, populations are small and fragmented, and there appear to have been local extinctions in several areas. It occurs in four IBRA regions (South East Highlands, South East Corner, Australian Alps and Victorian Midlands). Capture sites range from near sea level to at least 1,800 m altitude (Menkhorst and Broome 2008a, 2008b). KNP has a known population of Smoky Mouse, with records from Yarrangobilly to the north-east and Happy Jacks to the south.

Within this range, populations are fragmented and generally low in number, but can fluctuate in size. There is also evidence of apparent local extinctions. While records in new areas are still being obtained, the apparent instability of Smoky Mouse populations is of concern (Menkhorst and Broome 2008a, 2008b).

Biology:

The Smoky Mouse is similar in size to a small rat, with a head and body length averaging about 90 mm and a tail averaging 140 mm (OEH 2018). The Smoky Mouse is primarily herbivorous but also consumes invertebrates, with diet varying seasonally according to food availability and energetic demands. At the summit of Mt William, Cockburn (1981a) found that the fruiting bodies of underground fungi predominated in the diet in winter and early spring, with a small proportion of seeds and soil invertebrates. There was a sudden switch to flowers, seeds and Bogong Moths *Agrostis infusa* in late spring–early summer, while seeds predominated through summer and autumn (Menkhorst and Broome 2008a, 2008b).

Males have been surveyed as transient moving between sub-populations in search of mates (Ford et al. 2003). Long-term survival of the population may therefore be contingent on recruitment and immigration between habitat patches, and the regional dynamics of resource availability (Harrison 1994).

A characteristic of Smoky Mouse colonies is their ephemeral nature, both spatially and temporally. There are numerous examples of unsuccessful attempts to locate the species at sites where it had been found only a few months previously (eg. Lawrence 1986; Lintermans 1988; Ford et al. 2003; DECC, FNSW unpublished data). This may be due to shifts in home range following fluctuations in resource availability due to climatic fluctuations, or to differences in trappability, or, in the longer-term, to vegetation succession.

Breeding:

Smoky Mice occurs in small discrete colonies based around patches of dense heath. They sheltered in small groups, sometimes comprising a male and up to five breeding females, in a large, complex burrow system that can be up to 10 m² and more than 25m in length, with multiple nesting chambers (Ford et al. 2003; Woods & Ford 2000; Ford in prep.). Breeding occurred from September–April, and 1–2 litters, each of 3–4 young, were produced after a gestation period of about 30 days (Menkhorst and Broome 2008a, 2008b).

Habitat Requirements:

The precise habitat requirements of the Smoky Mouse are not clear. A wide range of vegetation communities are occupied, from damp coastal heath in East Gippsland, to sub-alpine heath. A characteristic of Smoky Mouse localities, except those in wet gullies, is a floristically diverse shrub layer with members of the plant families Epacridaceae, Fabaceae and Mimosaceae well represented (Menkhorst and Broome 2008a, 2008b).

Habitat types the Smoky Mouse has been recorded in include coastal heath to dry ridgeline forest, sub-alpine heath and, occasionally, wetter gullies (Menkhorst and Seebeck 1981). Ground cover is also likely to be critical and can be in the form of dense low vegetation, such as occurs in heaths, or grass tussocks, rocks and logs in more open habitats. Soil conditions also need to be conducive to burrowing and growth of hypogaeal fungi, a major component of the diet (Menkhorst and Broome 2008a, 2008b).

Threats: predation by introduced carnivores, habitat changes due to altered fire regimes and dieback caused by the Cinnamon Fungus *Phytophthora cinnamomi*, and loss, modification and fragmentation of habitat due to road construction and intensive timber harvesting (Menkhorst and Broome 2008a, 2008b).

Criteria	Discussion
1. Lead to a long term decrease in size of a population	Initial surveys undertaken in 2017/18 identified a Smoky Mouse population occurring in the southern portion of the Exploratory Works survey area along the upper sections of Lobs Hole Ravine Road, with the species recorded at 12 locations. Regional surveys undertaken in 2018/19 have identified the species across a broad area above 1,100 m, from Coppermine Firetrail in the north, Wallaces Creek Firetrail in the east, Link Road in the south and the Elliott Way in the west. The species is now known from 63 locations (four by terrestrial trapping and 59 by remote camera, Figure 6.7). This population is considered significant, being one of the largest known populations of the species. Original surveys found the species to be solely associated with PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion. Subsequent surveys have identified the species as being associated with two additional PCTs; PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner 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. The species was found above 1,100m ASL, although it is noted that regional surveys did not include locations below this elevation. However, surveys for Snowy 2.0 have included locations below this elevation. Despite this, associations with elevation remain unclear. All records are all along the upper sections of a north-south ridge. Vegetation consist of tall forests dominated by Mountain Gum and Snow Gum, with some other associated species. There is generally a moderate to dense shrubby midstorey with varying abundance of shrubs from the plant family <i>Fabaceae</i> (with some <i>Epacridaceae</i> and <i>Mimosaceae</i>), and dense groundcover with abundant sub-shrubs, logs and leaf litter. This type of microhabitat is believed to be preferred by the species to take refuge from predators. As a part of Modification 1, clearing of 1.57 ha of Smoky Mouse habitat is proposed, resulting in a cumulative impact of 1.77 ha when Exploratory Works is considered. The size of the local population is unknown, but given the extent of species recorded during regional surveys, and the extent of associated habitat in the region, this impact is likely to represent a very small portion of the available habitat for this population. Indirect impacts also have potential to occur as a result of Exploratory Works and Modification1 due to an increase in feral animal predation. As a result of increased disturbances in local area there is potential for feral animal numbers to increase. The feral cat and European fox are recognised threats to Smoky Mouse. The Biodiversity Management Plan (EMM 2019) includes a feral animal monitoring and control program to be implemented during construction and operational phases of the project. Introduction of weeds and pathogens will be managed through implementation of strict wash down procedures and monitoring, as per the approved BMP (EMM 2019). Exploratory Works, including Modification 1, will result in loss of 1.77 ha of habitat for Smoky Mouse. This represents a small percentage of the available habitat for the species in the region. Mitigation measures will be implemented in accordance with the approved BMP (EMM 2019) to reduce potential impacts from vehicle strike and feral animal predation. It is not expected the Exploratory Works, including Modification 1, will decrease the size of an important population of the species.
2. Reduce the area of occupancy for the species	The Smoky Mouse population has been recorded across the region, over an estimated 6,000 to 7,000 ha. In these areas, the species has been recorded across three PCTs: • PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South Eastern Highlands Bioregion and South East Corner Bioregion; • PCT 953 - Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion; and • PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion. This is a large tract of sub-alpine forest which provides suitable habitat for the species and supports Smoky Mouse populations. The cumulative impact of 1.77 ha represents less than 1% of the available habitat in the region. Therefore it is not expected that the Exploratory Works, including Modification1, will result in a significant loss of habitat or significantly reduce area of occupancy for Smoky Mouse.

3. Fragment an existing population into two or more populations	The Smoky Mouse population has been recorded across a broad area within the region, over an estimated 6,000 to 7,000 ha. To ensure there is no additional fragmentation of Smoky Mouse habitats or populations the existing Lobs Hole Ravine Road will be retained at the same width. Mitigation measure to avoid and reduce vehicles strike on Smoky Mouse will be implemented to ensure their safe movement across the road including avoiding and minimising vehicle movements at night and reducing speed limits. The Smoky Mouse population was also recorded within the Marica area. The vegetation within this area is largely intact, spreading south to Lobs Hole Ravine and north towards Coppermine Firetrail. Access tracks will be constructed in this area. However, the Smoky Mouse was recorded cross Link Road in 2019 (G.Madani pers. obs.), and therefore is likely to cross the access tracks at Marica. In addition, the species is able to move through unfragmented areas to the west. The removal of vegetation within this area is not likely to fragment the population. Therefore it is not anticipated Exploratory Works, including Modification 1, will fragment a population.
4. Adversely affect habitat critical to survival of a species	Primary habitat for the Smoky Mouse is located on upper ridgelines and slopes above 1,100m, within PCT 729 – Broad-leaved Peppermint - Candlebark shrubby open forest of montane areas, southern South, Eastern Highlands Bioregion and South East Corner Bioregion, PCT 953 - Mountain Gum - Snow Gum - Broad-leaved Peppermint shrubby open forest of montane ranges, South Eastern Highlands Bioregion and Australian Alps Bioregion and PCT 1196 - Snow Gum - Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion. To ensure no loss of Smoky Mouse habitat occurs the upper section of Lobs Hole Ravine Road will be retained at its same width, with some minor additional clearing adjacent to an existing powerline. No further vegetation clearing along Lobs Hole Ravine Road is proposed. Clearing of Smoky Mouse habitat in The Marica area will be undertaken for construction of access tracks and geotechnical drill pads. These will be rehabilitated after completion should Main Works not proceed. Exploratory Works, including Modification1, will result in clearing of 1.77 ha of Smoky Mouse habitat. There is an estimated 6,000 to 7,000 ha of habitat in the region. There is potential for the proposed Exploratory Works to have adverse indirect impacts on Smoky Mouse habitat through reduction in habitat quality. This may be due to increase in weed abundance or introduction of pathogens such as <i>P. cinnomomi</i>. Mitigation measures outlined in the BMP (EMM 2019) will be implemented to reduce these indirect impacts and maintain habitat quality including weed control, strict hygiene protocols for vehicles and machinery to minimise weeds being introduced and spread. Monitoring will be undertaken. Therefore, it is not anticipated that Exploratory Works, including Modification 1, will adversely affect critical habitat.
5. Disrupt breeding cycle of a population	Smoky Mouse occur in small discrete colonies based around patches of dense heath. They shelter in small groups, sometimes comprising a male and up to five breeding females, in a large, complex burrow system that can be up to 10 m² and more than 25m in length, with multiple nesting chambers (Ford et al. 2003; Woods & Ford 2000; Ford in prep.). Breeding occurs from September–April (Menkhorst, P. and Broome, L. 2006). Given the observed presence of males and females, the survey area is likely to support a breeding population of the Smoky Mouse. Increased levels of noise from additional vehicles and trucks, or drilling rigs, is not expected to impact on Smoky Mouse breeding given the extent of available habitat. Mitigation measures have been put in place to ensure vehicle movements at night will be limited to emergency vehicles movements only on Lobs Hole Ravine Road, and restrictions on vehicle speeds in the Marica area. No lighting is proposed along the existing Lobs Hole Ravine Road. Lighting for geotechnical investigation will be focused on the drill pad, with very minimal light spill to adjacent areas. Overall, the Exploratory Works, including Modification 1, is not expected to disrupt the breeding cycle of Smoky Mouse.
6. Modify, destroy, remove, isolate or degrade habitat to the extent that the species is likely to decline	Modification 1 will remove 1.57 ha of Smoky Mouse habitat, resulting in a cumulative impact of 1.77 ha for Exploratory Works. These areas to be removed are fragmented across the project boundary and are not likely to significant impact on the species by fragmenting their population. There is also potential for Modification 1 to reduce the quality of habitat, as a result of increased weed abundance or introduction of pathogens. A number of mitigation measures, outlined in the BMP (EMM 2019) will be implemented to ensure habitat quality is maintained including hygiene protocols to

	prevent introduction of weeds, the spread of weeds or the spread of pathogens and a monitoring program which will be extended to the Marica area. Based on the mitigation measures and the existing Lobs Hole Ravine Road to retains its current width, it is not expected Modification 1 will result in a significant loss of habitat availability or habitat quality.
7. Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The Exploratory Works, including Modification 1, has the potential to result in the introduction and spread of weed species, and increase in abundance of feral animals (including feral cats, foxes and feral pigs). As a part of the BMP (EMM 209) a detailed weed survey has been completed within the Exploratory Works impact area and adjacent habitats. Weed inspections and control in and adjacent to works areas have commenced, with baseline data collected. These surveys and inspections will be undertaken throughout the construction and operation period to control weeds and prevent them spreading to adjacent bushland. Hygiene protocols will also be put in place to ensure weeds are not brought in with vehicles, machinery etc. A feral animal monitoring and control program has also commenced as a part of the BMP (EMM 2019). This program will continue to be implemented during the construction and operational phases to minimise impacts of feral animals on wildlife. A focus in area of Smoky Mouse habitat will be feral Cats and Foxes as they are known to predate on the species. These measures will be extended to additional areas included in Modification 1. Based on the proposed mitigation measures it is not expected that Exploratory Works, including Modification 1, will result in an increase of invasive species.
8. Introduce disease that may cause the species to decline	A recognised threat to Smoky Mouse is dieback of susceptible heath species caused by <i>Phytophthora cinnamomi</i>. The fungus is a soil-borne water mould that produces an infection which causes a condition in plants called "root rot" or "dieback". It is a threat in some areas due to the substantial habitat changes that result in infected patches of vegetation. By bringing in vehicles, machinery and people there is potential they may carry soil which contains the mould. Mitigation measures outlined in the BMP (EMM 2019) include strict hygiene protocols to disinfect footwear, machinery and vehicles before entering the KNP and works areas. Monitoring will occur during construction and operational phases to assess for the presence of the <i>P.cinnamomi</i> in susceptible vegetation communities. No introduction of soil is proposed to minimise any chances of introducing diseases. These measures will be extended to additional areas included in Modification 1. Based on the mitigation measures outlined above, it is not expected that Exploratory Works, including Modification 1, will result in introduction of any disease that will cause the species to decline.
9. Interfere with the recovery of the species	Exploratory Works, including Modification 1, is not expected to interfere with the recovery of the Smoky Mouse. A population has been recorded in the project area, and habitats are in good condition. Clearing of 1.77 ha of Smoky Mouse habitat will result from Exploratory Works, including Modification 1. The extent of the regional population is in the order of 6,000 ha to 7,000 ha of available habitat. There is potential for impacts to Smoky Mouse populations from vehicle strike. The Exploratory Works, including Modification 1, will result in an increase in vehicles and trucks using the access road, therefore increasing risk of Smoky Mouse population decline. Impacts from vehicle strike are more likely to occur at night as the species is nocturnal and during breeding season when males are more transitory. Proposed mitigation measures to address vehicle strike including limiting vehicle movements on Lobs Hole Ravine Road to daytime only, and limiting vehicle movements in the Marica area to a speed of 20km/h between dusk and dawn. Indirect impacts also have potential to occur as a result of Exploratory Works, including Modification 1, due to an increase in feral animal predation. As a result of increased disturbances in local area there is potential for feral animal numbers to increase. The feral Cat and European Fox are recognised threats to Smoky Mouse. Therefore a feral animal monitoring and control program its outlined in the BMP (EMM 2019) and is currently being implemented during construction and operational phases of the project. This BMP will be extended to include additional areas outlined in this Modification. The Project is not expected to interfere with the recovery of the species, as impacts to habitat for the regional population of the species are negligible. Comprehensive mitigation measures, as detailed above, will also be implemented through the BMP (EMM 2019) to ensure indirect impacts are managed.

Conclusion

The project will not have a significant impact on the Smoky Mouse population as:

- impacts will result to less than 1% of the estimated 6,000 to 7,000 ha of habitat for the local population;
 - the proposed works will not result in the fragmentation of existing populations;
 - vehicle and truck movements will be minimised at night or be speed restricted to reduce the likelihood of Smoky Mouse being impacted by vehicle strike;
 - no lighting will be placed on the access road to avoid any impacts on Smoky Mouse breeding and foraging behaviour, and lighting for drilling operations will be directed onto drill pads minimising light spill;
 - strict hygiene controls will be put in place to prevent weeds or pathogens entering the site;
 - feral animal control will be implemented to reduce predation on Smoky Mouse;
 - a robust monitoring plan will be implemented.
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I.2 Significant impact criteria assessment for Alpine Tree Frog

Table I.2 Significant impact criteria assessment for Alpine Tree Frog

Species Profile	Alpine Tree Frog (<i>Litoria verreauxii alpina</i>) Status: Vulnerable (EPBC Act) Endangered (BC Act) Distribution: The species occurs in the south-eastern NSW and Victorian high country (alpine and sub-alpine zones) generally above 1100 m asl. Most locations are within National Parks. Biology: The species is a relatively small tree frog. Similar in appearance to the lowland Whistling Tree Frog (<i>Litoria verreauxii verreauxii</i>) the Alpine Tree Frog is distinguished by its warty back. Breeding: Breeding populations occur on plains or open valleys where there are stream side pools, fens and bogs, but is also be associated with artificial waterbodies such as small dams and reservoirs. Habitat Requirements: The Alpine Tree Frog is found in a wide variety of habitats, including woodland, heath, grassland and herb field at montane, subalpine and alpine altitudes. Breeding populations occur on plains or open valleys where there are stream side pools, fens and bogs, but is also be associated with artificial waterbodies such as small dams and reservoirs. During the non-breeding season individuals may be found amongst litter, under logs, beneath flat stones in stream beds or in rocky areas near streams. Threats: It is believed that the species is particularly susceptible to Chytrid fungus, with a decline co-occurring with several other alpine frog species. Habitat is susceptible to trampling by horses.
Criteria	Discussion
1. Lead to a long-term decrease of an important population of a species	Important populations have not been defined for the Alpine Tree Frog. There are records of this species within the area spanning from northern NSW to Vic. Using a precautionary approach and the definitions in the significant impact guidelines (DoE 2013a) it is possible that the population recorded across the Snowy 2.0 Main Works study area is an important population as the species has a limited distribution and would therefore be considered important as a key source population and for maintaining genetic diversity. That said, the recorded population is extensive and includes the catchments of the Murrumbidgee River, Tantangara Creek, Gooandra Creek and Nungar Creek. The Alpine Tree Frog was not recorded within the disturbance footprint during targeted surveys. The Alpine Tree Frog was recorded within multiple locations in adjacent areas around the edges of Tantangara Reservoir, breeding within the fluctuating levels of the Reservoir between MOL and FSL. Habitat has been defined as the area between MOL and FSL, as well as a 50 m buffer above FSL that may provide foraging and refuge habitat. Impacts arising from Modification 1 include clearing of 0.03 ha of foraging habitat above FSL. Several mitigation measures will be implemented to reduce potential for indirect impacts on Alpine Tree Frog populations. These include monitoring water quality, hygiene protocols to stop the spread of disease such as Chytrid Fungus and manage runoff to ensure no contamination or sediment entering adjacent watercourses. Given that Modification 1 will not result in loss of any primary breeding habitats for Alpine Tree Frog and mitigation measures will be implemented to ensure adjacent habitat quality is maintained it is not expected Modification 1 will decrease the size of an important population of the species.
2. Reduce the area of occupancy of an important population	As above.
3. Fragment an existing important population into two or more populations	As above.
4. Adversely affect habitat critical to survival of the species	Modification 1 will result in impacts to 0.03 ha of foraging habitat for the Alpine Tree Frog. This habitat is not considered critical to the survival of the species, given both the minimal impacts (0.03 ha), that impacts are limited to foraging and refuge habitat (rather than breeding habitat) and the extent of available habitat in the region.

Table I.2 Significant impact criteria assessment for Alpine Tree Frog

5. Disrupt the breeding cycle of an important population	Breeding is known to occur in December. The Alpine Tree Frog lays its eggs in deep pools, including fens, stream cut-offs, lakes and reservoirs. No Alpine Tree Frogs were recorded breeding during surveys within the disturbance footprint. Considering there are no suitable waterways within Modification 1 disturbance footprint it is considered the project will not disrupt the breeding cycle of a population.
6. Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Modification 1 will result in minor loss of 0.03 ha of Alpine Tree Frog foraging habitat will occur. No species were recorded within the disturbance footprint. It is highly unlikely that this will result in a loss of habitat to such an extent that the species is likely to decline.
7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The Exploratory Works, including Modification 1, has the potential to result in the introduction and spread of weed species, and increase in abundance of feral animals (including feral cats, foxes and feral pigs). However, the area of habitat identified is already heavily impacted through inundation, use of the area by recreational vehicles and impacts from feral horses. It is unlikely that the As a part of the BMP (EMM 209) a detailed weed survey has been completed within the Exploratory Works impact area and adjacent habitats. Weed inspections and control in and adjacent to works areas have commenced, with baseline data collected. These surveys and inspections will be undertaken throughout the construction and operation period to control weeds and prevent them spreading to adjacent bushland. Hygiene protocols will also be put in place to ensure weeds are not brought in with vehicles, machinery etc. A feral animal monitoring and control program has also commenced as a part of the BMP (EMM 2019). This program will continue to be implemented during the construction and operational phases to minimise impacts of feral animals on wildlife. These measures will be extended to additional areas included in Modification 1. Based on the proposed mitigation measures it is not expected that Exploratory Works, including Modification 1, will result in an increase of invasive species.
8. Introduce disease that may cause the species to decline	The Alpine Tree Frog is susceptible to chytrid fungus (<i>Batrachochytrium dendrobatidis</i>), which has been identified as the cause of amphibian declines and extinctions and linked to declines of the Alpine Tree Frog. Vehicle, machinery and people presence may introduce the disease to water bodies adjacent to the Modification 1 works area. Mitigation measures including, hygiene protocols to disinfect footwear, machinery and vehicles before entering the waterways or wet area in the works area will be implemented. These measures will be included in an updated BMP (EMM 2019).
9. Interfere substantially with the recovery of the species	No recovery plan has been produced for the Alpine Tree Frog. Regional priority actions are outlined in the Approved Conservation Advice for the species. Habitat loss has been limited, with negligible impact likely to result from Modification 1. The area of impact is already subject to high level of disturbance and weed invasion. Additional controls will be implemented to further mitigate the risk of invasive weeds being introduced. While there is some, limited, risk of Chytrid being introduced to areas around Tantangara Reservoir without mitigating, additional controls and washdown procedures will be included in the BMP (EMM 2019) to manage this risk. The Project is not expected to interfere with the recovery of the species, as impacts to habitat for the regional population of the species are negligible. Comprehensive mitigation measures, as detailed above, will also be implemented through the BMP (EMM 2019) to ensure indirect impacts are managed.

Table I.2 Significant impact criteria assessment for Alpine Tree Frog

Conclusion	The project will not have a significant impact on the Alpine Tree Frog population as: • impacts will be limited to 0.03 ha of foraging and refuge habitat, with no direct impacts to breeding habitat; • the area proposed for removal is not considered habitat critical to the survival of the species; • Modification 1 will not result in fragmentation of an important population; and • other impacts, such as weed invasion and introduction of Chytrid fungus, will be managed through additional controls to be outlined in the updated BMP (EMM 2019). The clearance of 0.03 ha of potential Alpine Tree Frog habitat will not result in a significant impact on the species and important populations will not be adversely affected.
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I.3 Significant impact criteria assessment for Booroolong Frog

Table I.3 Significant impact criteria assessment for Booroolong Frog

Species Profile	Booroolong Frog (<i>Litoria booroolongensis</i>) Status: Endangered (EPBC Act/BC Act) Distribution: The species is restricted to New South Wales and north-eastern Victoria, predominantly along western-flowing streams of the Great Dividing Range between 200 and 1,300 metres above sea level. Populations have also been found along eastern flowing streams. Two populations of Booroolong Frog have been recorded in north-eastern Victoria. Populations have undergone decline, particularly on the New England Tablelands (OEH 2012a). Biology: The species is a medium size, stream dwelling frog. It is nocturnal but can be seen during day on rocks in or near the water. There are 28 populations described across their range and the length of stream each population occupies varies significantly. The greater the length of stream occupied the less susceptible the species will be to local perturbations (OEH 2012a). Population abundance exhibits large fluctuations from one year to next, therefore population abundance isn't a useful indicator of population resilience (OEH 2012a). Breeding: Breeding is known to occur in spring and early summer, from October to early January. Egg deposition sites are typically in shallow, slow-flowing sections of stream or isolated rock pools along stream margins (OEH 2012a). Tadpoles take 2-4 months to develop, metamorphosing in late summer to early autumn (Anstis 2002). Survival rates are low with 10% annual survival for adult males and 20% annual survival for adult females (Hunter 2001). Habitat Requirements: Booroolong Frog are associated with permanent streams that are found in wet and dry forests, woodlands and cleared grazing land. Primary habitat requirements are extensive rock bank structures along permanent rivers with the key feature of these rock structures being rock crevices in relatively shallow, slow to medium-flowing sections of stream (Hunter 2007). Based on studies it appears this frog species is robust to a range of water quality parameters. It is more likely to be reliant on access to permanent water (OEH 2012). Adults tend to occur on or near cobble banks or bedrock structures within stream margins, or near slow-flowing connected or isolated pools that contain suitable rock habitats. By day frogs shelter under rocks or amongst vegetation near the ground along the edge of the stream. In summer individuals can bask in sun on exposed rocks or rock crevices near shallow pools or runs (OEH 2012). The Booroolong Frog is not known to move very far along the stream from where they are recorded (less than 50m within a season) with maximum movements recorded being 300m (Hunter 2001). Threats: Disease, habitat degradation, altered stream flows and stream drying associated with droughts and introduction of exotic predatory fish (OEH, 2012).
Criteria	Discussion

Table I.3 Significant impact criteria assessment for Booroolong Frog

1. Lead to a long term decrease in size of a population	The Booroolong Frog was recorded during targeted surveys within the project area. All sightings were associated with the Yarrangobilly River and nearby tributaries flowing into the river. The records are restricted to Lobs Hole Ravine. Individuals were recorded on the edge of stream banks associated with rocks or under vegetation, or in small pools of shallow water. Minor clearing of an additional 0.44 ha of Booroolong Frog habitat will occur in the 50 m buffer zone around the Yarrangobilly River, restricted to the two bridge locations. Cumulatively, this will result in impacts to 2.48 ha of Booroolong Frog habitat from Exploratory Works, including Modification 1. The two bridge constructions require additional areas of vegetation removal for stockpile and construction and therefore will not impact in-stream environments. A number of mitigation measures will be implemented to reduce potential for indirect impacts on Booroolong Frog populations. A key focus is managing water quality and in-stream environments to ensure that coarse sediment does not enter the waterway and result in changes to habitat structure for the species. A comprehensive stormwater management and erosion and sediment control plan are outlined above, identifying identifies the measures to be implemented. At the two bridge crossings of Yarrangobilly River and Wallaces Creek measures will be put in place to prevent sediment and rock entering the watercourse including sediment fencing, diversions and detention ponds. Runoff from spoil piles will also be managed to ensure there is no contamination or sediment entering adjacent watercourses. No works will occur within the waterway providing breeding habitat for the species. No change to stream flows will occur as a result of Exploratory Works, including Modification 1. Given that Exploratory Works, including Modification 1 will not result in loss of any primary breeding habitats for Booroolong Frog and mitigation measures will be implemented it is not expected that Exploratory Works, including Modification 1, will lead to a decrease in the size of the population of the species.
2. Reduce the area of occupancy for the species	Minor direct impacts associated with clearing Booroolong Frog primary habitat will occur. The removal of additional riparian vegetation for the two bridges will avoid any in-stream impacts. Removal of an additional 0.44 ha of riparian vegetation, and cumulative impacts to 2.48 ha of habitat, will have a small impact on the occupancy area for the population. Given that Exploratory Works, including Modification 1, will not occur within breeding habitat for the Booroolong Frog, habitat connectivity is maintained, and only minor impacts to foraging habitat will occur for bridge construction, it is not expected the Exploratory Works, including Modification 1, will reduce the area of occupancy for the species.
3. Fragment an existing population into two or more populations	Exploratory Works, including Modification 1, will not fragment the Booroolong Frog population. Targeted surveys to date have recorded the Booroolong Frog within the Yarrangobilly River, Sheep Station Creek and Wallaces Creek in close proximity to where they join the Yarrangobilly River. These watercourses and in-stream environments which support the Booroolong Frog populations will not be directly impacted by the project. Nor will they be fragmented, as in-stream impacts have been avoided and connectivity will be maintained. As a result of the avoidance and mitigation measures proposed it is not expected that Exploratory Works, including Modification 1, will fragment the Yarrangobilly River population..
4. Adversely affect habitat critical to survival of a species	No critical habitat of the Booroolong Frog has been identified. Using definitions outlined in DoE (2013a), impacts to habitat critical to the survival of the species are unlikely to occur, as in-stream impacts have been avoided, impacts to foraging habitat are limited to cumulative impacts of 2.48 ha, and the population is likely to extend upstream of the Exploratory Works project area. A number of mitigation measures will be implemented to reduce potential for indirect impacts on Booroolong Frog primary habitats. A key focus is managing water quality and in-stream environments to ensure that coarse sediment does not enter the waterway and result in changes to habitat structure for the species. A comprehensive stormwater management and erosion and sediment control plan has been developed, which identifies the measures to be implemented. At high risk areas such as bridge crossings of Yarrangobilly River and Wallaces Creek measures will be put in place to prevent sediment and rock entering the watercourse including sediment fencing, diversions and detention ponds. Runoff

Table I.3 Significant impact criteria assessment for Booroolong Frog

	from spoil piles will also be managed to ensure there is no contamination or sediment entering adjacent watercourses. No change to stream flows will occur as a result of Exploratory Works. During construction and operations 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 harmed during construction and from accessing the road crossing where they can be killed by vehicles and trucks. Fauna spotters will also be present and check areas prior to clearing for Booroolong Frog and translocate them to adjacent habitats away from impacts. These measures will be detailed in a Booroolong Frog Species Management Plan. Given that Exploratory Works, including modification 1, will not occur within breeding habitats for Booroolong Frog, impacts to foraging habitat have been limited, and the mitigation measures to be put in place will avoid indirect impacts to breeding habitat it is not expected the Exploratory Works, including Modification 1 will adversely affect critical habitat for the species.
5. Disrupt breeding cycle of a population	Breeding is known to occur in spring and early summer, from October to early January. Egg deposition sites are typically in shallow, slow flowing sections of stream or isolated rock pools along stream margins (OEH 2012). tadpoles take 2-4 months to develop, metamorphosing in late summer to early autumn (Anstis 2002). Survival rates are low within 10% annual survival for adult males and 20% annual survival for adult females (Hunter 2001). Exploratory Works, Including Modification 1, will not disrupt the breeding cycle of the Booroolong Frog population. Their breeding sites are within the in-stream areas and stream margins which will not be impacted by the works. A minimum of a 50m buffer is being provided to watercourses to ensure impacts to the Booroolong Frogs and their associated breeding and foraging areas are avoided and minimised to the greatest extent possible. The Exploratory Works, including Modification 1, will not have an impact on stream flow, and mitigation measures are being put in place to ensure water quality is maintained, such as the management of stormwater runoff. As a result of Exploratory Works, including Modification 1, avoiding breeding areas, not disrupting or changing water flows, and putting mitigation measures in place to maintain water quality and habitat features, it is not expected the proposed works will disrupt the breeding cycle of a population.
6. Modify, destroy, remove, isolate or degrade habitat to the extent that the species is likely to decline	Minor loss of Booroolong Frog breeding habitat will occur as a result of the original Exploratory Works project. No additional impacts to breeding habitat will result from Modification 1, as Modification 1 will avoid any in-stream impacts. Impacts to 2.48 ha of habitat will result from Exploratory Works, including Modification 1. There is potential for Exploratory Works, including Modification 1, to reduce the quality of foraging and refuge habitat through indirect impacts such as sediment run-off, increase in weed abundance as a result of clearing in adjacent areas and introduction of weeds. A number of mitigation measures will be implemented to ensure habitat quality is maintained including stormwater management, hygiene protocols and feral animal control program. Based on Exploratory Works, including Modification 1, avoiding breeding habitat, limiting removal to a cumulative impact of 2.48 ha and the mitigation measures in place, it is not expected that Exploratory Works, including Modification 1, will result in a loss of habitat availability or habitat quality such that the species is likely to decline.
7. Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The Exploratory Works, including Modification 1, has the potential to result in the introduction and spread of weed species, and increase in abundance of feral animals (including wild dogs, feral cats and feral pigs) as a result of vegetation clearing and additional vehicles and machinery being brought into the area. It is noted that the Yarrangobilly River is heavily infested with weeds, particularly Blackberry, due to past land use in the area. Detailed weed surveys have been completed, prior to commencement of works, and the identified weeds of concern sprayed to minimise any spread of seeds during clearing. Suitable control methods will be used where weeds occur near watercourses. Weed control in and adjacent to works areas will then be undertaken throughout the construction and operation period to control weeds and prevent

Table I.3 Significant impact criteria assessment for Booroolong Frog

	them spreading to adjacent bushland. Hygiene protocols will also be put in place to ensure weeds are not brought in with vehicles, machinery etc. A feral animal control program will be implemented during the construction and operational phases to minimise impacts of feral animals on wildlife. Based on implementing the proposed mitigation measures it is not expected the Exploratory Works will result in an increase of invasive species. It is proposed that as a result of the project increasing effort around weed control and feral animal control there may be an improvement in habitat quality and reduction of invasive species in the area.
8. Introduce disease that may cause the species to decline	A potential threat to the Booroolong Frog population may occur from introduction of 'Chytridiomycosis' disease to the area. This disease is caused by an infection with the Amphibian Chytrid Fungus (<i>Batrachochytrium dendrobatidis</i>) which has been identified as the cause of amphibian declines and extinctions on different continents (OEH 2012). By bringing in vehicles, machinery and people there is potential they may carry spores which then spread into water bodies. Mitigation measures, including hygiene protocols to disinfect footwear, machinery and vehicles before entering the works areas are detailed in the BMP (EMM 2019) and will be implemented. No introduction of soil is proposed to minimise any chances of introducing diseases. Hygiene protocols are outlined in the BMP (EMM 2019) and monitoring for Chytridiomycosis will be detailed the associated monitoring plan.
9. Interfere with the recovery of the species	Exploratory Works, including Modification 1, is not expected to interfere with recovery of the Booroolong Frog population. There is a large population that has been recorded within and adjacent to the Modification 1 project area, and habitats are in good condition. Exploratory Works, including Modification 1, is not expected to interfere with breeding and recovery of the species through avoiding primary breeding habitat.
Conclusion	Exploratory Works, including Modification 1, will not have a significant impact on the Booroolong Frog population as: • breeding habitat, which occurs in the in-stream environments, will not be directly impacted and a 50m vegetated buffer is being provided to Yarrangobilly River and associated tributaries to protect foraging habitats and minimise edge effects; • as a result of two bridge crossings of Yarrangobilly River and Wallaces Creek a minor temporary impact to 2.48 ha of foraging and refuge habitat is likely to occur; • water flows will not be impacted; and • comprehensive stormwater management and erosion and sediment control measures will be implemented to ensure coarse sediment material and any other contaminants do not enter watercourses.

I.4 Significant impact criteria assessment for Satin Flycatcher

Table I.4 Significant impact criteria assessment for Satin Flycatcher

Criteria	Discussion
1.Substantially modify destroy or isolate an area of important habitat.	Modification 1 does not contain important habitat for the Satin Flycatcher. One record of a Satin Flycatcher nest was recorded within adjacent vegetation within the Marica area. This area will not be disturbed by the project. The <i>Referral guideline for 14 birds listed as migratory under the EPBC Act</i> (DoE 2015) identifies a substantial loss or modification of important habitat are those that are likely to meet or exceed the thresholds of 1, 700 individuals of Satin Flycatcher. The species has been recorded on three occasions across the study area. Therefore the Modification 1 will no substantially modify, destroy or isolate an area of important habitat.

Table I.4 Significant impact criteria assessment for Satin Flycatcher

Criteria	Discussion
2. Result in an invasive species becoming established in an area of important habitat.	The <i>Referral guideline for 14 birds listed as migratory under the EPBC Act</i> (DoE 2015) lists Black Rat (<i>Rattus rattus</i>) and invasive vines of riparian habitat (including Rubber Vine (<i>Cryptostegia grandiflora</i>)) as invasive species harmful to the Satin Flycatcher. Weed control protocols will be undertaken in accordance with the
3. Disrupt the breeding cycle of a population.	Similarly to the guidelines for important habitat, the guidelines for disrupting the breeding cycle of a population is defined by affecting more than 1, 700 individuals. The Modification 1 project area does not support substantial breeding habitat for a large population, therefore will not disrupt the breeding cycle of the Satin Flycatcher population.
Conclusion	The project will not have a significant impact on the Satin Flycatcher as the area as the area does not contain important habitat, breeding and foraging habitat is sub-optimal and no large aggregations of the species is likely to occur.

I.5 Significant impact criteria assessment for Latham's Snipe

Table I.5 Significant impact criteria assessment for Latham's Snipe

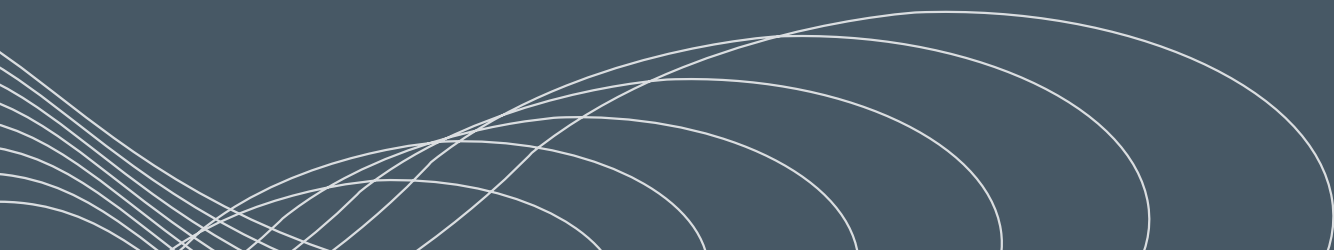
Criteria	Discussion
1.Substantiall modify destroy or isolate an area of important habitat.	The Latham's Snipe was recorded around southern Tantangara, within adjacent areas to the project area. Vegetation within the disturbance footprint of Tantangara Reservoir contain sub-optimal foraging habitat. Modification 1 does not support areas of important habitat for the Latham's Snipe as per the guidelines identified in <i>Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species</i> (DoEE 2017). The species was only recorded at most with 10 individuals at one time. The DoEE has identified that the entire global population of 25, 000 to 100, 000 birds is though to migrate to Australia. Therefore, the area of impact does not support at least 18 individuals of the species or identified as internationally important for the species.
2. Result in an invasive species becoming established in an area of important habitat.	The <i>Threat Abatement Plan for predation by the European red fox</i> (DoEWH 2008) identifies the Latham's Snipe as one of the species likely to be affected by the European red fox. Modification 1 will not result in an increase or introduction of the European red fox into an area of important habitat.
3. Disrupt the breeding cycle of a population.	The Latham's Snipe breeding range is confined to Japan and far eastern Russia, therefore the project will not impact the species breeding cycle.
Conclusion	The project will not have a significant impact on the Latham's Snipe as the area does not contain important habitat, no breeding habitat will be impacted, foraging habitat is limited to a small area and no large aggregations of the species is likely to occur.



CHAPTER

B

ASSESSMENT OF IMPACTS TO THE RAVINE FOSSIL BEDS



ASSESSMENT OF IMPACTS TO THE RAVINE FOSSIL BEDS FROM ROAD WIDENING ON RAVINE ROAD AS PART OF A MODIFICATION TO THE EXPLORATORY WORKS, SNOWY 2.0

Prepared by Dr. Ian Percival (Ph.D Palaeontology)

PURPOSE & AIMS

This report has been prepared to support a modification to the Exploratory Works for Snowy 2.0. A previous assessment prepared in October 2018 for the Exploratory Works EIS was based on interpretation of the results of a literature search of all scientific reports dealing with a road section that had been identified as having geoheritage significance in a study undertaken some four decades ago (Percival 1979). This report differs from the previous assessment in two important points, the first involving a modification (road widening) to the parameters provided in the Exploratory Works, and the second point of difference being that the extent and potential impact of the road widening was investigated during a site visit on 12th April 2019.

PREVIOUS ASSESSMENT OF THE SITE

The scientific significance of the Ravine fossil site has not changed from the explanation provided in the Exploratory Works. To facilitate comparison with potential impacts arising from widening of Ravine Road beyond the parameters specified in the previous assessment, key elements of that report are briefly reiterated here.

1. Geological and palaeontological studies

The Lobs Hole–Ravine valley and its surrounding elevated ridges is composed of rocks of the Byron Range Group that consists of three conformable units. The lowermost of these is the Milk Shanty Formation (170 m thick), a thick to massive-bedded fining upwards succession of clastic rocks devoid of fossils. It passes gradationally upwards into the Lick Hole Limestone – now known as the Lick Hole Formation – consisting of blue-grey fossiliferous limestone, often nodular and interbedded with siltstones and shales, with a total thickness of approximately 420 m according to Moye et al. (1969). Flood (1969) measured a comparable thickness of 488 m along Ravine Road. The limestone disappears up sequence and is replaced by fossiliferous quartzite containing undescribed lingulide brachiopods at the base of the Round Top Formation.

The first fossils to be described from the Lick Hole Formation were tentaculitids (small conical shells of unknown affinity), published by Sherrard (1967). Two genera and species were recognised: *Tentaculites chapmani* Sherrard and *Nowakia* aff. *acuaria* (Richter). Subsequently detailed geological mapping and palaeontological sampling of the Lobs Hole–Ravine area was undertaken by P.G. Flood and his colleagues from the University of New England in 1967. Results of this study, published two years later (Flood 1969), include a measured section through the Lick Hole Formation from which Flood obtained approximately 1,300 identifiable well-preserved conodont elements from the acid digestion of about 200 kg of limestone. Among 14 form species of conodonts identified by Flood, the

most important is the index microfossil *Polygnathus dehiscens* Philip & Jackson. This conodont, which is indicative of the early Emsian Stage in the later part of the Early Devonian Period, has been widely recognised in other Devonian limestones in southeastern Australia, including the Cavan Limestone and lower part of the Taemas Limestone at Burrinjuck Reservoir, and the Buchan Caves Limestone in the Gippsland region of Victoria. Mawson & Talent (2000) reviewed the evidence for the precise age of the conodonts obtained from this unit (citing an unpublished study by one of their students) and concluded that it could span the *dehiscens* and overlying *perbonus* zones of the lower Emsian.

The most abundant macrofossils found in the measured section are shells of brachiopods, less common corals, pelecypod molluscs and bryozoa. Only some of these fossils have been formally described. The brachiopods *Spinella yassensis ravina* Flood and *Uncinulus australis* Flood, described in Strusz et al. (1970) and Flood (1973) respectively, are closely allied to species recognised in the Taemas Limestone in the Burrinjuck Reservoir area. Flood (1973) also identified (but did not describe) the brachiopods *Parachonetes* sp. nov., *Athyris waratahensis* (Talent), *Howittia multiplicatus* (de Koninck), *Howellella* sp., and *Globithyris* sp. nov. Pedder (1971) described three new species including the corals *Tropidophyllum hillae* and *Chalcidophyllum discorde giandarrense*, and the bryozoan *Heterotrypa rapinae*.

2. Assessment of geodiversity significance

The first assessment of the geodiversity of the Lobs Hole–Ravine area, specifically focussing on the fossils in the Lick Hole Formation, was undertaken in 1978 by the current author and documented in an unpublished report prepared for the Australian Heritage Commission and the Planning & Environment Commission of NSW the following year as part of an initial statewide study of geological heritage in NSW (Percival 1979). In that report (p.98) the major risk to the site was identified as “unauthorised removal of the fossils”. To highlight the significance of the fossil site it was included in the KNP Plan of Management (1996) and listed in Schedule 1 along with other significant geodiversity sites. However, in order to minimise pilfering of the fossil shells, the site has not been publicised.

The site is **locally significant** for the following reasons:

1. It is the only limestone of Devonian age in KNP, and so represents an important part of the geological history of the Snowy Mountains region in NSW.
2. It contains microfossils (conodonts) and macrofossils (mainly brachiopods and corals) that enable precise correlation with strata of identical age (early Emsian Stage of the Early Devonian) and depositional environment (shallow marine conditions in a subtropical to warm temperate setting) elsewhere in southeastern Australia.
3. The fossiliferous rocks exposed in the road cutting are the type locality for several fossil species, including at least two brachiopods, two corals and a bryozoan.

Regionally, and in a statewide context, the palaeontological significance of the Lick Hole Formation is actually quite low. There are far more extensive outcrops of Early Devonian limestones in the Burrinjuck area to the north and the Buchan Caves Limestone to the south in Victoria that were deposited over a much greater time interval; these exposures are far more spectacular and are very much richer in fossil diversity and abundance. Hence the Murrumbidgee Group limestones around Burrinjuck Reservoir have been the focus of far more palaeontological research (summarised in Percival & Zhen 2017) and accordingly are much better known.

SITE VISIT AND OBSERVATIONS

A site visit was carried out over several hours on Friday 12th April 2019, involving the author in the company of Lawrence Wallis (EMM), Mark Barrett (Snowy Hydro road works design team), and Clare Bolton (EMM Site Safety Officer). During this inspection the entire section of the Lick Hole Formation exposed along Ravine Road was walked (Figure 1), the distribution of fossils was noted (and where possible these were identified), and the dips of some of the beds were measured. This field inspection provided an excellent opportunity not only to see how much additional excavation was being proposed to widen the road, but also to compare the present state of the outcrop with recollections of the author from a previous site visit forty years ago. Key observations of the section of interest are as follows:

1. Ravine Road, while considerably improved from that of four decades previously, remains a winding, single lane, gravel road confined to the west and southwest (upside) by low road cuttings through the Lick Hole Formation and with a moderate slope to steep drop-off to the valley on the northeastern side.
2. Exposures of the Lick Hole Formation appear to be largely as the author observed them on his previous visit, except for two features: (a) surfaces of the thick-bedded calcareous siltstone at the base of the section (northwestern end) are entirely now covered by lichens and algae which obscure any fossils on bedding planes or in cross section, and (b) there were far fewer specimens of the more obvious fossil shells *Spinella yassensis ravina* and *Uncinulus australis* remaining on the outcrop.
3. Limestone in the formation is relatively uncommon, being more prominent in road cuts towards the base of the unit, with cuttings further up the hill (to the south) becoming progressively dominated by siltstone interbedded with thin limestone layers. Rocks exposed in the road cuts through the stratigraphically highest parts of the formation are almost entirely weathered and bleached siltstone and shale.
4. Fossil shells remain obvious in the interbedded siltstone and limestone layers occupying the middle third of the exposures in the road cuts. *Parachonetes* (a rather inconspicuous flattened brachiopod with one valve convex and the other valve concave) seems to be most common, particularly on bedding planes on the upper surfaces of thin limestone beds, and occasionally is found as complete specimens weathered out from siltstone layers. Larger specimens of *Spinella* (a coarsely-ribbed triangular brachiopod with both valves convex) and *Uncinulus* (a finely-ribbed globose brachiopod), which also tend to weather out as whole shells, are uncommon.
5. No corals nor bryozoa were observed, though this is not surprising as both tend to occur in the more calcareous lithologies where their presence may be hidden beneath the overgrowth of lichens and algae.
6. Dips of the bedding in the Lick Hole Formation are moderately shallow (measured at 12°-15° towards the base of the section in thicker-bedded calcareous siltstone and limestone that is unlikely to have been disrupted by hill creep) and are exceeded by the gradient of the road which steepens up-hill, so that a continuous section up through the formation is exposed in road cuts from north to south.
7. There is considerable further lateral extent and thickness of the Lick Hole Formation forming the ridge on the upside of the road (i.e. to the west of the section). Moderately extensive outcrop of the unit also is visible adjacent to the downside of the road in the one area that was safe to examine, confirming that an increasing thickness of fossiliferous rock exists beneath the road as the section is ascended.

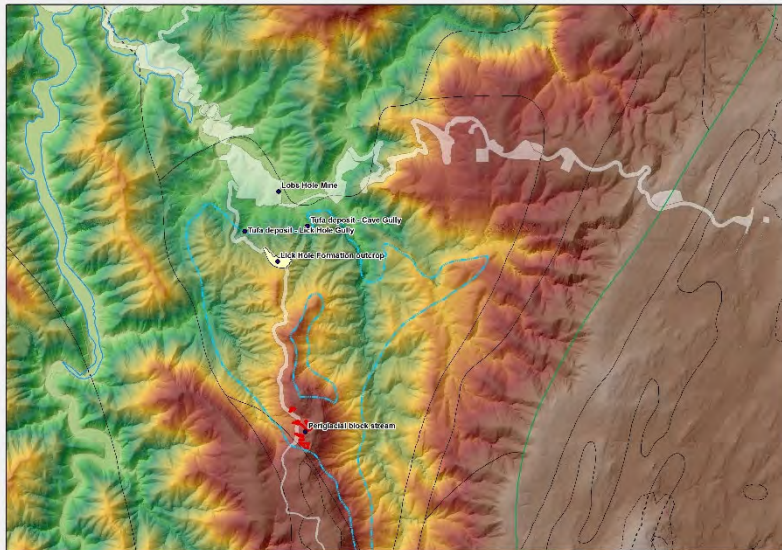


Figure 1. Digital Elevation Model of the Ravine–Lobs Hole area, showing outcrop of Lick Hole Formation (indicated in light yellow near map centre) on Ravine Road, which runs generally north-south though the centre of the lower two-thirds of the image. Highest elevations are coloured brown, grading through yellow to lower elevations in green.



Figure 2. Outcrop of limestone and rubbly calcareous siltstone near base of Lick Hole Formation on Ravine Road, showing gradient of road here only slightly exceeds the apparent dip ($\sim 5^{\circ}$ – 10°) of the strata. The outcrop continues in the road surface.



Figure 3. Detail of rocks forming outcrop shown in Figure 2, with pen (vertical, in centre of photo) for scale. Note overgrowth of lichens and algae, that is even more evident on bedding plane forming the planar surface at the top of the outcrop. No fossils were observed in these beds, though their presence may have been obscured by the vegetation overgrowth.



Figure 4. Lower third of section through the Lick Hole Formation, here consisting mostly of brown weathered and crumbling siltstones and shales that occasionally are fossiliferous. Gradient of the road exceeds the dip of the beds, so that younger strata are continuously exposed in the section as the road climbs the ridge.



Figure 5. A particularly fossiliferous exposure of the Lick Hole Limestone, located near the most easterly projection of Ravine Road. Lithologies exposed in this cutting consist of alternating siltstones and very thin calcareous siltstones grading to impure limestones. The road gradient here obviously exceeds the relatively shallow dip of the rock strata.



Figure 6. Outcrop about two-thirds up road section through the Lick Hole Formation, exposing interbedded calcareous siltstone and subordinate shale. Fossils appear to be relatively sparse in this cutting compared to those lower down the hill. Note road gradient (lower left hand corner) considerably exceeds shallow dip of the beds.



Figure 7. Uppermost outcrop in road section through the Lick Hole Formation. The rock type here consists of siltstone and shale, deeply weathered and bleached, and seemingly devoid of fossils.

IMPACT ASSESSMENT OF PROPOSED ROAD BOUNDARY CHANGES

The proposed road boundary changes, which will involve further widening of Ravine Road (or dropping of the road surface) to accommodate movements of very large trucks and pieces of machinery as well as improving safety of the road, will have both positive and negative effects on the Ravine fossil site.

The **positive effects** may include (but are not limited to) the following:

1. ‘freshening up’ of the site by removing weathered and crumbling strata and creating relatively fresh exposures in new cuttings situated further into the hillside, without the lichen and algae overgrowth that obscures the appearance of fossils on bedding plane and vertical surfaces. The height of the existing road cuts are likely to be increased, so increasing the extent of the fossiliferous outcrops. Note that it is highly unlikely that pristine (wholly unweathered) rock will be intersected by the excavation of an additional 4 metres into the existing cuttings, as the entire land surface was probably exposed to chemical leaching for much of the past 395 million years and certainly since the Miocene basalts were extruded approximately 12 million years ago.
2. The opportunity to move the weathered spoil material off-site to geoscientific institutions where research can be carried out on the fossils without causing threats to the safety of scientists collecting from the existing road cuts on the narrow winding road.
3. The potential to find new genera and species of fossils in strata that are known to be fossiliferous but which have only been studied in detail in a series of four papers published 45-50 years ago, all of which described only half a dozen fossil species from road cuts that have not changed in extent up to the present time.
4. The possibility of incorporating sufficient space into the widened road and its verges to allow for places for the public to safely stop and view the fossils in situ, assisted by interpretative signage. This would markedly benefit the educational aspects of the geodiversity site.

Negative effects may include:

1. Loss of the entire site (entailing complete degradation of its geodiversity significance) by removal of all the fossils during the process of road widening. However, this possibility is regarded as so unlikely, given the extent of the Lick Hole Formation into the ridge adjacent to Ravine Road, that it can be dismissed. The fossil distribution is partly determined by the type of lithology and partly by the stratigraphic level within the formation, neither of which are controlled by the lateral distribution of the rocks further into the hillside. The entire ridge capped by Round Top Trig would need to be removed in order to erase the significance of the site which is reliant on the Devonian fossils that are present through much of the formation – and this is not being contemplated as part of the road widening works.
2. Making the fossils potentially more susceptible to pilfering by increasing access to the outcrop. However, this possibility is mitigated by the fact that whole fossils are less likely to be easily removed from fresher rock. Certainly it is apparent that over 40 years considerably fewer specimens of the larger, more obvious shells remain at the locality, but this is largely because these fossils weathered out of the eroding siltstones and shales and were available to be easily gathered. The point of sending off bulk samples of the remaining weathered faces of the road cuttings is to ensure that further specimens of the fossil shells will be curated into museum and university collections where they can be studied by palaeontologists, rather than being collected by the general public merely for display as curiosities.

Impact of proposed additional areas of disturbance on integrity of the fossil site

Three options for boundary changes that are under consideration involve (1) minor changes plus 2.5 m of additional disturbance area on either side of the road (Figure 8.1); minor changes plus 4 m of additional disturbance area on either side of the road (Figure 8.2); and (3) minor changes only, involving minimal additional cut into the rock exposures (Figure 8.3).



Figure 8.1

Option 1: minor boundary changes with an additional 2.5 m of disturbance

(source: EMM)

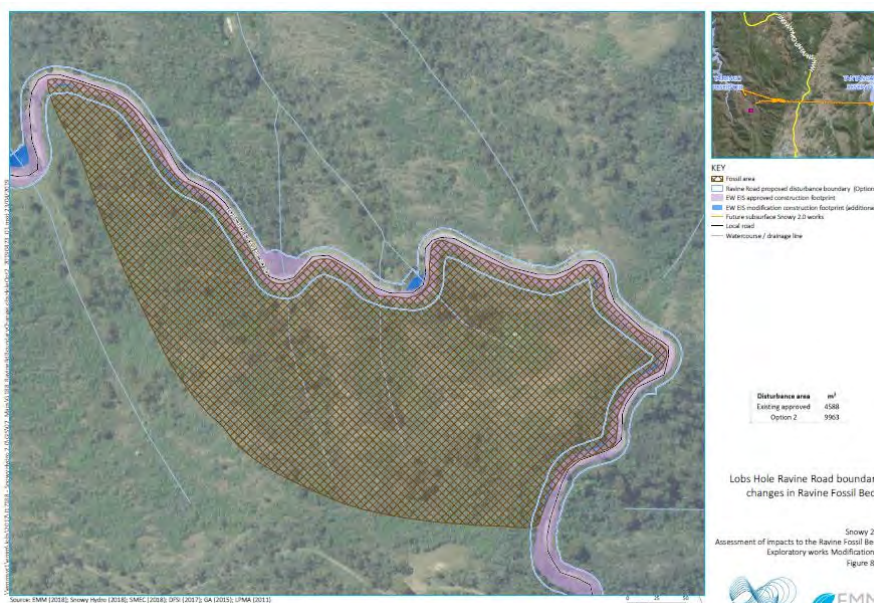


Figure 8.2

Option 2: minor boundary changes with an additional 4 m of disturbance (source: EMM)

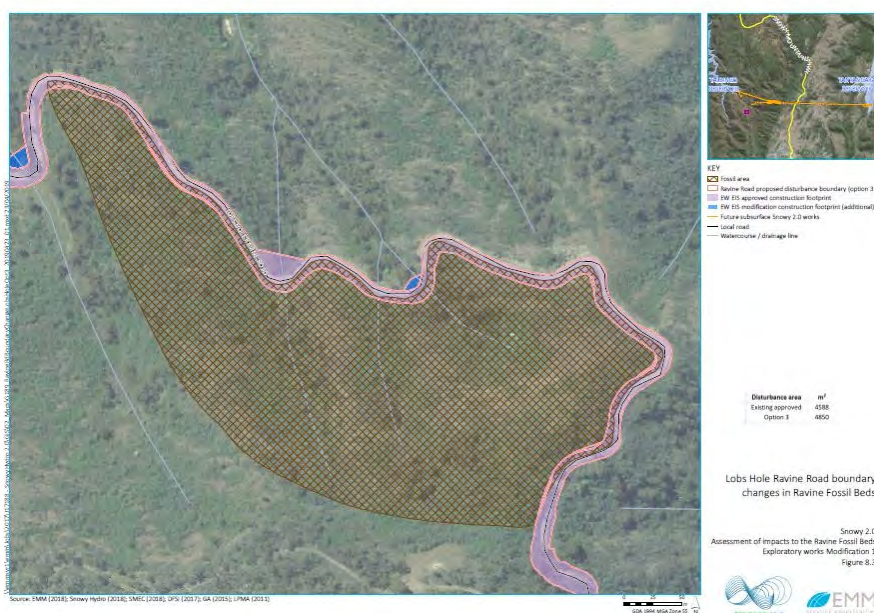


Figure 8.3

Option 3: minor boundary changes including additional excavation and disturbance (source: EMM)

Relative to the extent of the fossiliferous strata that extend both below the present road and also form the majority of the ridge on the upside of the road, the additional amount of excavation proposed in the options (1), (2) or (3) and its impact on the integrity of the fossil site is insignificant. Provided the same recommended procedures are adopted to retain representative samples of the weathered spoil for research purposes, and to not obscure the exposures in the new cuttings, there should be no appreciable differences evident in the number of fossils that remain on view in the cuttings after construction is finished. This opinion is supported by the field observation that while the distribution of fossils varies through the exposed road section, excavation of a strip essentially identical in width of additional spoil (be it minimal, 2.5 m or 4 m) along the same orientation of road section will not materially alter this distribution.

CONCLUSIONS

1. The Ravine Road fossil site is an artificial exposure. Had the road not cut through and exposed the fossiliferous beds, the site and its geodiversity significance as the sole instance of Early Devonian fossiliferous strata in KNP would have remained out of public view. Thus widening the exposure of the fossiliferous strata – provided it is done in a sympathetic manner to allow for future access by the public and palaeontological research workers – should not be detrimental. In fact, there are more positives than negatives.
2. Given the observed distribution of fossils in the road cuttings at present, excavation of an approximately consistently wide strip of spoil into the ridge on the upside of the road (whether involving an additional disturbance width of 1 m, 2.5 m, or 4 m relative to the original proposal) will not materially affect the distribution nor abundance of fossils that are anticipated to be exposed in the new road cuttings.
3. The proposed road widening (whether involving an additional excavation and/or disturbance width of 1 m, 2.5 m, or 4 m relative to the original proposal) will result in an improvement in site conditions, not only in terms of road safety and access for the general public once the Snowy 2.0 construction works conclude, but also in access to the fossiliferous layers.
4. Two opportunities to learn more about the site and its geodiversity significance will result from the proposed road widening – the first is research-oriented, whereby palaeontologists at several institutions will be offered bulk samples of the weathered fossiliferous rocks forming the faces of the present cuttings; the second is for public education, which will benefit from safe access and potentially interpretative signage.

RECOMMENDATIONS

1. The excavated rock faces in the new cuttings will be higher than at present, and so it will be necessary to ensure that they are stable by ensuring a suitable angle of batter.
2. A stepped design for the new cuttings, instead of a single slope, would also be acceptable as this would allow access to bedding planes.
3. Under no circumstances should the use of shotcrete, or vegetation seeding, be contemplated to stabilise or cover the new exposures. The new road cuttings must be allowed to naturally weather as the present ones have done (though this will take many decades).
4. Spoil from the weathered faces can be removed and offered to the following persons and institutions for future research:

Dr Yong-yi Zhen (Senior Research Scientist, Palaeontologist)

Geological Survey of New South Wales, WB Clarke Geoscience Centre, Londonderry
yong-yi.zhen@planning.nsw.gov.au ph. (02) 4777 7810

Natalie Schroeder (Collection Manager, Commonwealth Palaeontological Collection) Geoscience Australia, Symonston, ACT

natalie.schroeder@ga.gov.au ph. (02) 6249 9111 [switch]

Associate Professor Glenn Brock

Dept. of Biological Sciences, Macquarie University

glenn.brock@mq.edu.au ph. (02) 9850 8335

5. It is unnecessary to provide samples of spoil from the entire section exposed in the road cuts. Rather, for each recipient a bulk sample (no larger than the capacity of a bucket excavator) should be acquired from the sites shown in Figures 2, 4, 5 & 6, as these will be representative of the succession. The bleached siltstone at the top of the section (Figure 7) need not be sampled, as its potential for fossils is believed to be minimal.

ACKNOWLEDGEMENTS

Dr Alexa Troedson prepared Figure 1 from data provided by EMM. Lawrence Wallis (EMM) and Mark Barrett (SMEC) facilitated the site visit to Ravine Road; Claire Bolton (EMM) supervised safety aspects of the visit including provision of transport on site. A draft of this report was reviewed by Aaron Bowden and Lawrence Wallis.

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CHAPTER

C

HERITAGE SURVEY UNITS SUMMARY



C.1 Summary of survey units that intersect with the proposed modification footprint

Table C.1 Summary of survey units that intersect with the proposed modification footprint

Survey unit	Modification 1 element within survey unit	Landscape context	Predicted/known artefact density in SU	AHIMS sites within survey unit	Historic sites within survey unit
Talbingo Reservoir, Lobs Hole and Ravine Road					
RSU2	Additional EW EIS boundary	Flat landform. Dry sclerophyll forest with a thick shrubby understory. Thickets of blackberry. Depositional context.	Moderate	None within survey unit.	R54 (site of bridge) R82 (front seat of car; ~1960's)
RSU3	Additional EW EIS boundary	Flat landform. Dry sclerophyll forest with occasional grassy glades. Depositional context.	Low/moderate	56-6-0009 (Ravine; Lob's Hole; KNP91-59) 56-6-0495 (RSU3/L1) 56-6-0496 (RSU3/L2) 56-6-0497 (RSU3/L3) Test Transect 1 Test Transect 2 Test Transect 3 Test Transect 4	R44 (Stable Creek Stream Gauging Station) R45 (Lobs Hole Copper Mine water race) R55 (brick hearth) R80 (Elizabeth Frazer's orchard)

Table C.1 **Summary of survey units that intersect with the proposed modification footprint**

Survey unit	Modification 1 element within survey unit	Landscape context	Predicted/known artefact density in SU	AHIMS sites within survey unit	Historic sites within survey unit
RSU4	Additional EW EIS boundary	Crest/knoll landform. Cleared with some regrowth saplings. Scattered shrubs and blackberry. Shale bedrock. Negligible topsoil. Highly eroded with no or limited soil.	Low	56-6-0045 (KNP91-60) 56-6-0498 (RSU4/L1) 56-6-0499 (RSU4/L2)	R1 (1885 West Pinbeyan Station homestead site) R2 (metal water pipe) R3 (possible building structure) R4 (rectilinear depression) R5 (slag) R6 (stone flagging) R7 (depression) R8 (depression) R9 (Lobbs Hole Copper Mine) R10 (Lobbs Hole Copper Mine: No.1 Shaft, mullock and cage) R17 (a poorly defined/indistinct earth platform) R18 (rabbit proof fence) R19 (a levelled pad measures c. 4 x 2.5m) R33 (excavation and bricks) R69 (brick kiln) R74 (metal water pipe) R77 (site of meteorological station) R98 (excavated pit) R114 (excavation)
RSU11	Additional EW EIS boundary	Flat landform. Patches of regenerating dry sclerophyll forest and open grassland. Depositional context.	Low	56-6-0041 (KNP91-21; Ravine) 56-6-0047 (RSU11/L1) 56-6-0487 (RSU11/L1) 56-6-0488 (RSU11/L2)	R28 (pisé ruin) R21 (depression and debris) R20 (Washington Hotel ruin) Test Transect 1 Test Transect 2 Test Transect 3

Table C.1 **Summary of survey units that intersect with the proposed modification footprint**

Survey unit	Modification 1 element within survey unit	Landscape context	Predicted/known artefact density in SU	AHIMS sites within survey unit	Historic sites within survey unit
RSU12	Additional EW EIS boundary	The landform is a very gently undulating river flat directly adjacent to Yarrangobilly River. The aspect is open. Vegetation is patches of regenerating dry sclerophyll forest and open grassland. Soils are alluvial and deep. Surface river cobbles are visible throughout the SU, most likely a result of flood events as well as eroding conglomerate bedrock. The landform would be subject to periodic flooding. Depositional context.	Moderate/high	56-6-0042 (KNP91-22) 56-6-0046 (KNP91-61) 56-6-0478 (RSU13/L2) 56-6-0537 (RSU12/L1) Test Transect 1 Test Transect 2 Test Transect 3 Test Transect 4 Test Transect 5 Test Transect 6 Test Transect 7 Test Transect 8	R70 (concrete fireplace) R79 (bridge remains) R101 (possible building site)
RSU13	Additional EW EIS boundary	A crest landform of low elevation with a south westerly aspect. Vegetation in regenerating dry sclerophyll forest and open grassland. Geology is shale presenting as outcropping, cobbles, shatter and gravels. Soils are skeletal and very gravelly. The landform is eroding.	Low	56-6-0478 (RSU13/L2) 56-6-0483 (RSU13/L1)	R102 (stone culverts)
RSU17	Reduced footprint	A crest landform overlooking major water course to the east. The aspect is northerly. Vegetation regenerating dry sclerophyll forest with areas of blackberry thicket. Geology is shale and sandstone conglomerate. Shale presenting as outcropping, shatter, cobbles and gravels. Soils are a shallow skeletal gravelly loam. Erosional context.	Low	56-6-0477 (RSU17/L1)	R56 (excavated ditch) R57 (old road alignment) R76 (scatter of tin, glass and brick) R106 (old road) R107 (building platform) R120 (building platform)

Table C.1 **Summary of survey units that intersect with the proposed modification footprint**

Survey unit	Modification 1 element within survey unit	Landscape context	Predicted/known artefact density in SU	AHIMS sites within survey unit	Historic sites within survey unit
RSU18	Reduced footprint	A series of gentle simple slopes of gentle to steep gradients with a northerly aspect. Vegetation is regenerating dry sclerophyll forest, wattle regrowth with some grassland. Numerous thickets of blackberry. Erosional context.	Low	56-6-0476 (RSU18/L1)	R48 (excavation possible shed) R49 (circular stone wall) R50 (shed with bullock wagon frame) R75 (mine shaft on ML 31) R104 (Lick Hole Gully water race) R105 (ditch) R108 (old road) R109 (house platform with wooden cross) R110 (building platform)
RSU21	Additional EW EIS boundary Proposed TBM load extent (Lobs Ravine Road upgrade)	Gently undulating crest landform at south end, becoming steep to north. The aspect is mostly northerly. Vegetation is a dry sclerophyll forest. Geology is meta-sedimentary shale presenting as outcrops, shatter, cobbles and gravels. The SU is slightly rocky. Soils are a shallow skeletal gravelly loam. Erosional context.	Low	None within survey unit.	R72 (stone furnace) R131 (excavated area)
RSU22	Additional EW EIS boundary	Crest landform. Regenerating dry sclerophyll forest. Shale bedrock. Erosional context	Low	56-6-0504 (RSU22/L3) 56-6-0505 (RSU22/L2) 56-6-0507 (RSU22/L1)	R83 (pile of sheet metal)
RSU23	Borehole BH 7012 and associated access track MOD 1 disturbance boundary	Gentle simple slope. Regenerating dry sclerophyll forest. Thickets of blackberry. Erosional context.	Low	56-6-0502 (RSU23/L3) 56-6-0503 (RSU23/L2) 56-6-0506 (RSU23/L1)	R84 (possible old road) R85 (possible old road) R86 (possible old road)

Table C.1 **Summary of survey units that intersect with the proposed modification footprint**

Survey unit	Modification 1 element within survey unit	Landscape context	Predicted/known artefact density in SU	AHIMS sites within survey unit	Historic sites within survey unit
RSU24	Additional EW EIS boundary	Gently undulating crest landform at south end, becoming steep to north. Dry sclerophyll forest. Erosional context.	Low	56-6-0536 (RSU24/L1)	None within survey unit.
RSU26	Additional EW EIS boundary	A series of narrow [c.10-20m wide] spur crests of gentle to moderate gradient with a west north westerly aspect. Vegetation is Eucalypt and wattle regrowth woodland with an understorey of grasses with areas of impenetrable infestations of blackberry and briar rose. Geology is shale presenting as outcrops, shatter, cobbles and gravels. The SU is very slightly rocky. Soil is a skeletal shallow light brown gravelly loam. The SU is comprised of large amorphous landforms situated well away from water.	Negligible	None within survey unit.	R124 (SMA laydown area) R125 (SMA quarry) R126 (SMA survey marker) R127 (SMA survey marker)
RSU28	Lobs Hole substation disturbance area	A series of short moderate to steep simple slopes with gradients ranging from 20° to 32°. The aspect is mainly northerly. SU dissected by minor drainage lines. Vegetation is scattered shrubs with occasional small Eucalypt becoming very dense in areas. Heavy infestations of blackberry throughout SU. Geology is a mix of conglomerate and meta-sedimentary shales presenting as outcrops, cobble, gravels and very high levels of shatter. The SU is very rocky. Tuff and chert occurring naturally as rounded and angular pebbles. Traces of low-quality quartz was observed in the background stone profile, none of which is likely to be artefactual. Soils are skeletal and very gravelly. The landform is eroding.	Negligible	None within survey unit.	None within survey unit.

Table C.1 **Summary of survey units that intersect with the proposed modification footprint**

Survey unit	Modification 1 element within survey unit	Landscape context	Predicted/known artefact density in SU	AHIMS sites within survey unit	Historic sites within survey unit
RSU29	Lobs Hole substation disturbance area	A very gently to gently undulating crest landform with a south-westerly aspect. Vegetation is an open mixed age Eucalypt forest with an understorey of banksias and heath. Geology is metasedimentary presenting as outcrops, shatter, cobbles and gravels. Large area of smooth conglomerate boulder outcropping along break of slope along western boundary of SU. Outcrops are greater than 2 metres wide. Soils are a shallow brown gravelly silty loam. Landform is eroding.	Negligible	56-6-0048 (KNP91-63) 56-6-0540 (RSU29/L1)	R46 (large excavation)
RSU31	Borehole BH 7001 and associated access track	A very narrow [c.20-30m wide] spur crest of gentle to moderate gradient with a south westerly aspect. Very steep slopes off the crest. Vegetation on upper slope is an open scrub with grasses becoming an open Eucalypt forest with an understorey of heath and banksia on the lower slope. Geology is a metasedimentary presenting as shatter, cobbles and gravels. Occasional small discrete bedrock outcropping. SU becomes very rocky at higher elevations. Soil is a gravelly loose loam.	Negligible	None within survey unit.	R52 (survey mark) R53 (old road)

Table C.1 **Summary of survey units that intersect with the proposed modification footprint**

Survey unit	Modification 1 element within survey unit	Landscape context	Predicted/known artefact density in SU	AHIMS sites within survey unit	Historic sites within survey unit
RSU32	Borehole BH 7012 and associated access track MOD 1 disturbance boundary	Moderate to steep simple slopes with gradients ranging from 20° to 32°. The aspect is mainly south westerly. SU dissected by minor drainage lines. Vegetation is scattered shrubs with occasional small Eucalypt becoming very dense in areas. Heavy infestations of blackberry throughout SU. Geology is a mix of conglomerate and meta-sedimentary shales presenting as outcrops, cobble, gravels and high levels of shatter. The SU is very rocky. Tuff and chert occurring naturally as rounded and angular pebbles. Traces of low-quality quartz was observed in the background stone profile, none of which is likely to be artefactual. Soils are skeletal and very gravelly. Erosional context.	Negligible	None within survey unit.	None within survey unit.
RSU35	Additional EW EIS boundary	A simple slope landform of moderate gradient with a southerly aspect. Vegetation is a dense forest of Eucalypt, blackberry, wattles and grasses. Forest floor has a thick cover of litterfall. Geology is metasedimentary presenting as gravels. Soil is rich brown slightly gravelly loam. The landform is aggrading.	Negligible	None within survey unit.	None within survey unit.
Marica					
MSU6	Borehole No.8 and access track	Forested ridge crests and simple slopes; undulating; heavily wooded; conglomerate geology with an abundance of water worn cobbles and pebbles.	Negligible	None within survey unit.	M1 (no description available for this item or any reference to it in the historic literature) M2 dilapidated stone trig. SMA
MSU7	Boreholes No. 10-15 and associated access tracks	Forested ridge crests and simple slopes; steep valley sides; heavily wooded; conglomerate geology with an abundance of water worn cobbles and pebbles.	Negligible	None within survey unit.	None within survey unit.

Table C.2 Summary of survey units that intersect with the proposed modification footprint

Survey unit	Modification 1 element within survey unit	Landscape context	Predicted/known artefact density in SU	AHIMS sites within survey unit	Historic sites within survey unit
Tantangara Reservoir					
TSU1	Proposed geophysics line	A low relief, gently undulating crest of an east facing spur. The aspect is easterly. The landform overlooks a major watercourse, the former Murrumbidgee River, now Tantangara Dam. Geology is volcanic presenting as outcropping, cobbles and gravels. The area has occasional low outcrops of volcanic rock and is thickly vegetated with native grasses and Hakea shrubs. Increased outcropping exposures on the higher points across the SU. Soils area a slightly gravelly brown silty loam. Soil depths are variable from shallow to c.25cm maximum. Short drainage lines which flow from springs run easterly along the length of crest on the northern and southern boundaries.	Very low	57-4-0127 (Quarry Rd 1) 57-4-0287 (TSU1/L4) 57-4-0288 (TSU1/L7) 57-4-0289 (TSU1/L6) 57-4-0290 (TSU1/L5) 57-4-0310 (TSU1/L2) 57-4-0311 (TSU1/L3)	E13 (SMA survey mark 1003TS)
TSU2	Borehole No.3 & 4 and associated tracks	A gently undulating crest of a north east facing spur. The aspect is north easterly. The SU overlooks the former Murrumbidgee River. The area is covered with dense patches of Hakea; small heath shrubs and native grasses. Geology is volcanic presenting as outcropping, cobbles and gravels. Occasional low outcropping of highly eroded volcanic bedrock. Soils area a dark brown sandy loam. Soil depths are variable from shallow to c. 30cm maximum. Short drainage lines which flow from springs run easterly along the length of crest on the northern and southern boundaries.	Very low	57-4-0125 (Quarry Road 5) 57-4-0126 (Quarry Road 3) 57-4-0224 (Quarry Road 4) 57-4-0255 (TSU2/L9) 57-4-0263 (TSU2/L6) 57-4-0264 (TSU2/L8) 57-4-0265 (TSU2/L2) 57-4-0266 (TSU2/L3) 57-4-0267 (TSU2/L5)	None within survey unit.

Table C.2 **Summary of survey units that intersect with the proposed modification footprint**

Survey unit	Modification 1 element within survey unit	Landscape context	Predicted/known artefact density in SU	AHIMS sites within survey unit	Historic sites within survey unit
TSU3	Small portion of proposed access track	A gently undulating crest of a southeast facing spur. A relatively broad landform. The SU overlooks the former Murrumbidgee River. Vegetation is grassland with Hakea. Geology is volcanic presenting as outcropping, cobbles and gravels. Numerous areas of volcanic bedrock exposed in the form of low outcropping. Soils are a gravelly silty loam, shallow with abundant decomposing saprolite. Short drainage lines which flow from springs run easterly along the length of crest on the northern and southern boundaries.	Low	57-4-0143 (Quarry road 1) 57-4-0128 (Quarry Road 2) 57-4-0293 (TSU3/L1) 57-4-0292 (TSU3/L2) 57-4-253 (TSU3/L3) 57-4-0254 (TSU3/L4) 57-4-0270 (TSU3/L5) 57-4-0269 (TSU3/L6) 57-4-0268 (TSU3/L7) 57-4-0271 (TSU3/L8) 57-4-0273 (TSU3/L11) 57-4-0272 (TSU3/L12) 57-4-0274 (TSU3/L13) 57-4-0275 (TSU3/L14) 57-4-0262 (TSU3/L15) Test Transect 1 Test Transect 2 Test Transect 3 Test Transect 4 Test Transect 5 Test Transect 6 Test Transect 7	None within survey unit.

Table C.2 **Summary of survey units that intersect with the proposed modification footprint**

Survey unit	Modification 1 element within survey unit	Landscape context	Predicted/known artefact density in SU	AHIMS sites within survey unit	Historic sites within survey unit
TSU4	Existing access tracks	A very gently sloping east facing low relief crest landform. The area is vegetated with Hakea shrubs; occasional trees and an understorey of native grasses and scattered heath. Geology is volcanic presenting as outcropping, cobbles and gravels. Soil is a fine sandy loam up to a maximum depth of c.40cm. Short drainage lines which flow from springs run easterly along the length of crest on the northern and southern boundaries.	Low	57-4-0123 (Quarry Road 2) 57-4-0124 (Quarry Road 6) 57-4-0252 (TSU4/L1) 57-4-0257 (TSU4/L3) 57-4-0258 (TSU4/L4) 57-4-0260 (TSU4/L2) 57-4-0261 (TSU4/L6)	E21 (dug out feature)
TSU5	Existing access tracks	A very gently sloping broad terminal spur crest directly above a valley floor and creek. The aspect is easterly. A deeply incised east-west drainage line traverses the southern boundary. Vegetation is low Hakea shrub and low heath groundcover. Occasional mature snow gums located along the edge of crest. Geology is volcanic presenting as outcropping, cobbles and gravels. Numerous low outcropping of highly eroded volcanic rock on crest proper and only skeletal soils remain. Soil is a shallow fine sandy loam up to a maximum depth of c.20cm.	Very low to low	57-4-121 (Quarry Road 8) 57-4-122 (Quarry Road 7) 57-4-0251 (TSU5/L5) 57-4-0259 (TSU5/L3) 57-4-0294 (TSU5/L4)	None within survey unit.



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